

Presented by

R DELETAIN / C FABRE AIRBUS

ECOLOG (Extinguishing **C**oncept **L**owering **O**zone depletion and **G**reen house effect)

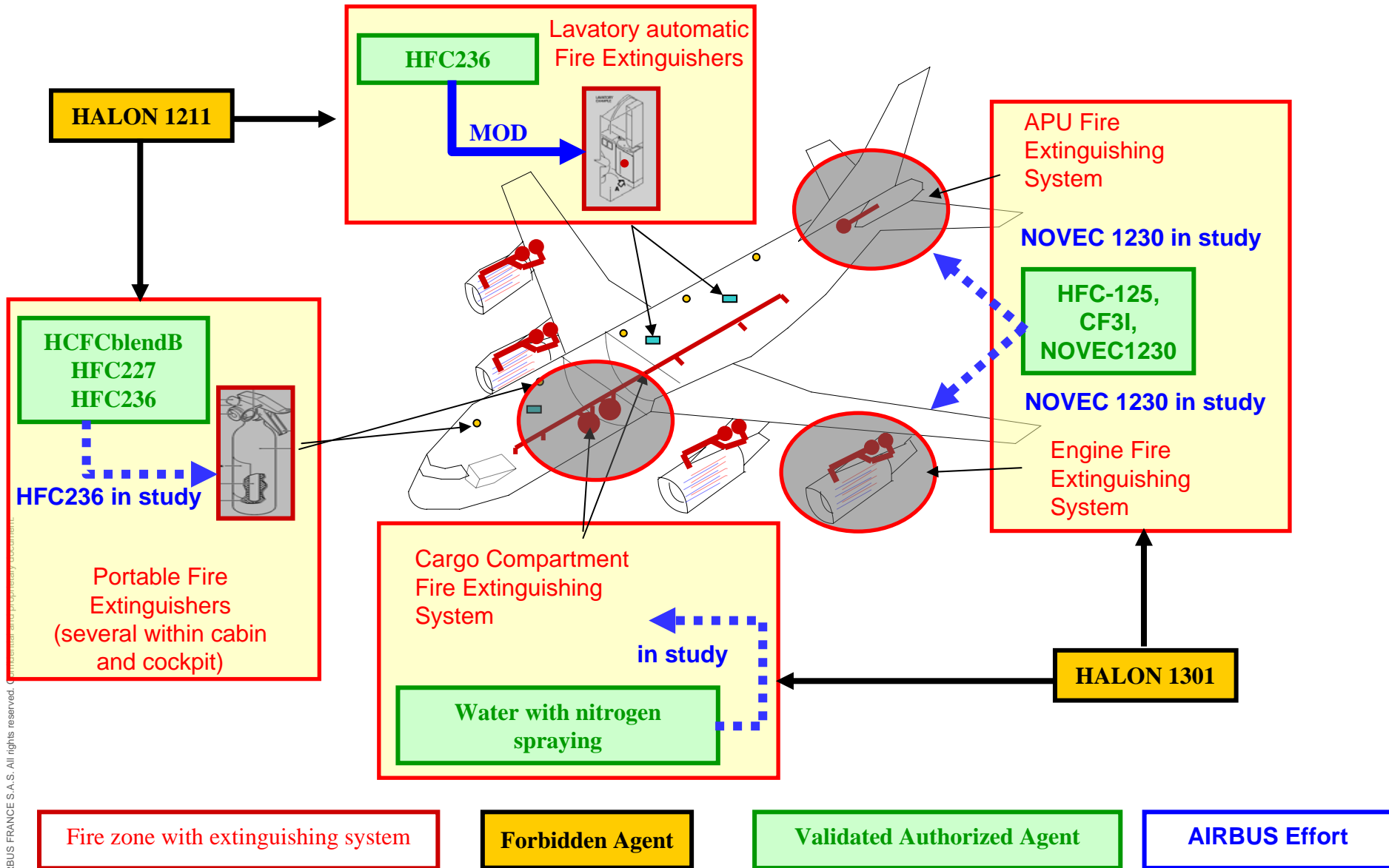
**An Airbus Project addressing the Halon Replacement concern
for Engine/APU fire extinguishing application**



AGENDA

- Halon Replacement Problematic
 - Context & drivers for Halon 1301 replacement
 - ATA26 Firex Problematics
- ECOLOG Background – Research Phase
- ECOLOG – Feasibility Study
- Summary

Aircraft Fire Extinguishing Agents & Problematics



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Aircraft Fire Extinguishing Agents & Problematics

Main Considerations

- In the past 2 Agents for 5 applications
 - Today:
 - Methods of compliance customized for each application (fire threat related)
 - No Unique agent identified for all applications
 - No Unique agent validated for all applications
- ⇒ Industrial efforts are significant
- ⇒ Several different New Agents and New Technologies needed
- ⇒ ECOLOG dedicated to offer and Engine/APU response to problematic

ECOLOG Project Objective

PROJECT OBJECTIVE:

ECOLOG (*) = HALON¹³⁰¹ replacement for **ENGINE**
and **APU fire extinguishing systems**

- for new A/C (starting from **A350**)
- for existing A/C (in **production** or by **retrofit** application)

PROJECT INITIATED / COORDINATED / FOUNDED BY AIRBUS

(*) ECOLOG: “Extinguishing Concept Lowering Ozone depletion and Green house effect”

ECOLOG RESEARCH PHASE

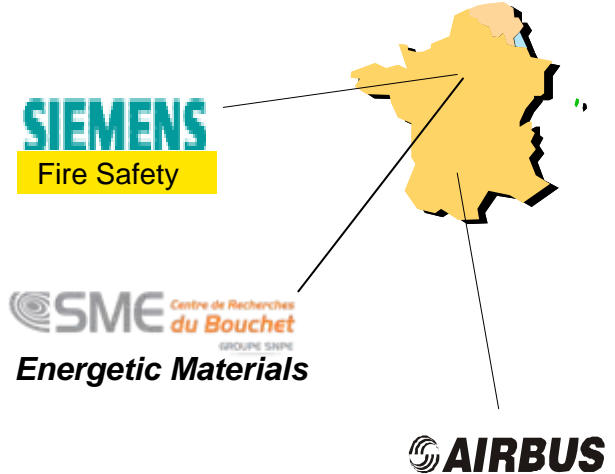
- Phase launched mid 2002 :

- ▶ 2 industrial partners associated

- **SIEMENS SBT** (Fire Det/Ext specialists)
- **SNPE- Pyroalliance** (Pyrotechnic Materials design&manufacturing)

selected to be able to propose & develop concepts and technology bricks leading at the end of the study to the definition of a system :

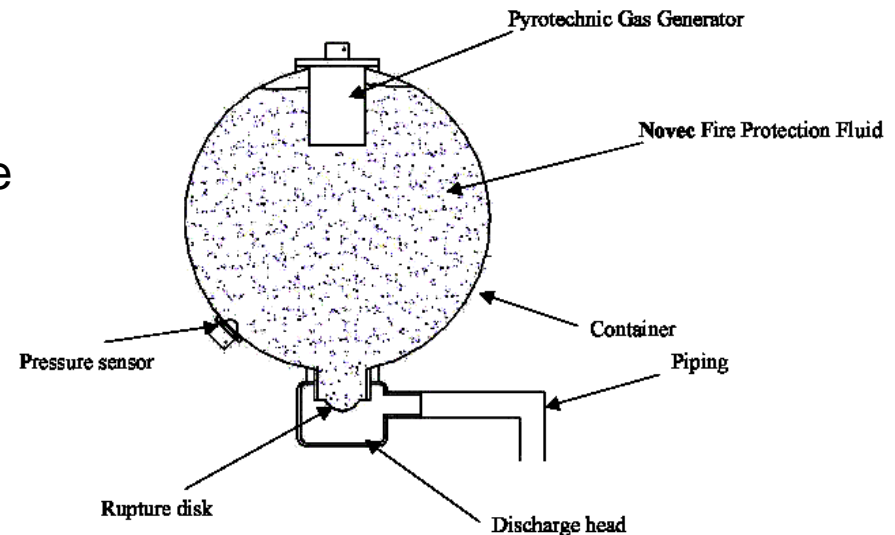
- mature
- industrially realisable
- answering the certification criteria



FIRE EXTINGUISHER CONCEPT

General principle

- Concept based on both:
 - a new environmental friendly “quasi liquid” extinguishing agent (**Novec 1230 (3M)**)
 - a solid propellant gas generator permitting the pressurization of the container and the efficient spraying of the agent.
- Extinguishing agent stored at low pressure in the container
- When electrically ignited the gas generator produces inert gases, which pressurise the container, burst the rupture disk and expel the extinguishing agent.



ECOLOG BACKGROUND - Research phase

New Fire Extinguishing Agent

LOAEL: Low Observed Adverse Effect Level

NOAEL: No Observed Adverse Effect Level

ODP: Ozone Depletion Potential

GWP: Global Warming Potential

AL: Life duration in the atmosphere (Year)

Agent	Vapour Pressure	Boiling Point	Concent. Ration	LOAEL	NOAEL	ODP	GWP	AL	Weight	Volume
HALON 1301	14,6 bar	-57,8°C	5%	7%	5%	10	6900	65	1	1
NOVEC 1230	0,4 bar	49°C	5-6%	>10%	10%	0	1	0,013	2,12	0,96

- complies with the Halon replacement criteria

- ▶ Ozone Depletion Potential (ODP=0)
 - ▶ Global Warming Potential (GWP=1)
 - ▶ Atmospheric Lifetime (AL=0.014)
- is not concerned by Montreal and Kyoto Protocols (not a HFC)
- offers a comfortable margin regarding toxicity

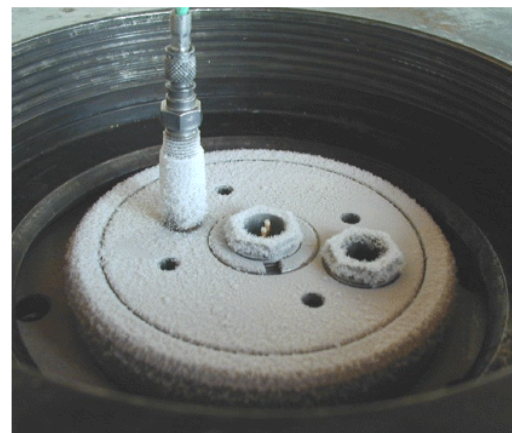
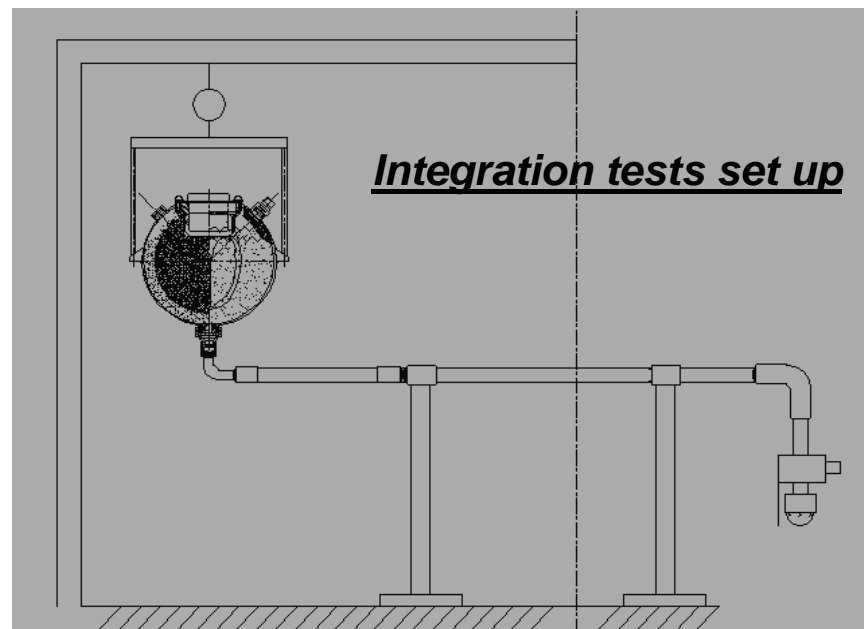
ECOLOG BACKGROUND - Research phase

Fire extinguisher bottle design and testing

- Design and Manufacturing of a full scale demonstrator
- Extinguisher integration
- Test campaign realisation (agent spraying tests) range of temperatures (-55 °C to 95 °C)



Full scale demonstrator

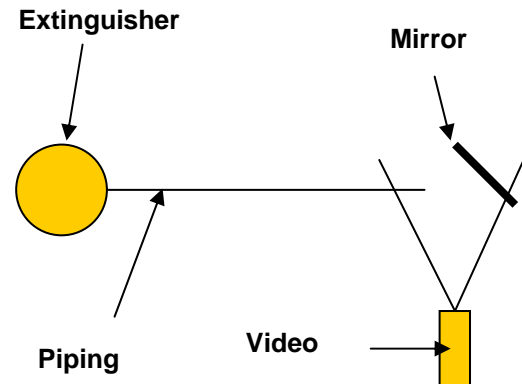


Hot and cold tests

ECOLOG BACKGROUND - Research phase



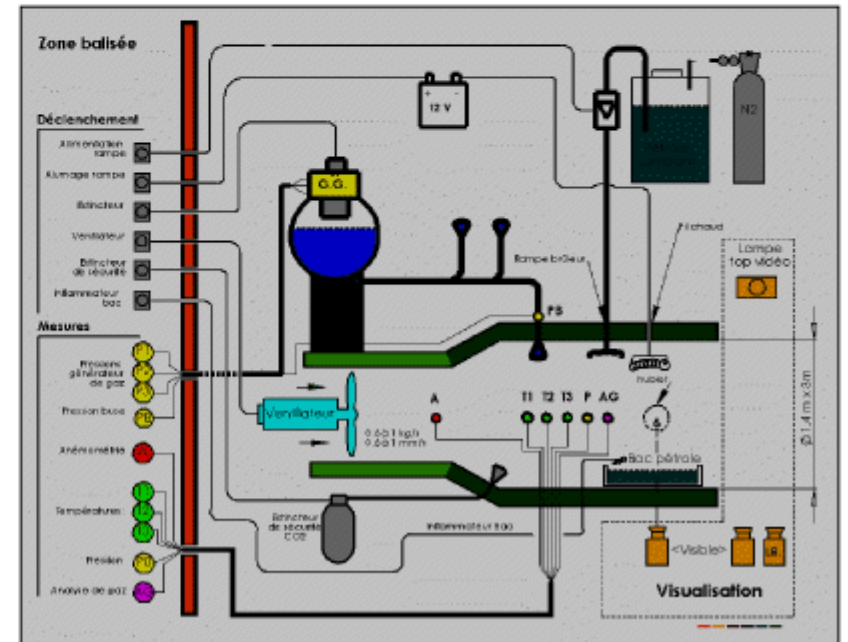
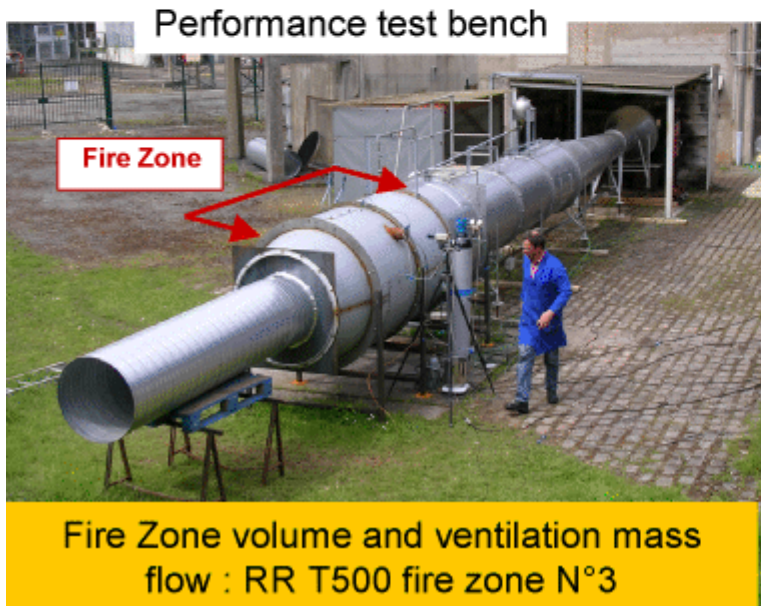
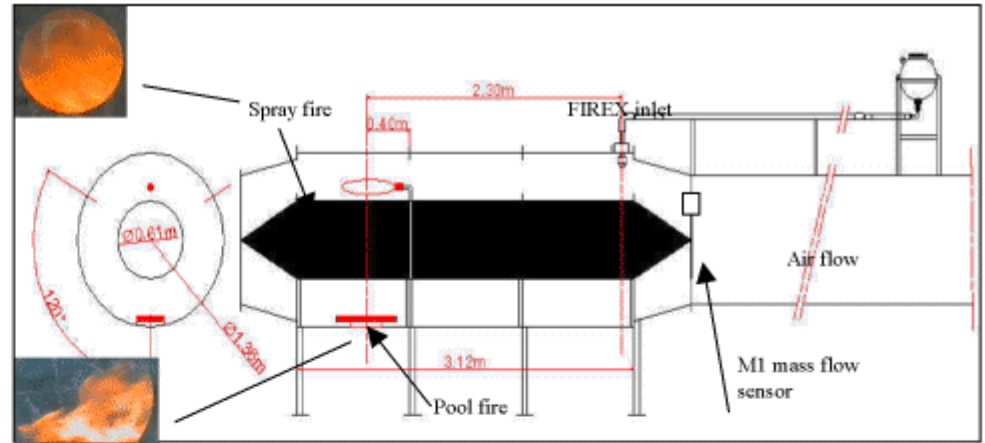
Click on the picture



ECOLOG BACKGROUND - Research phase

Fire extinguishing efficiency tests

- Performance test bench design and manufacturing
- Test campaign realisation (extinguishing tests) according several different engine fire scenarios (spray fire and pool fire tests)



Test set up

ECOLOG BACKGROUND - Research phase

Fire extinguishing efficiency tests : Spray fire

Window view →



Internal view →

AIRWORTHINESS AUTHORITIES – FAA TEST CAMPAIGN

- First contacts have been established with Airworthiness Authorities (**EASA & FAA**) in October 2005).
- On Airbus's request the **FAA** has accepted to **launch** an official NOVEC 1230 agent validation test campaign (duration 4 months starting march 2006), at the FAA Technical Center.
- This campaign has permitted to **officially** determine the agent concentration value to use.
- This value 6,1 % by volume has been released by the FAA –TC during the last IAFPWG meeting (International Aircraft system Fire Protection Working Group) in November 2006.

ECOLOG BACKGROUND - Research phase

Test campaign at the FAA-TC

goal:

- New agent qualification
- Determination of the minimum quantity to use for same extinguishing efficiency than when using halon



R&D to Feasibility Study

In 2006, Decision to move the project from R&D activities to a feasibility study based on :

- Green characteristics of Agent
- Promising results from the technology from the R&D efforts
- Promising results from the Agent evaluation at FAA Technical Center
- Recurring A/Ls request for Airbus efforts on Halon Replacement
- Increasing threat of derogation cancellation for Halon use

SCOPE AND OBJECTIVES

- ▶ Assessment of the possibility to implement the NOVEC onboard Engines and APU: **all engines and APU SA, LR & LA (Retrofit, forward fit) and new A/C (I.e A350XWB)**
- ▶ Provide relevant data to **make decision possible for development phase launch** such as technical repercussion data
- ▶ Prepare **Supplier selection**
- ▶ Prepare **certification hypothesis**

MAIN MILESTONES

- ▶ Contacts with suppliers for new FireX based on NOVEC 1230.
- ▶ Request for information to several suppliers for NOVEC 1230 possible FireX technologies.
- ▶ Efficiency demonstration of technologies using dedicated Test benches
- ▶ Aircraft test campaign – Full Scale demonstration (A340-600)
- ▶ Building Firex Simulation Tools
- ▶ Building Certification Referential for Halon replacement by NOVEC1230 with validated technologies
- ▶ Request for proposal to several suppliers for NOVEC 1230 validated FireX technologies for an identified A/C
- ▶ Decision gate for development phases

ECOLOG/MPP - Feasibility Study phase

TESTS - Aircraft test campaign Engine & APU on A340-600

- **ENG3** and **APU** compartment instrumented for **HALON & NOVEC** measurement, as well as *pressures, temperatures, air flows & air speed*
- Tests have shown a **satisfactory behaviour of NOVEC** – Certification criteria reach.
- **Data collection** for firex simulation tool correlation

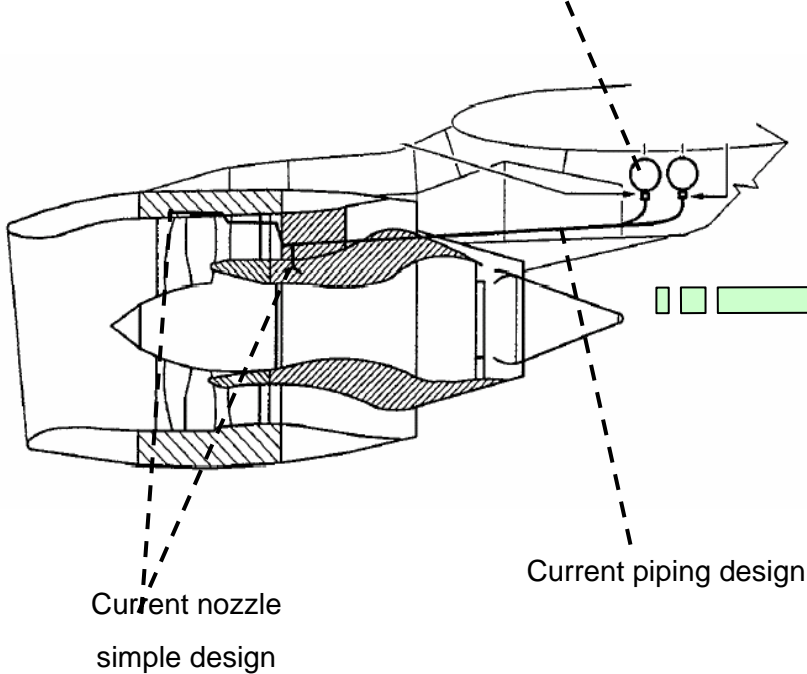


ECOLOG/MPP - Feasibility Study phase

SYSTEM DESIGN

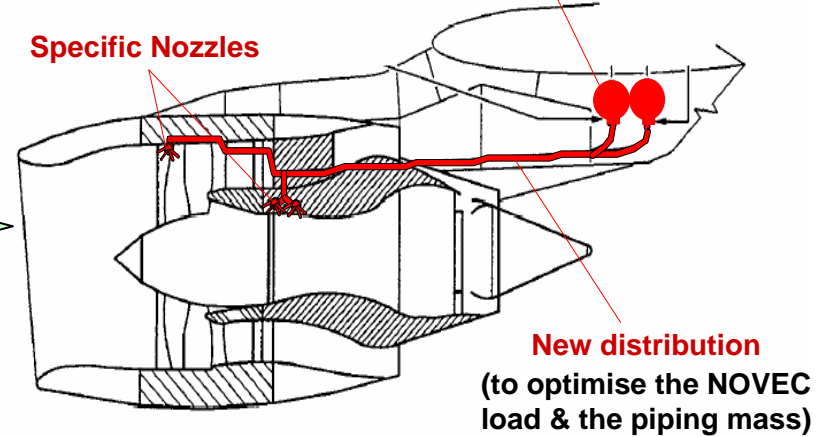
Example of NOVEC installation on board

Current bottle: Halon1301



NOVEC Bottles
(optimised volume & mass)

Specific Nozzles



HALON Bottle

NOVEC Bottle

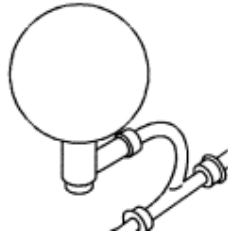
SIMULATION TOOLS

- Development of a Simulation method to calculate and design an optimized system, until its Certification
- Several applications:
 - ▶ Development of new systems
 - ▶ Certification support
 - ▶ In Service events
 - ▶ Analysis of given scenario
- Validation / correlation with data from Ground and Aircraft Tests
 - ▶ Piping pressures and temperatures
 - ▶ Concentration levels
 - ▶ Mass balance between powerplant Designated Fire Zones

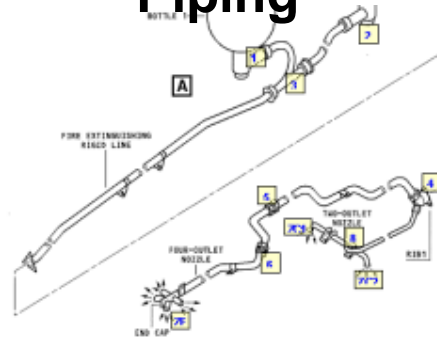
ECOLOG/MPP - Feasibility Study phase

SIMULATION TOOLS

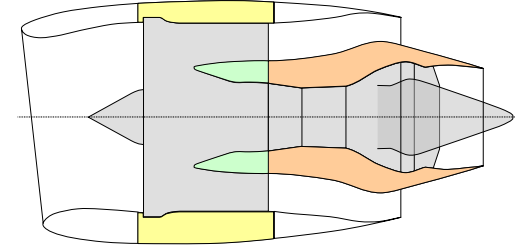
Bottle discharge:



Piping



Agent Dispersion



Available Tools

Legacy F77 code
=>HFLOW
(Halon only)

Single Element
Reduction Method

Global Mass Budget

Integrated Tool

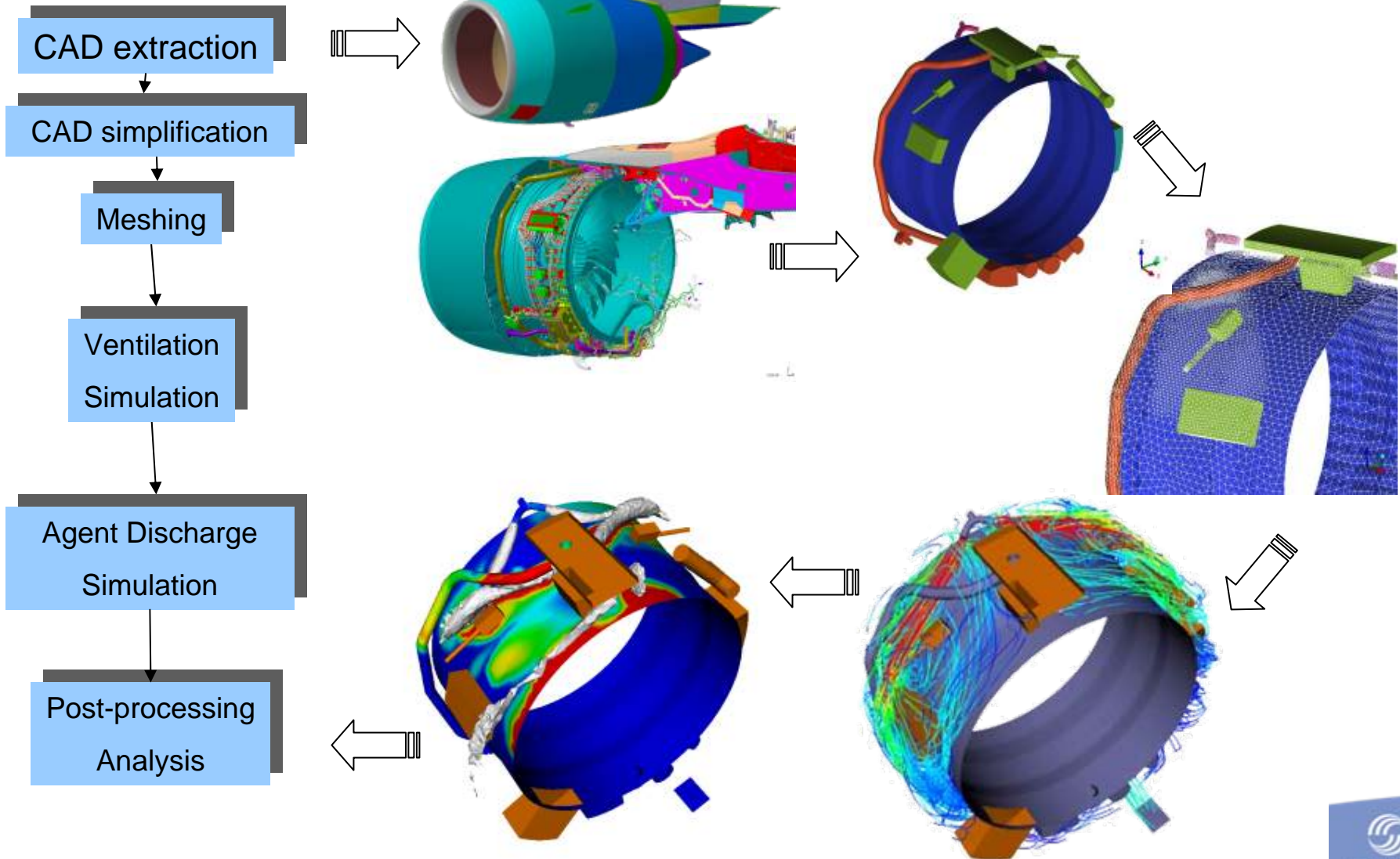
**New bottle
Characteristics**

**Real network
computation**
=>Precise pressure
loss prediction
=>Precise mass
distribution

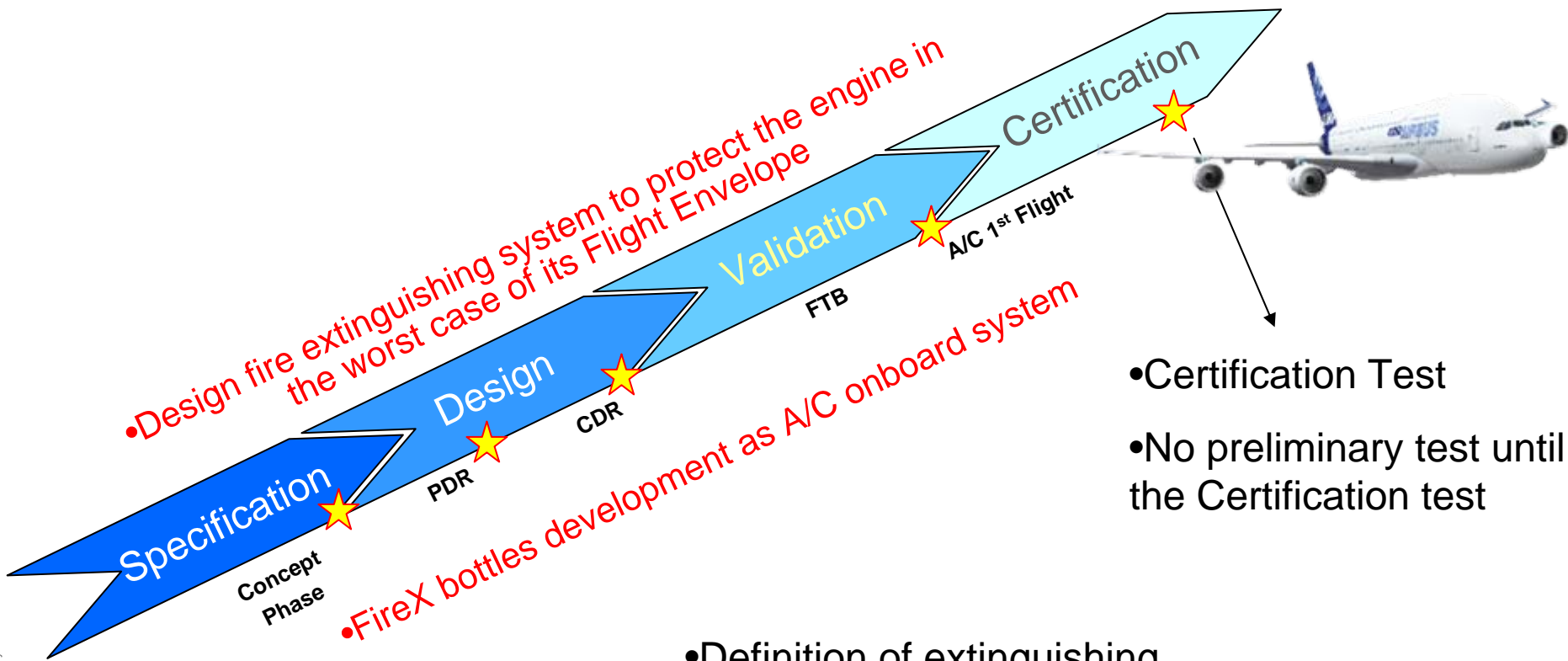
**High precision
Dispersion models:**
=> **CFD solutions**

ECOLOG/MPP - Feasibility Study phase

SIMULATION TOOLS



ECOLOG – Development For Identified A/C



- Certification Test
- No preliminary test until the Certification test

- Definition of extinguishing system needs for piping and bottles allocation
- Trade-off studies - performance against engine volumes and ventilation

SUMMARY

- R&D phase completed
- Feasibility Studies :
 - ▶ Technology “bricks” validated
 - ▶ Main Technical Parameters identified
 - ▶ Industrial Solutions under evaluation
 - ▶ Integration Problematic under evaluation
 - ▶ Simulation Tools under development
 - ▶ Data collection for Certification Frame Definition on-going
- Development Phase
 - ▶ Process and plan under adaptation to match A/C development

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