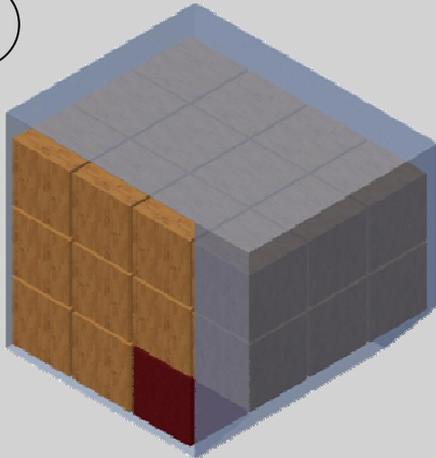


Maturity of AOA's Fire Extinguishing System

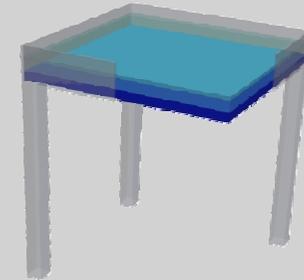
Dr. Gerd Wedler

**AOA Apparatebau Gauting GmbH
Ammerseestraße 45-49
82131 Gauting
Germany**

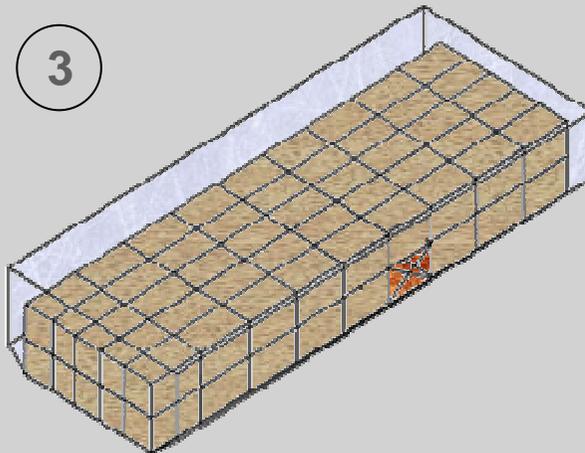
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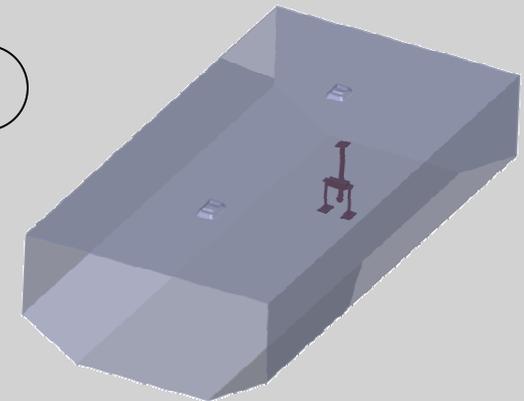
2



3



4



note technical note technical

Minimum Performance Standard for Aircraft Cargo Compartment Halon Replacement Fire Suppression Systems (2012 Update)

John W. Reinhardt

May 2012

DOT/FAA/TC-TN12/11

This document is available to the U.S. public through the National Technical Information Services (NTIS), Springfield, Virginia 22161.

This document is also available from the Federal Aviation Administration William J. Hughes Technical Center at actlibrary.tc.faa.gov.



U.S. Department of Transportation
Federal Aviation Administration



Water-Mist Nitrogen Fire Suppression System

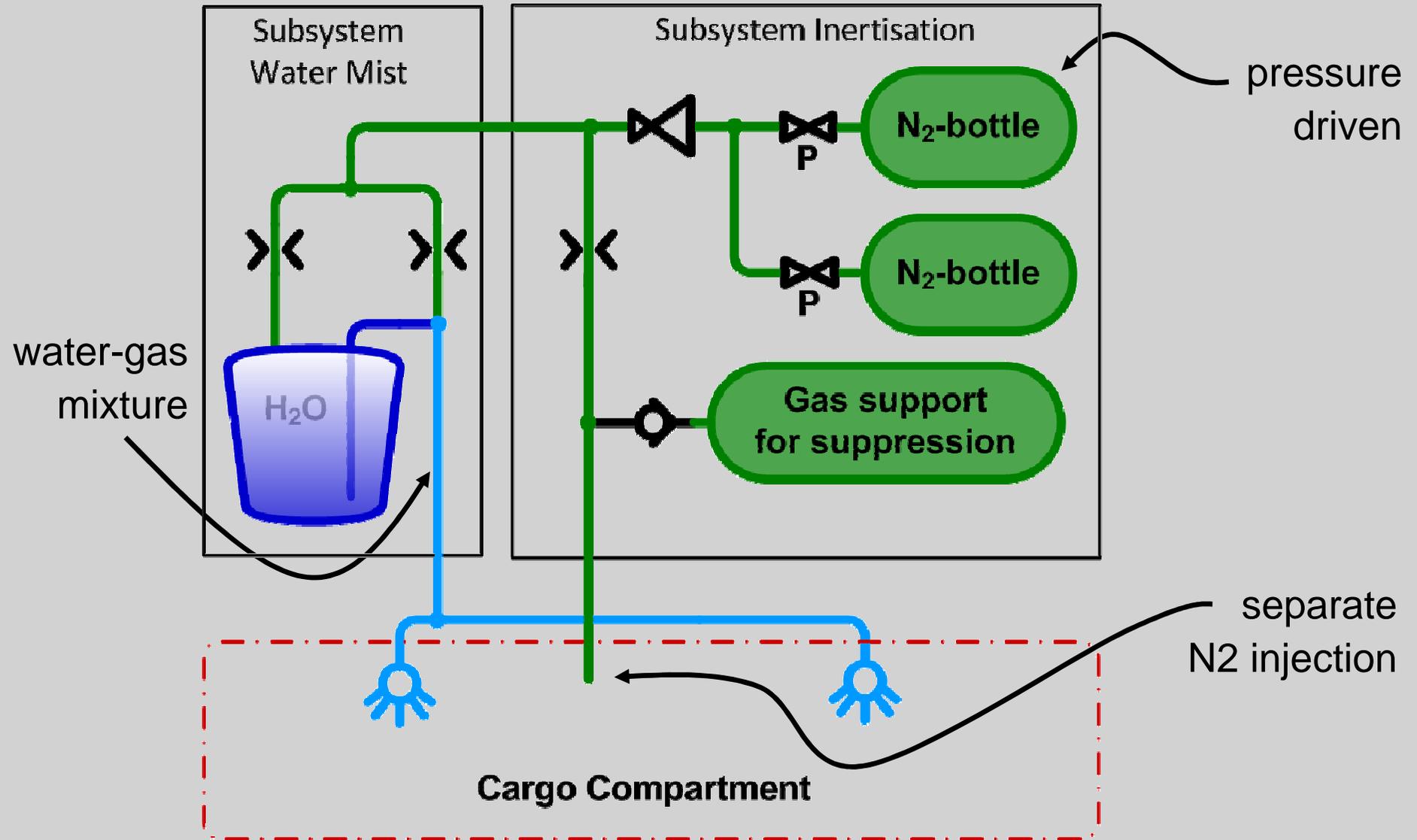
1.) knock-down phase (2-4 min)

- fire-cooling
- oxygen depletion

2.) suppression phase (ETOPS)

- keep O₂ conc. at 12 Vol.%
up to evacuation

AOA System Principle

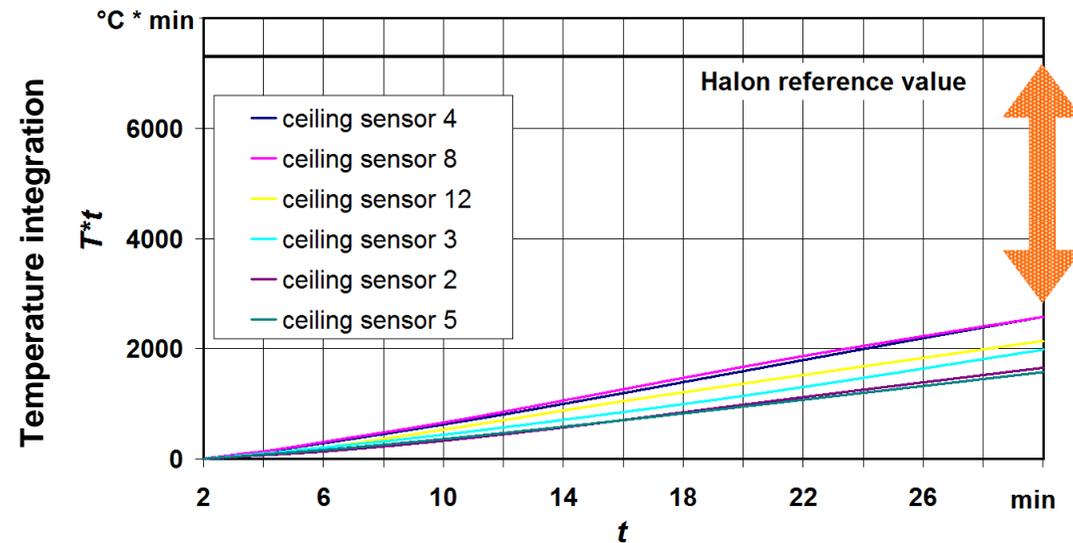
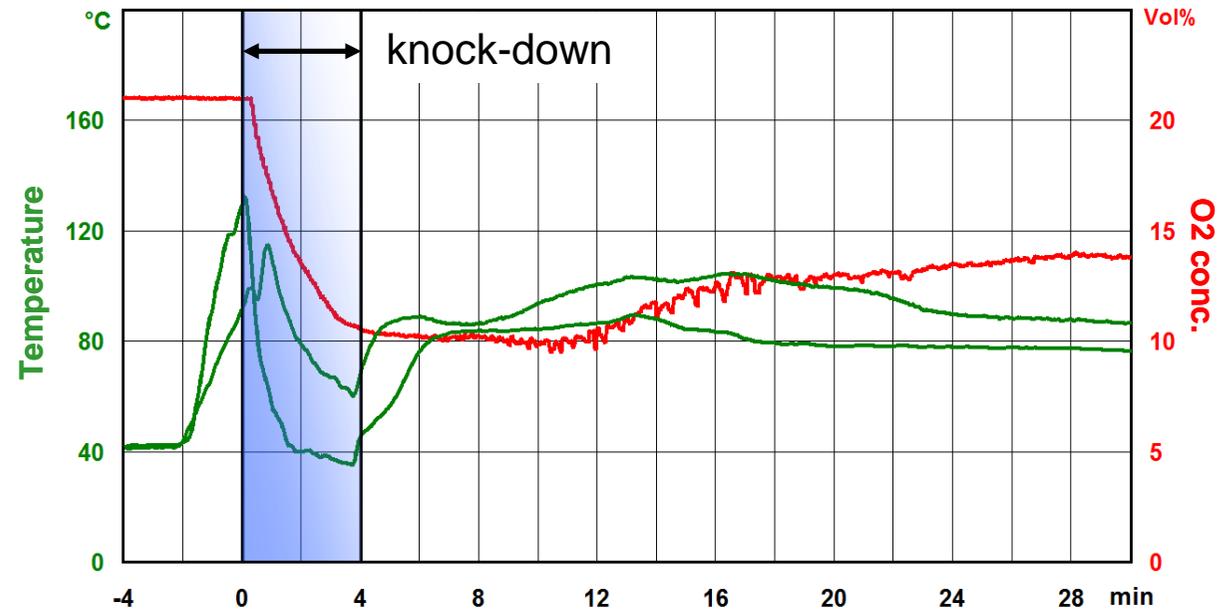


Experimental Setup @ AOA



- mock-up size close to MPS dimensions
- leakage rate adjustable by turbo-fan
- 100 full size fire experiments

Experimental Results – Containerized Fire



Full Size Fire Verification @ DLR Testcenter



- optimized watermist: droplet size / velocity / throughput / nozzle number
- water amount < 10 kg (< 3 gal) / nitrogen amount ~ 25 kg (~ 55 lb)
- all tests passed successfully

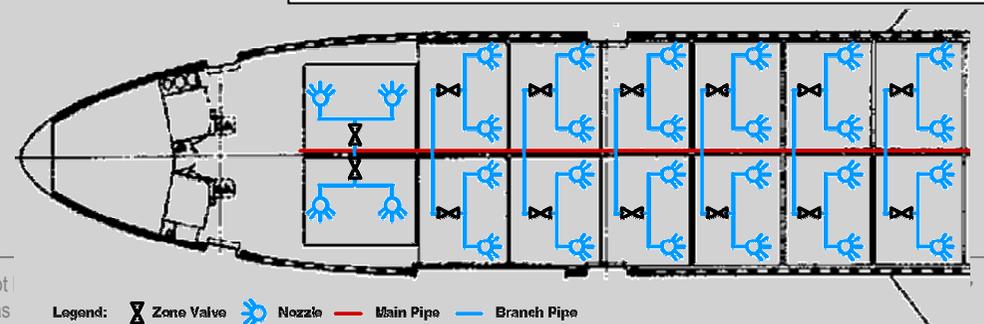
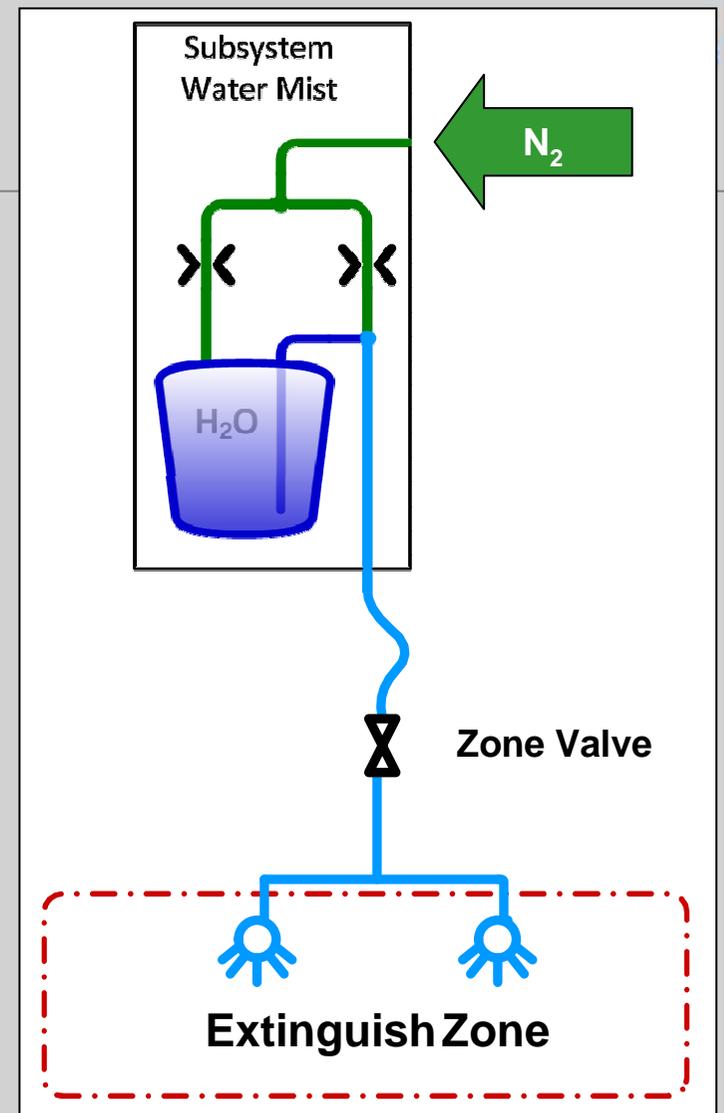


Class E Tests @ FAA Testcenter

- adaption of AOA system to Class E conditions
- oxygen depletion by nitrogen not possible
- goal for AOA was the measurement of the extinguishing contribution of pure watermist:

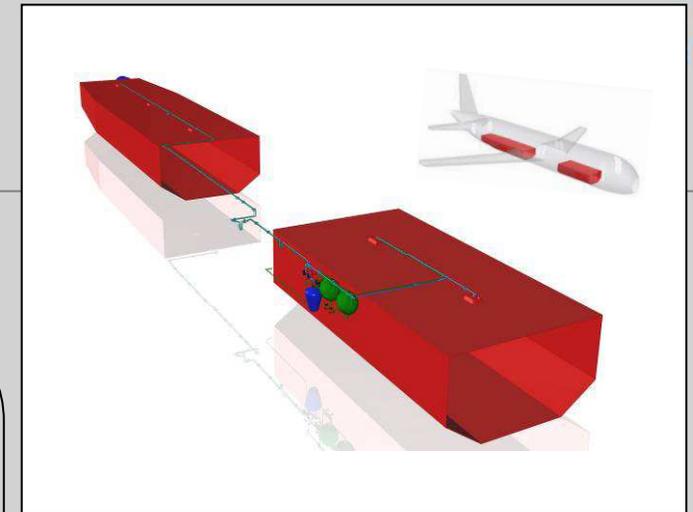
⇒ for class C a watermist-nitrogen system is determined mainly by oxygen depletion

⇒ watermist is necessary to get a cooling shield in the critical „hot temp. phase“



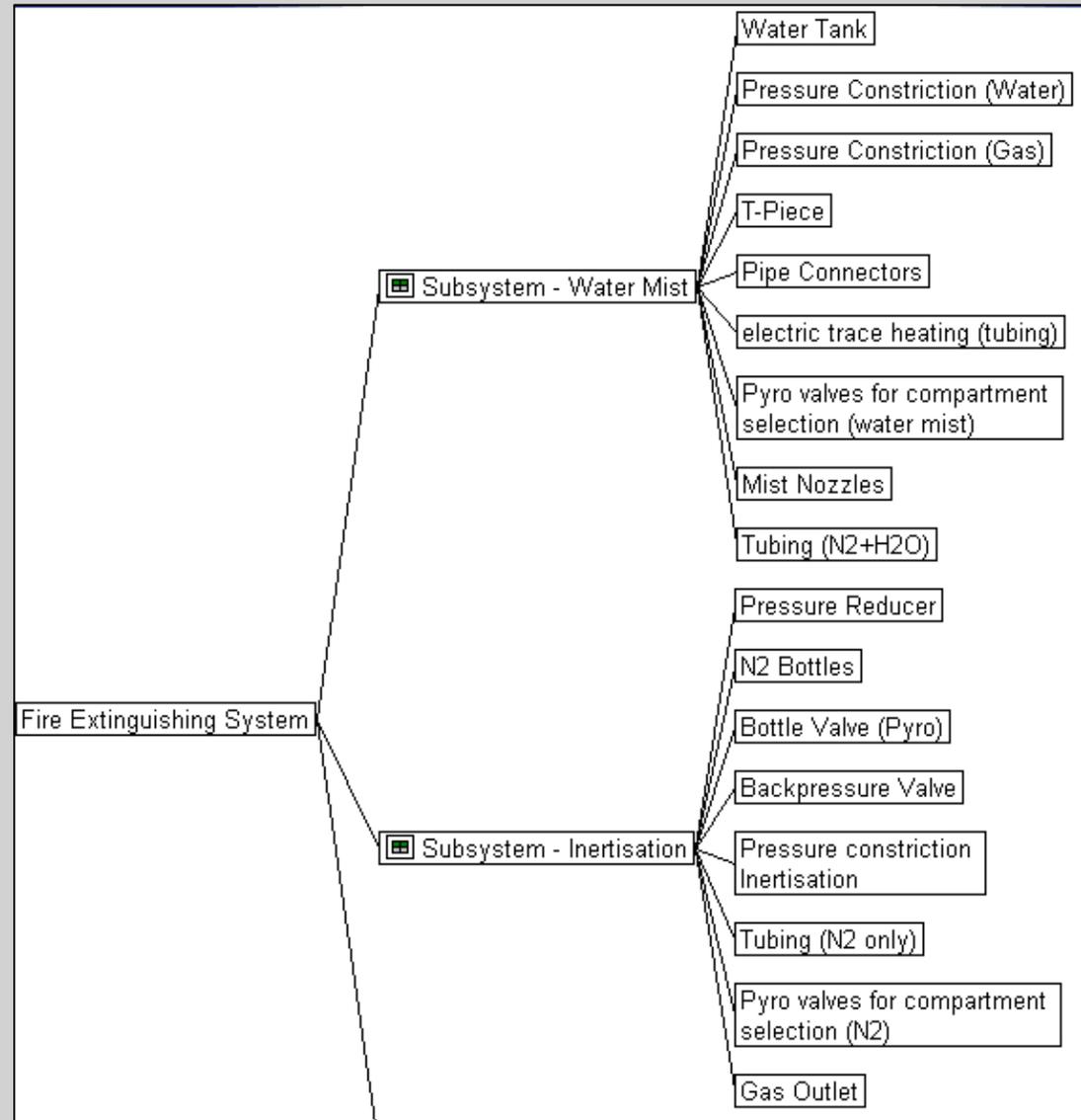
Single Aisle Weight Assessment

component	quantity	mass
pyro valve	4	
back-pressure valve	3	
pressure reducing valve	1	
switching valve	2	
gas- and water nozzles	8	
heated pipes + cables	1	
control unit + IPCU	1	
water	1	< 6 kg (<2 gal)
gas (for knock-down phase)	1	< 13 kg (<30 lb)
water tank	tbd.	
gas bottles	tbd.	



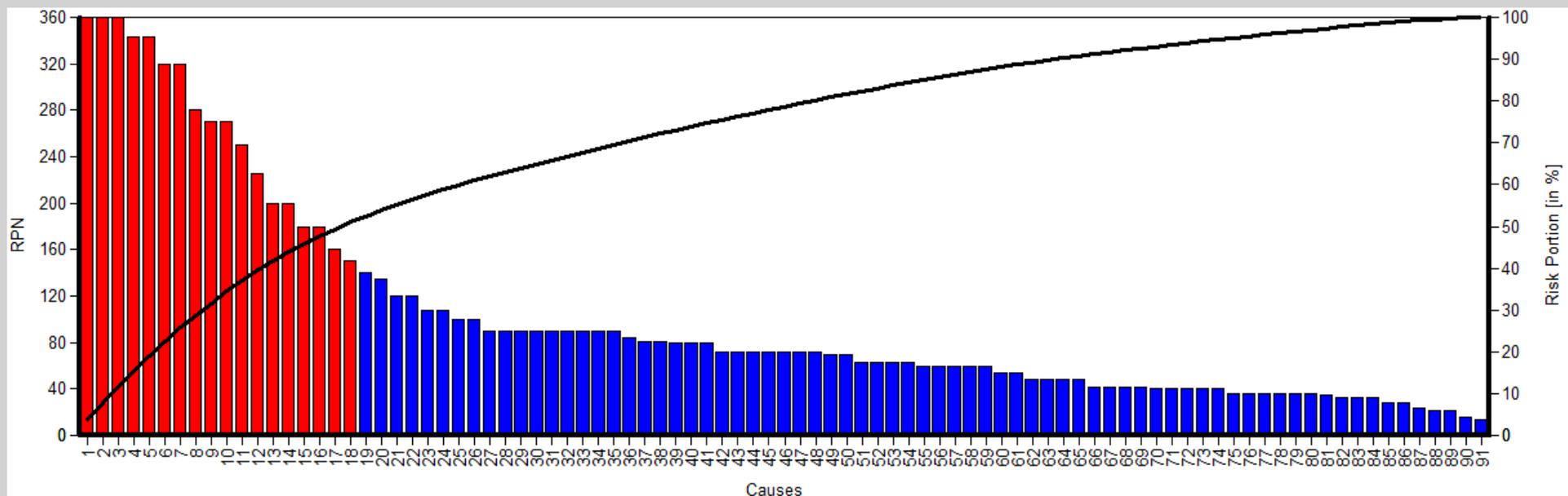
< 50 kg (110 lb)

- Design FMEA done for mechanical parts
- analysis of most critical failures
- electrical system analysis ongoing ...



DFMEA cont'd

- detractor pareto now available incl. RPN
- due to simplicity of system (no pumps etc.) no significant additional detractors compared to halon-system
- main detractor is still gas bottle including pressure-reducing-valve



Motivation:

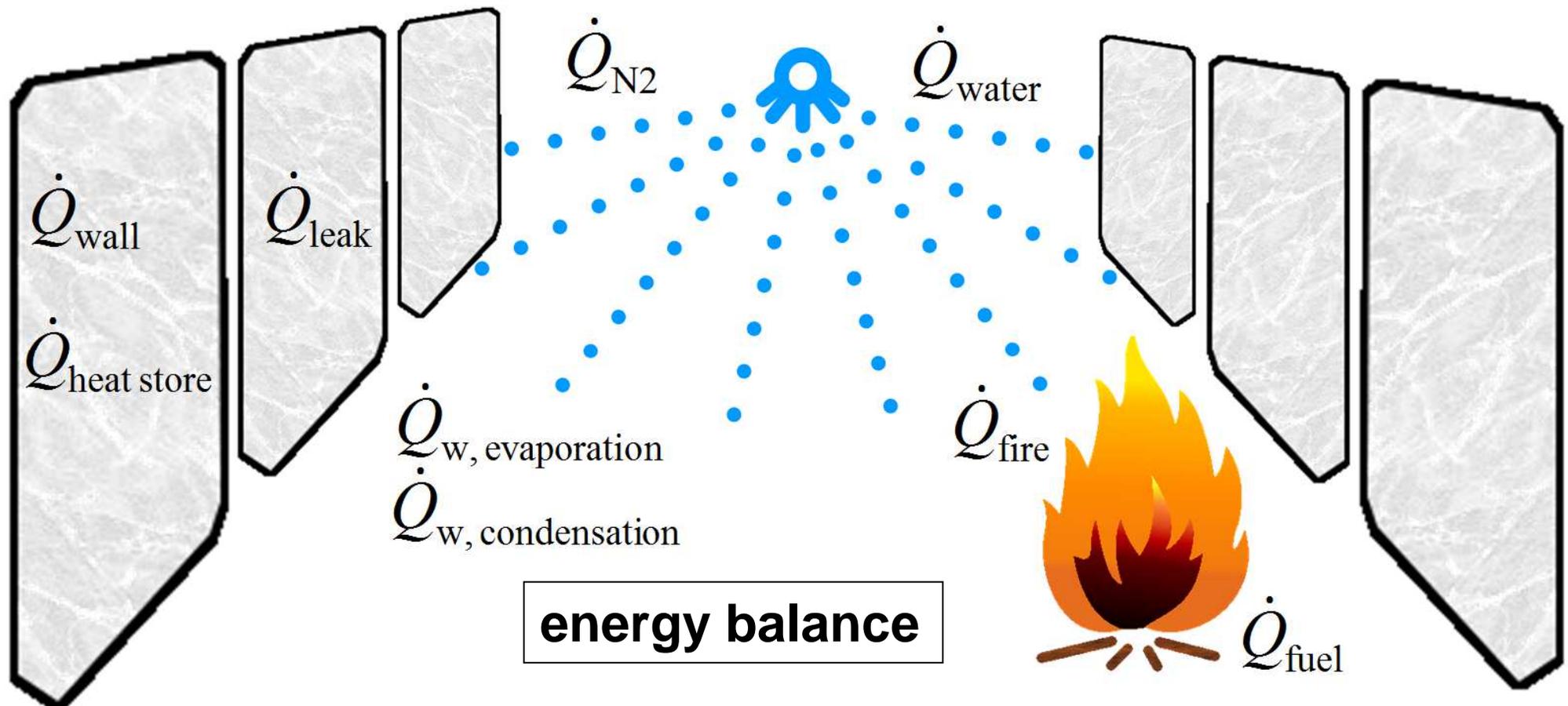
- simulation model for watermist+nitrogen extinguishing
- theoretical understanding of interaction of watermist+nitrogen vs. fire-scenarios
- simulation helps to predict

critical temperature behaviour
in-flight pressure increase

independent on experiment realization

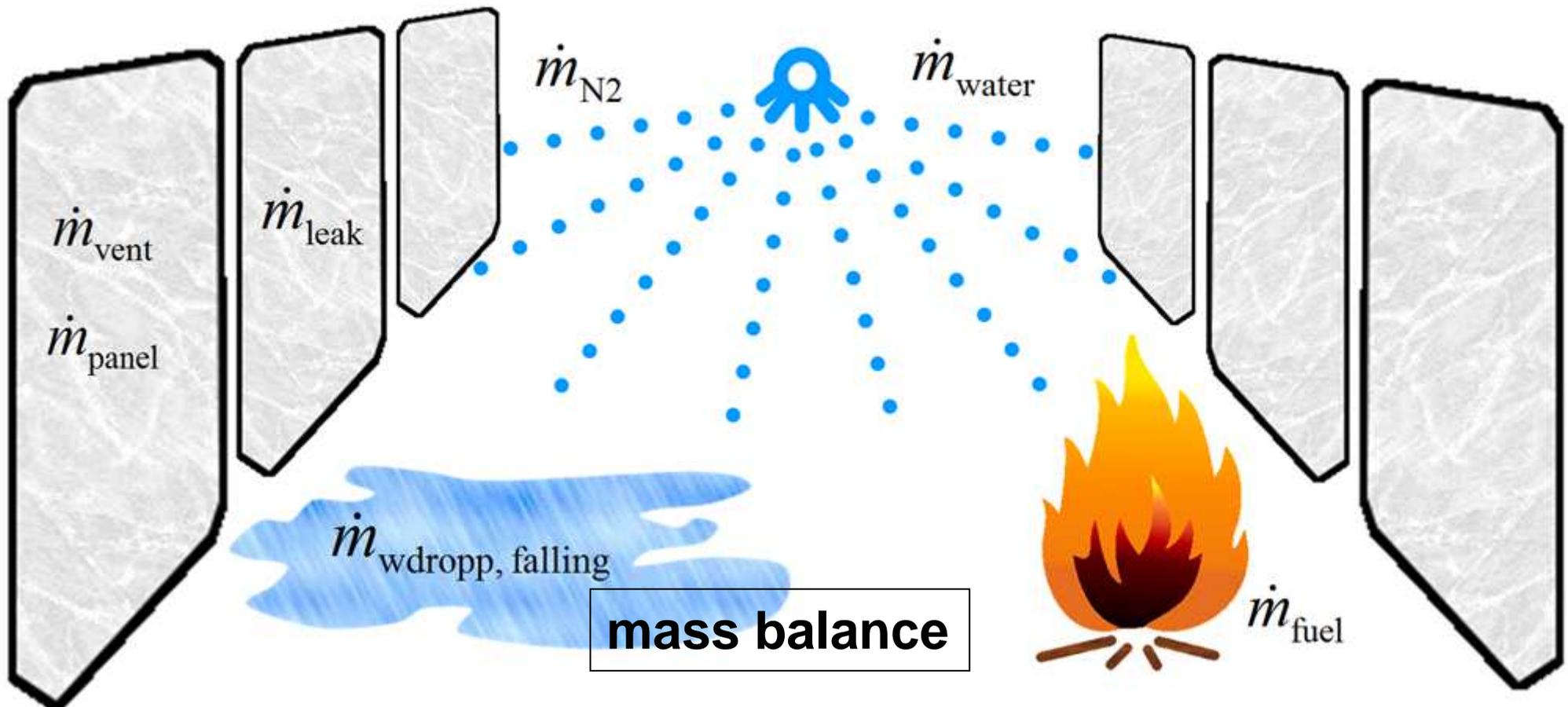
Simulation of Water Mist + Nitrogen Fire Suppression

- 1-Zone model
- aircraft boundary conditions
- oxygen depletion
- water mist



Simulation of Water Mist + Nitrogen Fire Suppression

- 1-Zone model
- aircraft boundary conditions
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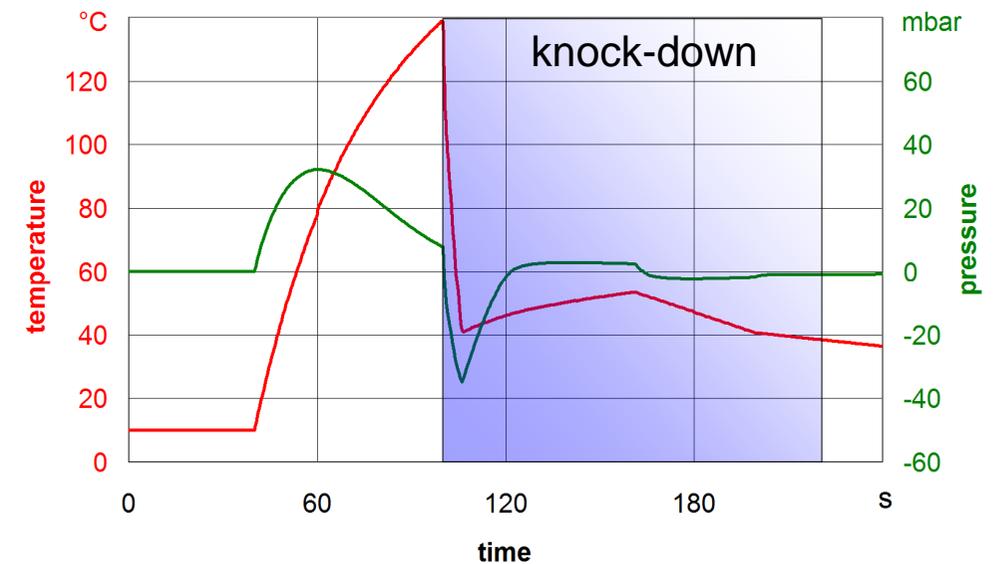
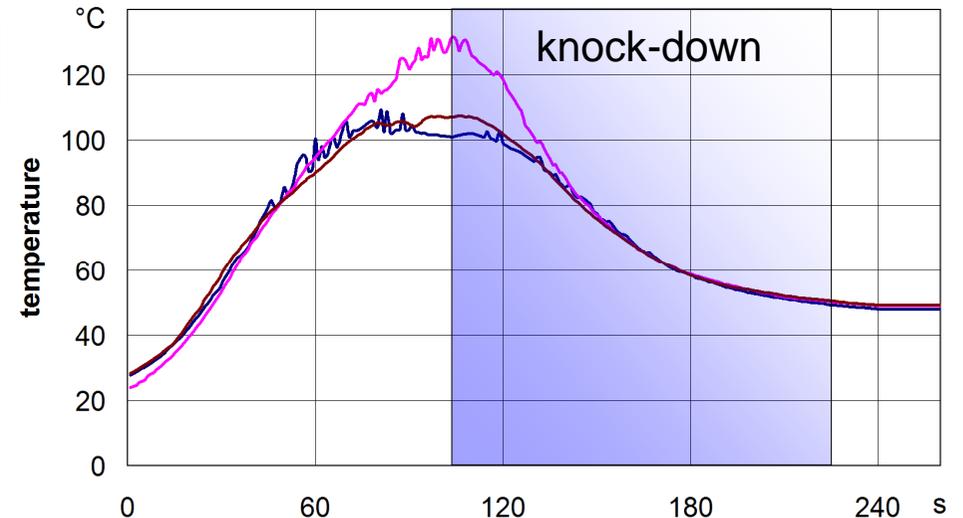
Comparison of Simulation and Experiment

Experiment

- 3 pool fire tests
- 2 min water mist + N₂

Simulation

- simulation of pool fire
- output: temperature & in-flight pressure



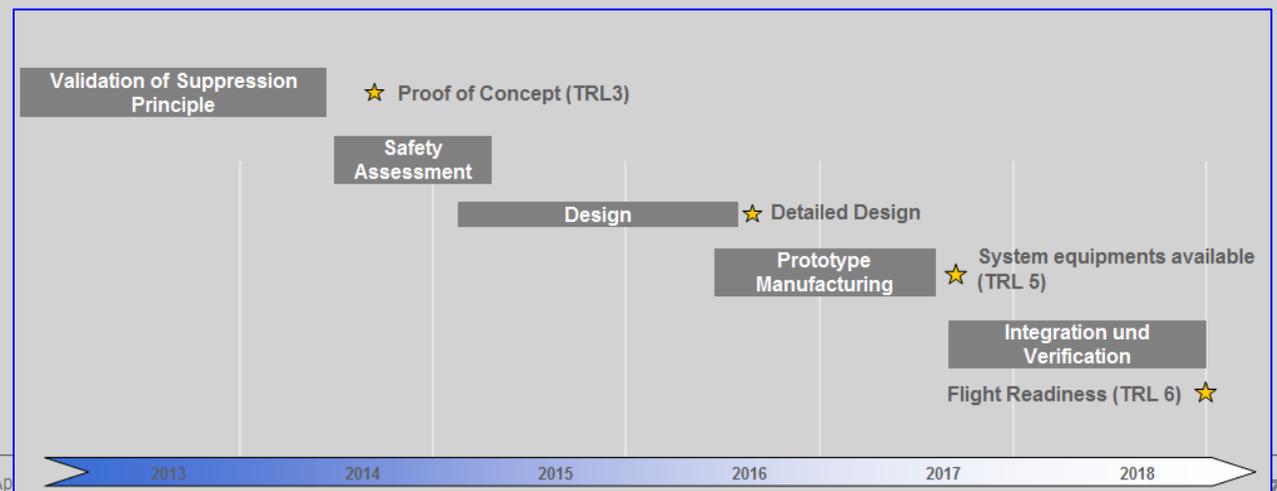
Summary



- AOA's watermist+nitrogen system has shown the proof of concept now (TRL3)
- successful external tests with optimized system (@ DLR testcenter Trauen "Class C" / @ FAA Techcenter A.C. "Class E")
- System Design-FMEA almost done, safety analysis started now
- 1-zone simulation model available for critical in flight pressure/temperature

⇒ progress in maturity of AOA's system

⇒ time schedule until flight readiness (TRL 6) will be presented in ICCAIA meeting on Friday Oct. 31



Thank you for your attention!

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