Forced-flow Fire Testing with "cold"-soaked FK-5-1-12

Federal Aviation Administration

Presented to: International Aircraft Systems Fire Protection Working Group

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Presentation Overview
Major Discussion Points

- **Purpose**

- **Test Conditions**

- **Test Fixture Modifications**

- **Status, Halon Replacement/Engine Nacelle**

Forced-flow Fire Testing, "cold"-soaked FK-5-1-12

- **Purpose**
  - To present circumstances for fire extinguishment assessment of FK-5-1-12 in the Nacelle Fire Simulator (NFS)
  - Circumstances related to
    - JP8 pool- and spray-based fire threats
    - "cold" conditions analogous to civil transport aircraft operations

Forced-flow Fire Testing, "cold"-soaked FK-5-1-12

- ## **Test Conditions**
  - NFS
    - same geometry of previous MPSe testing descriptions
    - relatively "clean" cross section
    - single air flow; ambient temperature, $\approx$ 1.4 kg/s
    - partial external boundary; ambient- or "cold"-soaked temperature
    - 2 fire threats presented; JP8-based spray & pool fire behaviors
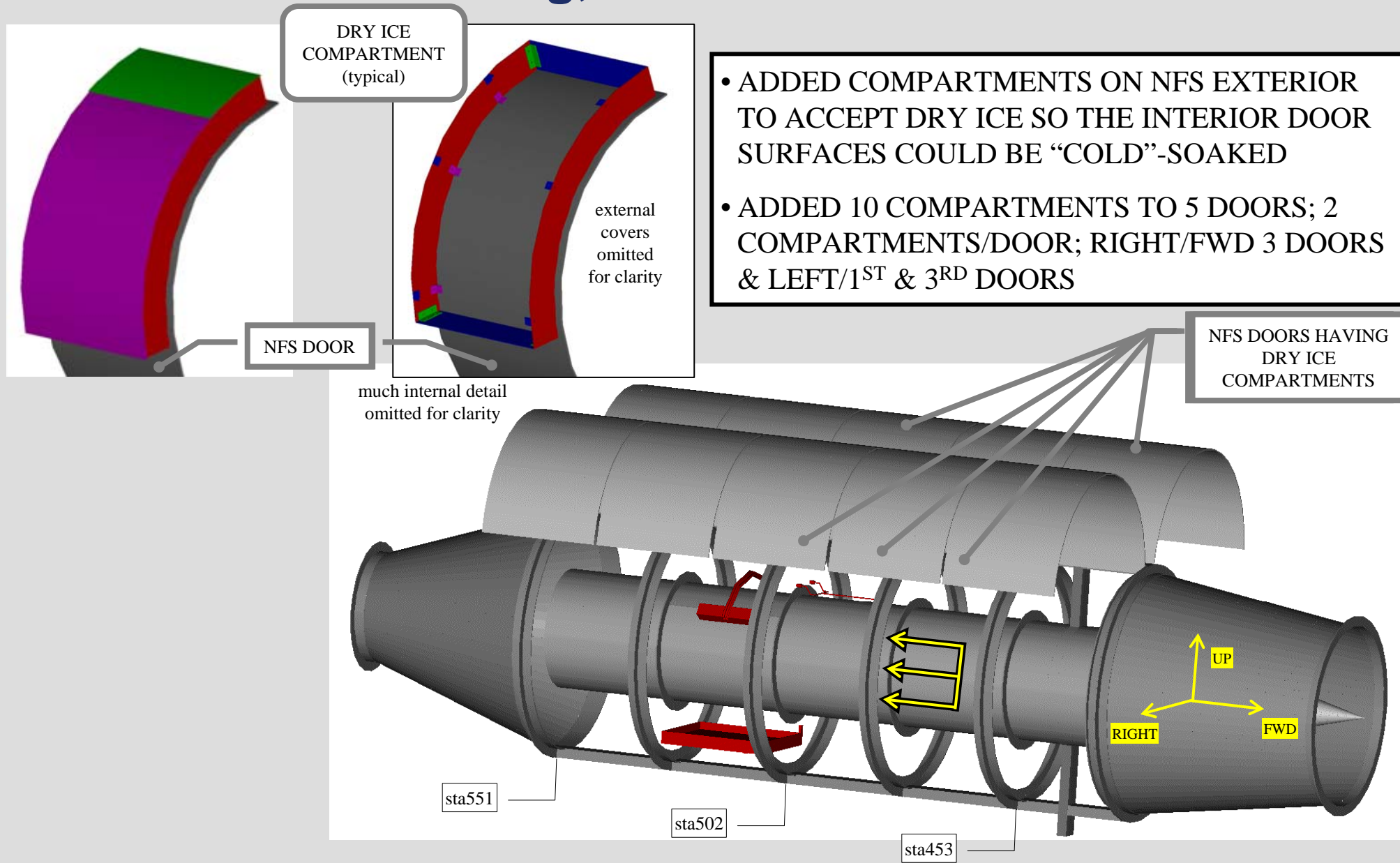 - Fire extinguishing (firex) agent
    - varied firex agent storage temperature; ambient-, "hot"- or "cold"-soaked
    - varied firex agent storage pressure
    - varied firex agent mass
    - varied injection configuration
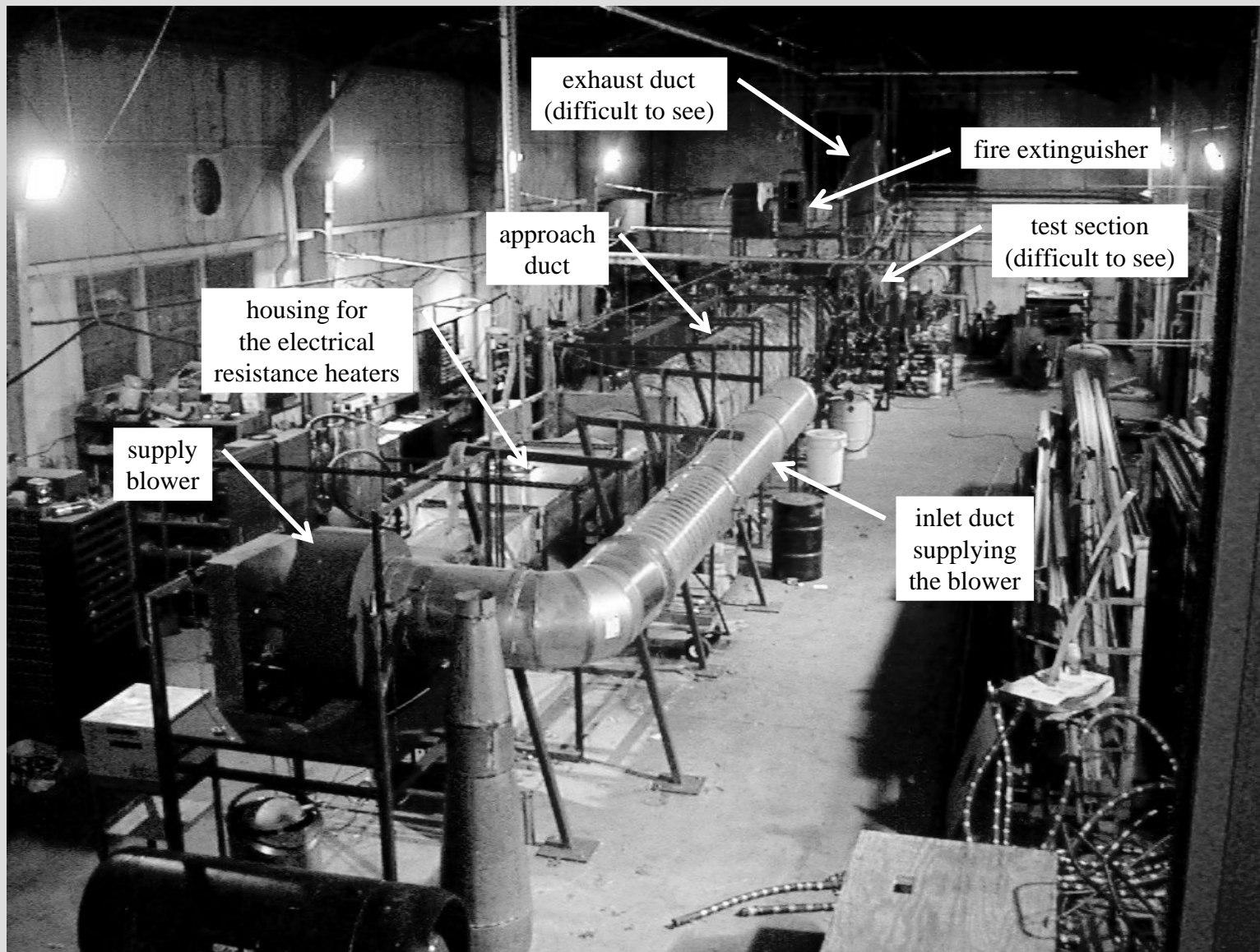
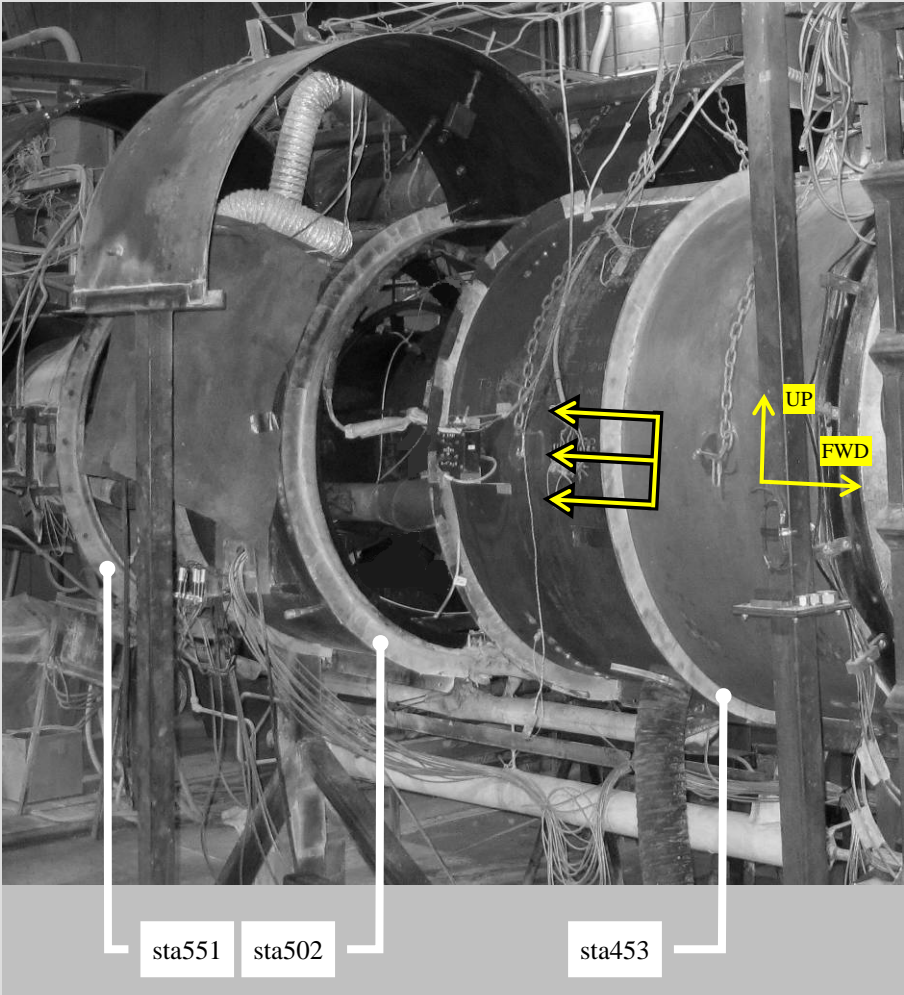# Forced-flow Fire Testing, "cold"-soaked FK-5-1-12

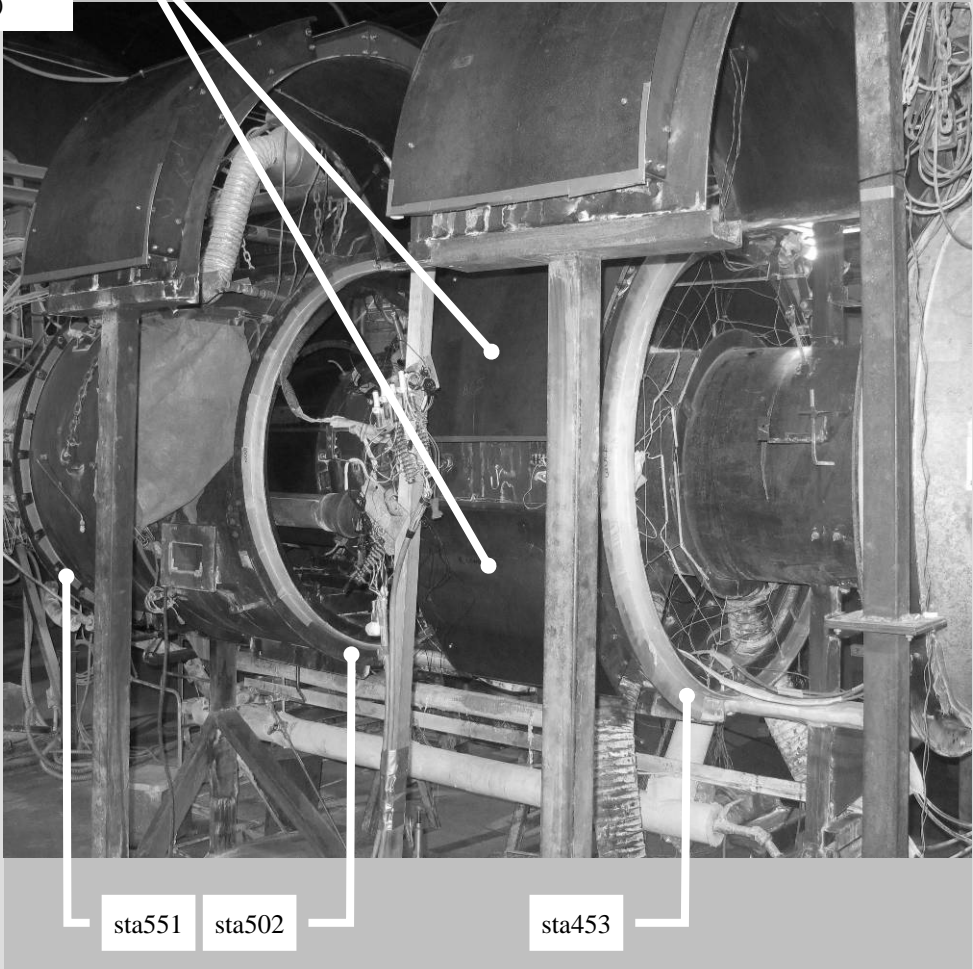# Forced-flow Fire Testing, "cold"-soaked FK-5-1-12

DRY ICE COMPARTMENT (typical)

external covers omitted for clarity

NFS DOOR

much internal detail omitted for clarity

- ADDED COMPARTMENTS ON NFS EXTERIOR TO ACCEPT DRY ICE SO THE INTERIOR DOOR SURFACES COULD BE "COLD"-SOAKED
- ADDED 10 COMPARTMENTS TO 5 DOORS; 2 COMPARTMENTS/DOOR; RIGHT/FWD 3 DOORS & LEFT/1ST & 3RD DOORS

NFS DOORS HAVING DRY ICE COMPARTMENTS

UP
RIGHT
FWD

sta551

sta502

sta453

Forced-flow Fire Testing, "cold"-soaked FK-5-1-12

NFS DOORS WITHOUT DRY ICE COMPARTMENTS

UP
FWD

sta551 sta502 sta453

NFS DOORS WITH DRY ICE COMPARTMENTS
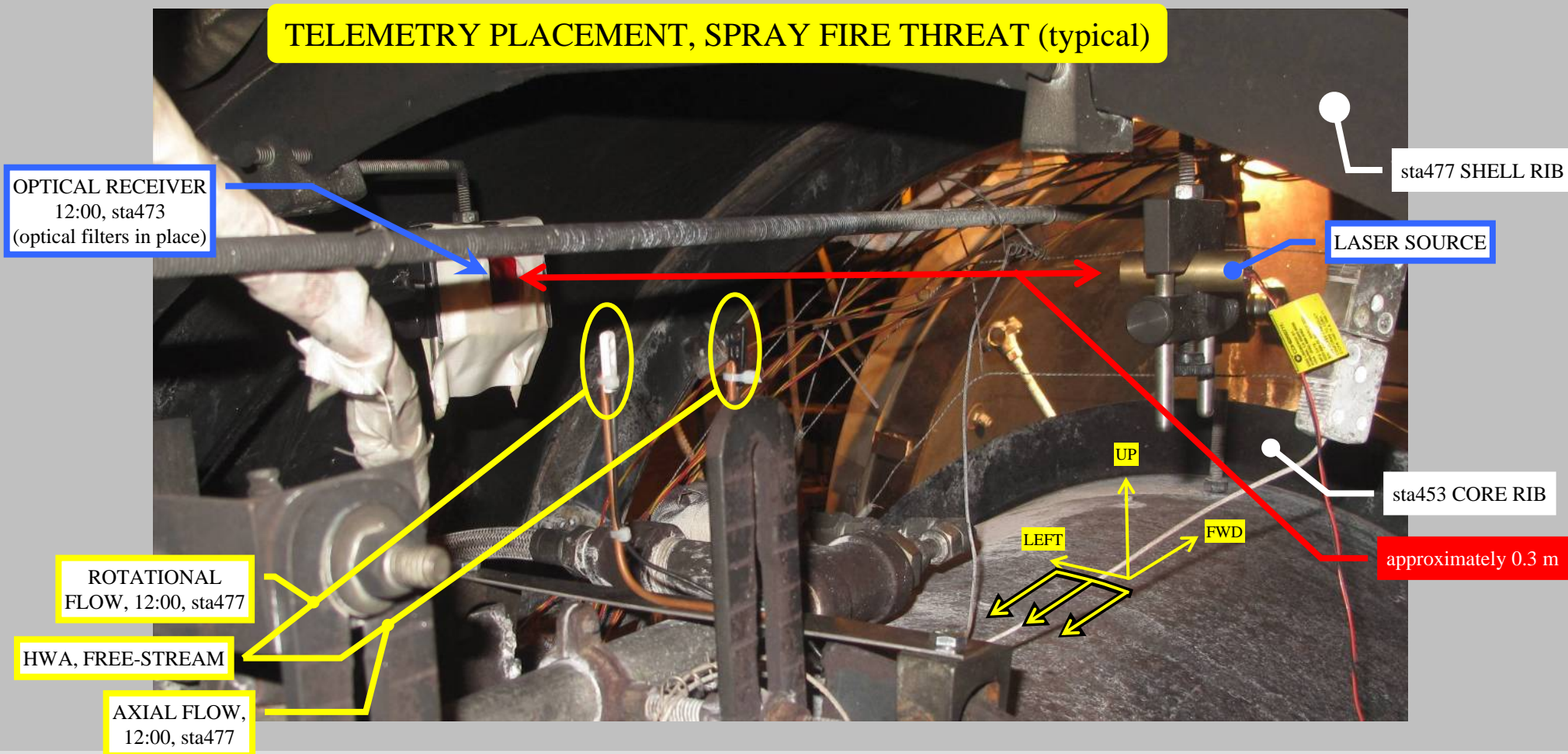
DRY ICE COMPARTMENT (typical)

sta551 sta502 sta453

Forced-flow Fire Testing, "cold"-soaked FK-5-1-12

COMPLIMENTED EXISTING TELEMETRY WITH ADDITIONAL SENSORS TO CAPTURE BEHAVIORS
- THERMCOUPLES : CERTAIN WALL & FIRE EXTINGUISHER THERMAL BEHAVIORS
- HOT-WIRE ANEMOMETERS (HWAs) : RELATIVE FLOW-FIELD SPEED IN SELECT LOCATIONS
- LASER-EXCITED OPTICAL RECEIVER : RELATIVE AEROSOL DENSITIES IN SELECT LOCATIONS

TELEMETRY PLACEMENT, SPRAY FIRE THREAT (typical)

OPTICAL RECEIVER
12:00, sta473
(optical filters in place)

sta477 SHELL RIB

LASER SOURCE

sta453 CORE RIB

approximately 0.3 m

UP

LEFT

FWD

ROTATIONAL
FLOW, 12:00, sta477

HWA, FREE-STREAM

AXIAL FLOW,
12:00, sta477

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THERMOCOUPLE PLACEMENT, INTERIOR NFS DOOR (typical)
Note : NFS door is supported in the OPEN position

sta440/LEFT DOOR, INTERIOR SURFACE

UP

LEFT

FWD

THERMOCOUPLE, INTERNAL NFS DOOR SURFACE, "pinch"-mounted, sta445/07:30

THERMOCOUPLE, INTERNAL NFS DOOR SURFACE, "pinch"-mounted, sta445/10:30
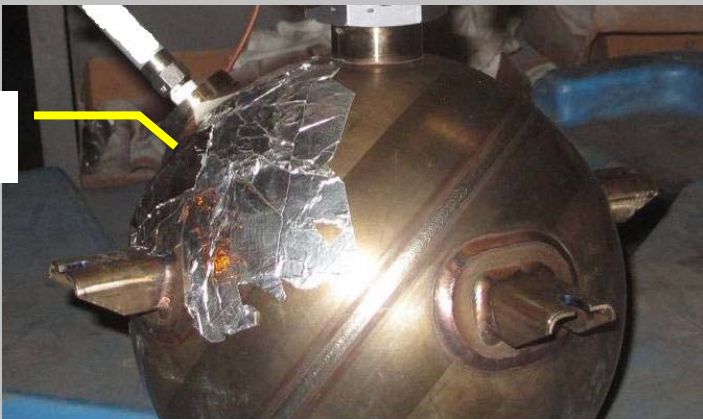
TELEMETRY, FIREX BOTTLE (typical)

PLUMBING ASSEMBLY USED TO SENSE INTERNAL TEMPERATURE & PRESSURE

TAP FOR PRESSURE TRANSDUCER

THERMOCOUPLE TIP

THERMOCOUPLE, SURFACE MOUNTED

Presentation Conclusion
Status, Halon Replacement/Engine Nacelle

- **"Cold" FK-5-1-12 testing/analysis incomplete**
  - Support paused
  - Report to be published; date indeterminate

- **Solid aerosol testing/analysis incomplete**
  - Support :
    - resuming
    - expected uninterrupted through conclusion
  - Report to be published; date indeterminate

Presentation Conclusion
Status, Halon Replacement/Engine Nacelle

- **Further change to MPSe rev04 not expected**

- **Plan to author/release publically-available reports**
  - 1ST report : MPSe development history & latest revision
    - developmental history up to & including MPSe rev04
    - detailed NFS descriptions
    - MPSe rev03 testing outcomes
  - 2ND report : MPSe rev04 outcomes for a given solid aerosol
  - 3RD report : "cold" FK-5-1-12 testing

End

- ## Acronyms, short-hand notations

  APU = Auxiliary Power Unit

  fwd = forward

  FK-5-1-12 = 3M Novec 1230

  MPSe = Minimum Performance Standard for Halon Replacement in Civil Aircraft Engine Nacelle & APU Compartments

  NFS = nacelle fire simulator for the MPSe, located at the FAA WJ Hughes Technical Center

  OD = outside diameter

  rev = revision

  sta = station number, longitudinal position in the NFS

  vent = ventilation