**<u>Federal Building and Fire Safety Investigation
of the World Trade Center Disaster</u>**

Simulation of the Fires in WTC 1, 2 and 7

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Overview

- Development and validation of the Fire Dynamics Simulator for use in the WTC investigation is complete

- Numerical simulations of fires in WTC 1, 2 and 7 on-going using the latest information provided by the airplane impact and photo analysis teams

- A set of "standard fires" has been developed to bound possible outcomes of the calculations
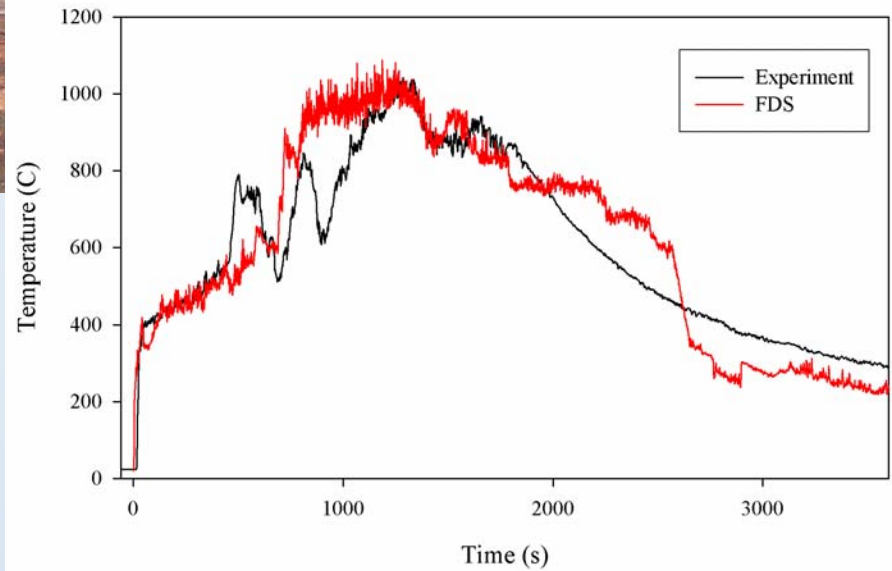
NIST

10:22:59 a.m.
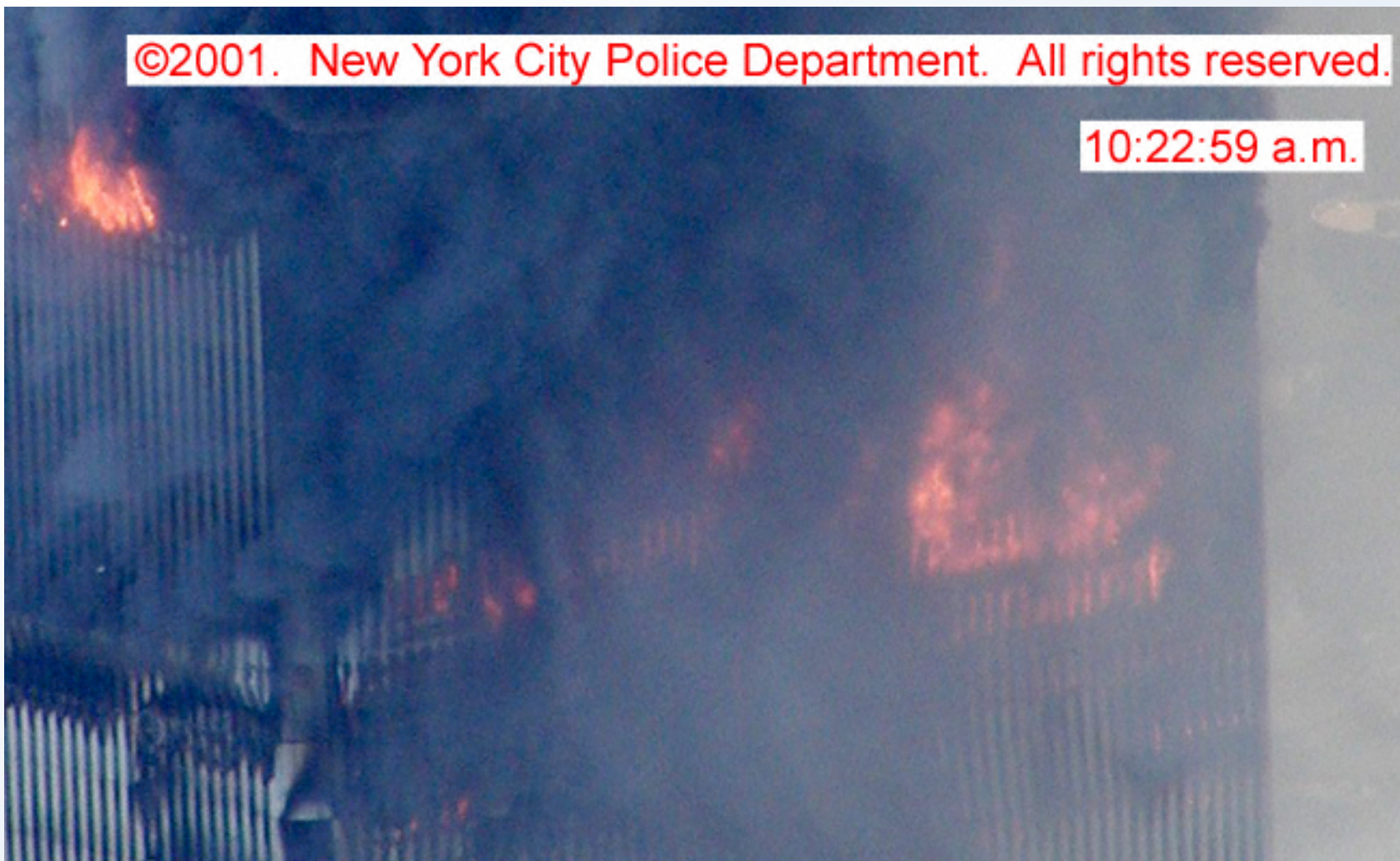
Goal: numerically simulate the fires within WTC 1, 2 and 7 so that the uncertainty in the calculations is less than the uncertainty in the initial and boundary conditions.
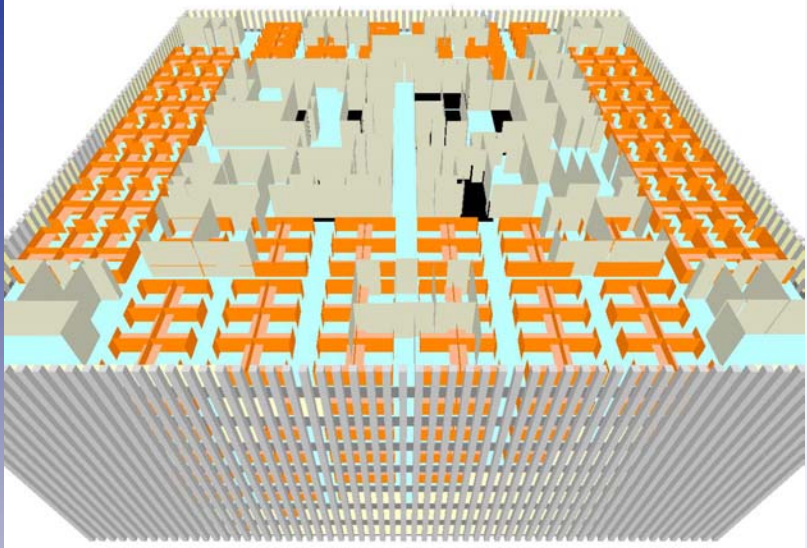
NIST

**Phase 2
Experiment
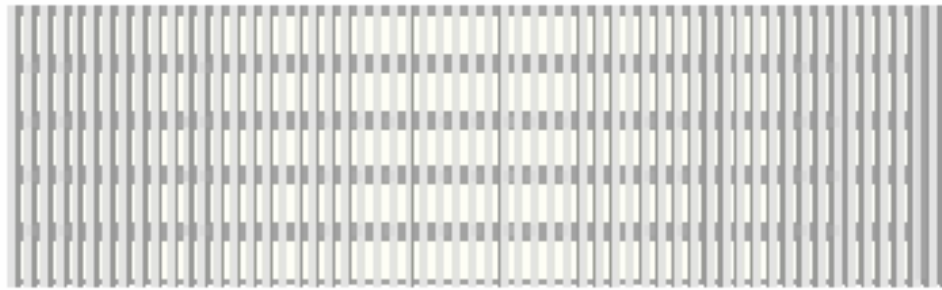3 Workstation Fire**

**FDS Prediction of
Compartment
Temperature**

Layout of typical floor, WTC 1

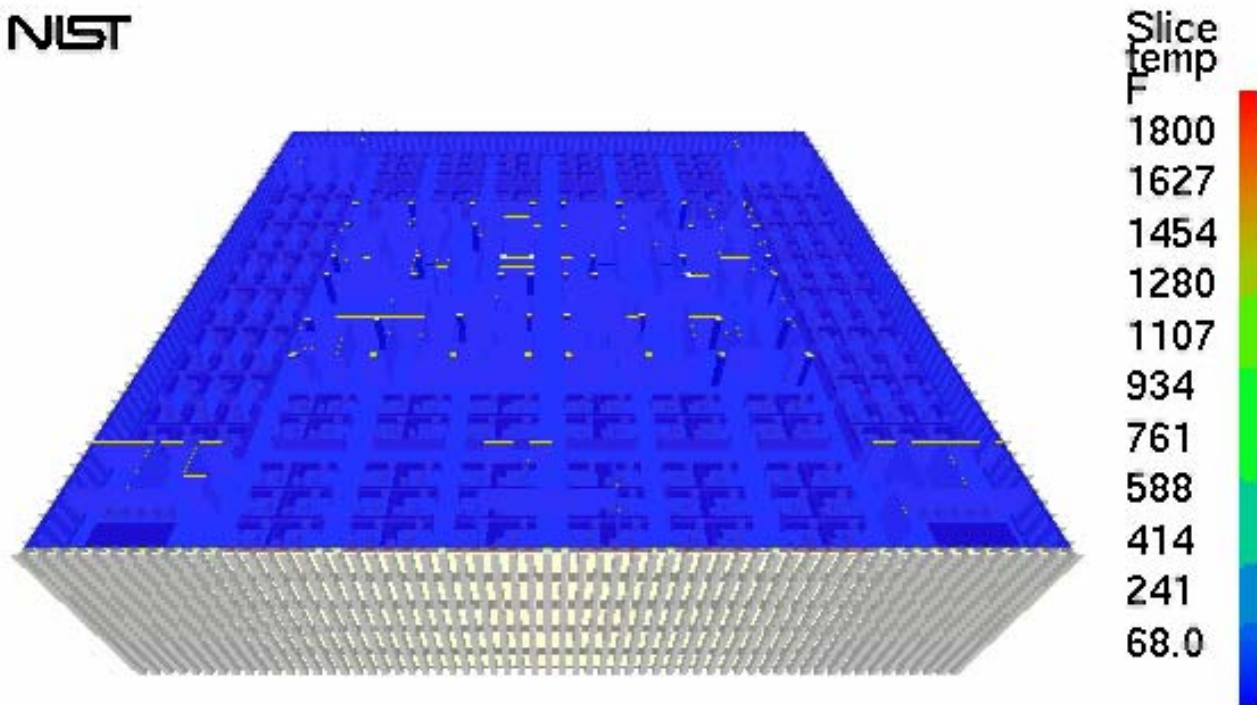**Walk-through of 94th floor, WTC 1 (animation)**

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Model Inputs

- Initial Conditions:

  - Damage to building exterior/interior

  - Jet fuel distribution

  - Combustible load (furniture mass per unit area)

- Boundary Conditions:

  - Window breakage

  - Wind

  - Thermal properties of furnishings

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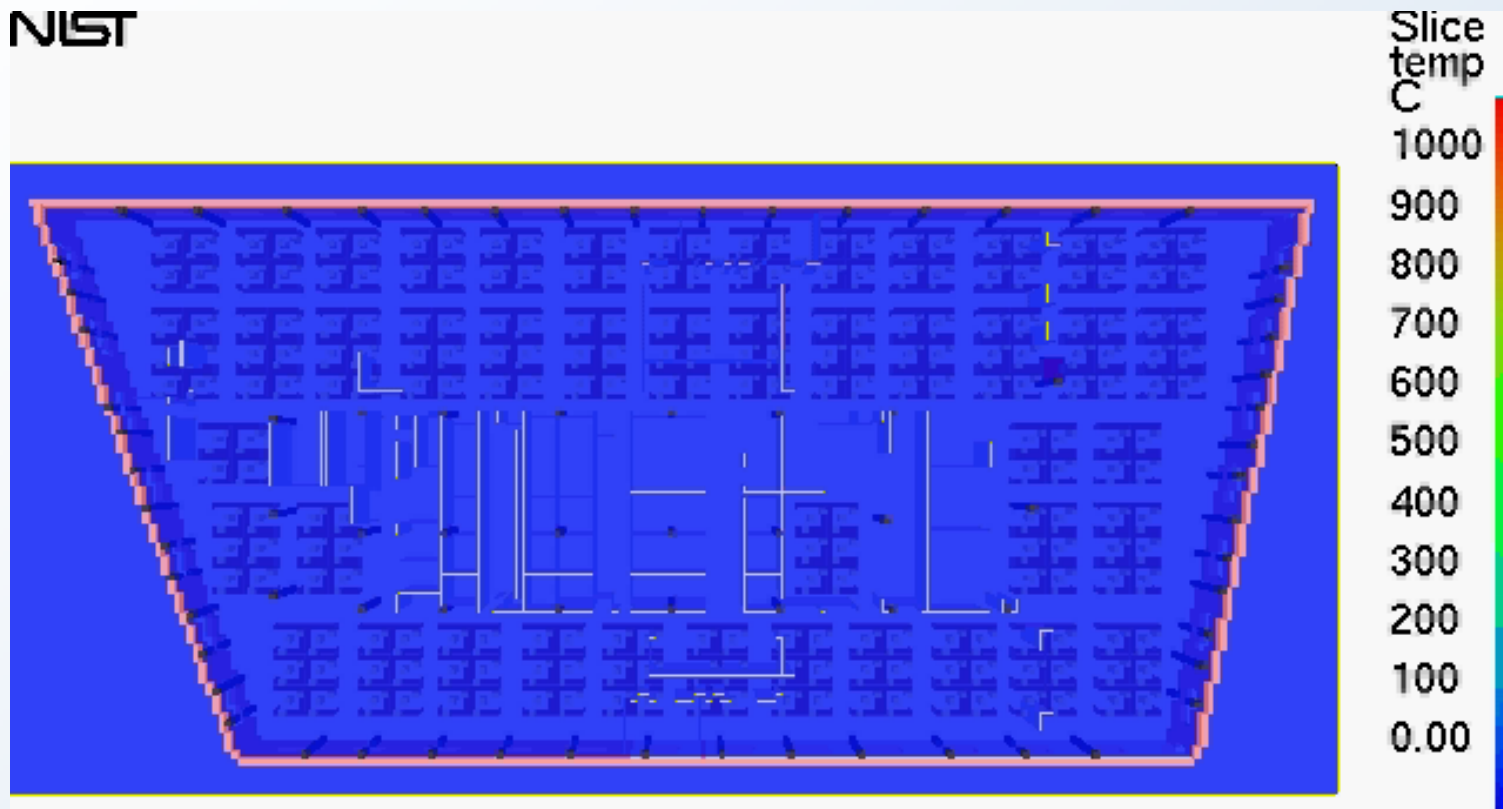# Upper Layer Temperatures, WTC 1, Floor 97
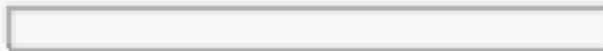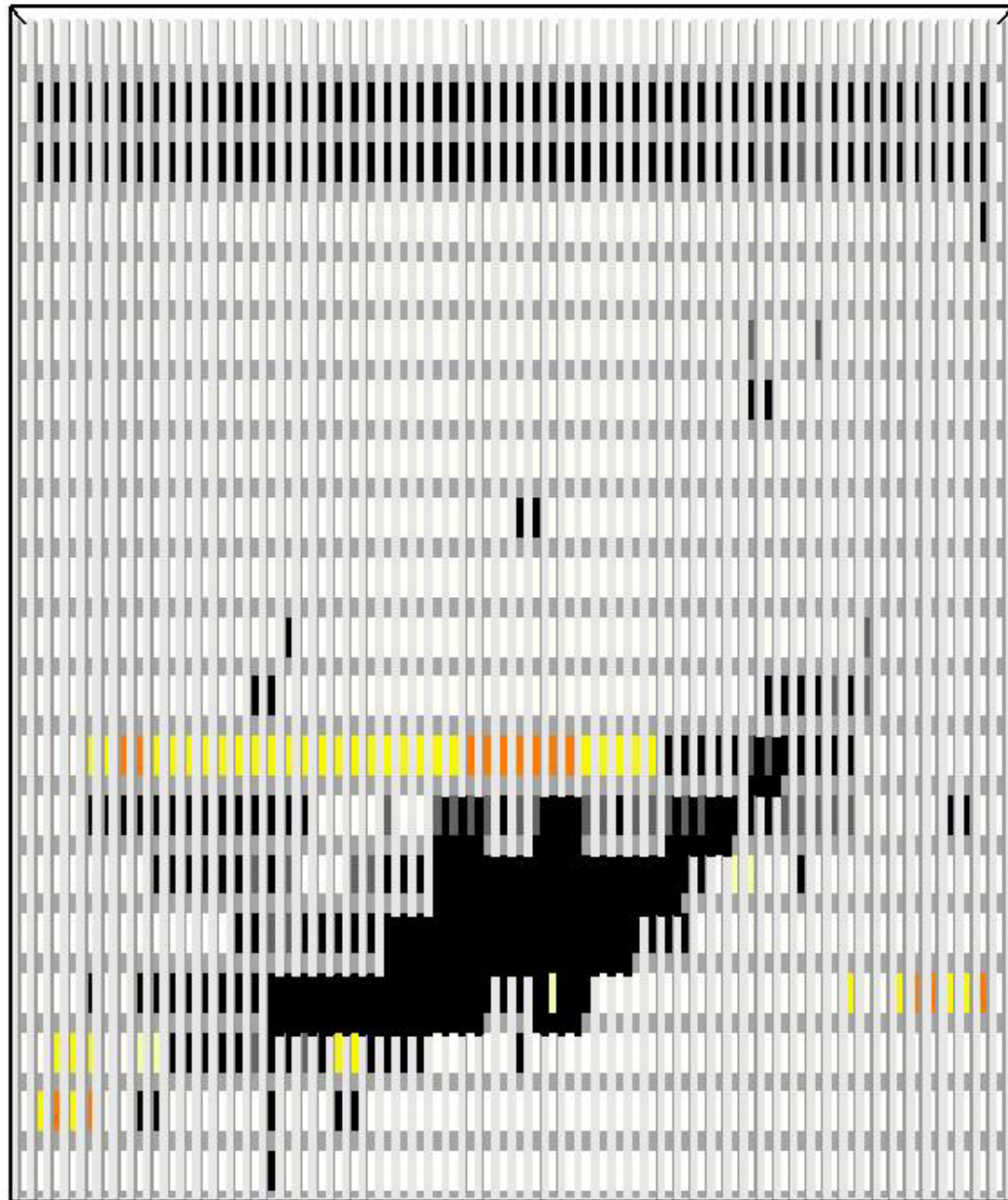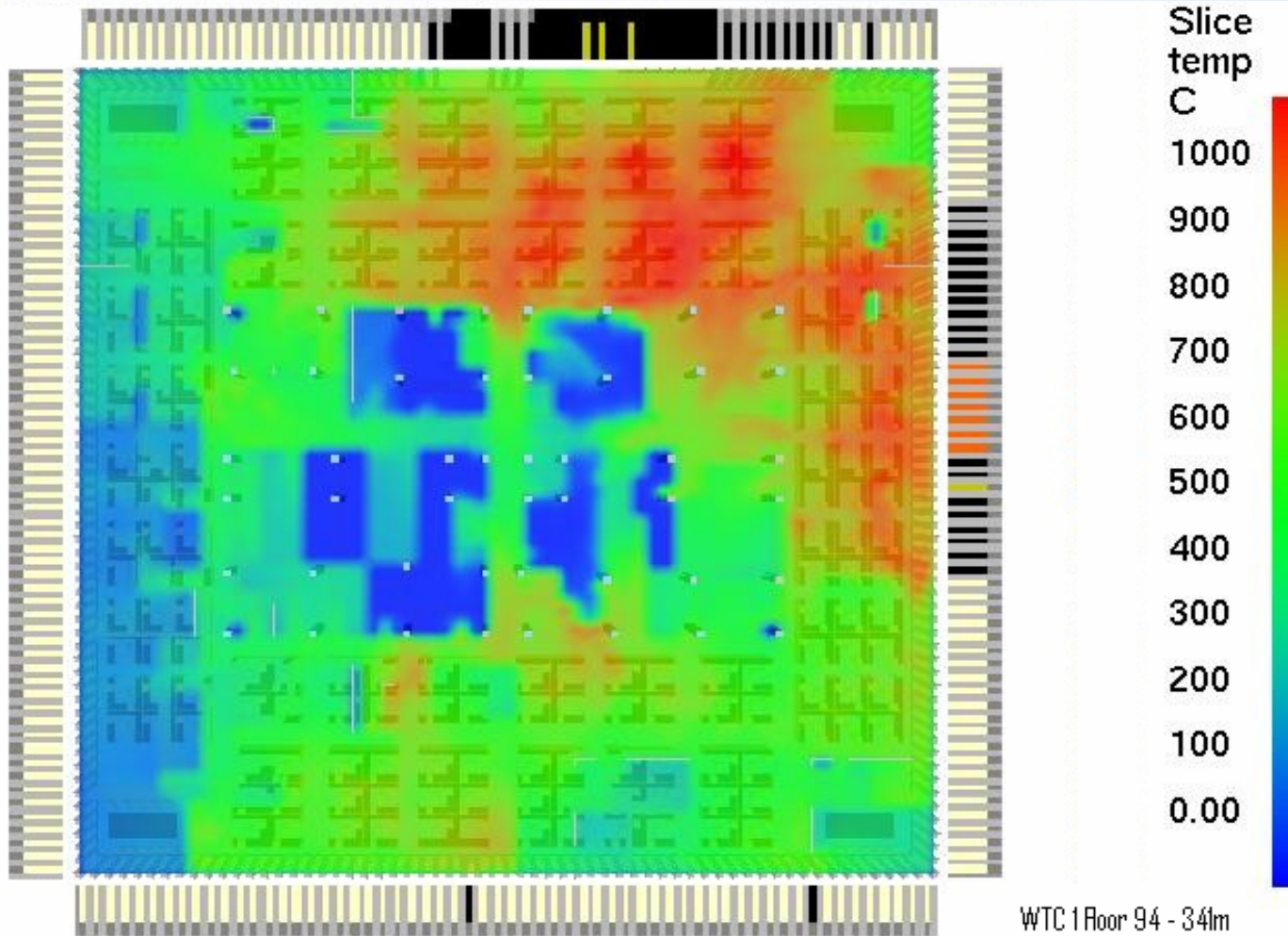
Upper Layer Temperatures, WTC 7, Floor 8

Summary of Fire Activity WTC 1 North Face

WTC 1, Floor 94, 10 min after impact

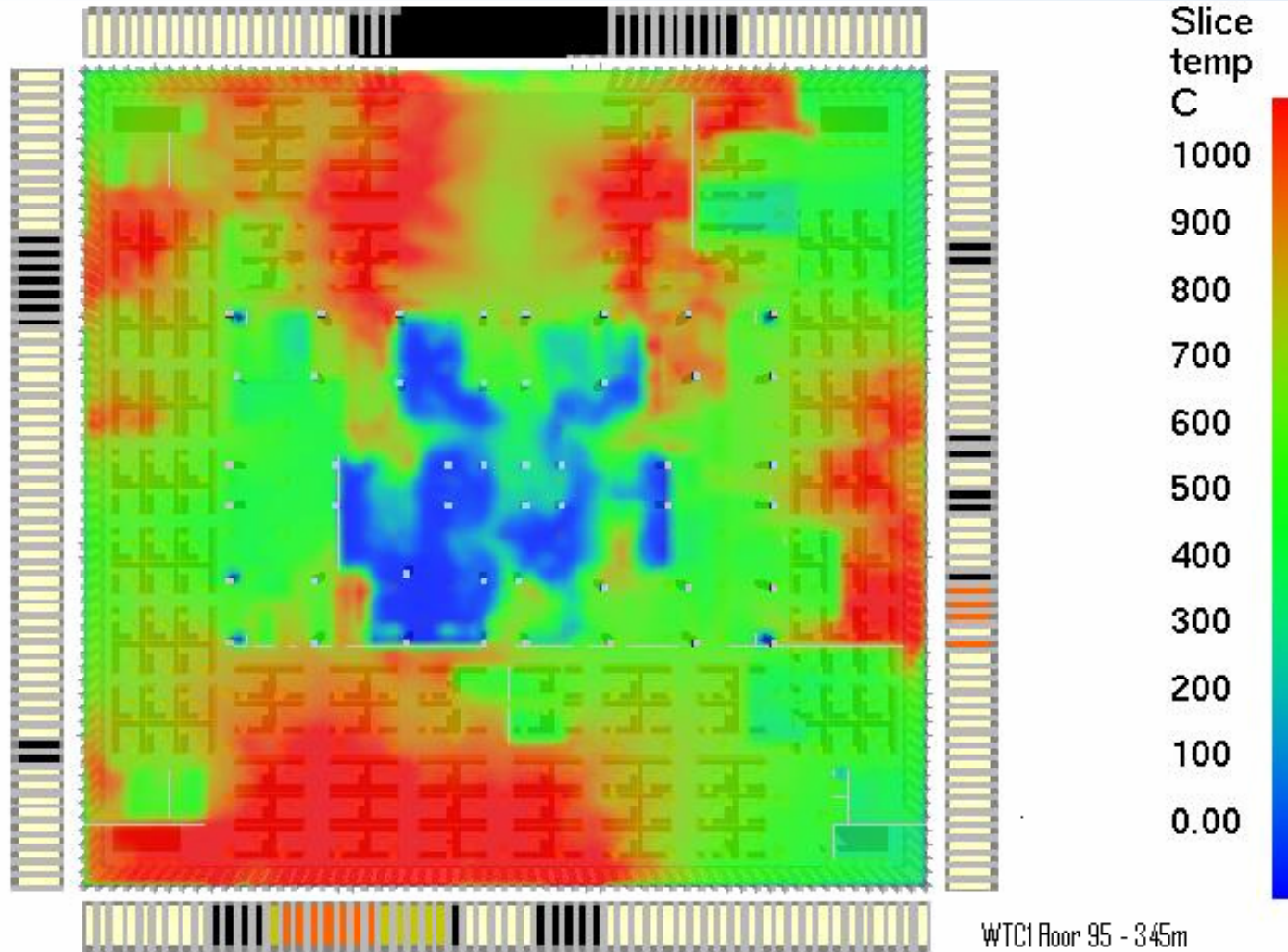# WTC 1, Floor 95, 40 min after impact

WTC1 Floor 95 - 345m

0:40:00.0

WTC 1, Floor 96, 30 min after impact
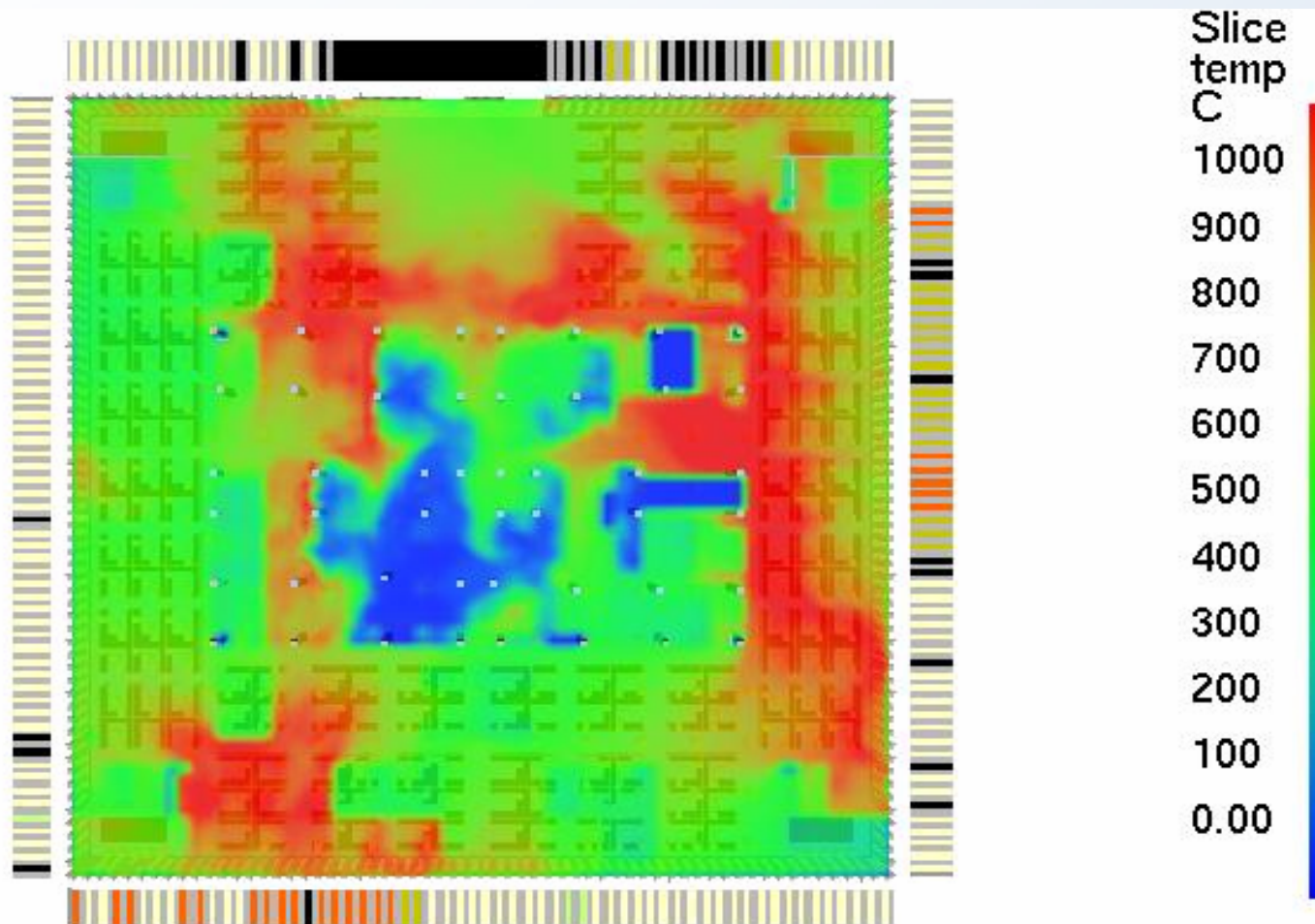
WTC 1 Floor 96 - 348m

0:30:00.0

Maximum Credible Fire – Undamaged Tower

- Sprinkler system is compromised, overwhelmed, or not present
- No active firefighting
- Combustible building contents averaging 10 lb/ft^2
- Floor-to-floor fire spread to next upper floor at 30 or 60 min
- Ventilation from windows broken by fire and a total of 50 ft^2 of air leakage between floors

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"Standard" Fires

- Towers

  - Exterior wall: maximum observed duration

  - Exterior wall: maximum observed expanse

  - High threat to a building corner

  - Full floor: relatively undamaged floor (e.g., WTC1-98)

  - Full floor: damage to the tenant space and the core (e.g., 96)

  - E-119 time-temperature curve (spatially uniform)

- WTC 7

  - Mechanical space (floors 5-6): largest possible 3 h fire

  - Tenant space (floors 7+): high combustibles load

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Summary

- FDS has been "frozen" and the documentation is in review

- Numerical simulations of fires within WTC 1, 2 and 7 have been performed with a variety of initial and boundary conditions to assess sensitivity of results

- A set of "standard" fires has been defined to bound possible outcomes

- Simulations will be re-run using results of airplane impact study

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Thank you

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