National Construction Safety Team Investigation

The Station Nightclub Fire: Testing and Validation Experiments to Support Simulation

NCST Advisory Committee
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The Need for Testing and Experiments

- Computer fire simulations require input data such as

  Building Geometry – floor and ceiling dimensions

  Ventilation – location and dimensions of windows and doors

  Material Properties – Ignition temperature, thermal conductivity, heat capacity, density, heat/energy release rate

- Data for common materials available in reference libraries; for less common materials additional testing required:

  Cone Calorimeter lab test used to collect data on polyurethane foam, and ceiling tiles

  Large Fire Facility experiments used to collect data on pyrotechnics (Gerbs) and fire spread at real-scale

- NIST tested no materials removed from The Station

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Objectives:

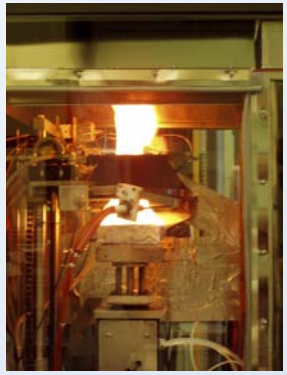
To assess material burning behavior to determine a correlation to the materials in the nightclub and develop source term data for modeling from

- Cone calorimeter data
  - Polyurethane foams
  - Ceiling tiles
- Pyrotechnics
  - Gerbs

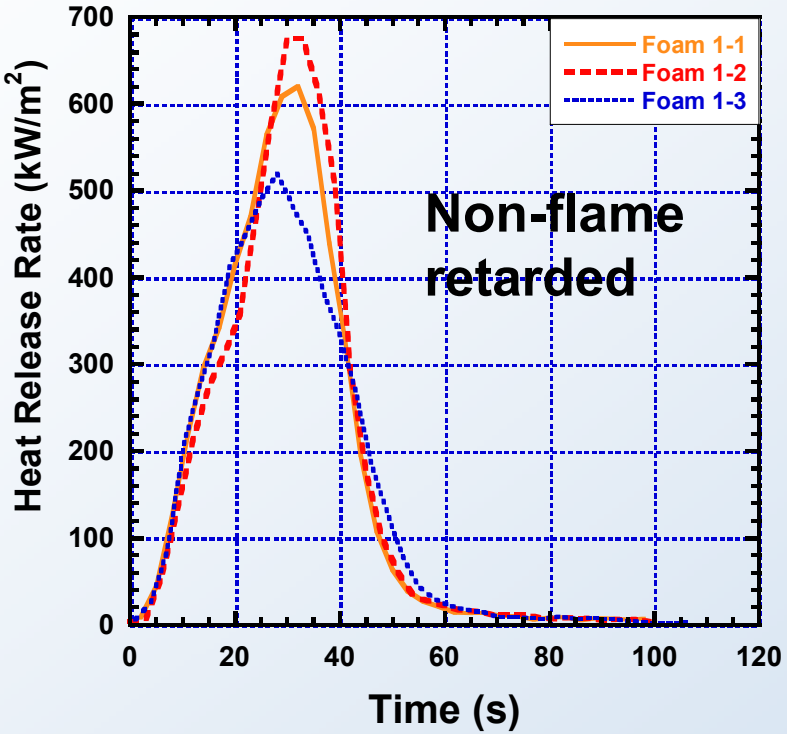
Use full-scale experiment to verify ability of model to predict fire conditions

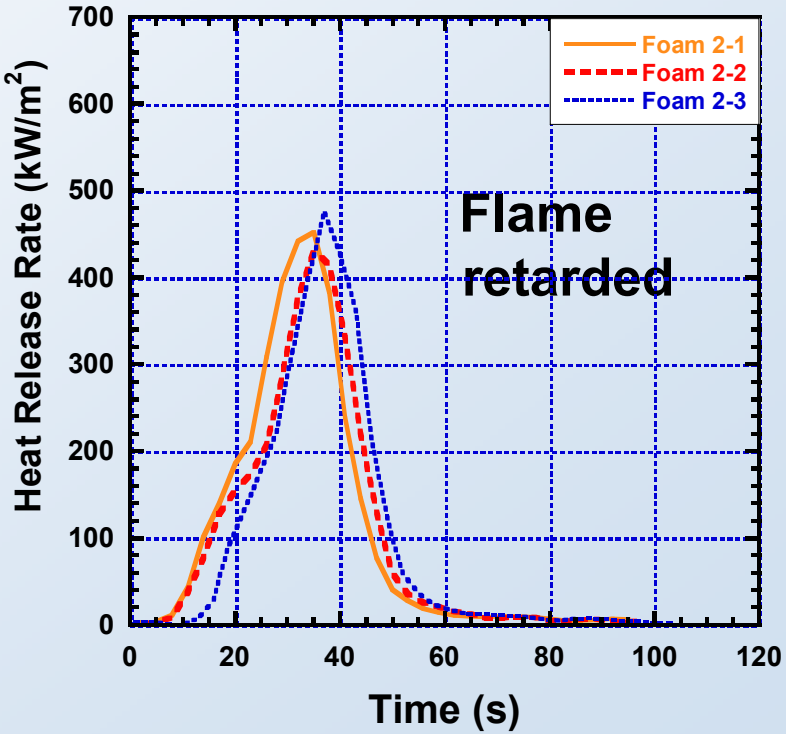
Compare experimental results to model predictions of flame spread, layer development, and gas concentrations (oxygen and carbon dioxide)

Cone Calorimeter Testing of PU Foam* Heat Release Rate:



Incident Heat Flux: 35 and 70 kW/m^2





* PU foam purchased from a commercial supplier, American Micro Industries, Inc.

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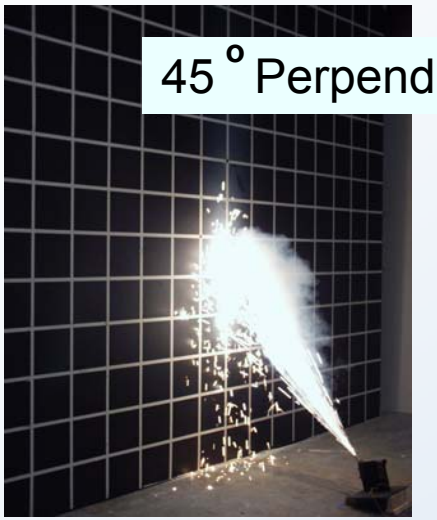
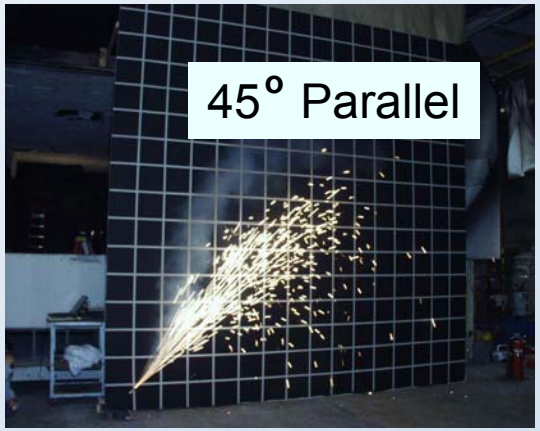
Pyrotechnics – Gerbs*

(White color, 15 second duration, 15 foot throw)

- **Video recordings, multiple geometries**
- **Thermal Radiation- heat flux to surface**
- **Temperature – gas temps of "plume"**



16 -18 s after Gerb Ignition



*** Gerbs purchased from a commercial supplier, Luna Tech, Inc.**

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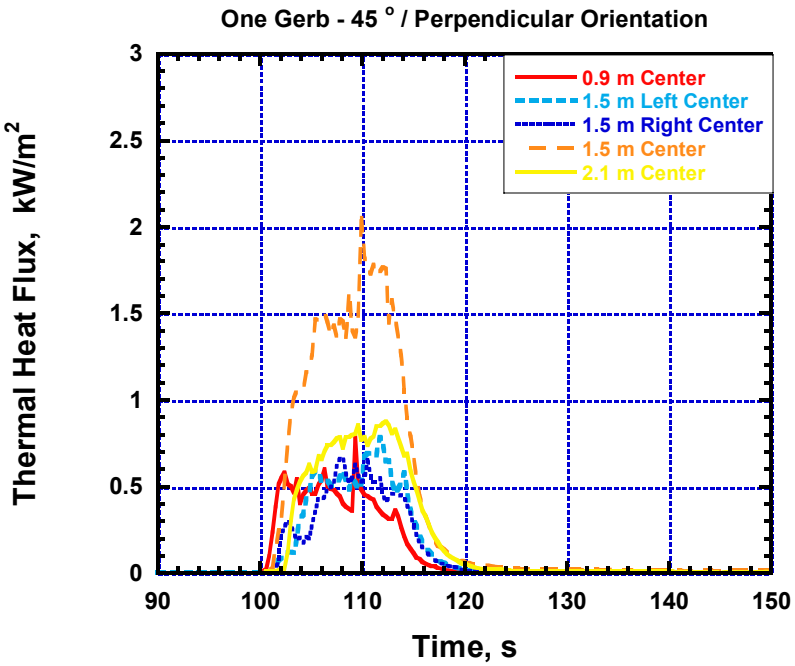
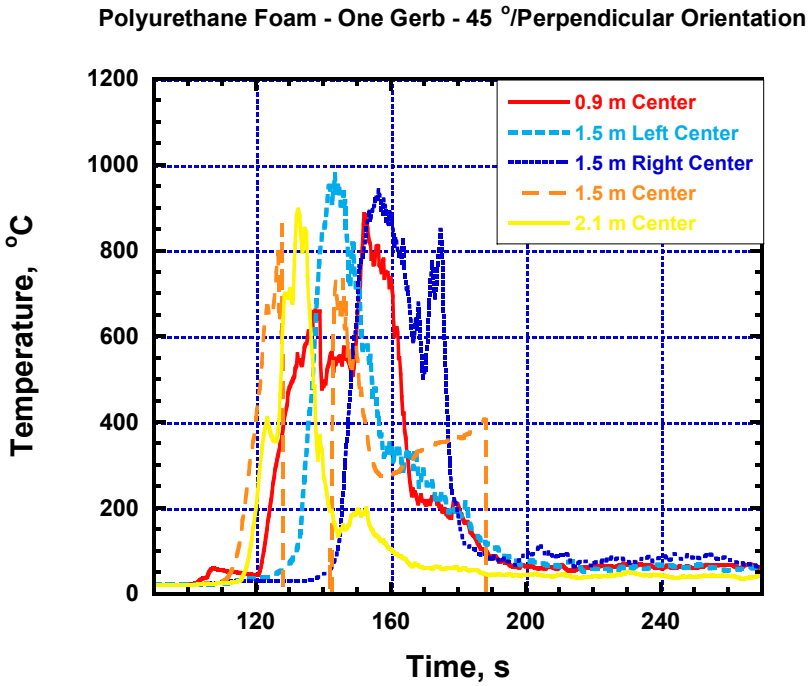
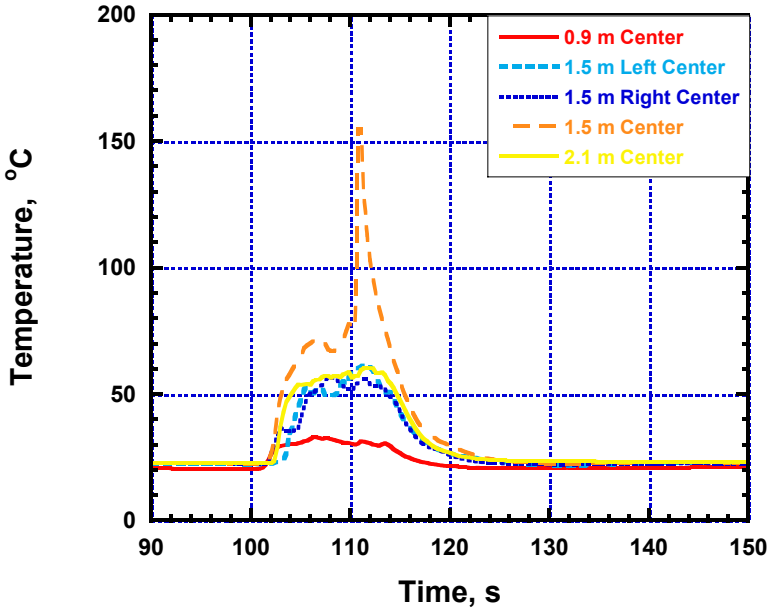
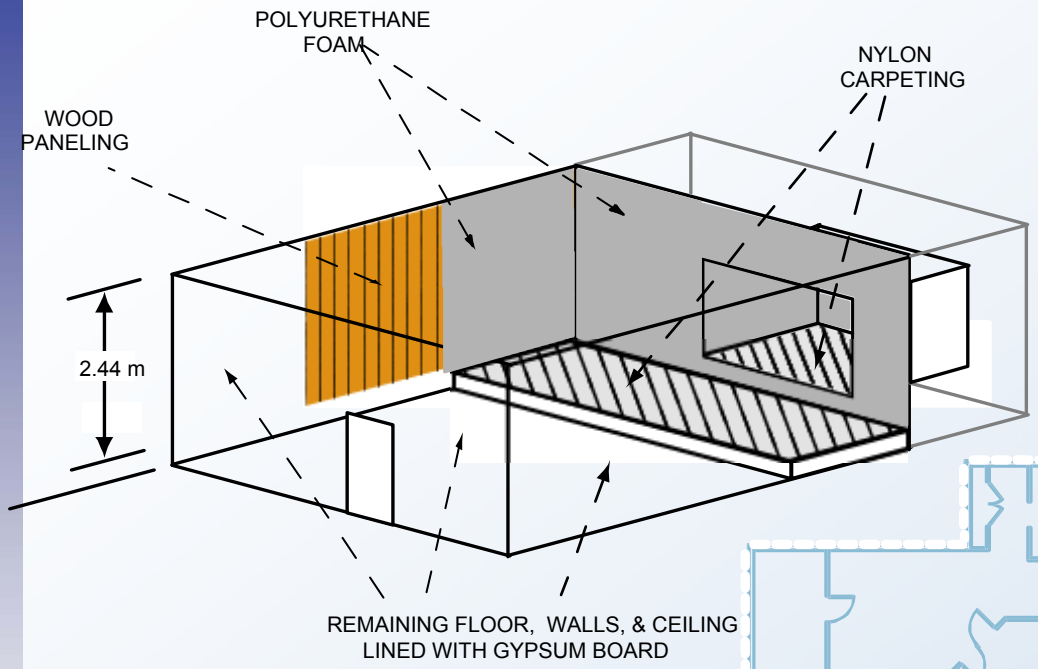
Temperature and heat flux:
45° Perpendicular Orientation

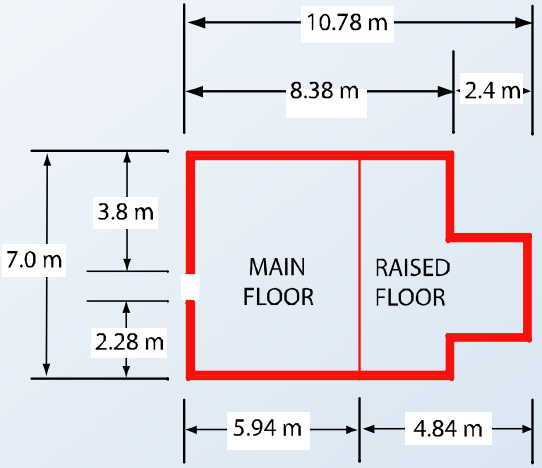


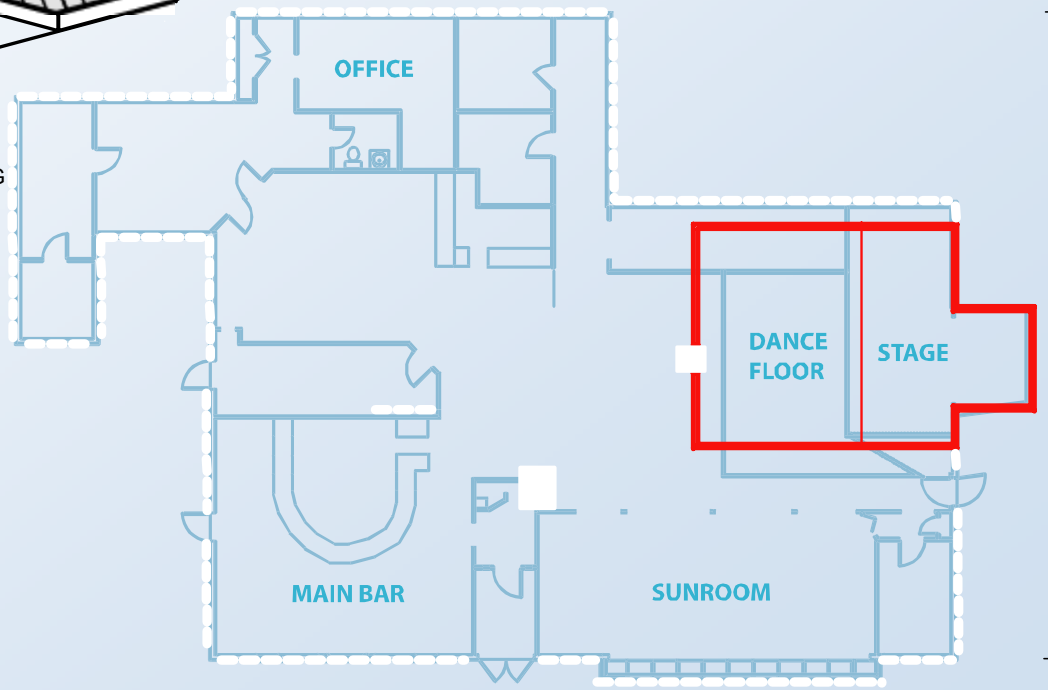




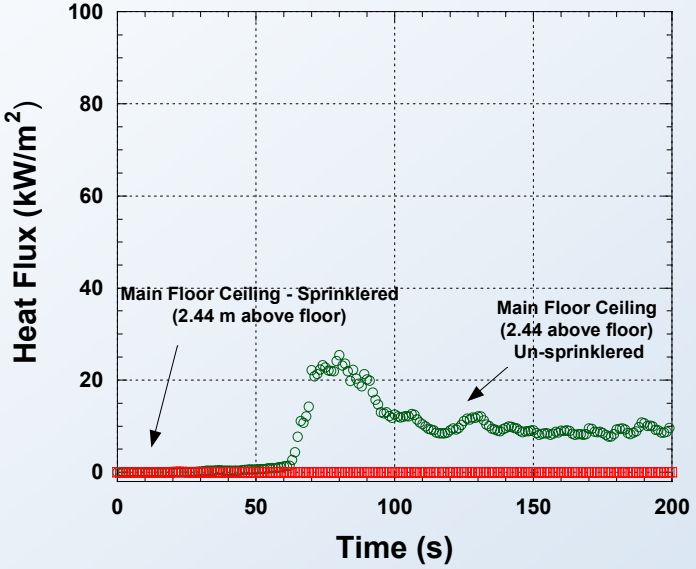
Stage Area Fire Experiments

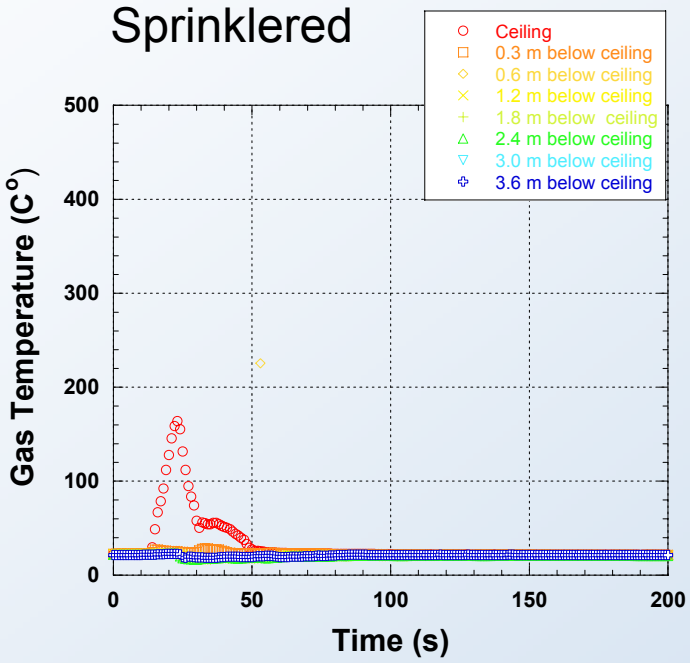


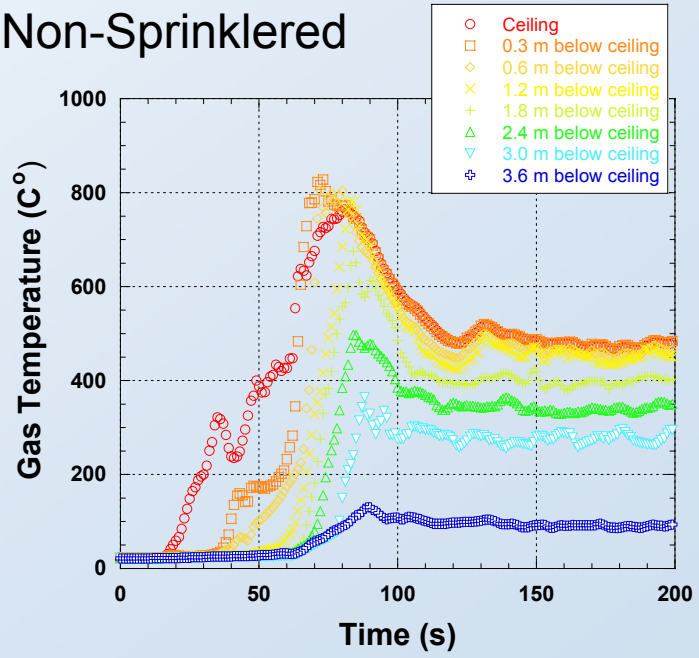




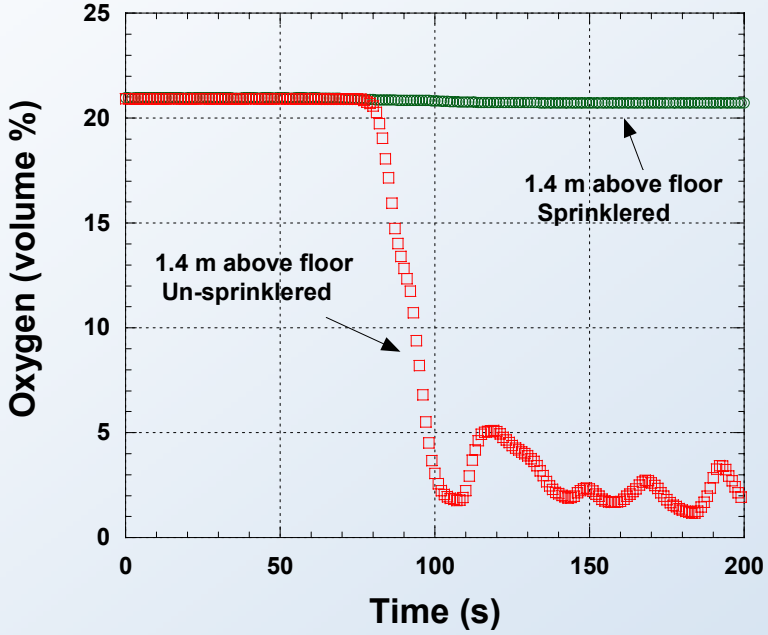
Ceiling heat flux and gas temperatures near room center -

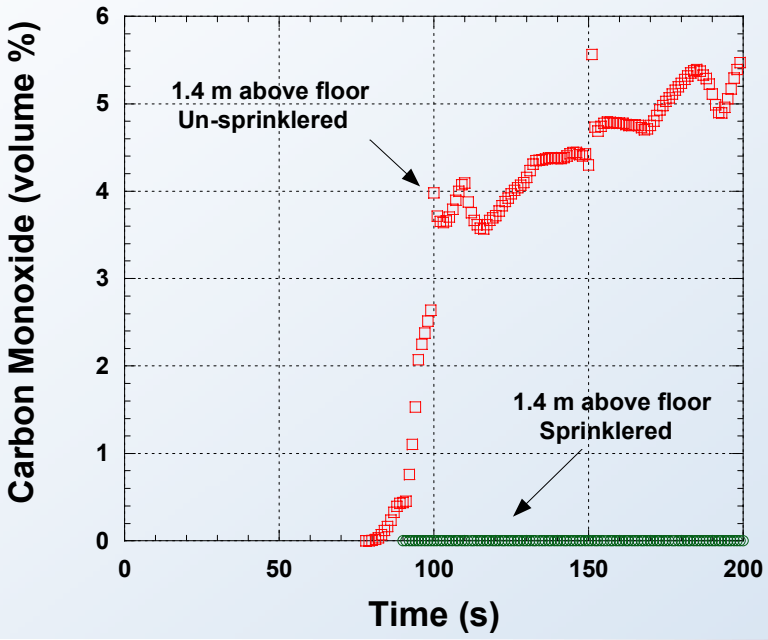


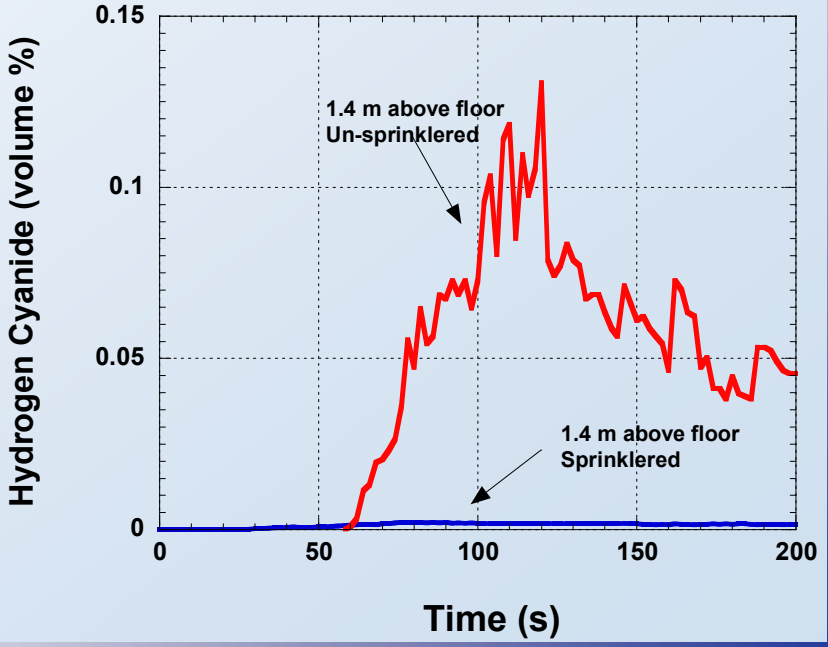




Gas volume fraction measurements near room center, 1.4 m above floor







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Summary

- Real-scale fire experiments were conducted to collect temperature, concentration, fire spread and heat release rate data over a room with polyurethane foam-covered walls.
- Non-sprinklered experiment led to flashover conditions within alcove in approximately 60 s.
- Resulting high temperatures, low oxygen, high carbon monoxide, and high hydrogen cyanide concentrations suggest conditions in the un-sprinklered test became untenable in less than 90 s.
- With sprinklers, near-ambient temperature and oxygen levels were maintained 1.4 m above floor.

Status of Technical Investigation

6/22/04

- Overview - W. Grosshandler

6/23/04

- Egress study, and review of model building and fire codes - W. Grosshandler
- Documentation of emergency response - K. Kuntz
- Testing and validation experiments to support simulation - N. Bryner
- **Simulation of fire and smoke movement in laboratory reconstruction - D. Madrzykowski**

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