

**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

## Objectives:

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

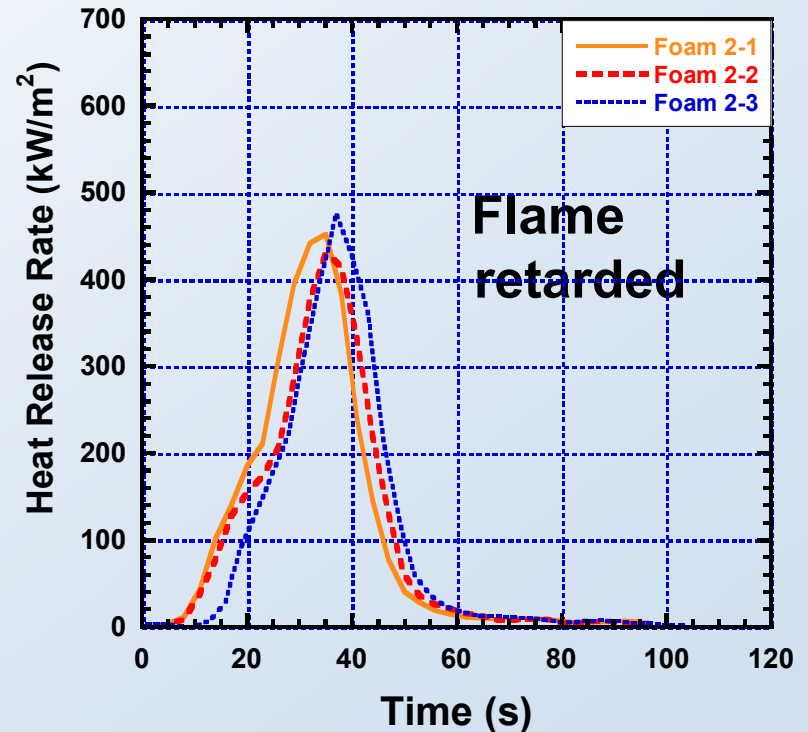
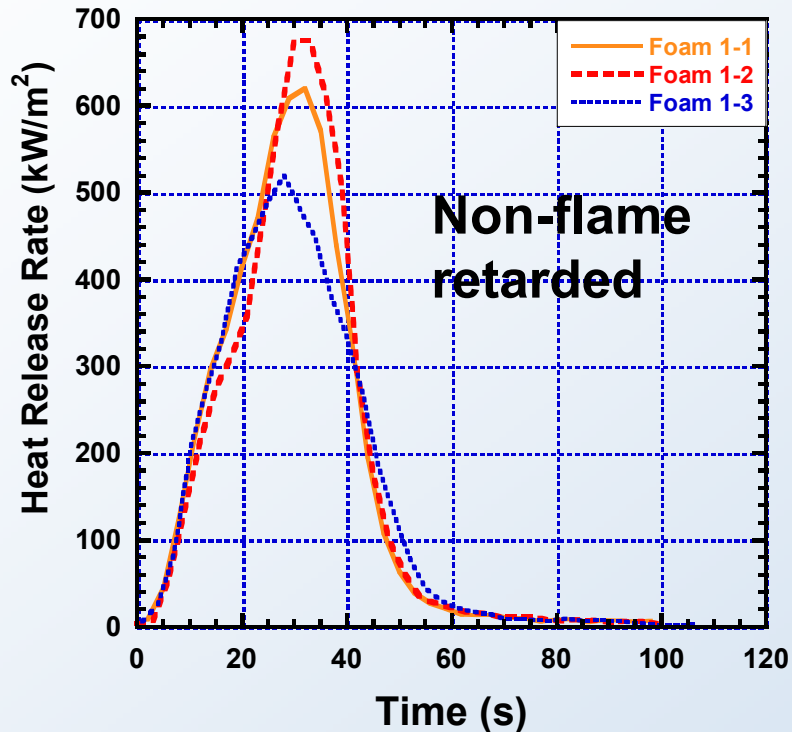
- Cone calorimeter data
  - Polyurethane foams
  - Ceiling tiles
- Pyrotechnics
  - Gerbs

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<sup>2</sup>



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

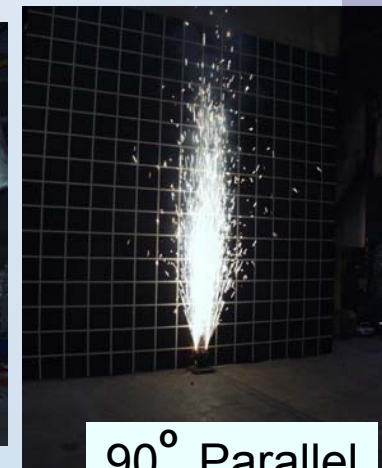
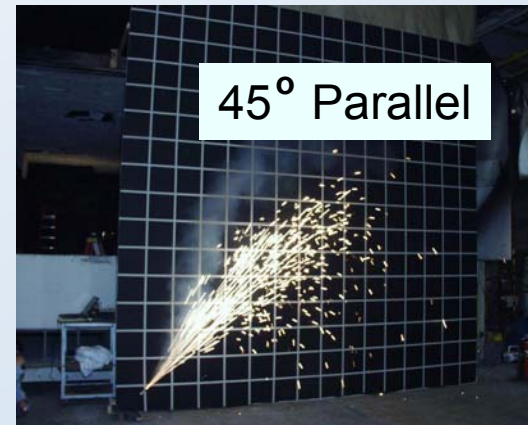
# Pyrotechnics – Gerbs\*

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

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

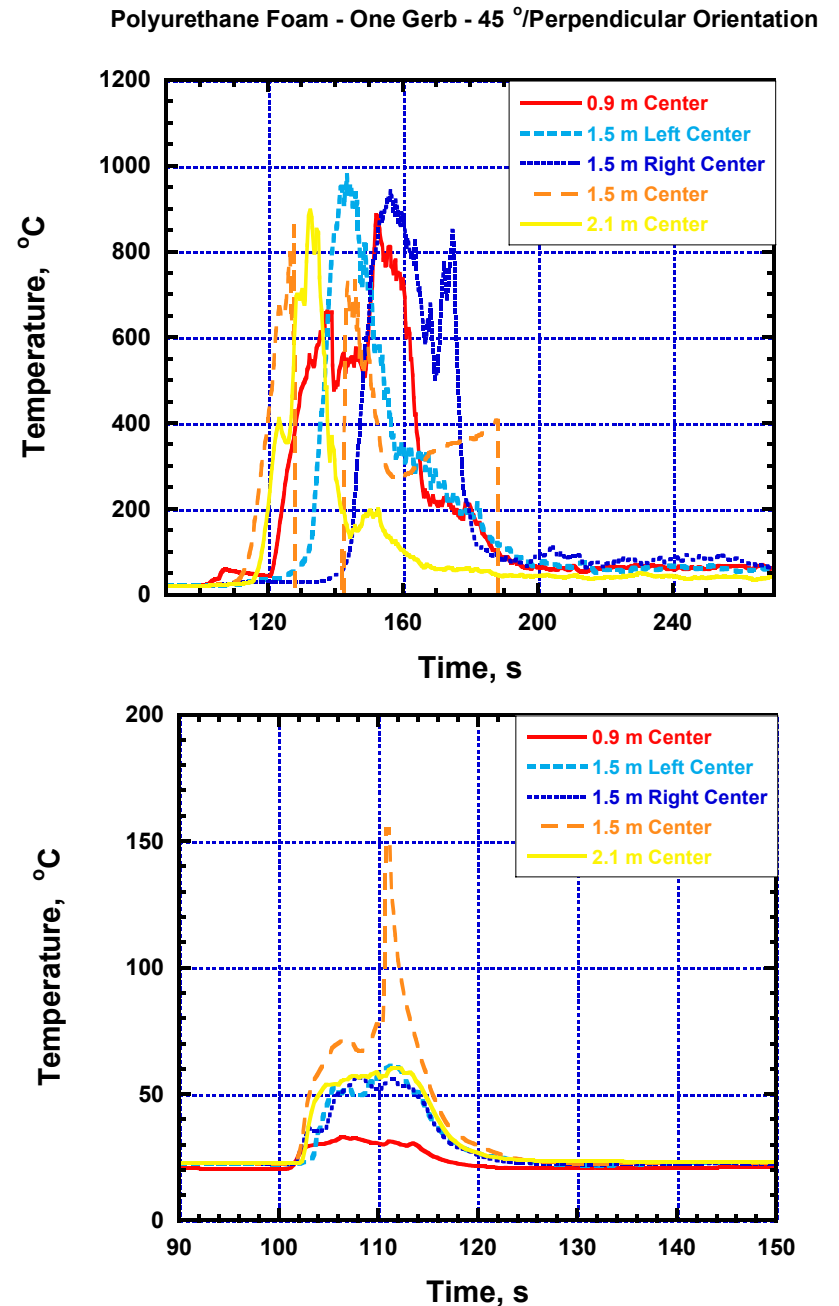
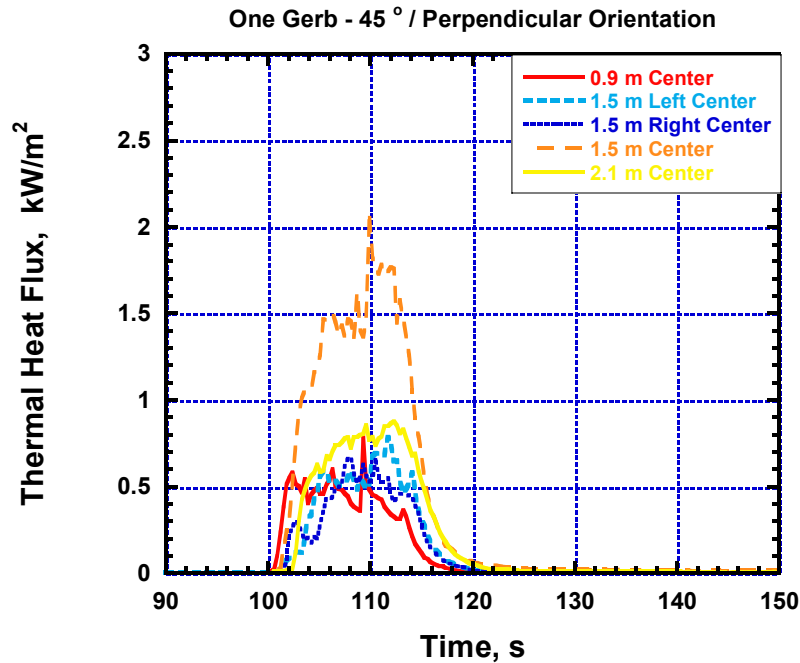


16 -18 s after  
Gerb Ignition

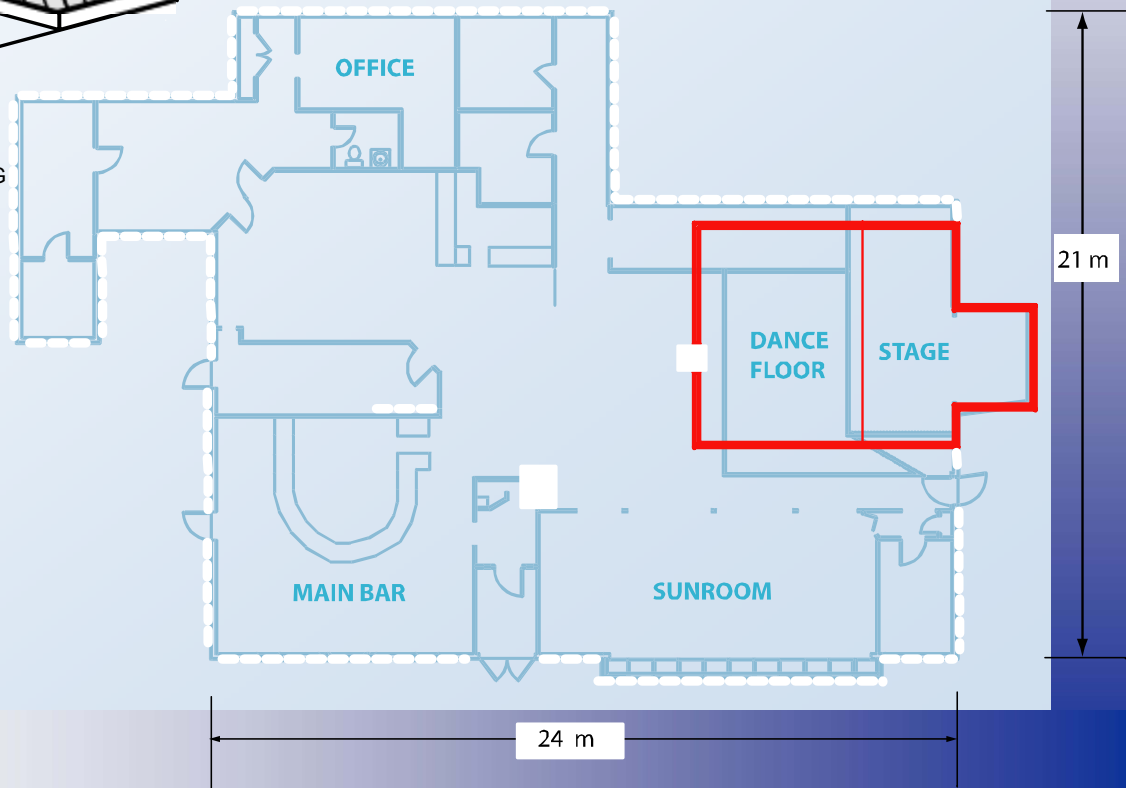
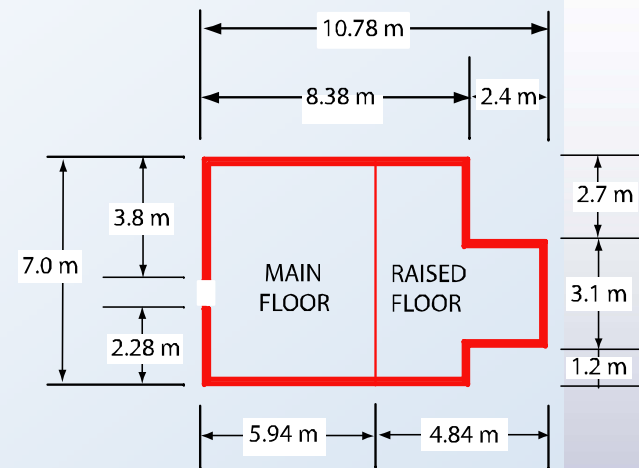
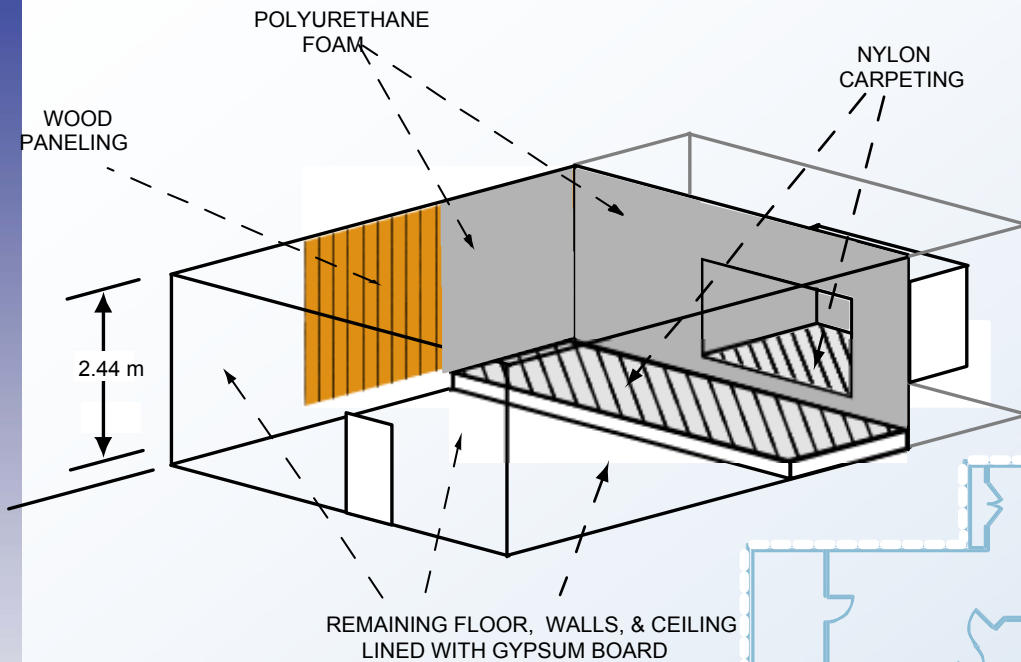


\* Gerbs purchased from a commercial supplier, Luna Tech, Inc.

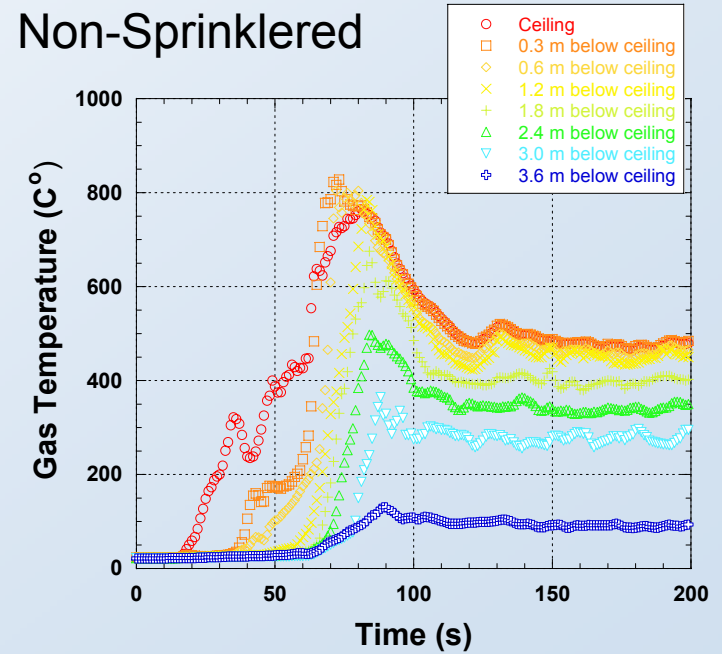
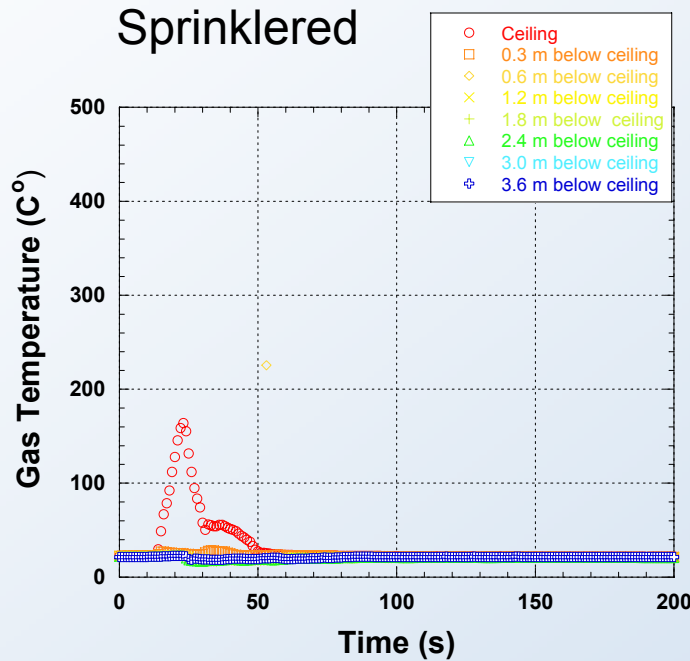
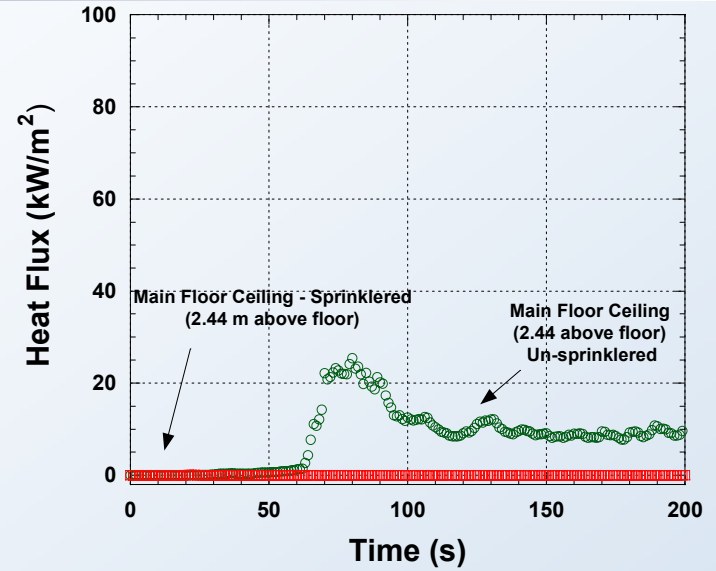
# Temperature and heat flux: 45° Perpendicular Orientation



# Stage Area Fire Experiments

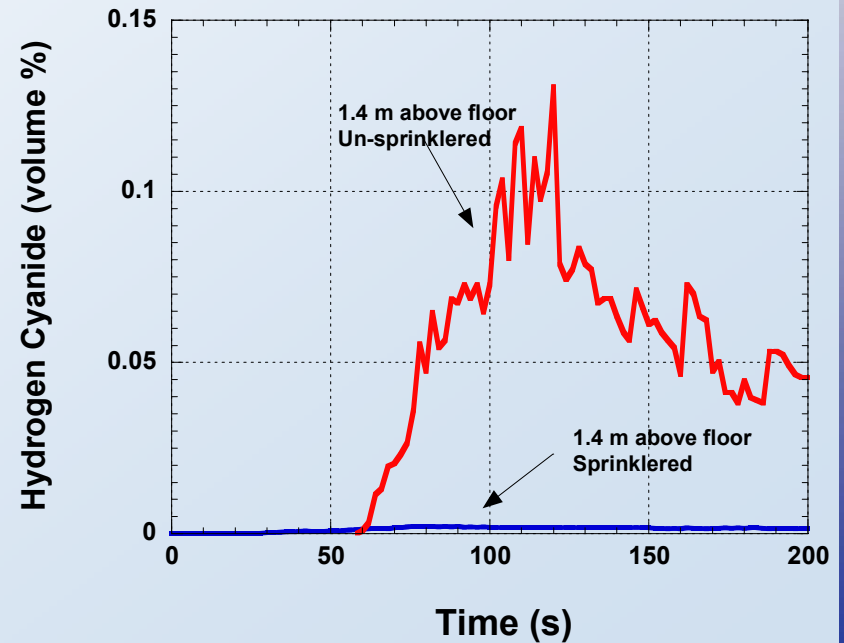
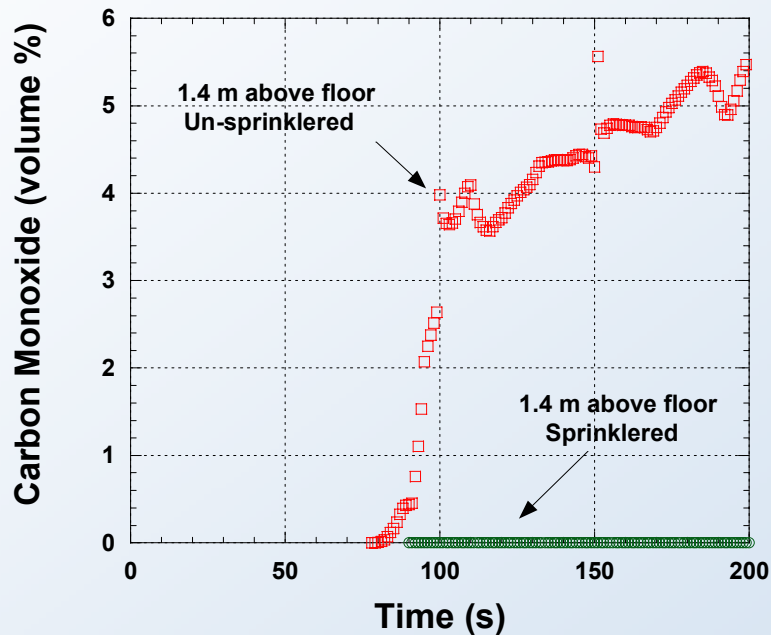
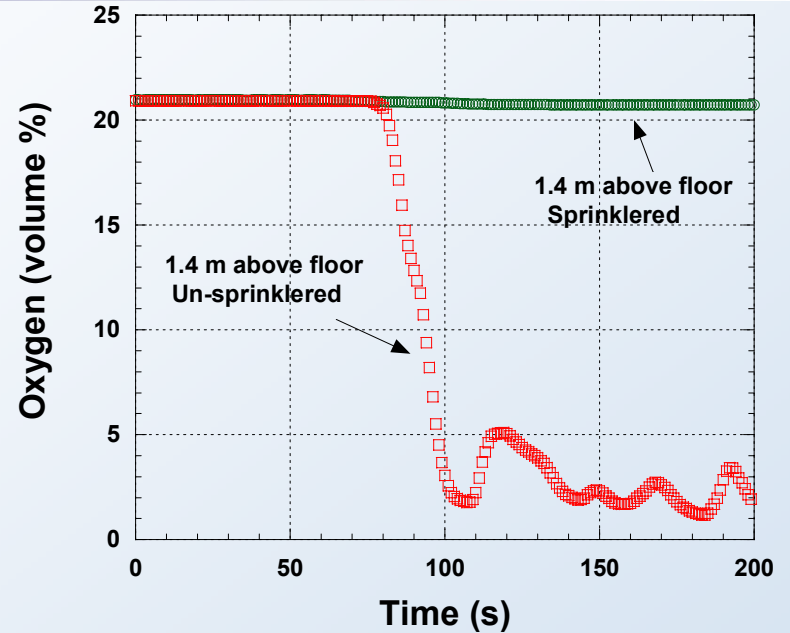


# Ceiling heat flux and gas temperatures near room center -





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



## 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**