National Construction Safety Team Investigation

The Station Nightclub Fire Investigation
Status Report

NCST Advisory Committee
October 20, 2004

William Grosshandler
Building and Fire Research Laboratory
National Institute of Standards and Technology
U.S. Department of Commerce
William.Grosshandler@NIST.gov

NIST

Elements of NIST Technical Investigation

- Establishment of initial conditions
- Simulation of thermal and tenability environment
- Testing and validation experiments to support simulation
- Examination of possible impact of sprinklers
- Documentation of evacuation process
- Documentation of emergency response
- Recommendations for specific improvements to model building standards, codes and practices

Recent Activities

- Fact-finding, testing, and analyses have been completed
- Findings have been compiled in four categories
  - fire protection systems
  - materials
  - occupant load and egress
  - public building record-keeping practices

Key Findings Regarding Fire Protection Systems

- Heat detection/fire alarm system was installed in building and was activated (sound and strobe) by fire 41 seconds after ignition.

- Several hand-held fire extinguishers were located on premises, at least one of which was used in attempt to extinguish fire on stage.

- Building was equipped with emergency lighting and standard exit signs above each exit.

- Sprinklers were not installed in building.

Key Findings Regarding Materials

- Foam sample purchased by NIST ignited within 10 seconds when exposed to pyrotechnic device.
- Cone calorimeter testing of small foam samples:
  - NIST-purchased samples and ATF samples
  - 300 kW/m^2 to 900 kW/m^2 heat release rate
  - 35 kW/m^2 to 70 kW/m^2 radiant exposure
- Energy content of polyurethane foam estimated to have been 5% of energy content of wood paneling in main area of nightclub.

Key Findings Regarding Materials (continued)

- Simulations show that flames spread rapidly over foam finish material, generating 10 MW at fire's peak, enough to ignite wood paneling underneath and adjacent to foam.
- Fire transitioned to more traditional, ventilation-limited, wood frame building fire, with steady heat release rate calculated to be around 3.5 MW.
- Model codes require foamed plastic material used as interior finish to pass large-scale fire tests related to actual end use.

Key Findings Regarding Occupant Load and Egress

- Number of building occupants at the time of fire was reported to be 440.
- About 2/3 of occupants appear to have attempted to leave through main entrance in the front of building, and many were unsuccessful.
- Over half of all people who successfully escaped through doors exited via the main entrance.
- Windows in main bar room and sunroom became secondary routes of escape once main entrance became impassible, and accounted for over 1/3 of successful evacuations.

Key Findings Regarding Occupant Load and Egress (continued)

- The small number of victims found in main bar room suggests that main bar room exit door and windows provided open routes of escape for about as long as it took to reach untenable conditions in that area.

- High number of victims found relatively close to windows in sunroom suggests that environment became untenable quickly, eliminating option of a secondary route through sunroom windows once stage door and main entrance became unusable.

Key Findings Regarding Occupant Load and Egress (continued)

- An interior door which opened inward was located at stage exit, but did not play a role in evacuation process since rapid fire growth in that vicinity discouraged patrons from escaping via stage door exit.

- For more than a minute into the fire, the crowd moved in orderly fashion at an egress rate estimated to be a bit faster than 1 person/s through main entrance of building.

- Prior to 1 1/2 minutes into the fire, a pile-up occurred at front door, which almost entirely disrupted flow through that exit.

Key Findings Regarding Public Building Record-keeping Practices

- Records were not found of initial building design, and records of modifications, when located, lacked sufficient detail to track changes to structure.
- Neither historical nor most current use and occupancy permits for building were located; however, use of The Station was consistent with IBC occupancy classification of "Group A-2" and NFPA 5000 occupancy classification "Assembly."

Key Findings Regarding Public Building Record-keeping Practices

- Main deficiencies of building identified during inspections by city of West Warwick related to location of fire extinguishers, non-functioning exit signs and emergency lights, broken panic hardware on an exit door, and direction of swing of an exit door.
- On numerous reports, deficiencies identified by city inspectors were later annotated as "OK," but with no official re-inspection signature.
- No written reports prior to February 20, 2003 were located that mentioned foam materials on the walls of the nightclub, nor the use of pyrotechnics similar to the gerbs used the night of the fire.

Contents of Final Report (90 % complete)

- Executive Summary
- Background
- Description and Timeline of the Incident
- Fire and Emergency Services Response and Procedures
- Testing and Validation Experiments
- Simulation of Fire and Smoke Spread
- Analysis of Building Egress
- National Model Codes, Standards and Practices
- Summary of Findings and Recommendations
- Appendices

NCST members and technical support

- Team
  - William Grosshandler, NIST
  - Nelson Bryner, NIST
  - Daniel Madrzykowski, NIST
  - Kenneth Kuntz, FEMA
- Supporting Technical Staff
  - Stephen Kerber, NIST
  - Erica Kuligowski, NIST
  - David Stroup, NIST
- Contractors
  - ArupFire, Westborough MA
  - Koffel Associates, Ellicott City MD