Exterior Fire Protection for High-Rise Buildings

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Worldwide Problem for Tall Buildings

- Increased number of fires spreading on high rise buildings
Time is critical

- Address Downtown Hotel, Dubai 1, January 2016 – 14 people injured

4 floors on fire

20 floors on fire

+ 80 seconds
Height, Accessibility and Response Time

Address Downtown Hotel, Dubai 1, January 2016 – 14 people injured

- Fire reported to start on 20th floor, at approx. 60 m (200 ft)
- Best equipped fire service can reach 60 m (200 ft)
- External fires difficult to fight from the inside
- What about response time?
Autonomous Fire Suppression System

System Overview
Functional Requirements

1. **Speed** ➞ *detect and deploy against incipient fires in seconds*
   Fire service often takes minutes to respond and longer to become operational

2. **Fight fires at any height**
   Fire service hose can reach ~60m (~200 ft)

3. **Large coverage area**
   At least 50 m wide by 60 m high (20 stories)

4. **Use a small amount of “agent”**
   Utilize typical NFPA 14 standpipe water supply – e.g. 2000 lpm (500 gpm)

5. **Minimize structural & architectural impact**
System Components

2 x Array IR Flame Detectors
installed outside of the building

Robotic Monitor & Extension Boom
concealed in the building

Deluge Valve with Remote Resetting Trim
to open and close the water supply to the monitor

PLC & Software
autonomously controls and positions the system

Graphical User Interface & Web Server (Optional)
allows control from PC and smartphones
System Operation

**Detect & Locate**
Autonomously detects and tracks the 3D location of up to 4 fires simultaneously, recalculating position 10 times per second.

**Aim & Suppress**
*Within Seconds*, extends Boom and autonomously directs a high volume of water onto the fire.

**Remote Reset & Standby**
Goes into standby mode when flames are no longer detected.
Fire Performance Evaluation

Test Program Overview
Test Program Overview

- **SP Test Method 5483**
  - Validate targeting performance
  - Validate suppression performance

- **Testing Laboratory**
  - Thomas Bell-Wright International Consultants (TBWIC) in Dubai, UAE

- **Associate Laboratory**
  - Research Institute of Sweden (RISE)
Test Setup

Test Wall

D1

M1

M2

D2

35m

15m

25m
Test Setup
The wall represents part of the coverage area
The wall represents part of the coverage area.
The wall represents **part** of the coverage area.
Fire Performance Evaluation

Test Series 1: Targeting Performance
Test Series 1: Targeting Performance

- **Goal:**
  - Validate fire detection and targeting performance within coverage area

- **Performance criteria:**
  - Automatic detection and response to fire source
  - Water delivery to fire source with visible suppression
Test Series 1: Test Variables

- **Fire location:**
  - Based on coverage area

- **Pressure:**
  - 5 to 8 bar (72.5 to 116 psi)

- **K-factor:**
  - 374, 460 lpm/bar^{0.5} (26, 30 gpm/psi^{0.5})
Test Series 1: Fuel Package

- Flat panel fire:
  - 600 x 1200 x 50 mm mineral foam insulation panels soaked in 2.5 L of naptha
- 3D pan fire:
  - 841 x 594 x 130mm (w x l x depth) pan with 2.5 L of naptha installed on ledge
Test Series 1 (VIDEO PLACE HOLDER)
Test Series 1: Results

- A total of **28** tests conducted
- **Time to detection**
  - Average: 10 s
  - Minimum: 6 s
  - Maximum: 19 s
- **Water delivery time**
  - Average: 12 s
  - Minimum: 6 s
  - Maximum: 28 s
- All targets were highly suppressed or extinguished
### Test Series 1: Results continued

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<th>Reference Flow (LPM)</th>
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Fire Performance Evaluation

Test Series 2: Suppression Performance
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- **Goals:**
  - Validate ability to contain a fire and prevent fire spread for realistic façade system
  - Achieve comparable performance to successful assembly test (NFPA 285, BS 8414, SP 105, etc.)

- **Performance criteria:**
  - Limit damage and flame spread to below bottom of second window
Test Series 2: Test Variables

- **Fire attack:**
  - vertical downward, diagonal downward, horizontal

- **Settings:**
  - Minimum pressure / flow to reach target location

- **Test specimen:**
  - 4mm thick PE core ACP installed in an “open configuration”
Test Series 2: Fuel Package

- SP105 heptane trays in combustion chamber (15 - 20 minute sustained burn time)
Test Series 2: Free-burn (VIDEO PLACE HOLDER)
Test Series 2: Suppression Performance (VIDEO PLACE HOLDER)
Detection as soon as the flames are out of the combustion chamber
Time: 5m 25s
Damage after 17 minutes with active fire suppression
Damage after 6 minutes of Free Burn
*(manually suppressed for safety reasons)*
Test Series 2: Results
Conclusions

1. Rapid detection and location of incipient stage fires is possible at over 50m

2. Early intervention with water can prevent PE panel delamination, contain fires

3. … at any height
Thank you