Hazard Evaluation vs. Risk Analysis
“A Way of Thinking”
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Christmas Tree Video

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Question

Question:
Is a hazard evaluation different than a risk analysis?

Answer:
Yes and that is what this presentation is about. Not a simple answer.

Simple Heat Detector

Elements of Fire Protection Engineering Practice
The Building and Fire Codes are meant to address hazards and reduce risk within buildings.

Fires do not care what the codes say.

Agenda

1. Introduction
2. Codes and Delegation
3. Myths & Facts & Reality
4. Hazard Evaluation
5. Risk Analysis
6. Risk Management
7. Example of an Application
8. Conclusions

Fire Safety is highly decision oriented

They are heavily influenced by:
- building codes,
- standards,
- insurance recommendations,
- and financial considerations.
System Planning Question:

Assume that you are consulting a client on an aspect of fire protection. The client has budgeted $200,000 (or $2,000,000) to spend on fire safety improvements.

1. What is the process by which you would decide how to spend the money?
2. How would you recognize the most cost effective improvement in the fire safety for the client?
3. How would you know that is the best investment for your client?

Hazards and Risks Questions for Consideration:

How do you know if a fire safety problem exists?
If a problem exists, what kind of problem do you have?
How serious is the problem? How do you know?
What are the alternatives for dealing with the problem?

Code Limitation – Questions:

You have 10 (or 100 or 1,000 or 100,000) buildings within your facility of fire safety responsibility. You do not have the resources to handle all of these buildings.

How do you identify the 10% of the buildings that have the greatest need for your attention?
Code Limitation – Questions:

You have 10 (or 100 or 1,000 or 100,000) buildings within your jurisdiction of fire safety responsibility.

How do you identify the buildings that have the greatest potential for
* Death or injury to fire fighters?
* Death or injury to occupants?
* Damage or down time that would cause business operation interruption?

"The most serious mistakes are not being made as a result of wrong answers. The truly dangerous thing is asking the wrong questions."

— Peter Drucker

Today we are describing a

**way of thinking**

about fire performance, hazard characterizations, and risk management
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Building and Fire Codes

- Historically, fire and panic regulations were enacted by municipalities in reaction to catastrophic fires that had already occurred
- Prescriptive/inflexible
- Not always based on science
- Subject to interpretation
- Regional in nature
- “Grandfathers” certain hazards

Modern Building and Fire Codes

- Consensus based-voting members
- Incorporate internationally recognized design standards by reference (NFPA, UL, ASME, etc.)
- Recognize “performance-based” approaches to compliance
- Permit engineering methods to arrive at acceptable levels of fire protection and life safety with CEO approval
Prescriptive vs. Performance

Regulatory Controls...

don’t always address your needs!

Aimed at:

- Life safety of building occupants
- Life safety of Fire Brigade personnel
- Preventing the spread of fire from building to building

NOT aimed at:

- Protection of building contents such as servers and cabinets
- Protection of business continuity
- Protection of the data and services
- Protection of reputation

Minimum compliance does not guarantee adequate life safety or fire protection.
Engineering Regulations in NYS

SED Law Article 145
Professional Engineering Practice

Sec. 7201. Definition of practice of engineering. The practice of the profession of engineering is defined as performing professional service such as consultation, investigation, evaluation, planning, design or supervision of construction or operation in connection with any utilities, structures, buildings, machines, equipment, processes, works, or projects wherein the safeguarding of life, health and property is concerned, when such service or work requires the application of engineering principles and data.

Only a person licensed or otherwise authorized under this article shall practice engineering or use the title "Professional Engineer."

Quick Legal Review

- SED requires a license to practice engineering.
- Board of Regents will allow ancillary work to be delegated. (No PE required)
- SED, Board of Regents, NSPE, NCEES, & PIE do not define Fire Protection Engineering as ancillary.
- Fire Protection Engineering requires a license in NYS. – Sprinkler system design requires a licensed professional.
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### Myth #1

**Myth:**  
A code compliant building is safe.

**Fact:**  
A code compliant building meets the publicly accepted level of safety. It does NOT mean its safe.

### Myth #2

**Myth:**  
Noncombustible buildings don't burn.

**Fact:**  
The contents of noncombustible buildings do burn.
Myth #3

**Myth:**
Limited area sprinkler protection is an acceptable practice.

**Fact:**
Limited area sprinkler systems provide a false sense of security and can easily be overcome by a fire.

Myth #4

**Myth:**
Fire-rated glazing is unnecessary if a sprinkler system is in place. (Sprinklers on both sides of glass.)

**Fact:**
Sprinklers do NOT provide a fire resistance rating.

Myth #5

**Myth:**
Everyone panics during a fire.

**Fact:**
Researchers (J.D. Sime and G. Proulx) have proven that people remain quite rational in these situations.
**Myth #6**

**Myth:**
Alarms sound safely before the fire is large.

**Fact:**
When and if there is detection for the type of fire, there may be an alarm.

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**Myth #7**

**Myth:**
Don't use water on flammable liquid/oil fires.

**Fact:**
The method of water application is the key.

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**Myth #8**

**Myth:**
Spontaneous combustion isn't real.

**Fact:**
Spontaneous combustion *is* real. Spontaneous ignition occurs with rags used with natural products such as tung oil and linseed oil.
Definition of workmanship?

Definition of fill capacity?

Where do I start?
At least they are accessible.

Something to consider?

Hanger or Head
Too close

Look, someone has a fire alarm pull station for sale on the bulletin board....

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What is the Hazard?
“the property of a substance or situation with the potential for creating damage”

In terms of fire - severity of a loss due to a fire event.

Hazard
A condition that is a prerequisite to a mishap, accident, or emergency

May be
INTERNAL or EXTERNAL

Hazard Classification
- Natural Hazards
- Anthropogenic (man-caused) Threats
- Technological or Accidental Threats
<table>
<thead>
<tr>
<th>Natural</th>
<th>Anthropogenic (Man-Caused)</th>
<th>Technological (Unintentional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avalanche</td>
<td>Arson</td>
<td>Building collapse</td>
</tr>
<tr>
<td>Cyclone - regionally, also:</td>
<td>Bomb Incident</td>
<td>Cyber outages</td>
</tr>
<tr>
<td>Hurricane, Typhoon, Tornado, Twister, etc.</td>
<td>Bomb Threat</td>
<td>Dam failure</td>
</tr>
<tr>
<td>Crop Failure</td>
<td>Detonation, explosion</td>
<td>Hazardous materials incidents</td>
</tr>
<tr>
<td>Drought</td>
<td>Device found</td>
<td>Stationary source</td>
</tr>
<tr>
<td>Agricultural</td>
<td>Civil disorder – riot</td>
<td>Transportation related</td>
</tr>
<tr>
<td>Urban</td>
<td>Collateral damage</td>
<td>Infrastructure failures -</td>
</tr>
<tr>
<td>Earthquake</td>
<td>Cyber Attacks – may also be terrorism related</td>
<td>Communications, Gas,</td>
</tr>
<tr>
<td>Epidemic – Pandemic</td>
<td>Explosion</td>
<td>Sewer, Water, Transport</td>
</tr>
<tr>
<td>Firestorm</td>
<td>Extortion attempt</td>
<td>Information systems crashes</td>
</tr>
<tr>
<td>Floods, Flash flooding, Riverene floods, Urban flooding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hailstorm</td>
<td>Funds missing</td>
<td>LifeLine failures – Infrastructure</td>
</tr>
<tr>
<td>Lahar – Mudslide</td>
<td>Kidnapping</td>
<td>Major fire</td>
</tr>
<tr>
<td>Landslide</td>
<td>Protests</td>
<td>Nuclear facility incident</td>
</tr>
<tr>
<td>Solar storm</td>
<td>Radioactive contamination</td>
<td>Power failure</td>
</tr>
<tr>
<td>Tropical storm</td>
<td>Subsidence - may also be natural or accidental</td>
<td>Subsidence - may also be</td>
</tr>
<tr>
<td>Tsunami</td>
<td>Terrorism</td>
<td>natural or anthropogenic</td>
</tr>
<tr>
<td>Urban-Wildland Intermix Fires</td>
<td></td>
<td>Supply chain failure</td>
</tr>
<tr>
<td>Volcanic eruption (ash, pyroclastic flow)</td>
<td></td>
<td>Transportation accident – Air, Highway, Pipeline, Rail, Water</td>
</tr>
<tr>
<td>Wildland fire</td>
<td>Wildland-urban intermix fire</td>
<td></td>
</tr>
<tr>
<td>Windstorm - Chinook, Foehn wind, Sandstorm, Sirocco, Williwaw</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lahar – Mudslide</td>
<td>Wildland-urban intermix fire</td>
<td></td>
</tr>
<tr>
<td>Landslide</td>
<td>Winter storm</td>
<td></td>
</tr>
</tbody>
</table>

- Lahar – Mudslide
- Landslide
- Solar storm
- Tropical storm
- Tsunami
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- Volcanic eruption (ash, pyroclastic flow)
- Wildland fire
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"Hazard Evaluation" is the equivalent of Qualitative Risk Assessment

Examples: EPA, IARC Cancer Monographs

Fire Growth Hazard Potential

Fire Hazard Evaluation

1. Identifies a fire scenario
   Given established burning
   Heat and flame movement description (no suppression intervention)
2. Evaluates automatic suppression performance.
4. Integrates suppression interventions.
Questions:

How can you discriminate among the relative hazard of different rooms?

How can you estimate the time duration between established burning (EB) and Full Room Involvement (FRI) for different room fire growth hazards?

How can you determine the fire characteristics you should use to test the fire defense components?
Hazard Evaluation Flow Chart

1. Identify All Hazards
2. For Each Hazard
3. Determine Severity and Frequency of Exposure
4. Assign Risk Level
5. Acceptable
6. Unacceptable
7. Apply Mitigation
8. Next Hazard
9. Restart

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Definition

Risk – the likelihood of a specific effect within a specified period
the probability of incurring a loss or injury

Different Types of Risk

- Voluntary or involuntary
- High-probability, low-consequence
- Low-probability, high-consequence
- Individual or societal
- Environmental or technological

Risk Analysis

To develop a Risk Management Plan the goals of the plan need to be identified:

1. Protection of Life
2. Protection of Property
3. Continuity of Business
Question

How will you decide -

“How much is enough?”

Risk Analysis Objectives

To **UNDERSTAND** building fire performance.

To use that understanding to **DECIDE** the most appropriate things to do.

To **COMMUNICATE** (“tell a credible story”) more effectively with others.

5 Steps to Fire Risk Analysis

1. Identify potential fire hazards
2. Decide who might be harmed and how
3. Evaluate risks and decide whether more needs to be done
4. Record findings – relate knowledge
5. Review from time to time and revise when necessary
Our world, and the decisions that we make in our routine, day-to-day work involve Certainty and Uncertainty

Illustrations of certainty

- An insurance policy to cover $1,000,000 of fire damage has been purchased.
- A heat detector is present in that room.
- The design team has complied with Building Codes.

Illustrations of certainty

- Fire damage in this building will be limited to one room.
- This detector will actuate before the flames in that room grow to 10 in (Established Burning).
- The level of fire performance for this building is adequate for the goals of the owner.
What Determines the Spread of a Fire?

- Building Design;
- Construction Materials;
- Building Furnishings;
- Contents;
- Ventilation and;
- Fire Suppression Systems

Ways a fire can spread

More than just fire
Example Event Tree

<table>
<thead>
<tr>
<th>Sprinkler System</th>
<th>Call to Fire Dept</th>
<th>Outcome</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success</td>
<td></td>
<td>OK</td>
<td>1</td>
</tr>
<tr>
<td>Failure</td>
<td></td>
<td>Partial Damage</td>
<td>2</td>
</tr>
<tr>
<td>Success</td>
<td></td>
<td>Partial Damage</td>
<td>2</td>
</tr>
<tr>
<td>Failure</td>
<td></td>
<td>System Destroyed</td>
<td>3</td>
</tr>
</tbody>
</table>

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Questions

With regard to fire safety, how would you decide whether it better (more cost effective) to
- do nothing?
- improve fire prevention and emergency preparedness programs?
- install fire protection equipment
  - what kind?
  - where?
  - how much?
Risk Management is decision making under uncertainty.

The balance between:

<table>
<thead>
<tr>
<th>Cost of Downtime</th>
<th>Cost of Uptime</th>
</tr>
</thead>
<tbody>
<tr>
<td>▶ Loss of life</td>
<td>▶ Cost of additional facilities (datacenters, recovery centers and workplace)</td>
</tr>
<tr>
<td>▶ Loss of revenue</td>
<td>▶ Cost of additional technology (servers, network, storage, etc.)</td>
</tr>
<tr>
<td>▶ Lost productivity</td>
<td>▶ Organizational geographic diversity</td>
</tr>
<tr>
<td>▶ Damaged reputation &amp; brand image</td>
<td>▶ Process definition</td>
</tr>
<tr>
<td>▶ Fines</td>
<td></td>
</tr>
<tr>
<td>▶ Rework</td>
<td></td>
</tr>
<tr>
<td>▶ Impaired financial performance</td>
<td></td>
</tr>
<tr>
<td>▶ Customer dissatisfaction</td>
<td></td>
</tr>
</tbody>
</table>
Before Fire Risk Analysis
(a)

Fire Risk Management
(b)

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Military Records Center Fire

- Building
  - 728 ft x 286 ft
  - Reinforced Concrete Construction
- 60% Records Storage
- 40% Office
- 2000 Occupants During Day
Military Records Center Fire

- Built 1956
- Records in Metal File Cabinets
- GSA 1960
- Rapid volume rise in records storage
- First fire safety analysis 1963
- Method fire safety analysis October 1972
80% of Army Personnel discharged November 1, 1912, to January 1, 1960

75% Air Force Personnel discharged, September 25, 1947, to January 1, 1964

Successful Application
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**Code and Hazard Advice**

- If you have an existing building, you need to watch out for applying current code sections directly to the building.
- Due Diligence is required to identify the required level of protection.

**Evaluations**

One size does not fit all.

The evaluation can be tailored to the needs and resources of the present situation.
Remember

Our goal is to understand how a building will perform in a fire

... so that we can make better decisions

... and be able to develop a logical explanation and documentation, if necessary.

Conclusions

Addressing a building’s fire performance goes beyond applying the code.

Identify Hazards and Risks

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