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Fight or Flight – What's Your Fire Response?

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Hazards31

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Introduction

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  - Graduate of Texas A&M University
    - B.S. Chemical Engineering, 2011
  - Senior Process Safety Engineer, Baker Engineering and Risk Consultants, Inc.
    - Primary focus areas:
      - Fire Hazard Analysis
      - Insurance Risk Engineering
      - Facility Siting Studies
      - Incident Investigations
    - Previous experience in petrochemical industry in process and process safety design for capital projects

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Presentation Overview

1. Background
2. Fire Hazard Analysis Approach
3. Case Study 1
4. Case Study 2
5. Key Takeaways

References to FHA

1. **United States References**
   API 2001, API 2510/A, API 2218, NFPA
2. **European References**
   Seveso Directive
3. **UK References**
   COMAH, Seveso Directive, HSE

- Referenced in many standards, practices, and guidance documents
- So, what is FHA?

What is a Fire Hazard Analysis?

The intent of an FHA is to identify the hazards that fires pose to:

- a facility,
- its employees, its neighbours,
- and the environment.

The FHA should:

- Identify and analyse the potential fire hazards
- Assess active/passive fire protection systems and fixed/mobile response.

What is a Fire Hazard Analysis?

- Fire Hazard Analysis (FHA) is referenced in many of the industry safety standards and guidance documents.
  - *FHA has many other names (FEA, FRA, etc.)*
- It is often “bundled” with other hazard requirements in standards and guidance documents
  - *Further complicated when corporate FHA methodology must address local requirements for different geographic locations*
- Industry interpretation of the methodology for the FHA therefore tends to be vague and subjective

What is a Fire Hazard Analysis?

Ideally, an FHA would also determine maximum fire water demand to ensure the system can meet this capacity.

Firewater demand is difficult to determine on a fire scenario basis due to the somewhat subjective methodology.	Many facilities simply default to a prescriptive, area-based firewater coverage calculation.	CCPS guidance recommends if there are no fire pre-plans, a facility may use an area-based firewater coverage calculation.

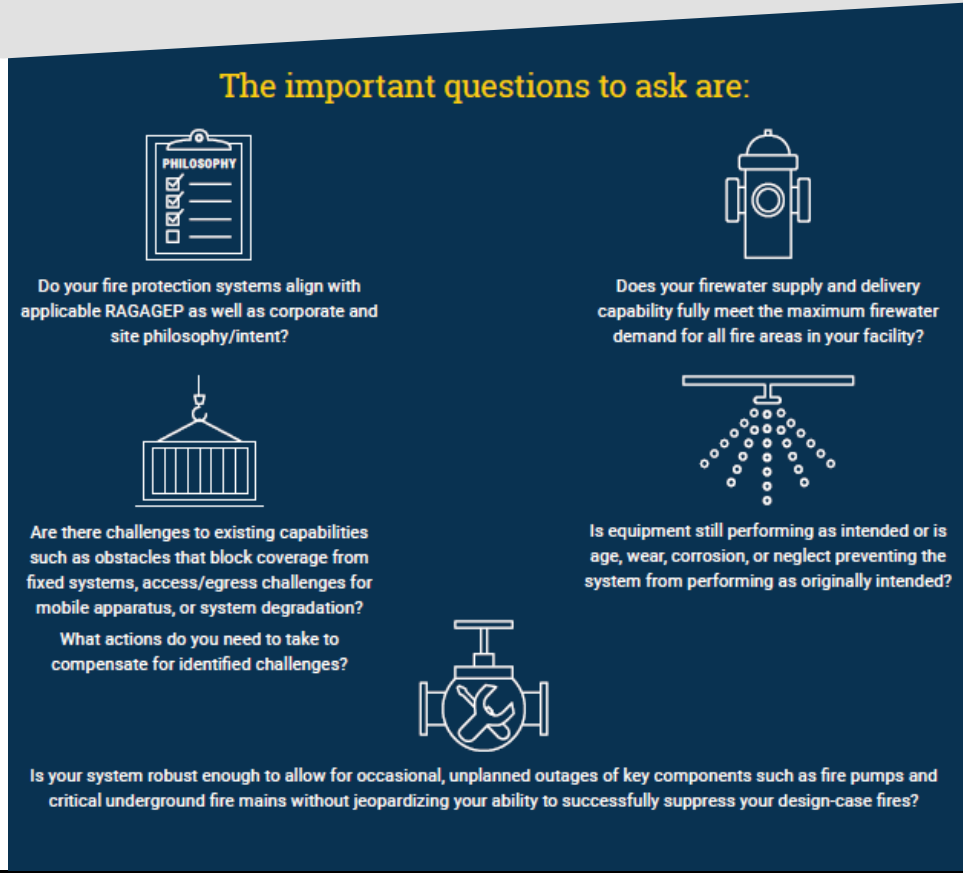
Calculating Firewater Demand in an FHA

Key steps in exploring the difference in applying a ***semi-quantitative method*** versus an ***area-based approach*** to determine the maximum credible firewater demand for a major hazard facility.

1. Understanding Firefighting Philosophy
2. Align Philosophy with Capability
3. Define the Design Basis Fire Case
4. Determine Maximum Firewater Demand

Understanding your Firefighting Philosophy

- The first step in conducting an FHA is to gain an understanding of the facility firefighting philosophy
  - *Would the site rely on fixed fire protection systems such as deluge or?*
  - *Would the site rely more on prompt and effective emergency response team (ERT) actions?*
  - *Or does the site depend on outside help such as the local fire department or a mutual aid group?*



Understanding your Firefighting Philosophy

- There is no “right” answer, but it is critical to ensure the philosophy aligns with the site’s actual capabilities
  - A site that plans to rely on fixed protection must ensure that the fixed protection is designed, installed, and maintained to support successful suppression.
  - A site that plans to rely more heavily on the ERT response, the ERT staffing, equipment, and training plans must be updated and well maintained to reflect that intent.
- Failure to achieve alignment between philosophy and capabilities may result in the inability to adequately respond to and mitigate a fire hazard.

Defining the Design Basis Fire Scenario

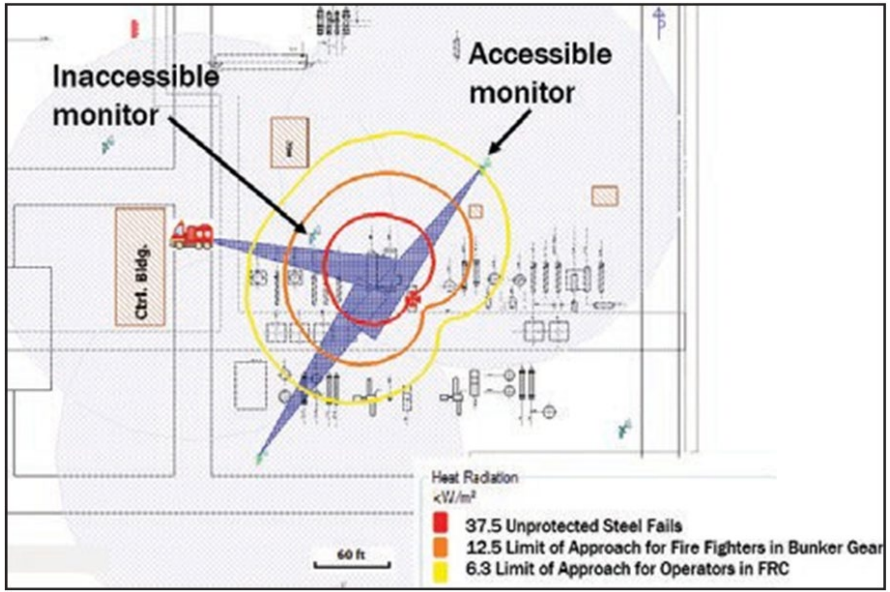
- The next step of the FHA is to determine the “design basis fire.”
- A design basis fire scenario is a scenario that is “likely to occur” but is *manageable* by *practicable* fixed system installations and emergency response procedures.

Beyond Design Basis Fire Events

- Catastrophic events are outside the scope of the FHMA
  - Explosions preceding fires, for example
  - Low likelihood events
  - Considered “unmanageable” consequences, not suited to FHMA approach
- Evacuate based on the “Rule of Thumb”
- Goal?
  - *Prevent manageable events from reaching catastrophic size!*

Determining Firewater Demand: Scenario-Based Approach

- Review “design case” fire scenarios in FHA workshop
- Evaluate fixed and mobile response equipment that would be deployed to fight each potential fire scenario
- Calculate firewater demand based on the sum of all firewater streams for each scenario
- Determine if the site can meet those demands based on system capacity



Determining Firewater Demand: Area Coverage Approach

The CCPS (CCPS 2003) Section 7.4.2 "Firewater Demand" suggests if pre-plans are not available, that the firewater demand be based on the "Risk Area" for the process unit.

- "Risk Area" is equivalent to the full surface area of the involved unit (i.e., the full "battery limits").
- The minimum manual firewater demand should then be calculated based on Figure 7-8 from that guideline.
- Flow demands for fixed water spray/deluge systems should be added to the value that is determined from the figure, to determine the full firewater demand for that Risk Area.

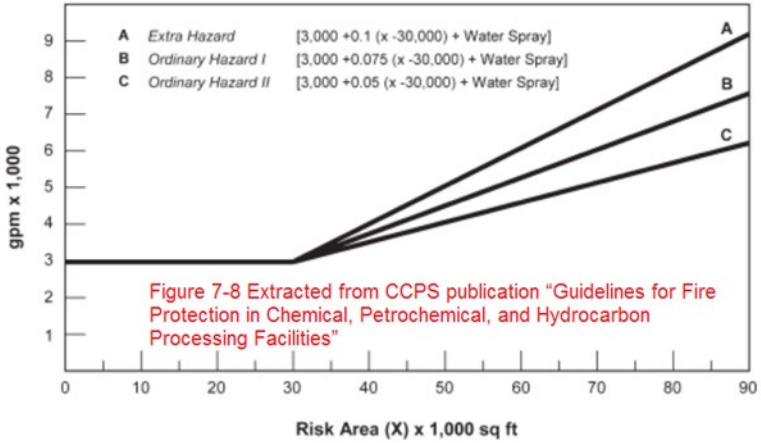
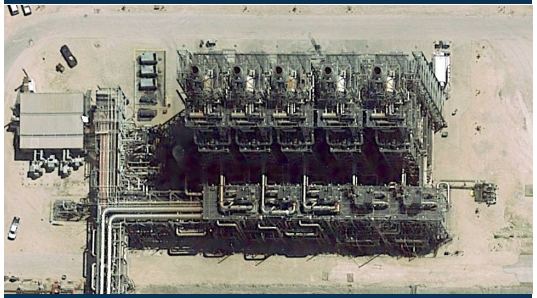


Figure 7-8 Extracted from CCPS publication "Guidelines for Fire Protection in Chemical, Petrochemical, and Hydrocarbon Processing Facilities"

Extra Hazard	Units with light material, vapor cloud explosion potential, liquid inventory over 10,000 gal
Ordinary Hazard I	Units with nonflashing material, inventory less than 10,000 gal
Ordinary Hazard II	Combustible materials

Case Studies

Case Study #1:
Example Ethylene Unit



Case Study #2:
Example Fired Heater Area

Two Case Studies are presented to illustrate the difference in calculated firewater demands between a scenario-based FHA vs area-density approach.

- Area Coverage and Scenario-Based approaches compared.
  - *The examples are intended to represent "typical" units.*
  - *The examples are not intended to provide recommended firewater demand based on facility or unit type alone.*

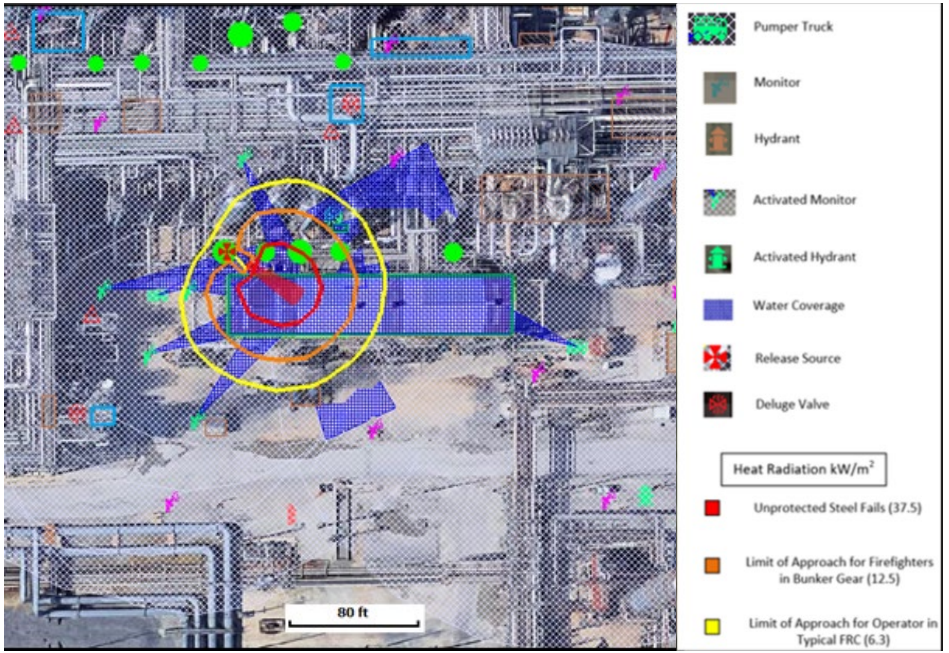
Case Study 1: Area-Based Approach

- The “risk area” for the unit based on the size is 339,500 ft^2 (31,540 m^2)
- Using the CCPS guidance

- To achieve this demand, the facility would need
  - 12-inch to 18-inch size mains with a high C-factor
  - 9 pumps rated for 5,000 gpm
  - Enough fixed fire water systems to deliver that capacity (e.g., 90 fire water monitors, each rated to 500 gpm).

Case Study 1: Scenario-Based Approach

- The technical team reviews a range of fire scenarios in the unit to determine which results in the highest firewater demand.
- The scenario with the highest total firewater demand is shown here.



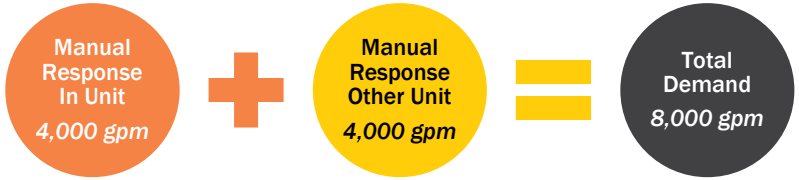
Case Study 2: Area-Based Approach

- The “risk area” for the unit based on the size of the unit is 56,000 ft^2
- Using the CCPS guidance

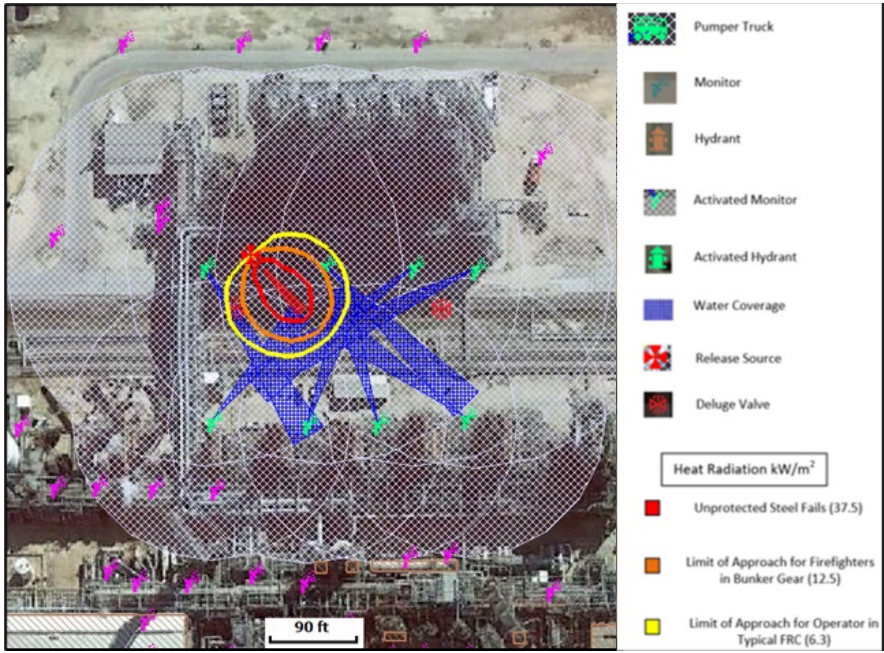
- This scenario shows that a fire can stretch beyond the “risk area” even if there is significant spacing between areas.
- The FHA methodology results in a more practical firewater demand estimate based on the site’s actual hazards and layout.

Case Study 2: Scenario-Based Approach

- For Case Study 2, the scenario with the highest total firewater demand is shown here.



  - Note: This estimate does not include a pumper truck response, but it is likely that either a truck could also be used to increase the demand, or an incident command would turn off monitors that are not as effective in the response.



Key Takeaways

1. **FHA Is a Requirement (or Recommended)**

   While guidance is often subjective, FHA – and calculation of firewater demand – is, at a minimum, recommended, and often a requirement.

2. **What is the site's firefighting philosophy?**

   That philosophy will guide the discussion when determining how a specific fire scenario is mitigated.

3. **Philosophy drives demand calculations.**

   Philosophy must match available capabilities. However, this is not a one-size-fits-all approach.

4. **Area-based approach may be misleading**

   Can under or over-estimate demand for a given unit. A scenario-based approach allows the facility's philosophy and hazards to drive firewater demand calculations.

Questions?

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