

Fire and Explosion Hazard Management (FEHM): An Overview

Overview of Fire and Explosion Hazard Management Figures

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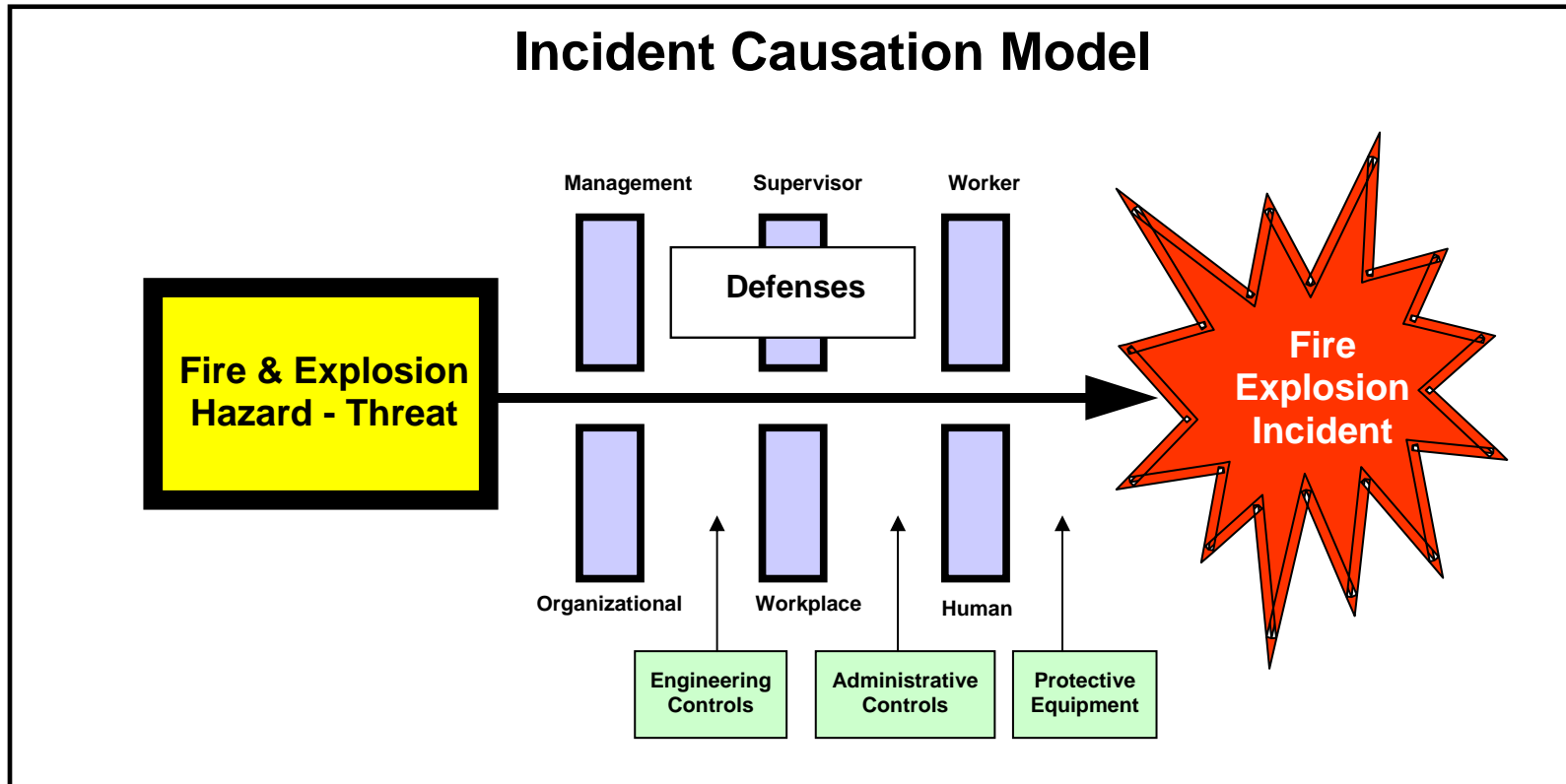
Overview of Fire and Explosion Hazard Management Figures

The purpose of the document is to provide a printable version and brief explanation of the diagrams used to develop Industry Recommended Practice IRP 18 – Fire and Explosion Hazard Management. These diagrams were created as part of the work of a Canadian Oil and Gas Industry Committee looking into fires and explosions in the upstream industry. Enform has issued an Industry Recommended Practice prepared by the IRP18 Committee. Further information about this IRP can be found on the Enform website <http://www.enform.ca/316>. These diagrams were created by Walter Tersmette, P. Eng., as part of his role as the Co-chairman of this industry committee.

Figure	Discussion
1	<p>Accident Investigation and Causal Analysis</p> <p>One focus of the IRP18 Committee’s work was to identify and analyze relevant fire and explosion case studies. To complete the analysis, two accident theory models used by the safety industry were applied: 1) James Reason’s “Swiss Cheese” model and 2) Edward Adam’s “Organizational Responsibility Model”. Reason’s “Swiss Cheese” model sets out the basic relationships between hazards, defenses and losses. The model identifies three basic levels of defenses based on organizational, local workplace and human factors and the potential holes in those defenses. Adam’s “Organizational Responsibility Model” looks more closely at the activities of managers, supervisors and workers, the key people in every management system.</p>
2	<p>Fire and Explosion Incidents: Relationship of Key FEHM Components</p> <p>This diagram illustrates the relationship between the key components of fire and explosion management relative to the sequential events in an accident.</p> <ul style="list-style-type: none"> • What was the fire and explosion hazard management process? (FEHM - This is described by Figures 5, 6 and 7) • Were the potential hazards fully recognized: fuel, oxygen-air and ignition-energy sources? (Figure 4) • What were the preventive barriers and controls? What plans and procedures were established to manage the potential job hazards? How did they or could they fail? Could these have been anticipated and addressed in the job planning stages? • What events occurred that may have escalated the severity of events? What protective measures did or could have altered the outcome?

Figure	Discussion
3	<p>Understanding Fire and Explosion Mechanics: A Simplified Fault-Tree Analysis</p> <p>This is a simplified fault-tree-analysis diagram based on the Ball Energy Model. One important addition resulting from the analysis of fire and explosion case studies was the recognition that dealing with a ‘closed’ system, there is a need to assess how oxygen may enter that system and the potential consequences should this occur.</p>
4	<p>Preventing Fires and Explosions - Understanding the Fire Triangle</p> <p>Based on the case studies reviewed, the committee ascertained that many of the incidents were the result of failure to recognize potential fire and explosion hazards. Figure 4 shows a more complete range of potential hazards related to fuel, oxygen and ignition sources.</p>
5	<p>Fire and Explosion Hazard Management (FEHM) Process</p> <p>This diagram depicts the relationship between an employer’s philosophy, fire and explosion hazard management process and prevention plans and controls.</p>
6	<p>Stages of a Fire and Explosion Hazard Management Process</p> <p>This diagram depicts the five stages of an effective FEHM process. The figure includes reduced images of a number of the other figures to help clarify the relationships between the figures in this document.</p>
7	<p>Potential Fire and Explosion Controls</p> <p>This diagram shows a list of potential controls that should be considered to prevent or reduce the risk of fires and explosions.</p>
8	<p>Fire and Explosions – Overview of System Dynamics</p> <p>This diagram shows the complex interrelations between the three components of the fire triangle and the factors affecting the probability of ignition.</p>

Figure 1 Investigation and Analysis of Fire and Explosion Incidents



- Determining the Nature of Incident Dynamics
- Understanding the Physical Operations Being Completed
- Identifying Site Layout, Equipment and Protection
- Assessing the Ability of People to Avoid Errors

Figure 2
Fire and Explosion Incidents:
Relationship of Key FEHM Components

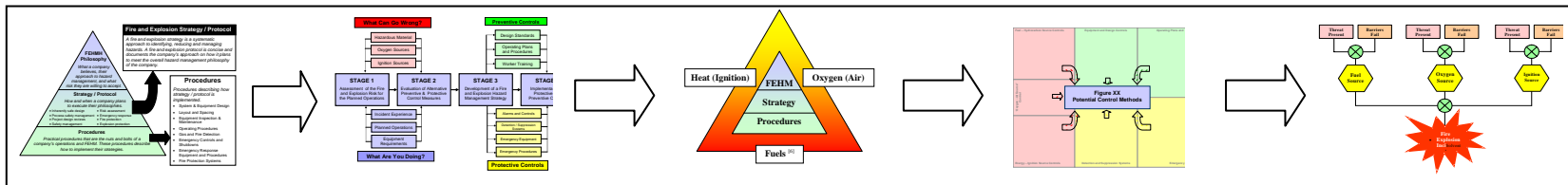
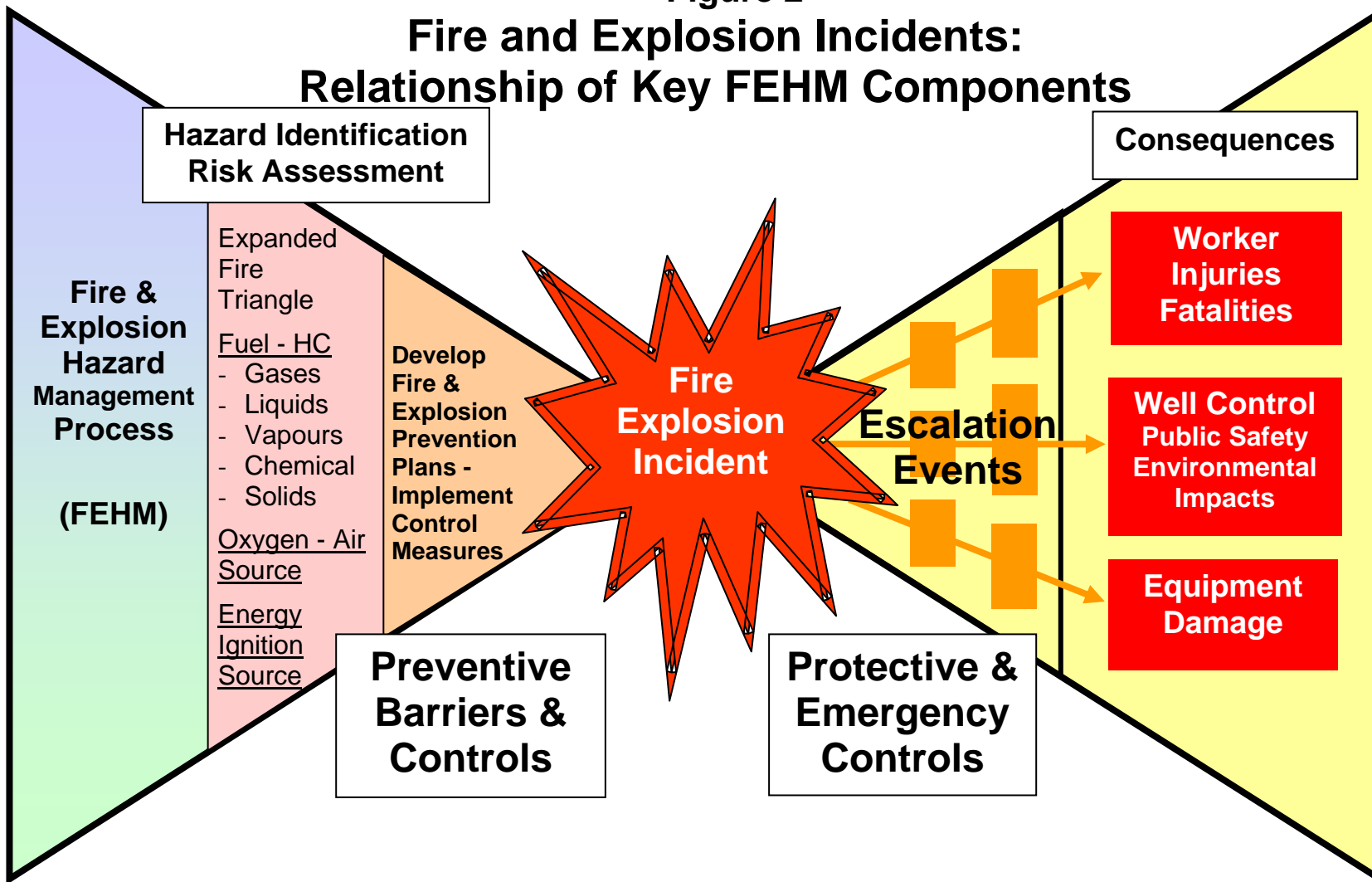


Figure 3
Understanding Fire and Explosion Mechanics
Fault-Tree-Analysis Diagram based on Ball Energy Model

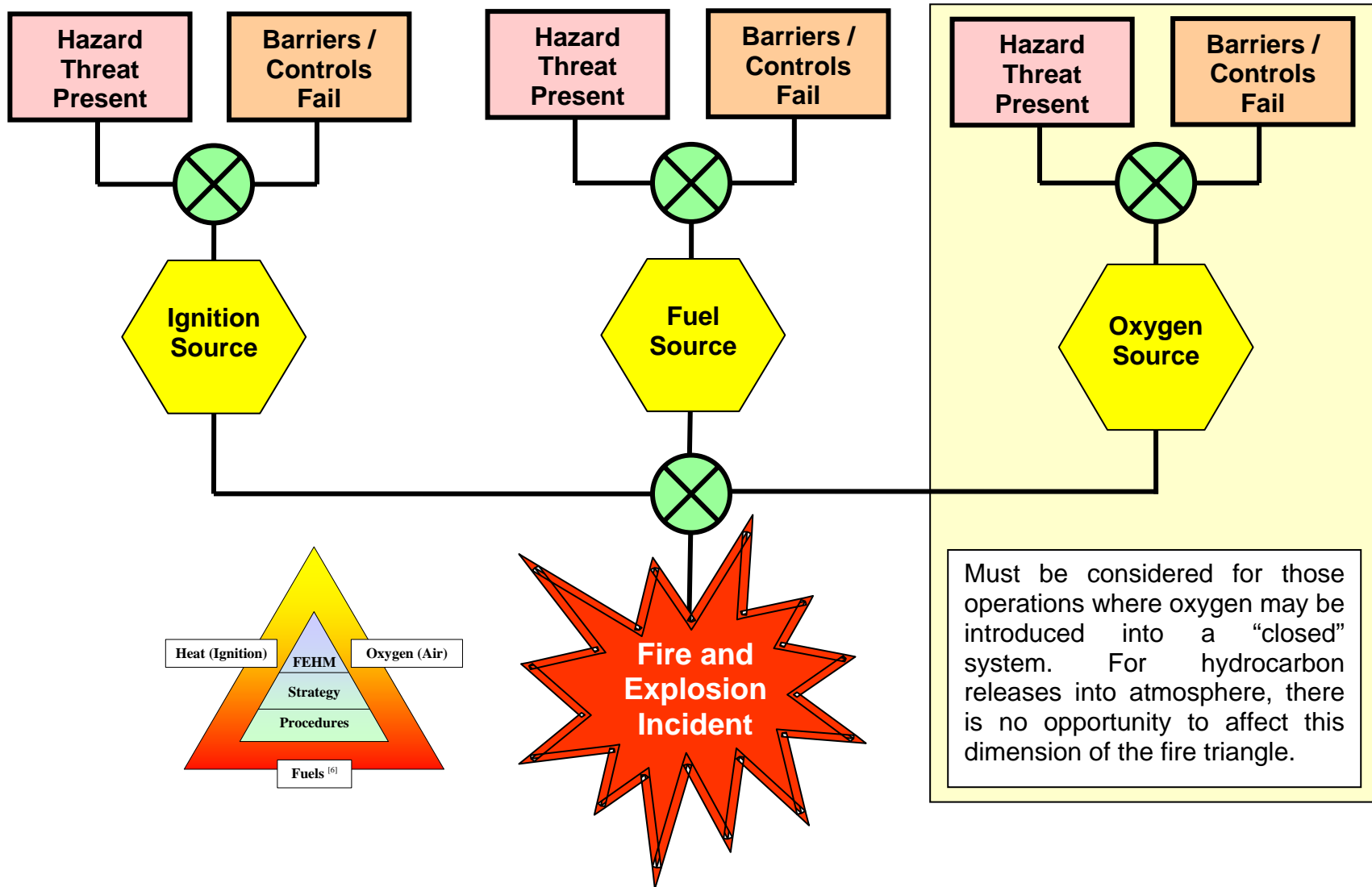


Figure 4
Preventing Fires and Explosions: Understanding the Fire Triangle

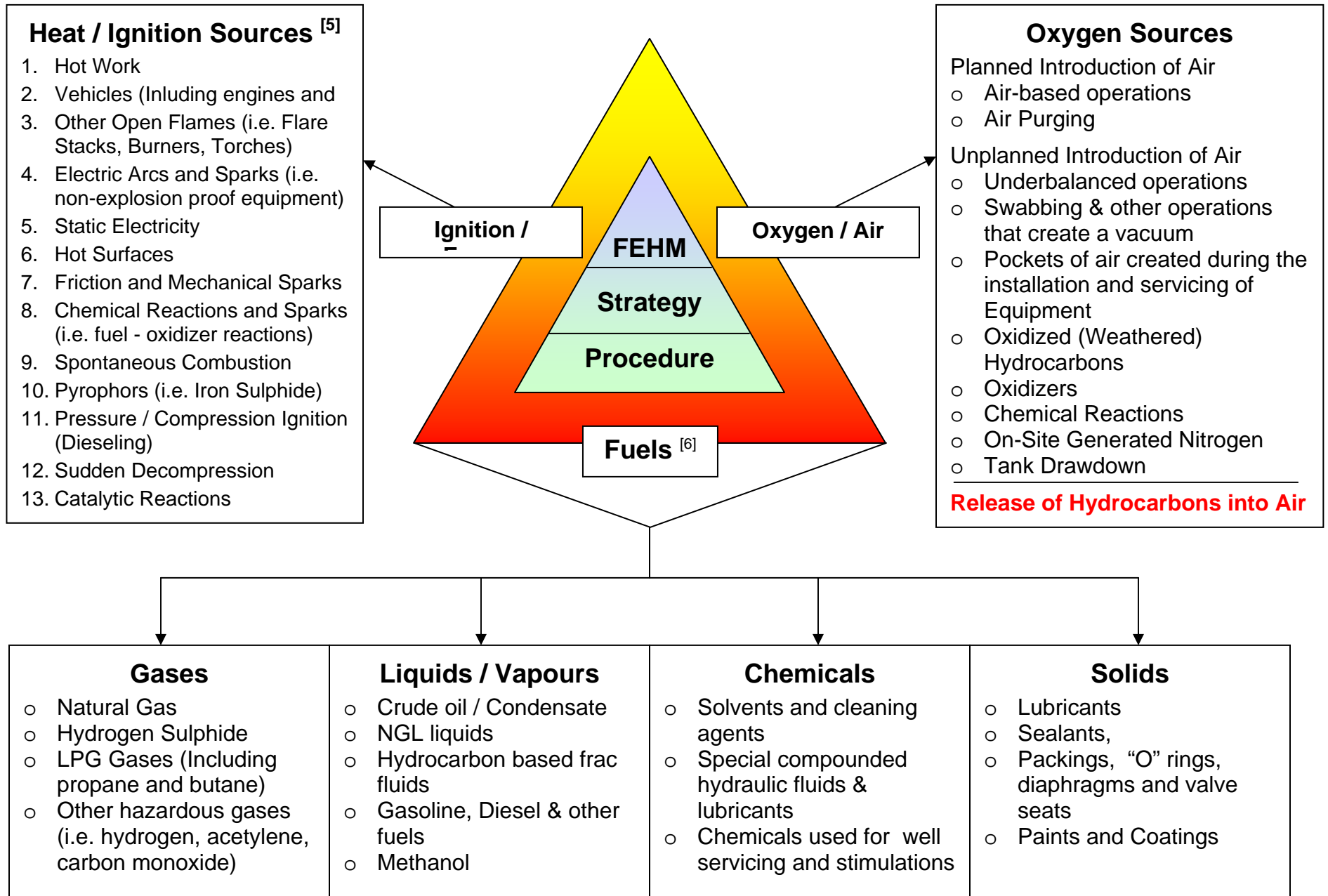


Figure 5

Fire and Explosion Hazard Management (FEHM) Process

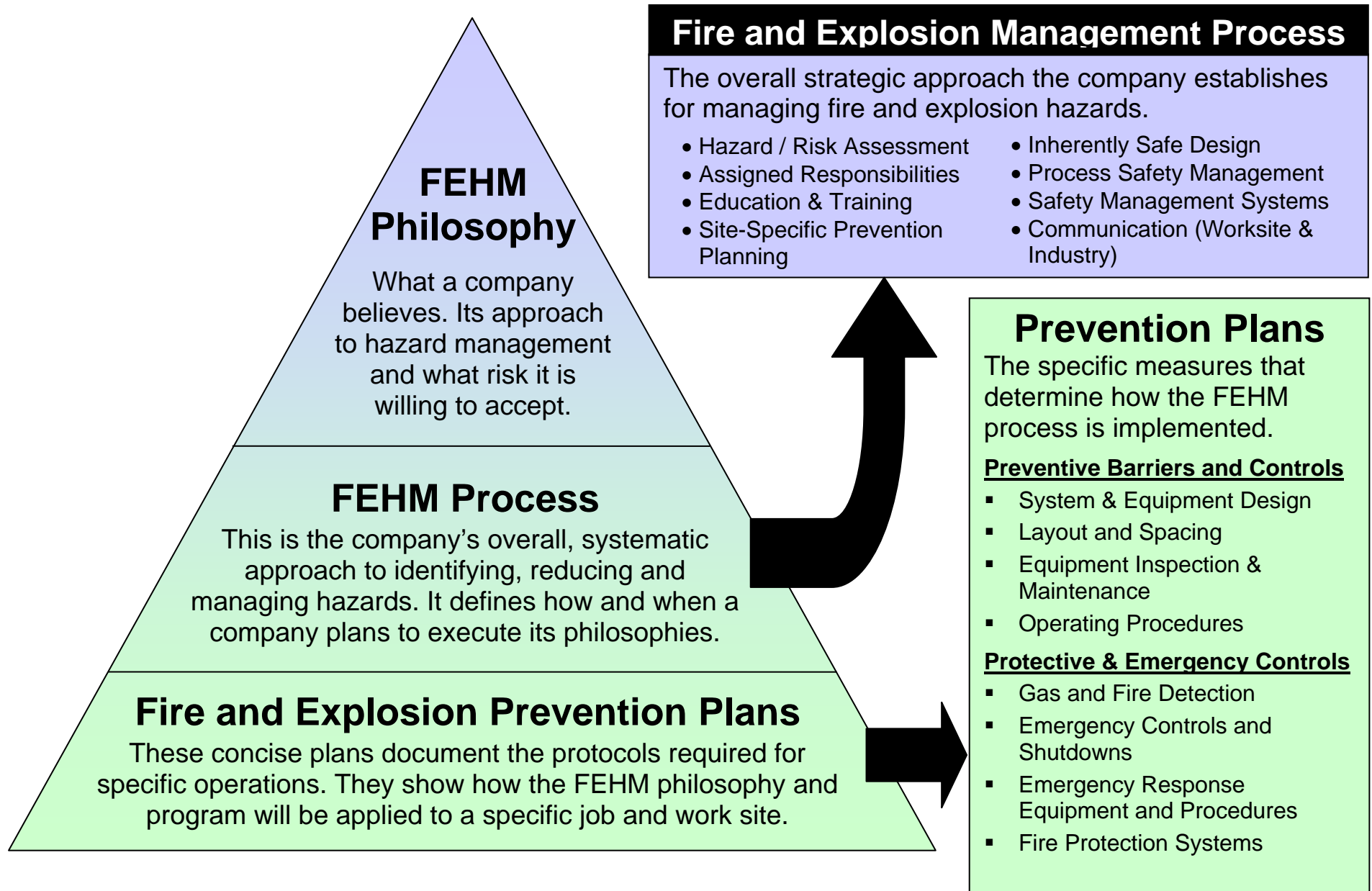
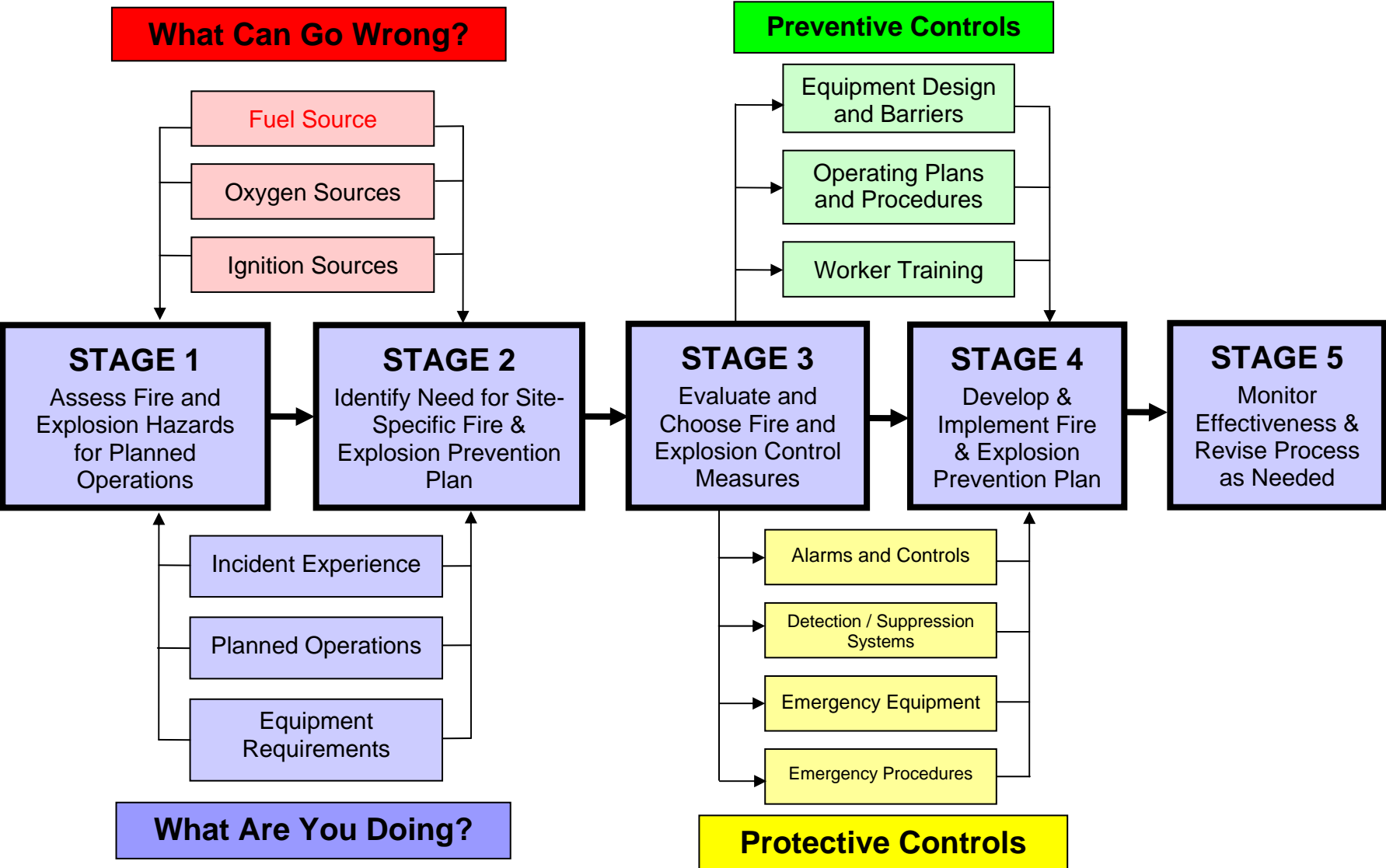


Figure 6– Stages of a Fire and Explosion Hazard Management Process



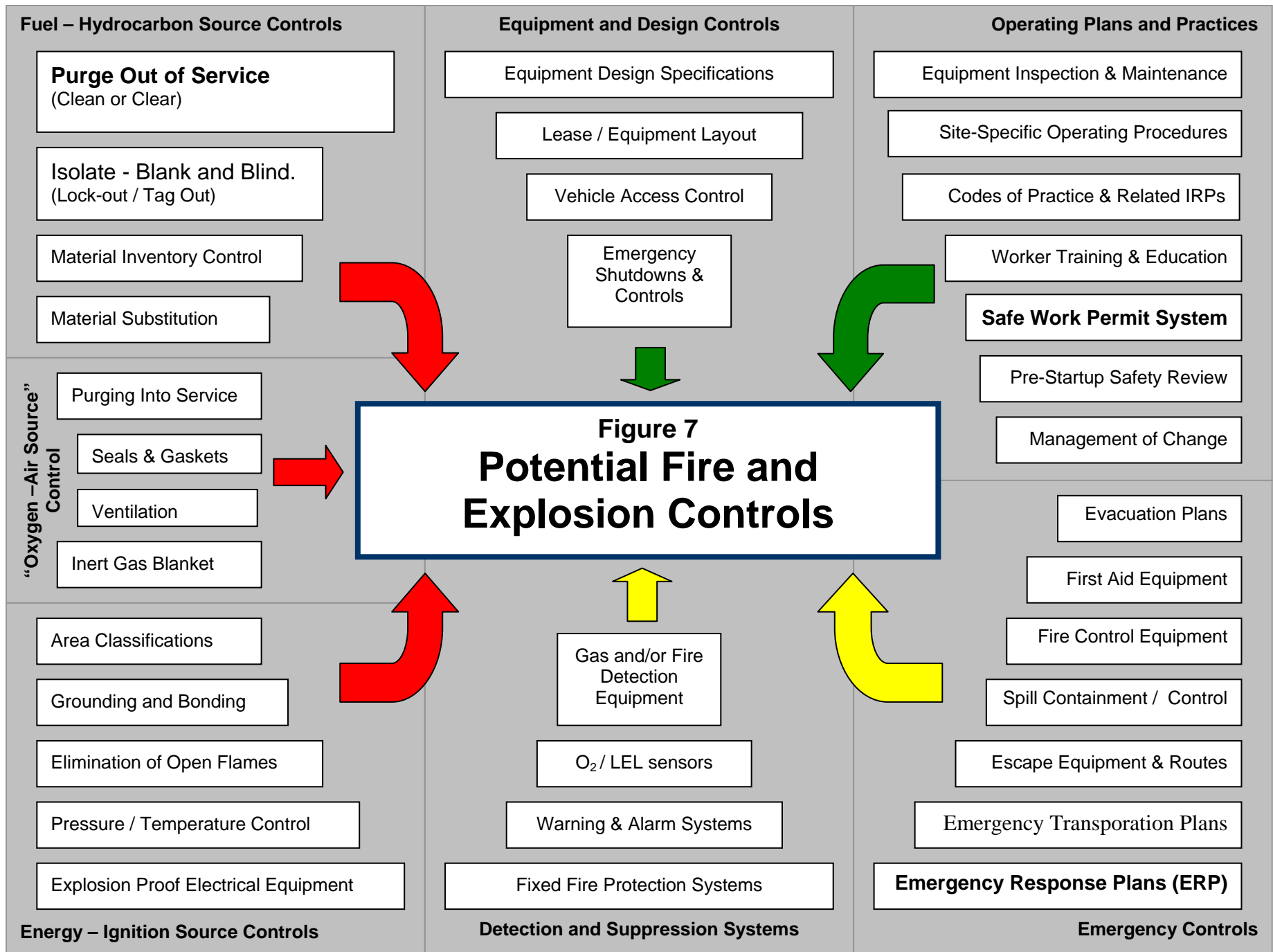
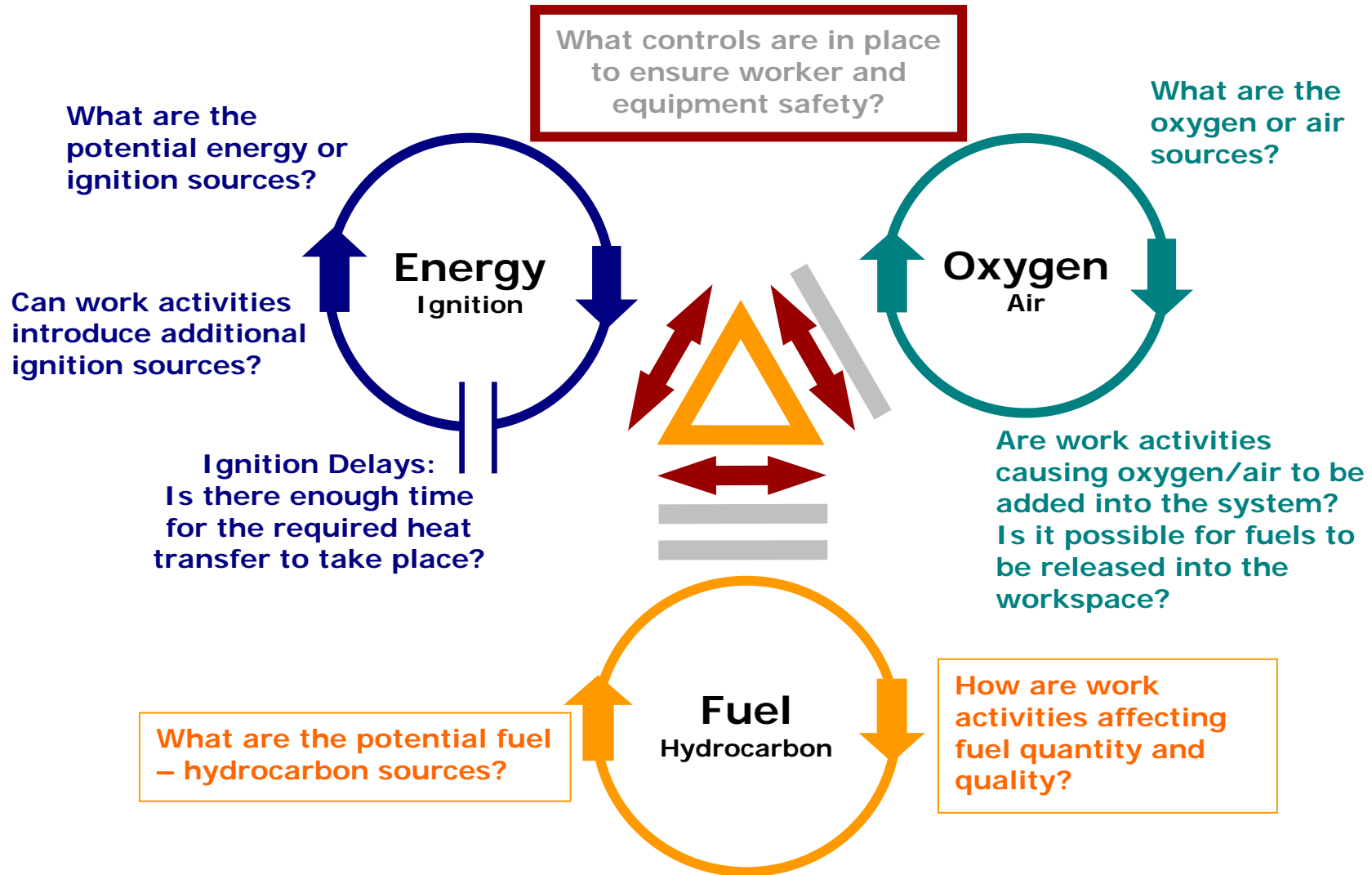


Figure 8 Fire and Explosions – Overview of System Dynamics



There are 3 key points that must be remembered:

1. Anytime all three sides of the fire triangle can co-exist, there is real potential for a fire or explosion.
2. There are 8 critical risk factors that increase the probability of a fire and explosion significantly.
3. The system is dynamic and circumstances change over time. As a result, safe situations may become unsafe.