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# INHERENT SAFETY PRINCIPLES

Clint Guymon

Brigham Young University

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## Learning Outcomes

- Define inherent safety and contrast it with procedural or add-on engineering controls.
- Apply the core principles of inherent safety: Minimization, Substitution, Moderation, and Simplification.
- Evaluate process designs to identify opportunities for “safety by design” rather than relying on administrative controls.

## Reading

- Foundations of Spiritual and Physical Safety: with Chemical Processes; Chapter 5, Sections 1

## 1 Process Safety

### 1.1 Safety Culture

How important is safety to you and those around you? What does process safety mean? What does it mean to your company? Are you willing to work for a company that does not value safety? Is it true that a company that does not value safety does not value you?

Ultimately, we are responsible for our safety, both physical and spiritual. We'll talk about many accidents in the course. For example, a few days ago, the Los Angeles Times reported about Zuko Carrasco, who was paralyzed while leading people on a trust fall. He blames himself as he was the last to descend when what he thought he heard was “on belay” but his belayer was not yet ready. He jumped and fell 40 feet and was paralyzed from the waist down. He had safely completed that activity many times before.

### 1.2 Voluntary and Involuntary Risk

Most are much more comfortable assuming voluntary versus involuntary risk. As a chemical engineer, how will you mitigate those two types of risk? Undoubtedly, a chemical engineer will work under voluntary risk and be on the front lines of helping to reduce involuntary risk to the public.

### 1.3 Safety Metrics

You say you're safe...prove it. Some safety metrics are training hours, near misses, number of lost time accidents, etc.

### 1.4 Accident Statistics

Accident statistics are used to help us understand the risks we face. They are also used to help us understand the effectiveness of our safety programs.

### 1.5 Safety Triangle

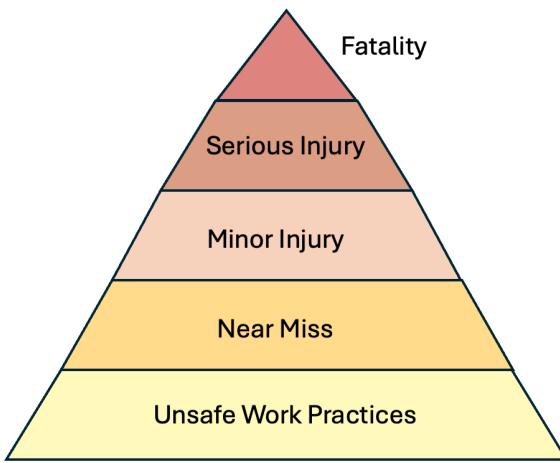


Figure 1: Safety Triangle showing that reducing the incidents of lower consequence events can reduce the quantity of higher consequence events.

### 1.6 OSHA Recordable

Employers with more than 10 employees are required to keep a record of serious work-related injuries and illnesses. This is called the OSHA 300 log. It is required by the Occupational Safety and Health Administration (OSHA) which has legal authority to enforce workplace safety laws. Recordable injuries and illnesses are:

- Any work-related fatality.
- Any work-related injury or illness that results in loss of consciousness, days away from work, restricted work, or transfer to another job.
- Any work-related injury or illness requiring medical treatment beyond first aid.
- Any work-related diagnosed case of cancer, chronic irreversible diseases, fractured or cracked bones or teeth, and punctured eardrums.
- There are also special recording criteria for work-related cases involving: needlesticks and sharps injuries; medical removal; hearing loss; and tuberculosis.

Consequences from OSHA violations can be severe in addition to the injury and illness suffered by the employee. Consequence of an OSHA recordable incident could include: increased scrutiny from OSHA, potential fines and penalties, higher workers' compensation costs, negative impact on company reputation, decreased employee morale, and increased insurance premiums; essentially, an OSHA recordable incident shows employees were unnecessarily harmed which can lead to significant financial repercussions.

**Action Items**

1. Define the six inherent safety principles (Minimization, Downsizing, Isolation, Substitution, Moderation, and Simplification) and provide one industrial example for each.
2. Personal Reflection: Identify one spiritual risk you face and explain how you could apply an inherent safety principle (like isolation or substitution) to mitigate it.