Assessing Operational Risk

The Fundamentals
and the Role of the Safety Professional

ASSE Heart of America Chapter
October 16, 2015

Bruce Lyon, CSP, PE, ARM, CHMM
Hays Companies
Assessing Operational Risk

- Fundamental Terms
- Risk Assessment and Risk Management
- The Risk Assessment Process
Hazards and Risks
Hazards

Source of Harm

- “The potential for harm.” (ANSI/ASSE Z590.3-2011 Prevention through Design)
- “A condition, set of circumstances, or inherent property that can cause injury, illness, or death.” (ANSI/AIHA/ASSE Z10-2012)
Hazards
Exposure

Contact with Hazard

• “Extent to which an organization and/or stakeholder is subject to an event.” (ISO Guide 73/ANSI/ASSE 690.1-2011)

• “Contact with or proximity to a hazard, taking into account duration and intensity.” (ANSI/AIHA/ASSE Z10-2012)

• Exposure includes:
  • frequency
  • duration
  • population or assets at risk
Risks

Estimated Severity and Likelihood of Harm


• “An estimate of the probability of a hazard-related incident or exposure occurring and the severity of harm or damage that could result.” (ANSI/ASSE Z590.3-2011)

• “An estimate of the combination of the likelihood of an occurrence of a hazardous event or exposure(s), and the severity of injury or illness that may be caused by the event or exposures.” (ANSI/AIHA/ASSE Z10-2012)
Definitions

• **Consequence** - Outcome of an event affecting objectives.
• **Severity** – Degree of harm.
• **Likelihood** – Chance of something happening.
• **Operational Risk** – Risks generated from the workplace including SH&E, liability, legal and information technology.
• **Acceptable Risk** - The risk level an organization is willing to accept in its current context.
Definitions

Risk Assessment


• “A process that commences with hazard identification and analysis, through which the probable severity of harm or damage is established, followed by an estimate of the probability of the incident or exposure occurring, and concluding with a statement of risk.” (ANSI/ASSE Z590.3 PtD Standard)
Risk Assessment

Hazard/Risk Identification
Find, Recognize and Record

Risk Analysis
Determine Severity and Likelihood

Risk Evaluation
Compare Risks Levels and Consider Controls
The Management of Risk

Coordinated activities of risk avoidance, control, and financing to a risk level that is acceptable
Risk Assessment within the Risk Management Framework

ISO 31000/ANSI Z690.2
The Need for Assessing Risk

Fortune 500 Company Study found 65% of serious incidents had no risk assessment

(Bruce Main – ASSE Webinar on ANSI Z590.3 PtD – 11/30/11)
Fatalities and Serious Incidents (FSI) Continue to Occur

- Major Disasters
- Fires and Explosions
- Chemical Releases
- FSI in Construction, Energy, Agriculture, Transportation, among other industries

Suggested sources: NIOSH FACE Reports  http://www.cdc.gov/niosh/face/inhouse.html
CSB Videos: http://www.csb.gov/videos/
The Need for Assessing Risk

“*A formal risk assessment* might have enabled the BP Macondo well team to identify further mitigation option to address risks…” p. 36
Global Trends in Managing Risk

Risk Assessments required in:

- many countries
- branches of the military
- NASA
- Chemical operations - OSHA PSM & EPA RMP
- Atomic energy field - NRC
- Pharmaceuticals - FDA
Global Trends
Key Standards

- ISO 31000 - ANSI/ASSE Z690-2011 Risk Management Standards
- ANSI/ASSE Z590.3-2011 Prevention through Design
- ANSI B11.0-2015 Safety of Machinery
- MIL-STD-882E-2012
Safety Management Systems requiring Risk Assessment

- OSHA’s Voluntary Protection Program (VPP)
- ANSI Z10-2012
- BS OHSAS 18001-2007
- International Labor Office ILO-OSH 2001
- ISO 14001-2004, Environmental management systems
The Rising Importance of Risk Assessment

- Established February 2013
- Risk-based information, tools, and research for safety professionals
- Risk Assessment Certificate Program

http://www.oshrisk.org/
OSHA Recognizes Need for Risk-based Approach

In a July 19, 2010 letter to the OSHA staff, Assistant Secretary David Michaels wrote:

“Ensuring that American workplaces are safe will require a paradigm shift, with employers going beyond simply attempting to meet OSHA standards, to implementing risk-based workplace injury and illness prevention programs.”
Risk Assessment Process

1. Establish Risk Criteria
2. Establish Context
3. Assemble Team
4. Identify Hazards
5. Analyze Risks
6. Evaluate Risks
7. Treat Risks
8. Document
9. Monitor / Review
Establish Risk Criteria and Matrix

- Define Risk Levels
  - Severity
  - Likelihood
  - Acceptable Risk Level
  - Actions Required
- Establish Risk Scoring System
- Select a Risk Assessment Matrix
To provide “a method to categorize combinations of probability of occurrence and severity of harm, thus establishing risk levels.” (ANSI/ASSE Z590.3-2011)

<table>
<thead>
<tr>
<th>Severity (S)</th>
<th>Insignificant (1)</th>
<th>Negligible (2)</th>
<th>Marginal (3)</th>
<th>Critical (4)</th>
<th>Catastrophic (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inconsequential with respect to injuries or illnesses, system loss or downtime, or environmental release.</td>
<td>First aid or minor medical treatment only, non-serious equipment or facility damage, chemical release requiring routine cleanup without reporting.</td>
<td>Medical treatment or restricted work, minor subsystem loss or damage, chemical release triggering external reporting requirements.</td>
<td>Disabling injury or illness, major property damage and business downtime, chemical release with temporary environmental or public health impact.</td>
<td>One or more fatalities, total system loss, chemical release with lasting environmental or public health impact.</td>
<td></td>
</tr>
<tr>
<td>Likelihood (L)</td>
<td>Frequent (5)</td>
<td>Likely (4)</td>
<td>Occasional (3)</td>
<td>Seldom (2)</td>
<td>Unlikely (1)</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Frequent (5)</td>
<td>Likely to occur repeatedly.</td>
<td>Probably will occur several times.</td>
<td>Could occur intermittently.</td>
<td>Could occur, but hardly ever.</td>
<td>Improbable, may assume incident or exposure will not occur.</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Risk Matrix (adapted/modified from ANSI Z10)
Establish Risk Criteria and Matrix

<table>
<thead>
<tr>
<th>Risk Level (RL)</th>
<th>Risk Scores</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>15 to 20</td>
<td>Operation not premissible. Immediate action required.</td>
</tr>
<tr>
<td>High</td>
<td>9 to 14</td>
<td>Remedial action to be given high priority.</td>
</tr>
<tr>
<td>Moderate</td>
<td>5 to 8</td>
<td>Remedial action to be taken at appropriate time.</td>
</tr>
<tr>
<td>Low</td>
<td>1 to 4</td>
<td>Remedial action discretionary.</td>
</tr>
</tbody>
</table>
Establish Context

• Purpose and Scope
• Boundaries and Limitations
• Select Risk Assessment Method(s)
  • Brainstorming
  • Checklists
  • Preliminary Hazard Analysis
  • What-if Analysis
  • Failure Mode and Effects Analysis
  • HAZOP
  • or other methods
Risk Assessment Team

- Cross-functional group familiar and knowledgeable with the hazards and operations
- Roles and Responsibilities
- Training in Method(s)
- Good communication and skills are essential
Hazard/Risk Identification

The process of finding, recognizing and recording:

- Hazards
- Causes and Sources
- Events, Situations or Circumstances
- Existing Controls
Identification Methods

• Brainstorming
• Checklists
• Regulations (OSHA, EPA, DOT etc.)
• Consensus industry standards (ANSI, ASTM, NFPA, etc.)
• Experts (external or internal)
• Job Hazard Analyses/Job Safety Analyses
• Accident/incident investigations
• OSHA Injury and Illness Records
• Insurance claims
• Formal hazard/risk identification techniques (31 listed in ANSI Z690.3-2011)
Risk Analysis

Analysis includes:

• Severity of consequences
• Likelihood of occurrence
• Effectiveness of existing controls
• Estimated risk levels
Consequence Analysis:

• Determine consequence(s) that could result from hazard
  • A hazard may produce multiple consequences with various severity levels, affecting multiple assets
• Estimate Severity Level for each consequence

<table>
<thead>
<tr>
<th>Severity Category</th>
<th>Injury/Illness Levels</th>
<th>Financial Loss Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic (4)</td>
<td>Fatality(s) or permanent total disability</td>
<td>More than $1M</td>
</tr>
<tr>
<td>Critical (3)</td>
<td>Hospitalizations, permanent-partial or temporary disability in excess of three months</td>
<td>$100K - $1M</td>
</tr>
<tr>
<td>Marginal (2)</td>
<td>Recordable Injury/Illness, minor injury, lost workday incident</td>
<td>$10K - $100K</td>
</tr>
<tr>
<td>Negligible (1)</td>
<td>First Aid or minor medical treatment</td>
<td>$0 - $10K</td>
</tr>
</tbody>
</table>
Risk Analysis

Likelihood Analysis:

• Review historical data and other relevant information
• Consider exposure frequency, duration and population
• Predictive techniques such as fault tree analysis (FTA) or event tree analysis (ETA) can be used
• Estimate Likelihood of Occurrence

<table>
<thead>
<tr>
<th>Category description</th>
<th>Time Period</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improbable</td>
<td>Century</td>
<td>Every 100 Years or more</td>
</tr>
<tr>
<td>Remote</td>
<td>Decade</td>
<td>Every 10 – 100 years</td>
</tr>
<tr>
<td>Occasional</td>
<td>Annually</td>
<td>Every 1 – 10 years</td>
</tr>
<tr>
<td>Probable</td>
<td>Monthly</td>
<td>Every 1 – 12 months</td>
</tr>
<tr>
<td>Frequent</td>
<td>Weekly</td>
<td>Every 1 – 4 weeks</td>
</tr>
</tbody>
</table>
Risk Analysis

Assessment of Controls:

• The adequacy and effectiveness of existing control measures greatly affect the level of risk and must be assessed.

• This assessment of controls should include determining the type of controls for each specific risk, and a judgment of their effectiveness based on the Hierarchy of Controls.

<table>
<thead>
<tr>
<th>Protection Factor (PF)</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elimination</td>
<td>0.1</td>
</tr>
<tr>
<td>Substitution</td>
<td>0.4</td>
</tr>
<tr>
<td>Engineering - Multiple</td>
<td>0.6</td>
</tr>
<tr>
<td>Engineering - Single</td>
<td>0.7</td>
</tr>
<tr>
<td>Warning</td>
<td>0.8</td>
</tr>
<tr>
<td>Administrative</td>
<td>0.9</td>
</tr>
<tr>
<td>PPE</td>
<td>0.95</td>
</tr>
<tr>
<td>No Controls</td>
<td>1</td>
</tr>
</tbody>
</table>
Risk Evaluation

• Compare estimated Risk Levels with established Risk Criteria
• Determine if Risk is Acceptable or if Treatment is needed
• Prioritize Actions based on Risk Levels
Risk – ‘As Low As Reasonably Practicable’

Decisions on treating a risk will depend on the risk level and the costs and benefits of implementing improved controls.

- **Unacceptable Risk**: Immediate action required. Operation not permissible, except in rare and extraordinary circumstances.
- **ALARP**: Remedial action is to be given high priority. Steps must be taken to reduce risk as low as reasonably practicable.
- **Very Low Risk**: Remedial action is discretionary. Procedures are to be in place to ensure risk level is maintained.
Risk Treatment

The process of reducing or modifying risk using Risk Treatment Options.
Risk treatment options are not always mutually exclusive or appropriate for all situations. Treatment options include:

1) **Avoidance** - avoiding the risk by deciding not to start or continue with the activity that gives rise to the risk;

2) **Elimination** - removing the risk source;

3) **Substitution** - changing the consequences;

4) **Engineering and Administrative controls** - changing the likelihood;

5) **Transfer & Financing** - sharing the risk with another party such as insurance contracts and risk financing; and

6) **Retain** - retaining the risk by informed decision.
# Hierarchy of Controls

<table>
<thead>
<tr>
<th>Most Preferred</th>
<th>Least Preferred</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk Avoidance:</strong> Prevent entry of hazards into a workplace by selecting and incorporating appropriate technology and work methods criteria during the design processes.</td>
<td></td>
</tr>
<tr>
<td><strong>Eliminate:</strong> Eliminate workplace and work methods risks that have been discovered.</td>
<td></td>
</tr>
<tr>
<td><strong>Substitution:</strong> Reduce risks by substituting less hazardous methods or materials.</td>
<td></td>
</tr>
<tr>
<td><strong>Engineering Controls:</strong> Incorporate engineering controls/safety devices.</td>
<td></td>
</tr>
<tr>
<td><strong>Warning:</strong> Provide warning systems.</td>
<td></td>
</tr>
<tr>
<td><strong>Administrative Controls:</strong> Apply administrative controls (the organization of work, training, scheduling, supervision, etc.).</td>
<td></td>
</tr>
<tr>
<td><strong>Personal Protective Equipment:</strong> Provide Personal Protective Equipment (PPE).</td>
<td></td>
</tr>
</tbody>
</table>
Documentation

Virtually all aspects of the process should be documented

- Selecting the risk assessment matrix
- Determining the purpose and scope (context)
- Selecting the team
- Identifying the hazards or operations to be assessed
- Hazard/risk identification
- Risk analysis
- Risk evaluation
- Communication and documentation
- Monitoring and continuous improvement
# Risk Register

<table>
<thead>
<tr>
<th>Case #</th>
<th>Location</th>
<th>Task</th>
<th>Hazard #</th>
<th>Hazard</th>
<th>Current State Risk Level</th>
<th>Additional Controls</th>
<th>Completion Date</th>
<th>Future State Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>QC Lab - Weld</td>
<td>Plasma cutter</td>
<td>1.1</td>
<td>Electrical Shock</td>
<td>14</td>
<td>Yes</td>
<td>2/20/2015</td>
<td>12</td>
</tr>
<tr>
<td>1</td>
<td>QC Lab - Weld</td>
<td>Plasma cutter</td>
<td>1.2</td>
<td>burns</td>
<td>15.2</td>
<td>Yes</td>
<td>3/15/2015</td>
<td>12</td>
</tr>
<tr>
<td>1</td>
<td>QC Lab - Weld</td>
<td>Plasma cutter</td>
<td>1.3</td>
<td>arc flash</td>
<td>11.2</td>
<td>Yes</td>
<td>2/20/2015</td>
<td>9.8</td>
</tr>
<tr>
<td>1</td>
<td>QC Lab - Weld</td>
<td>Plasma cutter</td>
<td>1.4</td>
<td>noise</td>
<td>19</td>
<td>Yes</td>
<td>3/15/2015</td>
<td>8.4</td>
</tr>
<tr>
<td>1</td>
<td>QC Lab - Weld</td>
<td>Plasma cutter</td>
<td>1.5</td>
<td>fire</td>
<td>14</td>
<td>Yes</td>
<td>3/15/2015</td>
<td>12</td>
</tr>
<tr>
<td>1</td>
<td>QC Lab - Weld</td>
<td>Plasma cutter</td>
<td>1.6</td>
<td>dust</td>
<td>11.2</td>
<td>Yes</td>
<td>3/15/2015</td>
<td>9.6</td>
</tr>
<tr>
<td>2</td>
<td>QC Lab - Weld</td>
<td>Weld Destruct</td>
<td>2.1</td>
<td>ergo-strains</td>
<td>14</td>
<td>Yes</td>
<td>4/15/2015</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>QC Lab - Weld</td>
<td>Weld Destruct</td>
<td>2.2</td>
<td>vibration</td>
<td>19</td>
<td>Yes</td>
<td>4/15/2015</td>
<td>4.8</td>
</tr>
<tr>
<td>2</td>
<td>QC Lab - Weld</td>
<td>Weld Destruct</td>
<td>2.3</td>
<td>noise</td>
<td>11.2</td>
<td>Yes</td>
<td>4/15/2015</td>
<td>10.8</td>
</tr>
<tr>
<td>2</td>
<td>QC Lab - Weld</td>
<td>Weld Destruct</td>
<td>2.4</td>
<td>struck by</td>
<td>15.2</td>
<td>Yes</td>
<td>2/20/2015</td>
<td>14.4</td>
</tr>
<tr>
<td>2</td>
<td>QC Lab - Weld</td>
<td>Weld Destruct</td>
<td>2.5</td>
<td>dust</td>
<td>16</td>
<td>Yes</td>
<td>4/15/2015</td>
<td>8.4</td>
</tr>
<tr>
<td>2</td>
<td>QC Lab - Weld</td>
<td>Weld Destruct</td>
<td>2.6</td>
<td>struck against</td>
<td>11.4</td>
<td>Yes</td>
<td>3/15/2015</td>
<td>6.3</td>
</tr>
<tr>
<td>2</td>
<td>QC Lab - Weld</td>
<td>Weld Destruct</td>
<td>2.7</td>
<td>falls same level</td>
<td>16</td>
<td>Yes</td>
<td>3/15/2015</td>
<td>11.2</td>
</tr>
<tr>
<td>3</td>
<td>Finishing</td>
<td>Wash Station</td>
<td>3.1</td>
<td>hot liquid</td>
<td>9</td>
<td>Yes</td>
<td>4/15/2015</td>
<td>6.3</td>
</tr>
<tr>
<td>3</td>
<td>Finishing</td>
<td>Wash Station</td>
<td>3.2</td>
<td>struck against</td>
<td>14.25</td>
<td>Yes</td>
<td>4/15/2015</td>
<td>0.2</td>
</tr>
<tr>
<td>3</td>
<td>Finishing</td>
<td>Wash Station</td>
<td>3.3</td>
<td>chem-corrosive</td>
<td>11.2</td>
<td>Yes</td>
<td>4/15/2015</td>
<td>4.2</td>
</tr>
<tr>
<td>3</td>
<td>Finishing</td>
<td>Wash Station</td>
<td>3.4</td>
<td>hot surfaces</td>
<td>14.25</td>
<td>Yes</td>
<td>4/15/2015</td>
<td>2.1</td>
</tr>
<tr>
<td>3</td>
<td>Finishing</td>
<td>Wash Station</td>
<td>3.5</td>
<td>mechanical</td>
<td>9.6</td>
<td>Yes</td>
<td>3/15/2015</td>
<td>4.8</td>
</tr>
<tr>
<td>3</td>
<td>Finishing</td>
<td>Wash Station</td>
<td>3.6</td>
<td>ergo-strains</td>
<td>11.2</td>
<td>Yes</td>
<td>4/15/2015</td>
<td>0.2</td>
</tr>
</tbody>
</table>
Monitoring & Continuous Improvement

✓ Hazards and operations change
✓ Changes can effect existing controls and their effectiveness
✓ Update risk assessments to consider these possible changes
Communication

✓ The importance of communication can not be overstated.

✓ Successful risk assessments are dependent on effective communication among stakeholders prior to, during and after the process.
The Take Away Message

✓ Take a Risk-centric Approach
✓ Establish a Strategy for Performing Risk Assessments
✓ Lead the Way
RISK ASSESSMENT
A Practical Guide to Assessing Operational Risks

GEORGI POPOV
BRUCE K. LYON
BRUCE HOLLcroft

WILEY