EVOLVING CONCEPTS IN FATALITY AND SERIOUS INJURY PREVENTION
Report of the Mercer ORC Fatality and Serious Injury Prevention Task Force
November 28, 2012

Ray Comingore
ExxonMobil

David Jacobi
Kimberly Clark

Glenn Murray
ExxonMobil

Lisa Potts
Sikorsky

Stephen Newell
Dee Woodhull
Principals

Mercer ORC HSE Networks

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“The greatest reward for doing is the opportunity to do more.”

Earl Warren
Session Objectives

I. Problem Statement and Approach, including:
   a. New Model for Addressing Serious Risk
   b. Framework and Tools for Implementing Concepts (15 Minutes)

II. Task Force Findings and Deliverables: (55 minutes)
   a. New approaches for using data
   b. A new way of thinking about risk assessments
   c. New tools concerning design and mitigation, the hierarchy of controls, and layers of control
   d. New tools for integrating human and organizational performance concepts
   e. Foundational elements needed to set the stage for the technical aspects of the work and build the necessary infrastructure to keep it going.

III. Pulling it All Together (5 minutes)

IV. Questions/Dialogue (20 minutes)

Preview of Coming Attractions: To be clear...we intend to give our work product away...available on 1/1/13 at www.saveworkerlives.org
Questions that We Will Attempt to Answer

• How do you identify situations that are likely to result in a fatality and/or serious injury?

• What is the best way to set priorities for addressing those situations?

• How do you determine the appropriate levels of control? Number of layers of control? How can you tell when protection is sufficient?

• Is there a way to identify company/site/process characteristics that are likely to contribute to fatalities and serious injuries?

• What are the best metrics for driving and sustaining fatality and serious injury prevention efforts?
Acknowledgements: We stand on the shoulders of many S&H innovators...

• Many Mercer ORC Network Members
• Tom Krause
• Todd Conklin, Rob Fisher, Tony Muschara, Scott Shappell, John Summers
• Sydney Dekker (Field Guide to Understanding Human Error)
• Fred Manuele
• Dan Petersen
• James Reason

• Note: Our teams have been “cross functional”…
A Few Key Concepts and Definitions

• Fatality and Serious Injury:
  – Fatality
  – Life-threatening injury or illness: one that if not immediately addressed is likely to lead to the death of the affected individual, and will usually require the intervention of internal and/or external emergency response personnel to provide life-sustaining support. Examples include, but are not limited to:
    - Laceration or crushing injuries that result in significant blood loss;
    - Injury involving damage to the brain or spinal cord;
    - Event which requires the application of cardiopulmonary resuscitation or an external defibrillator;
    - Chest or abdominal trauma affecting vital organs.
  – Life-altering injury or illness: one that results in impairment or loss of use of an internal organ, body function, or body part. Examples include, but are not limited to:
    - Significant head injuries
    - Spinal cord injuries,
    - Paralysis,
    - Amputations
    - Broken or fractured bones

• Fatality and Serious Injury Precursor: A combination of hazard(s) and underlying human factors and organizational deficiencies that if left unaddressed can result in a fatal or serious injury.
Problem Statement...

In many industries OSHA injury and illness rates have dropped dramatically in recent years; fatalities and serious injuries have not experienced a similar decline

- S&H pros perplexed about continuation of serious cases
- Some companies experiencing an up tick in “serious near misses”
- It is clear that traditional approaches to safety and health are not working
- Contractors represent a particular challenge

“We can't solve problems by using the same kind of thinking we used when we created them.”

Albert Einstein
Food for Thought: “Pillars” of the SH Profession That May be “Myths” When It Comes to Serious Injury Prevention

1. The mistaken interpretation of the Heinrich Pyramid that managing personal safety for less serious hazards at the bottom of the safety triangle will effectively address high gravity hazards at the top

2. Our collective misuse of OSHA data as the primary metric for driving and assessing safety performance;

3. Our over emphasis on history-based probability estimates when determining "likelihood" in conducting risk assessments that relate to high gravity hazards

4. Our failure to effectively argue against the mistaken belief that higher level controls are generally cost prohibitive; and

5. The incorrect assumption that most injuries are caused by unsafe acts (fueled and reinforced by flawed incident investigations).
Challenge:

If current approaches for identifying, evaluating, and managing hazards do not sufficiently protect workers from the most serious hazards, what is needed? What are the specific limitations/gaps in existing approaches and how do we overcome them?

Solution:

A new risk model that creates a separate track for addressing serious hazards

– Doesn’t require discarding what works; can be integrated into ongoing S&H prevention strategies
– Requires that key existing approaches be executed flawlessly at critical steps in your process/task
– Includes some new concepts and new tools

New model emphasizes the need for a heightened sense of awareness and vulnerability in precursor situations
Typical S&H Prevention/Risk Model

Evaluate Process

- Risk Recognition
- Risk Assessment
- Risk Management
Dual Path Strategy for Prevention

Risk Assessment:
F(x): Severity + Experience-Based Likelihood

Risk Mitigation:
Low to Middle Order from Control Hierarchy

Risk Assessment:
F(x): Severity + Control-Based Likelihood

Risk Mitigation:
High Order from Control Hierarchy; Layers of Protection

Hazard Recognition
Low Severity Exposure
Likely Precursor to Fatality or Serious Injury

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Challenge:

How do you translate key concepts into practical realities? Is it possible to identify a strategy that can be used in small and mid-sized establishments? That applies to different hazards? That can be sustained over time?

Solution:

Create a mechanism for implementing the model that can be used in a wide range of facilities with different sized workforces, with different hazards and different work processes.

The implementation strategy is NOT the answer for every situation.

Rather it is provided to illustrate concepts and an overall approach that could be implemented by individual companies
Implementation: Six Steps Towards a Fatality and Serious Injury-Free Workplace

1. Assess Current Situation and Set the Stage for the Technical and Cultural Shift Required to Prevent Fatalities and Serious Injuries

2. Identify and Inventory Situations that Are Potential Precursor to Fatalities and Serious injuries

3. Conduct Risk Assessment and Set Priorities for Intervention

4. Insure Adequate Control of the Hazard

5. Address Related Organizational and Human factors

6. Ensure Infrastructure (management systems, metrics, etc.) Required to Drive Continuous Improvement
There is always risk of sharing developmental work... a couple of caveats

• Our approach is task based.

• Our focus is on looking at causal relationships differently and on integrating concepts that currently exist in S&H prevention “silos”

• We combine different hazards with related human factors and organizational deficiencies to get a full understanding of the risk

• Although combined for risk assessment; the different hazards and underlying factors are disaggregated to implement and track corrective actions

• “Eye chart” pictures of new tools are shared today to illustrate “approach;” not discuss specific content

• The detail presented today is for illustrative purposes only.
  – The hazards identified may not be relevant for your process
  – The points we assign to hazards, underlying human factors and organizational deficiencies are based on experience; not science (further research needed)
Assess Current Situation and Set the Stage for the Technical and Cultural Shift Required to Prevent Fatalities and Serious Injuries

A. Assess Current Culture and Organizational Strengths and Weaknesses

B. Engage Senior Leadership

“The first step toward success is taken when you refuse to be a captive of the environment in which you first find yourself.”

Mark Caine
A. Assess Current Culture and Organizational Strengths and Weaknesses

1. Culture
   - Value of safety demonstrated by senior leadership
   - Employee engagement and empowerment
   - Supervisory Involvement and support
   - Risk tolerance
   - Recognition and reporting of serious hazards
   - Availability of necessary procedures, equipment, and tools to limit and mitigate exposure to serious hazards

New Tool: Safety Cultural Assessment Tool that examines organizational characteristics that may contribute to the likelihood of a fatality or serious injury
### Safety Reporting

Please provide any comments you have about **Safety Reporting** in the space below.

<table>
<thead>
<tr>
<th></th>
<th>Disagree</th>
<th>Tend to Disagree</th>
<th>Tend to Agree</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>This site provides adequate training on FSI hazard identification, control and reporting</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>I have received training on identifying serious hazards of processors to FSIs, their control and reporting in the last 12 months</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>I can report hazardous conditions without fear of negative consequences</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>In general, workers don’t bother to report minor process-related incidents, accidents, or near misses with ? gravity potential</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>I believe a culture exists at this site that encourages raising safety concerns</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>Corrective action is promptly taken when unsafe safety conditions are brought to management’s attention</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
| 7. | I am confident that fatalities, serious injuries and incidents with FSI potential  
   a. Thoroughly investigated  
   b. Appropriately resolved | 1 | 2 | 3 | 4 | 5 |
| 8. | Workers are informed about the results of investigation of incidents, accidents, and near misses with FSI potential | 1 | 2 | 3 | 4 | 5 |
| 9. | I am satisfied with the FSI reporting system at this site | 1 | 2 | 3 | 4 | 5 |
| 10. | I do not hesitate to report actions or conditions that raise a serious safety concern of any kind | 1 | 2 | 3 | 4 | 5 |
Assess Current Culture and Organizational Strengths and Weaknesses

2. Make initial assessment of gaps in organizational systems and processes
   A. Management system
      A. Leadership
      B. Employee engagement
      C. Planning
      D. Evaluation and corrective action
      E. Management review
      F. Accountability at all levels
   B. Metrics
      A. Trailing
      B. Leading
   C. Risk assessment methodology
B. Engage Senior Leadership: Have A Proactive Discussion About...

• Existing levels of risk
  – Organization’s S&H values/risk tolerance
  – Existing exposures that could result in unacceptable outcomes

• Limitations of current approaches for preventing fatalities and serious injuries
  – Using OSHA data to identify problems and target prevention efforts
  – Hazard recognition and risk assessment
  – Mitigation and control

• Availability of new tools and approaches for serious injury prevention
  ➢ Get empowered – make the value proposition for revitalizing the company’s approach to serious injury prevention
    – Moral
    – Financial
    – Customer
    – Worker satisfaction
    – Compliance
A. Key findings re factors that contribute to fatalities and serious injuries

B. A new approach for using data to identify situations that are precursors to fatal and serious injuries

C. A new tool that can be used to inventory precursor situations

“If you have always done it that way, it is probably wrong.”

Charles Kettering
A. Key Findings re Factors that Contribute to Fatalities and Serious Injuries

• Dan Petersen on serious injuries in 1989…
  – The causal factors are different. There are frequently different sets of circumstances surrounding severity:
    • In unusual and non-routine work
    • Where upsets occur
    • In non-production activities
    • Where sources of high energy are present
    • During at-plant construction operations

• Fred Manuele: “As the data clearly shows, frequency reduction does not necessarily produce equivalent severity reduction.”

  …The data requires that we adopt a different mindset, and a particularly different focus on preventing events that have serious injury potential.”
Tom Krause, BST: The traditional safety triangle is not predictive of FSIs.

Work situations with high portions of FSI precursors:
- Process instability
- Significant process upsets
- Unexpected maintenance
- Unexpected changes
- High energy potential jobs
- Emergency shutdown procedures

Work activities that may have high portions of FSI precursors:
- Operation of mobile equipment (and interaction with pedestrians)
- Confined space entry
- Jobs that require lock-out tag-out
- Lifting operations
- Working at height
- Manual handling

BST findings
BST Findings (Tom Krause-led task force findings)

• Injuries of differing severity have differing underlying causes. Consequently, reducing serious injuries requires a different strategy than reducing minor injuries.

• Most fatalities and serious injuries come from a discrete set of exposures. These exposures can be identified and addressed.

➤ Current measurement systems create a “blind spot” for serious injury prevention.

2007 Rand Study

• There appears to be no relationship between OSHA injury rates and fatalities.
  – The absence of minor injuries is NOT predictive of the absence of future fatalities.
  – The presence of minor injuries is NOT predictive of the presence of fatalities in the future.
Pulling It All Together

• Dan’s Petersen and Fred Manuele made the initial case that FSI’s result from a discrete set of exposures. The key question is: “where do you look?”

• The Rand study reinforced these findings and showed where NOT to look proving that OSHA injury and illness rates are NOT predictive of FSIs. Low OSHA rates do NOT indicate that a site is free of exposures with high gravity potential; high OSHA rates are NOT predictive of FSIs.

• The BST study completed and expanded the analysis by identifying specific precursor situations that could result in FSIs. More importantly the BST task force showed how this work could be done.
B. A New Approach to Identifying Situations That are Precursors to Fatal and Serious Injuries

Key first step

- Precursor data may vary by industry, employer, business unit, and even site. *Therefore, companies should begin looking for FSI precursors by examining their own data and creating an inventory of their own serious hazards. Underlying conditions that could activate or intensify the hazard should be also be factored into the hazard inventory. These include human factors and organizational deficiencies.*

- Relevant data are also available from BLS, OSHA, NIOSH, worker’s compensation, insurers, unions, etc.
  - *Supplemental data are important since individual sites may have exposures with serious injury potential that have not (luckily) resulted in a loss*

- Precursor data should be drawn from all available sources: accidents, injuries, serious near misses and exposures.
C. A New Tool That Can Be Used to Inventory Precursor Situations: Basis for Mercer HSE Networks Fatality and Serious Injury Precursor Rating Matrix

F&SI Causation Process

- Culture, Perceptions, and Beliefs
- Management Systems
- Process Conditions
- Human Factors

Contributing Factors

- Risk tolerance
- Employee engagement
- Value for safety
- Training
- Accountability
- Communications
- Planning and Evaluation
- Rules and Procedures
- Supervision
- Incident Investigations
- Controls
- Visibility
- Upset conditions
- Noise/vibration
- Equipment/facility design
- Warnings
- Cognitive
- Psycho-behavioral
- Physical and Mental limitations
- Perceptual
- Self-imposed stress
- Personnel

Outcomes

- Fatality or Serious Injury

Potential F&SI Hazard

F&SI Precursors EVENT
### Initial Task-based Fatality and Serious Injury Precursor Rating Worksheet

**Instructions for Use:** The Initial Fatality and Serious Injury Precursor Rating Matrix is NOT a risk assessment. Rather, it is a task-based tool to identify possible precursor situations that require further attention and assessment for inclusion in the site’s comprehensive inventory of Fatality and Serious Injury Precursors. To make an Initial Fatality and Serious Injury Precursor Rating of a task, identify the task to be evaluated, and select the applicable hazards from Column A that can create a potential precursor situation. Then look at Columns B-E and select each underlying factor present. Assign 10 points to each hazard and 1 point to each underlying factor.

Sum up the total points from the hazard(s) selected and from the underlying human factors and organizational deficiencies present. The total is the Initial Fatality and Serious Injury Precursor Rating. Tasks with the highest ratings should be subject to risk assessment first.

**Note:** Risk assessments will differ because they factor in likelihood of occurrence based on degree of control. Control issues are addressed later in the FSI prevention process.

**Task Description:** (Describe the work being performed. Select a clearly-defined piece of work, generally of short or limited scope and/or duration.)

#### Underlying Human Factors and Organizational Deficiencies (these activate or intensify a hazard) (1 point each)

<table>
<thead>
<tr>
<th>A. Hazards (10 points each)</th>
<th>B. Cultural/Organizational (attitudes and values)</th>
<th>C. Management Systems (policies and practices)</th>
<th>D. Process Conditions</th>
<th>E. Human Factors/Behavioral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical energy</td>
<td>High risk tolerance</td>
<td>Goals and objectives for safety performance have not been established</td>
<td>Significant process upsets</td>
<td>Physical ability not matched to job/task requirement(s)</td>
</tr>
<tr>
<td>Mechanical energy</td>
<td>Low employee engagement</td>
<td>Low management accountability</td>
<td>Unexpected maintenance</td>
<td>Physical or mental fatigue likely</td>
</tr>
<tr>
<td>Pressurized vessels of all types (cylinders, tanks, pipes, etc.)</td>
<td>Value for safety is not demonstrated by senior management</td>
<td>Poor risk recognition training</td>
<td>Unexpected repair</td>
<td>Cognitive over-saturation</td>
</tr>
<tr>
<td>Falls from Elevations</td>
<td>Production has higher priority/value than safety</td>
<td>Infrequent inspections</td>
<td>Unexpected process changes</td>
<td>Time pressure</td>
</tr>
<tr>
<td>Falls on same level</td>
<td>Supervisors do not receive support for safety decisions</td>
<td>Poor follow-up on identified corrective actions</td>
<td>Emergency shutdown</td>
<td>Incompatible work space(s)</td>
</tr>
<tr>
<td>Explosion and fire potential (chemical energy)</td>
<td>Safe behavior is not recognized by supervisors/managers</td>
<td>Poor communication</td>
<td>Prior changes not communicated</td>
<td>Distraction</td>
</tr>
<tr>
<td>Crushing hazards (heavy objects—caught under or between)</td>
<td>Alcohol and drug abuse is found in the workplace</td>
<td>Potential for miscommunication</td>
<td>Production pressure</td>
<td>Pre-existing illness/injury/condition</td>
</tr>
<tr>
<td>Engulfment hazards</td>
<td>Employees do not receive support for safety decisions</td>
<td>Procedures/work instructions not adequate</td>
<td>Poor visibility or lighting</td>
<td>Circadian rhythm desynchrony</td>
</tr>
<tr>
<td>Sustained loads</td>
<td>Personnel resources not adequate</td>
<td>Checklists not in use</td>
<td>Noise/vibration</td>
<td>Poor visual adaptation possible</td>
</tr>
<tr>
<td>Confined spaces or other suffocation hazards</td>
<td>Inadequate financial resources for safety</td>
<td>Standard terminology not in use</td>
<td>Confusing Controls/Switches</td>
<td>Physical task oversaturation</td>
</tr>
<tr>
<td>Highly toxic chemicals</td>
<td>Cross-monitoring not in use</td>
<td>Use of personal protective equipment creates awkward job</td>
<td>Drug use/self-medication</td>
<td></td>
</tr>
<tr>
<td>Extreme heat and cold</td>
<td>Pre-task planning/risk assessment not in use</td>
<td>Work/task resources inadequate</td>
<td>Dehydration</td>
<td></td>
</tr>
<tr>
<td>Radiation</td>
<td>Pre-task briefing not in use</td>
<td>Inadequate design</td>
<td>Lack of skills/education for task/job</td>
<td></td>
</tr>
<tr>
<td>Motor vehicles</td>
<td>Work-in-progress re-planning not in use</td>
<td>Inadequate warning mechanisms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other potential fatality and serious injury exposures should be anticipated</td>
<td></td>
<td></td>
<td>Inadequate warning mechanisms</td>
<td></td>
</tr>
</tbody>
</table>

**Task Precursor Relative Rating**

<table>
<thead>
<tr>
<th></th>
<th>A. Hazards</th>
<th>B. Cultural/Organizational</th>
<th>C. Management Systems (policies and practices)</th>
<th>D. Process Conditions</th>
<th>E. Human Factors/Behavioral</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
A. Hazards (10 points each)

• Electrical energy
• Mechanical energy (machinery and equipment)
• Pressurized vessels of all types (cylinders, tanks, pipes, etc.)
• Falls from Elevations
• Falls on same level
• Explosion and fire potential (chemical energy)
• Crushing hazards (heavy objects—caught under or between)
• Engulfment hazards
• Suspended loads
• Confined spaces or other suffocation hazards
• Highly toxic chemicals
• Extreme heat or cold
• Radiation
• Motor vehicles
Underlying Human Factors and Organizational Deficiencies:

B. Cultural/ Organizational (attitudes and values)

- High risk tolerance
- Value for safety is not demonstrated by senior management
- Production has higher priority/value than safety
- Supervisors do not receive support for safety decisions
- Employees do not receive support for safety decisions
- Safe behavior is not recognized by supervisors/managers
- Alcohol and drug abuse is found in the workplace
- Personnel resources not adequate for safety
- Inadequate financial resources for safety
C. Management Systems (policies and practices)

- Goals and objectives for safety performance have not been established
- Low management accountability
- Poor risk recognition training
- Infrequent inspections
- Poor follow-up on identified corrective actions
- Poor communication
- Potential for miscommunication
- Procedures/work instructions not adequate
- Checklists not in use
- Standard terminology not in use
- Cross-monitoring not in use
- Pre-task planning/risk assessment not in use
- Pre-task briefing not in use
- Work-in-progress re-planning not in use
Underlying Human Factors and Organizational Deficiencies

D. Process Conditions
- Significant process upsets
- Unexpected maintenance
- Unexpected process changes
- Emergency shutdown
- Prior changes not communicated
- Production pressure
- Poor visibility or lighting
- Noise/vibration
- Confusing Controls/switches
- Use of personal protective equipment creates awkward job
- Work/task resources inadequate
- Inadequate design
- Inadequate warning mechanisms
Underlying Human Factors and Organizational Deficiencies

E. Human Factors

• Physical ability not matched to job/task requirement(s)
• Physical or mental fatigue likely
• Cognitive over-saturation
• Time pressure
• Incompatible work space(s)
• Distraction
• Pre-existing illness/injury/condition
• Circadian rhythm desynchrony possible
• Poor visual adaptation possible
• Physical task oversaturation
• Drug use/self-medication
• Lack of skills/education for task/job
### Initial Task-based Fatality and Serious Injury Precursor Rating Worksheet

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Sum up the total points from the hazard(s) selected and from the underlying human factors and organizational deficiencies present. The total is the Initial Fatality and Serious Injury Precursor Rating. Tasks with the highest ratings should be subject to risk assessment first.

**Task Description:** (Describe the work being performed. Select a clearly-defined piece of work, generally of short or limited scope and/or duration.)

- Installing ceiling fans. Using scissor lift to do non-live installation of wiring of fans. Running conduit along ceiling; testing overhead 480-Volt electrical bus.

#### A. Hazards (10 points each)

<table>
<thead>
<tr>
<th>Task</th>
<th>10</th>
<th>Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical energy</td>
<td>10</td>
<td>High risk tolerance</td>
</tr>
<tr>
<td>Mechanical energy (machinery and equipment)</td>
<td>10</td>
<td>Low employee engagement</td>
</tr>
<tr>
<td>Pressurized vessels of all types (cylinders, tanks, pipes, etc.)</td>
<td>10</td>
<td>Value for safety is not demonstrated by senior management</td>
</tr>
<tr>
<td>Falls from Elevations</td>
<td>10</td>
<td>Production has higher priority/value than safety</td>
</tr>
<tr>
<td>Falls on same level</td>
<td>10</td>
<td>Supervisors do not receive support for safety decisions</td>
</tr>
<tr>
<td>Explosion and fire potential (chemical energy)</td>
<td>10</td>
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</tr>
<tr>
<td>Crushing hazards (heavy objects—caught under or between)</td>
<td>10</td>
<td>Alcohol and drug abuse is found in the workplace</td>
</tr>
<tr>
<td>Equipment hazards</td>
<td>10</td>
<td>Employees do not receive support for safety decisions</td>
</tr>
<tr>
<td>Suspended loads</td>
<td>10</td>
<td>Inadequate resources are not given for safety</td>
</tr>
<tr>
<td>Confined spaces or other suffocation hazards</td>
<td>10</td>
<td>Inadequate financial resources for safety</td>
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<td>Highly toxic chemicals</td>
<td>10</td>
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<td>Extreme heat or cold</td>
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<td>10</td>
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<tr>
<td>Motor vehicles</td>
<td>10</td>
<td>Work-in-progress re-planning not in use</td>
</tr>
<tr>
<td>Other potential fatality and serious injury exposures should be anticipated</td>
<td>10</td>
<td>Total</td>
</tr>
</tbody>
</table>

#### B. Cultural Organizational (attitudes and values)

<table>
<thead>
<tr>
<th>Task</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>High risk tolerance</td>
<td>1</td>
</tr>
<tr>
<td>Low employee engagement</td>
<td>1</td>
</tr>
<tr>
<td>Value for safety is not demonstrated by senior management</td>
<td>1</td>
</tr>
<tr>
<td>Production has higher priority/value than safety</td>
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<td>1</td>
</tr>
<tr>
<td>Pre-task planning/risk assessment not in use</td>
<td>1</td>
</tr>
<tr>
<td>Work-in-progress re-planning not in use</td>
<td>1</td>
</tr>
</tbody>
</table>

#### C. Management Systems (policies and practices)

<table>
<thead>
<tr>
<th>Task</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals and objectives for safety performance have not been established</td>
<td>1</td>
</tr>
<tr>
<td>Low management accountability</td>
<td>1</td>
</tr>
<tr>
<td>Poor risk recognition training identified</td>
<td>1</td>
</tr>
<tr>
<td>Infrquent inspections</td>
<td>1</td>
</tr>
<tr>
<td>Poor documentation</td>
<td>1</td>
</tr>
<tr>
<td>Potential for miscommunication</td>
<td>1</td>
</tr>
<tr>
<td>Procedures/work instructions not adequate</td>
<td>1</td>
</tr>
<tr>
<td>Checklists not in use</td>
<td>1</td>
</tr>
<tr>
<td>Standard terminology not in use</td>
<td>1</td>
</tr>
<tr>
<td>Cross-monitoring not in use</td>
<td>1</td>
</tr>
<tr>
<td>Pre-task planning/risk assessment not in use</td>
<td>1</td>
</tr>
<tr>
<td>Work-in-progress re-planning not in use</td>
<td>1</td>
</tr>
</tbody>
</table>

#### D. Process Conditions

<table>
<thead>
<tr>
<th>Task</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant process upsets</td>
<td>1</td>
</tr>
<tr>
<td>Unexpected maintenance</td>
<td>1</td>
</tr>
<tr>
<td>Unexpected repair</td>
<td>1</td>
</tr>
<tr>
<td>Unexpected process changes</td>
<td>1</td>
</tr>
<tr>
<td>Emergency shutdown</td>
<td>1</td>
</tr>
<tr>
<td>Incompatible work spaces</td>
<td>1</td>
</tr>
<tr>
<td>Distraction</td>
<td>1</td>
</tr>
<tr>
<td>Pre-existing illness/injury/condition</td>
<td>1</td>
</tr>
<tr>
<td>Crew rotation</td>
<td>1</td>
</tr>
<tr>
<td>Inadequate design</td>
<td>1</td>
</tr>
<tr>
<td>Inadequate maintenance</td>
<td>1</td>
</tr>
</tbody>
</table>

#### E. Human Factors/Behavioral

<table>
<thead>
<tr>
<th>Task</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical ability not matched to job/task requirements</td>
<td>1</td>
</tr>
<tr>
<td>Physical or mental fatigue likely</td>
<td>1</td>
</tr>
<tr>
<td>Cognitive over-saturation</td>
<td>1</td>
</tr>
<tr>
<td>Time pressure</td>
<td>1</td>
</tr>
<tr>
<td>Incompatible work spaces</td>
<td>1</td>
</tr>
<tr>
<td>Distraction</td>
<td>1</td>
</tr>
<tr>
<td>Pre-existing illness/injury/condition</td>
<td>1</td>
</tr>
<tr>
<td>Inadequate design</td>
<td>1</td>
</tr>
</tbody>
</table>

### Task Precursor Relative Rating

<table>
<thead>
<tr>
<th>A + B + C + D + E</th>
<th>Task Precursor Relative Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>45</td>
</tr>
</tbody>
</table>

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What Is Different With This Approach?

• Task–based approach

• Multiple hazards evaluated for each task

• Points assigned for each hazard

• Hazard severity rating also incorporates human factors and operational deficiencies that could accelerate or intensify the risk

➢ The approach integrates different S&H silos (hazards and key underlying factors) and sets the stage for an integrated workbook that incorporates a different approach to risk assessment; a different approach to hazard mitigation; addresses human factors and organizational deficiencies; and includes different S&H metrics.
Conduct Risk Assessment and Set Priorities for Intervention

A. Problem Statement and Proposed Solution
B. New Risk Assessment Tool
C. Example

“There is nothing so easy to learn from as experience and nothing so hard to apply.”

Josh Billings
Problem Statement

• Traditional risk assessment is based on judgment about the severity of the hazard and the likelihood of occurrence (probability).

• Probability (an educated guess in some circumstances) is given the same weight as scientific information about the severity of the hazard in most risk assessment matrices.

• Knowledge about probability is difficult to obtain; judgment is often subjective.

• Probability assessments are usually based on past experience, of which luck is a component, and OSHA data, which are not predictive of fatalities and serious injuries.

• Failure to accurately judge probability can lead to serious consequences.
Alternative Risk Assessment Approach for FSI Prevention – Consider:

1. The severity of the hazard

2. Degree of control
   a) The *degree of control* is linked to probability (high degree of control = low probability)
   b) It is easier to evaluate
   c) It is more compelling; high-rated hazards with low degree of control should be identified for higher priority

3. Actual exposure
   a) Number of employees exposed
   b) Frequency (and duration) of exposure
Task-Based Fatality and Serious Injury Risk Assessment Worksheet

<table>
<thead>
<tr>
<th>Task (Describe the work being performed. Select a clearly-defined piece of work, generally of short or limited scope and/or duration.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatality and Serious Injury Hazards&lt;sup&gt;1&lt;/sup&gt; (What hazards that could lead to a fatality are associated with performing the task?)</td>
</tr>
<tr>
<td>Description</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Controls (What measures are in place to protect people?)</td>
</tr>
<tr>
<td>Description</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Residual Risk (Number of people exposed)</td>
</tr>
<tr>
<td>Initial Risk Rating</td>
</tr>
<tr>
<td>Human and Organizational Deficiencies&lt;sup&gt;4&lt;/sup&gt; (Add one point for each issue)</td>
</tr>
<tr>
<td>Process Conditions&lt;sup&gt;5&lt;/sup&gt; (Add one point for each issue)</td>
</tr>
<tr>
<td>Exposure Factor</td>
</tr>
<tr>
<td>Initial Risk Rating</td>
</tr>
<tr>
<td>Process Conditions</td>
</tr>
<tr>
<td>Final Risk Score&lt;sup&gt;*&lt;/sup&gt; (Total of Initial Risk Rating + HOP Deficiencies + Process Conditions)</td>
</tr>
<tr>
<td>Description</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Total Risk Score for Task

---

3. RELATIVE HAZARD CONTROL RATINGS

<table>
<thead>
<tr>
<th>2 Point Values for Fatality and Serious Injury Hazards Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>8</td>
</tr>
</tbody>
</table>

---

Hazard - control = Residual risk: Residual risk x exposure factor = Initial Risk Rating Initial Risk Rating + Human & Organizational Deficiencies + Process Conditions = Final Risk Score

---

Catastrophic 9
Serious Irreversible 8
Serious Reversible 7
Fracture, serious illness, serious burns, Loss of consciousness, etc. 6
Safe Work Practices: Skill-based procedures and checklists, Effectiveness Dependent on Employee Actions = Control Somewhat Effective
Administrative Control: Scheduling Work to Reduce/Avoid Exposure, Distancing Employees from Hazard, Control Marginally Effective
3
Engineering Control I: Closed-loop Systems, Hazard Isolated from Employee Contact; Effectiveness Cannot Be Affected by Worker Actions = Control Highly Effective
Engineering Control II: Interlocked or Immovable Barrier Guard; Local Exhaust Ventilation. Effectiveness Can Be Influenced by Worker Actions = Control Generally Effective
Engineering Control III: Movable Barrier Guards; Effectiveness Dependent on Employee Actions. General Exhaust Ventilation = Control Marginally Effective
Administrative Control: Scheduling Work to Reduce/Avoid Exposure, Distancing Employees from Hazard, Control Marginally Effective
Safe Work Practices: Skill-based procedures and checklists, Effectiveness Dependent on Employee Actions = Control Somewhat Effective
Knowledge-based Rules and Standard Operating Procedures; Effectiveness Highly Dependent on Employee Actions = Control Generally Ineffective
Personal Protective Equipment I: Worker is fully enclosed in high-performing gear, such as Level A Hazmat Protection with SCBA, Fire Suit, etc.. Effectiveness Highly Dependent on Employee Actions = Control Somewhat Effective
Personal Protective Equipment II: High-performing gear such as heavy electrical-work gloves, air-supplied respirators, lanyards, Effectiveness Very Highly Dependent on Employee Actions = Control Somewhat Effective
Personal Protective Equipment III: Ordinary PPE, such as safety glasses, face shields, Respirators with APF < 25 Effectiveness Very Highly Dependent on Employee Actions = Control Highly Ineffective
Complete Lack of Controls 0

---

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## 2. Point Values for Fatality and Serious Injury Hazards Rating

<table>
<thead>
<tr>
<th>Point Value</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Catastrophic</td>
<td>Death</td>
</tr>
<tr>
<td>9</td>
<td>Serious Irreversible</td>
<td>Loss of body part or function, Severe disfigurement</td>
</tr>
<tr>
<td>8</td>
<td>Serious Reversible</td>
<td>Fracture, serious illness, serious burns, Loss of consciousness, etc.</td>
</tr>
</tbody>
</table>
# Relative Hazard Control Ratings

<table>
<thead>
<tr>
<th>Number</th>
<th>Control Type</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Hazard Eliminated/No Hazard</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Engineering Control I: Closed-loop Systems, Hazard Isolated from Employee Contact; Effectiveness Cannot Be Affected by Worker Actions = Control Highly Effective</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Engineering Control II: Interlocked or Immovable Barrier Guard; Local Exhaust Ventilation. Effectiveness Can Be Influenced by Worker Actions = Control Generally Effective</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Personal Protective Equipment I: Worker is fully enclosed in high-performing gear, such as Level A Hazmat Protection with SCBA, Fire Suit, etc.. Effectiveness Highly Dependent on Employee Actions = Control Somewhat Effective</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Engineering Control III: Movable Barrier Guards; Effectiveness Dependent on Employee Actions. General Exhaust Ventilation = Control Marginally Effective</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Administrative Control: Scheduling Work to Reduce/Avoid Exposure, Distancing Employees from Hazard, Control Marginally Ineffective</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Personal Protective Equipment II: High-performing gear such as heavy electrical-work gloves, air-supplied respirators, lanyards, Effectiveness Very Highly Dependent on Employee Actions = Control Somewhat Ineffective</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Safe Work Practices: Skill-based procedures and checklists. Effectiveness Dependent on Employee Actions = Control Somewhat Effective</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Knowledge-based Rules and Standard Operating Procedures; Effectiveness Highly Dependent on Employee Actions = Control Generally Ineffective</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Personal Protective Equipment III: Ordinary PPE, such as safety glasses, face shields, Respirators with APF &lt; 25 Effectiveness Very Highly Dependent on Employee Actions = Control Highly Ineffective</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Complete Lack of Controls</td>
<td></td>
</tr>
</tbody>
</table>
### Task-Based Fatality and Serious Injury Risk Assessment Worksheet

**Task**

Describe the work being performed. Select a clearly-defined piece of work, generally of short or limited scope and/or duration.

**Fatality and Serious Injury Hazards**

What hazards that could lead to a fatality are associated with performing the task?

**Controls**

What measures are in place to protect people?

**Residual Risk**

Failure to maintain lift controls and operating instructions

**Initial Risk Rating**

High risk tolerance

**Exposure Factor**

(Number of people exposed)

<table>
<thead>
<tr>
<th>Description</th>
<th>Rating</th>
<th>Description</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installing ceiling fans: Using scissor lift to do non-live installation of wiring of fans. Running conduit along ceiling; testing overhead 480-Volt electrical bus bar.</td>
<td>10</td>
<td>Leather gardening gloves</td>
<td>1</td>
</tr>
<tr>
<td>Exposure to live electrical circuits at 480 Volts</td>
<td>10</td>
<td>Railings to prevent falls</td>
<td>7</td>
</tr>
<tr>
<td>Working at height</td>
<td>10</td>
<td>Instructions, procedures</td>
<td>2</td>
</tr>
<tr>
<td>Working with mechanical equipment</td>
<td>10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Human and Organizational Deficiencies**

(Add one point for each issue)

<table>
<thead>
<tr>
<th>Description</th>
<th>Points</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor management accountability</td>
<td>1</td>
<td>Unexpected process changes</td>
<td>1</td>
</tr>
<tr>
<td>Poor work practices and checklists</td>
<td>1</td>
<td>Lack of skills/education for workers</td>
<td>1</td>
</tr>
<tr>
<td>Inadequate equipment</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Final Risk Score**

(Total of Initial Risk Rating + HOP Deficiencies + Process Conditions)

<table>
<thead>
<tr>
<th>Description</th>
<th>Points</th>
<th>Description</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value for safety is not demonstrated by senior management</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-task planning/risk assessment not in use</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work-in-progress re-planning not in use</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedures/ork instructions not adequate</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedures/ork instructions not adequate</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work/task resources inadequate</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lack of skills/education for workers</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete Lack of Controls</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Risk Score for Task**

56

### Notes

1. Transfer fatality and serious injury hazards selected from precursor worksheet.
2. Point Values for Fatality and Serious Injury Hazards Rating

<table>
<thead>
<tr>
<th>Hazard - Control</th>
<th>Residual Risk</th>
<th>Exposure Factor</th>
<th>Initial Risk Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catastrophic</td>
<td>High</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Severe</td>
<td>Low</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Serious</td>
<td>Very Low</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Minor</td>
<td>Low</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>No Hazard</td>
<td>Low</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

3. RELATIVE HAZARD CONTROL RATINGS

(See Compendium of Control Options for specific detail)

- Engineering Control I: Closed-loop Systems, Hazard Isolated from Employee Contact; Effectiveness Cannot Be Affected by Worker Actions = Control Highly Effective
- Management of Change Systems = Control Highly Effective
- Engineering Control II: Interlocked or Immovable Barrier Guard; Local Exhaust Ventilation. Effectiveness Can Be Influenced by Worker Actions = Control Generally Effective
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- Safe Work Practices: Skill-based procedures and checklists, Effectiveness Dependent on Employee Actions = Control Somewhat Effective
- Knowledge-based Rules and Standard Operating Procedures, Effectiveness Highly Dependent on Employee Actions = Control Marginally Effective
- Personal Protective Equipment III: Ordinary PPE, such as safety glasses, face shields, Respirators with APF < 25 Effectiveness Very Highly Dependent on Employee Actions = Control Highly Effective
- Complete Lack of Controls

4. Refer to Precursor ID worksheet for Human and Organizational Deficiencies issues.
What is Different?

• Precursor hazards are evaluated based on the potential severity of the hazard, the degree of current control, and the number workers exposed.

• Related human factors and organizational deficiencies are also evaluated and integrated into the risk assessment.

• The result is a Final Risk Score that can be used to set priorities for FSI intervention.

• This new risk assessment approach also serves as the basis for driving continuous improvement around hazard mitigation and for addressing key underlying factors (human factors issues and organizational deficiencies) that could make matters worse.
Insure Adequate Control of Hazard

A. Problem Statement and Proposed Solution
B. Compendium of Control Options
C. FSI Risk Mitigation Worksheet

“If you only have a hammer, you tend to see every problem as a nail.”

Abraham Maslow
Problem Statement

• **Hypothesis**: Occupational fatalities and serious injuries may continue to occur because decision makers incorrectly apply the hierarchy of control concept to corrective actions, often relying on lower order controls.

• **Corollary**: During investigations of events, causality may tend to focus on personal safety accountability and decision-making, which results in application of administrative controls (e.g. procedure rewrites, re-training) instead of higher order controls such as elimination, substitution and engineering (re)design.
Scope/Charter

• Focus on *mitigating the exposure* in the overall strategy for the prevention of fatalities and serious injuries.

• Develop a compendium of control options for the prevention of fatalities and serious injuries
Proposed Deliverable

Develop a resource list of practices and standards that offer control options for a “short-list” of the most common fatal/serious injury contact types.

– Include prevention-through-design considerations for construction, maintenance, and decommissioning of equipment/machinery/structures

– Include Management of Change concepts as a prevention strategy.
From “Leadership Matters: The Elimination of Fatalities” a 2009 publication of the International Council on Mining & Minerals

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HAZARD

PPE:
- Personal Fall Arrest System
- Flame retardant clothing
- SCBA

Administrative:
- Training
- Planned Inspections
- Audits
- Supervision
- Hazard Recognition & Risk Assessment

Critical Work Procedures
- High Risk Activity Permits
- Design Standards
- Preventive Maintenance

Engineering:
- Isolation
- Enclosure
- Ventilation

Risk Mitigation

RECEIVER:
- People
- Equipment
- Material
- Environment
Compendium of Control Options

1. Management of Change Guidance
2. Prevention through Design Options
3. Engineering (post installation or design) Controls
4. Administrative/Procedural Controls
5. Administrative/Task-Based Controls

• Reference recognized consensus standards
Common Fatal/Serious Injury Contact Types

1. Struck by falling objects (including *suspended loads*)
2. Operation of, or interaction with, powered industrial vehicles
3. Falls from height
4. Electrical contact
5. Bodily damage from non-electrical hazardous energy
6. Acute chemical exposure, atmospheric hazard, or chronic health hazard
7. Fires, explosions, heated materials
8. Road transportation
9. Workplace violence
## Sample of Control Options

### Operation of, or interaction with, powered industrial vehicles

<table>
<thead>
<tr>
<th>Prevention through Design</th>
<th>Management of Change</th>
<th>Engineering Control (Mechanical Options)</th>
<th>Administrative Control (Procedural Options)</th>
<th>Administrative Control (Task Options)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pedestrian contact</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| - Warehouse and loading dock areas will by design have separate pedestrian pathways or mezzanines that eliminate any interaction with powered vehicles. | - Any proposed change to lift-truck or pedestrian pathways must be reviewed by change control board. Changes may include:  
  - Acquisition of new powered industrial vehicles  
  - Relocation of inventory  
  - Modifications to established vehicle paths | - Establish pedestrian-free and/or lift-truck-free zones for mobile transport operations with floor demarcations, walkway barriers, etc. (complete transport safety assessment first to identify areas with greatest risk).  
- Provide separate doors between rooms/areas for use by pedestrians and lift-trucks.  
- Use convex mirrors at points of pedestrian and mobile equipment intersection.  
- Provide alarm signals or automatic bar system that blocks the pedestrian path as a lift-truck approaches the intersection between a transport aisle and a pedestrian walkway.  
- Install speed limit controls on lift-trucks and powered industrial vehicles. | - Complete a Transport Safety risk assessment for the entire facility and establish a corrective action plan to eliminate identified hazards.  
- Prohibit pedestrian use of lift-truck aisle ways and doors.  
- PIV Operators are required to use audible warning signals when approaching intersections. | - Only authorized personnel are allowed in lift-truck operation areas (e.g. warehouses) and only when wearing high-visibility vests.  
- Authorized pedestrians alert mobile equipment drivers prior to entering stacked materials storage areas.  
All drivers are trained in specific safety work rules for powered industrial trucks (speed limit, fork or pole height, use of horn in intersections) intended for the protection of pedestrians.  
- Designated walkways are used consistently by all pedestrians.  
- All events in this sub-category are promptly reported, investigated and communicated within the facility and externally to the business unit. |
# Sample of Control Options

## Struck by Falling Objects

<table>
<thead>
<tr>
<th>Prevention Through Design</th>
<th>Management of Change (Mechanical Options)</th>
<th>Engineering Control (Mechanical Options)</th>
<th>Administrative Control (Procedural Options)</th>
<th>Administrative Control (Task Options)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Establish permanent safe zones through guarding / interlocked doors, etc.</td>
<td>• Use correctly designed and sized J-hooks for spindle ends of rolls and cores that ensure full engagement. Match known load to marked capacity of all lifting devices (below-the-hook attachment, hoist or crane, bridge structure). Use appropriate attachments (clamps, poles, pallet forks, etc.) to ensure all loads transported by lift-trucks are secured and cannot fall during horizontal movement.</td>
<td>• All new lifting devices and equipment are constructed and installed under a recognized international standard and are certified by an appropriate authority. • All lifting device components are inspected (specific component criteria) before each use (pre-use inspections), regularly (periodic internal or external preventive maintenance inspection) according to the manufacturers’ inspection guidance, and annually by a competent 3rd party. • A formal permit to work system is used to control unique critical lifting operations. • Any major lift must include use of barricades and lift watch person during major lifts. • Where lift-trucks are used to load materials into hoppers, vessels or onto conveyors, protect operators in the area by the use of barricades or demarcation.</td>
<td>• Hoist operators will visually confirm spindle engagement in BOTH hooks before commencing lift. Employees never position themselves or parts of their body under loads or equipment during lifts. • Operators involved in major lifts receive specialized training. • Routine and non-routine lifting tasks are included in Planned Task Observations. • Pedestrian activity in storage areas where mobile industrial vehicles are used to stack or un-stack free-standing or racked materials is prohibited. • Hoist or crane operators confirm that center of gravity is directly under the below-the-hook device before beginning the lift. • Operators maintain a safe distance from any elevated load, and apply the 45 degree cone-of-safety concept. • All events in this sub-category are promptly reported, investigated and communicated within the facility and externally to the business unit.</td>
<td></td>
</tr>
<tr>
<td>• Install catch platforms, debris nets, or canopies wherever objects are moved overhead</td>
<td>• Ensure identification of safe zones and overhead hazards are identified on MOC checklists. Ensure that obsolete overhead equipment and structures are removed at the time of decommissioning.</td>
<td>• Install perimeter and vertical protection systems wherever appropriate.</td>
<td>• Ensure that obsolete overhead equipment and structures are removed at the time of decommissioning.</td>
<td></td>
</tr>
<tr>
<td>• Install perimeter and vertical protection systems wherever appropriate.</td>
<td>• Where feasible install walls or physical barriers between routine lifting areas and working areas or pedestrian zones.</td>
<td>• Install toe-boards, screens, or other physical guarding for wall / floor openings.</td>
<td>• Where feasible install walls or physical barriers between routine lifting areas and working areas or pedestrian zones.</td>
<td></td>
</tr>
<tr>
<td>• Where feasible install walls or physical barriers between routine lifting areas and working areas or pedestrian zones.</td>
<td>• Ensure areas of welfare (restrooms, cafeteria, locker rooms, etc.) and pathways to and from are located away from lift areas.</td>
<td>• Install toe-boards, screens, or other physical guarding for wall / floor openings.</td>
<td>• Ensure that obsolete overhead equipment and structures are removed at the time of decommissioning.</td>
<td></td>
</tr>
<tr>
<td>• Ensure areas of welfare (restrooms, cafeteria, locker rooms, etc.) and pathways to and from are located away from lift areas.</td>
<td>• Ensure that roof structures and overhead equipment that may be subject to corrosion or weathering are composed of materials that resist degradation.</td>
<td>• Where feasible install walls or physical barriers between routine lifting areas and working areas or pedestrian zones.</td>
<td>• Where feasible install walls or physical barriers between routine lifting areas and working areas or pedestrian zones.</td>
<td></td>
</tr>
<tr>
<td>• Ensure that roof structures and overhead equipment that may be subject to corrosion or weathering are composed of materials that resist degradation.</td>
<td>• Lift-trucks are equipped with enclosed cabs to protect the occupants from falling objects.</td>
<td>• Lift-trucks are equipped with enclosed cabs to protect the occupants from falling objects.</td>
<td>• Lift-trucks are equipped with enclosed cabs to protect the occupants from falling objects.</td>
<td></td>
</tr>
</tbody>
</table>

Dropped loads during handling (mechanical failure or incorrect application of equipment)

- Hoist operators will visually confirm spindle engagement in BOTH hooks before commencing lift. Employees never position themselves or parts of their body under loads or equipment during lifts.
- Operators involved in major lifts receive specialized training.
- Routine and non-routine lifting tasks are included in Planned Task Observations.
- Pedestrian activity in storage areas where mobile industrial vehicles are used to stack or un-stack free-standing or racked materials is prohibited.
- Hoist or crane operators confirm that center of gravity is directly under the below-the-hook device before beginning the lift.
- Operators maintain a safe distance from any elevated load, and apply the 45 degree cone-of-safety concept.
- All events in this sub-category are promptly reported, investigated and communicated within the facility and externally to the business unit.
## Task-based Fatality and Serious Injury Hazard Mitigation Worksheet

<table>
<thead>
<tr>
<th>Description</th>
<th>Rating</th>
<th>Rating</th>
<th>Rating</th>
<th>Rating</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installing ceiling fans. Using scissor lift to do non-live installation of wiring of fans. Running conduit along ceiling; testing overhead 480-Volt electrical bus bar.</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Exposure to live electrical circuits at 480 Volts</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Working at height</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Working with mechanical equipment</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Rating</th>
<th>Rating</th>
<th>Rating</th>
<th>Rating</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leather gardening gloves</td>
<td>1</td>
<td>9</td>
<td>2</td>
<td>18</td>
<td>3</td>
</tr>
<tr>
<td>Electrical gloves</td>
<td>3</td>
<td>7</td>
<td>2</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Railings to prevent falls</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Railings to prevent falls; lanyards</td>
<td>10</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Instructions, procedures</td>
<td>2</td>
<td>8</td>
<td>2</td>
<td>16</td>
<td>9</td>
</tr>
<tr>
<td>Instructions, Procedures, interlocks</td>
<td>9</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total Risk Score for Task:** 40

**Final Hazard Score:** 16
What is Different?

- Increased emphasis on higher level controls and prevention through design
- Realization that it is a mistake to expose workers to serious hazards, provide them with low level controls, and expect them to never make a mistake
- New approach for identifying appropriate layers of control and sufficiency of control
  - Assesses current level of control
  - Track adequacy of additional abatement(s)
- Compendium of control options for nine common fatal and serious injury contact types
  - Identifies control alternatives
  - Includes management of change considerations
  - Where appropriate incorporates consensus standards
Address Related Human Factors and Organizational Deficiencies

A. Problem Statement and Proposed Solution
B. Overview of Current Thinking
C. Improved learning from Past incidents
D. Operational Consistency: Techniques for Reducing S&H Performance Drift

“Do not go where the path may lead, go instead where there is no path and leave a trail.”

Ralph Waldo Emerson
Problem Statement

• There is a basic misunderstanding of human error – fueled by flawed incident investigations that frequently focus on affixing blame and concentrate on the last factor in a chain of events leading up to the case.

• Consequently organizational factors that contribute to serious incidents are frequently overlooked or misunderstood.
Understanding Human Error: James Reason

• Serious injuries have multiple causal factors.

• Less than adequate tools and equipment may be present for many years before they combine with local circumstances and active failures to penetrate the system’s layers of defenses.

Todd Conklin: Formerly Los Alamos National Laboratory

• Workers don’t usually cause events.

• Workers trigger latent conditions that exist in systems, processes, procedures, and expectations that always lie dormant on the job site.
Views of Human Error – Sydney Dekker

1. Human error is a symptom of trouble deeper inside a system

2. Complex systems involve trade-offs between multiple irreconcilable goals. In normal work that goes on in normal organizations safety is never the only concern or in many instances even the primary concern.

3. People have to create safety through practice at all levels of an organization

4. To explain failure find how people’s assessments and actions made sense at the time, given the circumstances that surrounded them.

Consider their:
• Point of view and focus of attention;
• Knowledge of the situation;
• Objectives and the objectives of the larger organization in which they work
Improved learning from Past Incidents

• Approach
  – Focus on different aspects of error, including factors that lead to intentional and unintentional behaviors that contribute to fatal and serious incidents.
  – Identify and test effective techniques for minimizing error

• Tools
  - Incident investigation (new tool under construction) that incorporates performance modes and key underlying factors
  - Data Analysis

• Objective is to Gain a Better Understanding of:
  - Active failures
  - Latent conditions
  - Process Characteristics
Promoting Operational Consistency

Sometimes referred to as “Operational Discipline:” Every (critical) task done the right way (safely) every time.

Operational consistency involves:

1. The head…knowing what to do and how to do it
2. The heart…wanting to do it the right way every time
3. Tools…checklists for complicated critical tasks
4. Accountability
Why Checklists???

- Our memory and judgment are unreliable.
- Checklists needed to remind us of the necessary steps.

“…the volume and complexity of what we know has exceeded our individual ability to deliver its benefits correctly, safely, or reliably. Knowledge has both saved us and burdened us.” — Atul Gawande
The Power of Checklists

1. Precise, efficient, to the point and easy to use even in the most difficult situations.

2. Provide reminders of only the most critical and important steps.
### Task-based Fatality and Serious Injury Risk Calculation Worksheet

<table>
<thead>
<tr>
<th>Task</th>
<th>Existing Human and Organizational Deficiencies</th>
<th>Points (from Risk Assessment Worksheet)</th>
<th>Corrective Actions to Address Human and Organizational Deficiencies</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installing ceiling fans. Using scissor lift to do non-live installation of wiring of fans. Running conduit along ceiling; testing overhead 480-Volt electrical bus bar.</td>
<td>High risk tolerance</td>
<td>1</td>
<td>Leadership re-align expectations</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Low employee engagement</td>
<td>1</td>
<td>Involve employees in workplace planning</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Checklists not in use</td>
<td>1</td>
<td>Develop and implement checklist use for safety-critical tasks</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Pre-task briefing not in use</td>
<td>1</td>
<td>Require pre-task briefings</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Failure to maintain lift controls and operating instructions</td>
<td>1</td>
<td>Establish maintenance schedule and checklist</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Low management accountability</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Prior changes not communicated</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Value for safety is not demonstrated by senior management</td>
<td>1</td>
<td>Safety first on every agenda, “walk the talk”</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Poor risk recognition training</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Pre-task planning/risk assessment not in use</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Work-in-progress re-planning not in use</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Procedures/work instructions not adequate</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Unexpected process changes</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Work/task resources inadequate</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Lack of skills/education for task/job</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

#### Final Risk Score

(Hazard Score from Mitigation Worksheet + Points After HOD Corrective Actions)
What is Different?

• Incorporates current human performance concepts that shift attention from blaming the employee and focusing on the last thing that happened in a chain of events to understanding and addressing human and organizational factors that could activate or intensify the hazard.

• New tool developed for incident investigation that promotes better understanding of contributing factors.

• Structured checklist approach for promoting operational consistency in critical tasks.

• New tool to drive continuous improvement and track progress in related human factors issues and for correcting organizational deficiencies that are error provocative.
A. Problem Statement
B. Management Systems
C. Metrics

Ensure Infrastructure (Management Systems, Metrics, etc) Required to Drive Continuous Improvement
Well Built Houses Require A Strong Foundation

In addition to new technical approaches, eliminating fatalities and serious injuries also requires:

• **Leadership** that views the safety and well being of the workforce as a critical element of business performance, and is committed and actively engaged in the injury and illness prevention process.

• A corporate **culture** that fosters universal recognition of worker safety and health as a **core value** of the company.

• **Employees** that are **actively engaged** in planning and driving the company’s safety and health program

• An effective **safety and health management system** that translates values, beliefs, commitments, and objectives into action

➢ **Objective** = Healthy employees productively at work
Management Systems Guidance

• Critical Success Factors for effective SH&E Management Systems – the ‘base case’
  – Appropriate/relevant content and scope
  – Truly systematic structure
  – Clear ownership and accountability by line management
  – Continuous improvement process
  – Appropriately resourced / sustained
  – Risk-based

• Considerations, aspects, attributes for SH&E Management Systems for enhanced prevention of FSIs – what is ‘different’ for FSI prevention
  – Risk Discovery
  – Focus on incident potential consequences (vs. just actual consequences)
  – Questioning culture
  – New metrics beyond traditional lagging metrics
  – Analyze / ‘mine’ data for FSI precursors, predictive metrics, unexpected/hidden relationships
  – Training and awareness of the ‘new paradigm’
  – Focus on higher-risk activities / operations
Source of Leading and Trailing Metrics

**F&SI Causation Process**

- **Culture, Perceptions, and Beliefs**
- **Management Systems**
  - Training
  - Accountability
  - Communications
  - Planning and Evaluation
  - Rules and Procedures
  - Supervision
  - Incident Investigations
- **Process Conditions**
  - Controls
  - Visibility
  - Upset
  - Noise/vibration
  - Equipment/facility design
  - Warnings
- **Human Factors**
  - Cognitive
  - Psycho-behavioral
  - Physical and Mental limitations
  - Perceptual
  - Self-imposed stress
  - Personnel

**Contributing Factors**

**Outcomes**

- Fatality or Serious Injury

**Potential F&SI Hazard**

- Risk tolerance
- Employee engagement
- Value for safety

**F&SI Precursors**

**EVENT**
Criteria Being Evaluated for Use as Outcome Metric For Fatalities and Serious Injuries

1. Fatalities
2. Amputations (involving bone)
3. Spinal cord injuries
4. Herniated discs of the cervical, lumbar, and/or thoracic spinal regions
5. Concussions and/or cerebral hemorrhages
6. Loss of consciousness
7. Injury to internal organs
8. Fractured bones or teeth
9. Cartilage, tendon, and ligament tears
10. Dislocation of any joint
11. Lacerations and punctures requiring wound closure, such as sutures, surgical glue, etc.
12. MSDs requiring surgery or resulting in permanent impairment
13. All 3rd degree burns. 2nd degree burns greater than 3 inches in diameter (100 cm²)
14. A punctured eardrum or confirmed work related STS and a 25db shift from audiometric zero in same ear
15. Injuries of the eye requiring the services of a physician (unless treatment is preventive)
Overall Summary...So What Is Different???

• A structured approach to assessing current organizational attributes needed for effective FSI prevention

• A new model that creates a dual track for addressing risk
  – Less serious personal safety hazards
  – Hazards with potential to cause serious injury and death

• An integrated workbook approach to FSI prevention
  – New model/tool for identifying precursors to FSIs that integrates information on the severity of the hazard with human factors and organizational deficiencies that can activate or intensify the hazard.
  – New risk assessment model/tool that determines “likelihood” by degree of control; not by estimates based on past experience. The model also incorporates human factors and organizational issues
  – New approaches to risk mitigation that provide a framework for determining appropriate layers of control
What is Different, Cont.

– New tools for conducting more informed incident investigations
– Checklist approaches for insuring operational consistency in key steps in your process
– Insights into the foundational infrastructure needed to drive continuous improvement for FSI prevention
  - Key performance metrics
  - Management system emphasis

Have We Solved the Problem?

• Of course not…much more research and work needs to be done
• Our hope is that we contribute to progress that is already being made by many in this room
• Please consider us a resource at www.saveworkerlives.org
• Thank you for your commitment and dedication
Questions???

Comments