Human performance - achieving a just and zero harm culture by minimizing errors and preventing events

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Wednesday, March 31, 2010 4 to 5 p.m.

Topics

- Human Performance
- Error versus Violation
- Acceptable Risk versus Intolerable/UA Risk
- Compliance versus Non-Compliance (unsafe acts)
- Anatomy of an Event
- Critical Steps
- Barriers / Defenses
- Error Likely Situations
- Error Precursors & Error Traps
- Self-Checking & Peer Checking
- Questioning Attitude
- Performance Modes
- SAFER Model
- Prevent Tools: STAP, 3QT, TWIN
- Process Improvement Framework

What is Human Performance?

BEHAVIOR + RESULTS = PERFORMANCE

Good compliant
Actual
Individual
Leadership
Organization
Bad
Perceived
Acceptable
Non-compliant
Unacceptable

HP techniques are applied to help create a learning environment, that is -- a workplace that constantly evaluates incidents and endeavors not to repeat them.

What is Human Performance Improvement?

Human Performance Improvement (HPI) is an approach that can be used to anticipate and minimize human error during the performance of work, such that you can ensure there are barriers/defenses in place that will prevent events.

Where did it Start?

Excellence in HPI started in the Nuclear Power Industry. Our Cook Plant has been using HPI for many years.

Why did it start?

To help workers perform their activities more reliably and to catch errors before they can cause harm to people, electrical system equipment or property.

Why a Human Performance Approach?

Helps change mindsets into a more consistent, methodical mental approach, by:

- Promoting becoming more Deliberate in our thoughts and actions
- Focusing a more appropriate level of Awareness of the potential consequences, based on better recognition of RISKS
- Helps identify error-likely situations

How Human Performance Can Help

Incidents

80% Human Performance
20% Individual Weaknesses/Errors

80% Organizational Weaknesses/Errors

Human Performance
**Purpose of Human Performance Focus**

To **proactively** prevent events triggered by human error

- Event means an incident with highly undesirable consequences
  - such as: Texas City refinery explosion, Bopal, Chernobyl

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**Strategic Perspective on Human Performance**

Reducing error **and** Managing defenses leads to ZERO Events

\[ R_e + M_d \rightarrow \emptyset E \]

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**Dr. James Reason’s Main Principles of Error Management**

1. The best people can sometimes make the worst errors.
2. Short-lived mental states are the least manageable – preoccupation, distraction, forgetfulness, inattention.
3. People will always make errors and commit violations, but we can change conditions to have less unsafe acts.
4. Blaming people for their errors has little effect on their future fallibility.
5. Errors are largely unintentional, which makes it difficult to manage what one didn’t intend to do in the first place.
6. Errors arise from informational problems, so need to improve information in person’s head or the workplace.

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**Human Performance Principles**

- **Humans are fallible.** People are fallible, and even the best people make mistakes.
- **Error is predictable.** Error-likely situations are predictable, manageable, and preventable.
- **Organization influences behavior.** Individual behavior is influenced by organizational processes and values.
- **Behaviors are reinforced.** People achieve high levels of performance due largely on the encouragement and reinforcement received from leaders, peers, & subordinates.
- **Events are avoidable.** Events can be avoided by understanding the reasons mistakes occur and applying the lessons learned from past events (or errors).

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**ERROR**

An action that **unintentionally** departs from an expected behavior according to some standard active - commission versus latent - omission

**VIOLATION**

A **deliberate** deviation from expected behavior

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**SOURCE: Reason, Managing the Risks of Organizational Accidents**

- More flawed defenses & error precursors
- Individual counseled and/or disciplined
- Latent organizational weaknesses persist
- Reduced trust
- Management less aware of jobsite conditions
- Less communication
An HP focused Just Culture doesn't embarrass or punish people for making an “honest mistake”

Recognizing the basic facts about Human Nature and Error

- Human actions are almost always constrained by factors beyond an individual’s immediate control; in other words —
  - Free will is an illusion because our range of actions is always limited by local circumstances
- People cannot easily avoid those actions that they did not intend to perform in the first place
- Errors have multiple causes: personal, task-related, situational and organizational factors
- Situations are more amenable to improvement than people

Just Culture Community: The Three Behaviors

<table>
<thead>
<tr>
<th>Human Error</th>
<th>At-Risk Behavior</th>
<th>Reckless Behavior</th>
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<tbody>
<tr>
<td>Inadvertent action: slip, lapse, honest mistake</td>
<td>A choice: Risk not recognized or believed justified</td>
<td>Conscious disregard of unreasonable risk</td>
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<tr>
<td>Manage thru changes in:</td>
<td>Manage through:</td>
<td>Manage through:</td>
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<tr>
<td>Processes</td>
<td>• Removing incentives for at-risk behaviors</td>
<td>• Disciplinary Action</td>
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<tr>
<td>Procedures</td>
<td>• Creating incentives for healthy behaviors</td>
<td>• Punitive Action</td>
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<td>Training</td>
<td>• Increasing situational awareness</td>
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<td>Design</td>
<td></td>
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<td>Environment</td>
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</table>

- Console
- Coach
- Punish

Compliance is a Continuous Fight with Human Nature

- At-risk behaviors are often more comfortable, convenient, and faster than safe behaviors.
- At-risk behaviors are often reinforced by the work culture
- At-risk behaviors rarely result in negative consequences (eg, injury or reprimand) powerful enough to discourage their performance
- Unchallenged or ignored, they can become “system enabled” OK to do

Why Non-Compliant, “Unsafe Acts” Can Easily Occur

\[
\text{Non-Compliance Index} = \frac{\text{(Burden + Inducement)}}{\text{(Risk + Peer Check)}}
\]

Dr. Chong Chiu of PII tells us:
- “Don’t expect people to endure burdensome situations unless they realize / appreciate the potential RISK & Consequences or peer pressure.

What to do about PPE Non-Compliance

- Fashion, fit, comfort & performance are key considerations.

According to a survey conducted at 2008 National Safety Congress, 89 percent of safety professionals polled have observed workers falling to wear PPE when it was necessary.

This is the third consecutive year the survey revealed a high rate of PPE non-compliance, with 87 percent in 2007 and 85 percent in 2006.

- Discomfort was found to be the chief cause of non-compliance.
- 2nd was workers’ opinion that their PPE was not necessary for the task.
- 3rd was complaints PPE was too hot, fit poorly, or was unattractive.
Your RISK Tolerance “T” depends on Pyramid of 3 P’s:

- OK / Tolerable ... because
  - Voluntary Choice
  - Under Own Control
  - Familiar Situation
  - Impacts Self
  - Minor Consequences

- Acceptable RISK
- Judgment Call
- Unacceptable RISK

THE GRAY AREA of CHOICE

Low “T”

- We want everyone
  - to have a Safe-

High “T”

- No Go / Intolerable

Causal Factors may involve:

- Poor Communication
- LTA Pre-Job Briefing
- Time Pressure (self-induced)
- Peer Pressure
- Bad habits / habit intrusion
- Lack of Accountability
- Inadequate Training
- Confusing written guidance
- Poor memory
- Lack of co-worker engagement (didn’t speak-up or have a questioning attitude)

Initiating Action

An action or behavior by an individual, either correct or in error, that results in an event.

This includes active errors that have immediate, observable, undesirable outcomes.

A Critical Step is defined as:

A task action that, if done incorrectly or not at all, would result in an unrecoverable condition that prevents successful job completion.

As such, not all steps are equally important . . .

Critical steps include things like:

- Actions aimed at changing the state of the electrical system or components
- Steps that are irrecoverable or actions that cannot be reversed
- Steps where the outcome of an error is intolerable for personnel safety or public safety or the safety & reliability of our distribution & transmission systems

Flawed Barriers/Defenses

Defects with defensive measures that, under the right circumstances, may fail to protect equipment or people against hazards, and fail to prevent the occurrence of active errors, violations, or at-risk behaviors.
Human Performance Process Issues
that can become *Latent Organizational Weaknesses*

- Training
- Procedures
- Goals & Priorities
- Task Structure
- Roles & Responsibilities
- Values & Norms
- Planning & Scheduling

* Undetected deficiencies in the management control processes (e.g., strategy, policies, work control, training and resource allocation or failure thereof evident, efficient, and assumptions) creating workplace conditions that can provoke errors (precursors) and degrade the integrity of defenses (flawed defenses).

Error-Likely Situations

- Conditions that increase potential for errors from slips, mistakes, or oversights
- Error-like situations have 3 components:
  1. The individual
  2. The presence of error precursors
  3. An action needs to be taken

TWIN Analysis: To identify possible Error Precursors / Error-Likely Situations

Note: Top Error Traps in bold type

**Task Demands**
- Time pressure (in a hurry, often self-imposed)
- High workload (memory requirements)
- Simultaneous or Multiple tasks
- Repetitive actions / Monotony Task
- Irreversible actions
- Interpretation requirements or Rule Changes
- Unclear goals, roles, or responsibilities
- Lack of clear standards

**Work Environment**
- Distractions or Interruptions
- Changes / Departure from routine
- Confusing displays / controls
- Unexpected equipment conditions
- Hidden system response
- Lack of alternative indication
- Peer Pressure or Personality conflicts

**Individual Capabilities**
- Unfamiliarity with task / 1st time (mental model)
- Lack of knowledge/ inexperienced
- New technique not used before
- Imprecise communications
- ½ hour after wake-up or a meal
- Unsystematic problem-solving skills
- Hazardous attitudes for critical task
- Stress / Fatigue – Fitness for Duty

**Human Nature**
- Compulsivity or Overconfidence
- Habit patterns (1st day after days off)
- Assumptions (inaccurate mental picture)
- Illness / Fatigue – Fitness for Duty
- Mental shortcuts (biases)
- Limited short-term memory

**Human Performance Tools for Individual To Combat Error Traps** (in addition to 3QT)
- Self Checking…. STAR…..
- Peer Checking
- Knowledge / Training
- Procedure Use and Adherence
- Questioning Attitude
- Place-Keeping
- Flagging (i.e., marking correct item to assure focus, or masking)
- Effective Communication with Repeat Backs (also known in most rigorous appl. as 3-Way Communications)
- Task-Preview, Pre-Job Briefing, Post-job Review or Critique or After Action Review
- Turnovers with “SAFER” Job Briefings

The Three Question Technique (3QT)

[ Questions to ask before you start work ]

1. What are the critical steps of the work activity ?
2. How can I make a mistake ?
3. What bad things can happen ?

X. What barriers or defenses are in place ?........ (administrative controls, safety equipment, PPE)

These can and should always be covered in a pre-job brief.
Self – Checking…

- Is a tool that helps you focus on Critical Steps by raising the level of individual awareness
- Creates deliberate thought prior to the performance of a Critical Step
- Creates an understanding of the expected outcome
- Means to verify results
- Is performed in addition to a thorough job briefing

Self-Checking Using the S-T-A-R Method

Stop -- Pause to focus your attention.
Think -- Understand what is being done, plan your actions, consider expected results, and decide what to do if expected results do not occur.
Act -- Carry-out the work activity, as planned.
Review -- Verify that results occur as expected. If unexpected, take action as planned.

Peer Coaching…

- Focus on the problem
- Use three way communication
- Ask questions
- Seek to understand
- Inform for clarity
- Collaborate
- Treat your peers with respect
- Reinforce safe behaviors

Looking out for others

Questioning Attitude

An individual’s willingness to search for understanding, guidance, expected results, and resolution of concerns before taking action.

Questioning Attitude Meter

3-Way Communication

Sender gets attention of the intended receiver by using person’s name and then delivers message.

Receiver can paraphrase message, but repeats any equipment identification / noun names verbatim

Sender confirms that the message was properly understood and restates or corrects the message (usually weakest link)
**Anatomy of an Event**

The holes in the layers are:
- due to active failures and latent conditions*
- not fixed and static
- in reality they are in constant flux
- holes shift around, shrink & expand depending on people’s actions and local situation

* Initially called latent errors, then latent failures, but now know as this, since may not involve either error or failure from --
  - poor design, gaps in supervision, undetected defects, maintenance failures, unworkable procedures, LTA-less than adequate training or tools & equipment

**The First Two HP Review Questions:**
1. How capable was the employee of doing this task?
2. Did we assign an employee who was properly prepared to succeed?

**Performance Mode**
depends on situation being routine or problematic

- Human being control their actions through various combinations of two control modes – the conscious and the automatic
  - In Skill-based mode, mainly on auto pilot
  - Example: riding a bike
  - In Rule-based mode, we try to match signs and symptoms to stored knowledge, only consciously focusing on rules when uneasy or sense sequence check
  - Ex: consult recipe card if we don’t remember exactly
  - In (Lack of) Knowledge-based mode, we try to match up something we do know with what we think fits what we don’t know… (recipe for disaster)
  - Ex: following road signs driving somewhere unfamiliar

**Performance Modes and %’s**

**Skill-based Errors:**
- ~ 90% of daily activities are Skill-based
- ~ 25% of all errors are Skill-based

**Rule-Based Errors:**
- * Occur during conscious decision making process
  - ~ 60% of all errors are rule-based

**Lack of Knowledge-based Errors:**
- * Characterized as stressful situations
  - ~ 15% of all errors are knowledge-based
Ranking error-producing conditions

HEART, Human Error Assessment and Reduction Technique by J. Williams British ergonomist on violation producing non-compliance factors

- Unfamiliarity with situation x17
- Shortage of time for error reduction x11
- No obvious means of reversing unintended action x8
- Capacity overload x6
- Need to unlearn a technique x6
- Need to transfer knowledge from one task to another x5.5
- Ambiguity in standards x5
- Mismatch between real and perceived risk x4
- Operator inexperience x3
- Incentive to use other, more dangerous procedures x2
- No obvious way to keep track of progress during task x1.4
- High level emotional stress x1.3
- Disruption during normal work-sleep cycles x1.1
- Task-pacing caused by intervention by others x1.06

Summarize Critical Steps

To aid you in determining critical steps, you can:
1) Consult a JHA
2) Consider Attributes (listed below in orange shaded box)
3) Review those in columns two and three of typical Distribution Line work Critical Steps.

<table>
<thead>
<tr>
<th>ATTRIBUTES</th>
<th>RECOGNIZED D-LINES</th>
<th>CRITICAL STEPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrecoverable Act is involved</td>
<td>Energize / De-Energize Lines</td>
<td>Pole Handling</td>
</tr>
<tr>
<td>High Risk to Safety or Reliability involved</td>
<td>Suspended Loads</td>
<td>Installing Protective Barriers (layer of protection)</td>
</tr>
<tr>
<td>High Energy Level(s) involved</td>
<td>Felling Poles or Trees</td>
<td>Area Clearing / Work Zone Control</td>
</tr>
<tr>
<td>Changing state of electrical equipment</td>
<td>Handling or Cutting Conductors</td>
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</tr>
</tbody>
</table>

Anticipate Error-Likely Situations

Anything can contribute to an error-like situation.
If you recognize it beforehand, it’s an error precursor.
If you don’t, then you may unknowingly “allow it” to trap you.

Review TWIN Analysis for possible job site conditions and typical problems (top error traps are in bold in the table), to identify errors that could be made during a critical step or where confusion may contribute to missing a critical step.

TWIN Analysis: To identify possible Error Precursors / Error-Likely Situations
Note: Top Error Traps in bold

Q-1: What is the worst that can happen?
Q-2: What is most likely to occur?
Remember: If the potential outcome is judged too severe or intolerable, do not proceed.

Evaluate Barriers / Defenses

(Multiple barriers/defenses also referred to as layers of protection)
To determine what control measures, PPE, and any special safety equipment that may be needed, consider:

Q-1. What are the hazards?
Q-2. What are the risks?
Q-3. What do we need to do to minimize the risks
to adequately protect personnel and the public?

Use the Barrier Analysis table (next slide), to review the typical defenses you want in place.
If you don’t ensure defenses needed are in place, then you may be creating “Unacceptable Risk.”
A Sequential Checklist of Barriers/Defenses to Minimize Errors that will Prevent Events

- Trained & Qualified workers assigned
- Personnel are fit-for-duty
- Critical Steps (from JSA/JHA) are known and discussed in Meaningful Pre-Job Brief conducted (SAFER Model)
- Roles & Responsibilities understood by each and all
- Peer Checker assigned (safety person, attendant, qualified observer)
- Communications will use repeat backs and confirmations during critical steps
- Workers wear PPE to protect themselves from unanticipated as well as recognized hazards
- Everyone is willing to exhibit a Questioning Attitude; Stop When Unsure (Situational Awareness); Speak-Up and Listen-Up
- Supervisor/Leader field visits – Observations for Coaching

When to Use Table of Human Performance Tools & Techniques

<table>
<thead>
<tr>
<th>HU Tool/Technique</th>
<th>When to Use</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Experience</td>
<td>Planning, PJB</td>
<td>Retrieve from all database</td>
</tr>
<tr>
<td>TWIN Analysis</td>
<td>Planning, PJB</td>
<td>To review error traps</td>
</tr>
<tr>
<td>3 Question Technique</td>
<td>Pre-Job, Field Work</td>
<td>Can use almost anytime</td>
</tr>
<tr>
<td>Training &amp; Qualification</td>
<td>Work preparation</td>
<td>Trained but Proficient?</td>
</tr>
<tr>
<td>Job Hazard Analysis</td>
<td>Planning, PJB</td>
<td>Growth opportunity</td>
</tr>
<tr>
<td>Peer Checking</td>
<td>Field Work</td>
<td>Willing to Speak-Up?</td>
</tr>
<tr>
<td>Pre-Job Brief</td>
<td>Pre-Job</td>
<td>Enables Safe Work</td>
</tr>
<tr>
<td>STAR</td>
<td>Field Work</td>
<td>Anytime, variations</td>
</tr>
<tr>
<td>Stop &amp; Collaborate</td>
<td>Field Work</td>
<td>Anytime questions or concerns</td>
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<tr>
<td>Time Out</td>
<td>Field Work</td>
<td>Like STAR</td>
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<tr>
<td>Verbalize</td>
<td>Field Work</td>
<td>Helps comm &amp; peer</td>
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<tr>
<td>3-Way Communications</td>
<td>Field Work</td>
<td>Phonetic alphabet use</td>
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<tr>
<td>Field Observations</td>
<td>Field Work</td>
<td>Reinforce safe work</td>
</tr>
<tr>
<td>Pre-Job Critique</td>
<td>Post-job</td>
<td>LIL to error proof</td>
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</tbody>
</table>

Tools For Leaders To Combat Error Traps

- Reinforce expectations
- Cultivate Questioning Attitude with
- Open and Honest Communication
- Observe & Coach

Review Operating Experience

For work activities involving typical critical steps, consider reported events that have occurred over the past quarter.

For less frequently performed work, you may wish to search for related events over the past year.

Sequence to Error Reduction Framework

PLAN

PREPARE

PERFORM

Pursue Excellence

Five Success Factors for HPI:

1. Each employee must believe and commit to make a difference.
2. Recognize that human error is unavoidable.
3. Recognize also that human error is unintentional and therefore must be guarded against.
4. Understand that it is impossible to work error free.
5. Use DEFENSES on every job to prevent events.
Perceiving the problem:
What visual clues lead you to believe there is a problem?

Description of Event Sequence
a. Crew was transferring a single phase transformer for a newly set pole.
b. New pole had been set at an earlier date in the rear corner of property.
c. Crew had used pads to pad in a small service bucket to work the pole.
d. Had a transformer gin and block on the pole with a rope and capstan.
e. They had finished transferring the transformer.
f. LMA-1 was removing the block from the gin.
g. When he turned to put it in the bucket, the block (approximately 15 lbs) slipped out of his hands falling to the ground (approximately 25 feet).
h. He instantly yelled headache, then immediately looked down and saw LMA-2 bend down and cover his head.
i. The block hit LMA-2 in the back between his shoulders. The LCS immediately attended to him. LMA-1 came down and took over, as LCS called for medical assistance, resulting in injured being “life-flighted.”
j. All crew members were wearing all appropriate PPE at the time of the accident. LMA-1 in bucket had Rubber Gloves and Stieves on also.

Extent of Injuries and Status on June 4th: Sustained concussion and fractured vertabra with full recovery expected after ~90 days off work.
Performance Mode

Performance Mode:
- **Skill Based**  **x**  **Rule Based**  **Knowledge Based**

Performance Mode Comments:

3 person crew consisting of: an LCS (38 years of service), two LMA's. LMA-1 (29 yrs) and LMA-2, injured employee (30 years of service). Additionally, these individuals have been working together for a long time and done this work before.

Error Traps

(i.e., Factors that help create an Error Likely Situation)

<table>
<thead>
<tr>
<th>Error Traps</th>
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<tbody>
<tr>
<td>Select all that apply from fact finding</td>
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<tr>
<td><em>Time Pressure</em></td>
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<td><em>Distractions or Interruptions</em></td>
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<tr>
<td><em>Multiple Tasks or Repetitive Actions</em></td>
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<tr>
<td><em>Overconfidence or Complacency</em></td>
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<tr>
<td><em>Vague Guidance (Written or Verbal)</em></td>
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<td><em>Assumptions</em></td>
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<td><em>Lack of or Unclear standards</em></td>
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<td><em>Unfamiliarity with task or inexperienced</em></td>
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<td><em>First time or lack of proficiency</em></td>
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<td><em>Imprecise communication habits</em></td>
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<tr>
<td><em>Peer or Self-Induced or Perceived Pressure</em></td>
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<td><em>Off-normal work time or Infrequent Conditions</em></td>
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<tr>
<td><em>Challenging or changing Physical Environment</em></td>
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<td><em>Fitness for Duty: fatigue or mental stress</em></td>
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<td><em>Reliance on Memory</em></td>
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<tr>
<td><em>Limited short term memory</em></td>
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<td><em>Inaccurate Risk Perception</em></td>
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<td><em>Shortcut choice</em></td>
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<td><em>Departure from routine or new technique</em></td>
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<td><em>Confusing displays or controls or indications</em></td>
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I-Team’s Judgment Statements on Contributions of Error Traps

- **Taking each other for granted** after working together for over 29 years.
- **Did not recognize the risk** of walking under the bucket while the worker aloft was handling or moving material.
- **Complacency**
- **Being in the line-of-fire**
- **Lack of communication** between crew members.
- Crew member **felt job was completed**… We cannot let our guard down by thinking the job is completed until all crew members are in the clear and on the ground.

Process Issues

<table>
<thead>
<tr>
<th>Process Issues</th>
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<tbody>
<tr>
<td><strong>x</strong> Training</td>
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<tr>
<td><strong>x</strong> Written Guidance (Rules, Policies, Practices, and Procedures)</td>
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<tr>
<td>x <strong>Roles &amp; Responsibilities</strong></td>
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<tr>
<td><strong>x</strong> Work Planning &amp; Scheduling</td>
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<tr>
<td>x <strong>Communications</strong></td>
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<tr>
<td>x <strong>Pre-Assessment &amp; Recognition of Risks versus Job Hazards</strong></td>
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<tr>
<td>x <strong>Task Structure</strong></td>
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<table>
<thead>
<tr>
<th>Process Issue Influences on the Error and Error-Proofing Opportunities Identified:</th>
<th></th>
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<tbody>
<tr>
<td>The PJB, Pre-Job Brief needs to define all the tasks, roles, &amp; responsibilities of the crew members.</td>
<td></td>
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<tr>
<td>… A good briefing would have enabled the crew to have defined roles and responsibilities that can be followed and adhered to.</td>
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<tr>
<td>… Defined tasks, roles, &amp; responsibilities provide barriers to protect workers from a significant event.</td>
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<tr>
<td>Proper communication skills between the worker aloft and the ground worker during movement or handling of material help keep workers out of “The Line-of-Fire.”</td>
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</tbody>
</table>
Review Questions

3 review questions for discussion with employees:

1. In our pre-job briefs, do our work crews routinely and adequately discuss what the possible critical steps are?

2. How can we better apply “lessons learned” from recent incidents involving similar work, to help prevent another event like this one?

3. Why are some employees seemingly reluctant to step-up and more actively engage in “observing” whenever they can, instead of only when it’s required?