Improving Human Performance: Building a Culture of High Reliability

James Merlo, PhD, Associate Director of Human Performance

March 26, 2013
Which Direction?
RRM Direction

• Reliability – addressing real problems to improve the reliability of the grid.
• Assurance – being accountable to customers, the industry and government for the performance of the grid.
• Learning – enabling the industry to learn from experience to improve future reliability performance.
• Risk-based model – focusing actions and programs on issues most important to grid reliability.
With Each Decade, U.S. Airline Safety Has Improved

* Scheduled passenger and cargo operations of U.S. air carriers operating under 14 CFR 121; NTSB accident rates exclude incidents resulting from illegal acts.

Source: National Transportation Safety Board (NTSB)
“Complicated Industry”
“Come along way”
“Can’t get to zero”
“Automate, technology reduces the need for human operator”
“Complicated Industry”
“Come along way”
“Can’t get to zero”
“Automate, technology reduces the need for human operator”
With Each Decade, U.S. Airline Safety Has Improved

* Scheduled passenger and cargo operations of U.S. air carriers operating under 14 CFR 121; NTSB accident rates exclude incidents resulting from illegal acts.

Source: National Transportation Safety Board (NTSB)
• Know thy user
• Elegant simplicity
• Actions not words
• The rat is never wrong
• You can’t afford not to know the truth
Five Questions

• Know thy user
• Elegant simplicity
• Actions not words
• The rat is never wrong
• You can’t afford not to know the truth
Know thy user

- Context Matters
- Human Ingenuity
- Only two hands, two eyes, see the pattern?
- If you only have a minute, it only takes a minute...
- Set me up for success...please...
- Human nature
Human Performance Tenets

• People are fallible, and all people make mistakes
• Error-likely situations are predictable, manageable, and preventable
• Individual behavior is influenced by organizational processes and values
• People achieve high levels of performance largely because of the encouragement and reinforcement received from leaders, peers, and subordinates
• Events can be avoided through an understanding of the reasons mistakes occur and application of the lessons learned from past events or near misses
Sometimes it is a Human
• Know thy user
• Elegant simplicity
• Actions not words
• The rat is never wrong
• You can’t afford not to know the truth
Elegant simplicity

- Russians and the US Space Program
- How many tools in the box?
- The tool shouldn’t be harder than the task.
- Surround the truth...it is out there somewhere...
Human Performance Tools

Error Prevention Tools Improve Human Performance

1. Review the latest information and procedures. Make sure you understand the details.
2. Take a moment to think through the process. Are there any steps that could be simplified or improved?
3. Ask yourself if this is the right thing to do. Is there a more efficient or safer way to accomplish the task?
4. If you are not sure, stop and ask for help. It is better to make a mistake and ask for help than to continue and make a mistake you cannot correct.

Stop When Unsure

- Be aware of your surroundings and the tasks you are performing.
- If you are unsure of a procedure, immediately stop and ask for clarification.
- Always double-check your work to ensure accuracy.
- If you are unsure of a situation, immediately stop and ask for assistance.

Three-Way Communication

1. Talk to the person on your right. Ask them if they have any questions or concerns.
2. Talk to the person on your left and ask them if they have any suggestions or ideas.
3. Talk to the person in front of you and ask them if they have any feedback or comments.
4. Talk to the person behind you and ask them if they have any questions or concerns.

Error Precursors (short list)

- Task Demands
  - Time pressure
  - High workloads
  - Lack of resources
  - Complexity of the task

- Information Capabilities
  - Lack of information
  - Misunderstanding of the task
  - Inadequate training

- Work Environment
  - Noise
  - Heat
  - Cold
  - Vibration

- Human Nature
  - Stress
  - Fatigue
  - Distractions
  - Personalities

- Three
  - Conversations
  - Instructions
  - Observations

Stop and Ask Questions:

- If you are unsure of a procedure, stop and ask for help.
- If you are unsure of a situation, stop and ask for assistance.
- If you are unsure of the task, stop and ask for clarification.

The Three-Way Communication approach is designed to ensure that everyone involved in a task is aware of the steps being taken and understands the importance of their role. By asking questions and communicating effectively, we can prevent errors and improve overall performance.

Contents

1. Error Prevention Tools
2. Human Performance Tools
3. Error Precursors (short list)
4. Three-Way Communication

RELIABILITY | ACCOUNTABILITY
Human Performance Tools

- Two Minute rule
- Stop when unsure
- Self checking (also called STAR and touch STAR)
- Procedure use and adherence
- Three way communication
- Phonetic alphabet
- Pre-job brief
- Peer check
- Concurrent verification
- Independent verification
- Flagging operational barriers
- Place keeping
- Post job interview
- First Check
Five Questions

• Know thy user
• Elegant simplicity
• Actions not words
• The rat is never wrong
• You can’t afford not to know the truth
• Actions not words
  ▪ It is not important unless it is checked.
  ▪ What is your story?
  ▪ Are you telling your story up or down?
• Know thy user
• Elegant simplicity
• Actions not words
• The rat is never wrong
• You can’t afford not to know the truth
• The rat is never wrong
  ▪ Behaviorism
  ▪ Not enforcing a policy is like not having a policy at all
  ▪ Don’t have a rule that you aren’t going to enforce
The rat is never wrong

Human behavior is shaped by interaction in the world...

- Punishment stops behavior
- Reinforcement shapes and sustains behavior
Silence is Consent
Five Questions

• Know thy user
• Elegant simplicity
• Actions not words
• The rat is never wrong
• You can’t afford not to know the truth
• You can’t afford not to know the truth
  ▪ Root cause
  ▪ Just Culture
  ▪ Near misses
Or...When Good Pistons go Bad!
Why Root Cause Versus Apparent Cause?

• Facts
  ▪ Jeep had 107k miles
  ▪ Cylinders were fine...no abrasions (whew, got lucky)
  ▪ Approx $2,500 to completely rebuild, same block just new pistons...
  ▪ Just MTBF for pistons...or maybe not...
• Mechanic noticed some scalding on other pistons
• No history of ever over heating...
• Jeep was hit on right side, at 70k miles....
• Right fender was replaced, radiator and fan blade..no damage to engine block
• New Fan blade was installed backwards!!!!
• Jeep was running hotter than it should...just slightly...not enough to notice...and there was a new owner so there was no baseline...
"Before you tell the "truth" to the patient, be sure you know the "truth,“ and that the patient wants to hear it."

Journal of Chronic Diseases (1963)
Dr. Richard Clarke Cabot
(1868-1939)
• We have not fully understood an event if we don’t see the actors’ actions as reasonable.

• The point of a human error investigation is to understand why people did what they did, not to judge them for what they did not do.

• The difference between an accident and a serious incident lies only in the result.
Can Your Organization Handle the Truth?
Five Questions

• Know thy user
  ▪ Human Ingenuity

• Elegant simplicity
  ▪ Russians and the Space Program

• Actions not words
  ▪ It is not important unless it is checked

• The rat is never wrong
  ▪ Behaviorism

• You can’t afford not to know the truth
  ▪ Root Cause
With Each Decade, U.S. Airline Safety Has Improved

*Scheduled passenger and cargo operations of U.S. air carriers operating under 14 CFR 121; NTSB accident rates exclude incidents resulting from illegal acts.

Source: National Transportation Safety Board (NTSB)
<table>
<thead>
<tr>
<th>Event Category</th>
<th>Summary Definition</th>
<th>Count (Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAT 1</td>
<td>3 or more generators (500 -1,999 MW); Failure or misoperation of BPS SPS/RAS; Unintended BPS system separation that results in an island of 100 to 999 MW</td>
<td>178</td>
</tr>
<tr>
<td>CAT 2</td>
<td>Complete loss of SCADA, control or monitoring for $\geq 30$ minutes; LOOP; Unintended loss of 300 MW or more of firm load for $\geq 15$ minutes</td>
<td>96</td>
</tr>
<tr>
<td>CAT 3</td>
<td>loss of load or generation of $\geq 2,000$ MW or $\geq 1,400$ MW or more in the ERCOT Interconnection. Unintended system separation that results in an island of 5,000 to 10,000 MW</td>
<td>9</td>
</tr>
<tr>
<td>CAT 4</td>
<td>loss of load or generation from 5,001 to 9,999 MW</td>
<td>3</td>
</tr>
<tr>
<td>CAT 5</td>
<td>loss of load or generation of $\geq 10,000$ MW</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total Events</strong></td>
<td></td>
<td><strong>288</strong></td>
</tr>
<tr>
<td><strong>Other occurrences reported</strong></td>
<td>Not meeting the above mentioned EA categories.</td>
<td><strong>1544 +</strong></td>
</tr>
</tbody>
</table>
Control Chart of Qualified Events

All Qualified Events (Cat 1 - Cat 5)

- Monthly counts
- Average
- UCL
- LCL

Count of Events

- November 2010 to February 2013
The Reliability Risk Management Group (RRM) has designed, developed, and implemented the North American Energy Reliability Corporation (NERC) Causal Code Assignment Process to allow accurate, efficient trending and subsequent analysis of events for sharing and providing a cooperative forum focused on improving the reliability of the Bulk Power System (BPS).
Cause Code Assignment Process (CCAP)

- A1 - Design/Engineering (23 sub codes)
- A2 - Equipment/Material (27 sub codes)
- A3 - Individual Human Performance (20 sub codes)
- A4 – Management / Organization (46 sub codes)
- A5 - Communication (25 sub codes)
- A6 - Training (11 sub codes)
- A7 - Other (8 sub codes)
- AZ - Information to determine cause LTA
• A1 Design/Engineering
• A2 Equipment/Material
• A3 Individual Human Performance
  ▪ B1 SKILL BASED ERROR
  ▪ B2 RULE BASED ERROR
  ▪ B3 KNOWLEDGE BASED ERROR
  ▪ B4 WORK PRACTICES
• A4 Management / Organization
• A5 Communication
• A6 Training
• A7 Other
**A3 - Human Performance**

- **A3 Individual Human Performance**
  - **B1 SKILL BASED ERROR**
    - C01 Check of work LTA
    - C02 Step was omitted due to distraction
    - C03 Incorrect performance due to mental lapse
    - C04 Infrequently performed steps were performed incorrectly
    - C05 Delay in time caused LTA actions
    - C06 Wrong action selected based on similarity with other actions
    - C07 Omission / repeating of steps due to assumptions for completion
  - **B2 RULE BASED ERROR**
  - **B3 KNOWLEDGE BASED ERROR**
  - **B4 WORK PRACTICES**
existent
### Root Cause Determinations

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>AZ – Information to determine Cause LTA</td>
<td>43%</td>
</tr>
<tr>
<td>A4 – Management / Organization</td>
<td>20%</td>
</tr>
<tr>
<td>A2 – Equipment / Material</td>
<td>14%</td>
</tr>
<tr>
<td>A3 – Individual Human Performance</td>
<td>7%</td>
</tr>
<tr>
<td>A1 – Design / Engineering</td>
<td>3%</td>
</tr>
<tr>
<td>A5 – Communication</td>
<td>2%</td>
</tr>
<tr>
<td>AN – No Causes Found</td>
<td>1%</td>
</tr>
<tr>
<td>A7 – Other</td>
<td>1%</td>
</tr>
</tbody>
</table>

- **AZ** Information to determine cause Less Than Adequate (LTA)
- **A4** Management / Organization
- **A2** Equipment / Material
- **A1** Design / Engineering
- **A3** Individual Human Performance
- **A5** Communication
- **AN** No Causes Found
Deeper Dive into Management/Organization (Based on Root Cause)

A4 – Management / Organization

B3C08 - job scoping did not identify special circumstances or conditions

B5C04 - risks/consequences associated with change not adequately reviewed

B1C03 - direction created insufficient awareness of impact of actions on safety/reliability

B1C04 - follow-up did not identify problems

B1C05 - assessment did not determine cause of previously event or known problem
A4 – Management Challenges

B1C05 - assessment did not determine cause of previously event or known problem
B3C08 - job scoping did not identify special circumstances or conditions
B5C03 - inadequate vendor support of change
B5C04 - risks/consequences associated with change not adequately reviewed
B1C08 - corrective action responses to a known or repetitive problem was untimely
B5C05 - system interactions not considered
B1C04 - follow-up did not identify problems
Top Causes for Management / Organization

**A4 – Management Challenges**

- **B1C05** - assessment did not determine cause of previous event or known problem
- **B3C08** - job scoping did not identify special circumstances or conditions
- **B5C03** - inadequate vendor support of change
- **B5C04** - risks/consequences associated with change not adequately reviewed
- **B1C08** - corrective action responses to a known or repetitive problem was untimely
- **B5C05** - system interactions not considered
- **B1C04** - follow-up did not identify problems
B1 – Management Methods

C05 - Assessment did not determine cause of previous event or known problem

Definition: Analysis methods failed to uncover the causal factors of consequential or non-consequential events.

- Review internal event analysis procedure and ensure that it includes a consideration of not just what happened but also why it happened.
- Determine why cause analysis was not implemented in former cases. Implement appropriate corrective actions. Establish a corrective action tracking process to close out and document the corrective actions.
- Where redundant systems are in use (production or primary and disaster recovery) troubleshooting and correct of problems on one system should be applied to all systems as required.
B3 – Work Organization and Planning

C08 - Job scoping did not identify special circumstances or conditions

Definition: The work scoping process was not effective in detecting work process elements having a dependency upon other circumstances or conditions.

- Review implementation of work planning processes, examining program-to-program interface requirements (configuration management, work planning, operations, engineering, maintenance).

- Company Generation will consider, as part of its initial maintenance procedures/plan development, the identification of a “single-point of failure” being created due to maintenance activities (e.g., electrical, fuel, water, mechanical, etc).
B5 – Work Organization and Planning

C03 - Inadequate vendor support of change

Definition: Management failed to adequately assess the ability of vendors to supply products or services in support of changing expectations for a particular objective.

- Review vendor program and self-verification process, examining inspection and testing activities, sampling plans, technology-based review and verification processes, and oversight methodologies.
- Work with peers to see if issues are unique to your organization or exist with others.
- Work closely with vendors to share expectations and involve them in problem solving.
C04 - Risks/consequences associated with change not adequately reviewed

Definition: Elements of the process or physical or cyber (to include software) systems changes were not recognized as having adverse impact or increased risk of adverse impact prior to implementing the changes.

- Include whether second and third-order changes to systems and procedures affect the way they are used in production.
- Before making changes to systems and procedures, conduct a pilot test to ensure that the new system or procedure does not have unintended consequences.
Summary

- Entity event analysis is critical to the identification and subsequent remediation of reliability threats
- Management and Organization challenges overshadow individual human error
  - Less than adequate job scoping is a threat to reliability
- Technical conferences and coordinated feedback to vendors will help drive solutions
With Each Decade, U.S. Airline Safety Has Improved

* Scheduled passenger and cargo operations of U.S. air carriers operating under 14 CFR 121; NTSB accident rates exclude incidents resulting from illegal acts

Source: National Transportation Safety Board (NTSB)
NERC – Event Analysis

Event Analysis Process

Questions and Answers

James Merlo, PhD
Associate Director, Human Performance, RRM
404-446-2560 office | 404-387-5249 cell
James.Merlo@nerc.net