Human Performance
Explain, Predict and Change Human Behavior

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• Reliability – addressing real problems to improve the reliability of the grid.
• Accountability – 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.
NERC List of Top Risks

- Changing Resource Mix
- Cyber Attack
- Extreme Physical Events – Acts of Nature
- Extreme Physical Events – Man-made
- Failure to Maintain and Manage BPS Assets Generator Unavailability
- Loss of Situational Awareness
- Pandemic
- Poor Event Response/Recovery
- Poor Human Performance
- Poor Resource Planning
- Protection System Failures
- Regulatory Uncertainty
- Uncoordinated Planning
Human Error
System Frequency During the Super Bowl
System Event Distribution

- **Event During the Game**
- **Event During the Commercial**

**Super Bowl 2008 First Half**
- Frequency vs. Time (EST)

**Super Bowl 2009 First Half**
- Frequency vs. Time (EST)

**Super Bowl 2008 Second Half**
- Frequency vs. Time (EST)

**Super Bowl 2009 Second Half**
- Frequency vs. Time (EST)
Non-summer months — Net load pattern changes significantly starting in 2014

Net load - March 31

Ramp need ~13,000 MW in three hours

Potential over generation
Lobes of the Cerebral Cortex

- Parietal lobe
- Frontal lobe
- Occipital lobe
- Temporal lobe
Three Types of Memory

**Sensory Memory**
- Very high capacity
- ¼ of a sec
- Adaptive

**Short Term (Working) Memory**
- 7 +/- 2
- 10-20 seconds
- Chunking

**Long Term Memory**
- Unlimited
- Indefinite
Some people believe that you can heat/cool a room faster by setting the thermostat to a higher/lower temperature than you really want, as if the thermostat were a valve for the heating/cooling system that lets more heat/cool air into the room the higher/lower you set it. In fact, the thermostat is simply an on/off switch for the heat/cool. It turns on as long as the room temperature is below/above the thermostat setting, and turns off when the thermostat setting is reached.
Breaker and Relay Cabinet Locks
Stickers Create Expectations
WHAT DO YOU SEEK?
It is not a matter of if the automation fails, it is a matter of when.
Six Human Considerations

- Attention
- Sensation
- Perception
- Cognition
- Decision making
- Action
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Scan
Focus
Act
Situational awareness is defined as the accuracy of a person’s current knowledge and understanding of actual conditions compared to expected conditions at a given time. 

The perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future.

Situation Awareness

Perception of Elements in Current Situation

Level 1
Situation Awareness

Perception of Elements in Current Situation
Level 1

Comprehension of Current Situation
Level 2
Situation Awareness

- Perception of Elements in Current Situation Level 1
- Comprehension of Current Situation Level 2
- Projection of Future Status Level 3
Situational Awareness

SITUATION AWARENESS
- Perception Of Elements In Current Situation (Level 1)
- Comprehension Of Current Situation (Level 2)
- Projection Of Future Status (Level 3)

Decision

Performance Of Actions

Feedback

Task/System Factors
- State Of The Environment

Individual Factors
- Goals & Objectives
- Preconceptions (Expectations)

Information Processing Mechanisms
- Long Term Memory Stores
- Automaticity

- System Capability
- Interface Design
- Stress & Workload
- Complexity
- Automation

- Abilities
- Experience
- Training
Stress is the body’s mental and physical response to a perceived threat(s) in the environment. It is the perception one has about his or her ability to cope with the threat.

Stress in itself is not a bad thing. Some stress is normal and healthy. Stress may result in more focused attention, which in some situations could actually be beneficial to performance.

The problem with stress is that it can accumulate and overpower a person, thus becoming detrimental to performance. Stress increases as familiarity with a situation decreases. It can result in panic, inhibiting the ability to effectively sense, perceive, recall, think, or act. Anxiety and fear usually follow when an individual feels unable to respond successfully.

Along with anxiety and fear, memory lapses are among the first symptoms to appear. The inability to think critically or to perform physical acts with accuracy soon follows.
Is Stress Always a Bad Thing?

emotional arousal vs task performance

Inverted-U Hypothesis
<table>
<thead>
<tr>
<th>Task Demands</th>
<th>Work Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time pressure (in a hurry)</td>
<td>Distractions / Interruptions</td>
</tr>
<tr>
<td>High workload (memory requirements)</td>
<td>Changes / Departure from routine</td>
</tr>
<tr>
<td>Simultaneous, Multiple tasks</td>
<td>Confusing displays / control</td>
</tr>
<tr>
<td>Repetitive actions (monotony)</td>
<td>Work - arounds</td>
</tr>
<tr>
<td>Unclear goals, roles, or responsibilities</td>
<td>Unexpected equipment conditions</td>
</tr>
<tr>
<td>Lack of or unclear standards</td>
<td>Back shift or recent shift change</td>
</tr>
<tr>
<td>Complex / High information flow</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Individual Capabilities</th>
<th>Human Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfamiliarity with task (first time)</td>
<td>Stress</td>
</tr>
<tr>
<td>Lack of knowledge (faulty mental model)</td>
<td>Habit patterns</td>
</tr>
<tr>
<td>Imprecise communication habits</td>
<td>Assumptions</td>
</tr>
<tr>
<td>Lack of proficiency; inexperience</td>
<td>Complacency / over confidence</td>
</tr>
<tr>
<td>Overzealousness for safety critical task</td>
<td>Inaccurate risk perception</td>
</tr>
<tr>
<td>Illness or fatigue – Fitness for duty</td>
<td>Communication shortcuts</td>
</tr>
<tr>
<td>Lack of big picture</td>
<td></td>
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A review of the INPO industry event data base reveals that events occur more often due to error-prone tasks and error-prone work environments than from error-prone individuals.

Error-prone tasks and work environments are typically created by latent organizational weaknesses.
But it is possible that under the **wrong set** of circumstances, an event could occur....
Equipment Reliability

Human Performance

Human Interaction with Equipment (coupled w/Automation)
"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)
Root Cause Determinations

A4 - Management

A2 - Equipment/Material Problem

AZ - Information to determine cause LTA

- A1 Design/Engineering Problem
- A4 Management Problem
- A2 Equipment/Material Problem
- A3 Individual Human Performance LTA
- A5 Communication LTA
- A7 Other Problem
- AN No Causes Found
A4 – Management Challenges

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

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B5C03 - inadequate vendor support of change
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B1C08 - corrective action responses to a known or repetitive problem was untimely
B5C05 - system interactions not considered
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Set Me Up for Success

• Those things that “set-up” a mistake to happen
  ▪ Task demands are greater than the worker’s abilities
  ▪ Confusing conditions make the job harder
  ▪ New techniques not used before
  ▪ Mental shortcuts
  ▪ Lack-of or unclear standards
  ▪ Illness / Fatigue

• Distractions
• Interruptions
• Unplanned changes
Solving Problems: Untying the Knot
Drifting to Failure*

: Desired approach to work (as imagined)
: Work as actually performed (allowed by mgmt!)

Stated Expectations

“Normal” Practice

Real Margin for Error

Errors

Hidden hazards, threats, unusual conditions, & system weaknesses

Latent Error
Inconspicuous and seemingly harmless buildup of “hidden” error and organizational weaknesses

* Adapted from Muschara Error Management Consulting, LLC
Example of Drift
No Room for Drift
Event

Near Misses

Safety Check

Misstep

Error Catches

Lucky

Peer Check
“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”
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With Each Decade, U.S. Airline Safety Has Improved
Since Deregulation, < 0.5 Fatal Accidents per Million Departures

*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)
• 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.
Sometimes it is a Human
• 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
Wine Making and Attention
Human Performance Tools

Error Preventing Tools Improves Human Performance

- STOP: Stop work and immediately correct the hazard.
- TALK: Talk about what you just saw and what could have prevented it, and talk to others about the hazard.
- PLAN: Plan for ways to prevent this type of hazard in the future.

Error Precursors (short list)

- Task Conditions
  - Time pressure (a hurry)
  - Work volume (too much)
  - Work complexity (too high)
  - Work environment (unfavorable)
- Human Error
  - Distraction
  - Misunderstanding
  - Inattention
  - Fatigue
  - Stress

Three-Way Communication

- Information: Make sure that all involved parties have the same understanding of the situation.
- Simplification: Use simple language and avoid jargon.
- Expression: Express the message clearly and directly.

Stop When Unsafe

- When in doubt about the safety of a job, STOP and get others involved.

Human Performance Tools:

- Review or what you are going to do and potential hazards involved.
- Take appropriate steps to prevent injury.
- Identify potential hazards, then review the potential consequences if an accident occurs.
- Provide information and training to all personnel involved.
- Communicate potential hazards and consequences to everyone involved.

N.A.: Not Applicable

Contents

- Error Prevention
  - T.A.P.
  - Environment
  - Potential Hazards
  - Task Conditions
  - Human Error
  - Learning Objectives
  - Error Precursors
  - Human Performance Tools
  - Error Prevention
- Communication
  - Three-Way Communication
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  - Learning Objectives
  - Human Performance Tools

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RELIABILITY | ACCOUNTABILITY
• 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
Human behavior is shaped by interaction in the world...

- Punishment stops behavior
- Reinforcement shapes and sustains behavior
Silence is Consent
Punishment vs. Negative Reinforcement

Does the behavior **increase** or **decrease**?
Get ‘er done
Questions and Answers

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