

PRACTICING WHAT MATTERS[®]



ALDAY
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THE DIRTY DOZEN

Causes of Errors and Accidents

SELLS Workshop



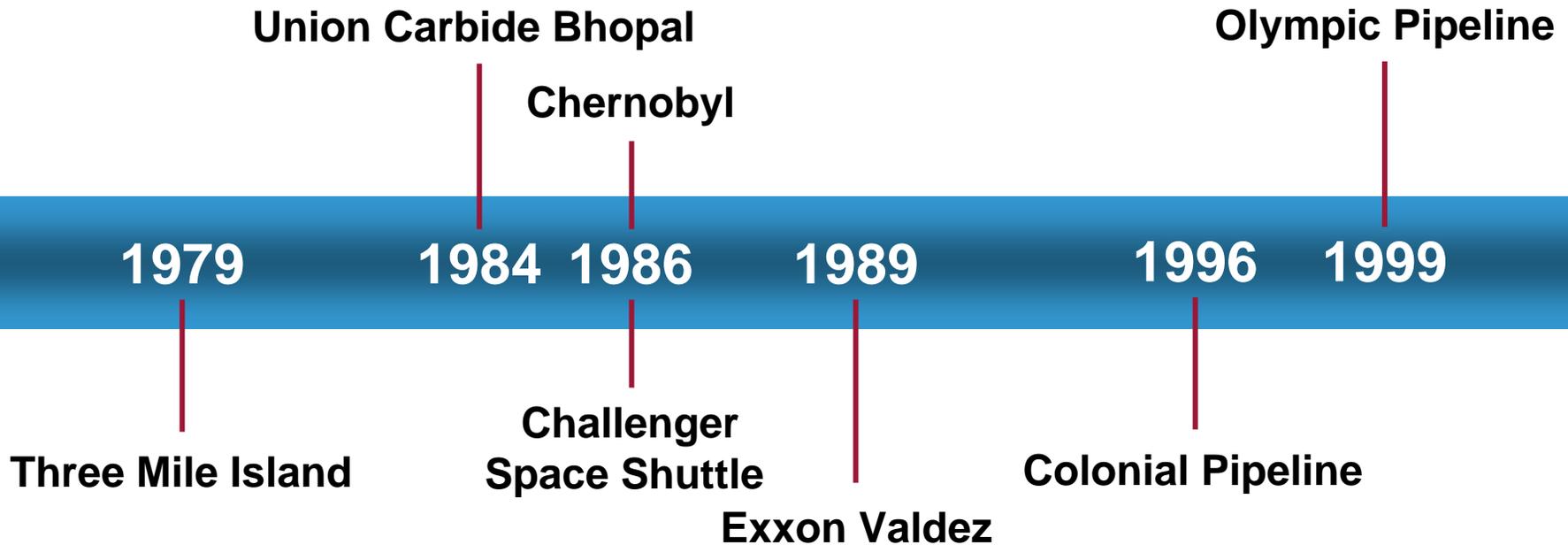
Charles Alday
October 18, 2006

THE DIRTY DOZEN

- Learning through Experience

*Some learn from the mistakes of others,
Some learn from their own mistakes,
Some never learn.*

Blame it on the Human!



Why Blame it on the Human?



Why Blame it on the Human?

- Because...
 - It's easier.
 - We want an easy explanation.
 - The legal system needs someone to be accountable.
 - Management wants to do something about the accident.
 - Humans are involved in all aspects of an organization.
 - Humans make errors.

Do Humans Make Errors?

- Studies show that a human error contributes in **80%- 90%** of all accidents.
 - A person can directly cause an accident.
 - People don't work to fail and to make errors.
 - People can make poor decisions even when aware of the risks.
 - People can intervene to stop potential accidents.
 - People can misinterpret information and act inappropriately.
 - People can minimize damage by their responses in an incident.

Consequences of Failures

- Active Failures
 - Have an immediate consequence.
 - Usually made by the front line people.
 - People on the “sharp end of the stick.”
 - Often caught by the person who fails, or the system.

Consequences of Failures

- Latent Failures
 - Usually hidden within an organization until triggered by an active failure.
 - Provide greater potential danger than active failures.
 - Made by people who are removed in time and space from operational activities.
 - People not on the sharp end of the stick.

Consequences of Failures

- What are examples of Latent Failures?
 - Poor design or testing or installation.
 - Poor training or support materials.
 - Poor leadership or management oversight.
 - Ineffective communications.
 - Delayed or cancelled maintenance.
 - Lack of clarity of roles and responsibilities.
 - Any others?

Human Factors – Key Aspects!

ORGANIZATION

- Culture
- Leadership
- Resources
- Work pattern
- Communications

Where are they working?

What are people being asked to do and where?

JOB

- Task
- Environment
- Workload
- Displays and controls
- Procedures

INDIVIDUAL

- Risk perception
- Competence
- Skills
- Personality
- Attitude

Who is doing it?

Organizational Factors

Where are they working?

ORGANIZATION

- Inadequate work planning, leading to high work pressure
- Lack of safety systems and barriers
- Inadequate responses to previous incidents
- Inadequate leadership and management
- Inadequate communication
- Inadequate work standards
- Poor management of health and safety
- Poor safety culture

Job Factors

What are people being asked to do and where?

JOB

- Poor design of equipment and instruments
- Constant distractions and interruptions
- Missing or unclear instructions
- Poorly maintained equipment
- Lack of parts and supplies
- High workload
- Noisy and unpleasant working conditions

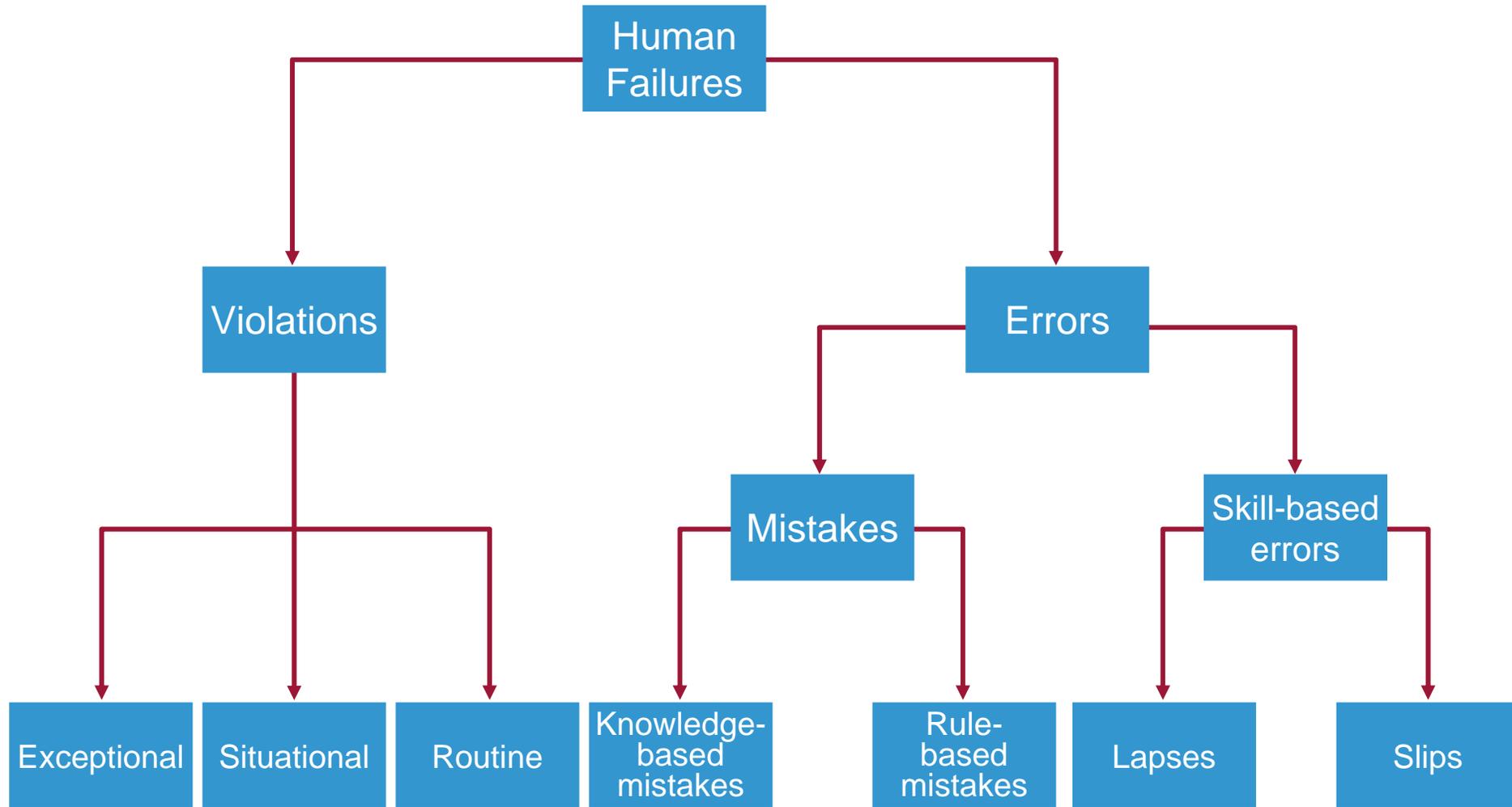
Individual Factors

Who is doing it?

INDIVIDUAL

- Low skill and competence levels
- Physical or mental capacities
- Personal or family problems
- Tired and stressed
- Bored or disheartened
- Medical problems

Types of Human Failure



What Can I Do?

- I can learn my capabilities and limitations.
- I can learn the ways I think, act, and behave.
- I can learn and avoid “The Dirty Dozen.”
- I can develop and use “Safety Valves.”
- I can understand that organizational and job factors also contribute to accidents and errors.
- But I will take responsibility for my errors.

THE DIRTY DOZEN

- Developed by Gordon DuPont, for Transport Canada.
- Used widely in human factors training for aviation maintenance technicians.
- Adapted, with permission, for use by Colonial Pipeline Co.
- Adapted, with permission, for use by Alday Consulting Services, Inc.

STRESS



STRESS

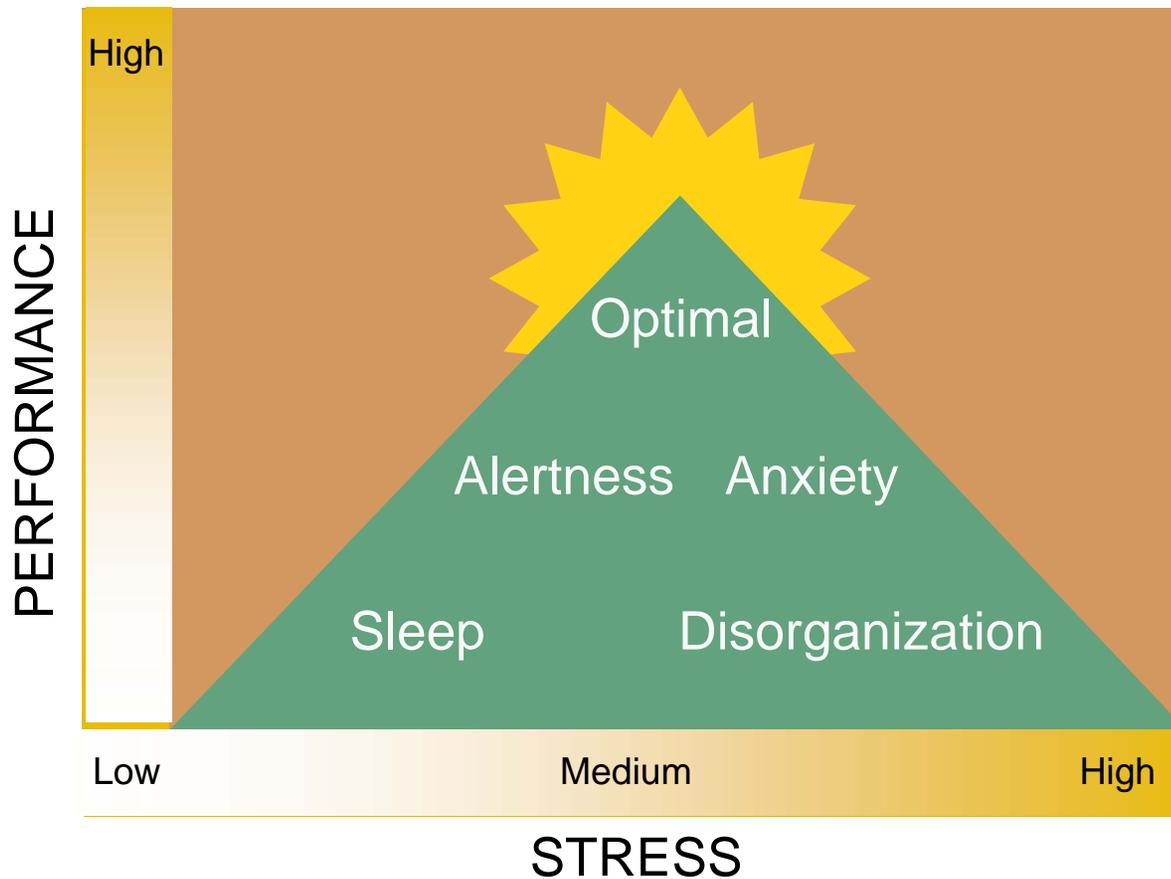
- Body's response to demands from self, others, or the environment.
- May exceed our available resources to cope with demands.

“Stress is a fact of life.”

~Chill Out or Burn Out booklet

STRESS

Performance Connection



STRESS

Learning from Experience

- 49 year old man with heavy work load and not getting adequate rest, leads a seminar in Nashville one day.
- Gets back to Atlanta around midnight; gets up next morning at 4:30.
- Drives to hotel for meeting; has headache and takes over the counter remedy.
- Meeting starts at 7:30.
- Man has seizure at 7:45.
 - *Was the man overstressed?*

STRESS

Safety Valves

- Be aware of the effects of stress on your work.
 - Most businesses provide educational materials.
- Discuss what is happening with someone.
- Ask a co-worker to check your work.
- Take time off; take breaks regularly.
- Eat properly, rest adequately, exercise.
- Plan an appropriate course of action.

FATIGUE



FATIGUE

- Performance impairment from lack of sleep and/or circadian disruption; tiredness.

“Our fatigue is often caused not by work, but by worry, frustration, and resentment.”

~ Dale Carnegie

FATIGUE

Performance Connection

- Task accuracy and timing suffer.
- Accept lower standards of performance.
- Difficult to maintain attention and awareness.
- Ability to integrate information diminishes.
- Every task becomes more difficult to perform.
- Social interactions decline.
- Attitude and mood deteriorates.
- Involuntary lapses into sleep may occur.

FATIGUE

Learning from Experience

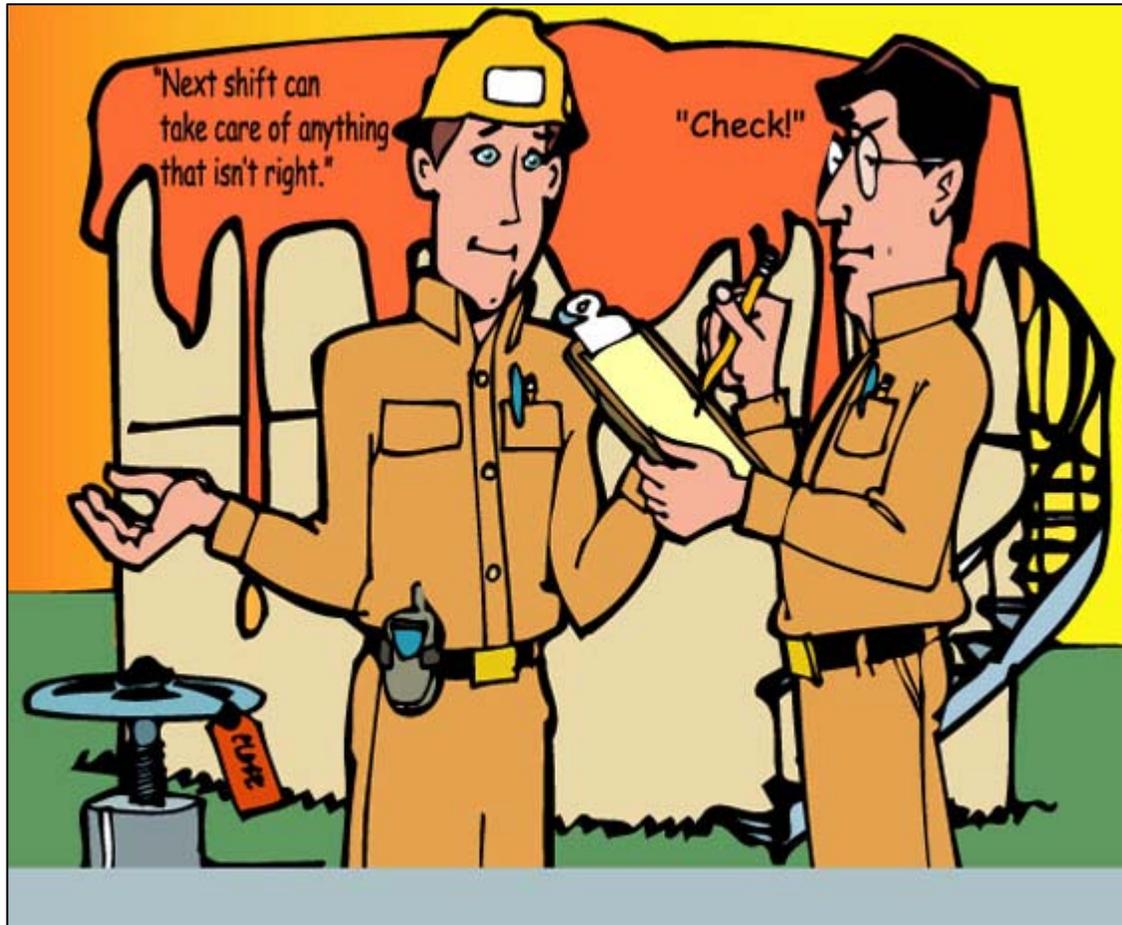
- During a shutdown, a crew worked 34 hours installing a new piping system.
- At hour 28, a laborer was trying to get two flanges aligned.
- He stuck his hand in the wrong place.
- Two fingers were cut and smashed.

FATIGUE

Safety Valves

- Get adequate amounts of sleep.
 - 8 hours each day/night for most people.
- Educate self on causes of and corrective actions for fatigue.
 - More and more resources on fatigue management.
- Get a physical check-up annually.
 - Address any sleep disorders.
- Eat properly and drink plenty of fluids.
 - Use caffeine strategically.
- Exercise regularly.

COMPLACENCY



COMPLACENCY

- Self-satisfaction accompanied by the lessened awareness of risks and situations.

“To take the measure of oneself by reference to one's colleagues leads to envy or complacency rather than constructive self-examination.”

~ Benno C. Schmidt, Jr.

COMPLACENCY

Performance Connection

- Letting your mind wander.
- Taking shortcuts and omitting steps.
- Fooling around or showing off.
- Thinking that everything will work perfectly.
- Working too long without a break.
- Taking the attitude that safety is someone else's job.
- Performing a task without using the procedures or recommended personal protective equipment.

COMPLACENCY

Learning from Experience

- **Corrective Maintenance Performed On Wrong Cooling Tower**
- Lesson ID: 2003-RL-HNF-0031 (*Source: SELLS*)
- Statement: Familiarity and **complacency** with the work environment allowed workers to troubleshoot an electrical system that was not isolated.

COMPLACENCY

Safety Valves

- Understand the human factors involved:
 - We have a mental bias that allows our experiences to guide expectations
 - We don't use our brains fully in the situation since our present circumstances *normally* match our past circumstances
 - We devote our brains to more interesting parts of a task.
- Recognize that “It can't happen to me” is a wrong belief.
- Expect success, but be prepared for failure.

COMPLACENCY

Safety Valves

- Always practice risk assessment.
 - Use the 5 Questions
- Use STAR with every task.
- Practice independent verification.
- Follow all policies and procedures.
- Train constantly.
- Create challenges for yourself.

DISTRACTIONS



"You won't believe how many things I've gotten done today."

DISTRACTIONS

- Loss of situation awareness, due to the surrounding environment, people, and/or circumstances

“Any occurrence requiring undivided attention will be accompanied by a compelling distraction.”

~ Robert Bloch

DISTRACTIONS

Performance Connection

- Interruptions
 - How can interruptions cause an error?
- “Multitasking is counterproductive.” (CNN.com)
- “Multitasking makes us stupid.” (WSJ article)
 - There is a ‘time-cost’ to switching tasks.
 - There is a ‘switching-cost’.
 - One must change goals.
 - What do I want to do now?
 - One must change rules.
 - What rules apply to this task?

DISTRACTIONS

Learning from Experience

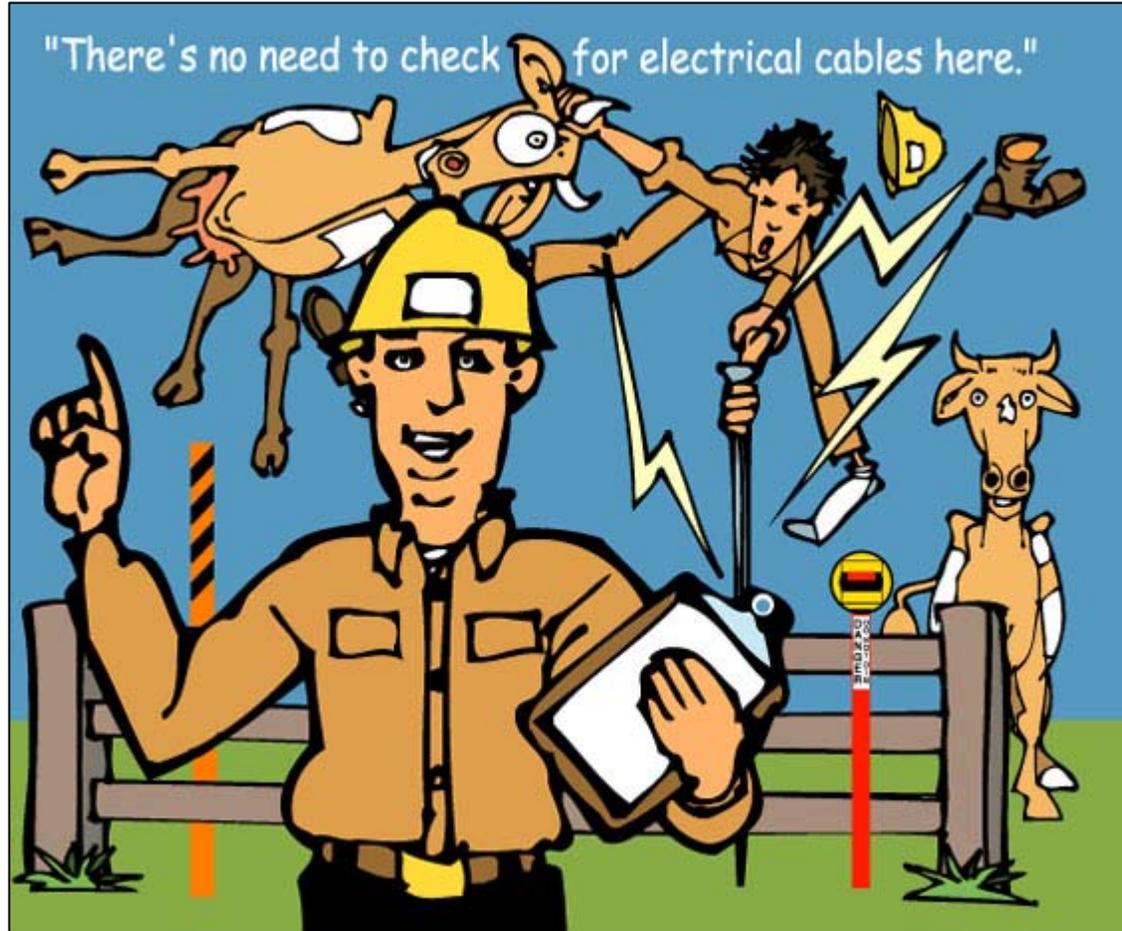
- **Distractions and Increased Workloads Decrease Effectiveness of Supervisory Control**
- **Lesson ID:** 2006-RL-HNF-0035 (*Source: User Submitted*)
- **Statement:** When performing high risk activities, such as entry or exit into a Limiting Condition for Operation, it is vital that the individual responsible for the activity establish the conditions for success.
- These include eliminating or delegating simultaneous, multiple tasks; removing unneeded personnel from the work area; and most importantly employing self-checking techniques to ensure all required conditions and configuration has been met before authorizing the activity.

DISTRACTIONS

Safety Valves

- Minimize or eliminate distractions.
- Ask people to be quiet and leave your area.
- Finish the task if possible.
- Complete tasks step by step.
- Flag and tag all uncompleted work.
- Use STAR.
- Use memory aids.
- Focus by practicing mindful attention.

LACK OF AWARENESS



LACK OF AWARENESS

- Failure to notice what is happening and think about the consequences of work being performed.

“Hold each moment sacred. Give each clarity and meaning, each the weight of thine awareness.”

~ Thomas Mann

LACK OF AWARENESS

Performance Connection

- **Level 1 Situational Awareness** involves perceiving critical factors in the environment
- **Level 2 Situational Awareness** understanding what those factors mean, particularly when integrated together in relation to the decision maker's goals
- **Level 3 Situational Awareness** is the highest level, an understanding of what will happen with the system in the near future.

LACK OF AWARENESS

Learning from Experience

- **Stay Aware of Surroundings and Changing Conditions**
- **Lesson ID:** 2006-ID-AMWTP-012 (*Source: User Submitted*)
- **Statement:** When operating equipment, stay aware of surroundings and consider taking alternate paths when conditions change. The combination of night lighting, uneven road conditions, and maneuvering in close proximity to other objects should cause us to re-evaluate our plan of action and take appropriate measures to mitigate the hazards.

LACK OF AWARENESS

Learning from Experience

- **Buried Utility Detection Systems**
- **Lesson ID:** SWPF-LL-134 (*Source: User Submitted*)
- **Statement:** No single utility location instrument can detect all types of buried utilities. It is therefore imperative to utilize a variety of instruments which are uniquely suited to a few tasks. Along with the use of Electromagnetic Instruments, some up-front due diligence must precede non-destructive methods of underground investigation. All available as-built information should be researched and a field walk down should be performed.
- **Discussion:** Every year people are injured or killed as a result of hitting buried pipes and cables during construction and excavation work.

LACK OF **AWARENESS**

Safety Valves

- Learn the principles and practices of situation awareness.
- Recognize the complexities inherent in the job.
- Understand that vigilance can deteriorate while performing a task.
- Learn and use human performance principles.

NORMS



NORMS

- Unwritten and written rules dictated and followed by the majority of a group.

“For to change the norms, the very foci of attention, of a cultural system is a difficult task – far more complex than that of changing an individual’s attitudes and interests.”

~ James S. Coleman

NORMS

Performance Connection

- Norms can be positive or negative
 - Three-way communication or not
 - Completing checklists or pencil whipping
- Norms exist for a reason
 - Restaurants have signs requiring employees to wash their hands. Why?
 - Sign in Nashville restaurant says “wash hands twice.” Why?
- Norms are set by the employees
 - Pipeline example

NORMS

Learning from Experience

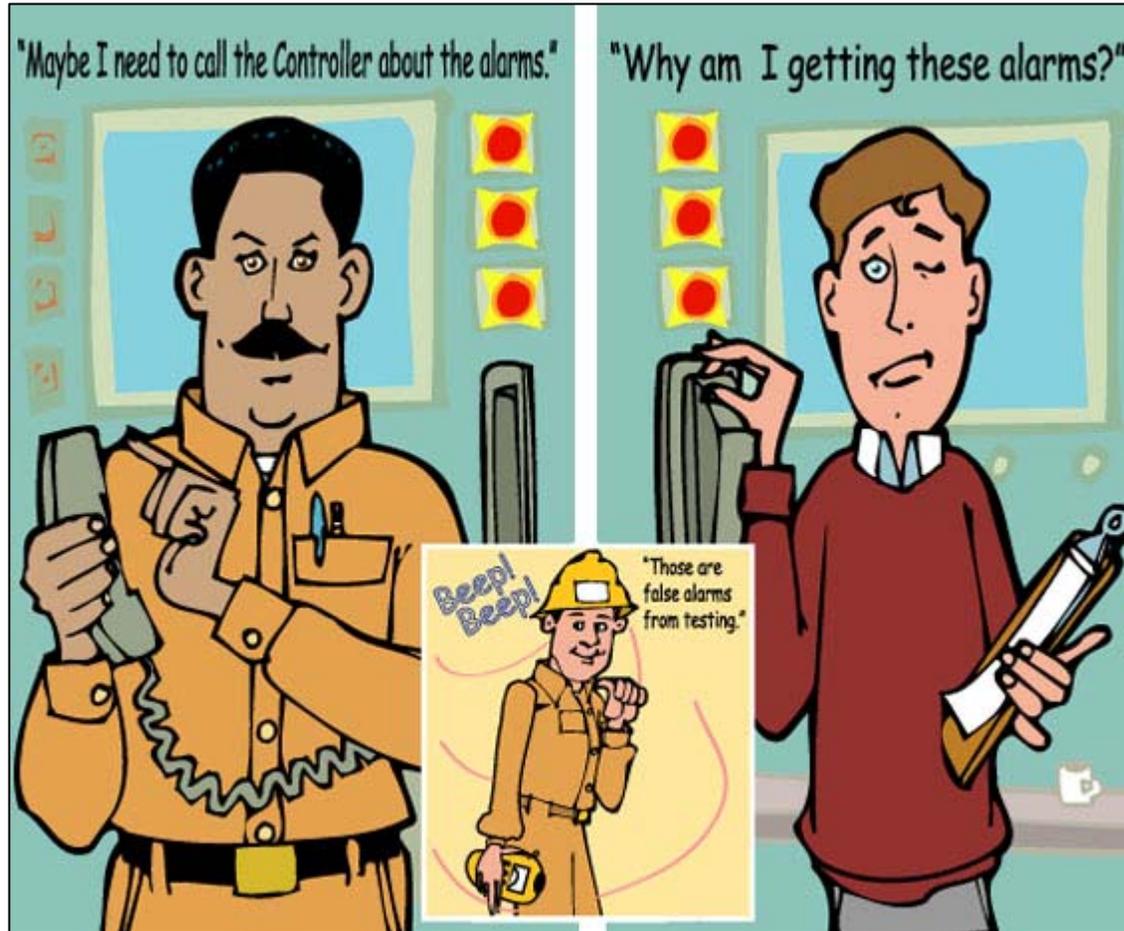
- **Oversimplification of Technical Information Could Mislead Decision-Making**
- **Lesson ID:** NNSA-04-CAIB-CI-1 (*Source: User Submitted*)
- **Statement:** The Columbia Accident Investigation Board Report described “oversimplification of technical information” as one lesson learned.
- This is a potentially serious issue within NNSA as well.
- Organizational **norms** may place a higher value on positive information coming forward than negative information in complex decisions. As a result, preparers may limit options to only those facts viewed positively by the organizational **norms** severely restricting information to the decision-makers.

NORMS

Safety Valves

- Recognize norms where we work and live
- Work on removing bad habits and behaviors
- Accentuate the positive, eliminate the negative
- Don't use shortcuts
- Abide by standards and requirements
- Be a good example for others
- Follow policies and procedures
- Keep in mind the “old way” may not be the best way

LACK OF COMMUNICATION



LACK OF COMMUNICATION

- Necessary information is not provided to the appropriate people at the right time.

“Communication is the glue that binds participants together in group interaction or team tasks. It is a transparent medium through which group work is organized and accomplished.”

~ Unknown

LACK OF COMMUNICATION

Performance Connection

- Lack of communication affects performance:
 - Misunderstandings occur between workers.
 - Hurt feelings lead to petty disagreements.
 - Job doesn't get done or is delayed.
 - Anger may affect individuals or groups.
 - Loss of trust
 - Near misses or incidents may result.

LACK OF COMMUNICATION

Learning from Experience

- **Lack Of Communication Among Personnel Can Cause Regulatory And Safety Concerns**
- **Lesson ID:** B-2005-OR-BJCPORTS-0501
(Source: User Submitted)
- **Statement:** The Waste Management Subcontractor at the Portsmouth Gaseous Diffusion Plant (PORTS) recently had two separate instances where the **lack of communication** led to potential regulatory and safety issues.

LACK OF COMMUNICATION

Safety Valves

- Practice 3-way communication.
- Write down important information.
- Always conduct briefings before, during, and after jobs.
- Use the MOC process.
- Provide the right information to the right people at the right time.
- Assume nothing.
- Don't tell someone something when they are in the middle of doing something else.
- Make sure you have the full attention of whoever you are talking to.

LACK OF ASSERTIVENESS



LACK OF ASSERTIVENESS

- Inability to express thoughts, feelings, opinions, beliefs and needs with confidence. Inability may lead to problems being ignored.

“Being assertive does not mean being aggressive. It is an honest and appropriate expression of one’s feelings, opinions, and needs.”

~ Edel Jarboe

LACK OF ASSERTIVENESS

Performance Connection

- In group settings, some people are hesitant to express their opinions.
 - Affects work planning, JHA, safety concerns.
- New employees may not ask relevant questions, even when uncertain.
 - Can cause accidents, rework, quality issues.
- Some employees will not contradict managers.

LACK OF ASSERTIVENESS

Learning from Experience

- **Severe Hand Injury to Worker Using a Table Saw**
- **Lesson ID:** INL-BEA-LL-2006-021 (*Source: User Submitted*)
- **Statement:** This accident could have been prevented. The lessons gleaned from this report are not unique to the affected research and development directorate. This event provides a case study showing the importance of each of the ISMS Core functions and Guiding Principles. Management must ensure that the workers and those supervising work have competence commensurate with responsibilities. This also must be coupled with clear roles and responsibilities communicated to those in direct supervision of the work.

LACK OF ASSERTIVENESS

Learning from Experience

- **Severe Hand Injury to Worker Using a Table Saw**
- **Discussion:** At approximately 9:15 a.m., on Wednesday, January 11, 2006, a newly hired electro/mechanical technician (the “Technician”) sustained a serious injury to his right hand while operating a table saw
- The Technician received a brief introduction into standard laboratory practices and processes with only the general training topics noted on the New Employee Checklist on his first day of work.
- On the same day at the facility, he reviewed two facility safety-related documents and five facility Job Safety Analysis (JSA) documents. He then signed, indicating the documents were understood.



LACK OF ASSERTIVENESS

Learning from Experience

- **Severe Hand Injury to Worker Using a Table Saw**
- On the Technician's second day of work, an authorization to operate machinery was signed off for the fabrication equipment that would be used that day.
- When work tasks changed or necessitated a reconfiguration of the table saw, the Technician sought assistance to remove the table saw blade-guard. He then proceeded to make dado cuts in previously cut-to-size plywood pieces.
- The final task to be performed by the Technician that day was that of rip cutting 2 inch thick polyethylene foam sheet into 2.75 inch wide strips. The affected employee continued to rip-cut without the blade guard in place. He used his hand to guide the foam. The accident occurred as the final rip-cut was being performed.

LACK OF ASSERTIVENESS

Learning from Experience

- **Severe Hand Injury to Worker Using a Table Saw**
- **Analysis:** Management was inattentive to a number of deficiencies in work control processes and allowed informality in execution of the integrated safety management program.
- The management assessments and oversight were ineffective in identifying implementation deficiencies in the Independent Hazard Review process.
- These were missed opportunities to evaluate the safety aspects of projects; training and skill level of personnel; to note the deficiencies in existing Job Safety Analysis'; and ensure rigorous implementation of requirements and expectations.

LACK OF ASSERTIVENESS

Safety Valves

- Practice your values and beliefs.
- Practice the company's values and beliefs.
- Refuse to compromise company and personal standards.
- Ask for what you need.
- Don't be afraid to express your opinion and ideas.
- Recognize your contributions matter.
- Learn how to be assertive on the job.

PRESSURE



PRESSURE

- A feeling of being overwhelmed by demands that a task be performed faster, cheaper, better.
- Can come from peers or manager or self.

“The only pressure I’m under is the pressure I’ve put on myself.”

~ Mark Messier

PRESSURE

Performance Connection

- Demands are sometimes made for workers to:
 - Meet unrealistic deadlines.
 - Be multiskilled.
 - Do many tasks in a workday, while multitasking.
 - Be as good or better than coworkers.
 - Perform all tasks safely and without error.
- Over time or anytime, these pressures can cause performance problems.

PRESSURE

Learning from Experience

- **Department of Energy Hoisting and Rigging Events**
- **Lesson ID:** DOE Special Report 2004-1 (*Source: User Submitted*)
- **Statement:** Safety Challenges Remain
- For instance, during the 36-month period from January 1, 2001 through December 31, 2003, 18 workers were injured and approximately 86 others were involved in near miss events.
- **Discussion:** The purpose of this report is to describe the commonly made errors in these incidents and to identify the lessons learned and specific actions that should be taken to prevent similar incidents from recurring.
- **Analysis:** Unforeseen Conditions must be addressed before the overall project can continue as planned and on schedule. Many times these problems require the use of H&R equipment in a “one-time” application, or an operation that has never before been performed by the personnel assigned. Often **pressure** to “get the job done” results in actions that can permit disastrous consequences (i.e., personal injury and/or property damage).

PRESSURE

Safety Valves

- Don't overwhelm yourself or others.
- Don't be afraid to ask for help.
- Communicate your concern to your manager and coworkers.
- Don't create a false sense of urgency.
- Don't take shortcuts; do the job right.
- Say no to pressure.
- Develop good planning and coping skills.

LACK OF TEAMWORK



LACK OF TEAMWORK

- Interdependent individuals not working together to achieve a common goal.

“In a growing number of industries, investigators have found that a large number of accidents have been caused primarily by a breakdown in team performance.”

~ Robert Helmreich

LACK OF TEAMWORK

Performance Connection

- When goals and vision are unclear, people on the team can be activity-driven instead of results-driven.
- Roles and responsibilities, if not clear, cause confusion and frustration..
- Communication problems lead to performance issues.
- Decisions are made by one or two people in the group, without the team's knowledge.
- Problems and underlying issues may not be addressed.

LACK OF TEAMWORK

Learning from Experience

- **Team Approach Effective Handling and Removal of UF-6 Line**
- **Lesson ID:** 2004-SR-WSRC-0039 (*Source: SELLS*)
- **Statement:** During deactivation of the 247-F Facility at SRS, uranium hexafluoride (UF₆) process lines needed to be removed. The project team evaluated the hazards and devised a plan to eliminate or mitigate each hazard.
- Project personnel employed a "team hazards analysis" approach using the Automated Hazards Analysis (AHA) program. Team members from Industrial Hygiene, Engineering, Radiological Controls, and Project Management participated in briefings and conducted mockup training.

LACK OF **TEAMWORK**

Safety Valves

- Clarify the team goals.
- Have an improvement plan.
- Clearly define the roles.
- Clear communication.
- Beneficial team behavior.
- Well-defined decision procedures.
- Balanced participation.
- Establish ground rules.
- Be aware of the group process.
- Use the scientific approach.

LACK OF RESOURCES



LACK OF **RESOURCES**

- Supplies, parts, personnel are not available for a job or task.

**For want of a nail
the shoe was lost.
For want of a shoe
the horse was lost.
For want of a horse
the rider was lost.
For want of a rider
the battle was lost.
For want of a battle
the kingdom was lost.
And all for the want
of a horseshoe nail.**

LACK OF **RESOURCES**

Performance Connection

- When supplies are not available, employees spend time trying to find substitutes.
- When parts are not available, delays are necessary while a part is ordered, made, or retrofitted.
- Employees may be tempted to omit steps that require a missing resource.
- Employees may “guess” at a solution, if the correct resource is not available.

LACK OF RESOURCES

Learning from Experience

- **Technical Capability To Track Known Problems And Manage Them To Resolution Is Essential**
- **Lesson ID:** NNSA-04-CAIB-TC-02 (*Source: User Submitted*)
- **Lack of resources** dedicated to data analysis, trending, and communication has resulted in NNSA being more reactive (to issues identified by others such as the DNFSB and OA) rather than identifying issues before others do.
- **Actions:** NNSA appears to be similar to NASA in both its need for capturing, analyzing and sharing safety information and its limited capability to do so.

LACK OF **RESOURCES**

Safety Valves

- Assess needs for new parts before beginning a job.
- Purchase and maintain critical parts inventory.
- Build a network with others in the company, vendors, and contractors.
- Don't compromise standards if the correct resources are lacking.
- Don't use work arounds if you don't have the proper parts or supplies.

LACK OF KNOWLEDGE



LACK OF KNOWLEDGE

- Deficiency in understanding how to do a task safely and correctly.

**My people are destroyed for lack of
knowledge**
~ Hosea

LACK OF KNOWLEDGE

Performance Connection

- Factors contributing to lack of knowledge:
 - Inadequate training
 - New equipment
 - Procedures and regulations
 - New technology
- Provide adequate training and reference materials.
- Use resources like the expertise of other people on shift, other people, and the manufacturer's manual.
- Teamwork and communication help to reduce the potential error due to the lack of knowledge.
- Address all changes, including temporary ones.

LACK OF KNOWLEDGE

Learning from Experience

- **Minor Shock from Improperly Grounded Subcontractor-Supplied Equipment**
- **Lesson ID:** 2004-RL-HNF-0027 (*Source: SELLS*)
- **Statement:** An FH deactivation and decommissioning (D&D) subcontractor received a minor shock from subcontractor-supplied equipment, which had an improperly terminated ground wire. The equipment was not listed by a Nationally Recognized Testing Laboratory (NRTL) or labeled by a qualified UL 508A firm.
- The direct cause of the shock was a poorly terminated ground wire in the pendent cable causing an electrical potential of 76 volts from the connector to ground, likely from induced voltage in the ground wire.
- The root cause of this situation was judged to be *lack of knowledge* of Hanford Electrical Safety Program requirements.

LACK OF **KNOWLEDGE**

Safety Valves

- Get the necessary training.
- Be a lifelong learner.
- Use procedures and manuals.
- Don't do a task if you don't know how to do it.
- Ask someone who knows.
- Don't let pride get in the way.

THE DIRTY DOZEN

- Stress
- Fatigue
- Complacency
- Distractions
- Lack of Awareness
- Norms
- Lack of Communication
- Lack of Assertiveness
- Pressure
- Lack of Teamwork
- Lack of Resources
- Lack of Knowledge

THE DIRTY DOZEN

- Learning through Experience

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Some learn from their own mistakes,
Some never learn.*

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