Human Performance Engineering

"Sharing best Practices to Protect Electricity Networks from Natural Disasters"

Vienna, July 2nd 2014
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National Critical Energy Infrastructures vary within the different Member States of the OSCE, but they have at least one challenge in common. All are all obliged to ensure that they can continue to function in the most adverse conditions since their breakdown can have catastrophic consequences - as shown during the fatal Fukushima incident.

How can National Critical Energy Infrastructures be protected against man-made or natural threats?

What are the best strategies to manage major blackouts?

How to assess and manage these risks for Critical Energy Infrastructures in the best way?

Definitions

(EU Council Directive 2008/114/EC)

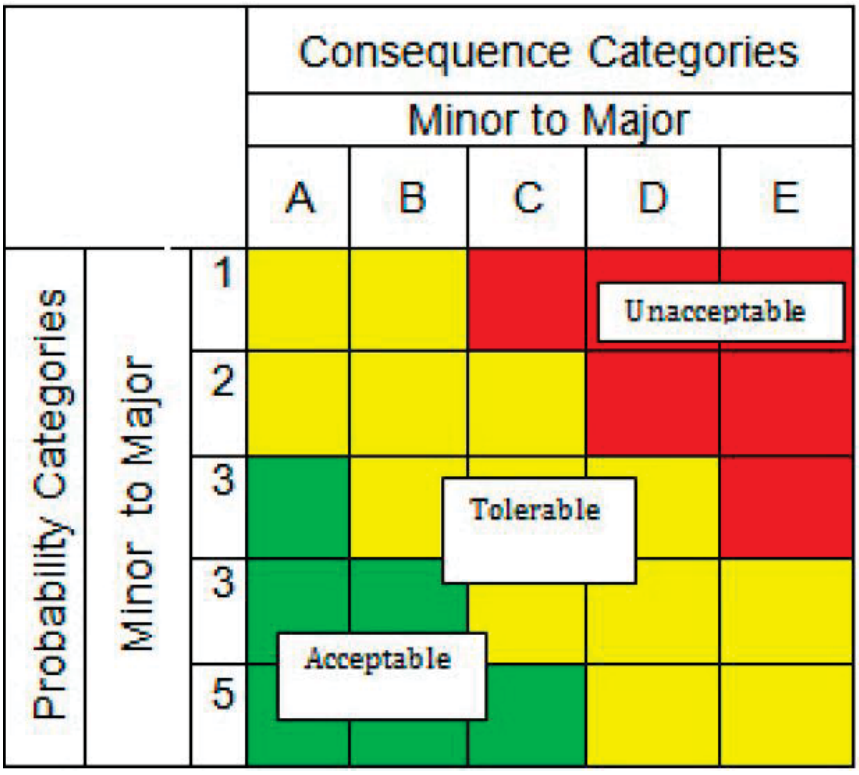
- **Article 2, (a),Critical infrastructure'** (ECI)means an asset, system or part thereof located in Member States which is essential for the maintenance of vital societal functions, health, safety, security, economic and social well-being of people, and the disruption or destruction of which would have a significant impact on Member State
- ECI:
  - Energy :
    - Electricity
    - Oil
    - Gas
  - Transport
    - Road
    - Rail
    - Air
    - Waterways & Ocean

- **Article 2, (e) ,Protection'**

Means all activities aimed at ensuring the functionality, continuity, and integrity of critical infrastructures in order to deter, mitigate, and neutralise a threat, risk or vulnerability

- **ECI** is defined by cross-cutting criteria:
  - Causalities criterion
  - Economic effect criterion including potential environmental effects
  - Public effect criterion (public confidence, physical suffering, disruption of daily life,loss of essential services..)

Risk matrix



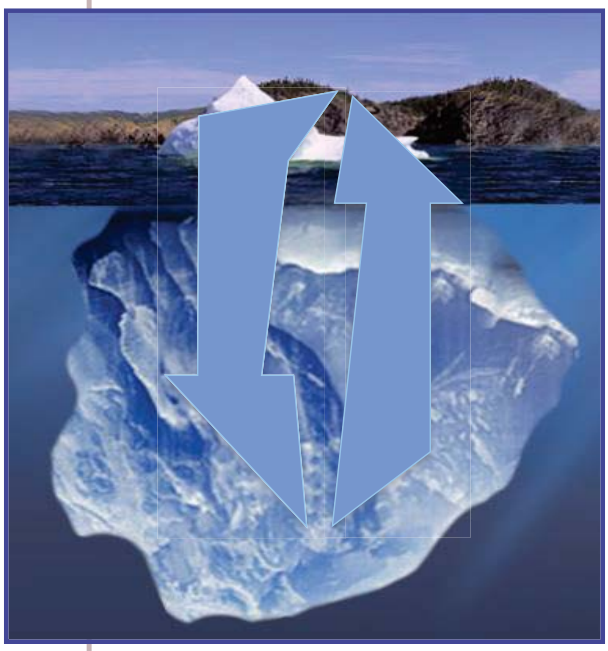
What Causes ECI Accidents?

- Nature phenomena (earthquake, tsunami, flooding,..) including solar storms
- Underestimation of hazards/risk in all organizational level (lack of Safety culture)
- Design Flaws
- Failure of Control Systems
- Lack of Maintenance
- Operator Fatigue- Human failure
- Poor risk analyses and plan for risk mitigation
- Risk accumulation /multidimensional combination/

Human error and unsafe behaviour accounts for almost 80% of all accidents

Edgar Scheins Metaphor of Culture

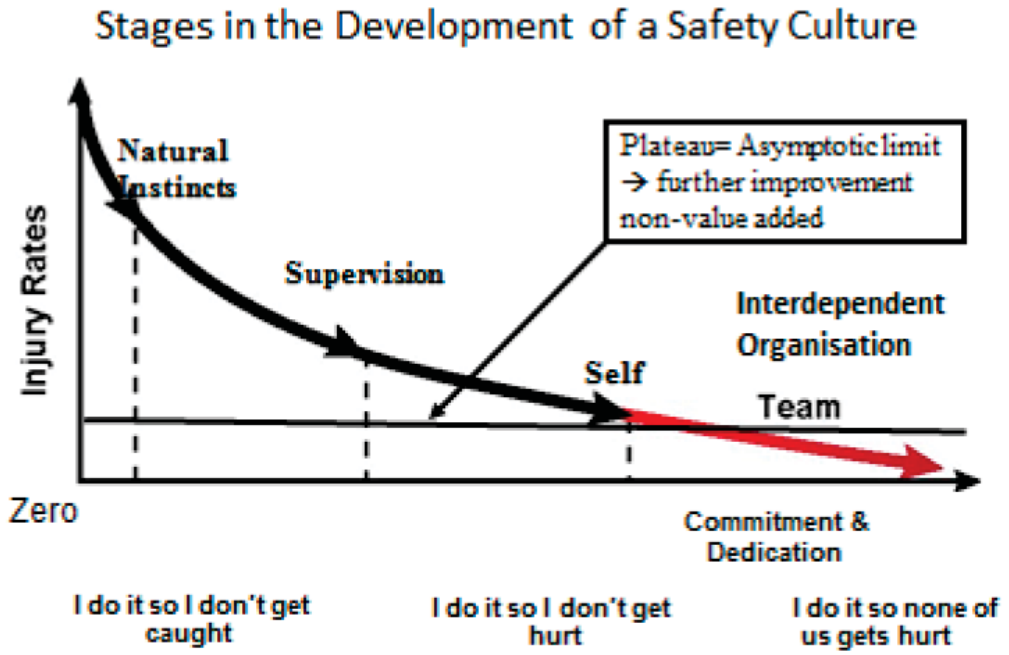
Most of the culture is below the surface



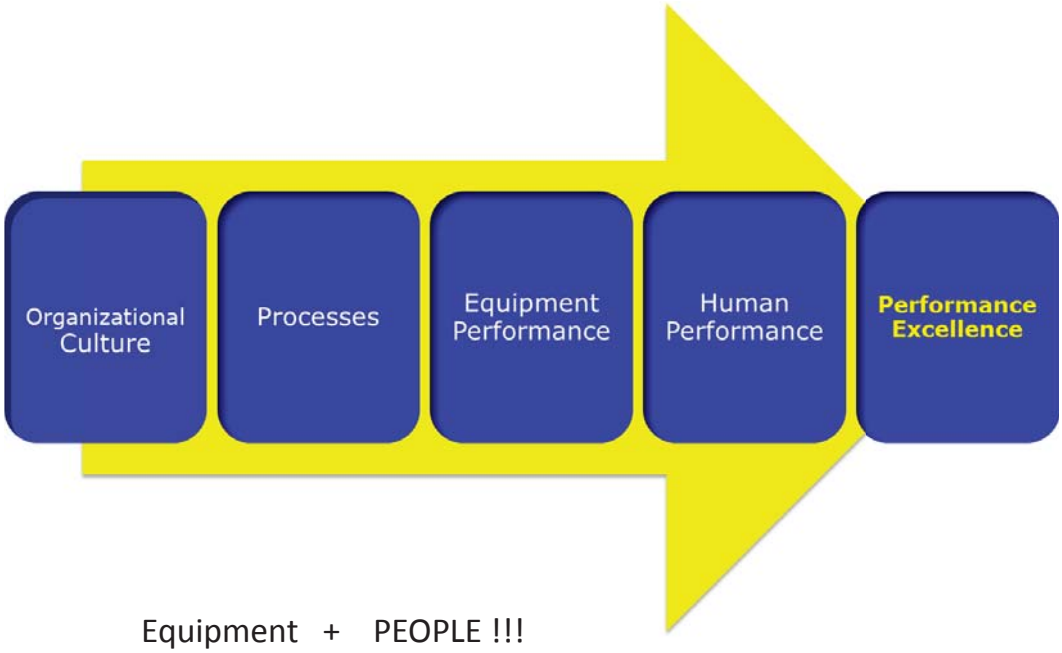
Above the surface we find: the visible aspects of culture: artefacts, people's actions, language use

Below the surface we find:
norms
values
fundamental assumptions of reality – *the shared understandings*

Safety culture levels

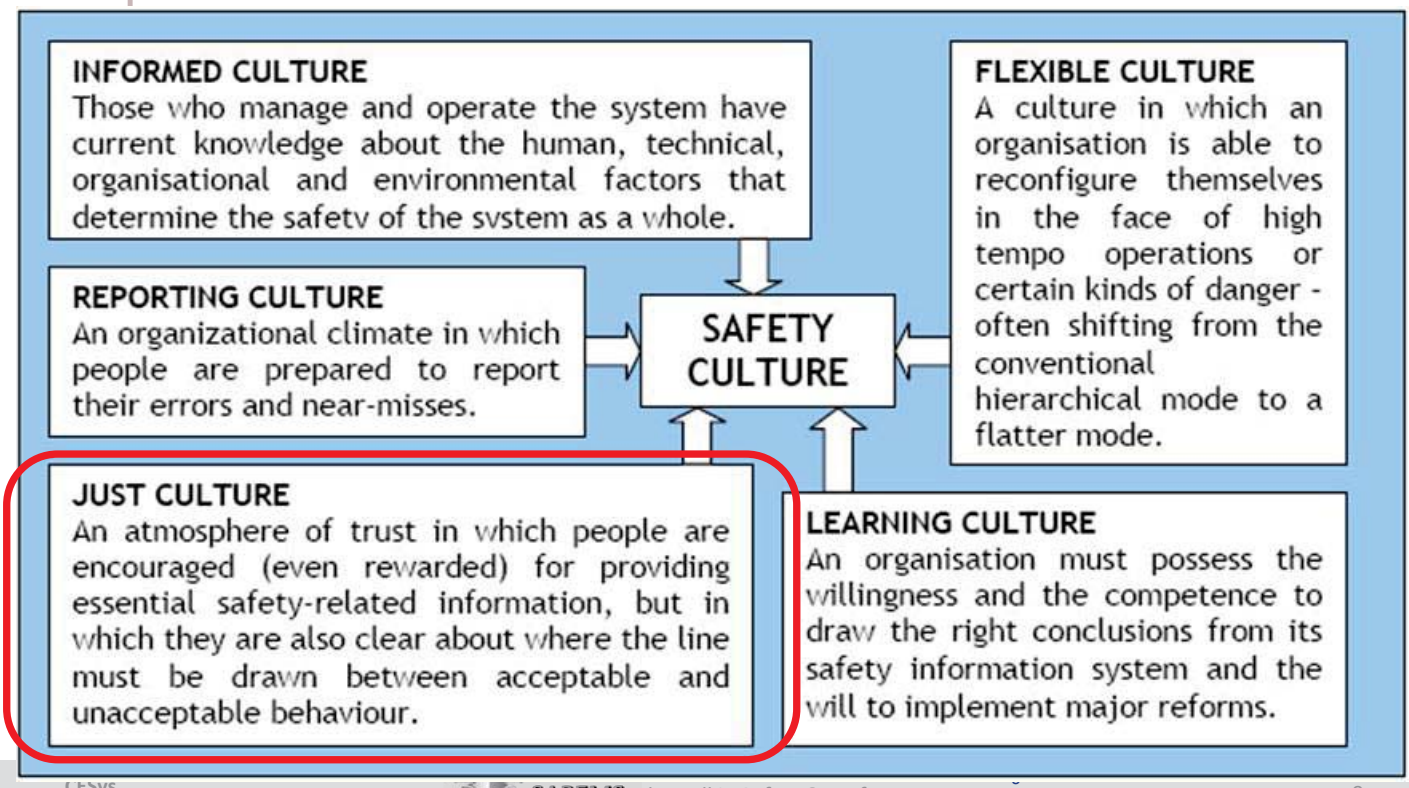


Focus on performance drivers



Equipment + PEOPLE !!!

James Reason – Five components of Safety Culture



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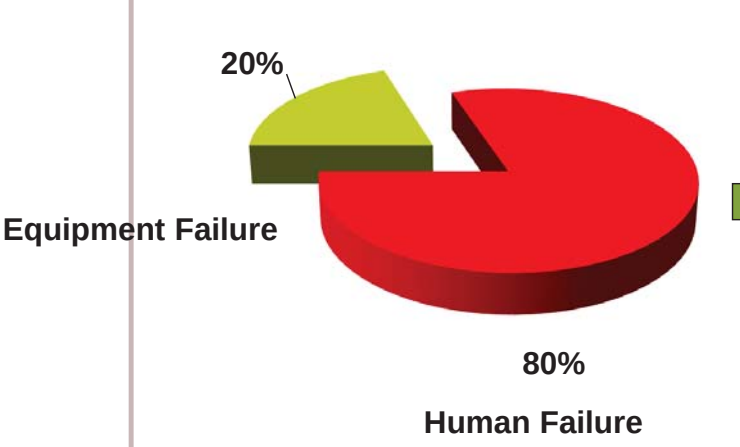
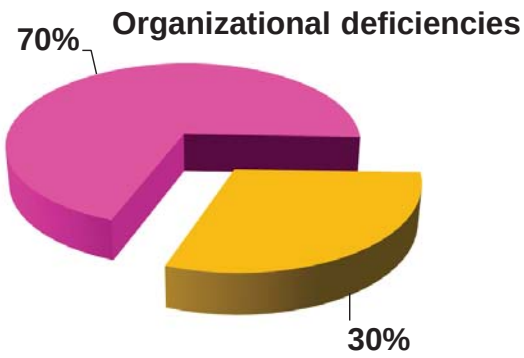
Introduction

Direct Causes of Events



Causes of Human Failures



What is Human Performance?

A series of behaviors executed to accomplish a specific task.

$$P = B + R$$

Performance = Behavior + Result

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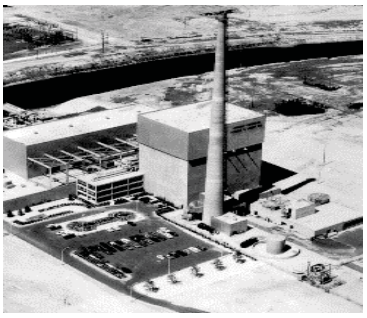
Introduction

Expected BEHAVIORS are the proper use of these <u>Error Prevention Tools</u>

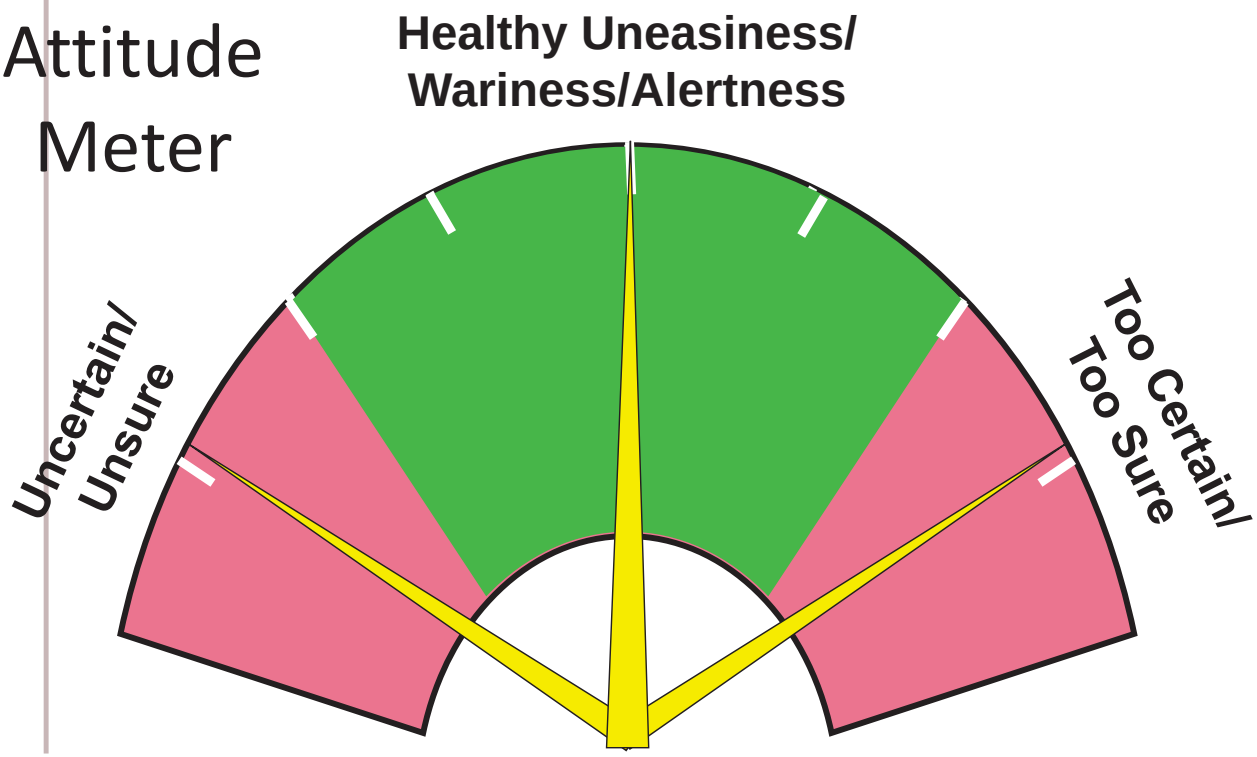
- **Pre-Job Briefings**
- **Procedure Use and Adherence**
- **Self Checking**
- **Peer Checking**
- **Effective Communications / Phonetic Alphabet**
- **Questioning Attitude**
- **…**

Desired Attitudes

- Uneasiness for & intolerance of error traps
- Belief in the effectiveness of the rigorous use of error-prevention tools
- Vigilant situational awareness
- The will to communicate
- Value relationships



Attitude Meter



Error *Likely* *Situation*

Unintentional deviation from preferred behavior

Risk Factors

- **Task**
- **Work Environment**
- **Individual Capabilities**
- **Human Nature**

Significant probability of an error due to *risk factors* (error precursors) is an error likely situation.

- Humans are fallible . . . even the best ones
- Error likely situations are predictable and error can be avoided
- Organization influences behavior …
- Behaviors are reinforced …
- If we understand causes, events are avoidable

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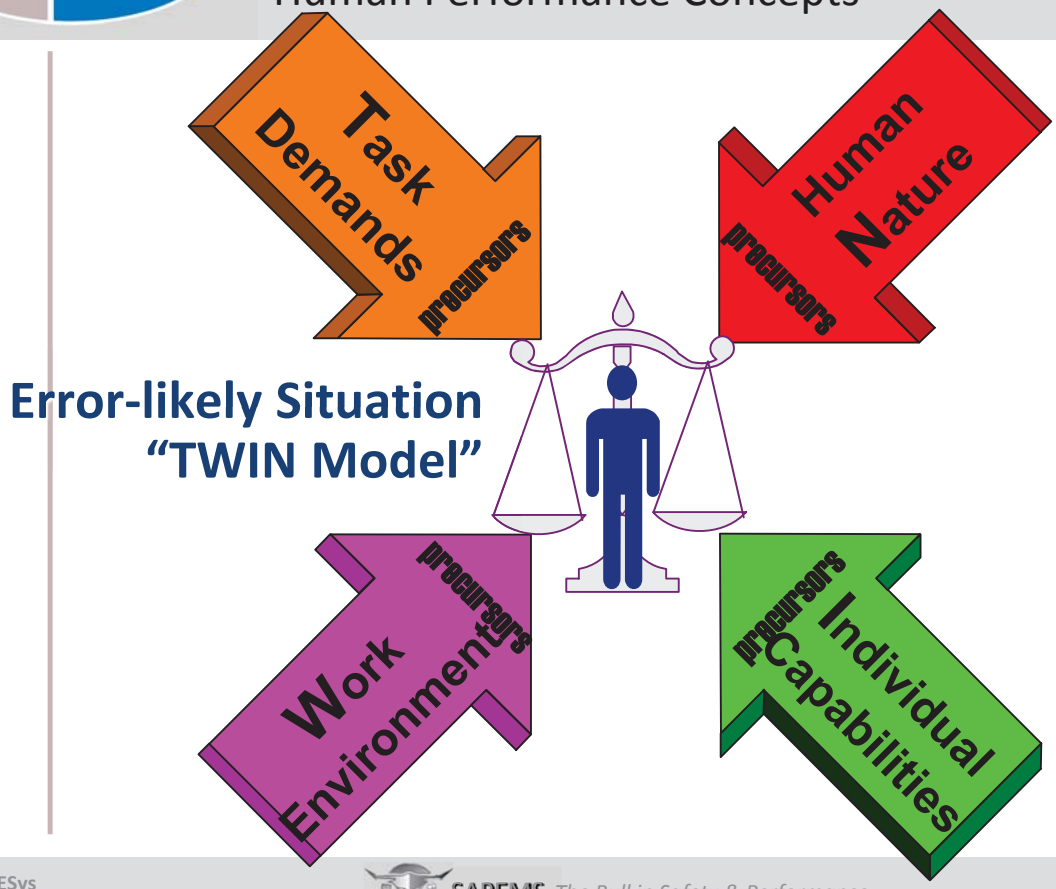
Human Performance Concepts



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Error Precursors … not a full list

Task Demands	Individual Capabilities
• Time pressure (in a hurry)	• Unfamiliarity with task / First time
• High Workload (memory requirements)	• Lack of knowledge (mental model)
• Simultaneous, multiple tasks	• New technique not used before
• Repetitive actions, monotonous	• Imprecise communication habits
• Irrecoverable acts	• Lack of proficiency / Inexperience
• Interpretation requirements	• Indistinct problem-solving skills
• Unclear goals, roles, & responsibilities	• "Unsafe" attitude for critical task
• Lack of or unclear standards	• Illness / Fatigue
Work Environment	**Human Nature**
• Distractions / Interruptions	• Stress (limits attention)
• Changes / Departures from routine	• Habit patterns
• Confusing displays or controls	• Assumptions (inaccurate mental picture)
• Workarounds / OOS instruments	• Complacency / Overconfidence
• Hidden system response	• Mindset ("tuned" to see)
• Unexpected equipment conditions	• Inaccurate risk perception (Pollyanna)
• Lack of alternative indication	• Mental shortcuts (biases)
• Personality conflicts	• Limited short-term memory

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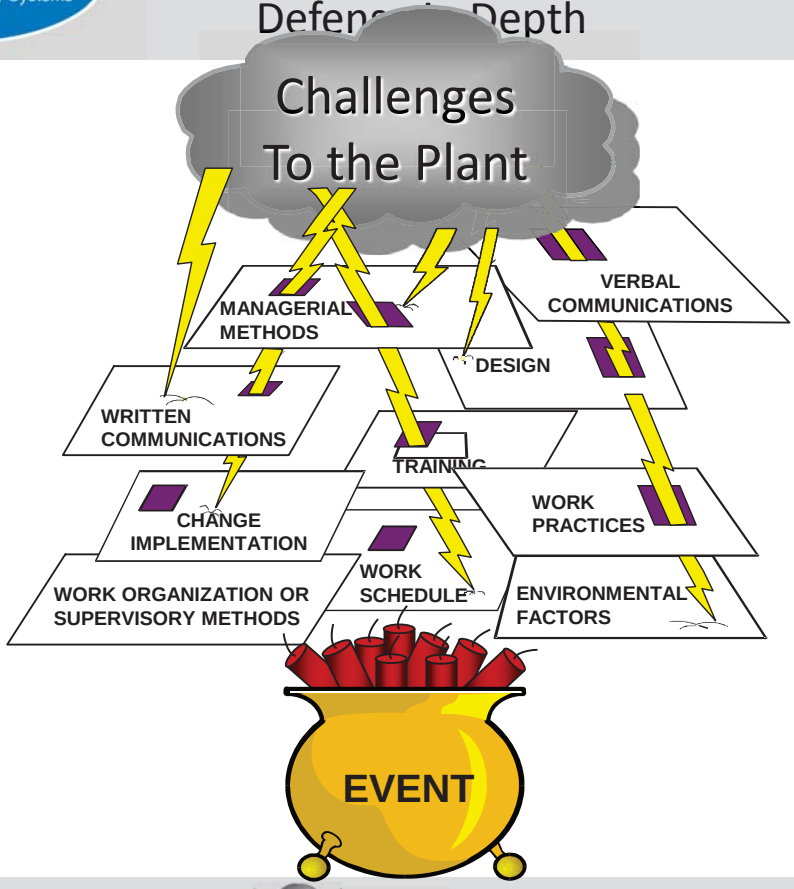
Defen[illegible] Depth



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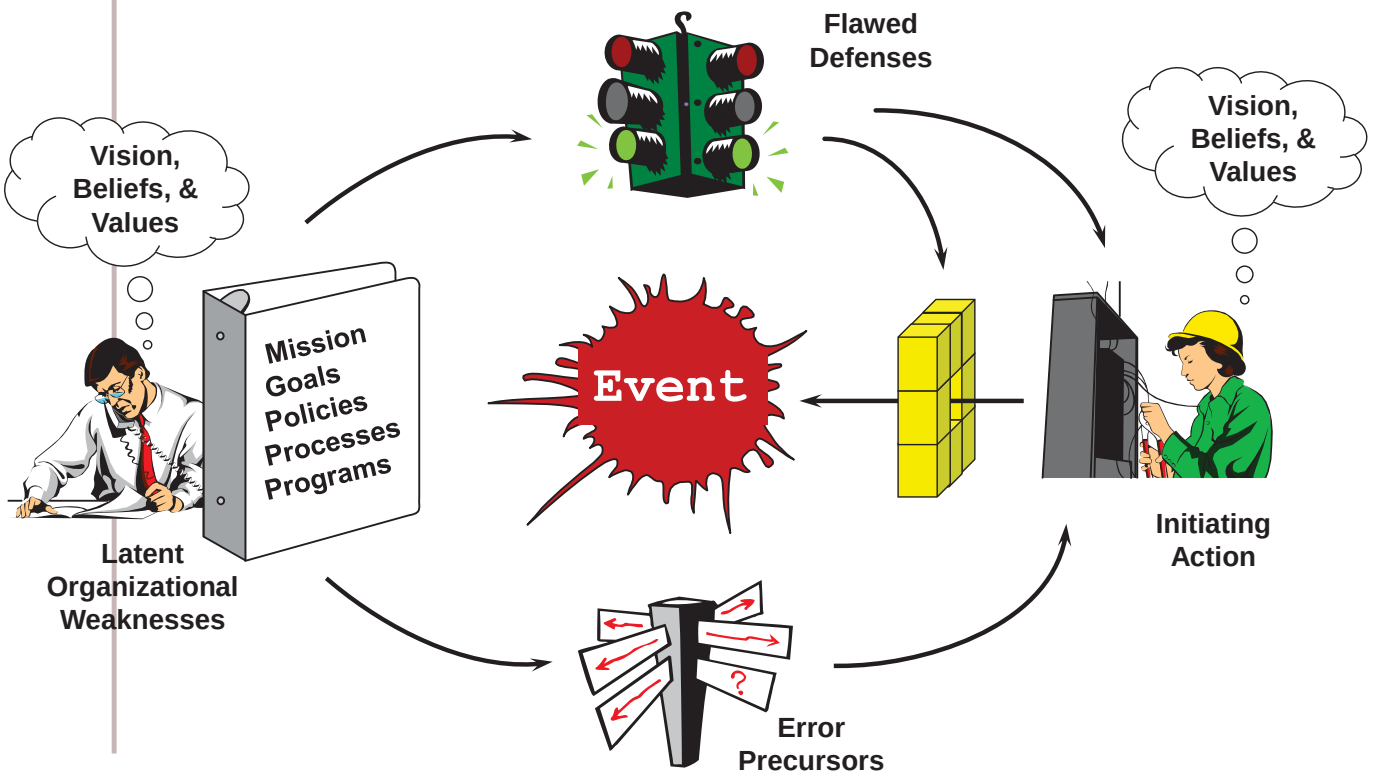
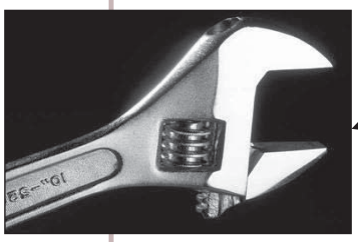
Anatomy of an Event



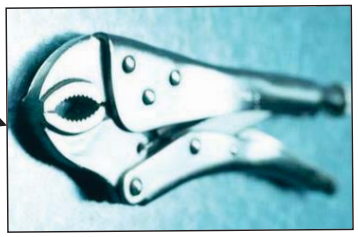
Questioning Attitude/
Stop When Unsure

Effective
Communication

Human
Performance
Toolbox



Two-Minute Drill



Pre-Job Briefs

Self-Checking

Procedure Use & Adherence

Peer-Checking

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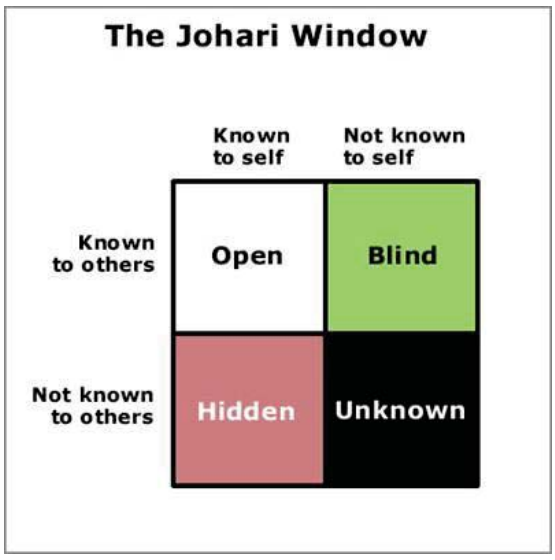
Effective communication

- The goal is mutual understanding between two or more people
- Especially communication involving technical information related to plant operation or personnel safety
- 2 tools:
  - Three-way Communication
  - Phonetic Alphabet



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Pre-Job Briefing

- A pre-job briefing is a dialogue between workers and leaders held prior to performing a job to discuss the tasks involved, hazards, and related safety precautions.
- Ensures understanding of task scope.
- Ensures understanding of roles and responsibilities.
- Anticipates problems and identifies responses.
- Discusses plant and/or industry lessons learned and operating experience.
- Minimizes the potential for making mistakes

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Peer checking

- It is a series of actions by two individuals working together at the same time and place, before and during a specific action – critical step, to prevent an error by the performer.
- Involves two people (performer and peer) self-checking in parallel, agreeing together that the action is the correct action to perform on the correct component.
- The peer, an individual familiar with the activity, may see hazards the performer does not see.

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Procedure use and adherence

- Procedure adherence means understanding the procedure's intent and purpose and following its direction.
- The user performs all actions as written in the sequence specified by the document. If it cannot be used as written, then the activity is stopped and the procedure is corrected before continuing.
- Place Keeping
  - Prevents omitting or duplicating steps in a document.
  - Maintains a record of steps completed and those not yet performed.
  - Helps procedure users to return to the last step performed after interruptions or delays.

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Self-checking

- Self-checking helps the performer focus attention on the appropriate component, think about the intended action, understand the expected outcome *before* acting, and verify the results after the action.

1. **Stop** – Focus on the task's objective.
2. **Think** – Understand what will happen when the correct action is taken on the correct component.
3. **Act** – Perform the correct action on the correct component.
4. **Review** – Verify anticipated result obtained.

- A questioning attitude fosters situational awareness, encouraging thought about safety before action is taken.

1. **Stop, Look, and Listen** – Proactively search for work situations that flag uncertainty.
2. **Ask** questions – Gather relevant information.
   - » Use Qualification, Validation, & Verification (QV&V)
3. **Proceed if sure** – Continue the activity if the uncertainty has been resolved with facts. Otherwise, STOP!
4. **Stop when unsure** – If inconsistencies, confusion, uncertainties, or doubts still exist, do the following:
   - » Stop the activity, place equipment and the job site in a safe condition.
   - » Notify your immediate leader.

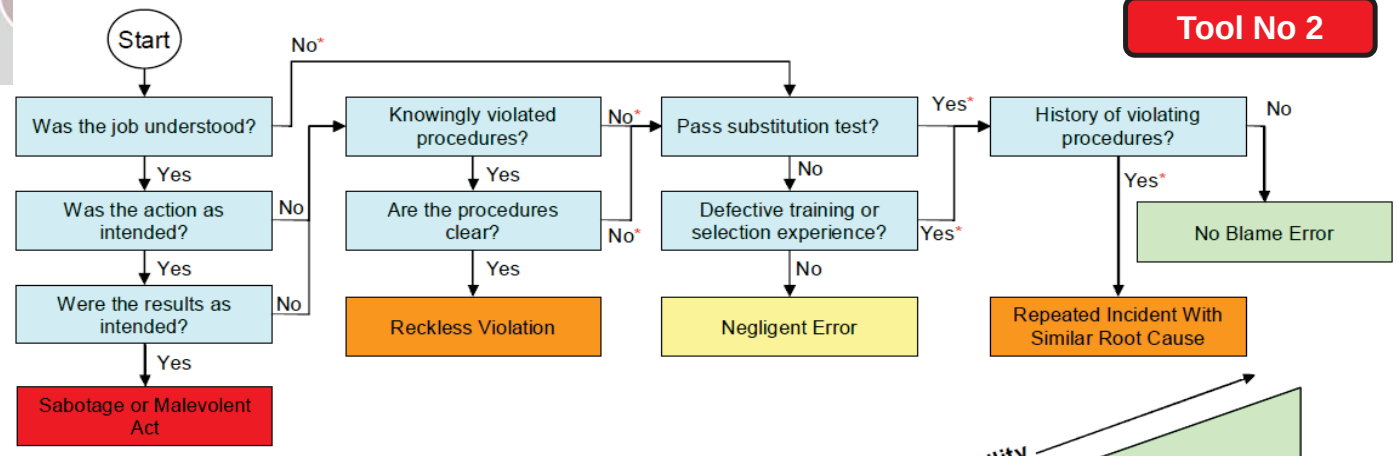
Culpability tree implementation Just Culture Principle

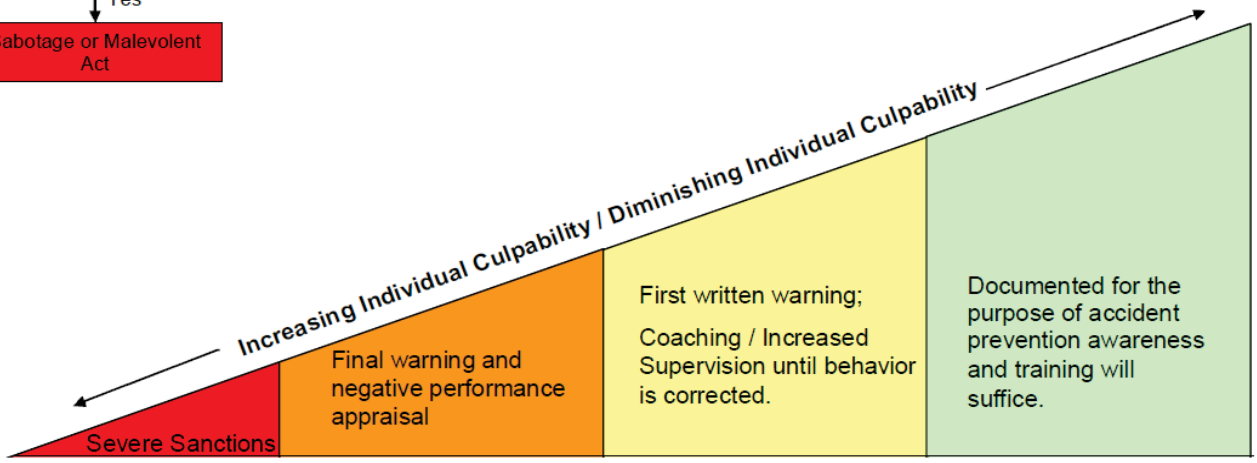
What it is?

How it is related to safety culture reinforcement?

Just Culture Process

Tool No 2





* Indicates a 'System' induced error. Manager/supervisor must evaluate what part of the system failed and what corrective and preventative action is required. Corrective and preventative action shall be documented for management review.

Confidential reporting

Why?

Industry statistics

- 8 from 10 safety significant events was caused with contribution of human failure
- 75% reported events at is caused by human error
- 15% - 20% of production loss are results of incorrect company decisions
- Trust is important factor in reporting

Weekly Safety Message

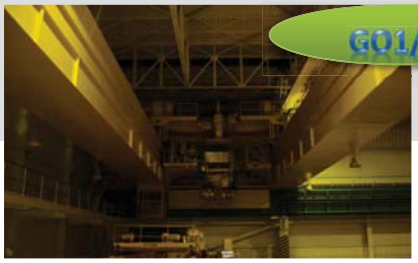
How it is related to safety culture reinforcement?

Weekly Safety Message

Goal?

- **Initiate regular discussion** between management and employees on safety issues.
- **Reinforce a risk awareness** environment
- **Reinforce an involvement and responsibility** of each employee for SC improvement
- **Achieve common understanding** and implementation of values and behaviors which support SC principles

1. **Everyone is personally responsible for safety.**
2. Leaders demonstrate commitment to safety.
3. Trust permeates the organization.
4. Decision making reflects safety first.
5. The nuclear technology is recognized as special and unique.
6. **A questioning attitude is cultivated.**
7. **Organizational learning is embraced.**
8. Safety undergoes constant examination.



Week 16

Relates to SC principles: 1, 6, 7

•When lifting, slinging and handling loads safety is a priority

• Safe behaviour examples

- ✓ I only carry out lifting and slinging work with the required qualification.
- ✓ As a slinger I monitor the whole path of the load. I make sure it is not transported over people working below and I myself do not stand under the load.
- ✓ As a slinger I warn people about the load moving above them in a timely manner.
- ✓ When a load is lifted in a complex environment, an independent supervisor is called for.
- ✓ Before working with lifting equipment I review its functioning and make sure there are no unsecured objects that may fall.

Risks and unacceptable behaviours

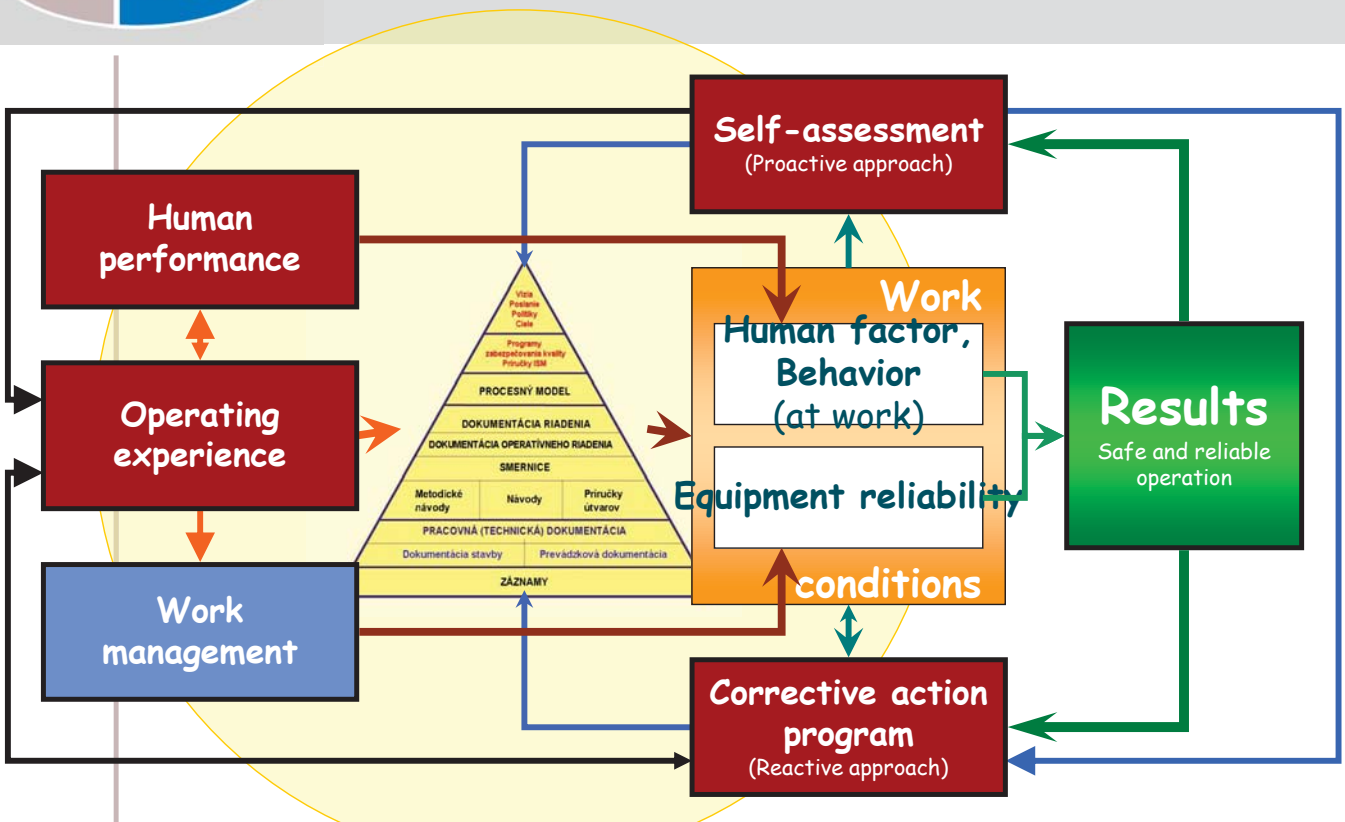
- ✘ Persons passing under the moving load do not avoid the load being transported.
- ✘ When transporting the load, the slinger does not move along with the load to warn the persons passing by.
- ✘ Managers are not trained about the basic rules of load lifting and slinging.
- ✘ Issues and near-misses related to slinging and lifting are not reported or investigated.

Safety Message of the Week

Area: **Occupational Health and Safety**

Author: **Maintenance – B2000**

Continues improvement processes



- **Roles and responsibilities**
  - –Managers
  - –Supervisors
  - –Workers
- **Process controls**
  - –Written expectations, …
  - –Procedures, guidelines, work plans, …
  - –Training – classroom & practical (dynamic training)
- **Performance monitoring**
  - –Event Free Clock Program

Human Error prevention Tools and Observation Program

Conclusion

To date the power energy infrastructure so far has shown an appropriate reliability level, but new threats can be foreseen.

Some of the threats are internal to the infrastructure, mainly due to the increasing complexity of many technical and market components, such as:

- the institutional fragmentation among the different states,
- menace of terrorism in the form of cyber attacks ,
- human failure,
- nature phenomena