The Human and Organizational Part of Nuclear Safety
Safety is more than the technology
The root causes

Organizational & cultural root causes are consistently identified as cross-cutting contributors to significant events:

- Insufficient understanding of the complexity of ‘reality’ by leaders (‘good news’ cultures, failure to encourage constructive challenge, compartmentalization)
- Insufficient connection and integration across consultant/contractor/vendor network
- Insufficient understanding of nuclear/process safety issues in decision-making and actions
- Normalisation of abnormal conditions or deviations
- Failure to learn from previous events and experiences
- Complacency
- Inability to invite the full intelligence of the organizational members into improvement processes
- Inadequate systemic approach to safety in oversight and supervision
Systemic Approach to Safety - The interaction between Human, Organisational and Technical factors (HOT)
The Interaction between individuals, technology and the organization

3.14. “An important factor in a management system is the recognition of the entire range of interactions of individuals at all levels with technology and with organizations. To prevent human and organizational failures, human factors have to be taken into account and good performance and good practices have to be supported.”
The Interaction between individuals, technology and the organization

- 2.32.”All safety barriers are designed, constructed, strengthened, breached or eroded by the action or inaction of individuals. Human factors in the organization are critical for safe operation and they should not be separated from technical aspects. Ultimately, safety results from the interaction of individuals with technology and with the organization.”

- 2.33. ”The concept of safety culture embraces this integration of individuals and technical aspects.
The Interaction between individuals, technology and the organization

• 2.34. “In a strong safety culture, there should be a **knowledge and understanding** of human behaviour mechanisms and established human factor principles should be applied **to ensure the outcomes for safety** of individuals–technology–organization interactions. This could be achieved by **including experts on human factors in all relevant activities and teams.**”
Systemic Approach to Safety

Same concept – different labels

- Systemic safety
- Systems view
- Holistic safety
- System safety
- Socio-technical system
- MTO/ITO/HOT

*This concept is not new it was born out of TMI*
Systemic Approach to Safety

Stressing the dimension of:

- Interactions
- Dynamics
- On-going
- Complexity
The weakest link

The technical factors are advanced and robust
• The safety principles are well developed
• The safety review services and assessments are effective
• The safety processes are advanced and well developed
All these are well structured and provides high level of safety

But, the root causes to accidents are not be found solely in the technology – they are rooted in the human and organizational constraints

The root causes are found in:
• How the technology is maintained
• How the safety principles and safety standards are implemented
• How the safety review services are assessments are utilized
By the humans and organizations
The safety science state the human and organizational factors interaction with the technology as the weakest link
Examples of Human, Organizational and Technical Factors

Organizational Factors (OF):
- Vision and objectives
- Strategies
- Integrated Management System
- Continuous improvements
- Priorities
- Knowledge management
- Communication
- Contracting
- Work environment
- Culture
- etc

Technical Factors (TF):
- Existing technology
- Sciences
- Design
- PSA/DSA
- I/C
- Technical Specifications
- Quality of material
- Equipment
- etc

Human Factors (HF):
- Human capabilities
- Human constraints
- Perceived work environment
- Motivation
- Individuals understanding
- Emotions
- etc
Complexity and Systemic Challenges in relation to Safety

Organizational Factors (OF):
- Alignment of vision and objectives
- Clear and appropriate strategies
- Current Integrated Management System
- Continuous improvements
- Priorities
- Transfer of knowledge
- Openness of communication
- Contractor management
- Systematic and continuous improvements of safety culture
- etc

Technical Factors (TF):
- Existing technology
- Advanced technology
- Automation
- Analogue/digital
- Modifications
- etc

Human Factors (HF):
- Job readiness
- Cooperation and teamwork
- Learning and reflection
- Stress and fatigue
- Motivation
- Individuals understanding
- Trust
- Self-management
- etc
The Complex Perspective

Examples of external factors which influence the ongoing interactions between HF, OF and TF

- Societal context
- Political climate
- Culture
- Peoples understanding
- Generational shift
- Implementation and reinforcement of Law – Regulations
- New management trends
- New sciences
- Public opinion
- Media
- International Standards
- Financial climate
- International Standards
Systemic View of Interactions between Organizations

- Legal Bodies
- Media
- Suppliers
- Universities
- Professional Associations
- Standards Organizations
- Lobby Groups
- Competing Energy Providers
- Work Unions
- Interest Groups
- Energy Markets
- International Bodies
- Vendors
- Technical Support Organizations
- Governmental Ministries
- Regulatory Body
- Licensee
- Waste Management Organizations
The complexity of the system
The researchers’ recommendations

To be better prepared for the unexpected organizations need to;

• **Avoid simplification – encompass the complexity**  
  High Reliability Organization (Weick & Sutcliffе)

• **Enhance organizational Mindfulness and Heedfulness**  
  High Reliability Organization (Weick & Sutcliffе)

• **Build organizational capabilities for flexibility and adaptation**  
  Resilience Engineering (Hollnagel, Paries, Woods)

Link to DVD and materials from the TM on Managing the Unexpected 
http://gnssn.iaea.org/NSNI/EaT/TM/Pages/MtU.aspx
The researchers’ messages

• It not enough to learn from past successes and failures

• Need to anticipate complexity of future possibilities

• Asking what we do not know

• Thinking out of the boundaries with the help of exposure to diversity of disciplines

• Cultivate a culture of inquiring

There is a tendency to rely on past experiences
The Hindsight bias

Figure 6: The orderliness of looking back.

Ref. Hollnagel
Figure 5: The indeterminacy of looking ahead.

Ref. Hollnagel, 1998
Reactive towards Proactive

The concept of HOT can be used as a tool to structure our thinking
Principles of HOT

Value and seek diversity through

- Ensure diversified competencies in teams
- Encourage diversity in thinking and opinions as it minimize simplification in safety decisions
- Be comfortable with ambiguity
- Encompass the complexity, the nature of dynamic and non-linear relationships
- Communicate through dialogue rather than argumentation to avoid polarization
The Human and Organizational factors

• Depends on the quality of interactions
• Ability to share information, knowledge and the understanding about the reality
• Level of collaboration
• Urge to think out of the boundaries – to continuously inquiry the boundaries of the unknown
Performance

- Depends on the ability and willingness of individuals to continuously think, engage, and demonstrate safe behaviours

- Shaped by:
  - Personal motivation
  - Shared space
Shared Space Characterized by

- Working relationships that support trust
- Decrease of power dynamics
- Mutual respect
- Openness – free flow in sharing of thoughts and ideas
- Enables individuals to express views related to their inner thoughts and feelings about a particular issue without fear of recrimination or exclusion
- Shared space goes deeper than sharing facts
- Dialogue instead of discussion/argumentation
The Difference....

Debate  Discussion  Dialogue
Ultimate Goal of Shared Space

To tap into the wealth of knowledge, experience and insight in the organization, and to build shared understanding that supports safe behaviours and good performance.
Shared space addresses the deeper levels of safety culture.
Shared space as a tool for cultural change
Human interactions and Shared Space

Me

Shared space

External space
Paradigm shift in the basic principles

To connect the earlier mentioned to nuclear reality we can look at one of the conclusions of the Investigation Committee on the Accident at the Fukushima Nuclear Power Stations of Tokyo Electric Power Company:

“The Investigation Committee is convinced of the need of a paradigm shift in the basic principles of disaster prevention programs for such a huge system, whose failure may cause enormous damage.”
The complexity of the system...
Nuclear Safety and Human Interactions

• What connects the factors (nodes) in the system is the capability/constrains of the interactions between humans and organizations
• The quality of how we interacting with each other have crucial influence of the outcome on a individual, group, organizational and inter-organizational level
• Mindfulness and Shared Space are tools to achieve effective continuous improvement of nuclear safety
...Thank you for your attention