



Canadian Nuclear  
Safety Commission

Commission canadienne  
de sûreté nucléaire

# ***Integration of Human and Organization Factors in Canada Enhancing Nuclear Safety***

***Presented to***

**International Atomic Energy Agency**

**International Conference on Challenges Faced by Technical and Scientific  
Support Organizations in Enhancing Nuclear Safety and Security**

***Presented by***

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**[nuclearsafety.gc.ca](http://nuclearsafety.gc.ca)**

# *Presentation Outline*



- Human and Organizational Factors (HOF)
- CNSC Regulatory Framework
- Practical Examples
- Benefits to Safety
- Conclusions

# *Human and Organizational Factors: Proactive Approach*



- If human and organizational factors are common to many major events, how can we integrate the treatment of HOF in a proactive manner to improve nuclear safety?
- How can the principles and guidance of the IAEA which relate to human and organization factors be operationalized?

# *Human and Organizational Factors*



## IAEA: Fundamental Safety Principles SF-1

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.”





# *Human and Organizational Factors and Management Systems*



## IAEA: The Management System for Nuclear Installations GS-G-3.5

“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**.”

# How to Operationalize IAEA Principles and Guidance



## Human Performance

### Organization

- Management system
- Safety Culture
- Assessment & continuous improvement
- Organizational Structure
- Roles and Responsibilities
- Minimum staff complement

### Technology

- Plant design
- Equipment design & user interface
- Task design and allocation
- Physical work environment
- Procedures

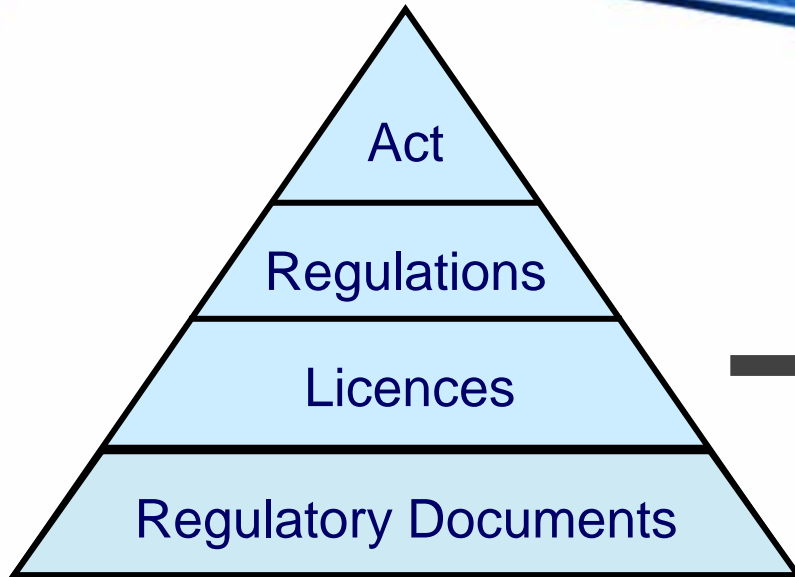
### Individuals

- Training, qualification & certification
- Work practices: 3-way communication, procedure adherence, independent verification
- Fitness for duty
- Hours of work

### Examples of Factors Supporting Human Performance

***Human and organizational factors related to the organization, technology, and workers can be conceptualized as the foundation that supports human performance.***

# CNSC Regulatory Framework: Human & Organizational Factors



- **Management system**
- **Human performance**
- **Minimum staff complement**
- **Training**
- **Certification and examination**



**Human and Organizational Factors**  
**Regulatory Documents: [nuclearsafety.gc.ca](http://nuclearsafety.gc.ca)**

# HOF Related Regulatory Documents



## Human and Organizational Factors - Specific

- Personnel Training
- Personnel Certification
- Minimum Staff Complement
- Human Factors Engineering Program Plans
- Human Factors Verification and Validation

## Human Factors and Organizational - Integrated

- Accident Management
- Nuclear Emergency Preparedness and Response
- Maintenance Programs
- Design of new Power Plants
- Licence Application Guide

## National Standards

- Management Systems
- Human Factors in Design



# *Safety and Control Area (SCA) Framework*



- Identifies the technical topics CNSC staff use across all regulated facilities and activities
- Establishes an integrated approach to gathering, collecting, managing and presenting information used for licensing and compliance purposes
- Formalizes the treatment of cross-cutting topics such as human and organizational factors
- Provides structure to the regulatory framework and CNSC research program

# CNSC SCA Framework



Functional Area	Safety and Control Area
Management	<ul style="list-style-type: none"><li>1. Management</li><li>2. Human Performance Management</li><li>3. Operating Performance</li></ul>
Facility and Equipment	<ul style="list-style-type: none"><li>4. Safety Analysis</li><li>5. Physical Design</li><li>6. Fitness for Service</li></ul>
Core Control Processes	<ul style="list-style-type: none"><li>7. Radiation Protection</li><li>8. Conventional Health and Safety</li><li>9. Environmental Protection</li><li>10. Emergency Management and Fire Protection</li><li>11. Waste Management</li><li>12. Security</li><li>13. Safeguards</li><li>14. Packaging and Transport</li></ul>

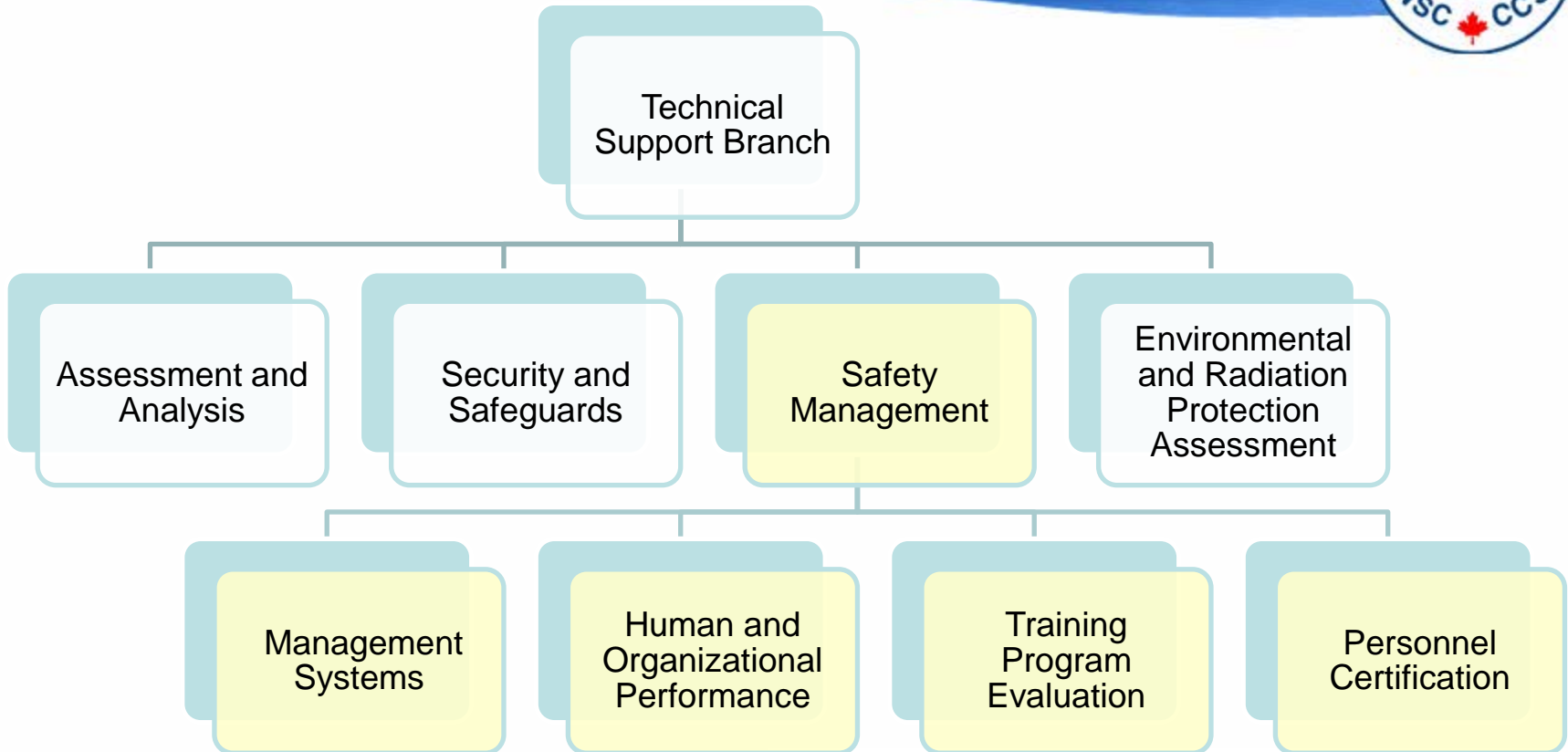
# Human and Organizational Factors in the SCA Framework



Safety and Control Area	Specific Areas
<b>1. Management System</b>	<ul style="list-style-type: none"> <li>•Management System</li> <li>•Organization</li> <li>•Performance Assessment and Management Review</li> <li>•Operating Experience</li> <li>•Change Management</li> <li>•Safety Culture</li> <li>•Configuration Management</li> <li>•Records Management</li> <li>•Management of Contractors</li> </ul>
<b>2. Human Performance Management</b>	<ul style="list-style-type: none"> <li>•Human Performance Programs</li> <li>•Personnel Training</li> <li>•Personnel Examination, Certification and Requalification</li> <li>•Minimum Staff Complement</li> <li>•Fitness for Duty</li> </ul>
<b>3. Operating Performance</b>	<ul style="list-style-type: none"> <li>•Procedures</li> <li>•Reporting and Trending</li> <li>•Accident Management and Recovery</li> </ul>
<b>4. Safety Analysis</b>	<ul style="list-style-type: none"> <li>•Human Actions in Safety Analysis</li> </ul>
<b>5. Physical Design</b>	<ul style="list-style-type: none"> <li>•Human Factors in Design</li> </ul>

# Technical Support Branch

## Directorate of Safety Management





# HOF Integration Opportunities



- Regulatory documents
- Fukushima Action Plan
- Emergency exercises
- Security exercises
- Multi-disciplinary inspection guides and teams
- Facility Assessment and Compliance Teams (FACT)
- Joint technical assessments
- Minimum Staff Complement (MSC) technical assessment



# *Example of Multi-Disciplinary Integration*

## *Technical Assessment of Licensee Minimum Staff Complement*



### **CNSC Team**

- Human and Organizational Performance (lead)
- Probabilistic Safety and Risk Assessment
- Security
- Site Inspectors
- Personnel Certification
- Emergency Management Programs
- Radiation Protection
- Environmental Monitoring
- Reactor Behaviour

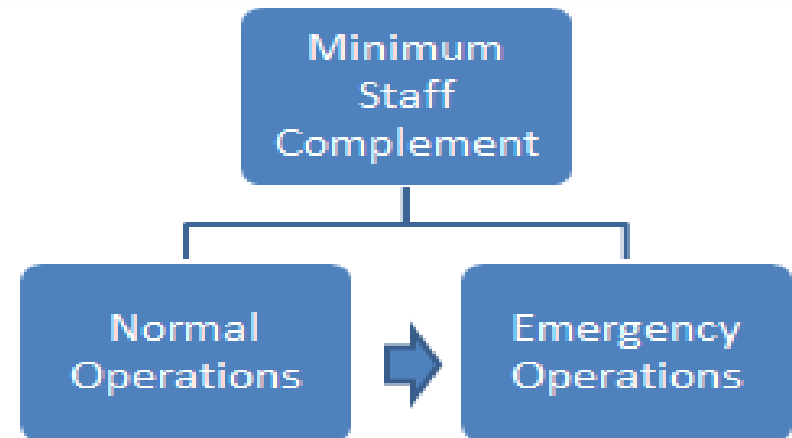


# Concept of Minimum Staff Complement



“ The minimum number of qualified workers who must be present at all times to ensure the safe operation of the nuclear facility and to ensure adequate emergency response capability”

This includes licensed and non-licensed operators, maintenance and emergency staff.



# Technical Assessment of Licensee Minimum Staff Complement



## Systematic Analysis

- **Goal:** Licensee identifies the most resource-intensive conditions under all operating states, design basis accidents and emergencies
- **Actions:** CNSC reviews analysis documentation, meet with the licensee to confirm the adequacy of the systematic analysis



## Validation

- **Goal:** Licensee determines the degree to which the design of the system facilitates the achievement of the overall safety goals
- **Actions:** CNSC observes validation activities demonstrating the adequacy of the minimum staff complement, reviews validation report





# ***MSC Technical Assessment: Benefits to Nuclear Safety***



- Validation of credited operator actions identified in the safety report
- Coordinated training for main control room and field staff in simulators and in the field
- Improved command and control practices when the main control room is uninhabitable
- Improved functionality and use of the emergency communications system
- Enhanced staff assembly and accounting procedures

***Holistic understanding of event  
progression and emergency response***

# ***Benefits to the Technical Support Branch with an Integrated Approach***



- Development of a cross-disciplinary knowledge base amongst specialists
- Facilitates knowledge transfer and management
- Improved working relationships between specialists and with the regulatory operations branch
- Breaking down of silos
- Collaborative environment fosters the safety culture of the regulator

***Multi-disciplinary integration and collaboration leads to improved nuclear safety***

# Summary



The CNSC has taken a proactive approach to the treatment of human and organizational factors through the following:

- Development of a robust regulatory framework which incorporates human and organizational factors
- Leveraging the Safety and Control Area framework to formalize the integration of human and organizational factors in our core activities
- Creation of opportunities for multi-disciplinary integration

# Conclusions:



## The integration of Human and Organizational Factors within the CNSC regulatory activities:

- Fosters the continuous development and availability of scientific knowledge
- Strengthens the capabilities of the Technical Support Branch
- Promotes effective regulatory oversight
- Leads to improved nuclear safety





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