



# Human performance management

# **Human Performance**

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## **Human Performance**

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Canadian Nuclear Safety Commission  
280 Slater Street  
P.O. Box 1046, Station B  
Ottawa, ON K1P 5S9  
Canada

Tel.: 613-995-5894 or 1-800-668-5284 (in Canada only)

Fax: 613-995-5086

Email: [cnscccsn@nsc-ccsn.gc.ca](mailto:cnscccsn@nsc-ccsn.gc.ca)

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

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## Preface

This regulatory document is part of the CNSC’s human performance management series, which also covers personnel training, personnel certification, fitness for duty and minimum staff complement. The full list of regulatory document series is included at the end of this document and can also be found on the [CNSC’s website](#).

Regulatory document REGDOC-2.2.1, *Human Performance*, clarifies requirements and provides guidance for understanding and managing considerations related to the humans, technology and organization within a business, with the aim of achieving safe and effective human performance.

This document is the second version and supersedes REGDOC-2.2.1, *Human Factors*, published in March 2019.

A graded approach, commensurate with risk, may be defined and used when applying the requirements and guidance contained in this regulatory document. The use of a graded approach is not a relaxation of requirements. With a graded approach, requirements are applied in proportion to risks and particular characteristics of the facility or licensed activity.

For information on the implementation of regulatory documents and on the graded approach, see REGDOC-3.5.3, *Regulatory Fundamentals* [1].

The words “shall” and “must” are used to express requirements to be satisfied by the licensee or licence applicant. “Should” is used to express guidance or that which is advised. “May” is used to express an option or that which is permissible within the limits of this regulatory document. “Can” is used to express possibility or capability.

Nothing contained in this document is to be construed as relieving any licensee from any other pertinent requirements. It is the licensee’s responsibility to identify and comply with all applicable regulations and licence conditions.

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# Human Performance

## 1. Introduction

### 1.1 Purpose

This regulatory document is part of the CNSC's human performance management series. It clarifies requirements and provides guidance and context on how to meet the requirements associated with a licensee's human performance program.

### 1.2 Scope

This regulatory document contains requirements and guidance applicable to all licensees of Class I nuclear facilities and uranium mines and mills, and to all those applying for a licence for a Class I nuclear facility or for a licence for a uranium mine and mill. For all other applicants and licensees, this document serves as guidance.

Note: In this document, the term "licensee" is used to refer to both applicants and licensees.

### 1.3 Relevant legislation

The requirements and guidance outlined in this regulatory document are associated with the [Nuclear Safety and Control Act](#) and its regulations, including the [General Nuclear Safety and Control Regulations](#), [Class I Nuclear Facilities Regulations](#) and [Uranium Mines and Mills Regulations](#).

### 1.4 National and international standards

The International Atomic Energy Agency (IAEA) has identified the need for regulators and licensees to address considerations related to the humans, technology and organization (HTO) in a systemic way. This regulatory document incorporates requirements and concepts from the following IAEA standards and guidance:

- IAEA Safety Standards Series No. SF-1, *Fundamental Safety Principles* [2]
- IAEA Safety Standards Series No. GSR Part 2, *Leadership and Management for Safety* [3]
- IAEA Safety Standards Series No. GSR Part 3, *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards* [4]
- IAEA Safety Standards Series No. GS-G-3.5, *The Management System for Nuclear Installations* [5]
- IAEA TECDOC No.1846, *Regulatory Oversight of Human and Organizational Factors for Safety of Nuclear Installations* [6]

Other important standards that are relevant to this regulatory document include:

- CSA Group, N286, *Management system requirements for nuclear facilities* [7]
- ISO International Standard 27500:16 - *The human-centred organization – Rationale and general principles* [8]
- ISO International Standard 27501:2019 - *The human-centred organization – Guidance for managers* [9]

## 2. Context

### 2.1 Human performance program

Human performance relates to the work activities carried out by people and teams, as well as their results [6], [10]. These work activities represent the work as it is actually performed, unlike tasks, which are generic descriptions of the work [11], [10]. Improvements can be made by examining the details of the work activities themselves – that is, the practical application of a given task in the real world [12], [13].

Human performance programs are broad in scope and are meant to foster a human-centric view of work activities. In turn, this allows the business to form a better understanding of the work and its context and to enable learning and continual improvement [8], [9], [14]. A well-designed human performance program better enables a business to achieve and sustain desired outcomes by considering the integration of work activities and how people are supported to carry out their work.

Within a business, a human performance program provides an overarching view of the factors that influence human performance, including how they are coordinated across the business to support workers and teams in carrying out their work safely and successfully [4]. This includes defining and implementing practices that contribute to excellence in worker performance [7].

By using the Safety and Control Area Framework, CNSC staff already consider various discrete factors individually, such as training, human factors in design and fitness for duty. The human performance program does not replace this consideration, but rather complements it by looking at the connections and relationships between the factors that influence work activities.

### 2.2 Understanding the influences on human performance

To form a complete picture of human performance, licensees need to take a broad view, known as the systemic<sup>1</sup> approach. The systemic approach helps to establish and make explicit the interactions between the humans, technology and organization (HTO) of the business, and is key to understanding, supporting and improving human performance [2], [14], [10]. The HTO concept was established in the nuclear power industry to emphasize the relationships and interdependencies between 3 elements:

- The human (H) sub-system includes a combination of physical, physiological, cognitive and social aspects related to people carrying out work activities.
- The technology (T) sub-system relates to the technology itself and how technology systems transform inputs to outputs.
- The organization (O) sub-system relates to the formal organizing arrangements and processes of the business, which are continually coordinated to achieve the business' goals, as well as to the informal and social aspects of the work activities.

The systemic approach provides a framework for understanding the different perspectives and influences on work activities, which can be explored to increasing degrees of complexity. The

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<sup>1</sup>Systemic refers to something that is system-wide, affecting or relating to a group or system as a whole, instead of its individual members or parts (not to be confused with systematic, which means methodical).

sub-systems can be used to describe, analyze and understand work as a dynamic system by looking at what they do and how they interact, to reveal useful information about human performance within the context of the work as it is performed.

Looking at the business at different levels can be useful in building a picture of the systems of work, for example [13], [10]:

- At an **individual level**, how a worker, in a given environment, with specific equipment, training, procedures, protective equipment, etc., carries out work activities safely and to the desired standards of performance. This level considers the activity.
- At the **group level**, how teams/departments plan, organize, supervise and resource the work, how they interpret policies and priorities, and how they interface and communicate within their group and with other groups in the business. This level considers the process.
- At the **business level**, how the priorities and policies promoted by management guide and influence organizational culture within groups and among individuals. This level considers the strategy.

By understanding the HTO interactions across these levels, licensees are better positioned to move towards an approach to safety where people within a business are supported and empowered to make things go right, rather than simply preventing them from going wrong [11].

Continually learning about the factors that influence human performance is one of the fundamental purposes of a human performance program. By collecting information about people's work activities, and their ability to achieve desired outcomes, as well as the licensee's performance as a whole, the human performance program can provide a comprehensive, integrated view of how the licensee is achieving or failing to meet its goals related to safety and performance. This approach acknowledges that people are fundamental to safety because their inherent adaptability and flexibility creates resilience, in particular where aspects of the organization and technology are rigid [15] [10]. A key part of a human performance program is recognizing where this human adaptability and flexibility can be leveraged to strengthen safety [12].

### 2.3 Managing human performance to strengthen safety

Analysis of events sometimes stops at the performer—that is, at the individual or team who are seen to be responsible for errors. This stopping point does not allow for effective organizational learning since errors, once analyzed using the systemic approach, are almost always found to be a symptom of deeper issues [15], [13]. The factors that contribute to errors are usually found in multiple places, at multiple levels and across various areas of the business, from design, planning or maintenance to management's supervision or decision making [16].

Licensees can enhance robustness by developing a strong foundation across the HTO system to prevent errors from propagating into problems, at all levels of the business. It starts with understanding error as a human characteristic within a situational context and considering “what happened and why?”, rather than “who caused the problem?” [17], [14].

In a work environment characterized by openness, trust and fairness, where provisions have been made to support the work effectively, people can provide a constant detection and correction function, which is a form of resilience [15]. Another way to introduce resilience within the system is to learn from successful daily work activities, which leaves the business better prepared to deal with the unexpected [18].

## 2.4 Organizational learning

Safe and successful work can be supported by making it easy for people to do the right thing and difficult for them to do the wrong thing [13]. Actively understanding, learning and putting measures in place to enable work to go well enhances safety. This includes having processes and methods to learn from both success and failure in the business, to understand the work as it is actually done and the system within which the work happens. Supporting the day-to-day work by seeking out and addressing known factors that can disrupt the work and increase workload provides workers with the increased capacity to identify and respond to any abnormal conditions, unusual factors or disruptions. The people who perform the work are often in the best position to offer suggestions for improving safety and performance, as well as to provide insight into how the work is carried out [16], [13].

Building capacity for safety throughout the business needs to be driven by management as a strategic and intentional priority that is active and visible [12]. Management directly supports human performance by providing workers with all that they need to carry out their work activities – such as resources, training and equipment. Management should promote the importance of organizational learning as an ever-present part of the business, as opposed to being a one-off initiative or response to an event.

A good practice is to review a given situation with honest enquiry, accept the reality of what is found and in turn to use the understanding gained to learn and improve. A strong foundation for continual learning is created when management fosters an environment where workers are encouraged to report concerns or suggestions for improvement and feel acknowledged when voicing issues, without fear of reprisal [15], [17], [13]. Openness and sharing of information regarding failures or problems is necessary in order to learn and improve.

## 3. Requirements and Guidance

### 3.1 Documenting the program's strategy and practices

The licensee shall document the strategy and practices of their systemic approach for managing human performance by describing:

- a. the goals and scope of the human performance program
- b. how the licensee implements a systemic approach to human performance
- c. how the licensee supports workers in day-to-day work
- d. how the licensee supports and prepares workers to respond during accidents and emergencies
- e. the ways in which the business learns about and seeks continual improvement of human performance
- f. the ways in which the human performance program is monitored and evaluated for effectiveness

### Guidance

Documenting the human performance program can be done through:

- a roadmap
- an overview that references and describes how management system documents, such as policies, processes, procedures or other documents, relate to human performance



- a stand-alone document

Licensees are not required to designate a formal human performance program in their management system. However, they should be able to identify the documents within their management system that relate to their human performance measures and which they consider as part of their human performance program. The approach taken should demonstrate that the licensee is addressing the cross-cutting scope and integration of human performance considerations across the business. This information only needs to be presented once.

The goals and scope of the human performance program should specify the departments, processes and/or procedures to which the program applies, and where it applies to contractors and vendors. This can also include the rationale for the program, which explains why a human performance program is important to the licensee's goals, as well as any risk management framework that has been applied to guide implementation of the program. The application of a risk-informed graded approach is described in REGDOC-3.5.3 [1].

To document the licensee's systemic approach to human performance, licensees may describe how the collection of elements is taken into account as a whole, including their relationships and influences, such as:

- describing any systemic analyses across the business, such as self-assessments, event analyses or audits
- identifying any performance indicators and associated data, which should be periodically analyzed
- specifying any roles or responsibilities for oversight of human performance across the business

Licensees can demonstrate that they support workers in day-to-day work through training, procedures, supervision, tools, usable equipment, etc.

Note that the term workers indicates to anyone in the business who performs work that is referred to in a licence [19], such as knowledge workers, supervisors, managers, front-end workers and contractors.

### **3.2 Implementing a systemic approach**

The licensee shall implement a systemic approach to managing the human performance program that supports safe and effective work for all workers.

#### **Guidance**

The systemic approach considers human performance within the context in which people work, viewing the business as a system [15], [20], [13], [14], [10]. Licensees should use a systemic approach when analyzing, recording and evaluating the HTO factors associated with:

- events and problems
- work that is known to be difficult or challenging
- work that went well (cases of performance excellence)
- feedback and suggestions for improvement from a range of sources
- proposed changes to be made

- outcomes of the changes made

Examples of how this can be accomplished include:

- establishing a team, made up of a diverse representation of key functions of the business, which is tasked with reviewing events, opportunities for improvement and things that went well from a systemic perspective
- creating systems maps to model and illustrate the interconnections in the system
- conducting periodic assessments of human performance by analyzing key work activities to understand the gaps between tasks and activities
- analyzing the goals, workflows, demands, pressures, conflicts, resources or uncertainties within the system [20]

### **3.3 Identifying responsibility for human performance**

The licensee shall identify a member of senior management who is responsible for the human performance program and define and document their associated roles, responsibilities and authorities.

#### **Guidance**

Roles and responsibilities for the human performance program should include:

- establishing and communicating the goals, vision and core values related to human performance
- establishing and maintaining the measures to support the desired human performance, such as policies and processes that enable personnel to raise safety concerns freely
- encouraging feedback and suggestions for improvements from across the workforce
- establishing the business requirements for the identification and systemic analysis of factors related to human performance in events [3]

### **3.4 Developing and sustaining continual improvement**

The licensee shall implement processes to enable the business to understand and learn about factors that influence human performance and to ensure they are considered in continual improvement.

#### **Guidance**

As part of the business' learning, the licensee should consider goals, such as:

- developing knowledge and understanding of work activities and the provisions that support them, using a systemic approach
- identifying and sharing results and knowledge across the business so that the systemic nature of work is understood and leveraged
- improving work activities to achieve the desired results

When analyzing past performance in order to learn and improve, licensees should consider work as it was done in practice (activities) alongside work as prescribed in procedures (tasks). This can be accomplished through interviews, workers' feedback, procedure walkdowns or supervisor/manager observations in the field, for example. Another good practice is to analyze the

context of prospective changes in the business during their development using the systemic approach to understand the factors that influence human performance [14].

Licenseses' processes for learning related to human performance and safety should include:

- ways to collect feedback and data on the processes and factors supporting the desired human performance
- leadership training on supporting and improving human performance across the business
- training for all workers on the aims of learning and improving their work and what this means for their roles
- a description of how an environment of openness and trust is fostered to encourage workers to report concerns and problems
- event analyses that identify the context of work activities and that are used to understand the specific drivers of human performance
- mechanisms for leveraging the knowledge and experience of workers to gain a deep understanding of a given work activity, such as through the learning team approach [21]
- evaluation of changes after implementation to measure their impact

## Glossary

For definitions of terms used in this document, see [REGDOC-3.6, \*Glossary of CNSC Terminology\*](#), which includes terms and definitions used in the [Nuclear Safety and Control Act](#) and the regulations made under it, and in CNSC regulatory documents and other publications. REGDOC-3.6 is provided for reference and information.

The following terms are either new terms being defined or include revisions to the current definition for that term. Following public consultation, the final terms and definitions will be submitted for inclusion in the next version of REGDOC-3.6, *Glossary of CNSC Terminology*.

**(new)**

**activity** (*activité*)

with respect to human performance, the actual work carried out by people and teams in a work environment. Also called work as done.

**(add)**

**business** (*entreprise*)

an organizational entity with accountability to implement all or some of the requirements of CSA-N286-12, *Management system requirements for nuclear facilities*. (Source: CSA-N286-12, *Management system requirements for nuclear facilities*).

**(modify)**

**human factors (HF)** (*facteurs humains [FH]*)

Factors that influence human performance as it relates to the safety of a nuclear facility or licensed activities over all phases, including design, construction, commissioning, operation, maintenance and decommissioning. Some examples are organizational and management structures; policies and programs; allocation of functions to humans and machines; the design of user interfaces; staffing provisions; job-design features; work schedules; design of procedures; training; and the physical work environment. See HTO and systemic approach.

**(modify)**

**human performance** (*performance humaine*)

Human activities carried out in a work setting and the results of these activities. See activity and task.

**(additional acronym)**

**HTO** (*HTO*)

Humans, technology and organization

**(new)**

**human performance program** (*programme de performance humaine*)

A group of management system elements, such as policies, processes and procedures, which are related to human performance and that are implemented and managed in a coordinated way.

**(new)**

**systemic approach** (*approche systémique*)

An approach in which an entity is considered to have the properties of a system, such as interdependency and connectedness. Note: An example of a systemic approach is where the interactions across the human, technology and organizational aspects of a business are considered at various levels of abstraction to understand, learn and improve performance.

**(additional entry)**

**task** (*tâche*)

With respect to human performance, a description of work to be done. Also called work as prescribed.

## References

The CNSC may include references to information on best practices and standards such as those published by CSA Group. With permission of the publisher, CSA Group, all nuclear-related CSA standards may be viewed at no cost through the CNSC Web page "[How to gain free access to all nuclear-related CSA standards](#)".

- [1] CNSC, REGDOC-3.5.3, Regulatory Fundamentals, Ottawa, 2023.
- [2] IAEA, IAEA Safety Standards Series No. SF-1, Fundamental Safety Principles, Vienna, 2006.
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## CNSC Regulatory Document Series

Facilities and activities within the nuclear sector in Canada are regulated by the CNSC. In addition to the *Nuclear Safety and Control Act* and associated regulations, these facilities and activities may also be required to comply with other regulatory instruments such as regulatory documents or standards.

CNSC regulatory documents are classified under the following categories and series:

### 1.0 Regulated facilities and activities

- Series 1.1 Reactor facilities
- 1.2 Class IB facilities
- 1.3 Uranium mines and mills
- 1.4 Class II facilities
- 1.5 Certification of prescribed equipment
- 1.6 Nuclear substances and radiation devices

### 2.0 Safety and control areas

- Series 2.1 Management system
- 2.2 Human performance management
- 2.3 Operating performance
- 2.4 Safety analysis
- 2.5 Physical design
- 2.6 Fitness for service
- 2.7 Radiation protection
- 2.8 Conventional health and safety
- 2.9 Environmental protection
- 2.10 Emergency management and fire protection
- 2.11 Waste management
- 2.12 Security
- 2.13 Safeguards and non-proliferation
- 2.14 Packaging and transport

### 3.0 Other regulatory areas

- Series 3.1 Reporting requirements
- 3.2 Public and Indigenous engagement
- 3.3 Financial guarantees
- 3.4 Commission proceedings
- 3.5 CNSC processes and practices
- 3.6 Glossary of CNSC terminology

**Note:** The regulatory document series may be adjusted periodically by the CNSC. Each regulatory document series listed above may contain multiple regulatory documents. Visit the CNSC's website for the latest [list of regulatory documents](#).