Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Eidgenössisches Nuklearsicherheitsinspektorat ENSI
Inspection fédérale de la sécurité nucléaire IFSN
Ispettorato federale della sicurezza nucleare IFSN
Swiss Federal Nuclear Safety Inspectorate ENSI

Oversight of Safety Culture in Nuclear Installations

ENSI Report on Oversight Practice

December 2016 edition

Oversight of Safety Culture in Nuclear Installations

2nd edition, December 2016

ENSI Report on Oversight Practice   ENSI-AN-8980

Contents

Preface to second edition

As the first edition of this report explained, the interpretation of and positions in relation to the concept of safety culture as well as their significance for the work of supervisory authorities are constantly evolving in research and in practice. Since this report first appeared in February 2014, the interpretation and practices at ENSI have also evolved to the extent that ENSI considers it expedient to issue a second, updated edition.

The new edition better reflects an integrated understanding of the concept of culture. The focus is explicitly expanded from the often limited examination of nuclear safety to encompass all aspects of an organisation's culture that are significant to guaranteeing safety in the sense of protecting humans and the environment from the risks associated with the peaceful use of nuclear energy in accordance with Article 1 of the Nuclear Energy Act (NEA). In addition to the nuclear safety of the installations and processes, this perspective includes in particular the security of nuclear installations and nuclear materials, the radiation protection of employees and the population, fire protection, conventional occupational health and safety, emergency protection measures and IT security, as well as the safety and security of transports of radioactive material and the storage and interim storage of radioactive waste.

Internationally, by analogy to the concept of safety culture in the area of nuclear safety, discussions relating to security have increasingly focussed on "security culture" in recent years. In 2016, the Amendment to the Convention on the Physical Protection of Nuclear Material entered into force, incorporating principles relating to the concept of "security culture" for the first time. The second edition of this report on oversight practice examines the ongoing discussion and sets out ENSI's position in relation to it.

Summary

In this report, ENSI illustrates how it supervises safety culture. Based on a model for the oversight of safety culture, it demonstrates that the supervisory authority cannot treat the entire content of safety culture in the same way. Part of this content can be observed and assessed with classical supervisory instruments, whereas other content – specifically, the values and world views of the members of the supervised organisation – is not accessible for oversight by means of the conventional instruments.

It is not possible to arrive at an across-the-board assessment of safety culture. ENSI endeavours to take account of all types of content of safety culture in its activities. Thereby, it takes a view that interprets safety to mean the protection of humans and the environment against ionising radiation and that, accordingly, considers all aspects of culture that are relevant to safety in this broader sense. In particular, this also includes the aspect of security. Content that can be assessed individually on the basis of clear requirements is covered during the course of oversight in the stricter sense. If content that cannot be assessed singularly generates questions of general significance, ENSI steps up its supervisory activities in a targeted manner, for example by additional inspections. ENSI also makes use of specialist discussions promoting a dialogue on safety culture in order to engage the supervised organisations to reflect on their safety culture.

The report shows that the oversight of safety culture is an issue that continues to spur controversial discussions in academic circles and among the authorities. Further analysis is required of the implications of more recent concepts resulting from safety research, as well as from the lessons for the oversight from the accident at the Fukushima nuclear power plant in Japan. Additional efforts are required to develop suitable methods for apprehending the content of safety culture and for strengthening a good safety culture. ENSI has mentioned specific projects for this purpose in the report. Not least, the supervisory authority must address its own supervisory culture, as it influences the safety culture of the operators under its oversight.

1   Introduction

Accidents occurring in working environments with major hazards are often attributed to a deficient safety culture. This is specifically true of the nuclear and chemical industries, the aerospace sector, railways and hospitals. The latest example in the nuclear industry is the accident at the Fukushima nuclear power plant in Japan in 2011. After an earthquake measuring 9 on the Richter scale followed by a tsunami, core meltdown occurred in three of the six units at the Dai-ichi site, with an extensive release of radioactive material. Long-term evacuation of the population in the area surrounding the nuclear power plant became necessary. Investigation reports[1,2,3] have criticised the safety culture of the operator and the supervisory authorities.

There is widespread agreement across all specialist areas and sectors about the importance of safety culture. A good safety culture is of paramount importance in organisations that deal with major hazards. A deficient safety culture increases the risk of accidents.

As yet, there is no consensus on how the safety culture concept can help to make the operation of complex systems safer.[4] In the meantime, the relevance of a nuclear installation's environment to the safety culture in the installation has also become a subject of discussion. This environment includes external players such as manufacturers and suppliers, research institutions, supervisory authorities, political and policy-making bodies, including legislators, and the media. They all contribute to shape the nuclear installation's safety culture. For their part, these players are influenced by the prevailing social values and norms which they themselves help to develop (cf. figure 1). In addition, economic constraints constitute an important factor.

---

[1] Investigation Committee on the Accident at Fukushima Nuclear Power Stations of Tokyo Electric Power Company (2012). Final Report.

[2] The National Diet of Japan (2012). The Fukushima Nuclear Accident Independent Investigation Commission (NAIIC), Official Report.

[3] Swiss Federal Nuclear Safety Inspectorate ENSI (2011). In-depth Analysis of the Accident at Fukushima on 11 March 2011, With Special Consideration of Human and Organisational Factors. ENSI. (https://www.ensi.ch/en/2012/08/08/analysis-fukushima-11032011/).

[4] Wäfler, T., Künzler, C., Schmid, J., Gärtner, K. & Bezzola, J. (2010). Klärung des Standes von Wissenschaft und Praxis im Bereich der Erfassung von Sicherheitskultur, Fachhochschule Nordwestschweiz.
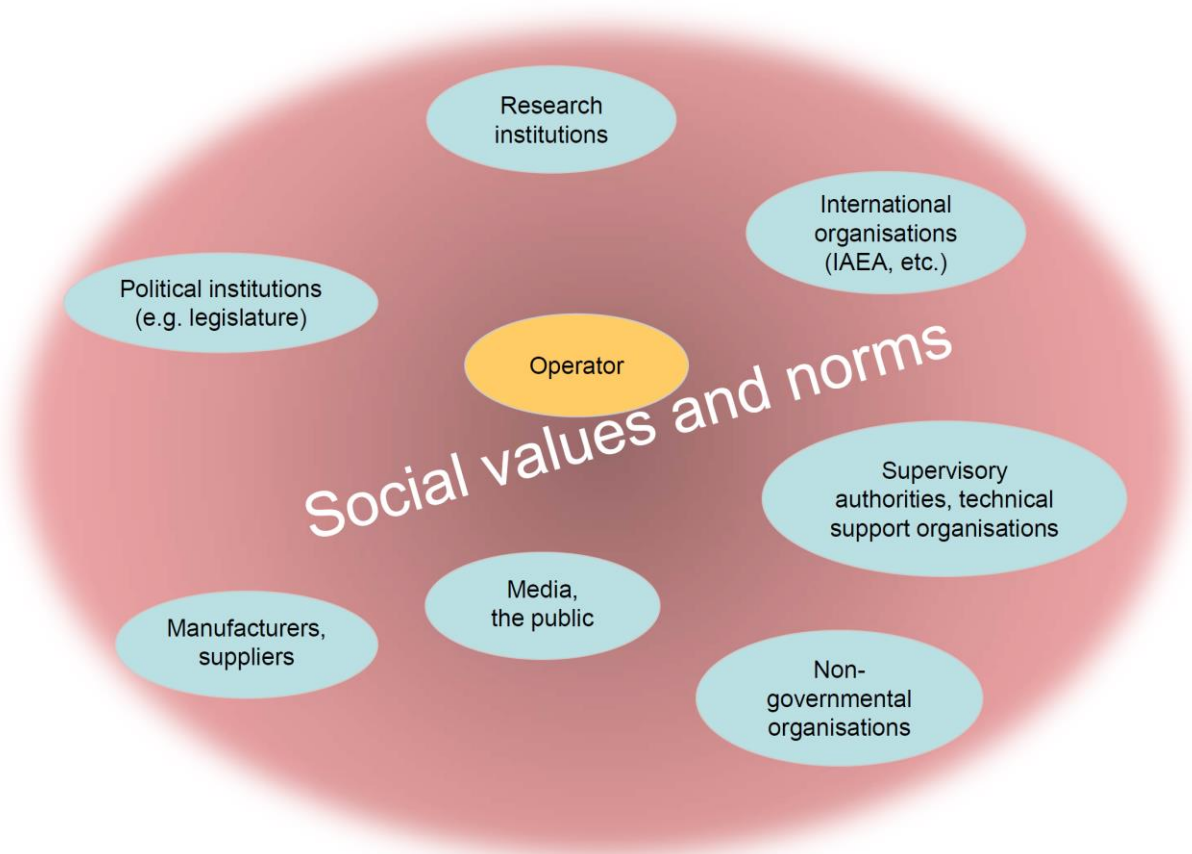
Figure 1: Environmental factors that impact the operator's safety culture[5]

Academics and supervisory authorities debate how the safety culture of organisations can be apprehended and assessed, and whether it can and should be supervised. International organisations such as the IAEA and the OECD Nuclear Energy Agency have issued a series of publications and have staged various events focusing on these topics.

A joint workshop staged by the Working Group on Human and Organisational Factors (WGHOF) of the OECD Nuclear Energy Agency and IAEA[6] reached a broad consensus on the need for supervisory authorities to have processes and methods for the purpose of supervising

---

[5] The term "operator" refers to the company which possesses the licence to operate a nuclear installation (licensee) and which operates the installation (operating organisation). Depending on the legal situation, this term therefore denotes not only the organisation of a nuclear facility (such as a nuclear power plant) at its operational location, but also the company or parent company which is the legal holder of the operating licence. However, the content of the report (and especially of sections 2 and 3) is of course also applicable as appropriate to organisations of other types (e.g. those which do not yet have or no longer have an operating licence, as well as organisations not subject to oversight by ENSI, such as suppliers).

[6] CSNI WGHOF/IAEA (2008). Maintaining Oversight of Licensee Safety Culture – Methods and Approaches. Proceedings of a CSNI/IAEA Workshop, Chester, United Kingdom.

the safety culture of nuclear installation operators. The supervisory authorities should define their approach and communicate it to the supervised parties, other authorities and the general public.

Since the accident at Fukushima, the influence of supervisory authorities on the operators' safety culture has received greater attention, for instance at IAEA events. The supervisory authority's role in influencing and supervising the operator's safety culture is frequently discussed in this context.

The debate about the supervisory authorities' approach to safety culture is ongoing. ENSI has now consolidated its position, which is described in the present report. It will continue developing this position in the future.

The report is addressed to the organisations supervised by ENSI, interested members of the public in Switzerland and abroad, and to ENSI itself. It is intended to provide a basis for further discussion.

In the following sections, ENSI presents those elements of its supervisory activities, and other activities, which relate directly to safety culture.

In addition, ENSI has drawn up various guidelines which contain specific requirements on safety culture in nuclear installations. The following guidelines may be mentioned here:

- Guideline ENSI-G07: The Organisation of Nuclear Installations

  Measures for the purpose of observing, assessing and fostering a good safety culture must be incorporated in the management system.

  It is necessary to promote a working atmosphere that encourages trust, cooperation and open communication, and one which attaches value to the communication of problems.

  Consideration must be given to cultural aspects in connection with the organisation's own staff and third-party personnel, and efforts shall be made to encourage a positive development of the culture in the nuclear installation.

- Guideline ENSI-B02: Requirements for periodic reporting by nuclear installations

  As part of the periodic reporting, the programme and measures to foster a good safety culture shall be presented, alongside a comparison of the measures implemented with the expectations.

- Guideline ENSI-A03: Periodic safety reviews of nuclear power plants

  As part of the periodic safety review, aspects of the safety culture shall be described and assessed, especially as regards measures to foster safety awareness and to implement a learning organisation.

- Guideline ENSI-B10: Basic training, recurrent training and continuing education of personnel in nuclear installations

  The operator has to provide measures in the initial training programme, in the recurrent training programme and in the continuing education programme which in particular promote the workers' individual, methodical and social competence (soft skills).

  The personnel have to be continuously made aware of the significance of their tasks and activities, learning from experience as well as of the consequences that errors may have on safety.

The terms "safety" and "safety culture", as used in this report, are to be interpreted in a broad sense. As set out in Guideline ENSI-G07, the term "safety" is taken to mean the protection of humans and the environment against ionising radiation. Accordingly, the term encompasses both nuclear safety and security and all other spheres of activity, already set out as examples in the preface, that contribute to the protection of humans and the environment. In this report, this generalisation is also applied to the term "safety culture". The next chapter begins by taking a more detailed look at the reasons for this approach and at its implications. It then examines the term – interpreted in this broader sense – and concept of safety culture.

2 Safety culture: definition and accessibility

2.1 Safety culture and security culture: two different cultures?

Internationally, a distinction is increasingly[7] being drawn between safety culture and security culture. Security culture is defined analogously to safety culture but with an explicit focus on the security of nuclear installations and nuclear materials; that is, on preventing the impairment of safety due to sabotage, unauthorised acts, the deliberate release of radioactive substances into the environment and the theft of nuclear materials.

The concepts of nuclear safety and security aim to achieve the same objective, namely the protection of humans and the environment against the harmful effects of ionising radiation. As mentioned earlier, therefore, this report in general uses the term "safety" to refer to both nuclear safety and security. However, this section addresses the two concepts of safety culture and security culture explicitly and explains ENSI's approach to dealing with these concepts for oversight purposes.

To begin with, a good security culture is characterised overwhelmingly by the same behaviour patterns, values and world views as a good safety culture (cf. section 3).[8,9]

One of the key reasons for drawing a distinction between the two concepts of culture is the fact that certain requirements in relation to nuclear safety and those in relation to security can sometimes come into conflict with one another. As a result, situations can arise in everyday work where employees are confronted with contradictory behavioural requirements, for example in relation to the handling of certain information or the provision of escape routes: if the situation is viewed from the perspective of safety culture, the priority is placed on open and transparent communication and on minimising obstacles (e.g. open doors) should it be necessary to evacuate the installation quickly. However, if the same situation is viewed from the perspective of security culture, priority is given to the confidential handling of certain information or to the prevention of unauthorised access to the installation or the theft of radioactive materials in certain rooms by taking additional security measures, for example by locking doors.

Differences between the perspectives of safety culture and security culture also manifest themselves in, for example, the interpretation of possible errors or errors that have already been made: from the point of view of safety (culture), errors are generally taken as unintentional or possibly as the result of negligence, but at any rate not as actions intended to cause damage. They are seen as something that it is never possible to avoid altogether and even as learning

---

[7] Particularly at the IAEA, cf. e.g. IAEA Nuclear Security Series No. 7, Implementing Guide, Nuclear Security Culture, 2008.

[8] cf. e.g. IAEA Nuclear Security Series No. 7 Implementing Guide, Nuclear Security Culture, 2008.

[9] cf. e.g. World Institute for Nuclear Security WINS (2011), International Best Practice Guide for your Organisation, Nuclear Security Culture, Revision 2.0. Vienna: WINS.

opportunities. Security, on the other hand, focuses primarily on actions committed deliberately and with "malicious intent" in an attempt to cause damage. Errors of this kind must be prevented wherever possible.

The perspectives of both safety and security must be firmly anchored in the culture of any organisation that deals with nuclear goods. They must be considered jointly and must not be played off against or mutually impair one another. Any conflicts that do arise must be resolved and overcome. As in the case of nuclear safety, the security of nuclear installations is the responsibility of all employees and not only of the security guard or of technical specialists and line managers. If safety culture and security culture are considered and addressed separately, there is a danger that a "silo mentality" will form and that, as a result, existing or arising areas of conflict will not be resolved constructively or may not be identified at all.[10]

For these reasons, ENSI explicitly refrains from drawing a distinction between safety and security culture in its supervisory activities, although it does consider the specific requirements for security and nuclear safety. The themes of safety and security are dealt with under the generic term safety culture and the associated supervisory activities are conducted in accordance with the methods and approaches described in this report.

2.2   The term safety culture[11]

The term safety culture was introduced by a group of experts (the International Nuclear Safety Advisory Group, INSAG) of the International Atomic Energy Agency (IAEA) after the accident at Chernobyl (1986). On that occasion, this group defined safety culture as:

> *"... that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance" (IAEA, 1991, p. 1).*[12]

---

[10] This integrated view also corresponds to the interpretation of the operators of the Swiss nuclear power plants, who take the view that safety culture and security culture are, in principle, based on the same attitudes and ways of thinking. Accordingly, they do not differentiate between the two terms and instead either include security within the conceptual framework of safety culture or talk about a corporate culture that is orientated towards acting safely and incorporates all relevant aspects. Where security and safety are in competition with one another, comprehensive collaboration is the only way to identify solutions that satisfy all the requirements.

[11] The Swiss Federal Nuclear Energy Act (NEA) does not use the term "safety culture" but refers instead to "safety awareness". An organisation's safety culture influences the safety awareness of its members, and manifests itself in that awareness. Conversely, the members' safety awareness influences the safety culture of the organisation.

[12] International Nuclear Safety Advisory Group (1991). Safety Culture. A report by the International Nuclear Safety Advisory Group. Safety Series No 75-INSAG-4, IAEA.

Since then, numerous definitions of the term safety culture may be found in the literature, based on different interpretations of the notion of culture. For example, the widely used definition by the International Nuclear Safety Advisory Group implies that a company either has or does not have a safety culture. In simplified terms, this means that a company which does not award the highest priority to (nuclear) safety does not have a safety culture. This definition is therefore normative, in that it already implies characteristics of a good or desirable safety culture. In this interpretation, safety culture means a culture that is geared towards the highest level of safety.[13]

ENSI regards safety culture as a part of the organisational culture.[14] Every company has a safety culture just as every company has an organisational culture. The difference between companies is therefore defined not by whether they have a safety culture or not, but by the nature of their safety culture and the degree to which it is geared towards the objective of a high level of safety.

The term culture refers to something that is shared by many individuals. It includes shared **values and world views, behaviours** and the **human-made physical environment**. This environment, in turn, has repercussions on individuals.

For the purposes of oversight of the Swiss nuclear installations, ENSI defines the term safety culture as follows:

Safety culture comprises **values**, **world views**, verbal and non-verbal **behaviours** and characteristics of the **human-made physical environment** which are shared by the members of the organisation of the operator of a nuclear installation.[15] Safety culture includes those values, world views, behaviours and environmental features that determine or demonstrate how the members of the organisation approach and deal with safety.

In this context, values are regarded as aims and evaluation criteria. World views are descriptions of reality and explanatory models. The human-made physical environment is considered to comprise the technical equipment of the nuclear installation, its condition, the documents created and used for work, and other physical elements such as the buildings.

The world views of the members of an organisation and the documents in their physical environment also include, in particular, assumptions and specifications regarding the organisational structures and processes.

---

[13] Grote, G. (1995). Sicherheitskultur. In: B. Ludborsz, H. Nold & B. Rüttinger (publ.), Psychologie der Arbeitssicherheit: 8th Workshop, 1995. Asanger, 52-660.

[14] IAEA Safety Standard GS-G-3.5. The Management System for Nuclear Installations, 2009.

[15] It should be assumed that no single, homogeneous (safety) culture exists within an organisation but that there are various sub-cultures which depend on areas of responsibility and professional backgrounds. The unit whose safety culture is under consideration therefore depends on where the boundaries of the human-technology-organisational system are drawn – and it may range from a small group of employees within a company to a comprehensive consideration of all the players (cf. figure 1).

2.3   The conceptual framework for oversight

On the basis of its definition of the term safety culture and in keeping with E. Schein's multi-level concept of organisational culture[16], ENSI distinguishes the following content (cf. figure 2) which it classifies according to the different levels of accessibility relevant to supervisory activities.

Accessibility	Approach by the supervisory authority	Content
Easy	Observation Queries Document analysis	**Human-made physical environment** (e.g. technical equipment, documents used) **Behaviour** (e.g. working methods, verbal statements)
Moderate	Queries Document analysis	**Conscious values** (goals and evaluation criteria) **Conscious world views** (descriptions of reality and explanatory models)
Difficult	Limited queries	**Non-conscious values** (goals and evaluation criteria) **Non-conscious world views** (descriptions of reality and explanatory models)

Figure 2: ENSI's model for oversight of safety culture in nuclear installations

Only matters that can be observed or questioned may be subject to official oversight in the stricter sense.[17] This comprises behaviours, the physical environment and the values and world views of which the members of the organisation are consciously aware. A supervisory authority can only draw assumptions about the values and world views which are unconscious. For this reason, oversight in the stricter sense must focus on matters that can be observed and questioned, whereas the unconscious content of safety culture calls for a different approach.

---

[16] Schein, E. H. (1992). Organizational Culture and Leadership (2nd Ed.). Jossey Bass.

[17] Oversight in the stricter sense comprises monitoring whether a licensee meets its obligations and intervention if this is not the case. Oversight in the broader sense also includes prompting self-reflection in the ways described in section 4.3.3.

2.3.1 Physical environment

Numerous characteristics of the physical environment are accessible to the supervisory authority, including the actual nuclear installation and the available documentation. The physical environment develops and changes during the history of a nuclear installation. It shapes those elements of the safety culture that are established in the minds of the members of the operator's organisation, i.e. the values and world views of the organisation's members. However, the safety culture is also the expression and product of these values and world views. At the outset, the physical environment is mainly defined and created by the installation's manufacturers (taking account of the framework of legal conditions, requirements imposed by the authorities and the requirements of the future operator). The manufacturers' philosophy and culture (automation philosophy, philosophy as regards use of procedures, etc.) therefore play a key role in shaping the new operator's safety culture. The physical environment changes as time goes by, following the stages of an installation's lifecycle, changes in safety requirements, technological developments and the operator's needs and experience. These changes impact the operator's culture, which in turn has an influence on the changes. The characteristics of the physical environment are important subjects for supervision as regards the safety culture. Reviewing the content and quality of safety-related documents and inspections of the condition of the installation on the basis of technical criteria, as well as inspections of housekeeping, are included among the tasks of an authority which is responsible for supervising safety.

2.3.2 Behaviour

The operation methods of the staff required to operate a nuclear installation can be observed during inspections. Specifically, it is possible to verify whether the operation methods conform to defined instructions and safety principles, and whether activities are carried out in a precise and cautious manner. Verbal statements can also be observed during supervisory discussions and inspections – for example, it is possible to observe how managers exchange information about safety-related findings and which measures they propose.

2.3.3 Conscious values and world views

The behaviour of an organisation's members depends on the values and world views of those members. Oversight of an operator's safety culture therefore includes asking the members of the operator's organisation about their values and world views, insofar as they are significant in terms of safety.

Examples

- What criteria does a power plant manager apply when deciding whether the plant should be shut down due to a leak?

- What objectives does a department head pursue when drawing up the requirements for new systems as part of a modernisation project?

- How does the shift leader describe the current condition of his shift group?

- How does an employee explain the repeated failure of a component?

- How is it ensured that the possibility of deliberate acts (sabotage) is taken into account in the case of events that defy comprehension?

- How is the unexpected addressed and awareness ensured as part of personnel training?

2.3.4   Non-conscious values and world views

The members of an organisation are not consciously aware of certain values and world views. If values and world views are not consciously known, it is impossible to query them directly; this means that they are not accessible to oversight by the authority.

Some of the values and world views which are not consciously perceived by the individuals who hold them, can be made conscious by encouraging self-perception and self-reflection. Hence, values and world views that are not consciously known are not covered by official oversight in the stricter sense. However, by encouraging the supervised parties to engage in self-reflection processes (cf. section 4.3.3), the supervisory authority can help to open up access for the operator and the supervisory authority to part of the inaccessible content of safety culture. This helps increase the portion of the safety culture which can be influenced.

2.4   How does (safety) culture arise, have an effect and change?

The model for safety culture oversight in figure 2 indicates matters covered by the safety culture and shows whether and how this content is accessible to the supervisory authority. However, it does not state how the individual content categories affect each other, nor does it indicate the external factors that influence them. The entire content of safety culture – values and world views, behaviour and the physical environment – is influenced in many different ways. Here a distinction should be drawn between the influence of members of the operator's organisation (internal influences) and the influence of stakeholders outside the organisation (external influences).

2.4.1   Internal influences

Different members within the organisation hold differing values and world views. They also behave in different ways. Different patterns can prevail within different organisational units and at different levels of the hierarchy, giving rise to what may be termed different sub-cultures.

The values and world views held by members of management and the behaviour they display are of particular importance. For instance, the extent to which the line managers at various levels of management are present and accessible for their employees, expresses the importance they give to the employees and their work. The behaviour of the employees is influenced by the behaviour and characteristics of the physical environment (installation condition,

documentation) that are tacitly or explicitly accepted by line managers. The values and world views of the employees, and their behaviour, are influenced by the behaviour manifested by the managers themselves, and by the organisation's acceptance of such behaviour.

The way a nuclear installation deals with errors that do not directly impact the installation's safety but should nevertheless be avoided in the future is an expression of the nuclear installation's safety culture, and it also influences the safety culture. A work climate that is based on trust and openness is another factor in the positive development of the culture in a nuclear installation's organisation. Readiness to communicate an error will be greater in an environment where reporting an error to the line managers (or to the supervisory authority) or by means of a (confidential) reporting system provided for this purpose is understood as an opportunity to learn from experience. In an environment where an error results in sanctions, there will be less readiness to report.

Finally, the values, world views and behaviour patterns of new members joining the operating organisation are also important. Especially during periods of increased staff turnover, new members who join the organisation can make more significant contributions to changes in its culture. An organisation influences the way it changes by means of the mechanisms and criteria that it uses to select new members.

2.4.2 External influences

External influences include the social environment with its values and world views on nuclear energy and safety, as well as the relevant behaviour in this context. These influences comprise informal public opinion as well as formal governmental and political structures and instruments, ranging from legislation to supervisory activities relating to nuclear installations.

The values and world views of the members of an operator's organisation, as well as their behaviour, are influenced by various factors: whether public opinion agrees or disagrees with the use of nuclear energy, which obligations the legislators and the supervisory authority impose on the operators of nuclear installations, and how the supervisory authority, the media and the general public react to the operators' behaviour. Legislators, the supervisory authority, the general public and the media therefore influence the operators' safety culture, as shown in figure 1.

Differing social demands can generate areas of tension which may in turn lead to problematic effects on the safety culture. For example, a conflict of objectives may arise between the creation of a culture that is not based on blame and punishment (cf. sections 3 and 4.1) within the operator's organisation responsible for safety and the supervisory authority on the one hand, and the desire for maximum public transparency and the provisions of criminal law on the other. All the stakeholders (particularly the operator and the supervisory authority) must be aware of these conflicts of objectives, and must tackle the ensuing challenges. Moreover, potential negative effects should already be identified and avoided when legal provisions are being drawn up, as far as possible.

2.5 Safety culture and the management system

Guideline ENSI-G07[18] stipulates that measures must be incorporated within the management system in order to observe, assess and promote a good safety culture. In the management system, the nuclear installation must be described as a socio-technical system consisting of three components: humans, technology and organisation. When considering this system, account must be taken not only of its individual components and their interactions, but also of external influences on the system (of an environmental, social, political and cultural nature).

A management system that is backed and implemented by management should guarantee:

- a shared understanding of the characteristics of a good safety culture

- adequate resources for the employees to carry out their tasks safely

- methods to prevent errors and to enable learning from experience

- continuous, ongoing development of the safety culture

In its Safety Standards, the IAEA stipulates a management system that fosters and supports a good safety culture.[19] IAEA Safety Guides GS-G-3.1[20] and GS-G-3.5[14] include additional recommendations on how the safety culture in the organisation and in the management system should be taken into account.

The management system is deployed as an instrument to exert a positive influence on the organisation's safety culture. It should impact the physical environment, the behaviour of the employees and their values and world views in a manner that promotes safety (cf. figure 2). Furthermore, the management system and the way it is implemented on a day-to-day basis are themselves expressions and results of the prevailing safety culture.

---

[18] Guideline ENSI-G07 (2013). The Organisation of Nuclear Installations.

[19] IAEA General Safety Requirements GSR Part 2. Leadership and Management for Safety, 2016.

[20] IAEA Safety Guide GS-G-3.1. Application of the Management System for Facilities and Activities, 2006.

3 Characteristics of a good safety culture

To show what is meant by "a good safety culture", some of the key characteristics of such a culture are listed below. They are based on the definition in IAEA Safety Standards GS-G-3.1 and GS-G-3.5 and on other basic findings, in particular from safety research.[12,21,22,23,24,25,26,27,28] This list of characteristics is not exhaustive because a good safety culture also depends on the organisation in question and on local and national cultural factors. Guideline ENSI-G07[18] states that one characteristic of a good safety culture is a "working climate ... that encourages trust, cooperation and open communication and that values the communication of problems".

a. Safety is a clearly recognised value

Members of all the hierarchical levels of an operator's organisation are committed to safety. If in doubt, priority is given to safety. Safety-conscious behaviour is socially accepted, desired and is supported by formal as well as informal means.

The operator explicitly awards safety the first priority in its documents, communication and decisions. Safety plays a fundamental part in the allocation of resources.

b. The management unambiguously backs safety

Individuals at management level are aware of their influence on safety culture and their function as role models. They clearly express their commitment to safety and communicate the safety message frequently and consistently. They define clear expectations regarding safety, and they behave in accordance with these expectations. They demonstrate their commitment to safety in word and deed (e.g. by playing an active part in important safety-related activities). They continuously endeavour to ensure good, open communication within the company and relationships based on trust with all employees.

---

[21] Dekker, S. (2007). Just Culture. Balancing Safety and Accountability. Ashgate.

[22] Grote, G. (2004). Uncertainty management at the core of system design. Annual Reviews in Control 28, 267-274.

[23] Grote, G. & Künzler, C. (2000). Diagnosis of safety culture in safety management audits. Safety Science 34, 131-150.

[24] IAEA (1998). Developing Safety Culture in Nuclear Activities. Practical Suggestions to Assist Progress. Safety Reports Series No. 11.

[25] Künzler, C. (2002). Kompetenzförderliche Sicherheitskultur – ein Ansatz zur ganzheitlichen Gestaltung risikoreicher Arbeitssysteme. vdf.

[26] Reason, J. (1997). Managing the Risks of Organizational Accidents. Ashgate.

[27] Weick, K. E. & Sutcliffe, K. M. (2001). Managing the Unexpected. Assuring high performance in an age of complexity. Jossey Bass.

[28] Weick, K. E. & Sutcliffe, K. M. (2007). Managing the Unexpected. Resilient performance in an age of uncertainty (2nd. Edition). Jossey Bass.

c. Everyone is aware of his responsibility for safety

Each and every employee is aware of his responsibility, influence and exemplarity in relation to safety.

The responsibilities (obligations) and powers (rights and authorities) w.r.t. safety are defined for all the functions and tasks in the organisation. Every member of the operator's organisation knows the tasks entrusted to him (i.e. they know what they must achieve by which due-date and how the quality of the result can be measured). Members perform these tasks in accordance with the requirements and they inform their line managers if they do not attain their objectives and, in particular, if they have any concerns about safety.

All members of the operator's organisation apply the regulatory framework and the procedures in a conscious way. The binding nature of regulations and procedures is clearly stipulated and is known to everyone. High priority is given to compliance with rules and regulations.

The basic principle that the licensee and its operating organisation is responsible for the safety of its nuclear installation at all times is taken into account in the relationship between the supervisory authority and the operator. The authority is aware that the relationship between it and the supervised parties may include mechanisms that influence safety.

d. All activities are essentially safety-oriented

Safety is established in the organisational structure and processes. All activities and processes are safety-oriented throughout. Safety is understood as an explicit part of the operator's core task (e.g. the safe production of electrical energy through nuclear fission in nuclear power plants, or the safe management of radioactive waste in intermediate storage facilities, etc.).

The members of the operator's organisation who manage the company or who operate the nuclear installation have up-to-date knowledge about the human, technical and organisational factors, and the external influences on them, which affect the safety of the nuclear installation. When making decisions, consideration is given to their relevance to safety.

A "questioning attitude", a "rigorous and prudent approach" and a "communicative approach"[29] are encouraged and implemented in all areas and at all hierarchical levels of the operator's organisation.[12]

Work is structured in a way to support collaboration and communication among the members of the operator's organisation so as to develop their understanding of relationships.

The employees are involved in decisions and changes. In particular, they participate in developing and modifying work instruments (e.g. procedures, operating controls, etc.). In this way,

---

[29] This is also seen as a fundamental principle of security, where it is also desirable, for example, that employees talk openly about deficiencies that they have identified, about unusual observations, or about mistakes that they or others have made so that problems relating to security can be dealt with proactively. Nevertheless, with regard to security, there are restrictions regarding the handling of certain information, which must be dealt with confidentially in order to prevent unauthorised access to it.

they can contribute their knowledge and experience on the one hand, and can influence the inevitable restrictions on their personal autonomy on the other.

e. Safety is developed through ongoing learning

The operator is able to identify and limit the occurrence of errors and unforeseen incidents, and to recover from them quickly. The characteristic feature of such a learning organisation is that errors or unforeseen incidents do not paralyse it or render it incapable of action. The organisation endeavours to be flexible so that it is capable of adapting to changing requirements. It is geared to learning from errors – as opposed to basically avoiding all errors – and to quickly implementing the lessons learned.[30]

The operator pays attention to the safety of operations, and is aware of trends and changes before they lead to malfunctions. The operator expects the unexpected. The operator assumes that it will be impossible to foresee and regulate all situations. The operator anticipates problems and seeks out the potential causes.

In the operator's organisation, a climate of trust prevails in which the members are encouraged to report errors, near misses, deviations, malfunctions and other safety-related information – and are even rewarded for doing so.[31] Such a reporting culture based on trust may also be supported by alternative reporting channels in addition to open communication among the members of the organisation at all hierarchical levels.

The operator is willing and able to reflect on itself in order to identify and communicate concealed weak points and errors at an early stage, to learn from its own and others' experience and to initiate suitable measures. Activities and procedures in which problems have arisen, receive maximum attention. Weak signals are also taken seriously. Reasons are sought out.

---

[30] Flexibility is a sensitive issue in a nuclear installation, given that activities should be carried out according to clearly stipulated rules. Nevertheless, flexibility is actually required in order to gain control of events that were not anticipated and which therefore require action as appropriate to the particular situation. More recent developments in safety research stress the importance of flexibility (e.g. Bieder, C. & Bourrier, M., 2013. Trapping Safety into Rules. How desirable or avoidable is proceduralization? Ashgate; Grote, G., 2009. Management of Uncertainty. Theory and application in the design of systems and organisations. Springer; Hollnagel, E., Pariès, J., Woods, D. D. & Wreathall, J., 2011. Resilience Engineering in Practice. A guidebook. Ashgate). The implications of these research results and theories for supervisory work in connection with safety culture still have to be analysed in depth by the supervisory authorities – including ENSI – in the future.

[31] In this context, what is known as a "just culture" is required nowadays (cf. Reason, J., 1997. Managing the Risks of Organizational Accidents. Ashgate; Dekker, S., 2007. Just Culture. Balancing safety and accountability. Ashgate). "Just culture" denotes an atmosphere based on trust in which employees are encouraged to report errors and other information which may be significant in terms of safety, but in which there is no tolerance of grossly negligent or intentional behaviour that is contrary to safety. In this regard, the challenge for operators, supervisory authorities and legislators is to define the boundary between tolerable behaviour that should not be sanctioned and behaviour that must not be tolerated.

The complexity of systems, processes and events is taken into account here. Simplified interpretations are avoided. Each and every individual supports the principle of continuous improvement.

The operator is aware of the dangers of success, and takes active steps to counter them. These dangers include, but are not limited to, complacency, blindness to operational deficiencies, the temptation to reduce safety margins and the tendency to resort to automated mechanisms when performing work. The operator encourages all its employees to adopt a questioning attitude. The operator fosters the diversity of opinions and experiences. There is a need for lateral thinkers and sceptics. Unconventional ideas and solutions are regarded as important.

Within the operator's organisation, high priority is given to employees' technical expertise and ability, and to their experience. These assets are taken into account when decisions are made. Corresponding efforts are made to develop the employees' competences (knowledge and abilities). Basic and advanced training activities are not the only means of developing employees' capabilities. Efforts are also made to provide a working organisation that fosters competence and is motivating, and which (for example) allows the employees to influence work content and conditions.

The operator assesses the safety of its entire organisation. It carries out regular self-assessments, and third-party assessments.

In principle, all of the features of a good safety culture described so far also apply to security. However, there are potential areas of conflict that must be resolved. These lead to the derivation of further requirements for an organisation's culture:

f. Integrated consideration of all requirements for the protection of humans and the environment

The operator takes an integrated approach to dealing with all requirements for the protection of humans and the environment. In doing so, it recognises (potential) areas of conflict between different requirements and, through constructive cooperation between all participating actors, resolves these in a way that provides optimum protection for humans and the environment.

The above-stated characteristics of a good safety culture are not intended for a general assessment of safety culture, but to encourage a reflection on the safety culture in nuclear installations and a dialogue between the authority and the operators about the safety culture of both parties and about ways in which safety culture is influenced.

4 Oversight of safety culture

4.1 Conceptual basis

"… the biggest danger (…) is for a safety authority to believe that it knows how things should be done, how safety culture can be guaranteed, and to enforce its model on operators – and to assume once that is done that its task is forever completed. A regulator is not an operator, he needs to keep a reasonable distance and to let operators exert their responsibilities" (A.-C. Lacoste, p. 165).[32]

The operator of a nuclear installation is responsible for its safety and safety culture at all times. In all cases, however, the supervisory authority exerts an influence on the operators' safety culture.[33,34] Even so, the impact on the operator's safety culture and the fulfilment of its responsibility is dependent on the supervisory approach. The supervisory authority must take account of this in its oversight principles and methods.

It is not possible to supervise the entire content of safety culture in the same way. It is possible to assess a target condition or status that can be defined on the basis of design and operating requirements. This is not the case for values and world views. There is no generally valid way of defining which safety culture is the right one or the best. Culture – including safety culture – cannot be prescribed or changed at will.[13] Culture in an organisation develops over a lengthy period on the basis of the organisation's past experience, and is relatively stable.[35] Changes to culture require time and can only be partly controlled. Even the replacement of key individuals in the organisation does not necessarily trigger a change in the culture.

Finally, a substantial number of cultural aspects cannot be measured directly because there are no suitable instruments, so a comprehensive and systematic assessment is impossible.[4]

As regards safety culture in nuclear installations, ENSI's supervisory activities should be targeted at the following objectives:

- exerting a positive influence on the safety of the nuclear installations

- exerting a positive influence on the safety culture of the supervised organisations

---

[32] Lacoste, A.-C. (2002). Role of the regulator in the development of safety culture. Paper presented at the International Conference on Safety Culture in Nuclear Installations, Rio de Janeiro, IAEA.

[33] Durbin, N., Melber, B. & Blom, I. (2002). Regulatory Strategies and Safety Culture in Nuclear Power Installations. Paper presented at the International Conference on Safety Culture in Nuclear Installations, Rio de Janeiro, IAEA.

[34] Sorensen, J. N. (2002). Safety Culture – A Survey of the State-of-the-Art, NUREG-1756. U. S. Nuclear Regulatory Commission.

[35] Schein, E. H. (2002). The difficult cultural issues in promoting safety. Paper presented at the International Conference on Safety Culture in Nuclear Installations, Rio de Janeiro, IAEA.

- encouragement of the operators to take responsibility for their own actions

- avoiding anything which makes it more difficult for operators to meet their responsibility for safety

- promoting overall conditions that are suitable for these purposes

These conditions include a framework of legal, institutional and cultural conditions in which learning from experience is encouraged and rewarded. This calls for an environment that is not based on blame and punishment, but one in which grossly negligent behaviour and intentional breaches of safety rules are not tolerated – in other words, what is known as a "just culture".[21,26] This learning also includes processes for reflecting about one's own culture, particularly the safety culture.

4.2   Oversight principles

With respect to safety culture, ENSI also bases its oversight on the following principles:

- The responsibility for safety is borne by the operator of a nuclear installation. The supervisory authority verifies whether the operator is meeting its responsibility for safety. For this purpose, it gathers the information required in order to obtain a realistic overall picture of the nuclear installation as a human-technology-organisational system.[36]

- If the supervisory authority finds that the operator is not meeting its responsibility for safety in full, it implements supervisory and enforcement measures.

As is the case with safety in general, ENSI is unwilling and unable to make an across-the-board statement about the safety culture of the operators of nuclear installations. It can, however, make statements about specific safety-related facts and circumstances insofar as they can be accessed and assessed.

4.3   Methods for oversight of safety culture in nuclear installations

In accordance with the Integrated Oversight approach[36], ENSI supervises the safety-related issues in a nuclear installation graded according to their importance for safety. Figure 2 shows that there are variances in the extent to which the supervisory authority can access these safety-related issues. Accordingly, different methods of access are required for the oversight of different parts of the safety culture content (cf. section 2.3).

---

[36] Swiss Federal Nuclear Safety Inspectorate (2015). Integrated Oversight, ENSI Report on Oversight Practice, ENSI-AN-8968. ENSI.

4.3.1 Observable content of safety culture, incorporated into the systematic safety assessment

Most of ENSI's supervisory activities – specifically, compiling expert opinion reports and safety-related statements, controlling reporting and notifications by the licensees, performing inspections, analysing reportable events, issuing permits, and staff licensing – are aimed at ensuring that the matters under oversight meet the requirements for safety measures at nuclear facilities. These requirements include a clearly defined target condition. The actual condition that is observed can be measured against these requirements.

As part of ENSI's systematic assessment of safety[37], the observed issues are assigned to the following categories on the basis of the subjects involved: "Design requirements", "Operating requirements", "Condition and behaviour of the plant" and "Condition and behaviour of man and organisation".

Documents containing design and operating requirements, the installation's condition and behaviour, or evidence (as an aspect of the "Condition and behaviour of man and organisation"), form part of the human-made physical environment. The working methods of members of the organisation fall within the category of "Condition and behaviour of man and organisation" and (as per figure 2) form part of behaviour. Matters related to the physical environment and to behaviour can be observed and are therefore accessible to the supervisory authority, within the limits of the actual observation. Accessible safety culture content of this sort is incorporated into ENSI's systematic assessment of safety (cf. figure 3).

---

[37] cf. section 5 of Integrated Oversight, ENSI-AN-8968.

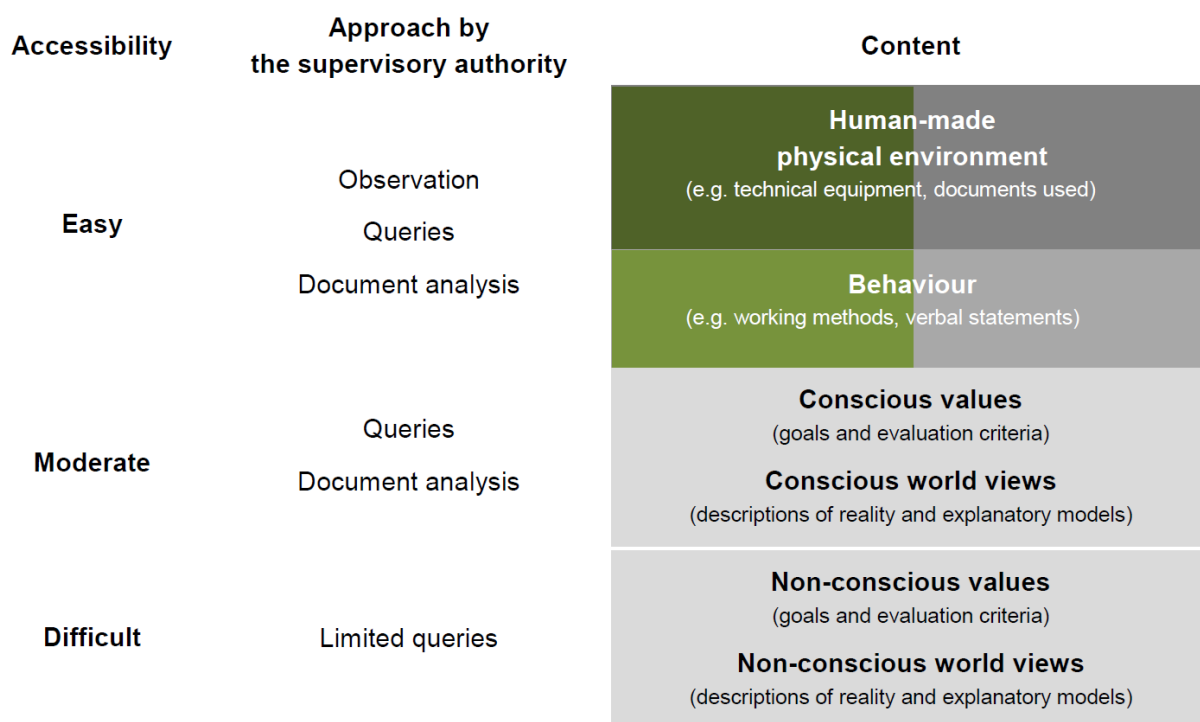| Accessibility	Approach by the supervisory authority	Content
Easy	Observation Queries Document analysis	**Human-made physical environment** (e.g. technical equipment, documents used) **Behaviour** (e.g. working methods, verbal statements)
Moderate	Queries Document analysis	**Conscious values** (goals and evaluation criteria) **Conscious world views** (descriptions of reality and explanatory models)
Difficult	Limited queries	**Non-conscious values** (goals and evaluation criteria) **Non-conscious world views** (descriptions of reality and explanatory models)

Figure 3: Observable content of safety culture, incorporated into the systematic safety assessment

The observable content of safety culture – such as the condition of the installation, the behaviour of the staff and the management system – shows how the supervised operator deals with safety on a day-to-day basis, and indicates the current safety status of the installation. These aspects are assessed on the basis of the licensed or authorised installation-specific operating conditions and on the regulatory framework for nuclear technology.

4.3.2 Observable or queriable content of safety culture, not incorporated into the systematic safety assessment

With respect to some of the observable content of safety culture, no specified requirements exist for a clearly defined target condition. It follows that such content cannot be assessed individually, so it cannot be incorporated into ENSI's systematic safety assessment.[38]

Likewise, there are no specified requirements for a clearly defined target condition in the case of values and world views. Values and world views are accessible to the regulatory body through questioning insofar as the individuals who hold such values and world views are aware

---

[38] This applies, for instance, to the operator's activities related to safety culture which it carries out of its own accord, such as self-assessments or third party assessments of its own safety culture. Activities of this sort represent key elements of efforts made at the operator's own responsibility to promote and to continue the development of safety culture, and ENSI regards these activities as indications of how the operator is meeting its own responsibilities.

of them, and insofar as they are prepared to reveal them. Given the absence of clearly specified requirements, it is also impossible for values and world views (as relevant to safety) to be incorporated into the systematic safety assessment.

As mentioned, it is impossible to make individual assessments of those elements of the safety culture that can be observed or queried but for which there are no clearly defined target condition requirements. Yet these elements, taken as a whole, contain information about the safety of the human-technology-organisational system. Hence ENSI has an interest in taking such content into account in the course of its supervisory activities (cf. figure 4).
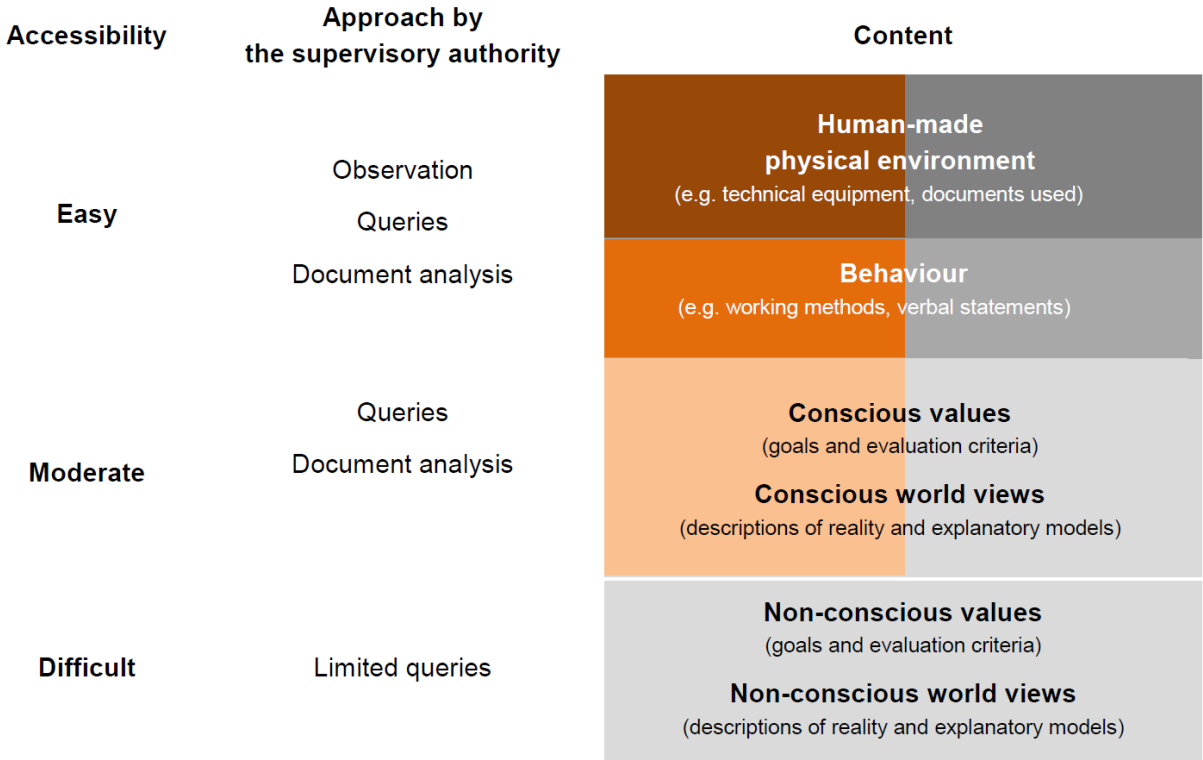
Accessibility	Approach by the supervisory authority	Content
Easy	Observation Queries Document analysis	**Human-made physical environment** (e.g. technical equipment, documents used) **Behaviour** (e.g. working methods, verbal statements)
Moderate	Queries Document analysis	**Conscious values** (goals and evaluation criteria) **Conscious world views** (descriptions of reality and explanatory models)
Difficult	Limited queries	**Non-conscious values** (goals and evaluation criteria) **Non-conscious world views** (descriptions of reality and explanatory models)

Figure 4: Observable or queriable content of safety culture, not incorporated into the systematic safety assessment

Even during those of ENSI's supervisory activities which are aimed at assessing observable circumstances – such as the compilation of expert assessments and statements on safety, evaluation of the periodic reporting, inspections, analysing of events and the process for issuing release permits – ENSI's employees observe circumstances for which no clearly specified requirements exist. Although these observations are secondary when considered in isolation, they may – taken in conjunction with other observations – reveal patterns that are significant beyond the individual situation.

An exchange of information with the supervised parties is required in addition to supervisory activities targeted at the assessment of observable circumstances. ENSI makes use of supervisory discussions and technical discussions for this purpose. These discussions, which take

place at various managerial, specialist and technical levels, also deal with issues of relevance to the safety culture. Examples include aspects of the supervised parties' management system, organisational or personnel changes, training of licensed and non-licensed personnel, and the operator's programmes and activities to foster its safety culture.

If indications of safety-related problems emerge when observing or querying circumstances that cannot be assessed individually, ENSI follows up such indications, for example during inspections. These indications may ultimately lead to findings that are incorporated into the systematic safety assessment (cf. section 4.3.1).

Findings related to safety culture that cannot be assessed individually are often discussed on an informal basis at ENSI. ENSI is reviewing options for recording and analysing such findings so that their informative value can also be capitalised upon more systematically. Analysing large numbers of findings of this sort may help to identify trends or patterns that could provide indications about an organisation's safety culture.

4.3.3 Safety culture content difficult to access

Values and world views of which the members of the operating organisation are not consciously aware are also part of the safety culture content. In order to make members of the operating organisation consciously aware of some of this content (cf. figure 5), ENSI makes use of special periodic **specialist discussions promoting a dialogue on safety culture**. ENSI aims to use these specialist discussions, which are conducted in an open and constructive manner, to prompt the supervised parties to reflect on their safety culture. ENSI makes a clear distinction between this instrument and supervisory instruments in the stricter sense, such as inspections and analyses of events, which lead to a formal assessment and (in case of findings) to requirements.

The issues to be covered in a specialist discussion promoting a dialogue on safety culture are defined on a case-by-case basis. One of the sources ENSI makes use of, are the characteristics of a good safety culture as mentioned in section 3.

Questions regarding safety culture arise also from the systematic safety assessment or from day-to-day oversight. Specialist discussions of this sort are also triggered by the ongoing development of scientific and technical knowledge in the field of safety culture or by experience gained in other nuclear installations or other industries. The frequency of specialist discussions promoting a dialogue on safety culture depends on the need and on the installation's hazard potential.

These specialist discussions comprise two parts with an interval of several weeks between them:

Part 1: discussion about the defined question regarding the safety culture and record of the discussion

Part 2: presentation of the findings and hypotheses drawn up by ENSI in the interim, on the basis of the recordings of part 1, but without formal assessments; discussion about these findings and hypotheses.
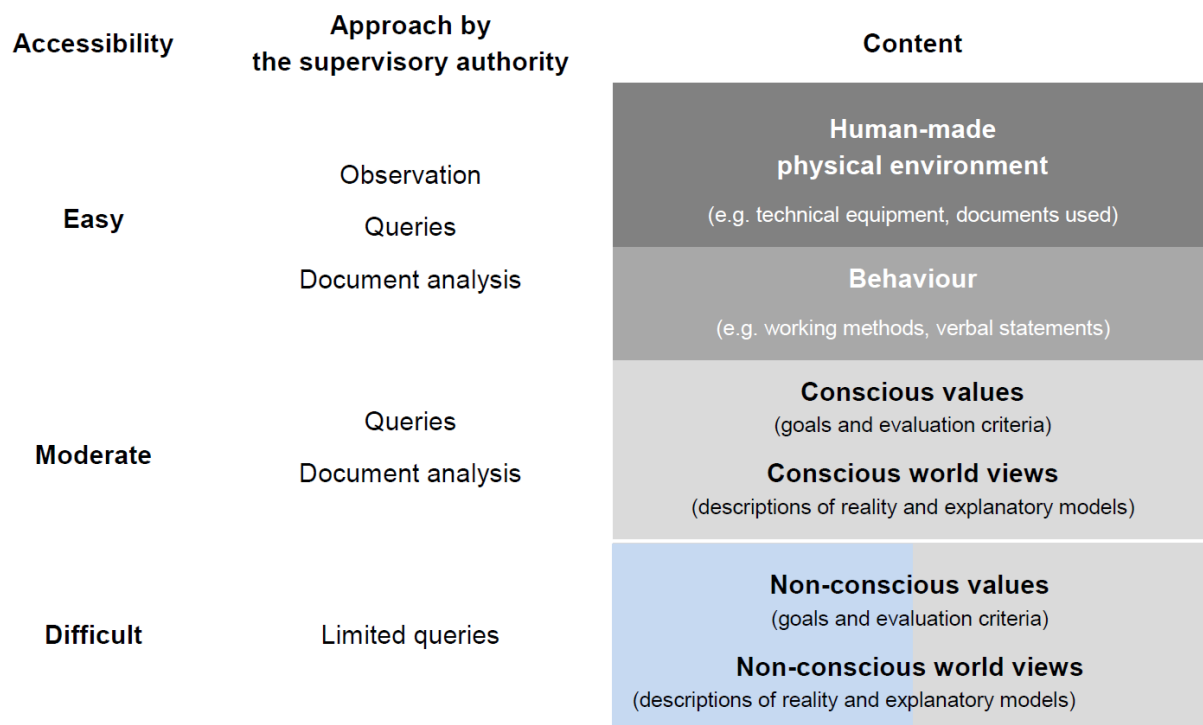
Accessibility	Approach by the supervisory authority	Content
Easy	Observation Queries Document analysis	**Human-made physical environment** (e.g. technical equipment, documents used) **Behaviour** (e.g. working methods, verbal statements)
Moderate	Queries Document analysis	**Conscious values** (goals and evaluation criteria) **Conscious world views** (descriptions of reality and explanatory models)
Difficult	Limited queries	**Non-conscious values** (goals and evaluation criteria) **Non-conscious world views** (descriptions of reality and explanatory models)

Figure 5: Safety culture content difficult to access

5   The safety culture of the supervisory authority

As explained in section 4.1, the supervisory authority influences the safety culture of the operators of nuclear installations it supervises. The supervisory authority must therefore examine its influence on the operators' safety culture. The objectives are to exert a positive influence on the operators' safety culture by means of the supervisory activities, and to avoid negative influences.

For this purpose, the supervisory authority must address its own safety culture, i.e. its supervisory culture, and must examine how this supervisory culture affects the safety culture of the supervised organisations.

ENSI focuses intensively on its own supervisory culture. To this end, it has conducted a several-year project whose aim was to launch and institutionalise a self-reflection process regarding its own supervisory activities and their impact on the safety culture of the supervised organisations. From this process, ENSI has derived measures to foster a safety-oriented oversight culture.[39]

---

[39] The concept, approach and results of the ENSI project on oversight culture were presented in a report: Swiss Federal Nuclear Safety Inspectorate ENSI (2015). Oversight Culture, ENSI Report on Oversight Practice, ENSI-AN-8707. ENSI. (https://www.ensi.ch/en/documents/oversight-culture-2015-ensi-report-on-oversight-practice/).

Annex: Requirements

Swiss legislation on nuclear energy

Article 5, paragraph 1, Nuclear Energy Act (NEA): "When designing, constructing and operating nuclear installations, preventive and protective measures must be taken in accordance with internationally accepted principles. These measures shall include (…) the fostering of a strong safety awareness".

Article 5, paragraph 3, NEA: "Security measures must be taken in order to prevent any interference with the safety of nuclear installations and nuclear materials through unauthorised acts or the theft of nuclear materials".

Article 22, paragraphs 1 and 2, letters a, b and j, NEA: "The licence holder is responsible for the safety of the installation and its operation. In this connection it shall: a. always give the necessary priority to nuclear safety during operation of the installation; b. establish a suitable organisation ... j. carry out appropriate measures to secure quality assurance for all activities conducted within the installation".

Article 28, paragraph 1, letter a in conjunction with Annex 3, Nuclear Energy Ordinance (NEO): "The mission statement specifies how the management staff of the nuclear installation interpret and promote safety culture, and define the factors and criteria that are used for assessing its effectiveness".

Article 30, paragraph 1, letter k, NEO: "The organisation of the installation must be structured in such a manner that it ensures internal responsibility for at least the following activities and areas: ... k. fostering of safety awareness".

Clause iv of the Preamble to the Convention on Nuclear Safety (CNS) of 17 June 1994 (SR 0.732.020): "Desiring to promote an effective nuclear safety culture".

Clause v of the Preamble to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the "Joint Convention") of 5 September 1997 (SR 0.732.11): "Desiring to promote an effective nuclear safety culture worldwide".

Articles 10 to 13, VAPK: The Ordinance concerning the Requirements for Personnel of Nuclear Installations (VAPK) requires that training and instruction should "strengthen awareness of safety".

Article 2a of the Amendment to the Convention on Physical Protection of Nuclear Material (CPPNM) of 8 May 2016 (SR 0.732.031): Fundamental principle F: Security Culture "All organizations involved in implementing physical protection should give due priority to the security culture, to its development and maintenance necessary to ensure its effective implementation in the entire organization".

IAEA Safety Standards

Requirements and recommendations for Member States and supervisory authorities

The IAEA formulates requirements and recommendations for the supervisory authorities with regard to safety culture:

IAEA Safety Standards Series, General Safety Requirements GSR Part 1 "Governmental, Legal and Regulatory Framework for Safety":

- Requirement 19: The management system of the regulatory body: "4.15. The management system of the regulatory body has three purposes: (…) (3) The third purpose is to foster and support a safety culture in the regulatory body through the development and reinforcement of leadership, as well as good attitudes and behaviour in relation to safety on the part of individuals and teams".

- Requirement 29: Graded approach to inspections of facilities and activities: "4.53. In conducting inspections, the regulatory body shall consider a number of aspects, including: (…) Safety culture".

IAEA Safety Standards Series, Safety Guide No. GS-G-1.3 "Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body", in particular paragraphs 2.3 and A.22: The supervisory authority's inspection activities should confirm that the supervised organisation displays a good safety culture: „The operator has a strong and effective management, good safety culture and self-assessment systems for ensuring the safety of the facility and the protection of workers, the public and the environment" (p. 3). Inspections should also ascertain "… how the management emphasizes the importance of safety and fosters safety culture" (p. 35).

IAEA Safety Standards Series, Safety Guide No. GS-G-1.2 "Review and Assessment of Nuclear Facilities by the Regulatory Body", in particular paragraphs 3.44 and A.10: Reviews and assessments on the installation by the authority should take account of the safety culture of the supervised parties: "Review and assessment by the regulatory body should … include consideration of the operator's organization, management, procedures and safety culture" (p. 26).

IAEA Safety Standards Series, Safety Guide No. GS-G-1.1 "Organization and Staffing of the Regulatory Body for Nuclear Facilities", in particular the Appendix: Knowledge of safety culture should be imparted as part of the training for supervisory staff.

IAEA Nuclear Security Series No. 20, Nuclear Security Fundamentals, "Objective and Essential Elements of a State's Nuclear Security Regime", in particular paragraph 3.12 (c): "A nuclear security regime ensures that each competent authority and authorized person and other organizations with nuclear security responsibilities contribute to the sustainability of the regime by: (…) (c) Developing, fostering and maintaining a robust nuclear security culture".

Requirements and recommendations for operators of nuclear installations

In the following Safety Standards, the IAEA states requirements and recommendations for the operators of nuclear installations (or for all organisations) regarding the promotion of their safety culture (including security culture):

IAEA Safety Standard SF-1 "Fundamental Safety Principles"

- para. 3.12: "(…) The management system also has to ensure the promotion of safety culture (…)".

- para. 3.13: "A safety culture that governs the attitudes and behaviour in relation to safety of all organizations and individuals concerned must be integrated in the management system. Safety culture includes: Individual and collective commitment to safety on the part of leadership, the management and personnel at all levels; Accountability of organizations and of individuals at all levels; Measures to encourage a questioning and learning attitude and to discourage complacency with regard to safety".

- para. 3.32: "Defence in depth is provided by an appropriate combination of: An effective management system with a strong management commitment to safety and a strong safety culture".

IAEA Safety Standard Series; General Safety Requirements No. GSR Part 2 "Leadership and Management for Safety", in particular the following paragraphs:

- para. 3.1: "The senior management of the organization shall demonstrate leadership for safety by: (c) Establishing behavioural expectations and fostering a strong safety culture".

- Requirement 12: Fostering a culture for safety: "Individuals in the organization, from senior managers downwards, shall foster a strong safety culture. The management system and leadership for safety shall be such as to foster and sustain a strong safety culture".

- para. 5.1: "All individuals in the organization shall contribute to fostering and sustaining a strong safety culture".

- para. 5.2: "Senior managers and all other managers shall advocate and support the following:

  (a) A common understanding of safety and of safety culture, including: awareness of radiation risks and hazards relating to work and to the working environment; an understanding of the significance of radiation risks and hazards for safety; and a collective commitment to safety by teams and individuals;

  (b) Acceptance by individuals of personal accountability for their attitudes and conduct with regard to safety;

  (c) An organizational culture that supports and encourages trust, collaboration, consultation and communication;

(d) The reporting of problems relating to technical, human and organizational factors and reporting of any deficiencies in structures, systems and components to avoid degradation of safety, including the timely acknowledgement of, and reporting back of, actions taken;

(e) Measures to encourage a questioning and learning attitude at all levels in the organization and to discourage complacency with regard to safety;

(f) The means by which the organization seeks to enhance safety and to foster and sustain a strong safety culture, and using a systemic approach (i.e. an approach relating to the system as a whole in which the interactions between technical, human and organizational factors are duly considered);

(g) Safety oriented decision making in all activities;

(h) The exchange of ideas between, and the combination of, safety culture and security culture".

- Requirement 14: Measurement, assessment and improvement of leadership for safety and of safety culture: "Senior management shall regularly commission assessments of leadership for safety and of safety culture in its own organization".

- para. 6.9: "Senior management shall ensure that self-assessment of leadership for safety and of safety culture includes assessment at all organizational levels and for all functions in the organization. Senior management shall ensure that such self-assessment makes use of recognized experts in the assessment of leadership and of safety culture".

- para. 6.10: "Senior management shall ensure that an independent assessment of leadership for safety and of safety culture is conducted for enhancement of the organizational culture for safety (i.e. the organizational culture as it relates to safety and as it fosters a strong safety culture in the organization)".

- para. 6.11: "The results of self-assessments and independent assessments of leadership for safety and of safety culture shall be communicated at all levels in the organization. The results of such assessments shall be acted upon to foster and sustain a strong safety culture, to improve leadership for safety and to foster a learning attitude within the organization".

IAEA Safety Standard Series, Specific Safety Requirements No. SSR-2/2 (Rev. 1) "Safety of Nuclear Power Plants: Commissioning and Operation"

- para. 3.2: "The management system (…) shall include the following activities: (a) Policy making for all areas, which includes: (…) Promoting a strong safety culture".

- para. 4.1: "(…) The safety policy shall promote a strong safety culture, including a questioning attitude and a commitment to excellent performance in all activities important to safety. Managers shall promote an attitude of safety consciousness".

- para. 4.19: "The training shall emphasize the importance of safety in all aspects of plant operation and shall promote safety culture".

IAEA Safety Standard Series, Safety Guide No. NS-G-2.4 "The Operating Organization for Nuclear Power Plants"

- para. 1.3: "The structure of the organization, management standards and administrative controls should be such that there is a high degree of assurance that (…) a strong safety culture is promoted and supported".

- para. 3.10: "The responsibilities of the plant managers encompass: (…) establishment and perpetuation of a strong safety culture (…)".

- para. 5.1: "The safety management system should comprise those arrangements made by the operating organization that are needed to promote a strong safety culture (…)".

IAEA Safety Standard Series, Safety Guide No. NS-G-2.8 "Recruitment, Qualification and Training of Personnel for Nuclear Power Plants"

- para. 1.1: "In order to achieve and maintain high levels of safety, nuclear power plants are required to be staffed with an adequate number of highly qualified and experienced personnel who (…) are motivated to adopt a positive attitude to safety, as an element of safety culture".

- para. 2.15: "(…) specific safety culture related attributes such as a questioning attitude, a rigorous and prudent approach, and communication and learning abilities should be taken into consideration in selecting candidates for safety related positions at a nuclear power plant".

- para. 3.3: "Staff should be trained (…) in how to promote safety culture and conservative decision making by means of positive feedback and recognition".

- para. 3.4: "Safety culture in terms of attitudes, as well as skills in communication, teamwork, management and supervision, leadership, appreciation and use of analytical methods, and other 'soft skills' should be demonstrated by plant personnel".

- para. 3.5: "The competence of plant personnel should also include such aspects of safety culture as a questioning attitude, a rigorous and prudent approach to safety, and the necessary communication skills (…)".

- para. 3.29: "(…) safety culture and safety management experience are specific attributes to be taken into account in the selection and assignment processes for plant personnel".

- para. 3.42: "Suppliers and contractors should understand the safety culture demonstrated by the plant personnel".

- para. 4.6: "Training is one of the means to promote safety culture, and, accordingly, should be fully encouraged and supported by plant managers, who should also be trained in safety culture".

- para. 5.1: "The basic principles of safety culture should be taught to all employees".

- para. 5.4: "Safety culture should be inculcated effectively in all staff involved in safety related activities. All training programmes for specific plant activities should make reference to safety culture".

- para. 5.11: "Training programmes for managers and supervisory personnel should emphasize the concept of safety culture (…)".

- para. 5.23: "An appropriate emphasis should be placed on safety culture in all aspects of the training for maintenance personnel".

- para. 5.33: "Personnel in the on-site training unit should also be properly trained in matters concerning the policies of the operating organization, in particular safety management and safety culture (…)" together with Appendix I (Attitudes and skills for safety culture) and Appendix II (Aspects of safety culture in individuals).

IAEA Safety Standard Series, Safety Guide No. GS-G-3.1 "Application of the Management System for Facilities and Activities", in particular paragraphs 2.32 to 2.36, which state the requirements more precisely and describe the characteristics of safety culture.

IAEA Safety Standard Series, Safety Guide No. GS-G-3.5 "The Management System for Nuclear Installations", in particular, paragraphs 2.6 to 2.31 and Appendix I – these passages state the requirements more precisely and with specific reference to nuclear installations; they describe characteristics of safety culture, give recommendations on improving safety culture and describe the warning signs of a deterioration in the safety culture.

IAEA Code of Conduct on the Safety and Security of Radioactive Sources (2004): Basic Principle 7: "Every State should, in order to protect individuals, society and the environment, take the appropriate measures necessary to ensure: (…) (b) the promotion of safety culture and of security culture with respect to radioactive sources".

IAEA Nuclear Security Series No. 13, Recommendations "Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities" (2011), in particular:

"Security culture:

All organizations involved in implementing physical protection should give due priority to the security culture, to its development and maintenance necessary to ensure its effective implementation in the entire organization (FUNDAMENTAL PRINCIPLE F: Security Culture).

3.48. The foundation of nuclear security culture should be the recognition that a credible threat exists, that preserving nuclear security is important, and that the role of the individual is important.

3.49. The four component groups — the State, organizations, managers in organizations and individuals — should work together to establish and maintain an effective nuclear security culture.

3.50. The State should promote a nuclear security culture and encourage all security organizations to establish and maintain one. A nuclear security culture should be pervasive in all elements of the physical protection regime.

3.51. All organizations that have a role in physical protection should make their responsibilities known and understood in a statement of security policy issued by their executive management to demonstrate the management's commitment to provide guidelines to the staff and to set out the organization's security objectives. All personnel should be aware of and regularly educated about physical protection".

IAEA Nuclear Security Series No. 7, Implementing Guide "Nuclear Security Culture", in particular the following statements:

- "All organizations involved in implementing physical protection should give due priority to the security culture; to its development and maintenance necessary to ensure its effective implementation in the entire organization".

- Nuclear Security Culture is defined as follows: "The assembly of characteristics attitudes and behaviour of individuals, organizations and institutions which serves as a means to support and enhance nuclear security".

- "The principal shared objective of security culture and safety culture is to limit the risk resulting from radioactive material and associated facilities. This objective is largely based on common principles, e.g. a questioning attitude, rigorous and prudent approaches, and effective communication and open, two way communication".

"An organization in charge of nuclear matters has to foster an approach that integrates safety and security in a mutually supporting manner".

ENSI-AN-8980

ENSI, Industriestrasse 19, 5200 Brugg, Schweiz, Phone +41 56 460 84 00, E-Mail Info@ensi.ch, www.ensi.ch