

01 Defining the key concepts

The first set of questions refers to the need to agree on how the definitions and models of the key concepts such as culture and safety are understood in the project. Many industries tend to use both concepts without an explicit definition, meaning safety culture may become associated mainly with occupational issues. However, occupational safety and process, or nuclear safety, are distinct types that require different approaches.

Question	
What safety are we talking about?	
Description	NPP construction
There is a need for clarity concerning what safety we are talking about: nuclear safety, occupational safety, environmental safety, security.	The distinction matters especially during NPP construction when occupational safety issues easily dominate over nuclear safety.
Question	
How do you define safety culture?	
Description	NPP construction
It's important to agree on a definition of safety culture that indicates how it differs from technical concepts and, for example, safety management systems.	Definition can include nuclear and occupational safety. Sometimes the term "nuclear safety culture" is used when the focus is solely on nuclear safety.
Question	
How does safety culture affect (nuclear) safety?	
Description	NPP construction
Since nuclear safety can be immediately endangered only after loading of the nuclear fuel, the mechanisms of influencing nuclear safety during construction need to be clarified.	The preconditions for reliable and safe operation are created during construction. Different types of organisations affect safety differently.

02 Identifying how to assess and influence culture

After defining safety and culture, the project organisations need to identify how culture can be influenced and whether the culture supports safety or not. There needs to be an agreement on what is a nuclear safety related event during design and construction. Typical nuclear events such as leaks, contamination or radiation dosages cannot yet happen. What can happen are various non-conformities in design review, construction and manufacturing activities, or even in quality control and assurance.

A QUESTION OF SAFETY

An expert team from Finland reveals what questions need to be asked to improve safety culture during the construction of nuclear power plants

A strong focus on safety is required from the very beginning of a nuclear power plant's (NPP) life-cycle to avoid latent defects in the design or uncorrected errors in the construction and ensure the licensee develops adequate capability to safely operate the plant. Organisations in the nuclear sector are required to have a good safety culture and this requirement is set in regulatory requirements and industry standards.

There have been two major NPP construction projects in Finland during the last decade: Olkiluoto 3 and the recently terminated Hanhikivi 1. We have worked as safety culture specialists and contract researchers in these two projects jointly for more than 20 person years. This article discusses our experience and lessons learned during 2006-2022.

We propose a set of questions that each NPP project must ask and find a shared solution, if they wish to build a culture that contributes positively to nuclear safety. We also provide examples of constraining questions that are too narrow and so misuse the safety culture concept.

Question	
How do we know the strengths and weaknesses in our safety culture?	
Description	NPP construction
This also includes the question of who defines the criteria for a good safety culture and what model to use.	There is a need for agreement on what is a nuclear safety related event during construction and what are the warning signs of declining safety culture.
Question	
How do you assure safety culture in the supply chain?	
Description	NPP construction
During construction, the future operator as well as the plant supplier need to assure safety culture in their supply chain.	Complex supply chains require grading of attention to most safety-significant companies, as well as contractual requirements for safety culture.
Question	
How do you systematically influence safety culture?	
Description	NPP construction
How to develop safety culture? Can you influence culture directly? Leadership and systematic culture development are important.	Leadership is about creating, maintaining and changing culture. The importance of leadership is emphasised due to the abstract nature of nuclear safety during the construction phase.

03 Realising what is the added value of a cultural approach to safety

Safety culture specialists focus on the human and organisational drivers and barriers of quality, going deeper than the quality specialists into the subjective and social issues such as norms, beliefs, and values. By adopting this wider perspective, a cultural approach should contribute to systems thinking. It should also contribute to an understanding of how different organisations tend to have a distinct view on safety and their role in achieving it.

Question	Description	NPP construction
How does safety culture assurance differ from quality management?	Quality and safety are closely related concepts. Quality management is also an established discipline and personnel in projects recognise quality as an issue to be integrated into the management system.	Safety culture is the link between the management system, its implementation and the final product.
What is the added value of the safety culture approach?	The project needs to understand why a safety culture approach is required and what it adds to the existing approaches.	Safety culture can be a reminder about the effects of personnel and organisations on nuclear safety during the construction phase and about the systemic influences on safety in general.

04 Deciding how to consider the context

The fourth set of questions has to do with the context; understanding the specific requirements of nuclear construction on safety culture and deciding on an approach to systematically develop safety culture in the project.

Question	Description	NPP construction
What requirements does the context set us?	Issues to discuss include what good leadership is in this context, how the contracts facilitate / hinder good quality work and how the supply chain should be managed.	Project environment: High turnover, multicultural context with language issues, people inexperienced in nuclear, education from basic to doctorate, schedule pressures combined with heavy regulation.
How should we take multicultural issues into account?	A specific question for large projects involving companies and individuals from all over the globe concerns multicultural issues.	Issues regarding leadership, authority and communication are especially relevant for the NPP construction project.
How should we approach safety culture in nuclear power construction?	This is a holistic question about how to proceed with the concept of safety culture in NPP construction.	Systems thinking, shared values, understanding of nuclear safety, future orientation, information flow, and influence of organisational structural issues such as contracts are important.

Conclusions

Systems thinking, shared values, understanding of nuclear safety, future orientation, information flow and influence of organisational structural issues such as contracts are important issues to consider in NPP construction projects. Leadership, communication and authority issues need also to be considered especially at the multicultural construction site. The project parties need to agree on how definitions and models of the key concepts such as culture and safety are understood, and how culture can be influenced. ■

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05 Constraining questions and counterproductive approaches

One of the major challenges of working with safety culture in the nuclear industry is, paradoxically, the fact that good safety culture is a requirement. This easily leads to a situation where the supplier or a sub-supplier is trying to prove they have a good safety culture, rather than openly trying to identify their weaknesses and develop activities.

Question	Description	NPP construction
How do you quantify safety culture?	Safety analyses require that risks are quantified. If safety culture influences nuclear safety, this effect needs to be a number, or so the logic goes.	The effect of safety culture on nuclear safety may be described in the Preliminary Safety Analysis Report, but its quantification should be avoided.
What exact behaviour and actions do you want to see?	This question is often asked if safety culture is a regulatory or contractual requirement.	It leads easily to overemphasis on easily counted and observable activities, and therefore a focus on occupational safety.
How do you certify safety culture or verify in audit?	Whenever there are contractual or regulatory requirements, these need to be verified in some manner, typically by an inspection or an audit.	The limits of the traditional audit approach need to be realised. Audits can reveal a lot about how the organisation develops culture, but not much about culture as such.
How many cultures do we need?	Safety culture is sometimes considered as one of several cultures that an organisation has or needs.	Project schedules and costs create pressure to devise a "project culture" as a counterforce to safety culture. This hinders attempts to create a company-wide culture.