



Safety culture as a matter of regulatory control and regulatory effectiveness

C.T.M. Camargo, E.B. Furieri, L.A.I. Arrieta, C.U.C. Almeida

Directorate for Radiation Protection and Nuclear Safety
National Nuclear Energy Commission – CNEN
Rio de Janeiro, BRAZIL

Abstract. More than 15 years have passed since the term “safety culture” was introduced by the International Nuclear Safety Advisory Group (INSAG), and although the concept now is widely accepted, practical applications and characteristics have been disseminated mainly for nuclear power plant operating organizations. There is still a lack of international guidance on the use of safety culture as a regulatory matter and on the application of the concept within regulatory organizations. This work explores the meaning of safety culture in two different fields: as an element of safety management systems it shall be a matter of regulatory control; as a complementary tool for quality management it should be used to enhance regulatory effectiveness. Brazilian recent experience on regulating nuclear power reactors provide some examples on how the concept of safety culture may influence regulatory strategies and regulatory management.

1. Introduction

The concept of safety culture is stated in INSAG-4 [1] as “safety culture is 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”.

The Safety Fundamentals publication, The Safety of Nuclear Installations [2], does not mention the expression safety culture at all. However, within its section 4, Management of Safety, related aspects are addressed as, for instance, the need to recognize the safety significance of each organizational activity. Principle (4), of reference [2], requires that “organizations engaged in activities important to safety shall establish policies that give safety matters the highest priority, and shall ensure that these policies are implemented within managerial structure having clear divisions of responsibility and clear lines of communication.”

As regulators have considerable discretionary authority in matters of nuclear safety, this Principle (4) should have influence on regulatory organizations, as well. According to INSAG-4 [1], in all types of activities, for organizations and for individuals at all levels, attention to safety involves the following elements: (1) individual awareness; (2) knowledge and competence; (3) commitment; (4) motivation; (5) supervision; (6) responsibility. These so called universal features of safety culture should imply on requirements at policy level and requirements on managers and on the response of individuals.

In spite of that, the IAEA Safety Requirements on Legal and Governmental Infrastructure [3] does not make use of the expression safety culture, although its scope covers regulatory body organization and activities. With respect to regulatory management system, it states only that “the regulatory body shall establish and implement appropriate arrangements for a systematic approach to quality management which should extend throughout the range of responsibilities and functions undertaken”.

Regulatory management systems have recently been the subject of a peer discussions among senior regulators, promoted by IAEA, which produced a technical report [4] containing a valuable set of good management practices on the subject.

Consistently with such practices, the top management of the Brazilian regulatory body issued, in 1996, its safety and quality policy statements. Later, a project co-ordination team was appointed to control the development and implementation of a quality management system within the Brazilian regulatory authority. This work presents some practical experience on the matter of safety culture and lessons learned during preliminary steps taken in this project, particularly when trying to apply available concepts to regulatory management and regulatory strategies.

2. Applying the concept for regulatory bodies

If the universal features of safety culture are easily recognizable as also applicable to regulatory organizations, some specific features of regulatory activity are not explicitly addressed in many IAEA documents dealing with safety culture. They were mostly developed for, and applicable to operating organizations. Nevertheless, they usually claim the applicability for any organization with some responsibility on safety. The authors experience showed the need to adapt some concepts to specific features derived from the regulatory mission.

The report INSAG-13, Management of Operational Safety in Nuclear Power Plants [5], has the purpose to build upon the ideas outlined in INSAG-4 and to develop a set of universal features for an effective safety management system, which is considered to be an integral part of the organization's quality management system. As safety is primarily the responsibility of the plant operating organization, to discharge its responsibility, the operating organization needs to establish an effective safety management system which, by definition, "comprises those arrangements made by the organization for the management of safety in order to promote a strong safety culture and achieve good safety performance". Therefore, the concept of safety management system does not apply to regulatory body itself. Nevertheless, as a tool to enhance safety performance of nuclear installations, safety culture should be object of systematic regulatory actions.

According to INSAG-10, Defence in Depth in Nuclear Safety [6], "safety culture is broadly relevant to all areas related to defence in depth and is particularly important for operational safety. One of the most important lessons learned from severe accidents is that there is a need to encourage a questioning and learning attitude to protection and safety and to discourage complacency." As an element of the defence in depth system, safety culture should also be a matter of regulatory control.

While the operators should declare, in their policy statements, a commitment to excellence in all activities important to safety, making it clear that safety has the highest priority, for regulators such an equivalent statement should declare a commitment to implement legislation and act to promote plant safety and protection of individuals and environment. As safety is the only aim of regulatory mission, instead of highest priority, the policy statement should address the commitment to apply the limited resources where the benefit to safety would be the greatest.

The Safety Report N^o 11, Developing Safety Culture in Nuclear Activities [7], recognizes that the approach to develop a safety culture has much in common with the approach to

developing an effective organization and that, in promoting an improved safety culture, an appropriate balance of behavioural sciences and quality management systems approach should be pursued. As a subset of the wider organizational culture, safety culture inside regulatory body can play an important role for regulatory effectiveness.

3. Regulatory control over safety culture

As discussed above, as an element of the defence in depth system and of the safety management system, safety culture within operating organizations shall be a matter of regulatory control. INSAG-13 [5] identifies two complementary aspects of the relationship of the regulator with the operator's safety management system which contribute to its effectiveness, by ensuring that there are critical self-assessment and corrective actions (described as self-regulation) and by avoiding to act in a manner that diminishes the responsibility for safety of the regulated organization.

The Safety Requirements, Safety of Nuclear Power Plants: Operation [8], does include, as general requirements for operating organizations, some "shall statements" with respect to safety culture, although it does not include neither the concept of safety management system nor the safety culture as regulatory matter.

The Brazilian nuclear standard, Safety in the Operation of Nuclear Power Plants [9], was issued in 1996 based on the previous IAEA standard for operation, Code on the Safety of Nuclear Power Plants [10], and it has just one broad "shall statement" addressing safety culture.

The Safety Report N^o 11 [7] recognizes considerable international diversity in the regulatory approach to safety with regard to where emphasis should be placed, particularly when dealing with the regulation of human and organizational factors. Three types of regulatory strategies are discussed, named compliance based, performance based and process based approaches. The report states the advantage of process based regulation for the areas of organization and safety culture because the assessments focusing on the logic of key organizational processes, and the care in implementing and self-assessing these processes, allow a degree of flexibility, avoiding to transfer to the regulatory body undue responsibilities over plant safety.

A solely performance based approach characterizes a "corrective regulatory control", based on indicators of safety performance. In nuclear safety matters, preventive actions should prevail over corrective ones. For the compliance based approach, a regular inspection programme covering all areas of operational safety characterizes a "preventive regulatory control". However, to increase regulatory efficiency, a "predictive regulatory control" should complementarily be followed, monitoring processes of the safety management system, focusing on trends of key process variables.

In 1997, Brazilian regulatory practices over nuclear power plant safety have experimentally introduced a formal strategy which included explicit consideration of safety culture within the operating organization. A methodology to determine the safety significance of a violation or a deficiency introduced the so called "Nuclear Safety Significance Scale" [11]. As a tool for the regulatory enforcement, the scale provides a classification of the issue into 3 possible levels of severity:

- **Level 3 or Impeditive**, which corresponds to unacceptable risk or unreviewed safety problem;

- **Level 2 or Conditional**, which corresponds to temporarily acceptable limitations;
- **Level 1 or Potential**, which corresponds to a systematic failure or deficiency in safety culture.

Additionally, when the deficiency has no safety consequences and can be considered as an isolated failure, the issued is classified as **Deviation**, corresponding to a **Below Scale of Severity**.

By definition, the existence of a single deficiency of severity level 3 is enough to impose a restriction to plant power operation mode. If a nominal weight of 1000 is associated to this single deficiency, it is possible to investigate how many deficiencies of different levels of severity will correspond to the same level of unacceptable risk. Assuming weight 100 for severity level 2, weight 10 for severity level 1, and weight 1 for below scale deviations related to safety, a Total of Demerits is defined as the weighted sum of all deficiencies and is used as a performance indicator for the safety management system. As one example of “predictive regulatory control”, monitoring time trends of the Total of Demerits, the regulatory strategy is focused on the ability of the safety management system to prevent or correct deficiencies during operation.

4. Enhancing regulatory effectiveness

According to the Safety Report N^o 11 [7], within an organization, safety culture is a subset of the wider organizational culture. Many practices which are used internationally to improve organizational effectiveness aim to promote the unity of purposes among the employees, motivating them to achieve organizational goals. The concepts of Mission, Vision, Goals and Values are often used to achieve these desired requirements.

To implement the safety and quality policies inside the Brazilian nuclear regulatory body, a project was launched for the development of a quality management system applicable to the main regulatory functions: rulemaking, licensing and control, review and assessment, inspection and enforcement. Soon it was recognized the importance of considering the cultural aspects inside regulatory organization. Different from operating organizations, a failure in human behaviour of a regulatory staff can not directly challenge the safety of nuclear installations. A consistent regulatory strategy, however, may have a stronger influence over plant safety performance.

If an adequate set of shared values can promote attitudes and behaviours of the individuals towards organizational goals, a selected set of regulatory principles will define the consistency of regulatory strategies. Focusing the resources on the mission, both initiatives will contribute to enhance regulatory effectiveness.

Initiatives derived from the adoption of the Nuclear Safety Significance Scale, to categorize deficiencies associated with the operational safety of nuclear power plants, and so prioritizing regulatory inspection efforts or escalating enforcement actions over plant operators, are consistent with the application of the concept of safety culture to regulatory bodies, warranting attention to issues proportionally to their safety significance.

5. Final remarks

As an element of defence in depth system and as a tool for the effectiveness of safety management systems, more than a regulatory concern, safety culture shall be matter of

regulatory control. Because safety culture involves human behaviour and organizational factors, special care should be taken when developing related regulatory strategies, to avoid being excessively prescriptive or unduly transferring responsibilities over safety management to the regulatory body.

Inside regulatory organizations, in the framework of a quality management system, the adoption of values and principles consistent with a strong safety culture will promote the fulfilment of the regulatory mission.

There is still room for international guidance on subjects related to safety culture within regulatory bodies and their relation with regulatory strategies and regulatory effectiveness.

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TOPIC 3:

**ASSESSMENT OF THE MANAGEMENT OF SAFETY
AND SAFETY CULTURE**