Review of International Oversight of Safety Culture in Nuclear Facilities

Letter Report

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Executive Summary

This report describes how regulatory agencies outside the United States address safety culture in nuclear facilities. It reviews regulatory approaches, inspection and evaluation methods, self assessments, conferences and workshops, and guidance documents.

Most regulators have incorporated safety culture into their policies and regulations. Evaluation techniques have become more sophisticated and more routinely applied, but vary significantly across regulators.

Widely accepted best practices for safety culture regulation include:

- Addressing safety culture as part of the assessment of management systems in nuclear organizations

- Focusing on the importance of organizational learning activities in promoting a strong safety culture. Learning activities include both organizational activities such as operating experience feedback programs and individual attitudes regarding reporting of events

- Requiring training programs in safety culture for both regulatory and licensee staff

- Emphasizing self-assessment by licensees

Overall, safety culture has emerged as an important component of regulatory activities to assure safety, but is still developing as an arena of regulatory attention.

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1.0   Introduction

Since safety culture was identified as an important underlying cause of the Chernobyl accident twenty years ago, nuclear regulators worldwide have engaged in efforts to address safety culture as a means to improve safety in nuclear power. Nevertheless, countries with mature nuclear industries–including Japan, the United Kingdom, France, the United States, and Hungary[1]–have had recent major nuclear safety events attributed to safety culture problems. These events have led to an increased concern regarding how nuclear regulators and licensees are addressing safety culture in nuclear power plants.

In response to these safety culture concerns, regulatory agencies have exchanged information and experience on safety culture, developed definitions of safety culture, identified factors that are associated with a strong safety culture, funded research on safety culture and designed methods to assess safety culture. Many regulators have incorporated safety culture into their oversight of the management and organization of nuclear facilities. In general, however, safety culture initiatives are still relatively new and experience has been limited–not only in the nuclear arena, but also in other safety sensitive industries such as aerospace and medicine. There is not yet a consensus regarding how safety culture should be incorporated into programs to assure safety in nuclear facilities. For example, a common definition of safety culture hasn't been adopted. Although the International Atomic Energy Agency (IAEA) definition of safety culture provided in INSAG-4[2] [1]is widely referenced, other definitions are also in use—each adding some additional aspect. The key characteristics and attributes of safety culture have also been identified by IAEA [1,2,3,4,5,6,7,8,9] and these are also widely referenced; however, other regulators, consultants, and licensee groups have developed their own lists of characteristics, elements, and attributes [10,11,12,13,14,15,16,17]. There is, however, an emerging consensus on the role of

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1 Japan: Takai Mura Fuel Fabrication Plant Accident resulting in fatalities and TEPCO maintenance and inspection failures. United Kingdom: Falsification of records and major business losses at British Nuclear Fuels (BNFL). France: Dampierre Nuclear Power Plant–threatened plant closure due to lack of safety awareness of plant personnel. United States: Davis Besse vessel head degradation and long term shutdown. Hungary: Paks, Hungary severe damage to 30 PWR assemblies and long term shutdown.

2 This definition is "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"[1].

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the regulator with regard to safety culture. Discussions at the 2002 IAEA conference on safety culture in Rio de Janeiro, Brazil focused on how safety culture can be effectively regulated [10,11,12,18,19,20,21,22] and certain common approaches to address safety culture have developed among regulators. For example, discussions at a technical meeting on the role of the regulator in promoting safety culture sponsored by IAEA in 2003 resulted in five overall recommendations for regulators

- "Regulatory staff should be trained on the potential impacts of their strategies and actions related to safety culture (both positive and negative).
- The regulator should reinforce the importance of a strong safety culture and ensure that licensees have a strong safety management system.
- The regulator should encourage licensees to identify, define and understand their safety culture including through self-assessments.
- Regulators should consider whether, when and how to carry out assessments of licensee safety culture and when and how to intervene, if necessary. This should include targeted inspections and continuous monitoring, e.g. by site or other inspectors.
- Regulators should require licensees to report on what they are doing to:
    - promote safety culture at all levels,
    - educate/train all employees on safety culture, and
    - assess safety culture and improve areas of weakness."[23:p.2]

In general, regulators have been following many of these recommendations and agreement has emerged about a number of best practices for addressing safety culture. Four of the most frequently cited include:

- Assessment of management systems, especially attention to the safety priority shown by licensee leaders and management processes
- Focus on organizational learning
- Training in safety culture for both regulator and licensee staff
- Licensee self assessments

The goal of this report is to describe how regulatory agencies outside the United States are addressing safety culture in nuclear facilities. The report focuses on the regulatory approaches, inspection and evaluation methods, and self assessments that are being used to address safety culture. It also provides a brief summary of international guidance and conferences on safety culture. The report is based on relevant documents that are commonly available. Key documents included reports and guidance documents from IAEA, the Nuclear Energy Agency (NEA), and other international organizations; Convention on Nuclear Safety (CNS) Reports from selected countries; reports on safety culture activities from the proceedings from conferences and meetings (e.g., the IAEA conference on safety culture in nuclear installations, IAEA technical meetings, Committee on Nuclear Regulatory Activities (CNRA) and Western European Nuclear Regulators' Association (WENRA) meetings); and information from the websites of nuclear regulators, including, in some cases, regulations and policy statements.

At least one source of information was obtained for 18 countries.[3] While a significant number of documents were reviewed, the report represents neither an exhaustive literature review nor a direct survey of regulators. Information regarding particular activities (e.g., requirements for safety culture self-assessments) is included for some regulators but was not available for all regulators. Hence, a listing of countries that have a particular requirement does not represent all countries with that requirement–only those where documentation of the requirement was found. In many cases the documents reviewed did not provide extensive detail regarding how programs are implemented, in those cases only the general overview of the program is provided.

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3 Argentina, Belgium, Brazil, Bulgaria, Canada, China, Finland, France, Germany, Japan, Korea, Mexico, Slovenia, South Africa, Spain, Sweden, Switzerland, and the United Kingdom.

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Despite these limitations, we believe the review provides a picture of the range of international activities regarding safety culture regulation of nuclear facilities.

2.0   Regulatory policies and approaches[4]

The role of the regulator in addressing safety culture has been addressed by both international groups and individual regulators [11,12,18,19,20,22,23]. Although there is some reluctance to "regulate" safety culture, most agree with IAEA and NEA that regulators can have an impact on safety culture. As part of this role they should engage in periodic safety assessments (examining such areas as management, programs, self assessments, accountability, regulatory relations, isolation, and attitudes) to identify signs of a weak safety culture [2,12,22,23].

Almost all regulators have incorporated either the term "safety culture" or commonly used aspects of safety culture into their official policy statements or regulations. Policy statements regarding safety culture are more common than regulatory requirements. Japan's policy, for example, states that *"Safety culture in an organization is so vital to ensure safety of the nuclear installation, that the lack of [a strong] safety culture may therefore result in serious consequences"* [24:p.10-1]. Policy statements usually include some description of what is meant by safety culture and its components. Belgium's policy is typical of these safety culture policy statements. It incorporates six principles needed for the development of a strong safety culture—"continuous improvement, integration, resources, communication, bench marking, and promotion of good safety" [25:p.1]. Major themes in policy statements in Belgium, the United Kingdom, South Africa, Mexico France, Brazil, Finland, Sweden, China, Korea, and Japan direct licensee organizations to promote safety culture and communicate strong safety priorities within their organizations [25].

Another approach is to incorporate safety culture into existing programs and documents. In Slovenia, for example, "the plant policy on safety culture is defined in documents such as: Quality Assurance Plan, Plant Management Manual, Krško NPP Policies and Goals, Company General Employee Training Handbook, Operating Experience Assessment Program, Codex on Safety and Business Ethics, etc." [26:p.31].

A few regulators have specific regulatory requirements regarding safety culture. Finland has formally established a safety culture regulation that incorporates safety culture into their oversight of management and organizational systems. Finland's regulation requires that *"advanced safety culture based on a safety-emphasizing attitude of management and the motivation of personnel for responsible work shall be maintained when designing, constructing and operating a nuclear power plant"* [27:p.9]. Other regulators, including Spain, Canada, and Germany, either require or strongly suggest that nuclear facilities have programs that include safety culture self assessments [25,28].

Several themes regarding what are considered best practices emerge in the policies and activities of regulators with regard to safety culture. First, safety culture is increasingly being addressed as intrinsically tied to the management systems of nuclear organizations. This theme is discussed in section 2.1. Second, the importance of organizational learning activities in promoting a strong safety culture is emphasized by many regulators. This theme is discussed in section 2.2. Third, attention to training and human performance is noted as critical to assuring a strong safety culture. This theme is discussed in section 2.3. Fourth, some regulators have engaged in direct

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[4] The discussion of regulatory policies and approaches is based largely on summaries of CNS Reports on Safety Culture (see reference 23) unless otherwise noted. Some of the full description of the policy for each country is lost in order to show similarities in basic ideas and content.

assessment and inspection activities. These are briefly noted in section 2.4; Section 3.0 provides more detail on some of the evaluation methods used. Fifth, regulators have required licensees to perform self assessments; these requirements are discussed in section 2.5 and more detail on self assessments by licensees is provided in section 4.0. Then, a brief overview of additional approaches of interest is provided in section 2.6. Finally, section 2.7 provides an overview of regulators' attention to their own internal safety culture.

2.1   Management systems

There is increasing attention on the role of management systems in creating and supporting a safety culture. In the IAEA Draft Safety Requirements (DS338) <u>Safety Standards for the Management System for Facilities and Activities</u> [29] management systems are defined as "a set of interrelated or interacting elements that establishes policies and objectives and which enables those objectives to be achieved in a safe, efficient and effective way". The safety requirements for management systems must "support two general aims of the management of safety .....
• To focus the performance of the organization on achieving and improving safety through the planning, control, implementation and supervision of safety-related activities in normal, transient and emergency situations; and
• To foster and support a strong safety culture through the development and reinforcement of good safety attitudes, values and behaviors in individuals, teams and the organization, so as to allow them to carry out their tasks safely"[29:p.1].

The IAEA Draft Safety Guide for these requirements (DS339) notes that "Organizations should integrate all their components into an integrated management system. These components include the structure, resources and processes. Therefore individuals, equipment and culture are part of the integrated management system as well as the documented policies and processes" [30:p.4]. Many regulators, including those in Finland, Spain, and Canada, explicitly require integrated management systems that support a strong safety culture [25].

The IAEA standard and guidelines for management systems reflect the practices of the majority of regulators with long-standing programs for evaluating the safety impacts of management and organizational systems. Safety culture has been incorporated into these programs. For example, Belgium, France, Germany, China, Mexico, South Africa, Bulgaria, France, United Kingdom, and Sweden have concrete safety objectives that focus on leadership and management [25,27,28,31]. Belgium, Switzerland, and the United Kingdom also focus on the integration of operational processes [25].

The approach of the Swiss Federal Nuclear Safety Inspectorate (HSK) is a good example of incorporating safety culture into safety management oversight. It is based on the position that safety culture should not be subjected to direct regulation by the regulatory authority [32]. The reasons include that
• safety culture is a complex concept that is difficult to define and to objectively measure;
• the responsibility for safety culture must reside with the licensee;
• the regulator must foster the learning process of the licensee (encouraging licensee self-assessment furthers this aim);
• any culture, including a safety culture, cannot be prescribed but develops over time [32].

The regulator therefore best influences the culture by using positive reinforcement for good safety-related efforts. Based on this analysis, the Swiss regulator has adopted a process-oriented, less prescriptive approach for the oversight of safety culture. The regulator focuses attention on licensee processes such as self-assessments and the

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safety management systems without prescribing what those processes should be[5]. In sum, *"HSK addresses those concrete activities and arrangements made by licensees in order to ensure and foster safety and to integrate them into the structure and processes of their organization, i.e., their safety management"* [32;page 7].

Some regulators also include attention to the allocation of resources in their oversight of organizational and management issues. Adequate resources for the appropriate priority of safety are noted in discussions of safety culture and required in Belgium, Mexico, Bulgaria, and Sweden[25]. Sweden is specific about time as a resource that must be addressed in planning so that time is adequate for safety measures and safety review [25].

2.2   Organizational Learning

Regulators have recognized that an environment that encourages learning at both the individual and organizational levels is supportive of a strong safety culture. Requirements that licensees gather information and operating experience and evaluate lessons learned—or, more generally, behave as "learning organizations"—are discussed by many regulators as part of their safety culture policies or requirements. For example, in their 2005 Convention on Nuclear Safety (CNS) reports [25], regulators report the following as part of their safety culture initiatives:

- Belgium, China, and Mexico address measurement, safety indicators, and evaluation of lessons learned in safety culture discussions.
- China, Mexico, Bulgaria, and Japan require that licensees must be learning organizations and include peer reviews, Operational Safety Review Team (OSART) inspections, international communication, and self assessment in their activities.
- Several regulators emphasize support for a "reporting culture". For example, Electricité de France (EDF) provides the "Right to inform: all players should have a questioning attitude when carrying out their tasks and inform their hierarchy whenever an order or instruction is liable to reduce the quality of their work" and the "Duty to report: All events considered by players to be more important for safety than previously determined by their immediate hierarchy should be reported by the player to an EDF division responsible for safety (the head of the plant Safety and Quality Advisory Unit, the Director for Nuclear Safety at the Nuclear Operations Department, the Delegate for Nuclear Affairs at the Energies Branch, or the Inspector General for Nuclear Safety at EDF)"[31:p.48].
- Bulgaria requires assurance of conditions required for performance and that such conditions be based on "all studies and consultations prior to making decisions related to the safe operation of the plant" [25:p.5].
- Bulgaria and the United Kingdom require assurance that procedures are updated based on plant and international experience.

2.3   Training and human performance

Another area addressed by regulators of nuclear power plants in conjunction with safety culture activities is training and human performance. IAEA provides training and guides for safety culture assessment and enhancement in their Safety Culture Enhancement Program (SCEP) [3,4,7]. This program offers training in self assessment to nuclear facilities in member states by request. Training programs in safety culture are also provided by regulators. For example, the Finnish regulator (STUK) provides safety culture training for regulatory staff and licensees [25,27]. The Swedish regulator (SKI)

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[5] A summary of the HSK program for evaluation is discussed below under "Evaluation and Inspection".

has provided training to licensee management as part of a project to make management aware of its own views on safety and safety-related work [33]. Seminars on nuclear safety are held for top licensee management in Japan [24]. Overall, training of regulatory staff and licensees is mentioned as an aspect of safety culture activities by Japan, Bulgaria, Sweden, Switzerland and the United Kingdom [25,32].

Licensee-based training is also noted by some regulators, including Mexico, Spain [25] and the United Kingdom [34], as an indicator of efforts to improve safety culture. For example, the operator of nuclear power plants in Mexico (The Comisión de Electricidad (CFE) Nuclear Power Management (GCN)) conducts seminars to "strengthen personnel and management understanding of safety culture" [25].

In addition to training, other aspects of human performance are noted. For example, in South Africa they use a system called the SIMON (Safe, Intelligent, Motivated, Observant, Nuclear Professional) program and require the placement of a permanent psychologist on site[6] [25]. The Nuclear Installations Inspectorate (NII) in the United Kingdom addresses whether licensees assure that no unfair blame is placed on an individual [16]. Both Finland and the United Kingdom address whether licensees assure a culture of open communication and co-operation [27,16].

2.4   Inspection and assessment activities

Regulators reported to the Convention on Nuclear Safety (CNS) in 2005 that they incorporate different inspection and assessment activities with regard to safety culture into their licensee oversight programs [24,25,26,27,28,31]. A brief overview is provided here, more detail on some of the evaluation and inspection activities are provided in section 3.0.

- The Nuclear Safety Commission (NSC) of Japan does a comprehensive study of safety culture, including interviews with operating personnel, collection of licensee best practices, and analyses of characteristics of Japanese safety culture [24:p.10-1].
- China requires each nuclear power plant to assess safety culture quantitatively.
- The Radiation and Nuclear Safety Authority of Finland (STUK) includes an assessment of safety culture in its top-level safety inspection program on safety management.
- Sweden's updated nuclear safety regulations (SKIFS 2004:1) contain provisions with regard to the licensees' priority of safety.
- Cuba has a national program for fostering and developing safety culture based on an initial national survey on safety culture conducted between 1990 and 1994. The effort is aimed at creating a national climate where a strong safety culture prevails [35].
- In South Africa, Brazil and Mexico facilities have had assessments of their safety culture independent of the regulator.
- Spain required each nuclear power plant to prepare a proposal for a safety culture program, including a safety culture assessment, by December 2005 [36].

2.5   Self Assessments

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6 The lack of social science and human factors expertise needed to address safety culture in nuclear facilities is an international issue. For example, Albert Frischknecht, in the Chairman's report for the IAEA technical meeting on the role of governments and regulators in fostering a strong nuclear safety culture, notes that "There is a need to devote more resources to the area of Human and Organizational Factors at nuclear regulatory organizations. That fact that only about 1% or less of the members of regulatory bodies are Human and Organizational Factors specialists questions the claims of managers in regulatory organizations that Safety Culture is an important issue. I recognized that a similar ratio of expertise applies to the IAEA" [23: p.4].

Self assessments by licensees are required by some regulators and reviewed as an indicator of performance by others. Regulatory requirements and actions regarding self assessments are briefly summarized here. More detailed discussions of self-assessment activities are provided in section 4.0.

Some regulators including Canada, Spain, China and Germany require that each nuclear power plant must perform a safety culture assessment. A number of regulators, including United Kingdom, Sweden, Finland and Germany, review the self assessments of nuclear facilities as part of their regulatory activities. The nuclear regulator in Spain, Consejo de Seguridad Nuclear (CSN), requires that each nuclear power plant submit a proposal for a safety culture program, including a safety culture assessment [36]. CSN is also informed of the initiatives of the licensees regarding the maintenance and improvements of the safety culture within their organizations [25]. Canada has developed a draft guideline on self assessment to assist licensees [37]. CNSC notes that licensee self assessment of safety culture is a key ingredient for the development and maintenance of a strong safety culture [38].

2.6   Additional approaches

Other approaches to safety culture oversight are mentioned by regulators, but not as consistently as those discussed above. These aspects of safety culture activities include:
- Establishment of safety committees (China)
- Active involvement of worker unions (South Africa) and contractors (China and South Africa)
- Enhancement of public interaction (China, South Africa, Japan)
- Assuring a good relationship between licensee and the regulator (China, South Africa)
- Reward systems for recognition of safety issues (South Africa, France)

2.7   Regulator safety culture

Although regulators have addressed safety culture primarily as it applies to licensees, a few have also addressed their own internal safety culture. For example, Brazil has a project to develop a quality management system applicable to the main regulatory functions, recognizing that "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 fulfillment of the regulatory mission" [20]. Argentina also notes the importance of the safety culture of the regulator in assuring safety culture among licensees [11]. Sweden's internal quality management office also considers internal safety culture issues.

Although the Canadian regulator (CNSC) does not do a formal internal safety culture evaluation, it has conducted a symposium on safety culture for licensees and its own staff. Canada is also in the process of training personnel to assist in the evaluation of safety culture and to promote a better understanding of safety culture. CNSC has an active Audit and Evaluation function which assesses CNSC's performance and advises it on improvement initiatives [25].

3.0   Inspection and Evaluation Methods

Several methods for evaluation and inspection have been developed and are in use internationally. The International Atomic Energy Agency (IAEA), The World Association of Nuclear Operators (WANO), and the Forum for Nuclear Cooperation in Asia (FNCA) have been active in supporting nuclear facilities through team evaluations, peer reviews,

and cooperative safety culture projects. Regulators have adopted methods and developed tools for evaluating safety culture. In this section some of these evaluation methods are briefly described. As noted earlier in the section on regulatory policies and approaches, many regulators incorporate safety culture into management systems or safety management programs. Some of the evaluation and inspection methods below, especially those summarized in 3.3, 3.4 and 3.5 focus on safety culture within a management system or a safety management framework. A brief overview of the IAEA program is provided below in section 3.1. The International Committee on Nuclear Technology (ILK) has produced a guidance document for managing licensees' self assessments of safety culture (3.2). Switzerland addresses safety culture through oversight of safety management. Their program is briefly outlined in section 3.3. Canada and the United Kingdom have developed inspection programs for safety culture which focus on management systems. These are discussed in sections 3.4 and 3.5.

3.1   International Atomic Energy Agency SCART program

IAEA has a program for safety culture evaluation through the Safety Culture Assessment Review Team (SCART[7]). SCART missions assist member states by assisting key staff at the operating organization, advising on safety culture improvements, identifying good safety culture practices and providing opportunities for experts from member states to increase their experience and knowledge of safety culture. The SCART program is based on assessing five primary safety attributes:
- Safety is a clearly recognized value
- Leadership for safety is clear
- Accountability for safety is clear
- Safety is integrated into all activities
- Safety culture is learning-driven[8:p.4]

The methodology uses a team of experts in nuclear safety. These experts are well trained to assess safety culture using observations and interviews, document review, and performance indicators.

3.2   International Committee on Nuclear Technology (ILK)

ILK has produced a statement which provides recommendations for regulatory oversight of licensee self assessments. The recommendations include that the regulator
- review the quality and application of the utility's system for self assessment
- review the actions planned as a result of the assessment
- review the use of rigorous root cause analysis (by the licensee)
- meet with senior utility management
- support licensee activities to improve safety culture

ILK's recommendations also include self assessing the regulator's own organization[39].

3.3   Switzerland

The Swiss Federal Nuclear Safety Inspectorate (HSK) evaluates safety management. As previously noted in section 2.1, HSK sees safety culture as an outcome of good safety management. The regulator has an inspection manual that provides expectations from the regulation HK-R-17, indicators for inspection criteria, assessment criteria for both the formal system (e.g., documented rules) and for customary actions (the perception, interpretation and management of the formal system), and methods for

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[7] Both IAEA and BNFL use the acronym SCART.

measurement. A table providing a sample of the inspection guidelines appears below.

Table 3: Illustration from the inspection manual for safety management (HSK)
[32:p.8]

HSK-R-17 Expectations	Indicators	Assessment Criteria	Method for Measurement
Responsibility of unit heads defined	Clear and comprehensive description of responsibilities incl. handling of interfaces	Formal: met—not met Customary: fulfilled—in part—not fulfilled	Document analysis Interviews with members of management team
Shift organization allowing adequate operation under all plant conditions	Size of shift groups adequate Extra capacity for emergencies and training defined and available	Formal: met—not met Customary: fulfilled—in part—unfulfilled	Document analysis Interview with head of operation Plant visit (e.g., shift turnover)

The actual inspection has five phases, which are preparation, inspection, analysis, feedback to the plant, and reporting. A key element when inspecting safety management is the feedback that has the following objectives: "It informs the management whether and how the HSK-R-17 expectations are met. It seeks to initiate a self reflection process where pros and cons of solutions are discussed if HSK-R-17 expectations are not met. It also might reveal contradictory statements found on the artifact and the espoused values level (cf. organizational model; Schein 1992), e.g. a plant policy document describes team work as important safety criteria of shift work but interview results reveal that the organization maintains a highly competing and individualistic gratuity system."[32:page 9].

3.4   Canada

The Canadian method uses Quality Management Audits to assess structural aspects of organizational safety and the Organizational and Management Review Method to assess behavioral aspects of organizational safety[8]. This assessment looks at the organizational influences on safety performance, including safety culture. A set of organizational behaviors are examined during an evaluation. The behaviors are selected based on a plant document review. In a plant of about 2000 staff, a stratified sample of approximately 120 people is interviewed and a random sample of about 20% of the plant staff is surveyed. In smaller sites the entire plant staff is surveyed. The data are analyzed to determine if performance objectives are met. Feedback is provided to the licensee on the results. CNSC intervenes if it determines that performance is declining. The primary intervention is increased oversight efforts until performance improves [25].

This method was piloted in nine power plants in Canada and the data collected were used to develop performance objectives and criteria against which organizational performance can be measured [38].

3.6   United Kingdom (UK)

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8 See Canadian Nuclear Safety Commission Research Report RSP-0060 "Development of a regulatory organizational and management review method" 1998 by S.B Haber and M.T. Barriere.

The Health and Safety Executive (HSE) of the UK has developed a draft inspector's toolkit for human factors in management of major accident hazards [16]. This tool kit includes instruction on planning and undertaking an inspection as well as a discussion of core topics and common topics. Common topic 4 is Safety Culture. The introduction to safety culture notes that while safety culture is important, it is difficult to tackle and it is recommended that "it is only to be taken on where there is a significant issue to address, such as a poor safety record over a period, and where the company is likely to be receptive to advice"[16:page 59]. The toolkit notes interviewing of a suitably representative sample of people from all levels as a way to gather evidence about a company's culture. Key aspects of an effective culture are noted and a set of questions is provided for each aspect. The aspects and two questions related to each aspect are provided below.

- C Management commitment
    - o Do they talk about safety when in the workplace and is this visible to the workforce?
    - o Do they deal quickly and effectively with safety issues raised?
- C Communication
    - o How often are safety issues discussed?
    - o Is there effective two way communication about safety?
- C Employee involvement
    - o How often are individual employees asked for their input regarding safety issues?
    - o Whose responsibility is safety regarded to be?
- C Training/Information
    - o Do employees feel confident that they have all the training that they need?
    - o How accurate are employees' perceptions of hazards and risks?
- C Motivation
    - o Do managers (at all levels, S/M/1st) always confront unsafe acts?
    - o Do employees feel they can report unsafe acts?
- C Compliance with procedures
    - o Are there too many procedures and rules?
    - o Are procedures audited effectively?
- C Learning organization
    - o Does the company really learn from accident history, incident reporting, etc?
    - o Do employees get feedback when they report incidents or unsafe conditions?

In addition to interviews, the inspection guidance suggests reviewing results of climate/attitude/opinion surveys and the results of procedure surveys.

3.8   Some other international regulatory approaches

Argentina applies direct on-site observation of safety performance, uses indicators of declining safety culture, and evaluates licensees' follow up of operating experience feedback and lessons learned [11]. Sweden does not have any direct requirements for safety culture, however, SKI looks at licensees' documented safety objectives and safety strategies to determine whether safety is always prioritized, follows up on licensees' and inspectors' routine safety assessments, identifies deviations from safety requirements, and takes measures to assure safety is maintained [25]. Korea has developed indicators based on the IAEA safety culture evaluation guidance documents [25].

4.0   Self Assessment Programs

Self assessments are employed by many nuclear facilities to evaluate and improve safety culture. The IAEA provides support for such efforts (discussed in 4.1). A discussion of

facilities who have conducted self assessments is provided in section 4.2.

4.1   International organizations

IAEA provides support for self assessments through their SCEP program [3,4], which recently has been further developed into EMS (Enhancement of Management Systems) and is based on the new IAEA Safety Standards for integrated Management Systems. The purpose of this service is to provide IAEA support to nuclear organizations who wish to assure that:

C   they have an implemented and effective management system

C   the mechanisms needed to continuously improve and enhance that system are in place assuring that all aspects of management systems are considered

C   the development of a strong safety culture is promoted and supported.

This support service provides seminars and workshops on integrated management systems, training in self-assessment techniques and processes, workshops on how to improve, manage change and become a learning organization [40].

NEA/CNRA has a report on licensee self-assessment (LSA) by nuclear power plant licensees that describes activities that a licensee should perform to identify opportunities for improvements. The report notes that an LSA is part of an organization's management system, and describes elements—such as "a process for choosing which identified potential improvements should be implemented and a process of project management for implementing the improvements chosen" [41].

4.2   Licensee self assessments

Self assessments have been done for a number of years by nuclear facilities world wide. The South African utility, Eskom, did an evaluation exercise in 1992 [25]. In Canada, several licensees have developed programs to enhance safety culture, which include self assessments. In Sweden the licensee carries out safety culture self assessments annually using a questionnaire originally developed by SwedPower. The questionnaire was developed by reviewing existing safety culture questionnaires available in 1996. Individuals are asked to respond on a seven-point scale regarding items such as
•   management's attitudes towards safety as perceived by subordinate groups
•   perception of available resources (time, staffing, etc.)
•   perception of communication patterns among groups
•   assessment of the quality of instructions and documentation
•   change management practices
•   perception of conflicts between safety and production.
Staff responds to about 60 items and can also submit free form comments. The survey is administered anonymously via the intranet at the plant. The survey has been evaluated and adjusted and continues to be evaluated and may be adjusted again. The results are discussed in focus groups at the plant with opportunity to discuss issues and possible follow-on actions [25].

Licensees in Spain have conducted self assessments of safety culture on their own initiative and are now required by the regulator to prepare a proposal for a safety culture program, including a safety culture assessment [36].

In Great Britain, BNFL has used at least nine different tools to measure and characterize safety culture. These tools have included the Safety Culture Assessment Method developed by T. Lee in 1991; Safety Culture Reviews of a Waste Management and decommissioning group by Newcastle University Joan Harvey, 1997 onwards; HSE

Health and Safety Climate survey tool applied to various Operations Groups since 1998 [14] and ENTEC Assessment of safety Culture [15]. In 2004 BNFL developed its own Safety Culture Assessment and Rating Tool (SCART) which was adopted in April 2004. It assesses site performance against five areas: Leadership, Learning, Team-working, Communications, and Personnel Behaviors and Competencies. In addition to providing performance measures, the process is seen as a vehicle to gather ideas for improvement [34].

5.0   Other Activities

Regulators and industry groups have engaged in other activities regarding safety culture. Two types of activities, conferences and workshops and guidance documents and reports, are discussed briefly below.

5.1   Conferences and workshops

There has been a great deal of international attention to addressing safety culture and sharing views and experiences. IAEA, for example, has hosted numerous meetings and workshops, including the International Conference on Safety Culture in Nuclear Installations, 2-6 December 2002. Reports on safety culture were presented by many regulators and licensees [10,11,18,19,20,21,30,34,35,42,43]. The Committee on Safety of Nuclear Installations (CSNI) Special Expert Group on Human and Organizational Factors (SEGHOF) holds specialist meetings and workshops on safety management [44,45,46,47]. In addition, there have been conferences and workshops held by the Nuclear Energy Agency (NEA), Forum on Nuclear Cooperation in Asia (FNCA) [43] and by regulators and licensee groups. CNRA is hosting a meeting in May 2006. One of the key topics covered will be how regulatory inspections can promote, or not promote, a good safety culture.

Communication mechanisms have also developed within countries and within regulatory and licensee organizations, including newsletters, meetings with employees, and the communication of safety policies. The regulatory body in South Africa and the licensee share the results of independent reviews with all plant personnel to promote safety culture. Newsletters about safety culture are sent to plant personnel in South Africa and many FNCA countries. In Cuba the promotion and dissemination of materials on safety culture began in the 1990's [35].

5.2   Guidance Documents and Reports

A significant number of guidance documents have been produced by international organizations, regulators, and licensees. For example, IAEA has produced a number of widely read reports related to safety culture [1,2,3,4,5,6,] as has the Nuclear Energy Agency (NEA) [12,13,22,41,48]. The International Committee on Nuclear Technology (ILK) has provided guidance to Germany and others on how regulators may manage licensee self assessments [39]. Regulators have also produced various guidance documents and reports, for example, the United Kingdom's Health and Safety Executive's Nuclear Installations Inspectorate (HSE/NII) has sponsored a report, *Development of a Business Excellence Model of Safety Culture* (1999) [15]. Guidance documents and reports have also been produced by licensee groups and by individual facilities. For example, the Institute of Nuclear Power Operations (INPO) [17] provides guidance on safety culture. In Japan, the Japan Atomic Industrial Forum has published a statement "Toward Reform of Japan's private Nuclear Industry" which includes safety culture aspects and states, in part, "Top management should establish practices that give due priority to safety and make safety culture prevail over the whole company"

[24:p.10-2].

Safety culture is also discussed in guidance documents that address management systems for nuclear power plants. For example, IAEA is in the process of finalizing a new Safety Standard and Guide on the management system for facilities and activities [29,30] which includes discussions of safety culture. Many regulators include safety culture as part of their oversight of management and organization.

6.0 Summary

The goal of this report has been to describe how regulatory agencies outside the United States have responded to the challenges of improving safety culture in nuclear facilities. It reviews regulatory approaches, inspection and evaluation methods, self assessments, conferences and workshops, and guidance documents.

Although regulatory approaches vary, most regulators have incorporated safety culture into their policies and regulations. They also either directly or indirectly assess the strength of the safety culture in the facilities they regulate. There are several themes regarding best practices that emerge in the policies and activities of regulators with regard to safety culture.

- First, safety culture is increasingly being addressed as intrinsically tied to the management systems of nuclear organizations. In addition to the new IAEA requirements on management systems, regulators in Canada, Finland, and Spain have specifically included management systems in their oversight of safety culture.

- Second, the importance of organizational learning activities in promoting a strong safety culture is emphasized by many regulators. This includes both requirements for organizational activities such as operational experience review and for encouraging individuals to have a questioning attitude.

- Third, training programs for both regulatory staff and licensees is noted as a critical element in safety culture programs by international organizations and many regulators.

- Fourth, self-assessments by licensees have increased worldwide and are increasingly being required by regulators. Assessment and evaluation activities have been carried out by international organizations such as IAEA, WANO, and FNCA; by regulators such as Finland and Canada; and by many nuclear power plant licensees. International organizations are assisting plants in developing and implementing self assessments; regulators are requiring licensees to perform self assessments and then evaluating the quality of those assessments and the licensee's response to the findings of self assessments. Licensees have tried many self assessment methods. Many licensees (e.g., in South Africa, Brazil, and Sweden) have had an on going program of safety culture assessments for several years.

International organizations have sponsored workshops and conferences on safety culture. Participation in these activities has been extensive, with participation by many regulators and industry experts on panels, committees and peer reviews. There has been increasing emphasis on safety culture and an emerging consensus regarding some best practices. Evaluation techniques have become more sophisticated and more routinely applied. However, the area is still developing as an arena of regulatory attention.

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