Fostering safety culture – approach taken by regulatory expert organization KINS and lessons learned

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1. Introduction

1.1. Safety Culture of regulatory body

The mission of the nuclear safety regulator is to provide oversight on nuclear safety to ensure safe operation of licensee on behalf of public. By nature of its role, the regulatory body deeply influence licensees' safety culture. The most important example of this relationship is revealed in the root cause analysis of the Fukushima Daiichi Accident reported by IAEA [1]. The IAEA Fukushima Daiichi Accident report stressed the fact that a basic assumption about the robustness of the technical design of NPPs was developed and reinforced over a long period of time among the stakeholders in Japan, including the regulatory bodies, which resulted in a situation where safety improvements were not introduced promptly. The conclusion for the international nuclear community, particularly including the regulatory bodies, is that "In order to promote and strengthen safety culture, individuals and organizations need to continuously challenge or re-examine the prevailing assumptions about nuclear safety and the implications of decisions and actions that could affect nuclear safety" [1].

It is also said that the Fukushima accident was preventable if the Japan's nuclear safety management activities were compared with the international safety standard and the best practices of international nuclear communities [2]. Hence, the regulatory body needs to be aware of its own safety culture's impact on the safety and safety culture of the organisations it regulates and oversees. And sharing of experiences regarding safety culture promotional activities are recommended.

Korea Institute of Nuclear Safety, KINS, is a dedicated technical expert organization for nuclear safety regulation, which is established in 1990 to protect the public from radiation hazard and to protect the public health and environment according to KINS Act. Safety culture principles for KINS is developed and defined in KINS safety culture management procedure [3]. KINS safety culture management activities are being planned, conducted, and checked with PDCA cycle according to the safety culture management procedure.

1.2. Purpose of the study

This study is to introduce the systemic safety culture development and management process of KINS adapted after 2013 with a brief history of safety culture development activities before 2012. This study also addresses the first tried entire organization-level safety culture assessment experience to share insights, practices including methods and tools used. Fostering of safety culture within organization is required as a basis for continuous improvement which is adapted as international safety standard in 2016. International trend and requirement on safety culture are briefly introduced.

2. International trend and requirement on safety culture

2.1. Requirement on Safety culture management and assessment

The principle 3 of the IAEA safety fundamental SF-1 states that "Effective leadership and management for safety must be established and sustained in organizations concerned with, and facilities and activities that give rise to, radiation risks". IAEA safety standard GSR Part 2 "Leadership and Management for Safety" is published in June 2016 to support the principle [4]. The GSR Part 2 requirements are applied to regulatory body and other competent authorities, and the organization responsible for the facility or for the activity. For the regulatory body, the adoption and effective implementation of the GSR Part 2 requirements is expected as a basis for meeting the responsibility which support Principle 3 of IAEA fundamental safety principles and also to ensure continuous improvement of safety. The requirements on safety culture in GSR Part 2 are as follows;

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.

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.

To support the implementation of GSR Part 2, IAEA also issued Safety Report Series No. 83 "Performing Safety Culture Self-assessments" in 2016 [5]. And the IAEA is also proceeding with the revision and merger of two Safety Guides: No.GS-G-3.1 "The Management System for Facilities and Activities" (2006) and No.GS-G-3.5 "The Management System for Nuclear Installations" (2009), in order to support GSR Part 2.

2.2. Safety culture of the effective regulatory body

Senior level task group of OECD/NEA members published Green Booklet titled "The Safety Culture of an Effective Nuclear Regulatory Body" in 2016 [6]. This report stresses the importance of self-assessment activities of regulatory bodies and of an attitude that places value to continuous improvement and learning, which states that "Continuous improvement, learning and self-assessment is one of five principles constituting a framework for a healthy safety culture within a nuclear regulatory body". The OECD/NEA started country-specific nuclear safety culture forum since 2018 to identify the influence of the national context on nuclear safety culture. The second forum was held in Finland recently on 6-7 March 2019 by NEA with WANO, and STUK, the nuclear regulatory body of Finland. The first country-specific nuclear safety culture forum was held in Sweden in 2018 with the host of SSM, the nuclear regulatory body of Sweden.

3. Safety culture development in KINS

3.1. History and current activities to foster safety culture of regulatory body

In September 1994, a nuclear safety policy statement was formulated and declared for the assurance of nuclear safety in Korea. In this statement, the Korean government also declared to develop safety culture. In February 2000, KINS officially announced the Mission Statement that would clearly define the mission, duty and responsibility of the regulatory expert organization as part of the regulatory body of Korea. And the Ethics Statement was announced at the same time to assure the objectivity and fairness in carrying out various regulatory activities. A questionnaire survey was conducted to the staff of KINS, in May 2002, for the purpose of preliminary evaluation of safety culture within KINS. In August 5, 2003 at KINS, a socio-drama titled "Let's exchange our roles" was on stage aiming to enhance nuclear safety culture of operator and regulator through role playing and also role reversal of operators, residents at NPP sites. From 2003 to 2007 several workshops have been held together with NPP operators to share the common understanding and current activities for safety culture.

The IAEA Integrated Regulatory Review Service, IRRS, team made a suggestion for safety culture in 2011. The IRRS final mission report said: "The new Nuclear Safety Commission, NSSC, and KINS should describe in their Management System Manuals what means they plan to use in order to ensure a common understanding of safety culture, to support individual and groups to carry out work in a safe way, to reinforce a learning and questioning attitude, and to continually develop and improve the safety culture." Following the suggestion given in the IRRS mission, KINS together with NSSC set up a project on enhancing safety culture within the regulatory body. In 2013, the project defined what actions have to be taken to comply with IAEA requirements on safety culture. One action was searching for common values which to be shared by all the members of the regulatory body including KINS and NSSC. The safety culture model within nuclear regulatory organizations in Korea and their interactions are identified [7]. And safety culture principles are being developed for members of KINS to recognize the importance of safety culture and to provide behavior principles to be performed by them in their individual activities to establish safety culture within the organization.

3.2. Safety culture and Management system

According to the IAEA requirement which requires an integrated management system to support the achievement of the fundamental safety objective, KINS has revised the Management System (MS) manual from Quality Management Program (QMP) in 2014.

In 2014 the implementation of safety culture related changes in the KINS MS were also accomplished. KINS declared safety culture as a prerequisite for achieving its organizational missions in its MS manual to establish and implement a long-term and comprehensive plan for safety culture promotion. After safety culture principles for KINS have been established in May 2016, KINS revised MS manual by adapting IAEA GSR Part 2 requirement. And "Safety Culture Management Procedure" is also developed and adopted to ensure appropriate and timely implementation of safety culture measurement, assessment, improvement, communication and education activities to foster safety culture within KINS in October 2016.

Safety Culture Management Procedure
Chapter 1 Objective
Chapter 2 Scope
Chapter 3 Requirement
Chapter 4 General
    4.1 Definition
    4.2 Responsibilities
Chapter 5 Procedure
    5.1 General
    5.2 Establishment of Implementation Plan
    5.3 Safety Culture Education
    5.4 Safety Culture Assessment
    5.5 Safety Culture Promotion
    5.6 Recording
Chapter 6 Appendices
    6.1 KINS Safety Culture Principles
    6.2 Safety Culture Attributes
    6.3 Self-assessment Form

Figure 1. KINS safety culture management procedure

The procedure requires annual activity plan to be prepared and approved by the management. The annual plan should include activities for assessment of the year.

The assessment program is composed of survey, interview, observation, review of audit results, causal analysis of failure, etc. This self-assessment can be triggered internally or externally and may be supported by international peer reviews or other types of external assessment. However, self-assessment and reviews of safety culture should not only be triggered by external peer reviews, but should be an integral part of the overall management cycle.
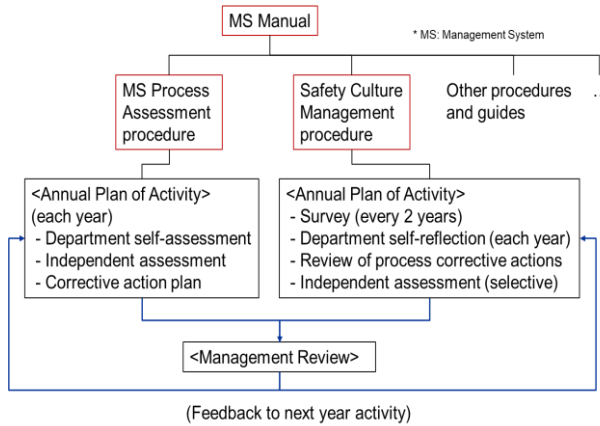

Figure 2. Continuous improvement process using MS and safety culture management procedure

3.3 Competency building

KINS developed a compulsory course for management system and safety culture of regulatory body. New employed staff must take this course in order to have basic understanding of MS and safety culture (SC). Current education and training courses for safety culture at KINS is as follows;

● Basic course for regulatory oversight of licensees' safety culture (classroom)
● Professional course for regulatory oversight of licensees' safety culture (classroom)
● Compulsory course for MS and SC of regulatory body (e-learning)

The **contents for MS** include: introduction to MS, its history, basic concept and type, IAEA standards, requirements, process approach to works, application to regulatory works, examples of foreign regulatory bodies, KINS MS structure, success keys to MS, and roles and responsibility of each staff.

The **contents for SC** include: the cause of Fukushima accident, the importance of safety culture in regulatory body, the characteristics of effective regulatory body, the meanings and concept of safety culture, history of safety culture, international activities, principles of safety culture, and current implementation and activities for safety culture.

4. Self-assessment of safety culture

As described above, requirement 14 of IAEA GSR Part 2 describes "Senior management shall regularly commission assessments of leadership for safety and of safety culture in its own organization". Stand-alone assessment methods for leadership for safety is not developed yet. However, the first-cycle safety culture assessment of KINS has been conducted from 2017 to 2018.

4.1. Self-reflection and self-assessment

The main objective of the safety culture assessment of the regulatory body is to identify any strength and weakness regarding the regulatory body's influence on licensees' safety culture. Besides self-assessment, self-reflection activities are commonly planned and conducted. Self-reflection and self-assessment can be distinguished as follows [8];

Self-reflection: descriptive (non-evaluative) introspection activities within the regulatory body aimed at understanding its own way of functioning and its impact on safety and the safety culture of the licensees and contributing to an environment of continuous learning.

Self-assessment: normative assessment activities within the regulatory body against a set of predefined criteria by means of a systematic and structured process. It aims at continuous improvement towards the fulfilment of specific norms or requirements.

While self-reflection can stand on its own, a self-assessment necessarily includes self-reflection. The descriptive part of the self-assessment can be characterised as self-reflection in the sense described above.

During 2017 and 2018, KINS has planned and conducted safety culture self-assessment with following steps;

Step 1. SC Survey
Step 2. Department level self-reflection
Step 3. Independent assessment by ad-hoc team
Step 4. Development of action plan and feedback

Top management approved the activity plan and supported the process of assessment. In particular, self-assessment by each department was carried out by the management's leadership.

Until now, the result of step 1, 2, 3 is reported to the management and KINS staffs [9].

4.2. Safety culture survey

Before 2010s, the SC survey items were developed using those questions suggested in the INSAG-4 "Safety Culture" and also OECD/NEA reports, "The Role of the Nuclear Regulator in Promoting and Evaluating Safety Culture" (1999). After the publication of the Green Booklet No. 18, "The Safety Culture of an Effective Nuclear Regulatory Body" (2016), own principles and

attributes of KINS were developed which, thus, were used for surveys and interviews. Based on the KINS MS requirements and safety culture procedure, the survey has to be conducted every two years.

The first cycle of assessment started in 2017 with the survey questionnaire to all the staff, and 40% participated in the survey. The survey was open for a month and the data were analyzed with statistical aids. Weak points and strong points could be found with some insights on the different perceptions of ages, departments and working levels.

Resource: About 20 man-days were necessary to conduct the on-line survey.

4.3 Self-assessment within department level

Based on the KINS MS requirements and safety culture procedure, each department has to conduct self-assessment of safety culture against the principles and attributes every two years. Each department manager is responsible for conducting this activity using, for example, brain-storm meeting, review of the department activities, and small group discussions. The assessment results are provided to the internal ad-hoc assessment team, which conducts independent assessment. All department of KINS accomplished the self-assessment.

Resource: Resources for self-assessment were dependent on department by department. Some managers did brain-storm meeting with their staff and others had small-group discussions.

4.4. Safety culture assessment by ad-hoc team

Based on the department-level self-assessment results, independent assessment team is composed and conducted interview-based review of safety culture. An internal ad-hoc assessment team was formed to conduct interview-based collection of views and opinion regarding the results of survey and self-assessment as well as broad spectrum of safety culture. The summary of prior results was found useful and helpful for the assessment team to involve interviewees. The team was composed of safety culture and human factors staff. They conducted individual interviews and group interviews to over 10% of the staffs. It took quite a long time of eight months for the whole process of the team composition, orientation, interviews, meetings for analysis and discussion, and reporting of final recommendations.

Resource: Quite large resources were invested to the assessment team. It is estimated as 103 man-days excluding the preparation time for each team members. Seven members held more than 50 interviews and met several times for discussions. Additional secretariat aids from the department in charge of MS and SC were provided.

4.5. Development of Action plan and Feedback

The final safety culture assessment team report was prepared and the report describes the current status of safety culture in terms of the principles and attributes and also suggest findings that warrant attention of the management and the staff. Based on the report, the department in charge of MS and SC will set up an implementation plan to address the findings and seek approval of the management in 2019.

5. Voice from licensees as a basis for self-reflection

In order to understand how the regulatory bodies actually impact the licensees and the safety of their installations as well as their safety culture, though, it will be necessary to involve licensees and to reflect with them on the regulatory impact. The impact on the licensees should be a major input for continuous self-reflection and self-assessment activities of regulatory bodies.

In order to assess the quality of interactions with licensees or the regulated, sometimes ad-hoc surveys to licensees are conducted. The gaps between the perceptions of the staff and the licensees provide the opportunity to understand the reflected features of our own. Result of Public Customer Satisfaction Index (PCSI) survey which is conducted every year by the government can be a source for self-reflection. Licensees with nuclear related facilities, radiation related licence holders, individual license holders (RO, SRO, RI, SRI, etc..) are the customers of the PCSI survey. Analysis of PCSI result are carried out and its insights are shared within KINS every year.

6. Challenges and lessons learned

Lack of reference

Safety culture of the regulatory body is an emerging area that agreed assessment methods and reference practices are not set up. The only published self-assessment experience was from ENSI, the Swiss nuclear regulator, which took 3 years for completion of the project [10].

Safety culture is an abstract concept that the regulatory staff, most of whom are engineers, would not accept the implications of cultural traits. The traits are too broad and basic ethical statements to have meaningful and useful guidance for behavior. Thus it is needed to explain the traits with concrete examples and situations where the traits are really helpful for inspectors or reviewers to act accordingly. Sometimes the traits play a critical role in conflict situations. Therefore, such experiences would be a good example for discussion and training.

Effectiveness of the SC assessment methods

Each assessment method has its own merits and demerits. For example, survey is the least resource-demand method but the interpretation needs the most caution. The resource to conduct the whole cycle of assessment is quite large. Thus a financial and human resource should be stable to continue the long-term cycle of assessment.

Handling of sub-culture

Involving support department staffs is one of the challenges. Support departments consider safety culture as none-of-their-business because safety culture focuses on regulatory works. Although it is plausible to explain the interconnected aspects of supporting and regulatory works, the regulatory works are highlighted in general.

SC capacity building

It is difficult to change the E-learning contents because it operates on a dedicated system. E-learning doesn't provide opportunity for discussions and must have interesting features to attract the attention of trainees.

Learning from failure vs learning from success

Collection of success story and sharing them would be good starting point for future safety culture activities. People would not remind their failures but want to reveal and provide their success story. When the success story is scrutinized, we can find cultural traits that led to success in a particular situation and context.

A process for learning from success was developed and applied to licensees of nuclear facilities [11, 12, 13]. Based on the good results obtained from the pilot application to licensees, the process will be applied to KINS internal works in the future.

7. Conclusions

The ultimate purpose of seeking healthy safety culture of regulatory body is to strengthen the effectiveness of regulatory activity. It should aim at identifying latent structural problems in regulatory staff's working for rules and standards, licensing and inspection, and enforcement and corrective actions. Regulatory staff know what the problems are, what should be done and what hinders the resolution. Reflection and assessment is the chance to hold an open forum where everyone is free to come and say with an equal opportunity.

The views and opinion from licensees about the culture of regulatory staff are helpful to identify the negative impact of regulatory staff's behavior on the regulated.

Learning from success can be a useful approach to enhancing the understanding of safety culture. People in organization would be reluctant to reveal their own errors or failures to their peers and supervisors unless reporting or sharing is required in a mandatory way. Instead of avoiding the repetition of failure, promotion of successful practices and sharing of good examples will be more acceptable. Process for learning from success are developed and good examples will be included in training of safety culture.

ACKNOWLEDGEMENTS

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