

KHNP Safety Culture Framework based on Global Standard, and Lessons learned from Safety Culture Evaluation

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1. Introduction

The accident occurring at the nuclear power plant gives a great anxiety to the general public and has a significant effect on the related industry. Therefore, the importance of safety culture began to be known widely by international organizations, regulatory body and nuclear operators [1]. In addition, perceptions of safety culture within nuclear industries began to change after Fukushima nuclear accident and Davis-Besse nuclear accident. In order to eliminate the vague fears of the people about the nuclear power and operate continuously NPPs, a strong safety culture of NPPs should be demonstrated. Strong safety culture awareness of workers can overcome social distrust about NPPs. KHNP has been a variety efforts to improve and establish safety culture of NPPs. Safety culture framework applying global standards was set up and safety culture assessment has been carried out periodically to enhance safety culture of workers. In addition, KHNP developed various safety culture contents and they are being used in NPPs by workers. As a result of these efforts, safety culture awareness of workers is changed positively and the safety environment of NPPs is expected to be improved.

2. Framework for Enhancement of Nuclear Safety Culture in KHNP

2.1 Safety Culture Principle based on global standard

Safety culture framework of KHNP was set up in 2012 after reviewing the principles or policies adopted by IAEA, NRC, and INPO [1,4]. However, safety culture framework was re-established in 2014 in order to meet the requirements of the international standards and strengthen the competitiveness in the world's market [3]. Safety culture was defined as the core values and behaviors by organization members that emphasize safety over competing goals to ensure protection of people's life and the environment. Safety culture 8 principles and 32 attributes were developed in consideration of the situation of NPPs and organizational culture.

Table 1. KHNP Safety Culture Principles and Attributes

No	Principles and Attributes
K1	All employees are responsible for nuclear safety.
K1A	The authority and responsibility for nuclear safety is clearly defined and well understood by from the CEO and total employees.
K1B	Support departments, such as human resources, labor relations, and business and financial planning, understand their role in supporting nuclear safety.

K1C	All employees rigorously comply with nuclear safety regulations.
K1D	The system of rewards and sanctions supports and reinforces nuclear safety.
K2	Managers lead by example in demonstrating their commitment to nuclear safety.
K2A	Managers practice tangible leadership by providing coaching, mentoring, and appropriate supervision to mitigate issues in the field.
K2B	Managers communicate clearly the management objectives to employees to avoid interfering with nuclear safety.
K2C	The background of important operating decisions, such as expected outcomes, potential risks, and contingency options, is communicated promptly to workers.
K2D	Ability of managers to embody nuclear safety culture is considered for their selection and evaluation.
K3	Mutual trust permeates the organization.
K3A	Employees give mutual respect to one another.
K3B	Employees raise safety concerns without fear of retaliation.
K3C	Managers answer questions in earnestness with open mind an open, honest manner and communicate with employees regularly.
K3D	Management changes are shared with all employees to maintain trust in the organization.
K4	Decisions are made with safety in mind first. Decision-making reflects safety first.
K4A	Executive members, supervisors, and employees have clear understanding of their roles in decision-making and respect others clearly understand and respect each other's roles in decision-making.
K4B	Power plant workers shall apply a formal rigorous approach to solve problems-solving and when not understanding the full scope, operate in a conservative manner. take operate conservative actions when understanding is incomplete.
K4C	When an important safety decision is made, accountability for the decision is established clearly, and evaluation and feedback are made continuously.
K4D	Regarding safety related issues, frank dialogs and discussion is encouraged and expert consultation is sought.
K5	Nuclear technology is recognized as special.
K5A	Activities that may induce reactor core responses are conducted with particular care and caution.
K5B	Design and operating margins are protected observed and are altered only with due consideration. In particular, special attention is made on safeguarding fission products from proliferation.
K5C	Power plant operation is comprehensive and maintained by high quality processes.
K5D	Power plant employees maintain sufficient professional capabilities to provide appropriate decisions and behaviors.
K6	It is encouraged to ask questions. A questioning attitude is encouraged.
K6A	All employees recognize the possibility of making mistakes and worst-case scenarios during all operations.
K6B	When anomalies are discovered, should be made up of thorough investigation, and prompt mitigation, and periodical analyses of the past incidents are those are conducted.
K6C	Employees do not proceed blindly in the face of uncertainty.
K6D	In order to avoid conformity within a group, diverse opinions and counter-arguments group-think, diversity of thought and opposing views are encouraged.
K7	Environments that cultivate continuous learning are encouraged.
K7A	The organization avoids complacency and cultivates a continuous learning environment.
K7B	Employees familiarize with other industry and power station experiences so that they do not repeat similar mistakes.
K7C	Subject matter experts are effectively consulted to confirm and correct the root cause of incidents.
K7D	Even for a minor incident, procedures are established to investigate and mitigate latent weaknesses.
K8	Nuclear safety is continually examined.
K8A	Self-assessment and independent inspection are performed in a balanced approach.
K8B	Safety culture assessments are conducted periodically and used as a basis for improvement.
K8C	The opinions and suggestions for improvement arising from quality assurance, safety assessments, employee concerns program, and independent reviews are considered in earnestness.
K8D	It is dangerous to focus only on a particular performance indicator; therefore, all performance indicators showing poor performance are confirmed and investigated.

2.2 Contents for Safety Culture Activities

KHNP developed several types of contents (posters, safety messages, videos) to help improving safety culture awareness of workers. Safety culture posters developed are posted at several places in NPPs, such as office, rest room, and break room. These contents have increased the interest of workers on safety culture and will enhance safety culture awareness of workers by

repetitive exposure. After reviewing the events in non-nuclear and nuclear industries, 80 topics for safety culture were selected and posters were developed. Safety messages were developed with reference to the safety policy of KHNP, trend analysis of corrective action program, executive's expectations for safety, and operating experiences. They were provided to NPPs on a weekly or monthly. The safety messages are delivered consistently and periodically to managers and employees. Their effect can be confirmed by the observation of managers in an organization.



Fig 1. Samples of Poster and Message for Safety Culture

3. Evaluation of Safety Culture in NPPs

3.1 Data Acquisition

The safety culture assessment of KHNP was conducted through on-line survey and interview during three months from June to August 2014. In this assessment, contractors as well as KHNP had participated in together. The total number of people who participated in the interviews was 565. Evaluation on interview was carried out by eight external experts.

3.2 Lessons learned

External experts collected evidences for safety culture principles during evaluation period and the evidences were recorded in the evaluation sheet. Good practices and areas for improvement were extracted after common consensus [5]. Good practices were spread to all NPPs for sharing and weaknesses are improved under short or long term plan.

The good practices included are the followings.

- Practice leadership for the settlement of safety culture by director and team leaders.
- Fostering of safety work environment such as sufficient time for maintenance work, communication with contractors, and an atmosphere of mutual respect.
- Strengthening the capacity of employees through such as senior managers'

experience transfer and industry-university cooperation programs.

- Trust formation with contractors by participating in the main meetings and giving their opinions in NPPs.

Areas for improvement are also suggested.

- The long-term staffing plan for specialists is needed. Sufficient career employees in a department are lacking by personnel movement not to consider expertise. Therefore, most employees in the department have less than five years' experience.
- It is needed to improve business processes and to reduce the administrative burden in order to carry out employees' duties faithfully.
- Technology transfer between contractors is difficult in reality. Therefore, it is necessary to review safety-related improvements and to strengthen safety culture training for partners.

4. Conclusions

KHNP established safety culture framework based on global standard to meet internal and external requirements about the importance of safety culture. Safety culture assessment in NPPs is implemented based on this framework and the results are the following: 1) Employees' responsibility awareness for nuclear safety was evaluated highly in six NPPs. This is because employees' responsibility awareness for safety was strengthened due to willingness of the executive, emphasis of safety, and campaigns for safety culture over the last three years. It was confirmed that employees understand their safety responsibility more clearly when management policy of director is well transferred to employees. 2) Employees' awareness for safety decision-making was evaluated below average value. This is because role and responsibility between maintenance departments are unclear. Vague role in a department generates conflict and has a negative effect on decision-making.

KHNP makes an effort to solve areas for improvement derived from safety culture assessment. However, there are some areas to take a long time in completing the work. Therefore, these actions are necessary to be carried out consistently and continuously. KHNP also developed recently safety culture enhancement system based on web. All information related to safety culture in KHNP will be shared through this web system and this system will be used to safety culture assessment. In addition to, KHNP plans to develop safety culture indicators for monitoring the symptoms of safety culture weakening.

KHNP has performed safety culture assessment periodically and done various activities for the enhancement of safety culture continuously for a long time. It is difficult for these endeavors to have a good effect on nuclear power plants within a short term period. However, thus endeavors will be the basis for the stable operation of NPPs in a long term.

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