# Development of Safety Culture Questionnaire Reflecting the Safety Culture Behavior Norm at KHNP

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## 1. Introduction

KHNP developed a safety culture model based on the INPO safety culture principles in 2012 [1] and has been using this model to enhance the safety culture of NPPs. This safety culture model is used as a reference in performing various activities to promote safety culture in NPPs such as establishing safety culture policy, evaluating and monitoring safety culture, and providing safety culture training program. The safety culture model should be consistent and continuous as it contains the norms and values of the members in the organization. However, the recent international trends represented the need of revising KHNP safety culture model. WANO published WANO Principles, *Traits of a Healthy Nuclear Safety Culture* in 2013 [2]. It is a meaningful document as it was developed through a collaborative effort of U.S. NRC, NPP operators and other stakeholders. The terms used by NRC and the nuclear industry for the safety culture were inconsistent, causing misunderstanding on the safety culture and deteriorating it. The regulator and NPP operators had laid the foundation to enhance the safety culture continuously by defining the terms that reflected meaning in two different sets of terms.

WANO is also working with the IAEA to develop a harmonized model for safety culture. The goal of this project is to establish an agreed framework that can be widely accepted by all the members of the nuclear industry overseen by the IAEA and other regulators. In response to these recent global trends, KHNP headquarter and the relevant department reviewed the need to revise the safety culture model which had been used for eight years and revised the model in 2019 to reflect the latest standard. The revision of the safety culture model required a new set of questionnaire to be developed in order to evaluate the safety culture. The questionnaire was reviewed to obtain more accurate and specific response. Safety culture behavior norms were defined and questions were developed based on the new model. The different sets of questionnaires were developed for each job position. Assessing respondents' perceptions towards the behavior norm for each job position will enhance the accuracy of the survey result. It will also enhance the effectiveness of the measures based on the result.

## 2. Development of Safety Culture Questionnaire for Each Job Position

### *2.1 Revision of KHNP Safety Culture Model*

As shown in Table 1, KHNP safety culture model composed of 8 principles and 32 attributes was amended to include 10 principles and 40 attributes. While maintaining the basic concepts and values in the previous model, the updated model explained its principles and attributes with daily policies, norms, work processes and actual behaviors in NPPs closely related to the principles and attributes. The principles No. 8 and No. 9 are the newly defined ones. The principle No. 8 in the previous version comprehends the message implied in the principle No. 8 of the new model, but it was specifically defined to encourage employees to apply them in the actual work processes. Similarly, the principle No. 3 in the previous version also comprehends the message of the principle No. 9 in the updated one, but it has been defined as a stand-alone principle to emphasize the importance of SCWE. The revised KHNP safety culture model is based on WANO 13-1 which reflected Korean culture and components of the safety culture defined by the regulatory body [3]. The nature of organizations in the nuclear industry is reflected in the new safety culture model. The model is written in active voice rather than passive voice to deliver its message in a concise manner. The KHNP headquarter and the central research institute coordinated to draft the revision and finalized it after appropriately reflecting comments from staff members stationed in nuclear power plants.

Table 1: KHNP Safety Culture Principle Rev. 0 to Rev. 1

| KHNP Safety Culture Principle_Rev0 | KHNP Safety Culture Principle_Rev1 |
|---|---|
| K1. Everyone is personally responsible for nuclear safety. | K1(PA). All individuals take personal responsibility for safety. |
| K2. Leaders demonstrate commitment to safety | K4(LA). Leaders demonstrate a commitment to nuclear safety in their decisions and behaviors. |
| | K3(CO). Communications maintain a focus on nuclear safety. |
| K3. Trust permeates the organization | K3(CO) |
| | K6(WE). Trust and respect permeate the organization, creating a respectful work environment. |
| | K9(RC). A safety-conscious work environment (SCWE) is maintained where personnel feel free to raise nuclear safety concerns without fear of retaliation, intimidation, harassment or discrimination. |
| K4. Decision-making reflects safety first | K5(DM). Decisions that support or affect nuclear safety are systematic, rigorous and thorough. |
| K5. Nuclear technology is recognized as special and unique | K10(WP). The process of planning and controlling work activities is implemented so that nuclear safety is |

| | |
|---|---|
| | maintained. |
| K6. A questioning attitude is cultivated | K2(QA). Individuals avoid complacency and continuously challenge existing conditions, assumptions, anomalies and activities to identify discrepancies that might result in errors or inappropriate actions. |
| K7. Organizational learning is cultivated | K7(CL). Opportunities to continuously learn are valued, sought out and implemented. |
| | K8(PI) |
| K8. Nuclear safety undergoes constant examination | K7(CL) |
| | K8(PI). Issues potentially impacting safety are promptly identified, fully evaluated and promptly addressed and corrected, commensurate with their significance. |

Table 2: Revised KHNP SC Model (principles, attributes)

| Principle | Attribute |
|---|---|
| 1. (PA) Personal Accountability | 1-A , Standards |
| | 1-B , Job Ownership |
| | 1-C , Teamwork |
| 2. (QA) Questioning Attitude | 2-A , Nuclear is Recognized as Special and Unique |
| | 2-B, Challenge the Unknown |
| | 2-C, Challenge Assumptions |
| | 2-D, Avoid Complacency |
| 3. (CO) Safety Communication | 3-A, Work Process Communications |
| | 3-B, Bases for Decisions |
| | 3-C, Free Flow of Information |
| | 3-D, Expectations |
| 4. (LA) Leadership Accountability | 4-A, Resources |
| | 4-B, Field Presence |
| | 4-C, Incentives, Sanctions and Rewards |
| | 4-D, Strategic Commitment to Safety |
| | 4-E, Change Management |
| | 4-F, Roles, Responsibilities and Authorities |
| | 4-G, Constant Examination |
| | 4-H, Leader Behaviors |
| 5. (DM) Decision Making | 5-A, Consistent Process |
| | 5-B, Conservative Bias |
| | 5-C, Accountability for Decisions |
| 6. (WE) Respectful Work Environment | 6-A, Respect is Evident |
| | 6-B, Opinions are Valued |
| | 6-C, High Level of Trust |
| | 6-D, Conflict Resolution |
| 7. (CL) Continuous Learning | 7-A, Operating Experience |
| | 7-B, Self-Assessment |
| | 7-C, Benchmarking |
| | 7-D, Training |
| 8. (PI) Problem Identification and Resolution | 8-A, Identification |
| | 8-B, Evaluation |
| | 8-C, Resolution |
| | 8-D, Trending |
| 9. (RC) Environment for Raising Concerns | 9-A, SCWE Policy |
| | 9-B, Alternate Process for Raising Concerns |
| 10. (WP) Work Processes | 10-A, Work Management |
| | 10-B, Design Margins |
| | 10-C, Documentation |
| | 10-D, Procedure Adherence |

### *2.2. Development of Safety Culture Questionnaire Reflecting the Safety Culture Behavior Norm*

KHNP conducts a survey each year to measure workers' awareness of safety culture, but the results are broad and conceptual. The survey was based on the previous safety culture model and it was difficult to identify specific areas of improvements from the result. Therefore, the questionnaires were written more specifically than the previous ones to assist respondents answer more easily and to implement more effective measures towards the issue. Different sets of questionnaires were developed for members of the following four job positions in KHNP: Senior Manager (SM), Manager (M), Supervisor (S) and Individual contributor (I). Prior to the development of the questionnaires, the safety culture behavior norms for each position were defined referring INPO 12-012 Addendum I [4] and considering working practices related to the implementation of operational procedures, processes and expectations. Table 3 describes how the safety culture behavior norms adhered by members of each position contributes to safety culture principles and attributes. The questionnaires were modified to ask questions related to standard behaviors in the behavior norms. In other words, the questionnaires asked questions to members in the certain job position whether they perform behaviors to pursue the certain safety culture attribute. Both the questionnaire for all respondents and the one for individuals holding the certain job position were developed. The commonly presented questionnaire focused on determining commitment of each respondent towards the safety the safety management system adopted in the NPP, whereas the questionnaire for individuals holding the certain job position mainly asked questions about the management's commitment towards the safety and items that the targeted respondents should be aware of.

Table 3: the safety culture behavior norms for each position (examples)

| KHNP SC model | | INPO Behaviors and Actions | | | | |
|---|---|---|---|---|---|---|
| Section | Attributes | Behaviors | Senior managers | Managers | Supervisors | Individual Contributor |
| Individual | K1A (PA.1) | a | | | | ○ |
| | | b | | | | ○ |
| | | c | | | | ○ |
| | | d | | | | ○ |
| | | e | | | | ○ |
| | | f | | | | ○ |
| Manager | K4A (LA.1) | a | ○ | ○ | | |
| | | b | | ○ | | |
| | | c | | ○ | | |
| | | d | | ○ | ○ | |
| | | e | ○ | | | |
| System | K7A (CL.1) | a | ○ | ○ | ○ | |
| | | b | | ○ | | |
| | | c | | | ○ | |
| | | d | | | ○ | |
| | | e | | ○ | | |

Table 4: the behavior norms for SC attributes (K4A)

| The behavior norms of each position contributing to K4A | Responsible Position |
|---|---|
| A. Managers ensure staffing levels are consistent with the demands related to maintaining safety and reliability. | SM, M |

| | |
|---|---|
| B. Managers ensure sufficient qualified personnel are available to maintain work hours within working hour guidelines during all modes of operation. | M |
| C. Managers ensure facilities are available and are regularly maintained, including physical improvements, simulator fidelity, and emergency facilities. | M |
| D. Leaders ensure tools, equipment, procedures, and other resource materials are available to support successful work performance, including risk management tools and emergency equipment. | M, S |
| E. Executives and senior managers ensure sufficient corporate resources are allocated to the nuclear organization for short- and long-term safe and reliable operation. | SM |
| F. Executives and senior managers ensure a rigorous evaluation of the nuclear safety implications of deferred work. | SM, M |

The interrogative sentences in the previous version of the safety culture questionnaire were amended to the declarative sentences and were written considering respondents' job position. Sentences were written to be easily understandable by avoiding the use of ambiguous terms and nuclear terms as much as practically possible. For example, KHNP Safety Culture Principle No. 4 states "Leaders demonstrate a commitment to nuclear safety in their decisions and behaviors," and its attribute 4A rules "Leaders ensure that personnel, equipment, procedures and other resources are available and adequate to support nuclear safety". Among six standard behaviors for this attribute described as items A to F in Table 4, items A, E, and F are the ones associated with Senior Managers, and a question was designed to ask them about their usual behavior. As a result, the question "I ensure sufficient corporate resources are allocated to the nuclear organization for short and long term safe and reliable operation" was selected to evaluate the above behavior. The Likert 7-point scale was adopted for the questionnaires. A total of 160 questions, 40 questions for each of four job positions, were developed. These questionnaires will be used in the survey for KHNP safety culture evaluation and the field of intensive interview on the subject nuclear power plant will be decided based on the survey result.

Table 5: the questionnaires for SC attributes (K4A)

| Target Position | Content |
|---|---|
| 1 | I ensure sufficient corporate resources are allocated to the nuclear organization for short and long term safe and reliable operation. |
| 2 | I ensure sufficient qualified personnel are available to maintain work hours within working hour guidelines during. |
| 3 | I ensure tools, equipment, procedures, and other resource materials are available to support successful work performance. |
| 4 | Our organization fully supports the manpower, equipment and materials necessary to successfully complete the work. |

## 3. Conclusion

The new safety culture questionnaires for each job position is based on the updated KHNP safety culture model and reflected work activities in the field to ask the respondents more specifically. The different sets of questionnaires were used for each job position to reflect the self-awareness of respondents and enhance the reliability of the result. These questionnaires would provide insight that indicates the behaviors undermining the safety culture and correcting them will enhance workers' awareness towards the safety culture. The questionnaires for each job position will be used for the KHNP safety culture evaluation survey, and their validity will be verified by statistically analyzing the results in the future. A correlation analysis will be conducted to verify that the questionnaires are correlated to the safety culture principle and that the questions are not repetitive in terms of their meaning. They will be updated in the future based on the analysis result.

## REFERENCES

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