

Development of Regulatory Oversight Model

In Korea, regulatory oversight program of Safety Culture(SC) was launched in 2012 to establish regulatory measures against several events caused by weak SC in the nuclear industry.

One purpose of SC oversight is to verify that licensees foster a healthy SC in their organization. Independent framework which fit best for the SC assessment is necessary for regulatory use.

Korea Institute of Nuclear Safety(KINS) developed SC oversight system for NPP operating organization including conceptual framework of oversight, prime focus area for oversight, and specific details on regulatory expectations.

The validity and effectiveness of SC oversight system is verified through survey analysis and pilot inspections at NPP operating organizations.

Safety Culture Oversight Framework

The regulatory oversight program of SC is composed of on-site observation, periodic SC inspection, in-depth assessment, and periodic review as shown in Figure 1.

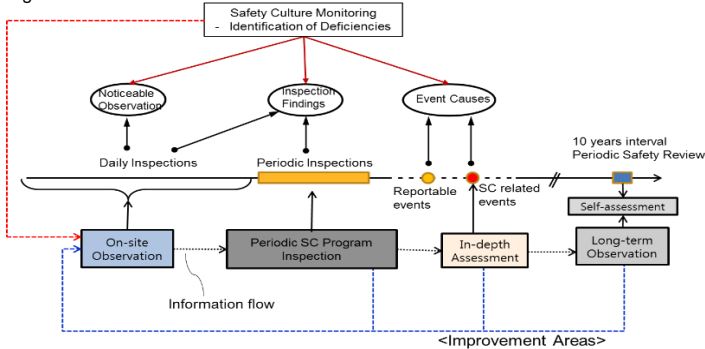


Figure 1. Safety Culture Oversight Framework

1. Resident inspector's observation of the works and activities of managers and employees in daily inspections.
2. Periodic audit on licensee's SC system and activities.
3. In-depth assessment and identification of root causes in case of SC related event.
4. Gathering of observation, audit, and assessment data in the SC database.
5. Monitoring of observation, inspection and event data to identify performance deficiencies and to detect early sign of SC decline.
6. Assessment of long-term change of SC in every 10 years during PSR.

Safety Culture Oversight Model

Safety Culture definition for Oversight

Safety Culture is that assembly of behavioural patterns, core values and basic beliefs shared by individuals in organization about the importance of Safety.

Basic Approach

The SC Oversight Model (SCOM) is developed to focus on the organizational capabilities to maintain, improve and recover the integrity of key elements which play a major role in implementing the concept of defense-in-depth.

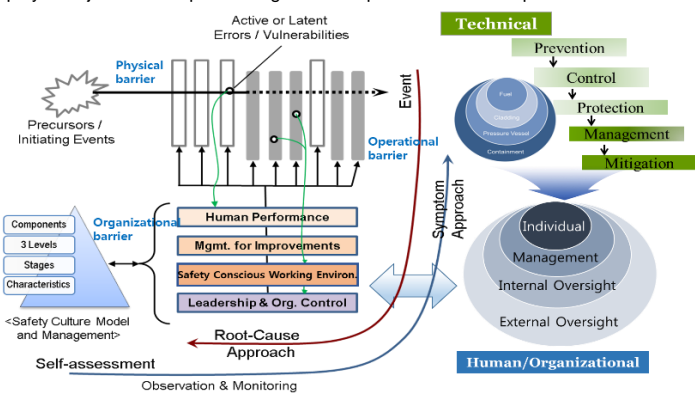


Figure 2. Concept and Approach for SCOM development

SCOM

SCOM assumes that SC is composed of 13 traits stems from 4 organizational barriers that describe areas important to keep healthy SC, and licensee's SC management system which is shown in Figure 3.

For each SC components, characteristics which represent regulatory expectations and reference standards are developed.

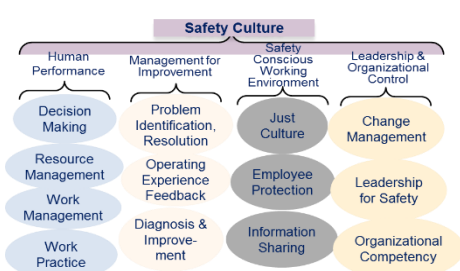


Figure 3. Overall structure of SCOM

Conditions for Effective SC Oversight Model

- a. Based on sound understanding of the national culture & industry characteristics
- b. Conformity with operating organizations' "actual" safety culture
- c. Meaningful and desired relationship with NPP safety performance

Validation of Safety Culture Oversight Model

Validation Process

The content, construct, and criterion related validity of SCOM are examined with 1,170 survey data obtained from 12 NPPs in Korea. The survey items are developed using SCOM. The validation process is shown in Figure 4.

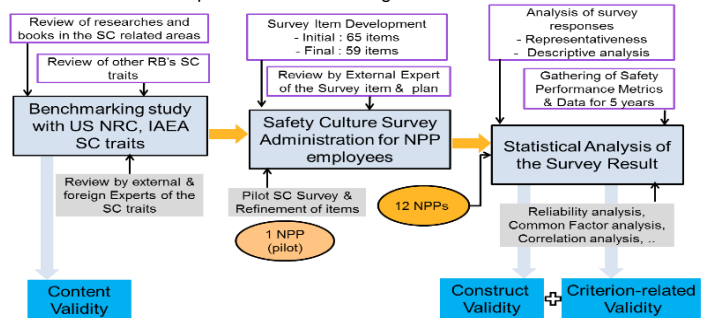


Figure 4. Validation process for the SC Oversight Model

Main Result of Validation Study

- a. Cronbach's alpha coefficient of each 13 components: 0.83 ~ 0.93
Cronbach's alpha coefficient of Safety Culture overall: 0.987
- b. Common Factor Analysis: first common factor explains 58.3% of variation. "SC"
- c. Identified relationship with Plant performance: Inspection findings, Human error event, NPP capacity factor, unplanned scram
- d. Structure of 4 areas and 13 components are validated using Dendrogram.
- e. Similar response patterns at all NPPs: HP>MI>SCWE>LOC

* Human Performance(HP), Management for Improvement(MI), Safety Conscious Working Environment(SCWE), Leadership and Organizational Control(LOC)

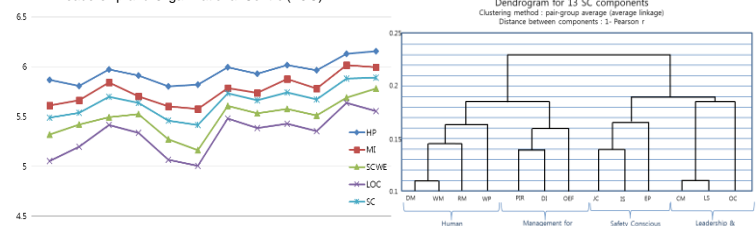


Figure 5. Average response of each NPPs

Figure 6. Distance between SC components

SC inspection using SCOM

Objective of pilot SC Inspections

To verify the feasibility and effectiveness of regulatory oversight.

To obtain baseline data of licensee's status with regard to the preliminary regulatory expectations of SC components.

To develop SC infrastructure of common understanding, methodologies, competencies, etc. within both regulators and operators.

Pilot Inspection Program

SC inspections were carried out at 10 NPP sites in Korea and KHNP head office for 2013 to 2015. Inspections are conducted for 2 to 4 days at each sites by a team of 2 to 6 KINS inspectors. Temporary inspection guides were drawn up. One inspection is carried out at NPP under construction to verify the adequacy of SC program to be implemented during operation.

Document review, gathering of insights of resident inspectors, interview with plant managers and employees, behaviour observation are used.

Areas for improvements(AFI) are identified compared to regulatory expectations with regard to SC components. The AFIs are communicated with NPP before confirmation. Pilot SC inspections were effective to identify AFIs, some of which requires long-term follow-up and most of them were not raised by normal regulatory inspections.

Lessons from Regulatory Inspections

1. Efforts and chances to convey regulatory expectations should be increased as regulatory activities get realized.
2. Inspection in an objective and consistent manner is important and will continue to be an issue. Resident inspectors need to be trained with recording and reporting SC findings through their daily observations.
3. Communication of inspection findings with licensee is necessary to convey the implications of findings and to give change motivation to responsible managers. High-level communication needs to be in process of SC inspection. Annual assessment meeting is necessary if long-term resolution is required and if there is a gap between the perspective of regulator and that of licensee.
4. The oversight of licensee's head office is crucial for successful development and alignment of SC management system in the whole organization, because safety leadership, management, policy and behavioural model come from top level of the corporate.
5. 'Influence' is preferred to 'Enforcement'. Good driving indicators will be needed. And influencing mechanism should be further developed.
6. SC inspection program is a useful tool to proactively promote the importance of licensee SC. KHNP started to establish SC policy, plan and periodic self-assessment of SC.