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Assessment of Safety Culture within the Pakistan Nuclear Regulatory Authority (PNRA)

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1. Introduction

Safety Culture (SC) is defined by the International Atomic Energy Agency (IAEA) as "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]. The concept of SC was initially introduced back in 1987 after the nuclear accident at the Chernobyl Nuclear Power Plant (NPP) in modern-day Ukraine. In the past, significant efforts have been made to ensure the safe operation of NPPs by improving designs and operating procedures; however, the nuclear accident at the Fukushima NPP in Japan in March 2011 revealed that the currently allotted hardware safety margins are not sufficient, and much work is needed to improve safety management in terms of SC.

Initially, the concept of SC was introduced for operating organizations to ensure safe operation of NPPs; nonetheless, more recent investigations of nuclear events and accidents, especially Fukushima, and at Davis-Besse, in the US, have revealed that a strong focus is required to address and improve the SC of Regulatory Bodies (RBs). Strong SC is considered a vital tool for RBs to achieve their objectives and discharge their responsibilities in an effective and efficient manner. Though the relationship between the SC of RBs and that of operating organizations is not straight forward, it is believed that the former has a strong influence over the latter [2].

The objective of this study is to assess the SC of the Pakistan Nuclear Regulatory Authority (PNRA) by developing a performance indicator-based questionnaire. Aspects that potentially play important roles in developing perceptions of SC, including age, type of job, gender and duty hours of regulatory staff, are given due importance in this study. The study also identifies the strengths and weaknesses in the SC of the PNRA and can be used as a model study to assess the SC of other RBs.

2. Methods and results

2.1. Development of the questionnaire

Under the present study, based on IAEA General Safety Requirements, Part 3, vital organizational aspects of the PNRA, including safety policy, management's commitment to safety, management system, safety communication, competence management, and resource management, are considered in assessing its SC [3]. The study was performed by developing a questionnaire that was in line with SC attributes identified by the PNRA. The key elements used to assess the SC of the PNRA are covered by the questionnaire given in Table I.

2.2. Results of the assessment

Feedback was obtained by distributing the questionnaire among different levels of PNRA staff. Participants' answers were marked on a scale from 1 to 5, with 1 representing strongly agree, 3 representing neutral and 5 representing strongly disagree. The questionnaire was distributed in hard and soft form to 55 individuals which were nearly 20% of technical and administrative staff of the PNRA, 40 of whom responded. The target staff was managers, mid-level officers, lower level supporting staff and administrative staff of the PNRA, all of varying age, gender and duty hours. Responders of the study are shown in Table II.

The responders were not bound to give feedback within a defined time frame; however, they were requested to consider it as a matter of priority. To make the feedback more transparent and factual, the identity of the responders was kept anonymous. The results of the study revealed that the majority of the responders have a good understanding of the basic elements of SC and its existence within the PNRA. The results of the study are shown in Fig.1.

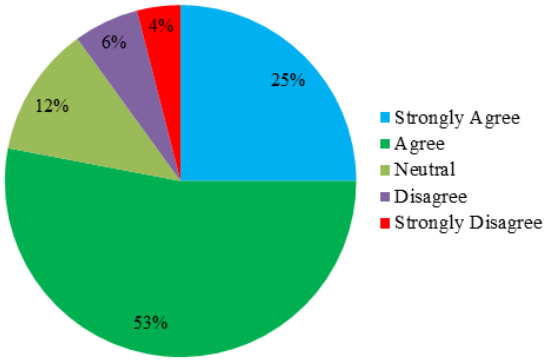

Fig. 1. Safety culture perceptions in the PNRA

Analysis of the results show that 78% of the responders perceive the existence of good SC in the PNRA; whereas, 10% consider the organization to be lacking elements important for good SC. Almost 12% of the responders feel that they are not in a position to support or oppose the existence of some important aspects that are vital in assessing SC in the PNRA.

Table I: Questionnaire developed for the study

A. Safety Policy of the PNRA
1) Safety policy is defined by the PNRA
2) Safety policy is reviewed and updated regularly
3) Safety goals are defined in line with the functions of the PNRA
4) Progress regarding achieving safety goals is reviewed periodically

B. Management's Commitment to Safety
5) PNRA management actively participates in safety-related activities
6) Safety is given top priority in managerial decisions within the PNRA
7) PNRA management follows a conservative approach in making decisions during ambiguous situations

C. PNRA Management System
8) The management system has been detailed by the PNRA in properly documented form
9) The PNRA management system pays due attention to safety policy and safety goals
10) The organizational structure of the PNRA, including roles and responsibilities of regulatory staff, are clearly and unambiguously described by the management system
11) The interfaces and interactions among the various groups of the PNRA are clearly established in the management system

D. Safety Communication
12) A system to disseminate safety-related issues has been established in the PNRA
13) Information dissemination on safety issues received from other organizations like the IAEA are disseminated at all relevant levels in the PNRA as well as other stakeholders on a regular basis
14) Safety issues are regularly highlighted during meetings at all levels in the PNRA

E. Competence Management
15) A system for the identification of current competence profiles of regulatory staff exists in the PNRA
16) Appropriate training programs are available with a focus on competence improvement at different working levels in the PNRA
17) The frequency of refresher courses on safety and technical issues conducted in the PNRA is sufficient enough
18) Training programs are revised based on feedback and updated information with a focus on safety

F. Resource Management
19) Sufficient numbers of competent and qualified staff are available in the PNRA
20) Resources provided to different groups of the PNRA are sufficient to complete their tasks
21) Sufficient numbers of specific tools and safety gadgets are provided to the regulatory staff to ensure their safety while carrying out regulatory assignments

G. Others
22) Questioning and comments by junior staff on safety-related issues are appreciated by PNRA management
23) A system has been established to ensure that safety is not compromised by PNRA staff due to time pressure or workload
24) PNRA staff members assume that severe accidents can occur at NPPs in Pakistan

Table II: Responders to the questionnaire

Sr. No	Responder's Category	No. of Responders	Sr. No	Responder's Category	No. of Responders
1	Principal Scientific Officers (Male)	*5*	6	Scientific Officers (Male)	*5*
2	Principal Scientific Officers (Female)	*2*	7	Scientific Officers (Female)	*2*
3	Principal Engineers (Male)	*5*	8	Supporting Staff (Male)	*5*
4	Senior Scientific Officers (Male)	*8*	9	Administrative Staff (Male)	*3*
5	Senior Scientific Officers (Female)	*5*			
Total Number of Responders 40					

2.3. Internal consistency check of the questionnaire

The internal consistency of the questionnaire is an important factor that ensures its credibility and authenticity. Computer code SPSS (16.0) was used to observe the reliability of the test scores by measuring Cronbach's Alpha. This code is well-known to produce an unbiased estimate of the generalizability of the study and measures how well the sum score on the selected items capture the expected score in the entire domain. The Cronbach's Alpha value remained 0.956, which was well above the recommended value of 0.7. The results of the reliability test performed to observe the internal consistency and credibility of the questionnaire are given in Table III.

Table III: Reliability statistics

Mean	Variance	Std. Deviation	Cronbach's Alpha
48.8205	204.256	14.29183	0.956

3. Discussions

A lot of work is done to assess SC in working organizations in the nuclear industry; however, not enough attention had been paid to evaluate the same for RBs. Now, the IAEA is putting great efforts to establish and enhance SC in RBs. Though primary responsibility for safety belongs to the operator, the regulator plays a significant role in the field of nuclear safety, as it is the regulator that actually decides what is considered to be safe [4].

Recently, international organizations including the OECD/NEA have increased efforts to establish criteria for assessing SC in RBs. The Korea Institute for Nuclear Safety (KINS) performed a similar study back in 2005, through feedback from both regulatory staff as well as from operating organizations, and made recommendations for improving its SC [5].

The PNRA is currently paying special focus to observe and improve its SC. As per its policy, "the PNRA is committed to develop and embed a safety & security culture in all activities and decisions and recognize that it is paramount. Each individual adopts and follows the attributes to maintain and enhance safety and security in his activities and decisions to ensure protection of public and environment" [6].

The analysis of feedback against the questionnaire reveals that PNRA staff have a very good understanding of the concept and importance of SC within the organization. By including responses from both technical and non-technical officers and lower level staff, the study was able to obtain a broader picture of SC in the PNRA. The responses reveal that there is little difference about such understanding at various working levels, indicating the vigilance and interest of PNRA management in promoting SC within the organization.

It has been observed that in the areas of competence management and resource management, the perception level varied among the responders. This may be attributed to a small percentage of responders (around 10%), mostly lower level supportive staff, not being fully familiar with the ongoing functions of the Human Resource Department of the PNRA. Similarly, some responders chose "neutral" responses with questions related to different aspects of PNRA management. This may be due to those responders being junior or new employees, or having been selected from remote sites of the PNRA; therefore, they currently might not be fully aware of specific management issues in the PNRA.

Combined, the percentage of responders who are not aware about the existence of SC within the PNRA or consider the SC to be poor is 22%. Such perceptions amongst the staff demand due attention by the management to further improve SC. Analysis of the overall perception of responders, against key elements important in assessing SC, indicates that a good level of SC exists in the PNRA.

4. Conclusions

The questionnaire, developed to assess the SC of the PNRA, was in line with the PNRA's own defined attributes for SC. The questionnaire was consistent in terms of the credible nature of its questions, and the response group covered different levels of PNRA staff, from managers to lower level staff. The results show that the PNRA staff have a very good understanding of the nature and significance of attributes of SC and are doing their best to exercise the same within the organization.

The study, therefore, concludes that an appreciable level of SC exists in the PNRA. This study can be used as a reference study to perform an evaluation of the SC of other RBs, like KINS and NSSC, Korea. The study may also be helpful for organizations like the OECD/NEA which are in the process of publishing a green book for assessing SC in RBs. The study was limited to a questionnaire-based survey--other important techniques, including interviews and direct observations, could not be used because of time and administrative constraints. Further assessments, by using surveys, interviews and direct observations are recommended to obtain a realistic and clearer picture of SC of respective RBs, including the PNRA.

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