A Study on C-CAP during a construction phase of NPPs project

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1. Introduction

It has been several years since the Korea Nuclear Power Plant (NPP) industry has used Construction-Corrective Action Program (C-CAP) widely in domestic and overseas construction projects. In U.S., the holder of a Combined License (COL) or Limited Work Authorization (LWA) issued under 10 CFR Part 52 should implement C-CAP for new nuclear power plants during engineering, procurement and construction activities up to the point in time determined by the licensee that the operations phase CAP is to be implemented [1]. In needs of a comprehensive condition reporting program that can be established providing timely, consistent classification and complete information to the licensee, C-CAP has been a solid part to provide the process for effective identification of problems, cause analysis, corrective action, and trend analysis during a construction phase of NPPs project.

In Korea, C-CAP was introduced for the first time in Shin Kori 3&4, and currently being used in all domestic and overseas construction projects. This paper begins with investigating current state of C-CAP applied to a selected single case; then, a couple of suggestions for future improvement of C-CAP will be addressed.

2. Methods and Results

This study first examined the overview of C-CAP, and then chose a case-study approach; on-going Barakah 1-4 construction project was selected as a single case.

2.1 Overview of C-CAP

The process used to identify, document, and correct any Conditions Adverse to Quality (CAQ) related to onsite construction and further ensure that, for Significant Conditions Adverse to Quality (SCAQ), reporting is made to appropriate levels of management and the cause and actions to preclude repetition are identified, implemented, effective, and timely. Effective identification of problems and resolving them are critical aspects of assuring nuclear plants are constructed in a quality manner. It is also imperative that good documentation is maintained of the identified problems and the actions taken to correct them. The licensee is responsible for assuring that CAQ are identified, corrected, and managed in accordance with the requirements and commitments of the facility quality assurance program (QAP) [1].

2.2 On-site C-CAP application

At the early days of Barakah construction site, C-CAP was used mainly for Health, Safety, Environment (HSE) Corrective Action Request (CAR) processing; because a large portion of on-site works were very close to it. According to the trend analysis report, 85% of Condition Reports (CR) was issued in area of HSE [2]. As shown in Table 1, issued CRs were classified into four different Significance Level (SL), and appropriate actions were differently taken per its SL [3].

Table 1: Screen criteria/actions for each significance CR

Significance	Screening criteria	Action
Level 1	An incident/problem that seriously affect safety and reliability of construction of safety-related Structures, Systems, and Components (SSC)	Root Cause Analysis (RCA)
Level 2	An incident/problem that can affects safety and reliability of construction of safety-related SSCs	Apparent Cause Evaluation (ACE)
Level 3	An incident/problem that has little effect on safety and reliability of construction of safety-related SSCs	Condition Evaluation (CE)
Level 4	An incident/problem that has almost no effect on safety and reliability of construction of safety-related SSCs	Not required cause analysis

One example where C-CAP was effectively utilized as follows: in the process of resolving the Deficiency Notification Report (DNR) that described "not authorized work by Work Process Procedure/Quality Control Instruction (WPP/QCI): grout placement into the structural concrete form during the concrete placing at the section of the Reactor Containment Building (RCB) foundation" accompanied by the Stop Work Order (SWO) of the project owner (ENEC) in 2012, CR of significance level 1 was processed with Root Cause Analysis (RCA), and contributed to the quality improvement of the on-site construction work.

2.3 *Relationship between C-CAP and quality activities*

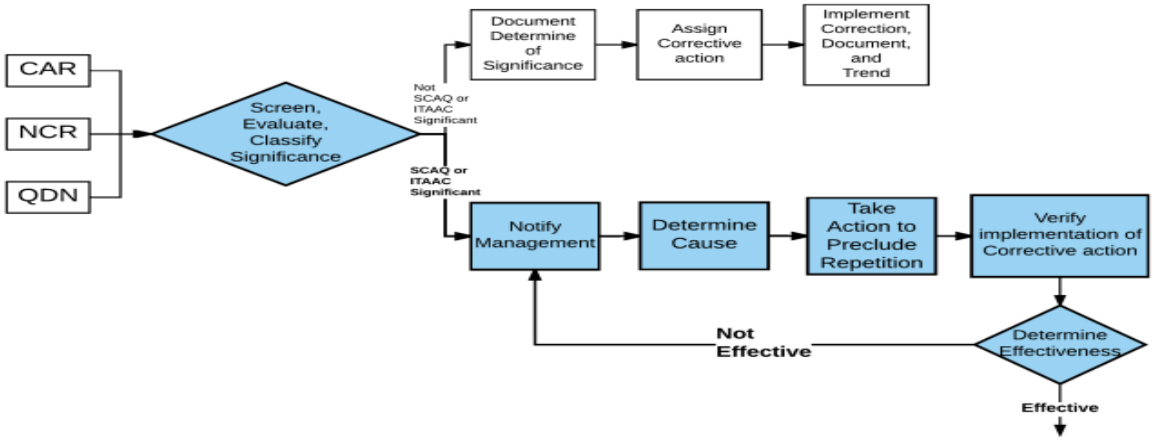

Figure 1. Improved QA/QS processes in C-CAP

The major types of quality assurance/surveillance processes operated in Barakah NPP site are Corrective Action Request (CAR), Non-Conformance Report (NCR), Quality Deficiency Notice (QDN); and, their applicable scopes and definitions are as follows:

a. CAR is used to identify and correct deficiencies that contravene QA requirements. CAR may result from QA audit/surveillance, significant NCR, self-assessment, etc. The responsible organization shall take action for the issue and be verified for their acceptability the next QA audit or verification activities [4].

b. NCR is issued for defective items and services. Nonconformance is defined as a deficiency in characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate. The disposition of NCR is classified into use-as-is, repair, rework, reject and conditional release [5].

c. QDN is issued for items and works which need improvement in quality and for documenting quality deficiencies found during construction. Anyone working as a quality inspector or relevant team engineer shall issue a QDN when an item/work which is potentially adverse to quality if it is neglected or a process is in need of enhancing the quality. QDN shall not be issued on a situation of NCR and CAR [6].

According to corrective action processes for new nuclear power plants during construction, C-CAP should be interpreted as umbrella concept used to collectively describe those systems to identify, document, and correct CAQ or adverse to certain other regulatory requirements [1]. C-CAP should aim to implement interface managements for all multiple QA/QS processes; however, our study showed that C-CAP in the Barakah project was used as an independent corrective action process that separated from CAR, NCR and QDN. Currently, C-CAP has been primary used as a mechanism for dealing with HSE CAR and near miss.

3. Discussion: practical improvement of C-CAP

Based on the study, the suggestions were possibly derived for practical improvements of C-CAP.

3.1 Adding screen evaluations to each QA/QS processes

According to the C-CAP flow in corrective action processes for new nuclear power plants during construction, a condition requiring a corrective action must be screened, evaluated and classified by the individuals who have the training and knowledge needed to be able to recognize the broader implications beyond the specific process where the condition was identified to determine when a SCAQ exists [1]. That is, corrective actions for the conditions should be processed differently depending on whether they are significant.

Figure 1. showed that a practical improvements of work flow for independent QA/QS processes. The essential parts of overall C-CAP are to judge the significance of each CR. The following actions should focus on correcting CAQ and precluding repetition of SCAQ. An effectiveness review of the corrective actions taken to preclude repetition should be performed and documented in the C-CAP. By elaborating those processes, screen and evaluate significance of CRs should be added to prior to taking corrective actions in existing QA/QS processes. Here, CRs comprise of preparation contents of CAR, NCR, and QDN.

3.2 Top management's attention to the most optimized QA/QS processes

Ultimately, top managements should be interested in establishing the most optimization of QA/QS processes in NPP construction projects. In some cases, the number of quality procedures does not always guarantee to make a good quality. On the other hand, the most

optimized and efficient quality processes make the best quality. In order to discover the improvements of QA/QS processes that attribute to C-CAP, a detailed review of the quality activities used in existing construction projects is always needed at the beginning of the project.

4. Conclusions

In NPP construction project, C-CAP can be utilized as primary means for workers to identify problems; and it also provides systematical methodology to resolve CAQ to safety and non-safety SSCs. It is also important on a construction site for management to establish an environment where all workers feel free to identify problems.

As an important part of nuclear safety culture and quality, management should promote prompt identification of conditions and appropriate evaluation, tracking, trending, and correction in a timely manner commensurate with the condition's safety significance and complexity. The concept of C-CAP is not separation from existing QA/QS processes; but, rather focus on integration and interface managements of all quality activities.

Acknowledgements

This research was supported by the 2017 Research Fund of the KEPCO International Nuclear Graduate School (KINGS), Republic of Korea.

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