Analysis for Risk informed decision-making regarding emergent issues relevant to nuclear power plants

Chan-Keun Yang, Choong-Sup Byun
[a]*Safety Technical Center, KHNP CRI, 70, 1312-gil, Yuseong-daero, Yuseong-gu, Daejeon, 34101, KOREA*
[*]*Corresponding author: petrosimon@khnp.co.kr*

1. Introduction

Recently, the CLP(Containment Liner Plate) problem of domestic nuclear power plants has become a major issue by regulatory body(KINS). CLP acts as a concrete casting mold at the time of construction and performs air tightness maintenance function to prevent radiation leakage. During the regular inspection, confirmation of the occurrence of corrosion of CLP ('16.6.28), the KINS asked KHNP to inspect for CLP of all the NPPs. In response to these requests from KINS, KHNP is working hard to solve the CLP problem.

In this paper, the regulatory process to solve the problem in case of emergent issue in overseas and compare it with the similar situation in Korea.

2. Regulatory procedures for emergent issues in KOREA

When a CLP problem occurs, the regulatory process is as follows. The first step is Issuance of Inspection note. In this step, KHNP checks the similar parts before the critical state, and Nuclear Safety and Security Commission (NSSC) require KHNP to establish measures to prevent recurrence. In the second step, KINS discusses CLP inspection methods and implementation directions with KHNP each branch offices and headquarters. In the third step, KHNP reported to NSSC that KHNP would check the status of CLP for all nuclear power plants. Inspection and maintenance are performed during OH period for 19 nuclear power plants with CLP installed in the last step.

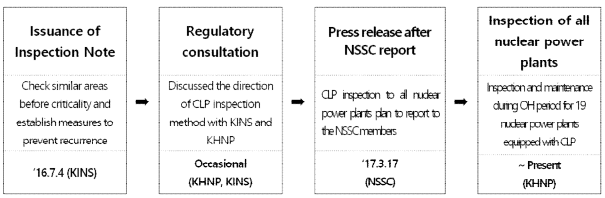

Fig. 1. CLP Procedure in KOREA.

As shown in the above procedure, KINS or NSSC requires all domestic nuclear power plants to conduct inspections and to take corrective action before the critical state of nuclear power plan. Although this procedure is not regulatory method, it is assumed that it will be a more reasonable regulatory method if the level of regulation is different according to its importance in consideration of the safety importance of the nuclear power plant when an emergent issue occurs.

Most importantly, there is no standardized procedure or method for dealing with emergent issue in nuclear power plants.

3. Regulatory procedures for emergent issues in USA

3.1. LIC-504 application

In the United States, there is a procedure called LIC-504, which is applied after confirming that certain requirements (Compliance with existing regulations, Consistency with the defense-in-depth philosophy, Maintenance of adequate safety margins, Demonstration of acceptable levels of risk, Implementation of defined performance measurement strategies) are met when emergent issues occur. The LIC-504 is a regulatory process that enables decision making and follow-up measures using risk information decision-making methods when new information emerges that does not belong to existing regulatory processes, such as operational change permits and inspections. The procedure for applying LIC-504 is as follows Fig1.[1].

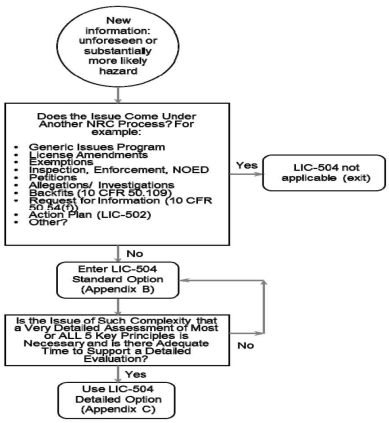

Fig. 2. Entering LIC-504[1].

If the LIC-504 is determined to be used to analyze emergent issues, the standard approach will be used. Generally, the standard approach should be used every time LIC-504 is applied. However, if it is judged that a careful decision-making process is necessary or a

systematic evaluation of risk, Defense-in-Depth and safety margin is needed, the detailed approach will be used.

3.2. The Risk-Informed Decision-Making Process

This process can be expressed in seven steps. Figure 3 explain the process to be followed for risk-informed decision-making[1].

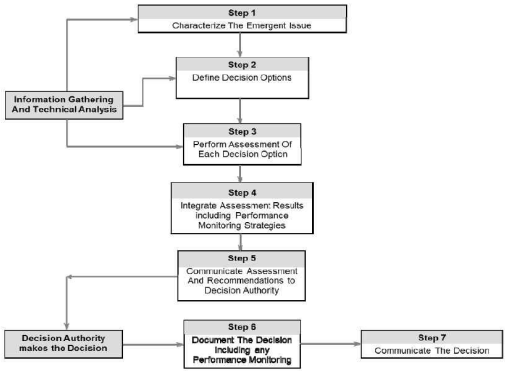

Fig. 3. Risk-informed decision making process[1].

Steps 1-3 of this process are identical to the risk information decision process in RG1.174. At this 1-3 stages, information is collected and technical analysis is performed. It also uses five key principles of risk information. This step will be repeated to identify the additional information needed.

This 4 step is part of the integrated decision-making phase of RG1.174. Thus, this step will provide additional guidance to address urgent issues. When comparing different options for solving emergent issues, the team should use the five key principles in Section 4.1 to determine which option best addresses the issue.

Step 5 provides decision makers with the information they need to make informed decisions. The information provided includes a brief emergent issue description, characterization of the issue, the options considered, recommended options, and recommended performance monitoring strategies.

This step is to document the decision. At this stage, the rational choice of decision-makers to address the emergent problem should be discussed. Agreement should be obtained from all affected technicians and project managers.

Last step is to communicate the decision to affected and interested parties.

3-3. Application example of LIC-504

During the spring 2016 refueling outage inspections, two PWR operators (Indian Point Unit 2, salem Unit) identified an unexpected level of deterioration in the BFB and found that the plant had not been analyzed. For the five potentially deteriorating plants, the LIC-504 process was used to assess the potential risks and ongoing plant operation results from extensive BFB degradation and determine the necessary regulatory action. The options considered for solving the BFB using the LIC-504 process are Option 1-Immediate Shutdown, Option 2-Restore to Acceptable Level within 2 Years, Option 3-Generic Communication & Information Gathering, Option 4-Status Quo.

The NRC concluded that Option 2 was appropriate through risk information decision-making with LIC-504. Recommendation means that Option 2 may result in some degradation in defense-in-depth at standpoint because of the potential possibility for local fuel cladding damage. If a LOCA(Loss Of Coolant Accident) or SSE(Safety Shutdown Earthquake) occurs before the inspection or bolt replacement and that result in a possible reduction in safety margins because the plant would operate with potentially degraded bolts. Finally, Because of the relatively short period of operation with potentially degraded BFBs and the staff's evaluation that the risk of core damage from BFB degradation over this time period is low, Option 2 is acceptable, based on risk.

4. Application Method in KOREA

Since the final decision maker is a regulatory body, it is natural for the regulatory body to take the lead in introducing a risk information decision-making system. While introducing risk information decision-making is one of several ways to enhance the safety of nuclear power plants, it is not the right way to pass all responsibility to regulators. Everyone involved in the domestic nuclear industry should strive to lay the foundations for a rational regulatory environment for nuclear power plants. In addition, introducing risk information decision-making directly into Korea may lead to unexpected difficulties. Nevertheless, if risk information decision-making is to be used as a reference element for decision-making, it is considered that the related procedures can be introduced at the present stage.

KHNP can operate the same procedures as the LIC-504 itself and the results of the same procedure as the LIC-504 will be used as a reference for the final decision making of the regulatory agency.

5. Conclusions

Currently, there is no procedure for systematic analysis in Korea when emergent issues occur during inspection. However, in the case of the United States, there are procedures to deal with emergent issues during the inspection, and how they operate. In this paper, the CLP problem is described as an example, but it seems appropriate to formulate a systematic procedure to deal with the probable problems that may arise during the inspection.

REFERENCES

[1] Steven A. Laur and Jennifer Uhle, Integrated Risk-Informed Decision-Making Process for Emergent Issues, revision 4 (ML14035A143), May 30, 2014.

[2] NSSC Reveals the Inspection Results of the Backside Corrosion of the CLPs in the Containment Buildings, Press Releases, July 27 2017