Lessons Learned Pre-Operational Inspection of Shin-Kori 1 and 2 NPPs

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1. Introduction

This study has been prepared to share the information on the pre-operational inspection(POI) experience of Shin-Kori 1 and 2 nuclear power plants (NPPs). The pre-operational inspection consist of 5 stages : structure inspection; installation inspection; cold functional test (CFT) inspection; hydrostatic test and hot functional test (HFT) inspection; initial fuel loading and startup test inspection.

In this paper, the types of inspection findings that had been identified due to the nonconformance with related requirements were analyzed. The characteristics of the findings per inspection stage were also observed.

Also, enhancing plan for the regulatory inspection was drawn from the POI experiences.

2. Inspection Result Analysis

Inspection results have been analyzed with a focus on inspection findings, which are problems identified during the construction due to the failures to meet related requirements. In addition, an inspection may be conducted after being notified by the licensee about problems generated already during the construction or tests. In this case, the licensee's handling process of the problem may be verified by inspectors without issuing the inspection finding. Such cases have been taken into consideration as well for this analysis.

Summary of Shin-Kori 1 and 2 POI is given in Tables 1.

Table 1 Inspection Summary of Shin-Kori Unit 1 and 2

Inspection Stage	Inspection Period (#1/#2)	Inspections Items	No. of Findings	No. of Recom.
Structure	#1 : Mar. 2006 ~ May 2010 #2 : Mar. 2006 ~ Apr. 2011	17	35	16
Installation	#1 : Mar. 2008 ~ May 2010 #2 : Mar. 2008 ~ Apr. 2011	52	44	15
Cold Functional Test	#1 : Dec. 2009 ~ May 2010 #2 : Jan. 2010 ~ June 2011	77	10	3
Hot Functional Test	#1 : Sep. 2009 ~ May 2010 #2 : Aug. 2010 ~ Aug. 2011	32	7	0
Startup Test	#1 : May. 2010 ~ Feb. 2011 #2 :	23	4	2
Total	-	201	100	36

2.1 General Result

Firstly, the major part of the inspection finding was issued during the structure inspection and installation inspection. As a result of POI for Shin-Kori 1 and 2, 35 and 44 findings were identified during the structure and installation inspection respectively. And also, 21 findings were identified during the performance inspection on the CFT, HFT, and initial fuel loading and startup test. In case of the structure and installation inspection, there are many detailed requirements of industrial technical standards that should be met for the construction materials, manufacturing, fabrication, installation, and inspection of the SSCs. In the process of verifying the conformance to these requirements, relatively large number of findings were identified. This tendency is quiet similar to the previous 8 units of KSNP as shown in Fig 1.

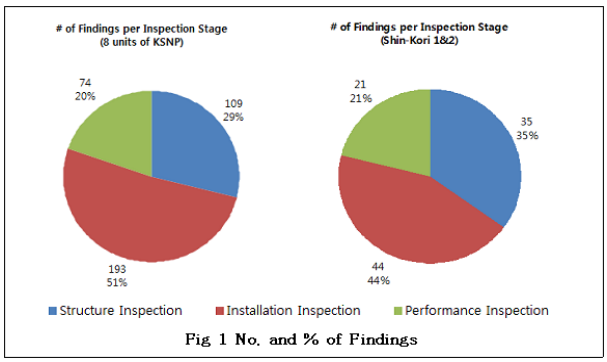

Fig 1 No. and % of Findings

Secondly, as shown in Fig. 2, during the installation and performance inspection for Yonggwang 3 and 4, early constructed units among eight plants, a large number of findings (84 and 30) were issued. However, with repeated constructions and tests of the same type of plant, the number of findings decreased abruptly so that only 28 and 5 findings were issued for Ulchin 5 and 6. On the contrary, in case of Shin-Kori 1 and 2, the number of findings increase greatly comparing with Ulchin 5 and 6. And the number of findings similar to Ulchin 3 and 4 which are early constructed units among 8 units of KSNP. This is likely due to the cutting of construction experience approximately 7 years since Ulchin 5 and 6.

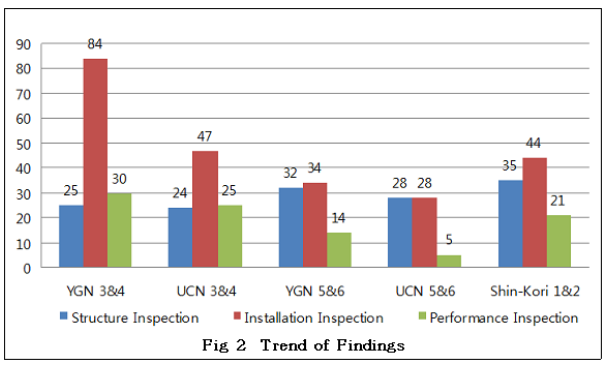

Fig 2 Trend of Findings

In case of structure inspection, the number of findings stays similar level. This is likely due to the

characteristics of construction work, which are highly dependent on the worker's skill, work environments, etc.

2.2 Characteristics of Inspection Results

The type of finding most frequently identified during the POI for Shin-Kori 1 and 2 is "violation of procedures" which amounts to approximately 26% of all findings as shown in fig 3.

Particularly, the amount of "violation of procedures" is abruptly increased almost 3 times more than the former 8 units of KSNP (9%). This phenomenon means that quality assurance activities have weakened a lot during the construction for Shin-Kori 1 and 2.

Typical example of procedure violations are as follows: inadequacy of test and inspection due to the insufficient understanding or poor acquainted with the work procedure, delayed issue for quality documents such as non-conformance report (NCR), field change request (FCR), test trouble report (TTR), non-compliance with quality control procedures etc.

Generally, this tendency is means enfeeblement of safety culture. It is very undesirable trend that is likely due to lack of safety consciousness, insufficient manpower, principle of "construction schedule first" so on.

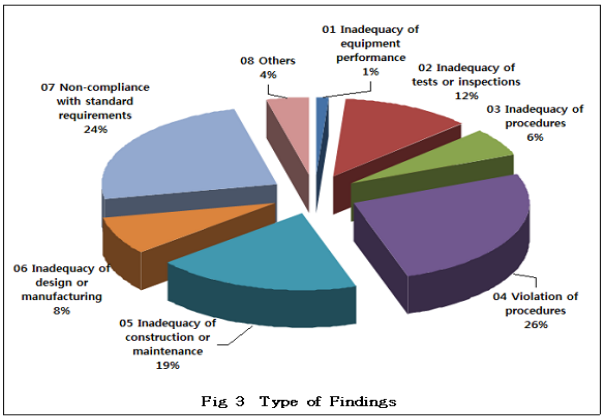

Fig 3 Type of Findings

The next common finding is " Non-compliance with standard requirement" and " Inadequacy of construction " which amount to 24%, 19% respectively.

Especially, the amount of " Non-compliance with standard requirement" is greatly decreased compared with previous 8 units of KSNP(45%). "Non-compliance with standard requirement" designates cases where, in the process of the construction, industrial technical standards, regulatory requirements, and PSAR whose validity has been verified through CP review are not met, therefore the adequacy of them should be separately evaluated or corrected. The failure to satisfy the requirements of such documents is due especially to insufficient understanding of the detailed contents of industrial technical standards (KEPIC, ASME, ACI, IEEE etc.) and the importance of them.

In addition, some requirements may be difficult to be kept in certain areas hard to construct or may not be met because of special situations of licensee's organization such as a difficulty to continue quality works for several years. For example, insufficient understanding of the contents and importance of the followings led to the inspector to issue findings during the inspection: applicable standard requirements in ASTM D 1556 regarding the soil compaction test; detailed KEPIC Code requirements regarding the field bending of reinforcing bar, detailed requirements of ASME Code regarding WPS and the treatment of unsatisfactory weld zones, the identification and indication of the safety and non-safety class for power terminal block nameplate, cableway, instrument, and indicator; the separation gap between channels etc.

On occasion, an inspection may be conducted after being notified by the licensee about problems generated during the fabrication of component or pipe spools such as omit to radiographic test for the main steam pipe and cladding material change for reactor outlet nozzle without designer approval etc. Consequently, when a major non-conformance that does not meet related requirements occurs, the licensee must promptly report to the regulatory body.

3. Summary and Conclusions

A summary of the inspection of characteristics and its lessons learned of Shin-Kori 1 and 2 is as follows.

Firstly, the number of findings is similar to that of Ulchin 3 and 4 which are early constructed units among 8 units of KSNP. This is likely due to the cutting of construction experience for approximately 7 years since Ulchin 5 and 6.

Secondly, the amount of "violation of procedures" is abruptly increased almost 3 times more than the former 8 units of KSNP (9%). This phenomenon means that quality assurance activities have weakened a lot during the construction for Shin-Kori 1 and 2.

Thirdly, on occasion, an inspection may be conducted after being notified by the licensee about problems generated during the fabrication of SSC. However, POI is not conducted at fabrication stage.

Therefore, following items should be reviewed for safety strengthening of NPPs under construction.

(1) Enhancing the regulatory inspection on the licensee's quality activities.
(2) Rule making for vendor inspection during the fabrication of SSC.
(3) Enhancing the reporting rules on significant issues which affect to the safety
(4) Introducing a construction supervision system to the NPPs

Reference

[1] KINS/GR-329, "Development of pre-operational inspection program of nuclear power plants for international cooperation", KINS, 2006.5