

FANR TSO (Technical Support Organization)'s Electric and Electronic Site Inspection for Barakah Nuclear Power Plant Unit 1, 2 & 3

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1. Introduction

In UAE, Barakah Nuclear Power Plants Unit 1, 2 and 3 have been built from years ago, and there has been a lot of planning, design, implementation, manufacturing, and testing for SSC (system, structure and components) for NPP. However for integrity of installation and commissioning of SSCs in site, FANR (Federal Agency for Nuclear Regulation) and its supporting group TSO have conducted the installation inspection for each plant unit in the phase of turnover to commissioning. This paper presents the status of site walk-down and inspection for electrical and electronic (Instrumentation and control) discipline performed by MIRAE-EN Co., Ltd. as member of TSO.

The site inspection of Barakah NPP units 1, 2 and 3 are scheduled based on the ENEC-KEPCO weekly electrical construction progress, and the target systems of inspection are selected among the safety systems and some of safety related systems. CON-15 [1] and CON-16 [2] provide the general guidelines for site inspection for Barakah Nuclear Power Plants Unit 1, 2 and 3. Furthermore the experience and knowledge for electric and I&C components design and equipment qualification in parallel with qualification management in Nuclear Power Plants is utilized for site inspection. Inspection period is determined by FANR almost quarterly, and each inspector group including mechanics prepares IR (Inspection Report) for review and approval of resident lead inspector in the debrief meeting.

2. Site Inspection

2.1 Inspection Plan and Topics

The following table gives inspection duration, inspection area, and other brief information;

Table 1 Inspection conducted (2015~2017)

Year	Duration	SSC(Structure, System AND Component)	Unit
2015	Jul.14-16	- 4.16 kV SWGR (1-823-E-SW02B) - Aux Bldg. 78'-00 electric DC/AC system	#1
2015	Sep.14-16	- CEDM (Control Element Drive Mechanism)	#1
2016	Aug. 22-24	- EDG (Emergency Diesel Generator)	#1
2016	Oct. 17-19	- PPS(Plant Protection System) & MMIS(Man-	#1

		Machine Interface System)	
2106	Dec. 19-21	- DPS(Diverse Protection System) & RSR(Remote Shutdown Room)	#1
2017	Feb. 13-15	- Class 1E 480V, Class 1E 125V DC power, Class 1E 120V AC	#1
2017	Jul. 17-19	- Reactor Containment Building (RCB) fire detection - Essential Service Water Intake Structure (ESWIS) electrical supplies	#2& #3
2017	Aug. 21-23	- Nuclear safety electrical such as Class 1E 125V DC Systems for unit	#3

2.2 Selection of Inspection System

The selection of the inspection target is determined by considering the plant start-up schedule of Barakah as mentioned in Table 1 above. The inspector has concentrated on the followings issues;

- 1) The validity of start-up test and CAT (Construction Acceptance Test)
- 2) Design verification and validation
 - All the suppliers who provide the design and equipment had conducted the comprehensive design process, verification and validation process ensuring that all the activities of those processes meet the PO (Purchase Order), standards and regulation. Thus the inspection is very limited and turned into the point to installation and startup test in site.
- 3) Equipment qualification issues including the CGI (Commercial Grade Item) dedication
 - Most of hardware including software is inspected by reviewing the material for equipment qualification and dedication reports for specific item.
- 4) Human Factor review for MCR
 - Most of inspection is for human factor review for Main Control Room, and some of digital display and bench board layout.

2.3 Documentation access

Whole design documents and relative materials necessary for site inspection are available through access of internet service in remote as well as in site.

Some design data not available on the web is requested through FANR DRF (Document Request Form) to vendors in site.

2.4 Type of inspection

The objective of inspection is the suitability of site installation and test of various equipment classified as safety-related electric and electronic systems, including sometimes the assessment of design, qualification and validation of those systems. Suitability of installation and startup test have been conducted based on the CON-15 and 16 series, and the assessment of EQ including software have been conducted to go over the CGIs dedication parts or system, implying the trend that there is obsolescence of equipment and parts, and a lot of equipment are assessed for dedication for nuclear qualification and application.

2.5 Inspection Reports

Inspection Basis

For Site Service Inspection (SSI), FANR provides the generic inspection guideline for electric and electronic area as in references [1] through [3]. Based on this, a lot of commissioning test procedure and result are reviewed for double checking the design, installation and test integrity. Thus the test acceptance criteria primarily are based on the values in these kind of guidance and documentation too.

Inspection Process

Inspection is prepared through entry meeting on the first day to select, collect the materials to review, and arrange the site walk down schedule for the second day. After that the inspection, a report [4] is prepared for submission to FANR. The result of inspection is concluded with observation and finding which is a kind of recommendation and official deviation with design that should be resolved by the designer respectively. Using this IR (Inspection Report), debrief meeting is held on the 3rd day to compile all the observation and finding through discussion with relative inspectors, vendors and designer. For completing this report, all the participants and stakeholder name in the meeting is attached at the end of this IR.

3. Conclusions

Due to the security agreement, much of detail data for inspection could not be open to release.

Most of inspection usually reveals the common anomaly for installation in order to turn over for commissioning department. The results of inspection has been reported to FANR resident lead inspector. And major observations are;

- 1) Site inspection plan is just a plan. Thus the site walk walkdown and inspection is out of the schedule dependent on the site circumstances
- 2) Violation of CON-15 and 16 for cable installation and testing
- 3) Inappropriateness of equipment qualification including CGI dedication

Reflecting that the dedication of equipment including hardware and software is remarkable trend in nuclear society, Barakah NPP also has a lot of CGIs. Thus inspector is responsible for verifying the suitability of items, and facing that the reluctance of cooperation by supplier is experienced too. This happens in case of the protection of IP (Intellectual Property) and Know-How of Supplier, which is one of the causes to make this dedication activity incomplete. Considering this, the policy for supplier management is required for consistent inspection.

- 4) Housekeeping matters for cleaning

As most of construction site does, the site in Barakah NPP come to face the house keeping matters in clearance of debris, dust, and space in electric and electronic cabinet for temporary storage for cable to be installed later.

- 5) Trend from analog to digital - Heat dissipation analysis

Most of electric and electronic components digitalized much more in Barakah NPP usually need more space and complexity to install, which decreases the void space in cabinet. For example, the Remote Shutdown Console (RSC) also is composed of parts changed from simple analog devices to complex digital devices. In the course of doing this, the density inside RSC bench-board is remarkable growing so that it might require heat dissipation analysis, which might be applicable to other system too. Unfortunately it is hard to take an appropriate action for the product that has been already delivered through purchase, design, manufacturing and fabrication, testing in factory.

- 6) Human Factor deficiency in Main Control Room

Some concern of HF (Human Factor) in MCR design, the readability and controllability of some hard panel is not appropriate for operator's action, which is anyway explained by supplier and designer though.

- 7) Others

Apart from 1) through 6), there have been many observations and findings in inspection. Those are debriefed in the debrief meeting to resolve those issues in order to complete each inspection.

In case of KHNP (Korea Hydro and Nuclear Power Co., Ltd.), it is assumed that there is no type of engineering service (i.e., outsourcing list) for electric and electronic domain for plant in start-up (Site Service Inspection: SSE) and in operation (In-Service Inspection: ISI) regardless of quality classes such as Q, A and S. It is recommended that this list of services by the third party shall be encouraged by KHNP in order to accomplish the integral support of start-up and periodic operation, which might be linked to PSA (Periodic Safety Analysis) for electric and electronic area while plant is in operation.

REFERENCES

- [1] CON-15, Rev A, Electric Cable Installation Activities (Inspection guideline)
- [2] CON-16, Rev. A, electrical component installation activities
- [3] FANR-REG-01, Regulation for Management Systems for Nuclear Facilities, Version 0
- [4] 9-037-B416-001, Rev 0, FSAR (Final Safety Analysis Report) for Barakah NPP 1&2
- [5] Inspection Report template