

Analysis on Regulatory Issues for Unified Application of Industrial Standards of Fire Protection Systems in Nuclear Power Plants

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1. Introduction

There has been a controversy over the dual application of Nuclear Safety Act (NSA) and Fire Service Acts (FSA) to the fire protection (FP) systems in nuclear power plants (NPPs). To resolve the double regulatory issues, Nuclear Safety and Security Commission (NSSC) and Ministry of Public Safety and Security (MPSS) executing NSA and FSA respectively had laid heads together; then, NSSC reorganized FP regulatory systems of NPP by independent under the consultation process with MPSS such as Notices No. 2015-11, "Technical Standards for Fire Hazard Analysis" and No. 2015-12, "Regulation on Establishment and Implementation of Fire Protection Program". In this study, the regulatory issues for unified application by the notices are introduced and described.

2. Background

2.1 Framework of NPP's Fire Protection Regulations

To construct or operate a nuclear power plant, a permit or a license shall be obtained from the NSSC as prescribed by NSA. However, NPP is also designated a "Specific Occupancy to be Fire-protected" by FSA. Therefore NPP licensee shall obtain a MPSS's consent to building permit in addition to the permit from NSSC. Table 1 shows the permits from the both governmental agencies at each stage.

Table 1 Comparison of FP Regulations between NSSC & MPSS

Stage	NSA of NSSC	FSA of MPSS
Design	Construction permit through review of PSAR ⁽¹⁾ , P-FHA ⁽²⁾	Consent to building permit based on design documents, drawings, and calculation sheets.
Construction	Pre-Operation Inspection	Inspection, Functional test,
	Operating license through review of FSAR ⁽¹⁾ , F-FHA ⁽²⁾	Usage license through review of supervision report
Operation	Inspection by NSSC	Inspection by licensee

Note. (1) P/FSAR : Preliminary/Final Safety Analysis Report
(2) P/F-FHA : Preliminary/Final Fire Hazard Analysis

FSA requires that FP systems shall be designed by National Fire Safety Codes (NFSC) issued as Notices of MPSS which provide relatively simple requirement. National Fire Protection Association Codes and Standards (NFPA) provide more detail design criteria and meet international level in FP systems of NPP which is a special-purpose industrial occupancy [1] [2].

2.2 History of Unification Process

The licensee had claimed that two different regulation should be unified regarding administrative confusion and technical standard's confliction through the special review results on the Gori Unit 4 fire event in March 8, 2006.

After review of research report [3] submitted by licensee in March 2009, NSSC had proposed to MPSS that performance based design stipulated in FSA could be applied for design and construction of FP systems in NPP. However, there was no agreement between NSSC and MPSS.

The double regulatory issues was raised again by special review group to review Fukushima NPP disaster occurred in 2011. Although a number of meeting between NSSC and MPSS were held, NSSC and MPSS went their own way [4].

With assistance of mediation role of the Prime Minister, MPSS had agreed with the NSSC's proposal. According to the agreement between NSSC and MPSS, NSSC has issued Notices No. 2015-11 and No. 2015-12 of NSSC as a amended NPP's FP regulations in Dec. 2016.

3. New Regulatory Issues

A research regarding the regulatory issues for unified application by the notices is in progress. Korea Institute of Nuclear Safety (KINS) analyzed on regulatory issues for unified application standard of fire protection facilities in nuclear power plants in December 2016 [5]. The major pending issues described in the report are the followings;

3.1 Design standard

In principal, the design standard of the FP systems moved to NFPA from running parallel of NFSC and NSA that embeds NFPA. Exceptionally fire extinguisher, hydrants, exit sign & lamp, air respirator, and heat-proof clothing could be designed as per FSA

for rationality in practice. The rationality in practice means easiness and familiarity in application and use without the yield of technology.

However, there is no statement for required standard of fire protection systems other than the exceptional cases mentioned above in the Notices; that is, NFPA is commented in the regulatory standard and regulatory guideline of KINS. It may call mandatory into question hereafter.

3.2 Third party's design review

The third party review on FP design shall be conducted under the revised NPP's FP regulation, which has not been executed before. The notices cite the third party review system from construction supervision of FSA, but the legal action for gross negligence in the third party review has not been stipulated in NSA yet. NSSC should consider to execute the legal action through enactment.

Also, the practical qualification of the reviewer is open to question because the design standard changed to NFPA is not familiar to many FP designers in the domestic market and the reviewers are used to FSA including NFSC.

3.3 Quality Management

Quality Assurance (QA) for fire protection equipment such as sprinklers, valves, detectors, fire control panel, manual call point, and so on are extended in terms of approved items and certificate authorities. Items approved by Korea Fire Institute (KFI) only have been applied in NPPs. By the way, the goods approved by international authorities as well as KFI can be installed in NPPs from now. Here the international authorities for the certification are UL (Underwriter Laboratory) and FM (Factory Mutual) as a representative.

However, to materialize FP design as per NFPA, fire protection equipment shall accord with NFPA in quality and standard. In other words, there is difference in test standard between KFI and UL (or other certificate authorities), which is resulted in the gap of quality and standard. This technical unconformity should be discussed in detail and get solution to realize the intended FP systems.

3.4 Construction Supervision

The provision of FSA with respect to construction supervision for FP system shall be applied in NPPs according to the Notice No. 2015-12 of NSSC. The construction supervision required by FSA is very exclusive and severe in legal responsibility because the supervisors do their work it instead of fire officials by law. Like the issues of the design review by the third party, there are opaque aspects on an administration

body and law implementation. It should be clear by establishing the provisions in NSA including the relevant Notices or other ways if possible.

Under FSA, design documents and drawings for FP system of NPP has been required to report to a fire department, but it is not demanded any more. Nevertheless, the design material needs to be continuously submitted for fire response in the event of fire in that fire fighters should confirm available information.

3.5 FP system maintenance

After obtaining operating license of NPPs, fire protection systems have been inspected to keep the performance of FP system. Notices No. 2015-12 quotes owner inspection of FSA and as mention in section 3.1 the design standard for NPP is NFPA. After all, the inspection that follows both FSA and NFPA will show some difference. Hence, the inspection requirements for the FP system maintenance shall be reviewed for each system based on FSA and NFPA respectively, then chosen as the optimal.

In addition, the administrative issue is like the thing of the third party's review and supervision. The related administrative procedure should be also organized by legislation.

3.6 Fire response system

The double regulation issue is not limited on design standards of FP system at the fire prevention stage. It has influences on fire response and recovery too, so there will be diverse interfaces between NSSC and MPSS in fire incidents. Since MPSS will not be involved in the design and installation process, MPSS could have a limited information compared to before. In fire incidents, responsibility and cooperation for the response activities should be well defined to perform the best work to ensure reactor safety. The fire at Sungnyemun in 2008 might be a specific example, which the cooperation for fire response between response partner-organizations was failed. To avoid similar failure, a lively discussion and effective collaboration will be done among NSSC, NPP licensee, and Fire Authority including fire brigades in district.

4. Conclusions

The amended Notice of NSSC would contribute to improve the fire safety of operating NPPs and to meet the global level of industrial fire protection standards. However, there are still something to be solved in the technical and administrative issues on unified application standards for fire protection systems as described in the above. Conclusively, it is requested that diverse arguments among government agencies,

stakeholder and experts be discussed to get a harmonized agreement on the pending issues.

Acknowledgement

This work was supported by the Nuclear Safety Research Program through the Korea Foundation Of Nuclear Safety (KOFONS), granted financial resource from the Nuclear Safety and Security Commission (NSSC), Republic of Korea (No. 1605002)

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