Analysis of Worldwide Regulatory Framework for On-Line Maintenance

Sang-Kyu AHN*, Kyu-Myung OH, Chang-Ju Lee
Korea Institute of Nuclear Safety, 19, Guseong, Yuseong, Daejeon, Korea, 305-600
** Corresponding author: k052ask@kins.re.kr*

1. Introduction

With the increasing economic pressures being faced and the potential for shortening outage times under the conditions of deregulated electricity markets in the world, licensees are motivated to get an increasing amount of on-line maintenance (OLM). OLM means a kind of planned maintenance of nuclear reactor facilities, including structure, systems, and components (SSCs), during power operation. In Korea, a similar situation is made up, so it needs to establish a regulatory framework for OLM. A few years ago, foreign countries' practices related to OLM were surveyed by the Working Group on Inspection Practices (WGIP) of OECD/NEA/CNRA [1]. The survey results and additional new information of countries' status will be helpful to establish our own regulatory framework for OLM, which are analyzed in this paper. From the analysis, some considerable points to be addressed for establishing a regulatory framework for OLM are suggested.

2 Foreign countries' practices of OLM

In USA, exactly whatever maintenance is allowed is governed, in part, by plant technical specifications, which are part of the plant's operating license. Beyond that, in general, licensees are permitted to do OLM, providing they can manage the increase in risk that may result from the proposed activities. Existing rules and regulations for OLM are plant-specific technical specifications, 10 CFR 50.65(Requirements for monitoring the effectiveness of maintenance at nuclear power plants), Regulatory Guide 1.160, and Regulatory Guide 1.182. Assessing and managing the risk associated with maintenance is governed by 10 CFR 50.65(a)(4) [2], and licensees themselves evaluate the risk with probabilistic and/or deterministic methods. Under the new Reactor Oversight Process, resident regulatory inspectors have to review licensees' OLM activities on a routine sampling basis. These activities are also in-depth reviewed by the region inspectors on a periodic basis.

OLM is permitted in the Spanish nuclear power plants. The unique principle for managing OLM is that licensees have to follow the plant-specific technical specifications. Additionally, the Maintenance Rule based on the US-Rule 10CFR 50.65 is required to the Spanish plants. Licensees carry out a deterministic assessment to ensure that taking into account the redundancy of the safety systems, so an individual train can be taken out of service (OOS) for maintenance, but coping with technical specification requirements. On the other hand, licensees perform a probabilistic safety assessment (PSA) for the plant, and individual maintenance activities are assessed in terms of their contribution to the plant risk due to the OOS. Spanish regulatory procedure for OLM is the procedure PT.IV.24 "Inspection of the fulfillment of the Maintenance Rule."

In Germany, the regulatory body licensed OLM under the recommendation by the Reactor Safety Commission (RSK). On December 1992, RSK provided the recommendation concerning OLM, which describes the allowable maintenance related to the degree of redundancy. For example, OLM is allowed only for one train out of n+2 trains of stand-by safety systems such as residual heat removal chain, and OLM is allowed only during undisturbed normal operation. On the other hand, it is not allowed during plant tests, in case of indications of difficulties, and coincident with other activities which increase the probability of the challenge of safety devices. Licensees have established the Technical Specification for OLM in accordance with the above mentioned RSK recommendation. In the operation manual, there are, among other things, a maintenance list and a list of allowed switch-off times for safety-related components. All safety evaluations are reviewed and approved by the regulatory body that is also supported by the Technical Inspection Agency, TUV.

OLM is also allowed in the Finnish nuclear power plants. The conditions for this activity are defined in the Technical Specifications and they are based on deterministic requirements and accepted in connection to the approval of the Technical Specifications. Even though there is no regulatory requirement for performing probabilistic calculations, licensees use a PSA as a justification of OLM. Detailed instructions for the performance of OLM are given in the operating and maintenance procedures. The shift supervisor of the plant is responsible to follow up the retention of safety and compliance with the Technical Specifications. During OLM, the resident inspectors of the Radiation and Nuclear Safety Authority (STUK) at the plant site supervise the work and safe operation. Guide YVL 1.8 describes how the STUK regulates OLM of SSCs at the facilities during operation.

In France, there is no particular regulation for OLM, but during any state of the reactor (operation or outage), the licensee has to cope with the technical specifications which predict which system is required or not and how long it can be out of service according to the considered state. There is no specific regulatory procedure for inspection of licensee's performance of OLM, but covered in the inspection scope of the surveillance program, which carried out on a sampling basis. The main difference between OLM and maintenance during outage exists in the process of system re-qualification after maintenance.

As well known, the CANDU is designed with four special safety systems which are independent from process systems and from each other. Each system has triplicate independent channels for each parameter and function, and operates on a 2/3 logic. These features assure that an operator can remove out a channel for a maintenance, calibration or testing, at any time during power operation. Because of these features of the CANDU, a lot of testing and calibration goes on at power, and there is no need to shut down for these tasks. Rules ensure that components of any channel are thoroughly tested before returning to service. The licensee presents a document describing its internal rules for availability of systems and components, including the guidelines for maintenance and testing, which will support the Canadian policy. Corresponding guidelines should be submitted to the regulatory body, CNSC, in order to ensure that the station remains in an analyzed state, as described in the licensee's Safety Report. Canadian policy is the allowable unavailability of a special safety system during the year. There is no regulatory procedure for inspection of licensee's performance of OLM during operation. CNSC evaluates the licensee with regards to its ability to meet its own objectives of maintenance, its completion ratio, its ratio of resources invested in OLM versus corrective maintenance. Another inspection point by the CNSC is a procedure quality for each maintenance activity.

In Japan, NISA (Japanese Regulatory Body) allows licensees to have an internal rule of maximum unavailability time spans (MUT). This is part of Technical Specifications and hence part of the license. The safety levels of MUT are evaluated by licensees, and reviewed by NISA. There is no regulatory procedure for inspection of OLM. Licensees have studied in order to apply OLM to their operation. The study has identified that many effects should be considered for ensuring safety of reactor facilities during OLM, that is, the effect of false signals; the effect of deviation from limiting conditions of operation (LCO) in other components; the effect of surveillance of other components, and the effect of repetitive use of allowable outage time [3].

3. Conclusions

From the survey results by NEA/CNRA, it was identified that in most countries OLM of safety systems during reactor operation is based on a concept of maximum allowable outage time (AOT) for systems and components important to safety, and the regulatory bodies allow licensees to have an internal rule of maximum AOT. Generally, this is part of the Technical Specifications and hence part of the license.

However, most of regulatory bodies do not have their own specific rules and/or principles except Finland, Germany, Spain, and USA. It seems that the degree of redundancy and the number of redundant trains of safety systems are one of key items which determine the possibility of performing OLM. In USA and Spain, licensees are permitted to do OLM after providing PSA results and the management capability for the risk increase due to the proposed activities.

It is noted that special consideration in establishing a regulatory framework for OLM primarily goes to the evaluation of licensee's readiness such as a risk management system and preparation of procedures & guidance for OLM, therefore, we have to prepare implementation principles and technical guidelines in order to assure licensee's program and implementation results.

ACKNOWLEDGMENT

This work has been carried out under the Nuclear R&D program supported by the Ministry of Education, Science and Technology (MEST), Republic of Korea.

REFERENCES

[1] Inspection of maintenance on safety systems during NPP operation, NEA/CNRA/R(2001)6, August 2001.

[2] 10 CFR 50.65, Requirements for monitoring the effectiveness of maintenance at nuclear power plants

[3] Presentation material, Implementation of On-line Maintenance and Regulatory Involvement, JNES, Dec. 2009.