

A Study on Guidelines for the Utilization of Unproven MMIS Technology In Nuclear Power Plant Application

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1. Introduction

New MMIS (Man Machine Interface System) technology is rapidly advanced as digital technology provides opportunity for more functionality and better cost effectiveness and NPP (Nuclear Power Plant) operators are inclined to use the new technology for the construction of new plant and for the upgrade of existing plants. However, this new technology poses risks to the NPP operators at the same time. These risks are mainly due to the poor reliability of newly developed technology.

KHNP's past experiences with the new MMIS equipment shows many cases of reliability problem. And their consequences include unintended plant trips, lowered acceptance of the new digital technology by the plant I&C maintenance crew, and increased licensing burden in answering for questions from the nuclear regulatory body.

Considering the fact that the risk of these failures in the nuclear plant operation is far greater than those in other industry, utilities require proven technology for the MMIS in nuclear plant plants. So that new MMIS technology might be testified as proven technology, guidelines for the utilization of unproven MMIS technology in nuclear power plant application is required for applying new advanced MMIS technology which is apparently needed to obtain a definite gain in simplicity or performance.

2. Background & Approach

Proven technology requirement of APR1400 provides only high level requirements rather than detailed plan and method which are required for using unproven technology. Also, it does not provide objective acceptance method and reasonable assurance for accepting unproven technology. Therefore, the guideline needs to be developed to meet following needs of utility and MMIS supplier that would apply new MMIS technology.

- Acceptance process to provide reasonable assurance that unproven technology meets requirement of proven technology
- Flexible and diverse acceptance process to sensibly adopt the most effective method in many cases

- Acceptance process consistent with the requirement of APR1400 KURD(Korean Utility Requirement Document)[1]

The reason to develop the guidelines presented in this paper as follows:

- Necessity for utility to apply new MMIS technology to promote performance of plant and economic efficiency with the advent of digital technology
- Necessity of application of R&D result for the purpose of localization

2.1 Approach for development of guideline

The process to prove unproven technology is as follows:

- Technical Evaluation: Activity to verify applicability of unproven technology in NPP, first, we need to evaluate whether or not unproven technology has been already proven. Second, if technology that we would like to apply proves to be unproven, we need to evaluate whether or not unproven technology is applied for safety and power production function (called Critical Function). And then there has to identify critical characteristics which have to be addressed in the evaluation process. At this time, In case that unproven technology is not accepted, alternative proven technology has to be prepared in this step.
- Implementation of acceptance process: Activity to implement acceptance process to objectively demonstrate and confirm that unproven technology is proven technology through three methods for acceptance.

First, unproven technology has to be first identified from technical evaluation and critical characteristics for proving unproven technology are identified from technical evaluation. Second, Acceptance method should be selected through the critical characteristics and the criteria for selecting acceptance method. Technology proven through these processes is considered as technology to be consistent with the concept of the requirement of proven technology in APR1400 KURD. Then this technology is applicable to the NPP.

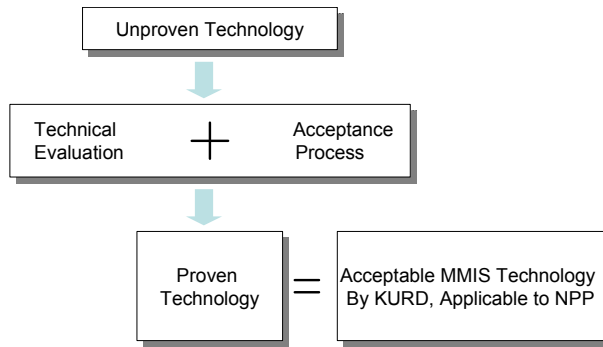


Figure1. Overall process for utilization of MMIS technology in NPP

2.2 Basic premises of the guideline

Basic premises to establish guideline are as follows.

- Guideline consistent with APR1400 KURD Criteria for Proven Technology (APR1400 KURD Chapter10, 3.2.1) are that it has at least three years of documented, satisfactory service as modules of subsystems in power plant applications similar to that in LWRs or in other than power plant applications which are similar to the use in the APR1400 M-MIS; or it has satisfactorily completed a defined program of prototype testing which has been designed to verify its performance in the APR1400 M-MIS application.

- Reference of guideline in use in nuclear industry Established practice of EPRI NP-5652[2] is applied for guideline of proven technology and contributes to the clearness of process. Following contents of EPRI NP-5652 can be applied:

- Technical Evaluation
- Identification of Critical Characteristics
- Acceptance Process
- Documentation
- Deficiency Reporting Responsibility

- Reflection of experience accumulation test According to the APR1400 KURD, experience accumulation test is required to meet the requirement and concept of criteria for proven technology.

- Application of acceptance process commensurate to the risk level

If uniform acceptance process will be implemented without considering the risk level on all of the technology, as a matter of fact, it leads to increase cost and unbalance the budget. Therefore, acceptance process of unproven technology should be implemented in the light of safety and power production operation from a utility's standpoint. Also risks (including Human hazard, Investment protection) to affect reliable power production operation are considered as high risk and should be removed without fail. Guidelines for the utilization of unproven technology will be applied to the

technology related to the function of safety and power production. Requirement corresponding to low risk such as maintainability and testability may be adequately managed through verification of the procurement requirement and the phase of acceptance test in procurement procedure.

- Exclusion of unnecessary verification and test Once regulatory requirement, requirement of the procurement specification and others were already implemented and verified through the other process for accepting technology, additional acceptance process need not to be fulfilled repeatedly.

- Reference of conventional process such as evaluation & approval by regulatory body The evaluation and approval process system for construction and operation such as submission of PSAR, additional request and answer and submit of SSAR is well established in the nuclear industry for a long time. Accordingly, we refer to the process of safety evaluation and approval which used to be by regulatory body for constructing evaluation process of unproven technology. If there is highly strict guideline, this part of guideline needs to be moderated through many discussions between utility and MMIS supplier.

- Uniformity and flexibility of guideline It is to be desired that the guideline for the utilization of unproven technology provides substantial acceptance process to become uniform practice in nuclear industry and also provides flexibility that can select the most effective method for accepting unproven technology. This approach is the same as the approach of EPRI NP-5652.

- Documentation of acceptance process The guideline for the utilization of unproven technology put an emphasis on the documentation, which should be generated in each phase of acceptance process.

3. Conclusion

Currently, we establish the guideline for the utilization of unproven MMIS technology in NPP. But there are many issues to be resolved from a standpoint of utility and supplier. Also, we try to make this guideline practically applicable guideline on the basis of previous and various supplier and utility's experience. This guideline would help all of utility and supplier to apply new MMIS technology.

REFERENCES

- [1] "Korean Utility Requirements Document: APR1400 Rev 0, 1998. 9, KHNP
- [2] "Guideline for the Utilization of Commercial Grade Items in Nuclear Safety Related Applications (EPRI NP-5652), June 1988