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Review of a Plant Engineering Model and Process Improvement

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1. Introduction

Nuclear power utilities are operating plants by their own operating processes. Most of leading operators have standardized management models for the enhancement of fleet-wide operation performance. Korea Hydro & Nuclear Power (KHNP) developed Standard Equipment Management Model (SEMM) for above purpose in 2013. [1] Additional purpose of the model is implementing KHNP's own engineering model at overseas nuclear plants. The SEMM is developed from Nuclear Energy Institute (NEI) Standard Nuclear Performance Model (SNPM). [2] SNPM adopted processes collected from Institute of Nuclear Power Operations (INPO)'s utility best practices. [3, 4, 5] KHNP revised the model by comparing current plant engineering processes with the model recently. As a result, some part of the model was modified and some of plant engineering processes are to be revised. The new model has the title of standard engineering model. This paper introduce the process of revising plant engineering model and its results.

2. Method and Results

In this section the method how the model revised and the results are reflected into the plant engineering processes are described. The method includes gap analysis, expert panel review, plant survey, and local interview.

2.1 Gap Analysis

The first step of model revision is to compare current plant engineering processes with the model. Since the SEMM developed, plant engineering processes have been revised continuously so that the gaps between model and processes have been gradually increased. The result of gap analysis will be utilized in revising the model or processes to close the gap.

The SEMM has triple structure of process (level 1), module (level 2), and sub process (level 3). Revised model has a similar but slightly different structure of basic process (level 0), detail process (level 1), activity (level 2), and procedure (level 3). The scope of revised model has been decreased by excluding Information Technology process which is considered not directly related to plant equipment management. As a result, the number of Basic process and Activity have been decreased.

Table I: Comparison of model structure (SEMM vs. SEM)

Level	SEMM	SEM(revised)
1st level	Process (8)	Basic process (7)
2nd level	Module (34)	Detail process (34)
3rd level	Sub-process (74)	Activity (64)

The results of gap analysis are classified into 4 categories which are model flow change, procedure change, activity merge, and activity addition. This result has reviewed by expert panel who are in charge of plant maintenance department. Initial gap analysis suggested 73 items as model change which means reflecting current plant procedures to the model, but expert panel recommended keep the model and change the procedures for 28 items among them (Table II).

Table II: Result of gap analysis and expert panel review

Category	Gap Analysis	Expert Panel Review
Model flow change	73 Items	45 Items(-28)
Procedure change	24 Items	17 Items(-7)
Activity merge/add	-3/+2	-3/+2

In case of Equipment Reliability (ER) process, the gaps are deeper, especially at the Performance Monitoring and Continuous ER Improvement modules. It is because that ER related procedures have been halted or revised since the SEMM development. They are affected by organizational change of system engineering department which was suspended in 2013 until the rebuild of plant engineering department in 2015.

The activity merges are merging development and operation activity; Maintenance Rule (MR) program development activity is merged to MR monitoring, System monitoring plan activity to System monitoring activity, PM Template application activity to PM program activity.

2.2 Plant Survey and Local Interview

Plant survey and local engineer interviews are checking effectiveness of engineering processes. Subject matters experts at each plant evaluated contribution level and implementation level of engineering processes as very high, high, medium, low, and very low. Local interviews are performed at the selected plants and the results are compared to survey result. Process improvement tools, such as Self-assessment, Effectiveness review, Peer group, Performance indicator for each activity, are also evaluated.

The evaluation result for the most activities are high or very high, but some are evaluated as medium, low, or very low. In case of low, very low, and medium evaluation, plant engineers are requested to provide the reason of the evaluation. Many of the reasons are low effectiveness, low applicability, or the activity can be replaced by other more effective activity. Low effective processes are investigated to find a way to improve by revising procedure or applying process improvement tools.

Table III: Result of process effectiveness survey

Effectiveness	Contribution level	Implementation level
Very High	34(51%)	26(39%)
High	26(39%)	22(33%)
Medium	5(7%)	12(18%)
Low	2(3%)	7(10%)
Very Low	-	-

According to the effectiveness evaluation of process improvement tools, the Peer group is the most effective tool, but other tools are not often applied at plants. Just few activities have its own performance criteria so that process effectiveness is not well evaluated in a quantitative way. It is indicated that the peer group and performance criteria should be applied on all of applicable processes to improve process effectiveness.

2.3 Model Improvement

KHNP subject matters experts (SMEs) reviewed the gap analysis results and expert panel reviews to decide whether the gaps are disposed to procedure change or model change. As mentioned at the gap analysis result, the expert panel suggested to follow the model in many cases. The SME decisions are tend to consent to expert panel's opinion. In some cases SME suggested other options which are changing procedure and model at same time.

The final results are incorporated at new engineering model, SEM. It has slightly different structure and contents which is described in its process description document. It specifically describes each step of activity with organizational responsibility and detail step description. Each step is divided by organizational responsibility. If an organization requests to perform next step to other organization, it will be described as a separate step at the process description. The boundary of each step is expressed with separate boxes and arrows at flow diagram of each activity.

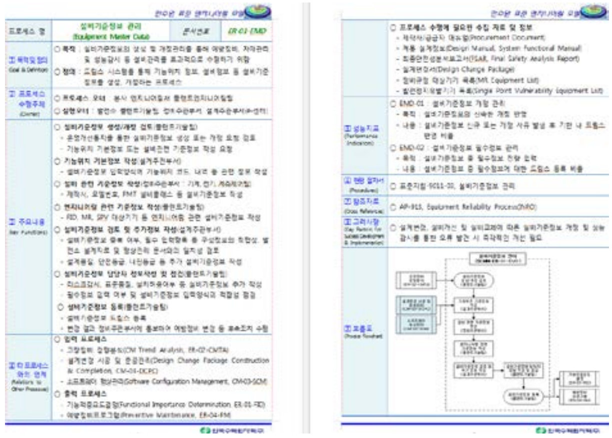

Fig 1. A sample of SEM process description document

3. Conclusions

KHNP recently reviewed and revised a plant engineering model called as SEMM. The revised model is more practical than previous model because it reflected actual plant engineering processes as a result of gap analysis. The new model is for explaining KHNP's own engineering process to internal employees, overseas nuclear operating organization and tentative candidates. Through the gap analysis, it resulted model improvement and also found the area for improvement in the current plant engineering procedures. This continuous process improvement effort will make KHNP engineering process more practical and effective.

REFERENCES

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