Development of a Standard Equipment Management Model for Nuclear Power Plants

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1. Introduction

Most utilities that have achieved high performance have introduced a management model to improve performance and operate plants safely. The Nuclear Energy Institute has developed and updated its Standard Nuclear Performance Model (SNPM) in order to provide a summary of nuclear processes, cost definitions, and key business performance measures for business performance comparison and benchmarking [1].

Over the past decade, Korea Hydro & Nuclear Power Co. (KHNP) has introduced and implemented many engineering processes such as Equipment Reliability (ER), Maintenance Rule (MR), Single Point Vulnerability (SPV), Corrective Action Program (CAP), and Self Assessment (SA) to improve plant performance and to sustain high performance [2]. Some processes, however, are not well interfaced with other processes, because they were developed separately and were focused on the process itself [3].

KHNP is developing a Standard Equipment Management Model (SEMM) to integrate these engineering processes and to improve the interrelation among the processes. In this paper, a draft model and attributes of the SEMM are discussed.

2. Development of the SEMM

2.1 Background and Development Strategy

Some engineering processes and programs have been developed and introduced since 2005; however, understanding and implementing these processes has proved difficult. These processes were introduced over a short period and developed separately, and consequently were not integrated. An integration model is required to show the inter-relations of these new processes with other processes, and how the processes work.

KHNP is developing a SEMM to integrate processes and improve effectiveness. The model is focused on equipment first; it will later be expanded to operation elements and to the implementation of a management model.

The SEMM is under development in the form of graphical images and several layers to show all possible relations to allow for easier understanding by managers and employees. The SEMM is also developed with reference to the world's best performance models and including a process model, process descriptions, and performance indicators.

2.2 Several Layers of the SEMM

The SEMM under development has three levels, as can be seen in the top level diagram, 2nd level diagrams, and process descriptions shown in Fig. 1.

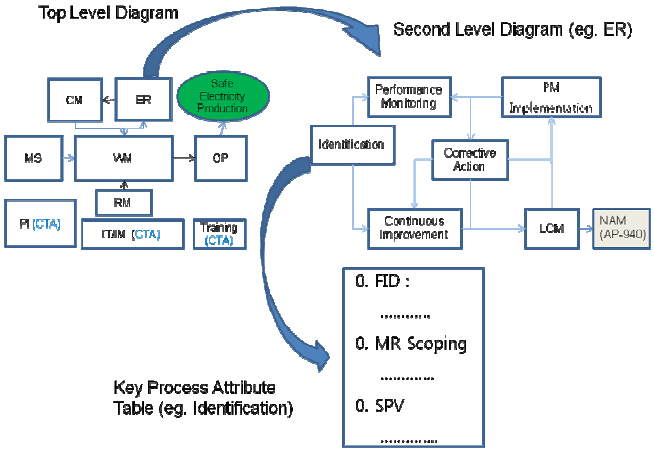

Fig. 1. Hierarchy diagram of SEMM

The top level diagram is a conceptual diagram that shows the higher level processes to be included in the model. The top level diagram has been developed for easier understanding by executives and managers. The draft top level diagram is shown in Fig. 2.

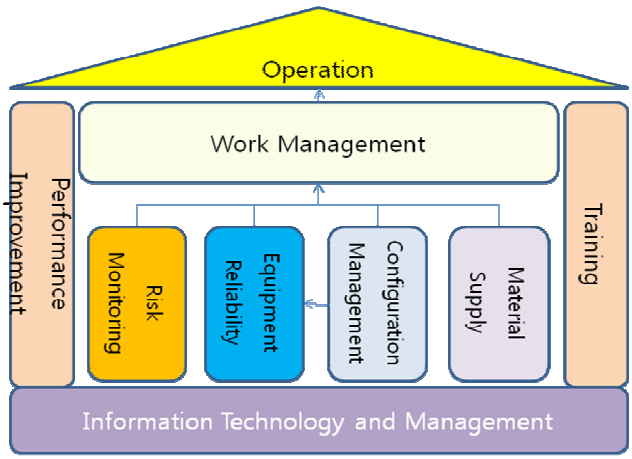

Fig. 2. Graphic image of SEMM as an executive view of top level.

The main target of an operating plant is to generate electricity safely and economically. Safe operation is

more important than ever after the Fukushima accident. For this purpose, a risk monitoring (RM) program has been added to the model in order to assess and monitor the risk while on-line and during outages.

The Work Management (WM) process is the main process supported from the ER, CM, MS, and RM processes, which in turn support operations that produce electricity. The Performance Improvement (PI), Information Technologies (IT), Information Management (IM), and training processes are used to support and provide feedback for all processes.

Each process has several sub-processes. The 2nd level diagram shows the sub-processes within a process and the processes or programs that are developed and used for each sub-process. The following is an example of the ER process. Each process and program for each sub-process of the ER is shown in Fig. 3.

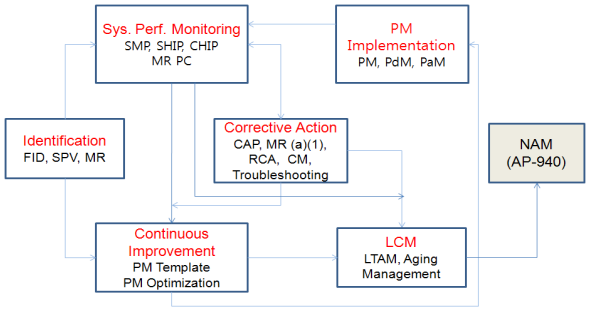

Fig. 3. An example of process relation for Equipment Reliability

2.3 Process Description of each SEMM Process

A process description is developed for each sub-process in order to describe the sub-process in detail with the following information;

1) Process name and definitions
2) Process owner
3) Key functions or concepts
4) Relations to other processes including input from and output to
5) Performance indicators for comparisons
6) Current status
7) Cross references

This document also includes a process diagram with information on process steps and interfaces with other processes. Fig. 4 is an example of a process diagram of System Performance Monitoring in the ER process.

The process diagram shows a simplified flow chart of the process including connected input and output processes. Colored box of input or output processes means to connect to other modules such as WM, CM or PI while white box processes are within the same module of the process. The process diagrams were developed separately for each process and later all the processes were connected to each other with inputs and outputs. Some loopholes and processes deviations were found while connected the processes and the process diagrams were reviewed and revised.

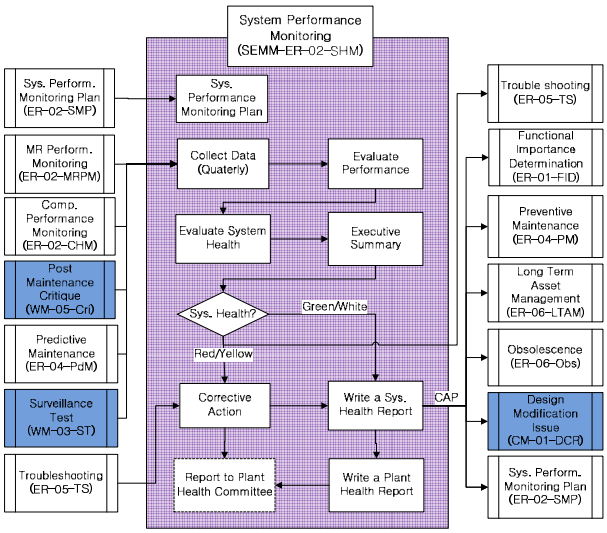

Fig. 4. An example of a process diagram in process description.

3. Conclusions

A SEMM is in development to integrate its processes, with a focus on equipment to improve the effectiveness of the current processes and to develop those processes systematically for new nuclear units. Graphical images and the several layers comprising the model can be used for easier understanding of the processes for all levels of employees including executives and managers.

Loopholes and weak points of the processes can be found during connection with inputs and outputs of the processes for integration.

This model is focused on equipment rather than on management; however, the model will be useful in supporting sustainable achievement of high performance. This model can be expanded to a management model by incorporating operation, leadership, costs, and other areas later.

REFERENCES

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[3] H.S. Chang, "Development of an Equipment Model to Improve Effectiveness of Processes", International Congress on Advances in Power Plants (ICAPP) 2012, 2012