Introduction of Function Modeling Technique to Nuclear Safety Regulation

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1. Introduction

Ensuring that nuclear installations are operated and maintained safely has been and will continue to be the cornerstone of nuclear regulation. The regulatory activities can be said "Effective" when the regulatory body performs its functions in a timely and cost-effective manner. Because the regulatory activities to ensure the nuclear safety have sometimes the complexity, it needs to identify the activities and to take appropriate actions to promote the safety improvement.

This paper aims to introduce the IDEF0 (Integration DEFinition language Zero) modeling technique to describe the tasks and the process in the nuclear safety regulation and to understand the true extent and complexity of the regulatory activities by the identification of inputs, outputs, mechanisms and constraints at each sub-stage. This approach will be useful for the regulatory activities to improve its efficiency and effectiveness.

2. What and Why is IDEF?

Many research projects or the engineering tasks are evolving the following questions; which functions (activities, actions, processes, and operations) are performed?, what controls the functions?, how are the functions interrelated?, etc. There is a system analysis technique that can give the precise answers to these and other questions. It is the IDEF (Integration DEFinition language) which is the common name referring to classes of enterprise modeling languages. IDEF has the family of methods: IDEF0 through IDEF5. This paper describes only the IDEF0 modeling the decisions, actions, and activities of an organization or system, in order to communicate the functional perspective of a system. IDEF0 can be used first to define the "As-Is" status of the given project by analyzing the functions the system performs and by recording the mechanisms. Also IDEF0 can be used to specify the requirements and the functions, and then to design the "To-Be" status that meets the requirements and performs the functions [1].

An IDEF0 model is shown as a hierarchical series of diagrams which display gradually level-down of the detail describing functions and their interfaces in the system. The diagrams consist of boxes and arrows, where the boxes represent functions, defined as activities, processes or transformations and the arrows represent data or objects related to the functions. In Fig.1, inputs means the items that trigger the activity, controls means the guide or regulate the activity, mechanisms means the systems, people, equipment used to perform the activity and outputs means results of performing the activity. The top-level diagram in the model provides the most general or abstract description of the subject represented by the model. This diagram is followed by a series of child diagrams providing more detail about the subject [2].

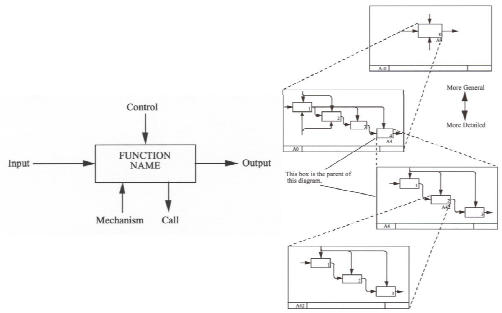

Fig. 1: Basic Element (left) and Hierarchical Series (right) of IDEF0

IDEF0 is a powerful tool to model the functions (activities, actions, processes, operations) of a wide variety of systems or subject areas to any level of detail. It can enhance communication between all persons involved in a project or subject area, allowing team consensus by shared understanding. And the hierarchical nature of IDEF0 allows the system to be easily refined into greater detail until the model is as descriptive as necessary for the decision making task.

3. Modeling Procedures and Sample Result

The first phase of the IDEF0 modeling is the creation of a process model describing the regulatory activities. In order to understand the complexity of the regulation process and tasks, "As-Is" process is defined, which means the list of the activities that forms the regulatory activities. To satisfy this need, all documents and system manuals are reviewed. They are made for Information Strategy Planning (ISP) System used in KINS, which is a kind of the portal system integrating the business process management, safety review, inspection, knowledge based research management system, electronic document management system, and knowledge management system.

When the procedure modeling needs to be understood by work units at any one time, the lists of regulatory activities defined in ISP system as shown in Fig.2 (upper) may be more useful to model the work

procedures by the IDEF0. However, this approach has too many work units and is not suitable for analyzing the whole regulatory procedure of long-term nuclear project [3]. In addition to works listed in ISP system, the life cycle of nuclear project including prior approval for construction site, construction permit, operational license(OL), QA inspection and so on as shown in Fig.2 (lower) is considered as the second phase of the IDEF0 modeling.

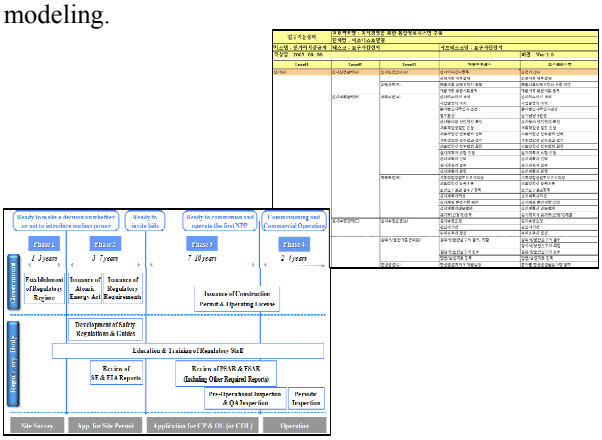

Fig. 2: Work Units (upper) and
Life Cycle of Regulatory Procedure (lower)

Finally, IDEF0 modeling by work units according to the life cycle of nuclear facility and radiation safety regulation is identified and the operational license (OL) step as the sample case is leveled down up to six steps as shown in Fig.3. This diagram is useful to describe; how the work procedures flow, what kinds of input and output materials are interfaced, how many sub-procedures are needed, which constraints or control variables effect on the function and how much the system can be refined into greater detail.

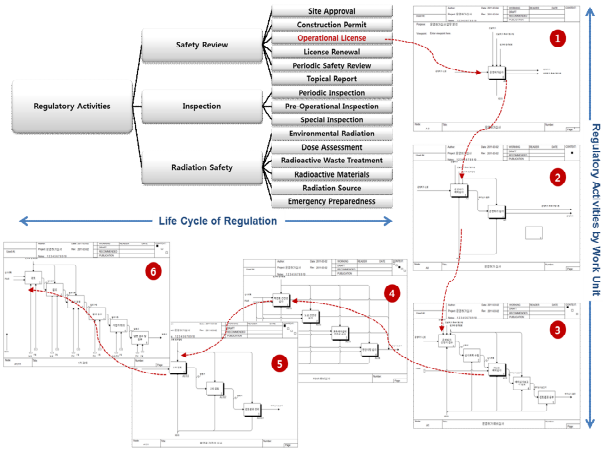

Fig. 3: Sample Result of IDEF0 Modeling for OL

Because all regulatory activities are not proceed as a single project and the regulatory activities are frequently overlapped with the projects more than one, it is necessary to estimate that how much manpower is expected to be deficient and which step the work flow is blocked at. However, IDEF0 modeling is not capable of simulation on how to allocate the resources effectively under the limited resources such as time and manpower. The simple analysis tool to show the manpower loading curve of a nuclear project as whole is developed in this study. This tool counts the time periods and manpower needed by each regulatory activity and by each expertise as shown in Fig. 4. This chart can give some information on which step the work load is concentrated on and which expertise or manpower needs to be reinforced. This tool will be improved in the near future to have the logic for resources optimization comparing to the increased regulatory work load to improve the regulatory effectiveness and efficiency.

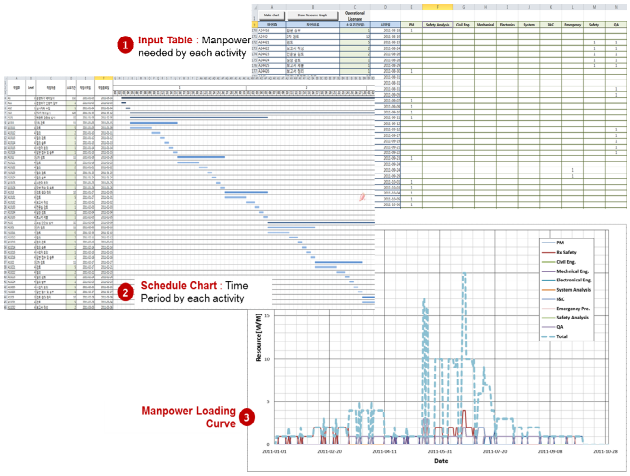

Fig. 4: Manpower Loading Curve

4. Conclusions

All regulatory activities by work units according to the life cycle of nuclear facility and radiation safety regulation are defined using the function modeling technique called as IDEF0. IDEF0 modeling has the advantages such as providing a concise description of systems and allowing the system for being refined into greater detail as descriptive as necessary.

However, because IDEF0 modeling doesn't consider originally the unbalance of manpower as the constraint, the simulation tool is being developed to make complements. If the IDEF0 modeling for safety regulation and resources optimization tool are integrated, this model can highly contribute to the analysis on the regulatory effectiveness and efficiency.

Acknowledgement

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REFERENCES

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[2] H.Siemann, Introduction to IDEF0, 2009
[3] KINS, Manual for Information Strategy Planning (ISP) System, 2007