A STUDY FOR EVMS APPLICATION TO NPP CONSTRUCTION PROJECT

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ABSTRACT

The earned value project management method integrates three critical elements of project management scope management, cost management and time management. It requires the periodic monitoring of actual expenditures and physical scope accomplish-ments, and allows calculation of cost and schedule variances along with performance indices. It allows forcasting of project cost and schedule at completion and highlights the possible need for corrective action. It is also anticipated that there will be intense competition in the nuclear industry as the cost and time for nuclear power plant construction. In order to attain competitive advantages under the globalized market, utilizing advanced project control systems by integrating cost and time management is of great concern for practitioners as well as the researchers. In this context, the purpose of this paper is to identify major previously improving activities that characterize the real-world Earned Value Management System (EVMS) implementation for nuclear power plant construction. And several distinct attributes of nuclear power plant construction were also investigated.

I. INTRODUCTION

An applications of earned value management techniques are scalable to individual projects as determined by their size and complexity. Small projects can use a simplified approach, while more costly, complex and time consuming projects may require more effort.

Effectively managing quality, cost, and time is the utmost objective for any type of construction projects, and the most advanced and systematic method of controlling these three performance measures in an integrated way is known as the 'Earned Value Management System' (EVMS). However, additional management effort required to collect and maintain detailed data has been highlighted as a major barrier to utilizing this concept over a quarter of a century. In order to maximize the benefits that this integration has to offer, tools and techniques to reduce the workload for integrated cost and schedule control should be investigated in a comprehensive manner. Nevertheless, there has been no enough research addressing these issues for nuclear construction. The purpose of this paper is to explore influencing attributes that would facilitate effective EVMS implementation for nuclear power plant construction.

II. EARNED VALUE MANAGEMENT BASICS

Earned value is a technique that project management practitioners have developed to measure project performance and progress based on a combination of schedule, costs, and work performed with a focus on early warning of trends in either of these areas. Following are the key earned value management elements :

Planned Value (PV) – The authorized budget assigned to the scheduled work to be accomplished for a schedule activity or work breakdown structure component.

Earned Value (EV) – The value of work performed expressed in terms of the budget assigned to that work for a schedule activity or work breakdown structure component.

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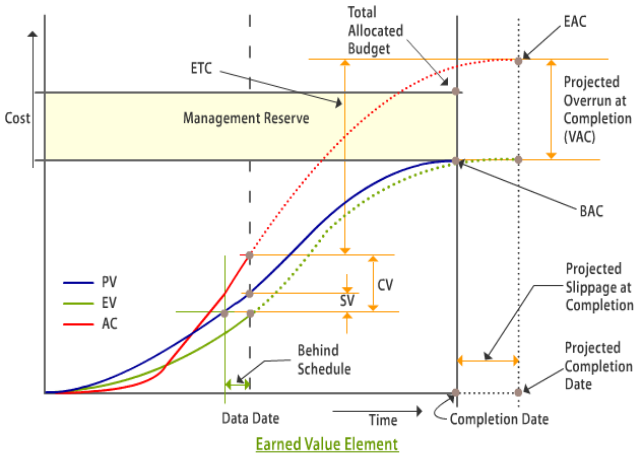

Figure 1. Earned Value Element

Cost Variance (CV) – A measure of cost performance on a project. It is the algebraic difference between earned value (EV) and actual costs (AC). CV = EV – AC. A positive value indicates a favorable condition and a negative value indicates an unfavorable condition.

Cost Performance Index (CPI) – A measure of cost efficiency on a project. It is the ratio of earned value (EV) to actual costs (AC). CPI = EV / AC. A value equal to or greater than one indicates a favorable condition and a value less than one indicates an unfavorable condition.

Schedule Variance (SV) – A measure of schedule performance on a project. It is the algebraic difference between the earned value (EV) and the planned value (PV).

SV = EV – PV.

Schedule Performance Index (SPI) – A measure of schedule efficiency on a project. It is the ratio of earned value (EV) to planned value (PV). SPI = EV / PV.

Estimate to Complete (ETC) – The expected cost needed to complete all the remaining work for a schedule activity, work breakdown structure component, or the project.

Estimate at Completion (EAC) – The expected total cost of a schedule activity, a work breakdown structure component, or the project when the defined scope of work will be completed. EAC is equal to the actual cost (AC) plus the estimate to complete (ETC) for all of the remaining work. EAC = AC + ETC.

III. EVMS APPLICABILITY TO NPP CONSTRUCTION

The construction of a nuclear power plant a large-scale technology oriented national project requires tremendous financial investment over a period of more than ten years, with the engagement of numerous stake-holders and large amounts of human and material resource. Accordingly, the adoption of the Earned Value Management System (EVMS), an advanced project management method can enable efficient management of project risks.

Nuclear power plant construction has many distinct characteristics as compared to general industrial plant construction. For the purpose of EVMS developing, these aspects, size of projects, project delivery systems, progress measurement/payment, and project management policies are briefly explored by comparing a different case. Table 1 provides an overview how nuclear construction is different from others and main characteristics are discussed as follows;

Table 1. Characteristics of Nuclear Construction EVMS

Description	Project A	Project B
Industry	Defense	Nuclear
Project type	R&D+ Production	E/P/C/M*
Project duration	About 75 months	About 55 months
Project budget	1.3 billion dollars	20 billion dollars
Delivery system	Multi-prime	D/B/M
Contract type	Cost reimbursable	Lump-sum
Progress Measurement	Milestone w/ percent complete	Earned Standard
Number of CA in EVMS	100~200	2000~3000

* E/P/C/M: Engineering/Procurement/Construction/Maintain
*DBM : Design/Build/Maintain , CA : Control Account

• Project Delivery Systems (PDS)

Engineering, procurement, and construction (E/P/C) as a single contract is typical project delivery system in the nuclear industry.

• Contract Types

As an EPC firm, the concept of fixed price budget is required for the purpose of risk management and cost engineering under any contract types, including unit price, reimbursable, and guaranteed maximum price.

• Project Management Policies

Due to the mega-size of the project and the technical complexity, nuclear plant construction is performed by multiple specialty entities.

• Project Management Policies

Due to the mega-size of the project and the technical complexity, nuclear plant construction is performed by multiple specialty entities. Therefore, the vertical integration inside an E/P/C organization, which can be observed in industrial plant construction, cannot be achieved. For this reason, indirect and contractual integration among many parties and disciplines is a crucial issue for project management organization (PMO). EVMS needs to support the PMO to enhance technical and managerial leadership and to improve organizational learning.

• Differences of WBS

EVMS integrates and manages the schedule and costs required for objective performance management including the risk management and future cost estimation. However current WBS's in actual NPP control activities and levels are different each from the schedule, cost, and earned progress management.

Schedule WBS ≠ **Earned Rate WBS** ≠ **Cost WBS**

IV. EVMS MODELS FOR NPP CONSTRUCTION

Based on the objectives, an EVMS model for nuclear construction project was proposed. And simple standard WBS were designed for nuclear EVMS.

• Develop the Integrated WBS for schedule and cost

As shown in figure 2, basic structure of WBS is in the sequence of discipline for design, procurement, construction and commissioning as follows.

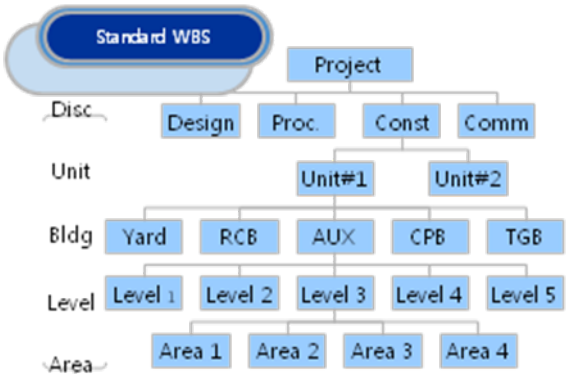

Figure 2. Standard WBS

• Implementation Model

Control Accounts(CA) established based upon Figure 2 standard WBS for the schedule, cost and earned value rates respectively. The number of CAs should be enough to manage at a glance and also detailed enough to encompass different types of work packages. The sample

EVMS model and implementation method is shown in Figure 3.

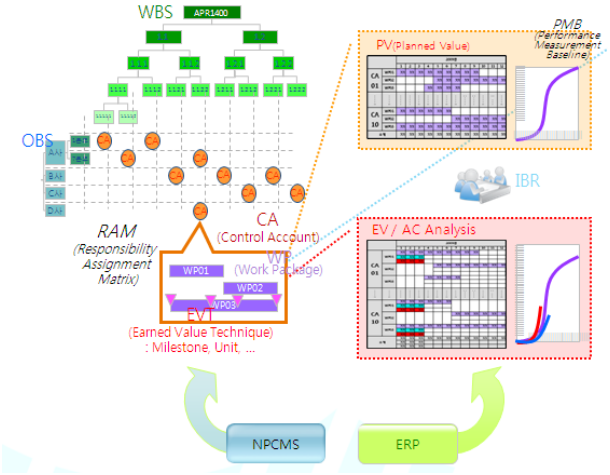

Figure 3. EVMS Model

V. EVMS BASED NPP PROJECT MANAGEMENT

An overall NPP construction Process management based on enterprise resource planning(ERP) system is proposed in the point of view of actual cost (AC) estimation and earned value (EV) estimation together. Actual cost means that in case of fixed work package, actual cost is same to the earned value in the viewpoint of contractors and self spending costs. On the other hand, earned value considers the automatic data acquiring of activity progress rate in the current nuclear power plant construction management system (NPCMS). Figure 4 shows the total company level integrated concept diagram which is related to the earned value management system (EVMS) in NPP construction program.

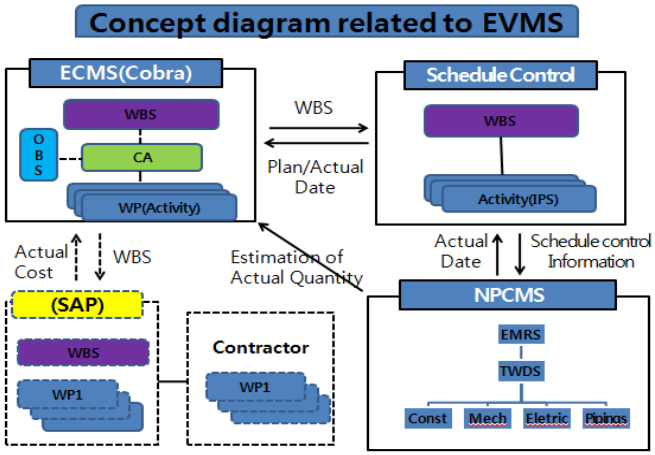

Figure 4. Concept of Data Flow for EVMS

CONCLUSIONS

It is observed that the implementation of EVMS in nuclear power plant construction makes more viable and effective. As a demand pull, strategic needs for enhancing cost and schedule control capabilities under globalized competition require the E/P/C firms to furnish EVMS techniques. It also could be recognized that EVMS implementation will be successful if it is properly optimized in terms of reengineering of WBS, workloads, and well allocated CAs. EVMS well combined with ERP system could be a most beneficial and economical management tool of NPP construction project

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