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EVMS for Nuclear Power Plant Construction : Status and Implementation

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ABSTRACT

The Earned Value Management System (EVMS) method integrates three critical elements of project management scope, cost and time management. It requires the periodic monitoring of actual expenditures and physical scope accomplishments 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 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, utilizing advanced project control systems by integrating cost and time management is of great concern for practitioners. This paper is to review the status of EVMS and its effective implementation to nuclear power plant construction.

INTRODUCTION

An applications of earned value management techniques are scalable to individual projects as determined by their size and complexity. 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 develop and maintain well combined WBS has been highlighted as a major barrier to utilizing this concept over a quarter of a century. 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.

EARNED VALU 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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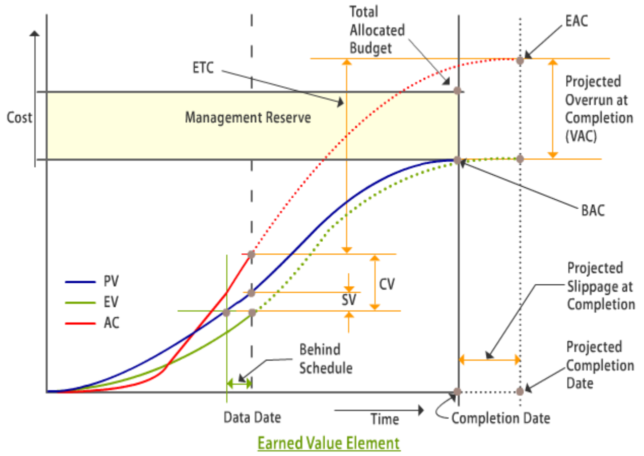

Figure 1. Earned Value Element

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.

CHARACTERISTICS OF NPP EVMS

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;

• **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.

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

• **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**

EVMS MODELS AND IMPLEMENTATION FOR NUCLEAR CONSTRUCTION

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

• **Development of 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.

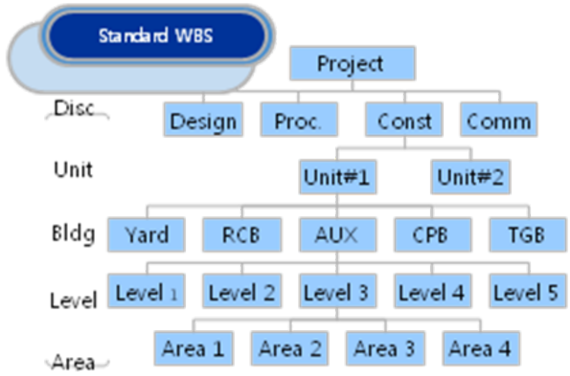

Figure 2. Standard WBS

• **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.

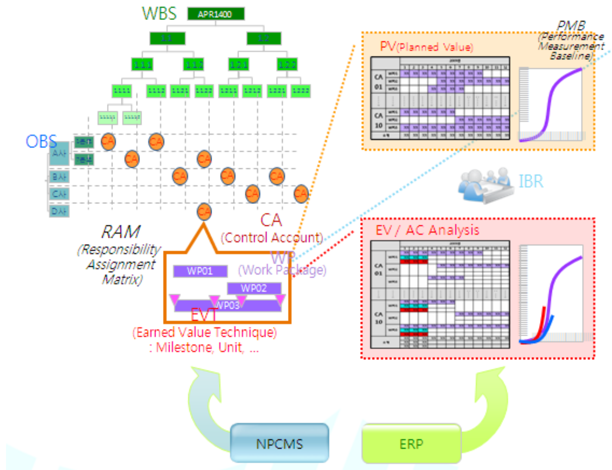

Figure 3. EVMS Model

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.

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