WBS setup & Critical Path Analysis on Proton Accelerator Research Institute Construction

Jin Sam Cho, Jun Yeon Kim, Kyeong Jun Mun, Seok Ki Lee, Yi Sub Min, Gye Po Jeon, Jung Min Nam
Korea Atomic Energy Research Institute
jscho@kaeri.re.kr

1. Introduction

PEFP(Proton Engineering Frontier Project) is supported by MEST(Ministry of Education, Science and Technology), putting its aim on technology innovation through developing a 100MeV, 20mA linear proton accelerator and technological fusion among subprojects. Its project host site was selected as Gyeongju city in January, 2006. So, the Proton Accelerator Research Institute is going to be constructed in the city from April, 2009 to March, 2012.

In this paper, WBS(Work Breakdown Structure) and Critical Path Analysis are studied for the construction management, considering many kinds of environment around the project.

2. Analysis Framework

The analysis framework is set up as below considering the characteristic of the construction. The framework consists of 7 steps. Steps 1 to 6 are studied in this paper. Step 7, meanwhile, will be performed during the construction period.

- Step 1: Understanding of project scope and characteristic
- Step 2: Project numbering system setup
- Step 3: Work breakdown structure setup
- Step 4: Activity relation analysis
- Step 5: Critical path analysis
- Step 6: Construction management system setup
- Step 7: Construction management

3. Project scope and characteristic

3.1. Diversity of buildings construction

Accelerator and Beam Utilization Facilities, Beam Experimental Hall & Accelerator related Building, Civil Construction, Ion Beam Utilization Building, Supportive Facilities, Utility Facilities, General Building, Yard construction.

3.2. Diversity of organization in charge

2 organizations are involved this construction: PEFP and Gyeongju local government. To manage collectively and effectively, a total management system should be set up.

3.3. Diversity of surroundings

The construction site is located in Gyeongju city which is famous for historical treasures. The construction period will be more than 3 years. So, cost escalation is expected to be unavoidable. Other political surroundings will possibly change.

4. Project numbering system setup

Generally, PNS is the starting point of the project management process, and important not only in project time management but also management on deliverables such as documents, drawings, and other items.

Fig 1. PEFP's PNS Structure.

4.1. PNS Structure

- 6 digit PNS fit for overall planning
- 2 digit activity codes, 3 digit activity serial numbers, and 1 digit origination code

4.2. Activity Code

- CA: Construction of Accelerator and Beam Utilization Facilities
- CB: Construction of Beam Experimental Hall & Accelerator related Building
- CC: Civil Construction
- C I: Construction of Ion Beam Utilization Building
- CS: Construction of Supportive Facilities
- CU: Construction of Utility Facilities
- CG: Construction of General Building
- CY: Construction of Yard

4.3. Activity Serial Number

Activity Serial Number is necessary to distinguish among similar work after the work breakdown process. According to the depth of breakdown process on each work, 3 digits are enough to identify them, similar with that of SNS(Spallation Neutron Source). SNS has also 3 digits in WBS in its preliminary scheduling [1]
3 digits are sub-construction, work type, and activity serial number successively.

4.4. Origination code

An origination code is either PEFP or Gyeongju local government according to who will be in charge of the activity: P(PEFP) & G(Gyeongju local government)

5. WBS(Work Breakdown Structure)

5.1. Types of breakdown methodology

There are two types of approach in WBS set up: Top-down and bottom-up approach. The latter is adopted in this study.

5.2. Activity set-up process

In the process of work breakdown, generally, the lowest level activity has no more than 2 weeks duration, because longer than that a rapid response with suitable countermeasure is usually impossible.

In this study, however, many of activities' durations are far more than 2 weeks. This is because, as a kind of preliminary planning, the study is focused on overall planning and rescheduling to cope with unexpected situations before construction starts.

5.3. WBS set-up process

General construction information on individual buildings was gathered from design companies: KOPEC and Heerim. According to the gathered information, WBS is set up which consist of 270 activities.

6. Activity Relation & Critical path analysis

6.1. Split order point in construction

It is expected that each building construction could be performed individually for some reason: Archeological excavation, construction budget and construction license approval delay, etc. To take this contingency into account, the activity relation is set up as below.

At first, resource leveling on building construction activities is limited within an individual building.

In other construction types such as electric facility construction, resource leveling is not considered. So, their activities are just arranged independently even though they are concentrated in the same period.

6.2. Key relation

Proton accelerator research institute construction consists of not only pure construction activities but also proton accelerator development & installation activities. These different types of activities should be connected in time throught construction. For this reason, some construction activities are critical for accelerator test and should be done no later than the beginning of the accelerator test. This is the key of the activity relation.

6.3. Connection and integration

At first, all activities which can directly influence the accelerator test are connected to the beginning of the test. Other activities are not directly related to the accelerator test. So, they are just connected to April, 1, 2012, the end of total construction. All defined activities are put into project management software, *Microsoft Project 2002 Professional*. The network diagram is as shown in Fig 2.

In Fig 2, Accelerator Development, Installation, and Test activities are connected with some construction activities which are critical to test the accelerator: Some of activities in Construction of Accelerator and Beam, Utilization Facilities, Construction of Supportive Facilities, Construction of Utility Facilities, and Construction of Yard. The connection almost coincides with a critical path in red shown in Fig 2.

Similarly in SNS project, this kind of connection and integration were important between accelerator system and other supportive construction such as conventional facilities. [3]

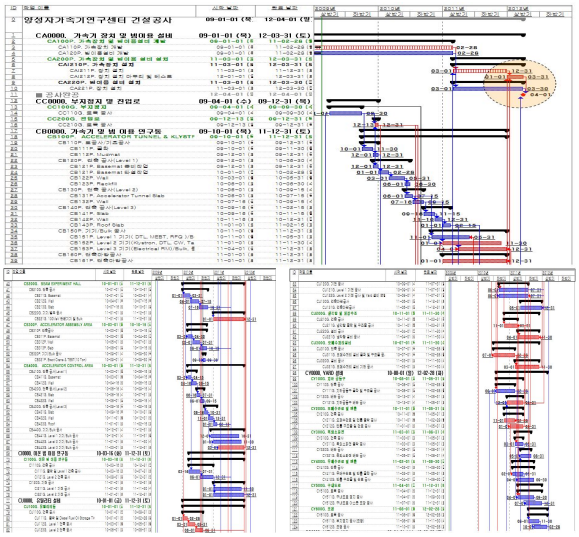

Fig 2. Activity relation & Critical Path.

7. Conclusion & Limitation

In this study, the critical path is analyzed. So, it becomes clear which activities are critical to finish the total project in time. Also, the management framework by this study was utilized to make 'Procedure Manual of Proton Accelerator Research Institute Construction' which will be published in March 2009. Nonetheless, detailed analysis by deeper level work breakdown and resource leveling still remain for the future.

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