

Review of Time Management for the Research Reactor Project

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1. Introduction

KAERI has implemented a process of time management for construction of research reactors since 1980s, when HANARO was constructed with domestic technology. The first turn-key package export of nuclear facility, the construction of Jordan Research and Training Reactor (JRTR: JRTR will be used as a short name for the project), a contract won by a consortium of KAERI and a construction company, DAEWOO is a good example of the time management in process.

In general, a process to plan time management consists of a series of steps: identification of constraints in the project, selection of execution scheme, and decision of terms of activities. During the process, conditions and environments are analyzed and a schedule is designed by considering activities, sequence of the activities, available resources, and period of the activities.

In JRTR, a master schedule was submitted in December 2012 whereas the project was contracted in October 2010. The schedule includes fixing the Engineering Deliverable List (EDL), the list of equipment, the actual issue date, the results of Primavera, a piece of software to manage progress, the progress rate and the issuance of the schedule based on the Project level III. Afterwards JAEC approved to the extension of the schedule from 56 months to 70.5 months mainly due to late preparation of the Jordanian nuclear legislative system. The project schedule was updated up to the fifth revision to compensate the delay by recovering measures such as for design, purchase, construction, and finally the owner of the project, Jordanian Atomic Energy Commission (JAEC) approved in August 2014. Construction work, the prerequisite for commissioning stage A had been finished in February 2016, and commissioning stage A has been being performed. The remaining works are commissioning stage B (fuel loading tests, initial criticality tests and low power tests) and commissioning stage C (power ascension test and power tests). And

then issuance of the operating license and the taking-over of the facility will be followed soon.

In this paper, the processes for the time management, which have actually been implemented for JRTR, are presented.

2. Preparation of Schedule

2.1 Definition of Activities

A project charter is first prepared, and then a project management plan (PMP) with a corresponding organization is followed by establishing a schedule. For planning a schedule, activities are identified with help of Work Breakdown Structure (WBS), a tentative reference to a scope of works. By elaborating and partitioning work packages, a schedule is then established [1].

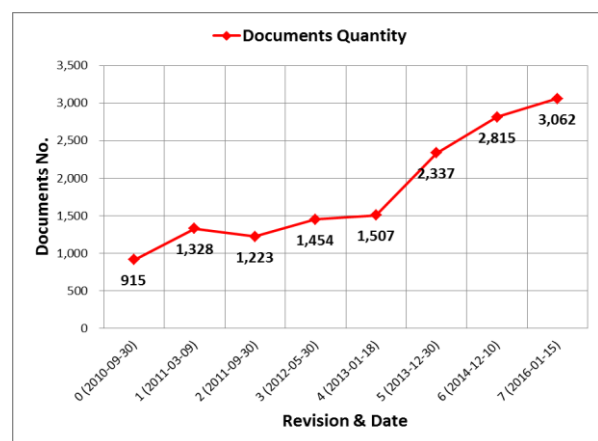


Fig. 1. Change in the number of D&D in the EDL

The technical proposal included safety assurance, system analysis, building structure, reactor, utilization facilities for isotope and neutron, transfer of technology, site evaluation [2]. The number of the drawings and documents (D&D) included in the contractual Engineering deliverable list (EDL) started from about

900, estimated at the time of April 2010 and ended up to about 3,300 in early 2016 as shown in Fig. 1 [3]. This huge increase in the number of documents is supposed to result from both inherent characteristics of construction of research reactors in that each research reactor has each own specialty and shortage of experience for construction of research reactors.

2.2 Assignment of Sequence, Estimation of Resource and Duration for the activities

Activity lists based on a draft of Project Work Breakdown Structure (PWBS) were used and network diagrams were drawn considering production, construction methods, interfaces, reduction in process. Project requirements were analyzed, work packages were divided before contract and PWBS and Project Procedure Manual (PPM) were made after contract [4].

The project, JRTR, won by the consortium has been in control mainly by DAEWOO E&C. Time management of JRTR has been conducted since the start of the project using a piece of software, Primavera Project Planner (Primavera).

From analyzing Level III Schedule that covers designs, purchases and manufacturing, construction and commissioning from P0 to P5 level, period of commissioning was decreased in order to meet the total period of the project with the period for designs, purchases and manufacturing, and construction fixed as shown in Figure 2 [5]. Time management from the stage of installing equipment after finishing construction work has been conducted by KAERI.

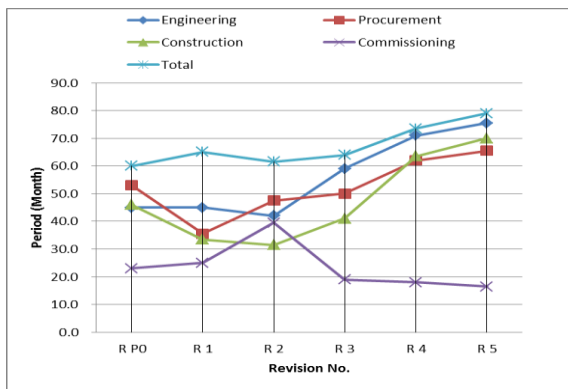


Fig. 2. Level III Schedule analysis

Activities are analyzed and required man power, budget, asset types, scales, and risks are calculated. Because a lot of man power, budget, and time are necessary to determine required resource for activities at the start of a project, experiences from reference projects are adopted to estimate the initial guess. The know-how experienced from HANARO as a reference project was fully incorporated into the project, JRTR throughout the whole process involved to develop any objects.

3. Development of Schedule

3.1 Establishment of Time

Critical Path Method (CPM) was applied to design schedule at the basis of working order and period of work, so early schedule plan was established without considering any interfaces between activities. At initial stage for planning time, a draft schedule plan as a baseline of final schedule is established considering whole activities only. A firmly established plan is determined after all constraints such as available resources, required schedule, limit on budget, procurement processes are reflected in a comprehensive way.

Series of process to establish schedule may be summarized as follows.

A. to determine a start date and a finish date considering activities, terms, resources, and restraints

B. to elaborate and specify whole processes in a repeatable and gradual manner by all team members

C. to hold rooms for compensating any risk due to much possible change in information having impacts on schedules.

D. to set up important milestones being able to evaluate productivity through base line defined as early project schedule).

E. to manage and to revise schedule continuously during the project.

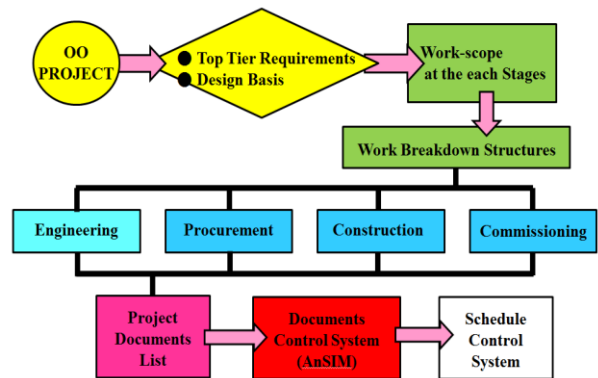


Fig. 3. A normal work flow in research reactors

The project charter and the design bases were prepared and the work scope of each step was organized in technical proposal of JRTR project. At the basis of the proposal, Project Procedure Manual (PPM) was made and the PWBS was included in the PPM. The Review and approval sheet were written. The work flows from the start of the proposal to the issuance of the EDL are presented as in Figure 3.

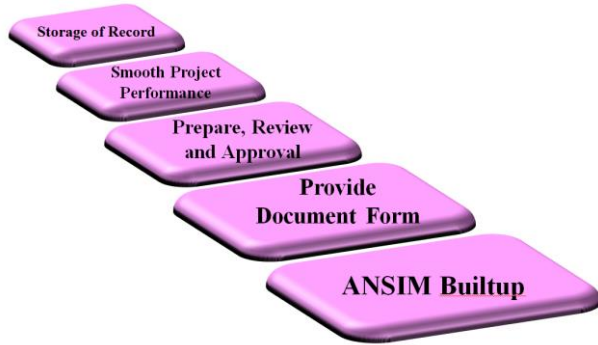


Fig. 4. Object of ANSIM System

A project document control system (DCS), advanced safety information management system (AnSIM) was developed for JRTR as in Figure 4. The AnSIM embodies an input system, a data loading system, and a search control system. The input system consists of engineering parts: input preparation parts, date, document number, revision number, title, safety classification, quality classification, and seismic classification, and administrative part for document approval. The data loading system loads prepared design document, design drawing, figure, and as low as reasonably acceptable (ALARA) check-list file. The input system and data loading system are supplied from the document control folder and document situation for approval is displayed. The searching control system searches and sorts out the approved inter-office communication (IOC), design data approval (DDA), design document, design drawing, and correspondence of the project manager (PM) memorandum, personal information, the document type, parts, and period of the present state.

Summarizing the project DCS,

- (1) A system is built to produce document form, document number, and approval line.
- (2) Design documents and drawings are manageable in the AnSIM system, and the document flow is disclosed to anyone from the project members and working efficiency was increased by helping easy assesses for co-work through easy exchange of information of concern.
- (3) The design document cover including the revision history, design document contents is made and the cover is merged into the main body of documents automatically during the approval process, and the finally well-prepared document is stored in the AnSIM system. The whole results from DDA, independent review, ALARA check list, and calculation as well as main body of design document are registered in the AnSIM system.
- (4) A system is well constructed to be capable of accumulating and transferring the experiences (the nuclear technology experiment and knowledge of the design, fabrication, testing, installation,

commissioning, and etc.) from generation to generation without severance.

The object to establish a DCS was successfully accomplished by JRTR document management system [6].

3.2 Development of Schedule

Activity duration is to calculate period of work package considering classification of resource, scale, input timing, and productivity. When creating mission duration, a scope of work, resource, human resource, procurement capability, riskiness, and result of similar project are considered and pretreatment period is included in addition.

Output of time management by the consortium with KAERI and DAEWOO is in Table 1. JRTR milestones schedule are arranged in each revision.

Table 1. Comparative Table of the JRTR Milestone

Revision No. Date	Construction Permit	Operation License	Final Acceptance Certification	Remark
Rev. P0 2010-12-17	2012-06-30	2014-08-31	2015-03-31	JRTR Contract 2010-03-31
Rev. 1 2011-04-21	2012-03-31	2014-08-31	2015-03-31	
Rev. 2 2011-10-27	2012-03-31	2014-08-31	2015-03-31	
Rev. 3 2012-05-31	2012-08-05	2014-09-30	2015-07-31	
Rev. 4 2013-09-30	2012-08-15	2015-11-15	2016-06-15	56M → 70.5M 2012-08-15
Rev. 5 2014-06-25	2012-08-15	2015-12-31	2016-06-21	

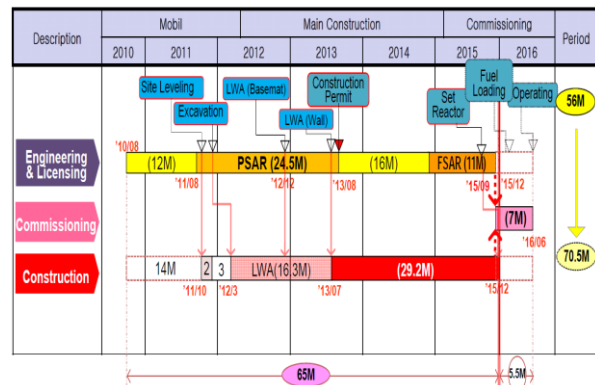


Fig. 5. The Project Milestone (revision 5)

The schedule, revision 5 was delayed 14.5 months than the initial one as shown in Figure 5. JRTR project time was 56 months on the point of the contract, and it was extended up to 70.5 months because of delay of the issuance of construction permit. But the time span does not seem unacceptable considering both the case of a reference project, HANARO construction (123 months was taken except utilization facilities) and projects for

power reactors that have been constructed in the same or similar type of reactors.

3.3 Upgrade interfaces between ANSIM and MS-Project in future

Documents for design, purchase, fabrication, installation, commissioning, and operation have been prepared according to the PWBS and the EDL documents activity. The process to make a document is to prepare EDL, input a schedule, calculate progress, and approve it. In future, we are willing to upgrade own system to a package combining a document management system with time management system in order to enhance project management like Figure. 6. It will be used in EMR (End of Manufacturing Report), test report or performance test report to link the end of activity with the real schedule [7].

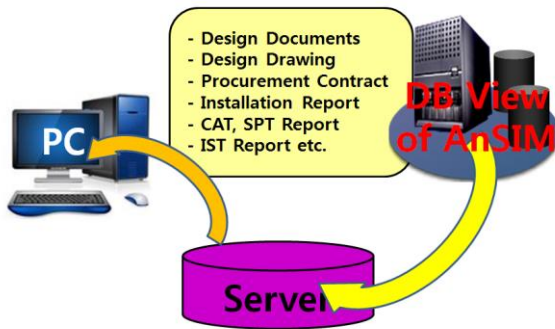


Fig. 6. Connection from AnSIM to MS-Project

4. Summaries and Concluding remarks

KAERI received the order; the JRTR construction project and the project are on-going based on the experiences that have been accumulated for 57 years in KAERI.

The EDL and document management system is well run in JRTR as in HANARO project. The level III schedule was developed for time management and then it came to manage risks within the project.

Based on the experiences from JRTR, the time control system will be upgraded for construction projects in future in order to accomplish followings:

- 1) to prepare clearer EDL,
- 2) to prepare project managing procedure
- 3) to judge proper decision for driving direction
- 4) to build configuration management organization

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