



Application of BIM Technology in Nuclear Power Construction Schedule Management

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Abstract. Schedule management is one of the important contents of nuclear power project management, which often leads to the lack of theoretical system due to the lack of sufficient information support. BIM technology provides a new solution for nuclear power project schedule management, ensures the effective linkage of all levels of schedule, reduces project delay and saves construction time. Combined with the theoretical basis of BIM and the characteristics of nuclear power project schedule management, this paper summarizes the application advantages of BIM technology in nuclear power construction schedule management.

Keywords: BIM · 4D · Nuclear power construction · Schedule management

1 Introduction

In the traditional domestic nuclear power construction schedule management, the progress work is carried out according to the hierarchical classification, and each project will form its own six-level schedule plan. The preparation and control of the schedule plan often depends on the professional level and engineering experience of the personnel. The construction progress is still managed based on two-dimensional drawing information, which is not effectively combined with the actual materials, equipment, manpower and other factors, it is difficult to track and analyze the progress, and it is impossible to effectively find the potential conflicts in the schedule plan. There is a lack of integrity in dealing with the deviation of the construction schedule, and it is difficult to coordinate and manage the participants, so it is difficult to achieve the goal balance of project duration, quality and cost.

The application of BIM technology can better interact and share engineering information, and reduce the communication obstacles and information loss caused by using two-dimensional drawings as information transmission medium [1]. Secondly, after many times of live process simulation, the connection of processes can be guaranteed to the optimal plan, and the amount of manpower, materials and equipment required can be accurately calculated to ensure the minimum error between experience estimation and

actual operation, and to ensure the accuracy and schedule of the project. To ensure the rationalization of resource allocation.

2 Nuclear Power Schedule Management Process Based on BIM Technology

The construction of domestic nuclear power general contracting projects generally adopts a six-level schedule system, which is decomposed and refined layer by layer from the first level of the project to the six levels of schedule, and the next layer of the schedule needs to undertake and respond to the target requirements of the upper level of the schedule. The traditional nuclear power construction schedule management includes the loading of enterprise resource information, schedule planning, progress monitoring and early warning, etc. The nuclear power progress management process based on BIM technology increases the requirements for the model and how the schedule plan is loaded on the model, as shown in the following Fig. 1.

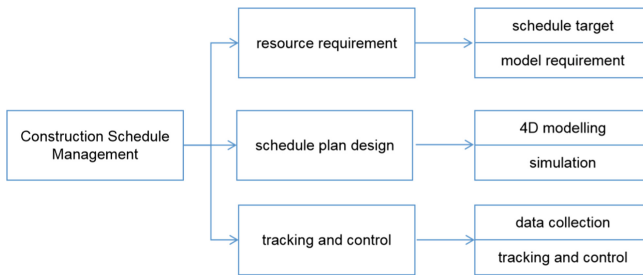
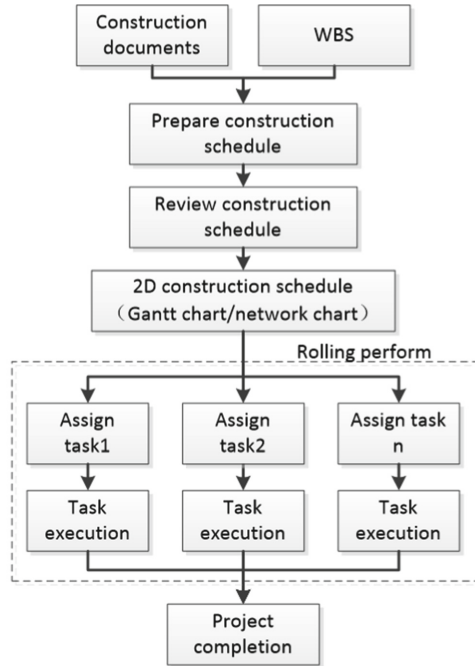


Fig. 1. Construction management process based on BIM

In the traditional construction schedule management, the loading of enterprise resource information needs to collect the data and basis for compiling the nuclear power construction schedule, and ensure the accuracy and validity of the data [2]. According to the collected resource information, the nuclear power construction activities are decomposed according to the WBS work task structure requirements, and the main objectives and activity contents of each level of progress plan are listed respectively. Determine each construction process and logical relationship according to the construction plan, and formulate a preliminary construction schedule, as shown in the following Fig. 2:

The nuclear power schedule management process based on BIM technology increases the requirements for the model and how the schedule plan is loaded on the model, and the construction schedule simulation model is generated through the correlation between the construction schedule plan and the construction drawing deepening design model. The loading of resource information also includes the standards or requirements of the construction drawing deepening design model, as well as the schedule and accuracy of each participant for the construction drawing deepening design model, and so on.



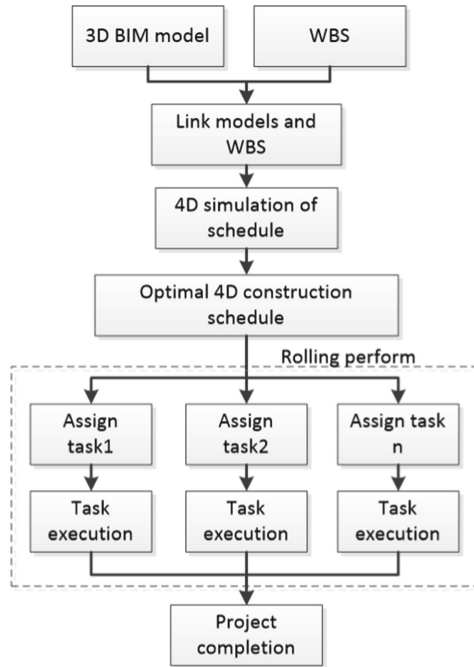
The traditional process of construction schedule management

Fig. 2. Traditional construction schedule management process

The virtual construction simulation is carried out by using the construction schedule simulation model to check whether each level of construction schedule is self-consistent, whether it meets the schedule target, whether it meets the constraints, the balance of quality and cost, and so on. If it is not met, it will be optimized and simulated repeatedly. After the optimized schedule is approved and accepted by all participants, it can be used to guide the construction of the project. This is shown in the following Fig. 3.

The construction schedule management based on BIM closely combines the project schedule with the three-dimensional visualization model, simulates the scene of the construction site in advance, corrects the problems existing in the construction process in time, and through repeated construction process simulation, the schedule plan and construction plan are the best, and the construction guidance obtained in this way is all reflected in the construction schedule model, which is simple and intuitive, and is easy for all participants to understand and implement.

Because the construction schedule management based on BIM is a virtual construction process, it is more convenient and economical than the traditional management mode, but it still needs a relatively complete BIM model. The scope and schedule of the model should be matched with the actual project. Different levels of schedule simulation can use different precision models, but the models must be consistent, which need to be considered in schedule planning.



Project construction schedule management based on BIM

Fig. 3. BIM-based construction schedule management process

3 Preparation of Technical Schedule Based on BIM

In the six-level schedule system of domestic nuclear power project construction, the first three levels of progress plan are mainly to meet the milestone nodes and the interfaces and main activities with design, procurement and commissioning at all stages of the project, as well as the logical relationship and mutual constraints among various activities. The four to six levels of progress plan is to further decompose the construction activities on the basis of the first three levels of progress plan.

According to the plant, work package, elevation, region, system transfer and other professional work steps and processes are detailed, but also in six months, three months, two weeks as a cycle to develop rolling plans for tracking.

The target time limit of the subordinate progress plan shall be consistent with the superior schedule plan, and when the superior schedule plan has been adjusted, the subordinate schedule plan shall be adjusted accordingly.

The traditional construction schedule mainly includes work breakdown structure (WBS), time limit estimation method and work compilation process.

The WBS of the project is the basic work of the project planning, implementation and control. In principle, the project schedule should be compiled according to the organization of the project WBS. The complex construction process is combed and decomposed

through WBS, so as to facilitate the organization and arrangement of various construction operations, so as to constantly adjust the schedule according to the implementation of the project, and successfully achieve the project schedule management objectives.

With the introduction of BIM technology, the project WBS decomposition should include the engineering entity work and non-entity work content in the construction stage, and the BIM model is linked to the engineering entity, that is to say, when making the construction schedule according to WBS, the model should be incorporated into it.

In order to associate the model with the plan, in addition to establishing the WBS coding system of the project and the logical relationship with each WBS work package, we also need to establish a schedule model that matches this WBS, as well as the data classification of the model and the delivery standards of each phase.

To realize the schedule planning based on BIM, a perfect BIM model must be established, and at the same time, the WBS work package of the project should be associated with the BIM model components, and each work unit of the construction should correspond to the model components. Work unit schedule information, including task name, code, plan start time, plan completion time, project period and corresponding resource arrangement, can be completed in planning software such as Microsoft Project, and then work unit schedule information and model information are combined to be simulated in construction simulation software, as shown in the following Fig. 4.

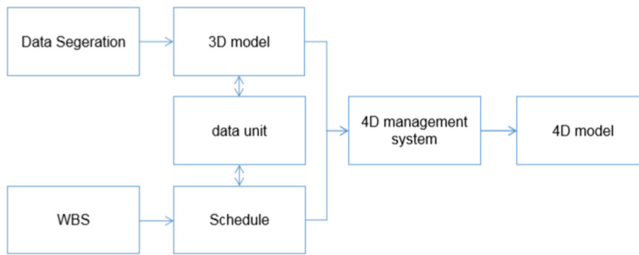


Fig. 4. Scheduling based on BIM technology

By associating the BIM model with the planned task, users are allowed to simulate the construction progress, construction process, construction scene and so on. The project team can collaborate to explore methods, solutions, and optimize results after schedule simulation. Through the visual simulation of the construction process, the construction schedule is arranged reasonably.

4 Progress Tracking and Control Based on BIM Technology

The key of progress tracking based on BIM technology is to collect and process the progress of the construction site in time, integrate the progress information, construction situation and 3D model, supervise and control the construction through 4D model, update dynamically and record the construction situation in real time [3]. The project should establish a 4D model synchronized with the construction progress, and each model component should belong to a construction work package, with work plan start time,

planned completion time, actual start time, actual completion time, the amount of work completed, the amount of resources, and so on. With the change of planning time and completion time, the system can automatically readjust and calculate, revise the target plan and update the corresponding resource data.

In the process of construction implementation, according to the actual project, the actual start time and actual completion time of each construction process need to be input in time in the 4D model, compared with the target plan, and analyzed whether the construction work is ahead of schedule or lagging behind [4]. Then carry on the follow-up schedule change adjustment to achieve the controllability of the schedule plan.

The general schedule management system will automatically check whether the progress of the schedule is in line with the compilation basis, and if it is found that it does not comply with its rules, it will enter the automatic correction and judgment procedure, and prompt the manager to continue the implementation only after the manager has made adjustments to the schedule. When the real-time progress of the automatic comparison of the schedule management information system lags behind the planned schedule, the system will actively prompt the manager whether to take rush measures according to the degree of lag, and revise the schedule plan and count the key lines. Modify the time limit and resource allocation plan, maintain continuous tracking and feedback on the implementation of the progress, and achieve dynamic management of the schedule.

5 4D Display and Application

There are two ways to associate WBS and model objects as the maturity of the BIM model advances. Under the current mode of low maturity of nuclear power BIM model, P6 and other planning software are used to compile the planning WBS structure, analyze the key duration and path, and then plan the WBS to be associated with the model object for 4D simulation and analysis. The title and custom properties of the WBS contain information that identifies the WBS, such as spatial location, such as the xx floor xx room of the xx factory building, system information, such as the 3RCV1 system, and category information, such as pipe bracket installation. The same information is contained in the name and properties of the model object, and the WBS can be automatically associated



Fig. 5. 4D scheduling management platform

to the corresponding model object by configuring association rules on the platform, as shown in the following Fig. 5.

Construction schedule management using BIM technology is more and more used in nuclear power construction. Taking the construction of a factory building as an example, the schedule planning is more quantitative and intuitive after adopting BIM technology, which can make managers understand the logic between construction processes more clearly, so as to arrange resources reasonably, and can make construction personnel aware of their own work contents and improve work efficiency. It is predicted that the critical path construction period can be reduced by 10% after adopting BIM technology. After the maturity of the BIM model reaches certain conditions in the future, the WBS can be created by dividing the model objects directly in the 4D planning software, so that the WBS and the model objects are naturally associated, which will make the automation of schedule scheduling more efficient and more efficient and convenient.

6 Conclusions

It can be seen from this paper that through the 4D dynamic Analog construction technology combined with BIM platform, the whole project implementation process is modeled by scientific methods, and the dynamic Analog analysis is carried out by combining the project plan and comprehensively considering the dynamic relations among the factors such as schedule, resources and site in the construction process, which can reflect the dynamics and relevance of various factors in the construction process.

Schedule management based on BIM technology can also predict the possible problems in the process of nuclear power construction, check, compare and optimize the construction schemes, and finally maximize the overall income of the project.

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