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Risk Analysis and Control Strategies for the Assembly of Major Structure Module in AP1000 Nuclear Power Project

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Abstract

Modular construction is used as the main construction technique in AP1000 nuclear power construction project. The technique can reduce installation workload in nuclear island, reduce cross operation relative to the traditional construction method, and shorten the construction period. While in the assembly process of large structure modules, there are frequent high risky operations including lifting, scaffolding, intensive welding & cutting, and so on. Accidents can be triggered and project schedule could be delayed if the control for the construction process is not sufficient. In this paper, the CA01 module assembly is taken to study as an example. The potential risks during the construction process of CA01 module are analyzed through Job Hazard Analysis, then the technical and management measures are put forward, which include construction scheme review & approval, safety and technical briefing, personnel training, special tradesman management, management system of mechanical equipment, work permit management on high risk work, construction housekeeping.

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Keywords: large structure module; risk analysis; modlue assembly; AP1000 nuclear power project; technical and management measures

1. Introduction

Modular construction is used as the main construction technique in AP1000 nuclear power construction project. The prefabrication of modules assembly is conducted outside the nuclear island area; this can reduce installation workload in nuclear island, thereby reducing cross operation relative to the traditional construction method, and

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shorten the construction period of AP1000 nuclear power plant Project^[1]. However, while the workload of site installation has been reduced, the workload of site module assembly has increased substantially. In the assembly process of large structure modules, there are frequent lifting, scaffolding, intensive welding & cutting, and other high risky operations. In addition, because the assembly work is conducted outdoor, the assembly process is also affected by possible adverse weather. Thus, if the control for the construction process is not sufficient, it can trigger object hit, lifting damage, falling from height, collapse, fire and other accidents, which may result in human injury and property damage, and cause delay of the construction project. Therefore, in order to avoid the occurrence of safety accidents in the process of module assembly and reduce the loss and impact of the accident, it is important to study the safety management and control measures on the assembly of large structure module.

In the past years, several studies are conducted on the assembly of large structure module, while the studies mostly focus on the quality control of the construction process: Zheng Donghong and Xiao Hongtao have studied the anti deformation design for large structure module (2012); Wang zenggao and Qi Hongbin have studied the welding quality controlling system for the assembly of structure module in 3rd generation of Nuclear power (2013).

2. Overview of major structure modules

In AP1000 Nuclear Power Project, the major structure modules mainly include CA01, CA03, CA20 and CB20, among which CA01 module is the most complex one. CA01 module is the structure in which reactor vessel, steam generator and pressurizer are installed, and it is located in Containment Vessel Building^[2]. The Module's size is about 28.9m long, 27.9m wide and 23.5m high, and about 788 tons in weight (not including concrete associated with the module, various welding plate, supporting, angle beam, slab reinforced and embedded parts, equipment, equipment module, auxiliary supporting and spreader). Fig.1 displays the lifting work of CA01 module. Fig.2 displays the assembly site of CA01 module.



Fig.1. lifting work of CA01 module



Fig.2. CA01 Module Assembly Site

3. Construction process and potential risks of module assembly

3.1. Construction process of CA01 module assembly

CA01 module is composed of 47 sub-modules, every sub-module is a structure made up of steel plate, profile steel and bolts, all sub-modules are fabricated in Shandong Nuclear Power Equipment Manufacturing

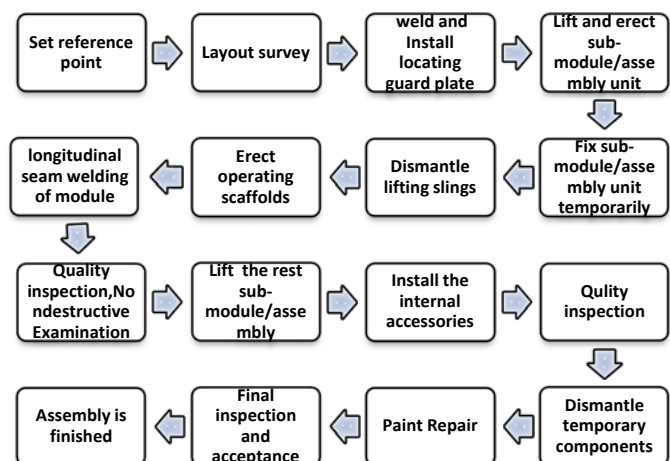


Fig.3. Assembly process of CA01 module

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