Design and Construction of Pool Door for Research Reactor

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1. Introduction

The pool door is a structure to isolate the reactor pool from the service pool for maintenance. The pool door is installed before the reactor pool is drained.

2. Design

2.1 Structure

The pool door consists of structural component and sealing component. The main structures of the pool door are stainless steel plates and side frames. The plates and frames are assembled by welded joints. Lug is welded at the top of the plate. The lug is used for clamping the pool door. Hanger bar, lug bracket and supporter are structures for storage of the door on the wall. The pool door maintains its structural integrity. The sealing components are inflatable gasket, air nozzle assembly, pressure gauge, etc. Two inflatable gaskets are attached to the side frame. Air nozzle assemblies are connected to the inflatable gaskets. The gaskets are inflated with compressed air for sealing.

Fig. 1. Configuration of pool door

2.2 Safety

The pool door is submerged in the pool water when it is used. Materials of the pool door should be resistive to corrosion and radiation. Stainless steel is used in structural components and air nozzle assemblies. EPDM (Ethylene Propylene Diene Monomer) is used in inflatable gaskets and static seals. Those materials are known to have good resistivity to corrosion and radiation.

The inflatable gasket expands with compressed air and it fills a gap between the pool liner and the side frame of the pool door at the pool gate. The pool door is equipped with two inflatable gaskets for safety. Leak tightness maintains even if one gasket does not work properly. Furthermore, malfunction of the gasket can be easily detected. Pressure of air in the gasket is indicated by the pressure gauge.

Fig. 2. Two inflatable gaskets

2.3 Analysis

The pool door is designed to withstand dead load, hydrostatic load, hydrodynamic load, seismic load and combinations of loads during earthquake. The hydrodynamic loads are calculated by using the formulas for dynamic pressure on fluid containers in TID-7024.[1] KEPIC SND and AISC N690 are used as a guide in the design for the pool door.[2, 3] It is confirmed through a structural analysis and evaluation that the pool door maintains structural integrity against all applicable design loads and load combinations for different conditions.

Fig. 3. FEM model of pool door

3. Construction

3.1 Fabrication

The pool door is assembled as a unit in the shop to ensure proper fits of parts, tolerances, welding, etc. The pool door is inspected and tested before packing for transportation to the construction side. All stainless steel surfaces are cleaned with acids.

3.2 Inspection and Test

The pool door is inspected and tested during fabrication and installation. It is also tested with procedures and plans in the commissioning stage.

Dimensions are inspected after the fabrication. Liquid penetrant test and ultrasonic test are performed on welding joints. Function of the inflatable gasket is tested as shown in Fig.4. Test conditions are gap between the pool door and the pool liner, hydrostatic pressure, air pressure in the gasket. Test conditions are applied under consideration of construction and safety. Leak of air, leak of water, and fracture of gasket are checked during the test.

Fig. 4. Test of inflatable gasket

3.3 Installation

The level of the pool door and the gap between the pool door and the pool liner are checked twice before and after the pool door is installed. Leak test is conducted after the installation.

Fig. 5. Installation of pool door

4. Summary

Features of design and construction of the pool door for the research reactor are introduced. The pool door is designed to isolate the reactor pool for maintenance. Structural analysis is performed to evaluate the structural integrity during earthquake. Tests and inspections are also carried out during construction to identify the safety and function of the pool door.

Acknowledgements

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REFERENCES

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