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Technical note

An evaluation on alternative cutting technologies for decommissioning of the components in a NPP

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ABSTRACT

This paper is to evaluate on alternative cutting technologies for decommissioning of the components in a nuclear power plant. Physical characteristics of the components were analyzed. Alternative cutting technologies of the components were evaluated. The optimal cutting technologies of the components in a NPP were suggested.

1. Introduction

Decommissioning of the major components in a nuclear power plant (whereafter 'NPP') is an important step for decommissioning of nuclear facilities (IAEA, 1999, 2008). The major components to be dismantled in a NPP are made up of several type plates and bolts. The plates consist of cylinder plates, circular plates, plain plates and curve plates. There are bolts surrounding the reactor pressure vessel (whereafter 'RPV') of a NPP.

In this paper, based on physical characteristics of the components, alternative cutting technologies of the components in a NPP were evaluated. The optimal cutting technologies of the components were suggested.

2. Physical characteristics of the components

2.1. Physical characteristics of the plates in the RPV

The plates consist of cylinder plates, circular plates, plain plates and curve plates. The cylinder plates are composed of the cut parts of reactor vessel, core barrel, pump casing, and pressurizer. The circular plates are composed of the plates of upper support, upper core, and lower core. The plain plates are composed of the plates of baffle and the cut parts of circular plates. And the curve plates comprise the plates of thermal shield.

Fig. 1 presents that there are the plates to be cut in the major components of a NPP. The cylinder plates could be cut along vertical axis and could be cut as many as circumference divided by the width of a waste package. The circular plates could be cut along vertical direction and are cut as many as circumference divided by the diameter of a waste package. The cut parts of circular plates could be classified by plain plates. If those were longer than the depth of package, the long plates could be cut. The plain and curve plates could be cut as the width and depth of a waste package.

2.2. Physical characteristics of the bolts in the RPV

Fig. 2 shows the RPV of a NPP and bolts in the RPV. There are bolts in the baffle, thermal shield, and former of the RPV as presented in Fig. 3. The heads of bolts in the RPV of a NPP are 741 of baffle, 168 of thermal shield, and 280 of former.

Baffle comprises a total 28 including 4 of 600 mm in width, 8 of 400 mm in width, 12 of 200 mm in width, and 4 of 170 mm in width. The range of weight is from 180 kg to 550 kg. Baffle as shown in Fig. 4 is constituted with former of 7 layers and play a role in fixing between fuel road and control rod. The baffle has to be dismantled because it is connected with fuel rod and high radioactive part. And it has to be divided from the former and extracted like a plate type.

The conditions of cutting are to cut the upper of a fixed baffle by the 23 mm in diameter and 20 mm in depth. Fig. 5 presents that the upper of baffle is an inserted 25 mm head of bolt and a 13 mm through part of bolt screw. If a remote manipulator has a

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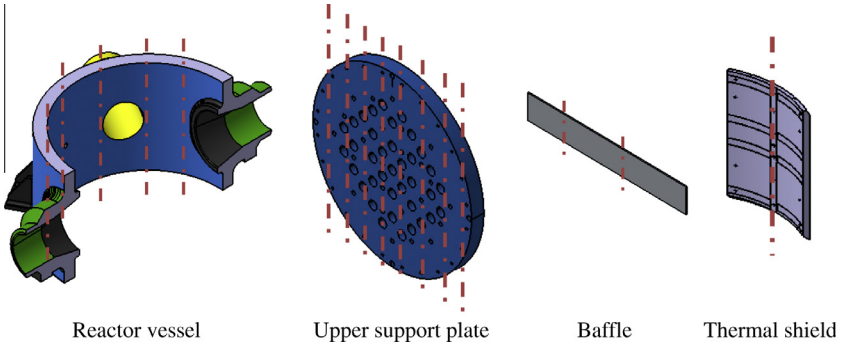

Fig. 1. The plates in major components and the cutting orbit of plates.

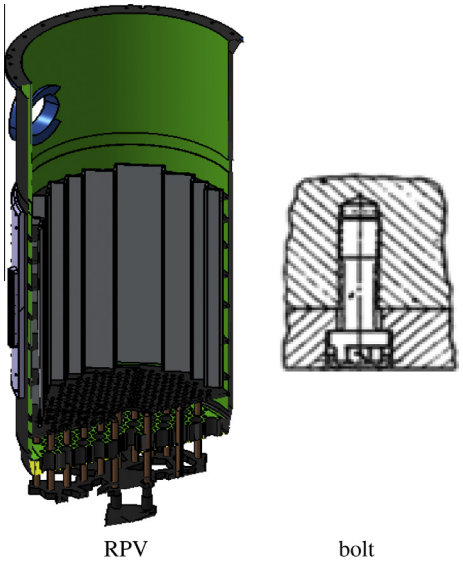

Fig. 2. The RPV and bolt in the RPV.

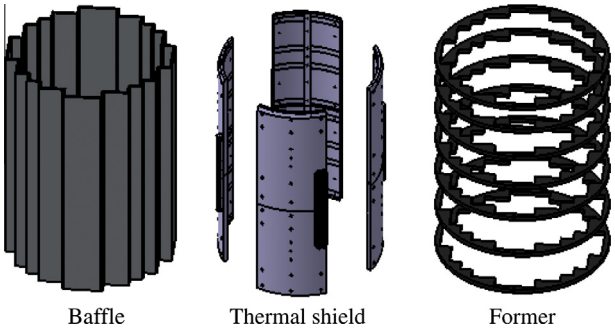

Fig. 3. The baffle, thermal shield, and former parts in the RPV.

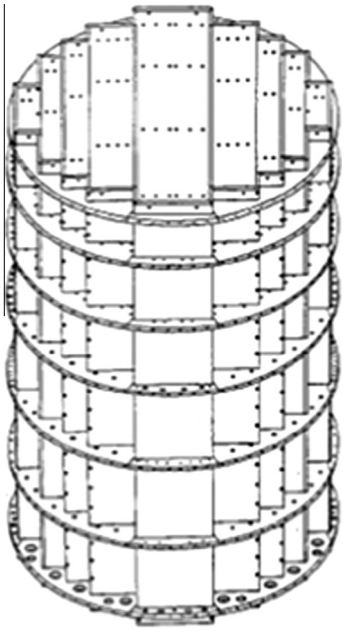

Fig. 4. The core structure in the RPV.

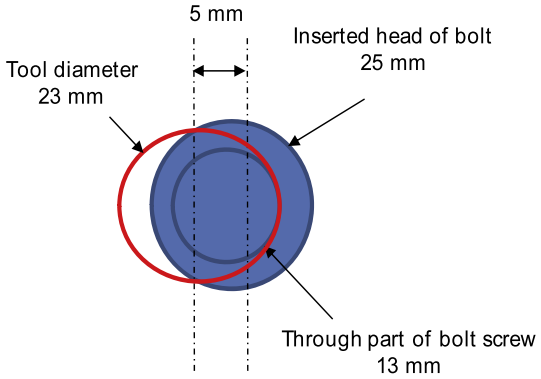

Fig. 5. The cutting concept for the heads of bolts in the RPV.

precision and operation error of ±5 mm, the diameter of cutting tool could be 23 mm. The cutting condition of thermal shield and former is the same as that of baffle.

3. Alternative cutting technologies for the components

3.1. Alternative cutting technologies of the plates

To choose an optimal technology of cutting the plates, the commercial cutting technologies as shown in Fig. 6, band saw, circular saw, and abrasive waterjet were considered.

3.2. Alternative cutting technologies of the bolts

To choose an optimal technology of cutting the heads of bolts in the RPV, the commercial cutting technologies are a mechanical drill and a contact arc metal drill (whereafter 'CAMD') were considered. Fig. 7 shows the drill bit of mechanical cutting and the electrod of CAMD cutting.