

## Development of Weld Overlay System for Dissimilar Metal Alloy 82/182 Butt Welds

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### 1. Introduction

As a result of the alloy 600 PWSCC(Primary Water Stress Corrosion Cracking), leak in the dissimilar welds in pressurizer nozzle was discovered recently in several US plants and the advanced companies had developed repair techniques. 2 or 3 years from now, more than half of the nuclear power plants in the country will be operated more than 20 years. Therefore, we need to develop repair techniques of dissimilar welds in pressurizer nozzle. With above backgrounds, we have developed a Prototype of Repair System for dissimilar welds in pressurizer nozzle.

### 2. The Weld Overlay System

There are three types nozzle such as safety, spray and surge in pressurizer.(Figure 1) The spray and surge nozzle in pressurizer is welded by 2G position. But the safety nozzle is welded by 6G position. Also around the safety nozzle is most complicated. With above backgrounds, we have decided to choose the target of design.

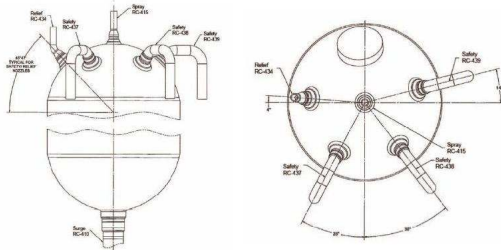


Figure 1. Three Types Nozzle in Pressurizer

#### 2.1 The Design of Weld Overlay Equipment

We checked the shape and dimensions of safety nozzle in pressurizer. In order to calculate the boundary of weld overlay, we postulated full structural weld overlay which is applied in penetration crack of nozzle. The full structural weld overlay has weld length and weld thickness as follows.

$$\text{Weld Length } \ell = 1.5 \sqrt{R \cdot T_o} \quad (1)$$

$$\text{Weld Thickness } t = t_o / 3 \quad (2)$$

R : radius of nozzle

T<sub>o</sub> : thick of nozzle

With above information, we decided strokes of equipment axes. The basic design requirement shows the table 1.

Table 1. Design Requirement

Axes	Design Requirement
Z Axis	Min. 15 mm
X Axis	Min. 90 mm
φ Axis	± 390°
Diameter of Body	φ 550 mm

We performed the basic and 3D design according to requirements. Figure 2 shows 3D design of overlay equipment. The equipment consists of two bodies, welding head, laser sensor and so on. What reason in designed two bodies is easy to install it in the nozzle of pressurizer. The laser sensor is used to measure the nozzle contour.

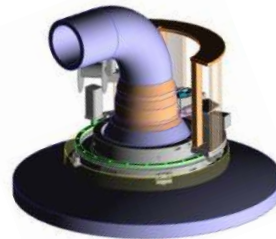


Figure 2. The 3D Design of Equipment

#### 2.2 The Manufacturing of Weld Overlay System

The weld overlay system have manufactured by basic and detailed design. Figure 3 shows the manufactured weld overlay system.



Figure 3. The Weld Overlay System

The weld overlay system consists of apparatus, controller and welding power supply. The apparatus consists of TIG welding torch, monitoring camera, tool for taking the temperature and brush for removing the oxide.

In order to control the apparatus and welding power supply, we have developed control program. Figure 4 shows the control program. The characteristic of developed control program is to perform the sectional welding in nozzle of pressurizer.



Figure 4. The Developed Control Program

The TIG power supply is Trans TIG 5000 model in Fronius. The power supply is controlled by Ethernet communication in controller. Figure 5 shows the TIG power supply.



Figure 5. The TIG Power Supply

### 2.3 The Mockup Test

We have performed mockup test using the developed system. Figure 6 shows the result of mockup test.



Figure 6. The Result of Mockup Test

We have evaluated the performance of developed weld overlay system from the safety nozzle mockup test. And we have checked the function of many tools such as camera, brush and so on.

### 3. Conclusion

We have developed weld overlay system for alloy 600 dissimilar welds in pressurizer nozzle. The weld overlay system consists of the apparatus, controller and TIG power supply. We have evaluated and checked the developed system from the mockup test.

We have a plan to adjust and complete the weld overlay system from the many test.

### REFERENCES

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