Quality of manufacture and construction

INPRO Dialogue Forum

November 19-23, 2013

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Evaluation parameter EP1.1.1.3:
Quality of manufacture and construction

Every weld in a pipe or vessel could be a source of failure; therefore a reduction of welds in piping or vessels clearly results in an increase of robustness of the design of an INS. In addition, fewer welds require less in service inspections and thus should lead to reduced doses for the personnel. As in other areas, progress in welding engineering and fabrication of pipes exists. Progress of welding engineering includes the application of automatic welding machines during manufacturing, which results typically in a higher quality of welds compared to manual welding procedures. Progress in fabrication of pipes includes the elimination of longitudinal welds by use of a cold-draw (extrusion) process.

Acceptability of EP1.1.1.3:
Evidence available to the INPRO assessor that demonstrates increased quality of manufacturing and construction of the INS in comparison to existing designs.
Overview

Manufacture technology such as welding, water jet peening and large/small size machining have been developed to increase the quality of manufacture.

1. Welding Technology Development
2. Other Manufacturing Technology
1. Welding Technology Development

2. Other Manufacturing Technology
Target of the Welding Technology Development

Example of Reactor Internals

Precise Welding Structures with
- Higher Reliability and Accuracy
- Lower Maintenance Requirement

- To Minimize Deformation after Welding
- To Suppress Residual Stress to minimize the SCC Risk
  (To Improve the Stress Distribution at the Welding Part)
- To Improve the Reliability
- To Improve the Work Efficiency and Work Environment

SCC: Stress Corrosion Cracking

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Hybrid Welding

Conventional Arc Welding

GMAW

Automatic GMAW

Laser + Arc (GMAW/GTAW)

Hybrid Welding

Laser Welding

Efficiency

Reliability

1960’s 70’s 80’s 90’s 2000’s
Development of Narrow Gap Welding

For many years, Narrow Gap Welding Technology have been developed to increase reliability and reduce welding cost.

The latest welding technologies in the world are continuously studied and developed by Hitachi.
Welding Technologies for ABWR RPV

**Narrow Gap MIG Welding**
- Small Weld Deposit and High Toughness by Low Heat Input
- Weld Cross Section
- SAW
- Narrow MIG

**Hot Wire Switching TIG(HST) Welding**
- High Efficiency & High Quality TIG Welding

**Single Layer Stainless Steel Cladding by ESW**
- Electro Slag Welding by 150 mm Width Wide Strip
- 150mm Stainless cladding
- Base Material 4mm

**Automatic TIG Welding of CRD Stub Tubes**
- Full Automatic 3-D Welding Machine Developed by BHK
- Conventional SMAW
- Automatic TIG Welding
1. Welding Technology Development

2. Other Manufacturing Technology
Development of Water Jet Peening

WJP is the Application after welding to improve the Stress distribution of Welded Part

Establish the residual stress of the welded part surface into compression side

High pressure water jet with cavitations hitting welded part

Higher Resistance to SCC
Improvement of Large Size Machining

Low Productivity with Manual Operation

Improve Productivity with NC Operation and High-speed type Cutting tool.

Enlargement and Improve Productivity with High accuracy and multifunction

Products Machined by Newest

Shroud Head
Shroud

1978

1982

2008
Improvement of Small Size Machining

Integrated Mill Turn Center can:

- Decrease Machining Lead time
- Increase Machining Capacity
- Improve Machining Quality

Before Improvement

1st NC Lathe

2nd Machining Center

3rd NC Lathe

After Improvement

Integrated Mill Turn Center
Only 1 Step
Summary

- Manufacture technology such as welding, water jet peening and large/small size machining have been developed to increase the quality of manufacture for ABWR.

- For many years, Narrow Gap Welding Technology have been developed to increase reliability and reduce welding cost.

- Water Jet Peening achieves higher resistance to Stress Corrosion Cracking

- In conclusion, ABWR is evaluated to meet AC1.1.1.3.