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Improving Productivity and Automation in Fabrication of Offshore Platforms and Pressure Vessels

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Abstract

For Offshore Process and Wellhead Platforms for Oil and Gas and Pressure Vessel Fabrication, increased Automation is the need of the hour, as it helps improve Productivity, reduces Skill dependency on Welders, and improves Product Quality. Proactive planning and implementation of correct welding process automation for defined Weld Joints speeds up weld deposition with good weld aesthetics with improved quality of weld. L&T-Modular Fabrication Facility at Hazira uses In-house Innovative ways to Weld Main Leg joints by SAW, T-K-Y joints by FCAW, Framing joints by FCAW, Weld Sector tubular joints by FCAW, Weld Miters in Jacket Lifting Sub-Assemblies by SAW/FCAW, Conductor Guides by SAW, Bottom Skirt pile guide by SAW and FCAW, External and Internal Shear key Fillet Welds by Twin Head SAW, Tray Support Rings and Crown to Petal joints in D'end of Pressure Vessels by SAW. As conventional SMAW is replaced, significant weld metal deposition in shortest possible time with stringent dimensional tolerances are achieved, without any rework and delay in acceptance. Proper sequencing, effective and repetitive implementation and optimised Welding parameters leads to desired bead size and finish, reduces Overall cycle time, cost and man days.

Keywords: Productivity; Automation; Quality; Cost.

1.0 Introduction

Project Objective / Aim : Improving Productivity with Quality and Cost Control by using Automation

Details of the Contribution Made:

1. Automation of Framing Main Leg to details Joints by SAW.
2. Automation of Framing beam joints by FCAW.
3. Automation of Sector tubular and detail plating by FCAW/SAW
4. Pad-Eye and Lifting Trunnion Assemblies Welding by SAW
5. Riser Clamp and Ring Stiffener Joints Welding by SAW
6. Shear Key Welding from ID side of skirt sleeves by SAW
7. Automation of D'end - Crown to Petal joint by SAW
8. TSR welding by SAW Twin-head technique

Challenges in Welding Automation:

- Complex joint design
- Space restrictions
- Out of position welding
- Welding process restrictions from client
- Initial Setup time

2.0 Case Studies

PROJECT 1 : Automation of Framing Main Leg to detail Joints by SAW

In Offshore Process and Wellhead Platforms, develop and implement SAW process for welding of Main Leg to Detail Joint improve productivity, quality and overall cost benefit.

Fig. 1 : Framing Main Leg to detail Joints by SAW

PROJECT 2 : Automation of Framing Joints by FCAW.

In Offshore Process and Wellhead Platforms, develop and implement FCAW process for Primary beam and Secondary beam joints improve productivity, quality and overall cost benefit

Fig. 2 : Framing beam (XYZ) joints by FCAW

PROJECT 3: Automation of Sector tubular and details plating joints by SAW.

In Offshore Process and Wellhead Platforms, develop and implement FCAW/SAW process for welding of Sector tubular joints and detail plating joints improve productivity, quality and overall cost benefit.

Fig. 3 : Sector tubular joints by FCAW

Fig. 4 : Details Plating joints by SAW

PROJECT 4 : Automation of T-K-Y joint by FCAW.

In Offshore Process and Wellhead Platforms, develop and implement FCAW process for welding of T-K-Y joints improve productivity, quality and overall cost benefit.

Fig. 5 : T-K-Y Joints by FCAW

PROJECT 5: Pad-Eye and Lifting Trunnion Assemblies Welding by SAW

A lifting trunnion assembly typically consists of Main shear plate, Mitre Tubular and Ring stiffener. Shear plates are welded to Main Leg of Jacket with double bevel groove welds. Mitre tubular are welded with each other by 90 Deg. Conventionally, these joints were welded by SAW using SMAW process. To decrease cycle time and maximize cost savings, indigenous setup was developed to employ SAW process in place of SMAW process.

PROJECT 6 : Riser Clamp and Ring Stiffener Joints Welding by SAW

Riser clamp is used by mechanical building trades to support vertical runs of piping at each level of jacket. The devices are placed around the pipe and integral fasteners are then tightened to clamp them onto the pipe. Riser Clamps Joints welded using SAW Process. Total 4 Nos. Ring Stiffener to Flange joints welded using SAW.

Fig. 7 : Riser Clamp joints by SAW

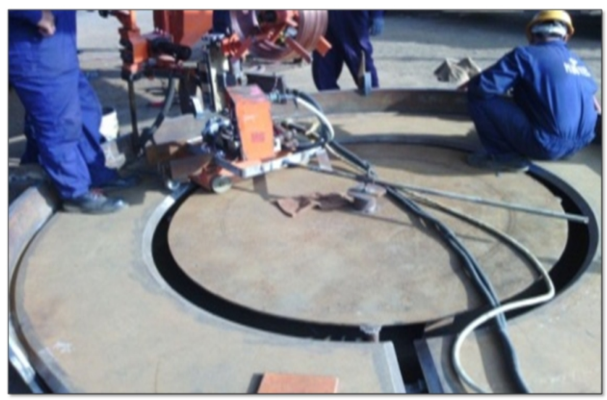

Fig. 8 : Ring Stiffener joints by SAW

Fig. 6 ; Lifting trunnion joints by SAW

PROJECT 7 : Shear Key Welding from ID side of skirt sleeves by SAW

Shear Keys (Square bars) welded using SAW on the inner surface of skirt leg. Increases sliding resistance between Skirt leg and Skirts piles. Transfers load from platform jacket to piles. Total 232 Nos. Shear Keys joints welded by SAW.

Fig. 9 : Shear Key Welding by SAW

Details of the project are as follows:

Total No's of Joints welded: 232

Total weld metal in TSR: 1126 kgs.

Total Man Days Save: 249 Man Days.

PROJECT 8: Automation of D'end - Crown to Petal joint by SAW.

In Pressure vessel fabrication, large diameter d'ends are made up of crown and petals. These crown and petals are formed from plate to the desired curved profile like ellipsoidal or hemispherical. These crown and petals are then welded together to form complete D'end. Welding of these crown and petal joints is done conventionally by manual SMAW process. Limitations of Manual SMAW process are Low Productivity.

1) Total 6 No's of D'ends welded,
   a) 4 D'ends - Thickness 70 mm and ID 3700 mm
   b) 2 D'ends - Thickness 78 mm and ID 4100 mm
2) Total WM deposited 745 kgs.

PROJECT 9: TSR welding by SAW Twin-head technique.

Strict dimensional tolerance is essential to avoid any fitment issues on site. These TSR's have fillet welds on both the sides. Welding from one side at a time leads to distortion or tilting of TSR due to shrinkage forces, hence simultaneous welding from both the sides is required. Stringent dimensional tolerances are must to pass quality inspection. Any deviation from specified tolerances leads to rejection and rework. Significant amount of weld metal is deposited to weld these TSR's as they are many in numbers which vary from case to case. Successful fabrication and inspection of TSR's is therefore considered a milestone during column fabrication.

Details of the project are as follows:

Total No's of TSR welded: 113

Column shell diameter: 3.3 m and 4.0 m

Fig. 10 : Welding using SAW with In-house arrangement

Length of Column: 74.95 m
Column Weight: 350 MT
Fillet weld size: 6 mm CFW
Total weld metal in TSR: 400 kg.

Benefits

- To increase productivity without compromising on quality
- To gain competitive advantage with shorter delivery time
- To decrease welder count at project peak load (Man days)
- Improved Weld Quality than Manual Welding
- Optimization of Resources

3.0 Conclusion

To remain in business and achieve sustainability, it is inevitable for any company today to remain alert and keep upgrading on technologies and human resource. In the continuous endeavour to set benchmark, MFF-H has tried to upgrade itself on technology front by adopting better Welding Processes, better documentation system, standardizing Good practices, etc. With the same, the company has been able to remain live in market and present very tough competition to our global counterparts.

- Improved productivity by 8 times.
- Better quality - 99.28 % first time NDT acceptance achieved.
- Better weld finish -Time savings in Weld dressing for final inspection
- Zero rejection and rework due to angular distortion. 100 % first time acceptance in dimensional inspection

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