THE NEW FRONTIER OF OIL AND GAS PRODUCTION

Ensuring Reliable Infrastructure

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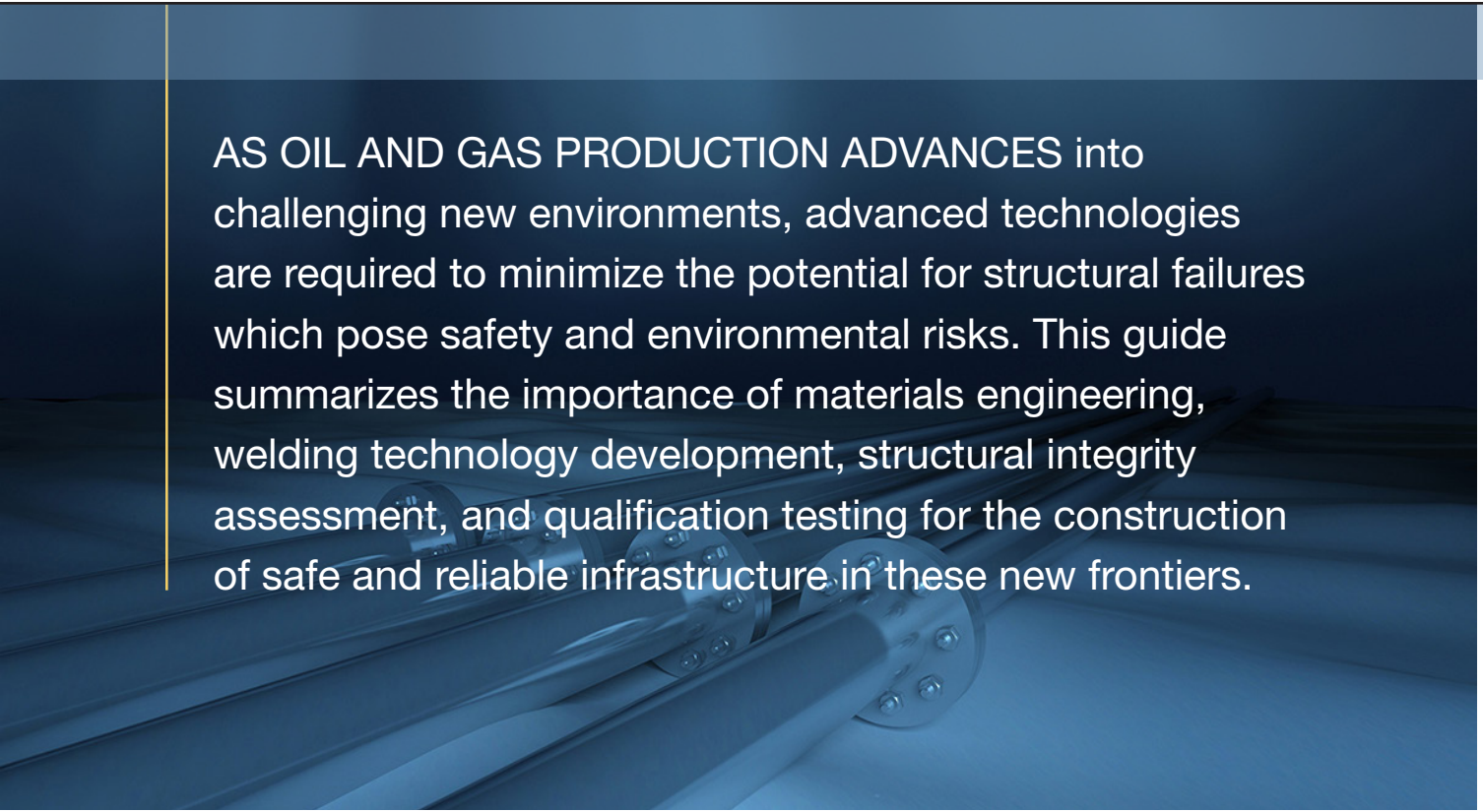
NFO&G1



AS OIL AND GAS PRODUCTION ADVANCES into challenging new environments, advanced technologies are required to minimize the potential for structural failures which pose safety and environmental risks. This guide summarizes the importance of materials engineering, welding technology development, structural integrity assessment, and qualification testing for the construction of safe and reliable infrastructure in these new frontiers.

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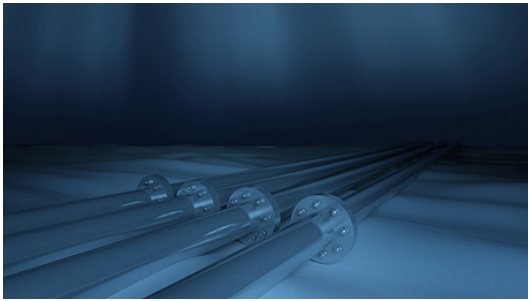
UNTAPPED RESOURCES

Vast Arctic, deepwater, and ultra-deepwater hydrocarbon reserves remain untapped and continue to drive oil and gas producers to push projects into these harsh environments.



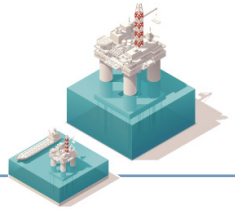
Estimated hydrocarbon reserves (U.S. Geological Survey study[1])

ARCTIC:

- 1,669 trillion cubic feet of natural gas
- 90 billion barrels of oil
- 44 billion barrels of natural gas liquids

DEEPWATER AND ULTRA-DEEPWATER:

- 160 to 300 billion barrels of oil



REMOTE BUT RICH

The Arctic contains 13% of the world's undiscovered oil reserves and 30% of the undiscovered natural gas reserves[2]

[1]http://pubs.usgs.gov/fs/2008/3049/fs2008-3049.pdf
[2]http://news.nationalgeographic.com/news/energy/2015/01/150122-norway-arctic-drilling-ice-climate-change-energy-oil/
[3]http://www.wilsoncenter.org/sites/default/files/Artic%20Report_F2.pdf

HARSH ENVIRONMENTS

Oil and gas production in extreme environments encounters significant technological challenges. In Arctic environments, structures must withstand ice and extreme temperatures, while the high pressures and increased temperatures of Ultra-Deepwater environments require complex safety systems. These environments require the use of unique materials and specialized welding techniques to ensure safe operation.

EXTREME ENVIRONMENTS PRESENT STEEP TECHNOLOGICAL CHALLENGES.

ADDRESSING CHALLENGES

Construction requirements for oil platforms in unconventional environments frequently call for the selection and use of new and specialized materials to ensure lifetime reliability of the structure. Qualified welding procedures must be developed prior to fabrication to avoid lengthy delays, or in some cases, catastrophic failures.

CASE STUDY

OFFSHORE CONSTRUCTION

In their initial procedure qualification attempts, an offshore construction company was unable to produce acceptable toughness levels in the heat affected zone (HAZ). To learn how EWI solved the problem, go to the next page…

MATERIALS ENGINEERING

Material failures account for two-thirds of all “loss of control” events to date, making proper material selection critical to the success of any project. Materials must be assessed to determine availability, cost, mechanical properties, compatibility, operational life expectancy, and any other factors relating to their intended use. Since the selected materials impact the lifecycle of the structure, it is critical to complete this assessment early in the engineering process.

INNOVATION IN ACTION

CASE STUDY

OFFSHORE CONSTRUCTION CONTINUED

[continued from previous page]

EWI determined *that low fracture toughness values were the result of a high concentration of impurities known as “tramp elements” and the mid-thickness of the base material. EWI developed a welding procedure to refine the microstructure of the HAZ to improve toughness. This was accomplished by reducing heat input, increasing the preheat temperature at mid-thickness, and modifying weld bead placement. EWI also recommended an alternate welding consumable to improve weld metal toughness. These improvements resulted in a welding procedure which passed client and industry requirements, allowing the project to continue without further delay. This translated to significant time and cost savings for the client.*

WELDING TECHNOLOGY DEVELOPMENT

The materials selected for a project have an impact on the welding procedure development. For example, high-strength steels require welding procedures that limit heat input to produce acceptable mechanical properties. Developing welding procedures which meet the requirements of a project not only ensures reliable joints, but also saves time and reduces unnecessary expenditures.

EWI ARC WELDING INNOVATION

EWI Associates have more than 250 years of combined arc welding experience, and have made innovations in:

- Narrow-Groove Welding
- Reciprocating Wire Feed GMAW
- Hybrid Laser Arc Welding (HLAW)
- Hybrid Arc Welding
- *EWI DeepTIG™* for GTAW
- Advanced Surface Engineering Technologies

STRUCTURAL INTEGRITY

Structural integrity assessment includes strength calculations, weldability evaluation, material testing, structural analysis, and lifecycle prediction. When determining a structure's reliability, it is critical to answer the following questions:

- Does the structure have sufficient strength to meet the demands placed on it?
- Can the base material and weld metal resist catastrophic crack propagation?
- What discontinuities can be tolerated?
- Will the structure pass qualification tests?
- Can the desired lifetime be achieved?

QUALIFICATION & TESTING

Testing the combinations of base materials and electrodes to be used is critical to the success of a project. Production cannot begin until a qualified welding procedure has been developed to meet the requirements for mechanical properties and weld quality. Thorough procedure qualification testing ensures that structures will be strong, reliable, and safe.

WELD QUALIFICATION PROCEDURES:

- SENT and SENB
- ASME VIII, AWS D1.1, API 1104

MATERIALS QUALIFICATIONS TESTS:

- API RP2Z/EN 10225
- Toughness Compatibility
- Weldability

NONDESTRUCTIVE EVALUATION

As the performance requirements of oil and gas structures continue to increase, the ability to validate the structural soundness of structure through nondestructive evaluation (NDE) methods becomes essential. The use of thicker wall tubulars and clad corrosion resistant alloy (CRA) systems are stretching the abilities of conventional NDE tools. Harsh environments make regular inspection of oil and gas structures impractical with current NDE methods.

EWI NDE

NON-TRADITIONAL METHODS

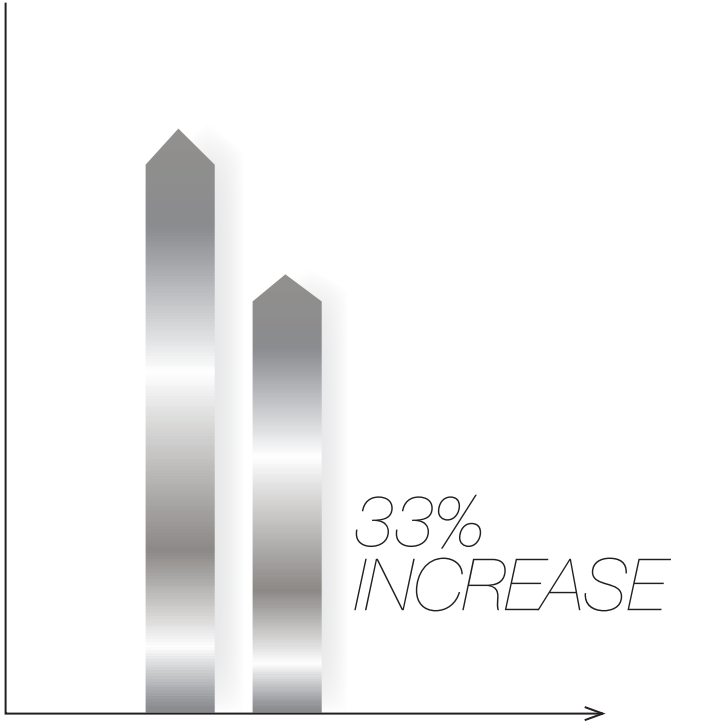
- Matrix-phased Array Ultrasonic Technology
- NDE of Clad Systems
- NDE Procedure and Probe Development
- Structural Health Monitoring Systems
- Advanced Eddy Current
- Video-laser Inspection

CASE STUDY

INCREASING PRODUCTIVITY

Solving Navy ManTech's Welding Challenge

One of EWI's unique strengths is the ability to use our experience across different industries to have a significant impact. Productivity is of primary importance in the shipbuilding industry. A Naval shipbuilder producing a large volume of thick-section, out-of-position welds required a significant increase in productivity to meet production demands. In addition, the materials being joined were heat-input sensitive high-strength steels. By applying mechanization to the previously manually applied process, EWI was able to increase the deposition rate and use less filler material while maintaining the required heat input. This allowed a 33% increase in overall productivity while meeting all mechanical property requirements.



increased the deposition rate

used less filler material

exceeded quality requirements

CONCLUSION

EWI is the industry leader in developing advanced welding technologies for oil and gas applications. With decades of experience, we have helped major oil and gas companies, engineering procurement contractors, oil services companies, and materials producers solve their most challenging materials, inspection, and welding-related issues. If you are currently experiencing any of these difficulties, EWI can help.

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