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Deepwater SCR Manufacturing Criteria

R.T. Hill, EWI Microalloying LP, and P.K. Mittal, Welspun

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Abstract

The successful design and installation of large diameter SCR relies on close control of the mechanical properties and the dimensional tolerances used in the manufacture of the line pipe product. Statistical assessment of the resultant properties and process control data has shown in the ability to provide pipe dimensions of up to 20 inch OD and 1.22-inch wall for an SCR application in over 7900 FSW.

This paper describes the manufacturing process used to produce a large diameter deepwater riser with closely controlled mechanical and dimensional properties. A statistical presentation of the resultant line pipe properties is included to demonstrate the effectiveness of the production process control parameters.

Introduction

The use of steel catenary riser (SCR) systems has gained prominence within the past few years. Predominately small diameter SCRs in the range of 6-inch to 12-inch have been used for infield flow line tie-backs; with diameters of up to 18-inch diameter being installed for export service. With the introduction of deepwater semi-submersible production platforms the installation and operation of large diameter SCRs has bought about increased requirements in the mechanical and dimensional characteristics of the pipes. Meeting the vessel response associated with a semi-submersible hull design, regardless of the draught and mooring system, can be difficult.

Supplemental specifications have been and will continue to focus on more stringent criteria, such as controlled strength levels, enhanced stain capacity and improved fit-up and fabrication performance. To withstand the demands of high installation loads, and extreme operating conditions, such as loop currents, and hurricane force winds and waves, seamless and longitudinal submerged-arc welded line pipe are being manufactured using the latest in steel making, rolling and line pipe production technology.

Unique to the use of longitudinal submerged-arc welded line pipe is the ability to meet pipe end dimensional requirements to minimize offset conditions in the girth welds (hi-lo conditions), thereby reducing stress concentration factors that are used in determining the life expectancy of the riser system. With seamless pipe the ends can be machined (boring operation), whereas longitudinal double submerged-arc welded pipe must obtain these tolerances as manufactured.

Deepwater SCR Requirements

There are a number of material and dimensional requirements deemed necessary to insure the safe installation and continued operation of a deepwater riser system. The ones chosen for presentation include:

- Chemical Composition
- Mechanical & Toughness Properties
- Dimensional Characteristics
- Manufacturing Controls

Specifics of each will depend on the installation technique and service conditions.

Chemical Composition

Control of the chemical composition predominantly focuses on weldability, resistance to environmental stress checking and the ability to secure high strength, ductility and toughness. To assist field and shop fabrication welding, the chemical composition is restricted in the form of a carbon equivalent (CE) or cold cracking parameter (Pcm). Usually values of 0.38% and 0.20% are specified as maximum values. A sulfur content of 40 ppm is also required to insure toughness and resistance to environmental degradation. For weld metals, the hydrogen and oxygen contents are verified to insure the integrity of the as deposited properties. Also limits will be specified for chemical elements used in sulfur reduction and de-oxidation of the steel so as not to impair the welding operation.

Mechanical and Toughness Properties

Restricted yield and tensile strength, as well as yield to tensile ratio are specified for both the longitudinal and transverse properties. In general, a spread of 15 to 20 ksi is used for yield and tensile strength; with a yield to tensile ratio of 0.90 for transverse and 0.92 for longitudinal properties specified so as