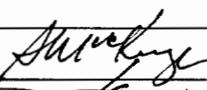
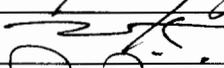
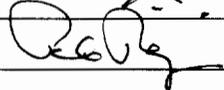


## Bayu Undan / Darwin LNG Facilities

### Technical Delivery Terms

<b>Material Description:</b> Austenitic Stainless Steel and Super Duplex Bolting	
<b>Doc No:</b> TDT 02	<b>Rev:</b> 3
<b>Prepared By:</b> S. MacKenzie 	<b>Date:</b> 23 January 2006
<b>Checked By:</b> C. Foong 	<b>DOC CON Ref:</b> ALL/CMP/SPE/002
<b>Approved By:</b> P. Rogers 	

#### 1 SCOPE

This document outlines the general technical requirements for the supply of

- Austenitic stainless steel bolting components
- Impact tested super duplex stainless steel bolting components suitable for use down to a minimum temperature of minus 50°C

for the ConocoPhillips (COP) Bayu-Undan and Darwin LNG Facilities. This does not include bolting components for structural applications covered by TDT07.

Specifically, bolting materials shall be manufactured under the general requirements of the following codes and standards:

ASME B1.1	Unified Inch Screw Threads (UN & UNR Thread Form).
ASME B1.13	Metric Screw Threads, M Profile.
ASME B1.2	Gauges and Gauging of Unified Screw Threads.
ASTM A193	Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service.
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.
ASTM A700	Packaging, Marking and Loading Methods for Steel Products for Domestic Shipment.
ASTM DS – 56 G	Metals & Alloys in the Unified Numbering System.
EN 10204	Metallic Products – Types of inspection documents.

Additionally, the bolt description shall clearly indicate the nominal diameter (in inches or metric), pitch (in threads per inch - TPI), length (in mm), material specification, and the required number of nuts (generally 2 per studbolt). Washers shall not be provided, unless specifically requested for hold down bolts for equipment.

## 2 EXCEPTIONS AND ADDITIONAL REQUIREMENTS

- Hexagon bolts shall have a washer face on the underside of the head.
- Stud bolts shall be threaded on the entire length. The length of the bolt is measured as threaded length excluding the height of the end points.
- Studbolt thread tolerance shall be Class 2A in accordance with ASME B1.2.
- Nuts shall be of heavy hexagonal series in accordance with ASME B18.2.2 with minimum height equal to the diameter of the bolt.
- Nuts shall have a chamfer of 15 degrees to 30 degrees on both faces.
- Nut thread tolerance shall be Class 2B in accordance with ASME B1.2.
- If heat treatment is required to achieve the mechanical properties as stated herein, the threads shall be formed after such heat treatment.
- Unified inch screw threads shall be of 'unified system threads' in accordance with ASME B1.1 and shall be formed by rolling. Machine cut threading is not permitted.
- Unified inch threading shall be Unified Coarse (UNC) finish for stud bolts up to and including 1" diameter. Stud bolts of diameter size greater than 1" shall be 8UN selected finish (equivalent to a constant pitch of 8 threads per inch - TPI)
- Metric screw threads shall be of 'Basic M Thread Profile' in accordance with ASME B1.13M

## 3 MATERIALS

### 3.1 Austenitic Bolting Materials

Studbolt: ASTM A193-B8M Class 2 up to 1½" or M39  
ASTM A193-B8M2 Class 2B over 1½" or M39

Nut: ASTM A194-8M

Austenitic stainless steel alloys that do not contain molybdenum, eg AISI Type 304, are strictly prohibited.

All bolting shall be supplied as clean finished and free of heat treated scale/oxide.

### 3.2 Super Duplex Stainless Steel Bolting

The material used for manufacture of these stud bolts, nuts and hexagonal bolts shall be a super duplex stainless steel conforming to one of the following material grades:

- UNS S 32550 (eg Ferralium 255),
- UNS S 32750 (eg Sandvik 2507),
- UNS S 32760 (eg Zeron 100)

The material shall have a PREN with a minimum value of 38. This value shall be derived using the following formula:-

$$\text{PREN} = \% \text{Cr} + 3.3 \times \% \text{Mo} + 16 \times \% \text{N}.$$

Super duplex stainless steel bolting shall be supplied as clean finished and free of heat treated scale/oxide.

### 3.3 Mechanical Properties

The mechanical properties of stud bolts at room temperature after heat treatment shall be equivalent to ASTM A193 Grade B7

In order to achieve the above properties, super duplex bolting materials may be supplied in solution annealed or solution annealed plus cold worked condition, or in the age or precipitation hardened condition. The age or precipitation hardening shall be conducted at a maximum temperature of 450°C.

The mechanical properties of the nuts shall be equivalent to ASTM A194 Grade 2H.

Failure of any of the tensile tests or the proof load tests shall constitute rejection of the entire batch.

### 3.4 Impact Testing

Material used for super duplex stainless steel stud bolts shall be impact tested after final heat treatment in accordance with Section 6.0 of ASTM A320 except that the final test temperature shall be minus 50°C with impact energy absorption requirements in accordance with table 2 of ASTM A320 (All Grades Except L1).

Impact testing of nuts is not required.

## 4 CERTIFICATION

All materials shall be supplied with EN 10204 type 3.1 specific test certificates for each batch/heat.

All the documents relating to quality assurance and quality control including certifications shall be in English and readily legible. Documents provided in other languages or illegible shall not be accepted and shall be referred to COP before clearing final inspection.

## 5 PACKING, SUPPLY AND DOCUMENTATION

The stud bolts and nuts shall be preserved, packed and supplied in accordance with good industry practice.

Each material and each size shall be packed separately.

Minimum preservation requirements as specified in ASTM A700 shall be met.

Packing information details as specified during the procurement stage shall be met.

Piping bolting components, which are supplied in stainless steel material, shall be supplied uncoated except for colour code marking on end of stud bolt and nut as follows;

### Bolting Colour Coding Table

Material	Colour Code
Imperial Austenitic stainless steel bolting ASTM A193 B8M/8M2	White
Metric Austenitic stainless steel bolting ASTM A193 B8M/8M2	Light Blue
Super Duplex stainless steel bolting	Orange