



GUIDANCE NOTES ON

TOPSIDE STRUCTURE FATIGUE ASSESSMENT FOR SHIP-TYPE FLOATING PRODUCTION INSTALLATIONS

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Foreword

The purpose of these Guidance Notes is to supplement the topside structure fatigue assessment of ship-type floating production installations in accordance with the *ABS Rules for Building and Classing Floating Production Installations (FPI Rules)*. These Guidance Notes provide recommended procedures for performing fatigue assessment of topside structures. Guidance Notes are not mandatory requirements.

These Guidance Notes become effective on the first day of the month of publication.

Users are advised to check periodically on the ABS website www.eagle.org to verify that this version of these Guidance Notes is the most current.

We welcome your feedback. Comments or suggestions can be sent electronically by email to rsd@eagle.org.

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SECTION 1 Introduction

1 General

The *ABS Rules for Building and Classing Floating Production Installations (FPI Rules)* require strength and fatigue assessment of the topside module/hull interface on the ship-type installations. The hull interface structure specified in the *ABS FPI Rules* is the interface structure between the main hull and topside structures, including associated stools and elastomeric bearings, as fitted. Topside modules are the discrete structural units that support production facilities and supporting systems, and fatigue analysis of these structures is not required by the *FPI Rules*.

For ship-type floating production installations such as FPSOs, topside modules installed on deck of an installation may include but are not limited to oil/gas processing modules, gas compression modules, power generation modules, flare tower, vent stack, helideck, pipe rack, and laydown areas. Newer generations of topside structures are large in size and heavy in weight. They are important parts of the installation structures that are critical to the operation and structural integrity of ship-type installations. Thus there may be a need to perform the fatigue assessment in addition to strength evaluation of the topside structures.

As a supplement to the fatigue assessment of the topside interfaces on ship-type installations, these Guidance Notes provide the recommended procedures for performing fatigue assessment of the topside structures on ship-type installations. In general, Guidance Notes are not mandatory requirements.

Note that Installation, Ship-type installation or Unit, as used in these Guidance Notes, refers to ship-type floating production installation.

3 Features

The topside structure fatigue assessment involves the evaluation of the following areas:

- Environment wave conditions
- Metocean data, sea state scatter diagram
- Design load conditions
- Finite element model local boundary conditions
- Structural geometry
- Structural stress range and stress concentration factor
- Fatigue analysis methodology
- Accumulated fatigue damage, fatigue acceptance criteria and design fatigue life

The primary features of these Guidance Notes include:

- Design principle of hull interface structure and topside structures
- Design loads for fatigue strength assessment
- Loading conditions for topside structure fatigue analysis
- Accumulated fatigue damage prediction
- Fatigue acceptance criteria for topside structures

5 Application

These Guidance Notes describe procedures to perform fatigue assessments of topside structures on ship-type floating production installations. The procedures can be used for

- Topside structure fatigue life prediction.
- Assistance in topside structure design and survey.

These Guidance Notes should be used in association with ABS Rules and Guides for fatigue assessment, such as the *ABS Guide for the Fatigue Assessment of Offshore Structures* and the *ABS Rules for Building and Classing Floating Production Installations (FPI Rules)*.

SECTION 2 Topside Structures

1 General

Topside structures are the modular structures including all types of equipment above the main deck, typically the processing modules on ship-type installations. The topside structures and the interface structures are designed to carry the weight of the equipment and topside structures, and to have structural adequacy for the inertia loads induced by the wave loads and the flexibility to minimize the stresses induced by the hull girder deformation in design environmental conditions and sea states. The stress distribution in the topside structure is governed by the structural design of the topside, local loads and ship-type installation's accelerations and deformations.

The design and analysis criteria to be applied to the topside structures and hull interface structures are specified in the *FPI Rules*. The structural strength design of the hull and hull interface structures on ship-type installations is to be in accordance with 5A-1-3/1 and Sections 5A-1-4 and 5A-3-2 of the *FPI Rules*, regarding how load components can be adjusted.

A detailed fatigue assessment may be performed for topside structures combined with hull interface structures. Rational fatigue analysis methods are acceptable if the forces and member stresses can be properly represented. The dynamic effects should be taken into consideration if they are significant to the structural response. For the frame members of the topside structures, the S-N curves specified in the *ABS Guide for Fatigue Assessment of Offshore Structures* and *API RP 2A (WSD -21st or later Edition)* are recommended. The stress concentration factors (SCFs) for unstiffened tubular joints may be calculated based on applicable empirical formulas with validity limitations. The SCFs should capture the geometrical discontinuities inherent to the design as well as the effect of fabrication tolerances, when deemed necessary (e.g. mismatch between abutting plates). In this regard, for complex critical connections, the hot spot stress approach should be used in line with the mesh recommendations defined in *ABS Guide for the Fatigue Assessment of Offshore Structures*.

3 Topside Design Principles

3.1 Hull Interface Structures

The various functions of the topside modules give rise to many disciplines in the topside design. The hull interface structures, which transmit loads between the main hull structure and topside structure, have impact on fatigue capacities of topside structures. Based on various deck stool design types, three typical designs of hull interface structures are illustrated.

3.1.1 Plated Support Structure

The connection between the deck and the stool or gusset is assumed to be welded. The actual connection design to the deck is typically comprised of welding along transverse frames and longitudinal stiffeners. Section 2, Figure 1 shows the typical hull welded connection in the longitudinal direction and shear plates in the transverse direction. The plated support structure, shear panels, decks including the hull backup structures and the reinforcements for the hull due to the transferred acceleration loads are to be designed in accordance with the *FPI Rules*. Fatigue calculations are to be performed for all vital components.