



GUIDANCE NOTES ON

NEARSHORE POSITION MOORING

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Foreword

These Guidance Notes provide direction for the design and analysis of nearshore position mooring systems used for floating structures such as Floating Offshore Liquefied Gas Terminals (FLGTs), Floating Storage and Regasification Units (FSRUs), Floating Production Storage and Offloading installations (FPSOs) and accommodation barges. Nearshore position mooring in these Guidance Notes is intended to provide long-term solutions for stationkeeping for these floating structures.

These Guidance Notes are applicable to the position mooring system and mooring equipment onboard the floating structures. The design of jetties or similar bottom supported structures used for the mooring of floating structures is generally the responsibility of the Owner. These structures should be designed in accordance with related industry guidelines and standards, and they should be able to provide required holding capacity to the mooring systems.

Nearshore position mooring in these Guidance Notes cover the following types of mooring configurations:

- i) Jetty Mooring
- ii) Tension Pile Mooring

These Guidance Notes should be used in conjunction with the *ABS Rules for Building and Classing Floating Production Installations (FPI Rules)*, *ABS Guide for Building and Classing Floating Offshore Liquefied Gas Terminals (FLGT Guide)* and *ABS Guide for Building and Classing LNG Regasification Vessels*.

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

These Guidance Notes provide direction for the design and analysis for nearshore position mooring systems used for floating structures such as Floating Offshore Liquefied Gas Terminals (FLGTs), Floating Storage and Regasification Units (FSRUs), Floating Production Storage and Offloading installations (FPSOs) and accommodation barges.

The nearshore mooring system in this document is intended to provide a long-term permanent stationkeeping solution, in that it is designed to keep the floating structure on position throughout its design life.

Position mooring systems should be designed in accordance with applicable rules or guides with a level of safety that matches the intended service. The requirements for mooring systems are in *ABS Rules for Building and Classing Floating Production Installations (FPI Rules)*. Industry guidelines, such as *Mooring Equipment Guidelines, 3rd Edition (MEG3)*, published by Oil Companies International Marine Forum (OCIMF), may be used for nearshore position mooring systems where applicable.

Nearshore position mooring systems have special characteristics in comparison with offshore mooring systems and nearshore temporary berthing covered by OCIMF MEG3. Comparisons of those mooring systems are shown in 1/3.9.

These Guidance Notes primarily focus on:

- i) Jetty mooring or tension pile mooring
- ii) Design environment considerations
- iii) Operating conditions
- iv) Survival conditions of mooring systems
- vi) Environmental Loads and bearing capacity of the mooring systems
- vii) Emergency release of the mooring system
- viii) Mooring equipment qualification
- ix) Maintenance, monitoring and inspection

The design of bottom fixed structures, such as a jetty, a pier, quay, sea island, wharf, or dolphins, which serve as holding foundations for the mooring systems, is generally the responsibility of the owner. Those structures should be designed in accordance with relevant industry guidelines and standards, and they should be able to provide the required holding capacity for the mooring systems.

3 Overview of Nearshore Position Mooring Systems

Nearshore position mooring systems have close proximity to the shoreline, and the access to the mooring system is relatively simple. In most cases, they can be accessed directly from structures that are connected to shore. They are normally located in areas where currents and wave motions are influenced by sea bed bathymetry.

Similar to the position mooring systems defined in the *ABS FPI Rules* and *ABS Guide for Building and Classing Floating Offshore Liquefied Gas Terminals (FLGT Guide)*, a nearshore position mooring system can be designed based on one of the following two options:

- i) *Non-disconnectable*. Floating structure stays at the location, even in severe weather. The mooring system is designed for extreme events with the floating structure connected.
- ii) *Disconnectable*. Floating structure departs ahead of severe weather. The mooring system is disconnected from the floating structure. The mooring system alone is designed for extreme events if applicable.

Nearshore position mooring in these Guidance Notes cover the following types of mooring configurations:

- i) Jetty Mooring (see 1/3.1)
- ii) Tension Pile Mooring (See 1/3.3)
- iii) Other Alternative Mooring Systems (See 1/3.5)

3.1 Jetty Mooring

Jetty mooring is a mooring system to affix the floating structure alongside a jetty structure. In a jetty mooring system, the anchoring points of the mooring system are either connected to onshore structures or nearshore structures such as a jetty (or a pier, quay, sea island, wharf, dolphins). A jetty mooring system consists of:

- Mooring lines (fiber ropes, chain, and/or wire ropes)
- Mooring end fitting and accessories (thimbles, shackles)
- Fenders
- Quick release hooks
- Mooring equipment onboard the floating structure (mooring winch, fairlead, chain stopper, chocks, bitts, rollers, and etc.)
- Jetty structure (mooring bollards, cleats, and/or other mooring equipment)

3.3 Tension Pile Mooring

A tension pile mooring system is similar to the tendon system used for a Tension Leg Platform (TLP). In such a system, the position of the floating structure is maintained by the tension of several vertical piles fixed to the seabed. The floating structure is connected at the piles through pins and hooks or other connection hardware. The piles are uplifted in tension with the buoyancy of the floating structure. A tension pile mooring system consists of:

- Piles and foundation of the piles
- Hooks on the top of piles
- Pins/extended pins on the hull of the floating structure

Tension piles are within the scope of ABS classification, and should comply with the requirements in Section 6-1-2 of the *FPI Rules*.

3.5 Other Alternative Mooring Systems

There are other alternative mooring systems such as:

- Guide pile mooring
- Hinged stiff leg restraint mooring

Unconventional mooring equipment is either in-use or proposed at a small number of terminals. Examples are:

- Vacuum pads
- ITB-style (Integrated Tug/Barge) hydraulic pins and matching slot

Nearshore position mooring technology is currently evolving. For innovative designs, reference can be made to *ABS Guidance Notes on Review and Approval of Novel Concepts* and the principles contained in these guidance notes.

3.7 Mooring Arrangement for Loading/Unloading Operations

For FLGT or FSRU, an LNGC is usually used to load/unload cargoes from the FLGT or FSRU. The arrangement of FLGT/FSRU, LNGC and sometimes a jetty structure can be one of the following configurations:

- i) *Side-by-side Mooring.* The LNGC alongside FLGT/FSRU, and FLGT/FSRU may be moored alongside a jetty structure in the case of jetty mooring, or with other types of mooring.
- ii) *Tandem Mooring.* The LNGC is moored behind the FLGT/FSRU, both may be moored alongside a jetty structure in the case of jetty mooring, or with other types of mooring.
- iii) *Cross Dock Jetty Structure.* The LNGC and the FLGT/FSRU are moored on either side of the jetty structure.

3.9 Comparison with other Mooring Systems

There are many commonalities between nearshore position mooring and offshore mooring in terms of environmental load analysis and strength assessment of the mooring system.

Nearshore position mooring also has similarities to temporary berthing systems in terms of surrounding environment, shore accessibility and mooring system arrangements.

Section 1, Table 1 provides a comparison between nearshore position mooring, offshore mooring, and temporary berthing. The list in the table highlights the differences that should be taken into consideration in the design of nearshore position mooring systems.

TABLE 1
Comparison of Mooring Systems

	<i>Offshore Mooring for FPI</i>	<i>Temporary Berthing</i>	<i>Nearshore Mooring</i>
Moored Floating Structure Types	Production facility/Terminal	Ocean going/trading vessels	Production facility/Terminal
Design Life	20 years or more	N/A	In accordance with the moored facility
Distance to Shore	No direct access to shore	Direct access to shore	Direct access to shore
Water Depth	In general water depth has no significant impact on wave and current load on the moored floater	No specific requirement for the return period for the high and low water level	Water depth has impact on wave and current load, as well as clearance. Should consider 100-year high and low water level in the analysis
Environmental Conditions	Open ocean condition, Site specific wave statistics are normally available	Site specific wave data may be derived from the record of deep water location. Bathymetry and bottom effect may be important. Increased current load due to small bottom clearance.	Similar to temporary berthing
Mooring Arrangement	No easy access to the mooring components. Mooring lines are submerged and relatively long. The natural period of the mooring systems is relatively long.	Mooring lines are in the air. Fenders attached to the terminals contact the moored vessels. Mooring lines are short and the natural period of the mooring systems is short.	For jetty mooring, similar to temporary berthing.
Equipment	Mooring equipment onboard the facility and controlled on the facility	Mooring equipment onboard the mooring terminals or on the vessel	Similar to offshore mooring
Mooring Line Adjustment and Replacement	Should be avoided if possible. Replacement is expensive and not easy.	Often adjusted, wear and tear could be high. The replacement is relatively easy.	Jetty mooring is similar to temporary berthing, however, replacement may disrupt the operation and the cost may be high.
Operational Considerations	Continuous production operation for a relatively long period of time	Loading/offloading in a relatively short period of time	Similar to offshore mooring
Monitoring Systems	Not often used during normal operation	Often used during mooring line adjustment, and berthing/unberthing	Should be used for mooring line adjustment and for disconnecting
Inspection Methods	Divers and ROV	Easy access for visual inspection and measurement	Similar to temporary berthing
Analysis Method	Coupled dynamic analysis method including motions and line dynamic effects	Uncoupled quasi-static method where dynamic effects are often not included	Recommend the coupled dynamic analysis method
Strength Assessment	100-year return period environment for strength assessment	No specific return period.	Recommend using 100-year return period environment and also include the values for maximum high water and minimum low water levels
Fatigue Assessment	Required	Not required	Required in general if the components are designed for long-term use. If the components are designed for periodical replacement, fatigue assessment may not be necessary