

Gulf of Mexico Annex - Modifications to Recommended Practice of T&R Bulletin 5-5A

Introduction:

This Annex describes the recommended site-assessment practice for jack-ups operating in the Gulf of Mexico during hurricane season. The jack-up's manned site assessment criteria assumes the rig can be evacuated within a period of time, typically 48 hours, prior to the arrival of a Tropical Revolving Storm. This Annex is to be used in conjunction with the current revisions of SNAME Technical & Research Bulletin 5-5 "Guidelines for Site Specific Assessment of Mobile Jack-up Units" (Guideline) and Bulletin 5-5A "Recommended Practice for Site Specific Assessment of Mobile Jack-up Units" (5-5A). The purpose of this Annex is to provide technical modifications to these references and to address unique characteristics of the Gulf of Mexico site assessment approach. The assessor may alternatively use both the Guideline and 5-5A.

The Gulf of Mexico is unique in that it is a relatively benign environment except when a major hurricane enters the region. Modern forecasting and storm tracking techniques generally provide a significant warning period in advance of the arrival of severe weather, except perhaps when a Sudden Tropical Revolving Storm (TRS) forms within the Gulf (sudden hurricane). The standard practice is to evacuate all personnel prior to the arrival of severe weather. In the case of a sudden TRS it may not be possible to evacuate personnel; however, historical met-ocean data indicates that tropical storms or hurricanes that develop within the Gulf are much less severe than the major hurricanes that develop in the Atlantic basin and migrate into the Gulf.

This Annex addresses both the major hurricane situation in which the jack-up is assumed to be unmanned and the sudden TRS situation where the jack-up may be manned, but the storm potential will be much less severe.

Site Assessment for Winter Storms should use the 5-5A approach.

Definitions:

All terms not defined below, in the Guideline, or in 5-5A may be considered to imply the standard technical definition. The definitions in this section are intended to be used with this Annex.

Sudden TRS: Tropical Revolving Storm that will affect a specific location with less warning than the evacuation period.

TRS Formation: Is the first designation as a tropical storm by the National Hurricane Center (NHC).

Evacuation Period: The maximum anticipated time required between TRS formation and full rig evacuation.

Assessment Case: The curves and tables define the wave height, wind speed, and current speed that represent a sudden TRS condition for manned operations. The data are based on 50-year sudden TRS independent extreme metocean criteria that will affect the location with less than 48-hour warning (see OTC17879). A standard 5-5A analysis, as modified by this Annex, will be used to evaluate the site with standard load and resistance factors applied.

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Contingency Case: These curves and tables define wave height, wind speed, and current speed that represent a special case of sudden TRS. The data are based on 50-year sudden TRS independent extreme metocean criteria that will affect the location with less than 72-hour warning (see OTC17879). The storm is more intense than that implied in the “Assessment Case”, reflecting storm strengthening during the time between intended evacuation and impact. The “Contingency Case” has more severe metocean criteria than the “Assessment Case” but the load factors used in the assessment are reduced.

Survivability: The Survivability assessment is for a demanned event only and evaluates the risk of damage to the global structural system due to a severe event that exceeds the environmental conditions for manned operation. In a survivability assessment the objective is for the rig to survive the event; however, structural damage may occur. The environmental criteria shall be based on agreement between stake holders.

Gulf of Mexico Practice:

For Hurricane Season, a Gulf of Mexico Annex site-assessment should follow the recommendations in 5-5A as modified by the following table. Notes are included where recommendations are believed necessary to enhance the existing T&R Bulletin 5-5A guidance.

The use of this annex is dependent on the existence of an effective evacuation plan (see Guideline 2.3.2) the intent of which is to evacuate all rig personnel within 48 hours. This 48-hour limitation is to ensure rig personnel are evacuated before storm conditions exceed the assessment criteria. If evacuation cannot be achieved within this time period, then the assessment criteria should match the period required to evacuate all personnel. Note: If the owner and operator demonstrate that an evacuation period of less than 48-hours can be assured, then the reduced evacuation time may be used to determine revised metocean data for input to the analyses.

Table 1. GOM Annex – Modifiers to 5-5A

Bulletin 5-5A should be used in its entirety with the following changes to modify the identified sections.

Section	Gulf of Mexico Annex	Bulletin 5-5A Comments
G2.3.2	50-year Sudden TRS Metocean Criteria may be used for site-assessment of Manned Conditions (Fig. 1, Fig 2, Table 2and Table 3)	See Guidelines of Bulletin 5-5.
3.1.2	Storm Preparation: Sufficient time prior to evacuation shall be allocated within the evacuation plan for the rig to be placed in survival mode, as described in the Marine Operations Manual (MOM). Where possible, the lower-guide should be located at an optimal position.	May include a requirement to skid the drill package to a storm position, raising airgap to avoid wave impingement on the hull, or reducing the dynamic effect by lowering airgap.

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Section	Gulf of Mexico Annex	Bulletin 5-5A Comments
3.2.2	<p>Conductor Support: Conductor support requirements shall not impede the placing of the jack-up into survival mode as prescribed by the Marine Operations Manual (MOM) or other site-specific requirements.</p> <p>If a conductor is to be supported during a storm, the resulting loads are to be considered in the assessment.</p>	
3.3.3	<p>Manned Operation: Individual Extremes: The 50-year sudden TRS Metocean Curves may be used (Fig. 1, Fig. 2, Table 2, and Table 3). Two levels of analysis are required.</p> <ol style="list-style-type: none"> 1. Assessment Case 2. Contingency Case <p>Demanned Operation: The survivability environmental criteria shall be based on agreement between stake holders.</p>	
3.5.1	<p>Kinematics Reduction Factor: A tropical revolving storm kinematics reduction factor developed specifically for jack-up units may be used in a Gulf of Mexico Assessment.</p>	
3.7.3	<p>Airgap During Hurricane: The analyst shall consider the possibility of wave impingement on the hull.</p> <p>The airgap considered in the site-assessment shall be appropriate for the water depth, spring tide, and the expected maximum wave crest height and storm surge due to the 100yr return period hurricane.</p> <p>The airgap shall also include an allowance for any settlement predicted by the survivability assessment.</p> <p>In the absence of a site-specific airgap assessment the curve “GOM Annex - Recommended Airgap for Hurricane Season” may be used. (Figure. 3)</p>	
3.16.2	<p>Geotechnical and Soil data for the location should be provided to the drilling contractor.</p> <p>These data should be suitable for a shallow foundation assessment and to a sufficient depth to capture soil characteristics that may affect the assessment.</p>	
6.2.2	<p>Bearing Capacity for clays after Bulletin 5-5A.</p>	<p>Recent work has suggested alternate approaches for calculating spudcan penetration. This work may predict penetrations greater than that produced by the current Bulletin 5-5A method.</p>

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Section	Gulf of Mexico Annex	Bulletin 5-5A Comments
C6.2.1	Backflow: Use the soil flow mechanism for backflow determination as proposed by Randolph, Hossain, Hu and White (see OTC17770).	This is believed to be a better description of the actual experience versus the collapsing hole assumed by 6.2.1 of the 5-5A Practice.
6.3.4	Foundation Fixity: Foundation Fixity may be included using the latest technology available.	
7.3.7.4	Soil Damping: Soil damping which includes hysteretic damping is permitted when determining the dynamic amplification factor. This soil damping is in addition to that found in the RP Table 7.1.	Care must be taken to ensure that soil fixity and damping are consistent (a matched set) to avoid under-prediction of the dynamic response which is further explained in 5-5A.
8.0	<p>Manned Operation:</p> <ol style="list-style-type: none"> 1) Assessment Case LF = 1.15, Resistance factors per 5-5A 2) Contingency Case LF = 1.0, Resistance factors per 5-5A <p>Demanned Operation:</p> <p>Survivability assessments should evaluate the risk of collapse due to TRS conditions exceeding the environmental conditions in the manned operations. The assessment may proceed using the following approaches:</p> <ol style="list-style-type: none"> 1. Elastic Analysis: Perform an assessment to Bulletin 5-5A with load & resistance factors set to 1.0 or without safety factors (or without safety factors, i.e. WSD). 2. Plastic Collapse (Pushover) Analysis: Load cases should be created for the environmental conditions selected for the survivability assessment using the calculation methodology in Bulletin 5-5A. The component strength checks in Bulletin 5-5A are replaced by a system strength check based on plastic collapse techniques. The effect of additional settlement should be included to assess the potential for collapse. <p>For both types of survivability analyses described above:</p> <ol style="list-style-type: none"> 1. The added P-Delta effect due to leg settlement shall be considered. 2. A Step 3 displacement check shall be performed for the foundations. 	Note; Unless stated otherwise herein, the regular 5-5A resistance factors apply.

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8.3.1	<p>Preload: The maximum feasible preload reaction should normally be applied. This may require individual leg preloading which is, in general, recommended.</p> <p style="padding-left: 40px;">Preload shall be applied and held for a reasonable period after penetration has ceased.</p> <p style="padding-left: 40px;">A reliability based approach may be used to account for the confidence in soil information (resistance factor selection).</p>	<p>Frequently the holding period is from 1-2 hours for a typical Gulf of Mexico location. This guidance should be tempered with knowledge of the soils at the location. For instance where punch-through potential exists holding times should be increased.</p>

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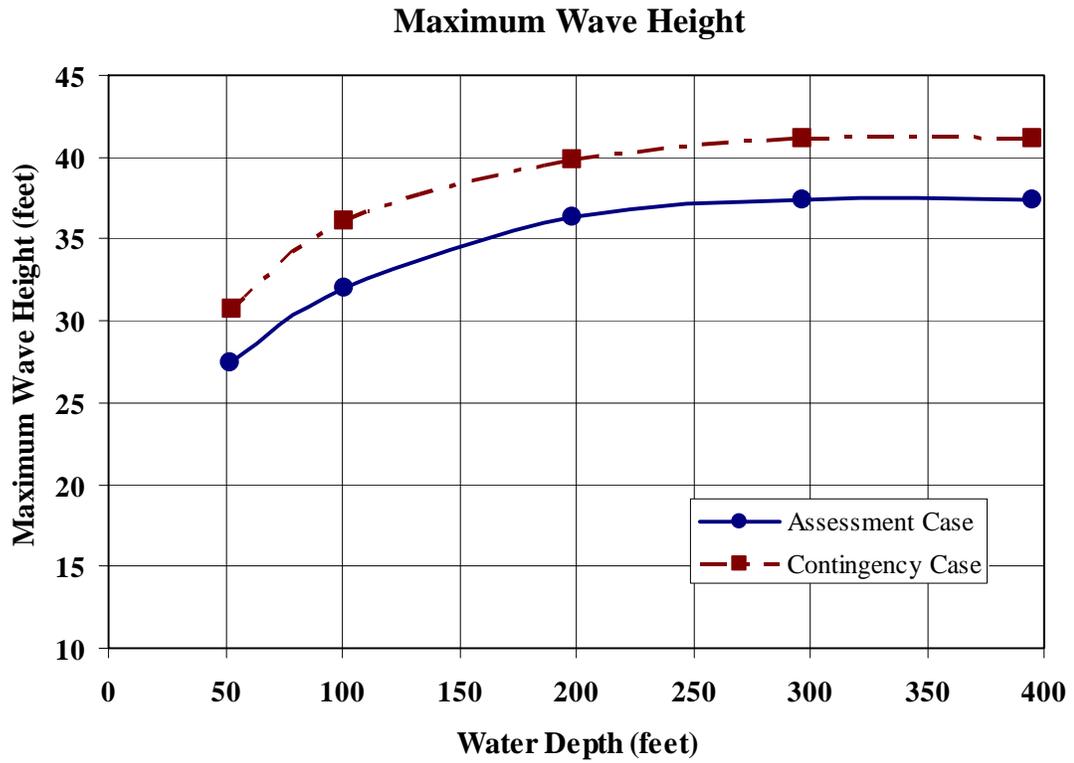


Figure 1. Max. Wave Height for GOM Annex Site Assessments

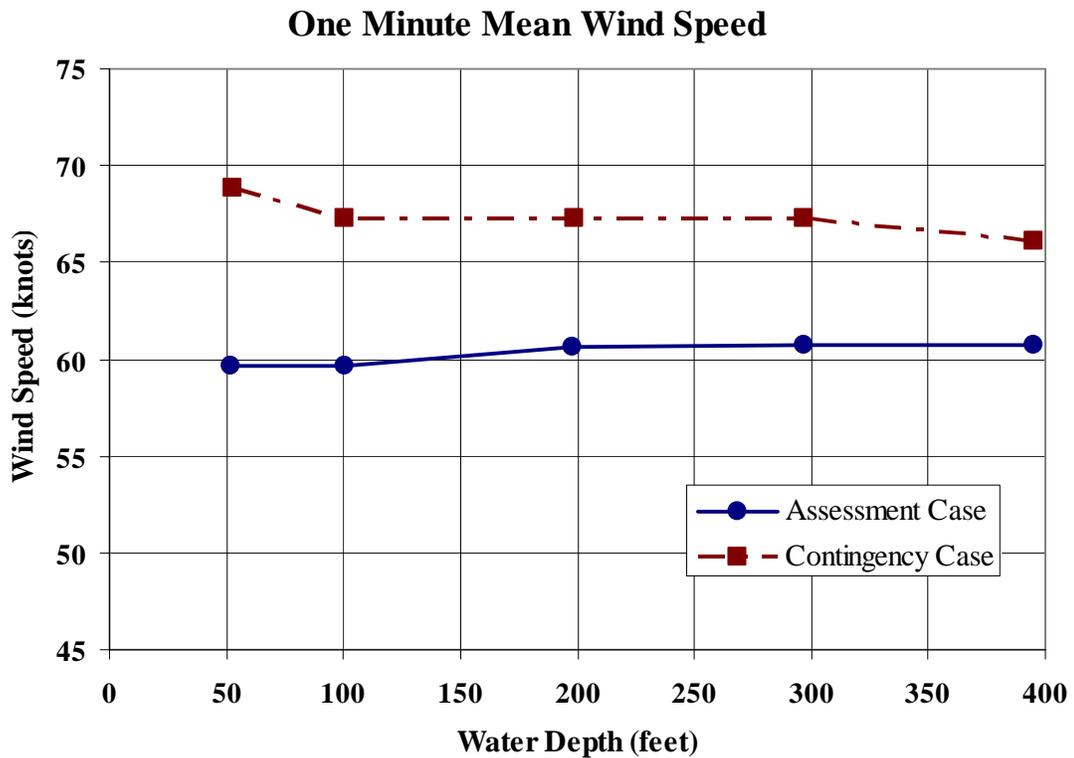


Figure 2. Max. Wind Speed for GOM Annex Site Assessments

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Table 2. Assessment Case Current Profiles

Current Table: Assessment Case				
Water Depth	Surface	Mid-depth	Bottom of Profile	Elevation Above Mudline
(feet)	(knots)	(knots)	(knots)	(feet)
50	2.4	2.2	2.0	10.
100	2.0	1.8	1.7	13.
200	1.5	1.4	1.3	16.
300	1.4	1.3	1.2	82.
400	1.2	1.2	1.1	180.

Table 3. Contingency Case Current Profiles

Current Table: Contingency Case				
Water Depth	Surface	Mid-depth	Bottom of Profile	Elevation Above Mudline
(feet)	(knots)	(knots)	(knots)	(feet)
50	2.8	2.6	2.4	10.
100	2.4	2.1	1.9	13.
200	1.7	1.6	1.5	16.
300	1.5	1.4	1.3	82.
400	1.3	1.2	1.2	180.

Note:

- 1) The current profiles in the above tables are defined from the surface to an elevation above the mudline defined in the right-most column. The current profile then decays linearly to the mudline.
- 2) For water depths not defined, interpolate between values given.

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Recommended Air Gap for Jackups in Hurricane Season

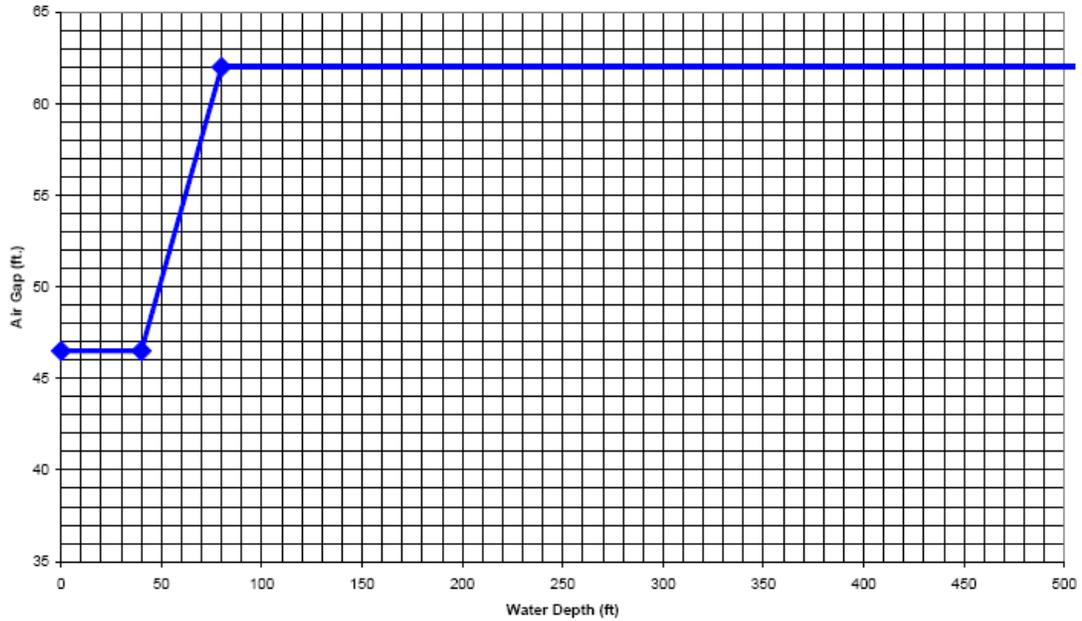


Figure 3. GOM Annex – Recommended Airgap above LAT for Hurricane Season

Note: This curve aims to reduce the risk of wave impingement on the hull during hurricane season. This graph is based on the 100-year “severe area” crest elevation including an uncertainty allowance of 5% and a settlement allowance of approximately 4 feet. If the foundation assessment reveals the possibility of greater settlement, then an additional margin may be required.