SNAME MARITIME 2022 CONVENTION

26-29 September | Houston, TX

SNAME J-REG JIP

Guidelines for Offshore Wind Farm Jack-ups

Presented by: James Brekke, Brekke Offshore Consulting, LLC

Panelists

- Jim Brekke, Brekke Offshore Consulting, LLC
- Alberto Morandi, GustoMSC
- Joe Rousseau, ABS
- Shannon Galway, Friede and Goldman
- Jose Vazquez, 3Dent Technology
- Craig Reid, Noble Denton Marine Services - DNV

Offshore Wind Turbines - Magnitude

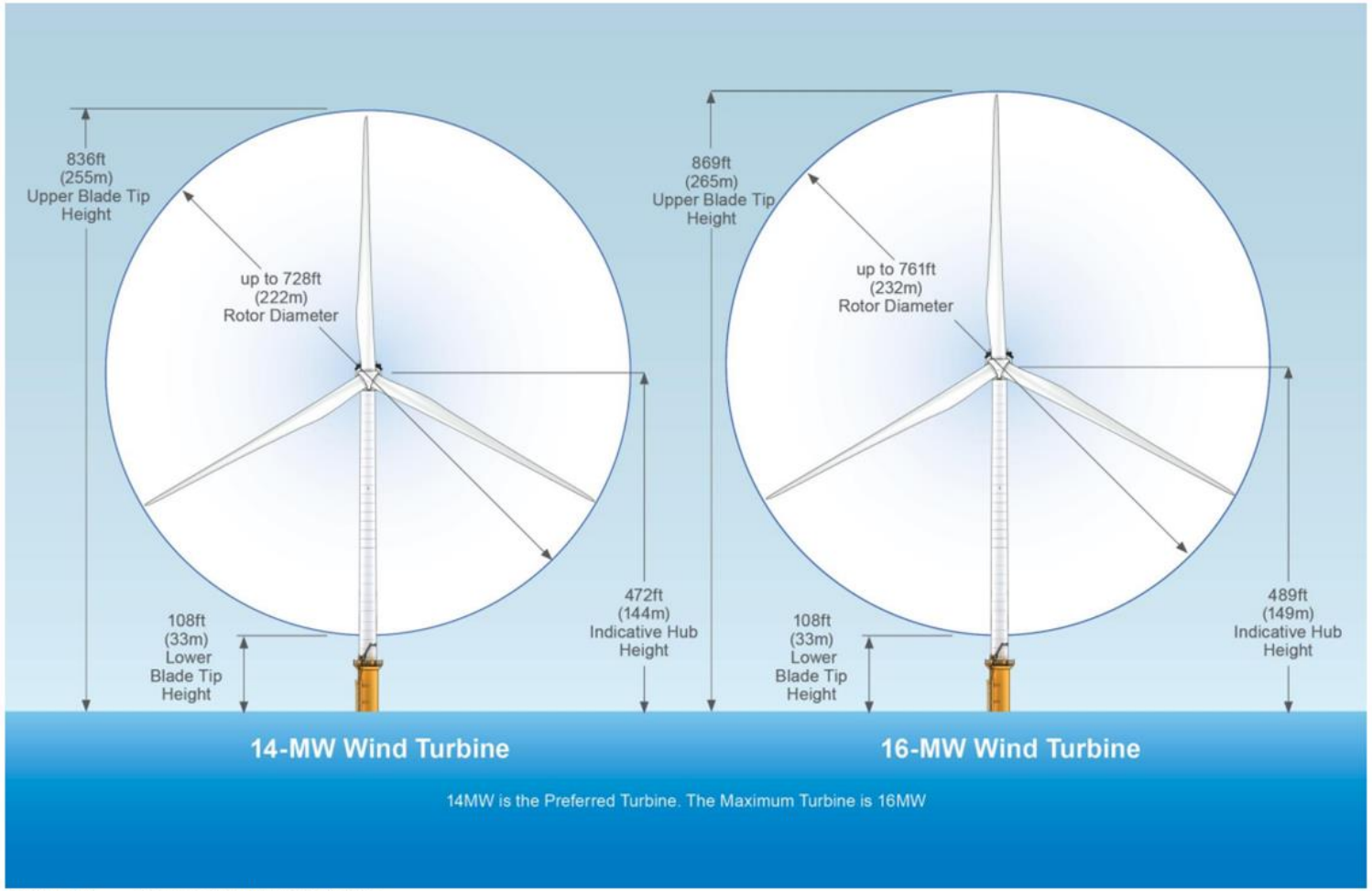


Figure I-1-2. Representative Wind Turbine Size

J-REG Participation

- **Phase I: started 8-2019; Phase II: 4-2021 thru 4-2023**
- **J-REG Participants – 110 individuals, 43 organizations**
- **12 Funding Participants / 31 Guest Participants**
- **Budget: $740k (Ph I&II), In-Kind Participation - heavy**
- **Developers, owners/contractors, designers, Class, MWS, turbine manufacturers, consultants, universities, Dept. of Energy, National Academies**

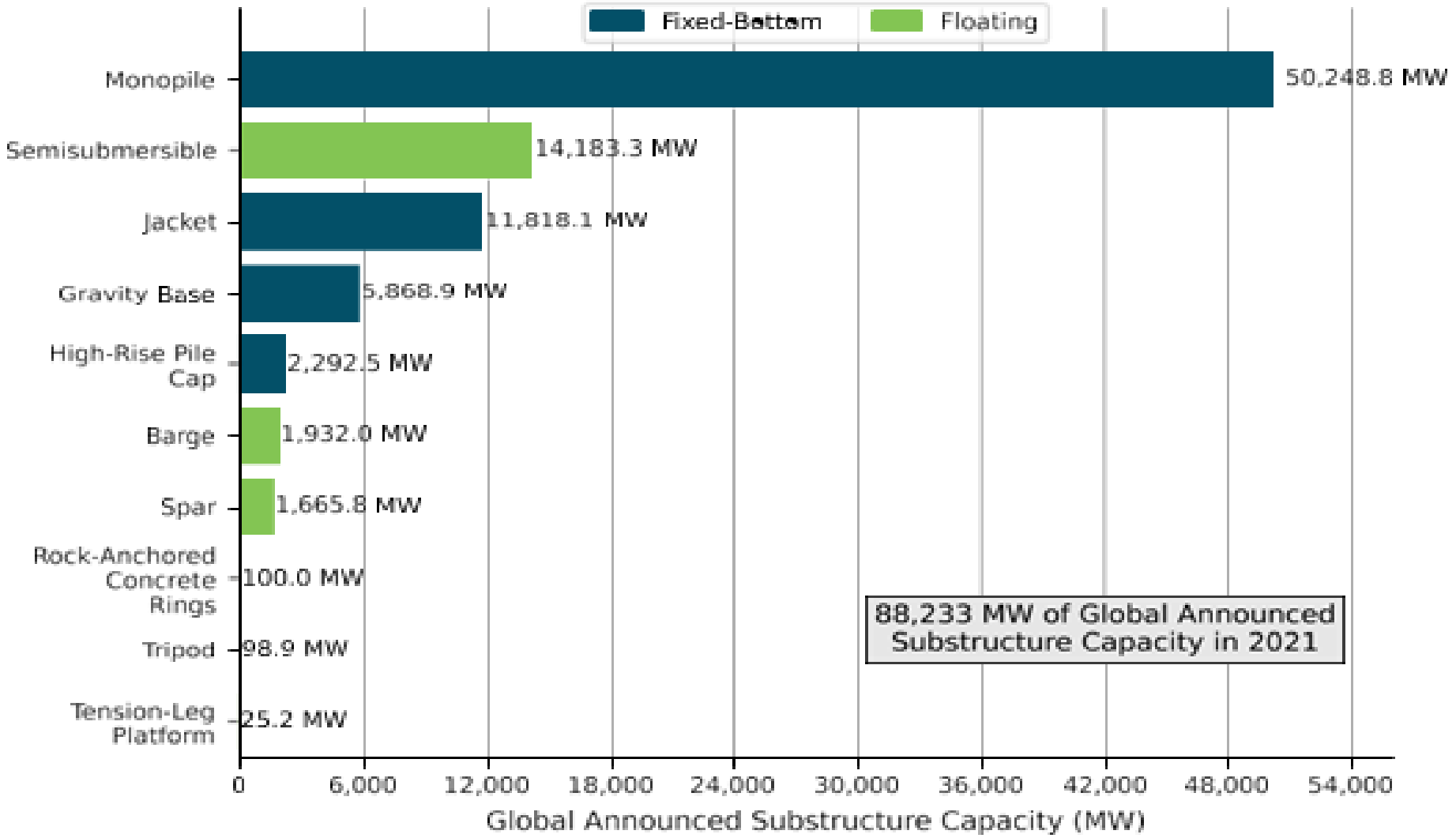
Offshore Wind Farm (OWF) Jack-up

Preview of Talk

- **Requirements of Funding Participants**
- **Gap Assessment (O&G vs OWF)**
- **Objectives**
- **Guideline and SNAME J-REG Bulletin**

Nomenclature: WTI, OWF, ORE, Fixed vs Floating

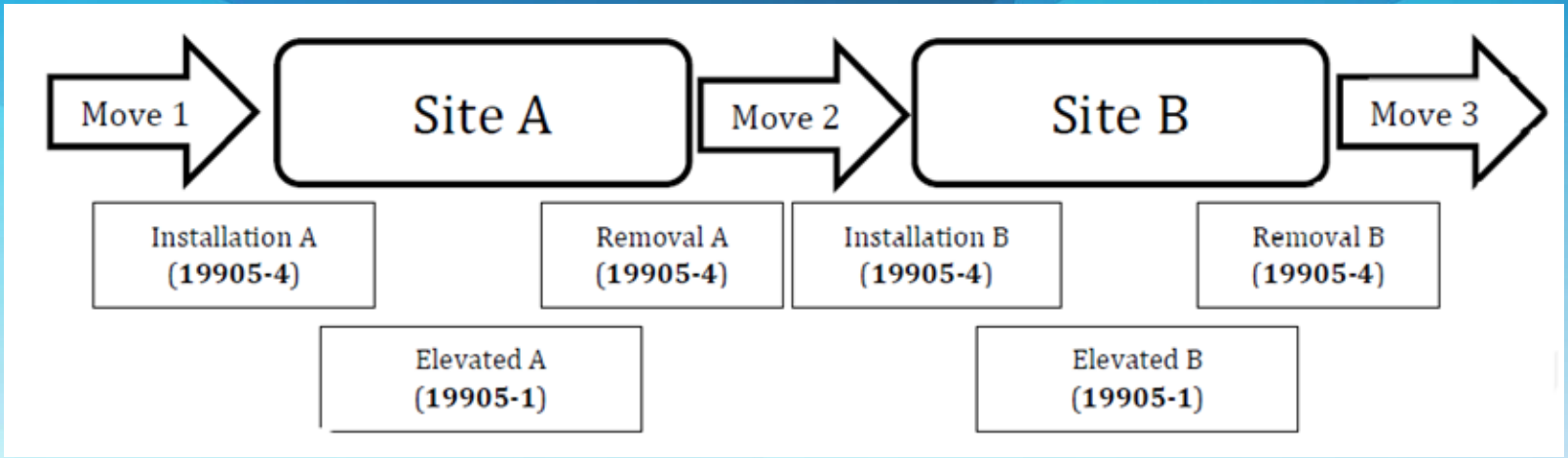
Fixed vs Floating OWF



Requirements of Funding Participants

- **Expedite delivery of SNAME Bulletin using JIP**
- **Address worldwide applications**
- **Supplement O&G standards (ISO) for jack-ups while elevated and during installation & removal**

Scope of Site-Specific Assessment (SSA-I, SSA-E)



ISO 19905-4 (SSA-I)

- **Going On Location and Touch-Down**
- **Soft Pinning at a Draft**
- **Jacking in preparation for Preload / Pre-drive**
- **Preloading / Pre-driving**
- **Jacking to Operating Air Gap(s)**

ISO 19905-1 (SSA-E)

- Elevated Operations, including Lifting and Handling Operations
- Elevated Storm Survival
- Elevated Earthquake

ISO 19905-4 (SSA-I)

- Jacking Down from Operating Air Gap(s)
- Leg Retraction, including Extraction and Jetting operations
- Going Off Location

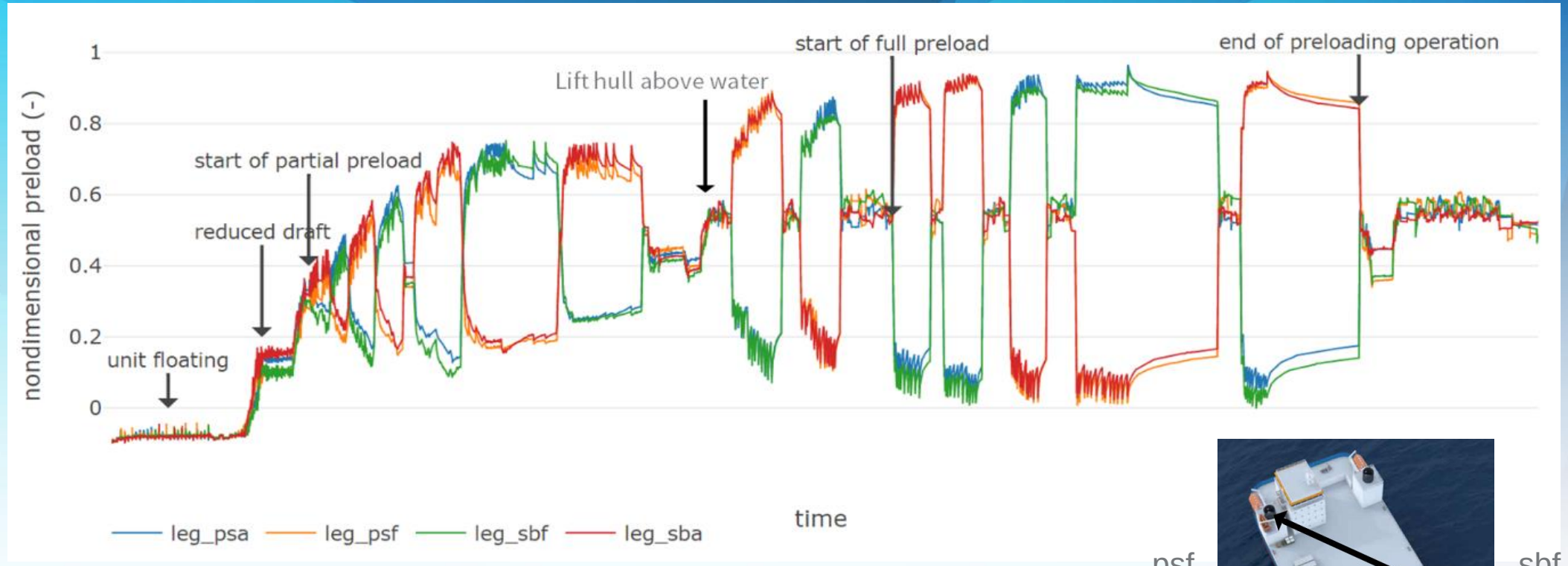
Primary Gaps

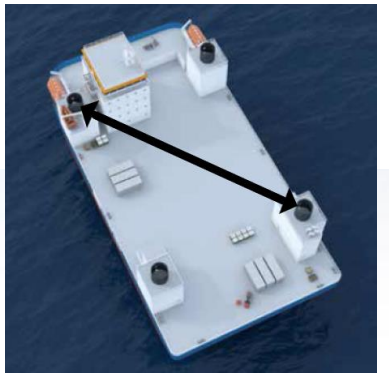
- **Frequency of Installation and Removal (1-2 days)**
- ***(Seabed characteristics and Geohazard Mitigation)***
- **Heavy Lifts with Crane**
- ***(Pre-driving 4-legged jack-ups; other configurations)***
- **Dynamic Positioning for Installation and Removal**
- **Severe Weather Procedures**

Pre-Driving of Four-Leg WTIV

No Ballast, Load on Diagonally Opposite Legs, Active or Passive

Use in SSA?





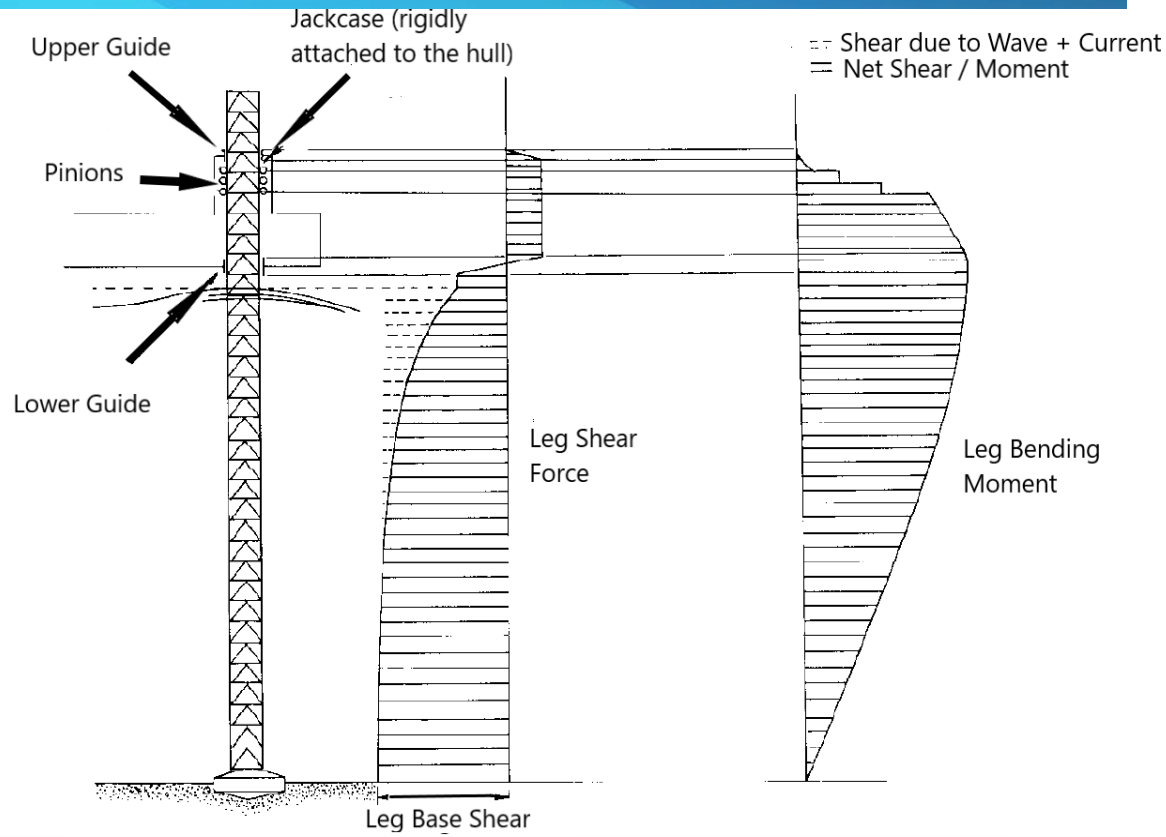
Credit: Vanderheggen, K., Meredith, N., Janssen, J., Morandi, A.C., 'Bringing Big Data Technology to Wind Turbine Installation Vessels', SNAME Maritime Convention, Providence, 25-29 October 2021.

Metocean Criteria Philosophy

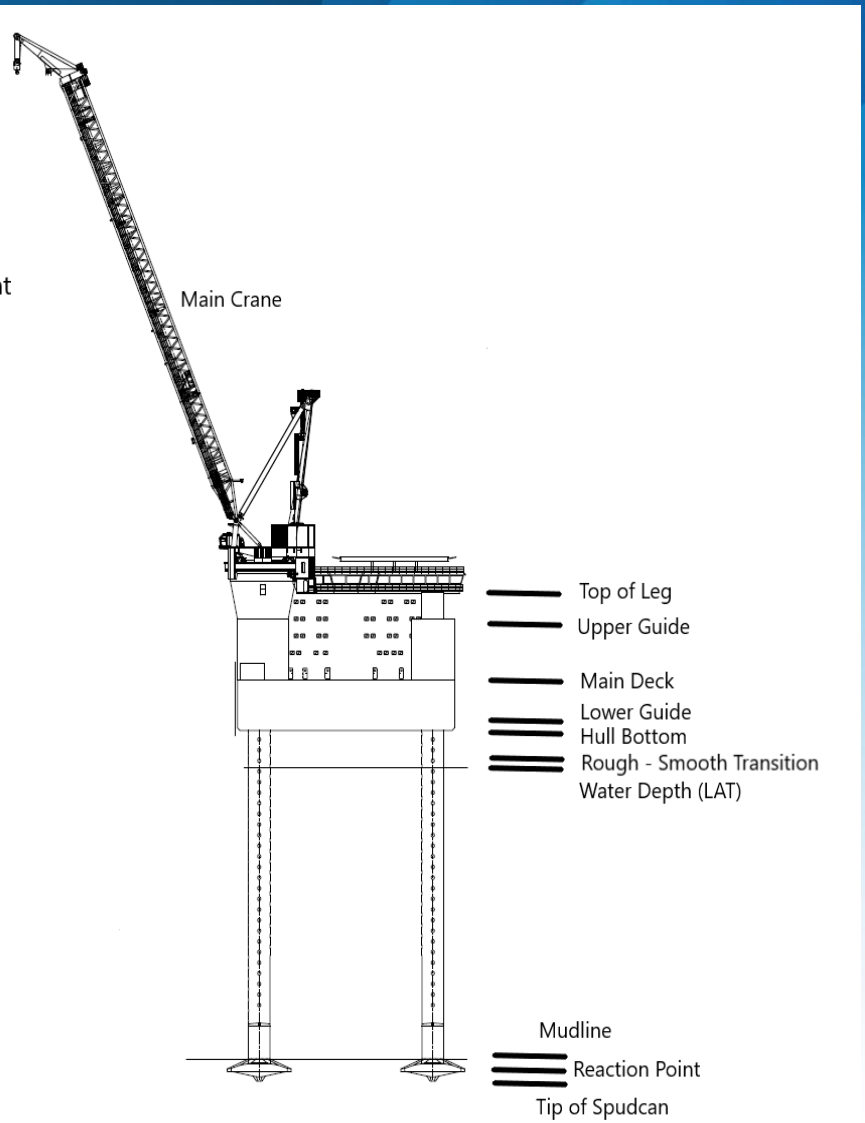
- **Weather-unrestricted operations extend beyond the duration of a weather forecast window and should be assessed against long-term statistics of metocean data that may take account of seasonal data.**
- **Weather-restricted operations are of limited duration and can be either completed or safely discontinued, with the jack-up brought to a safe condition within the remainder of the existing weather forecast window. Such operations are assessed considering appropriate safety margins against the forecasted weather conditions. Reliable weather forecasts can typically cover 3 days in areas where quality forecast services are available. The jack-up is considered in a safe condition when it can survive metocean conditions for weather unrestricted operations at the site or moved to an alternative safe location or moved to a port of refuge.**

Elevated SSA-E

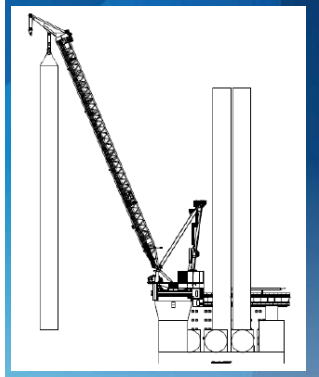
May be controlled by Operational Cases

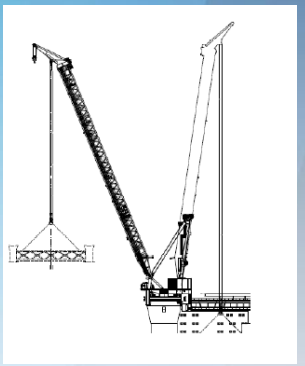


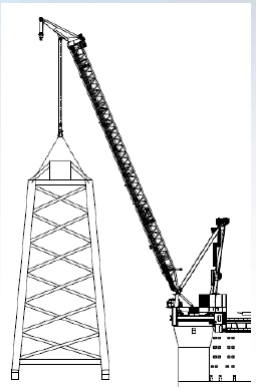
Wave + Current



Wind + Inertia + External (feeder e.g.)

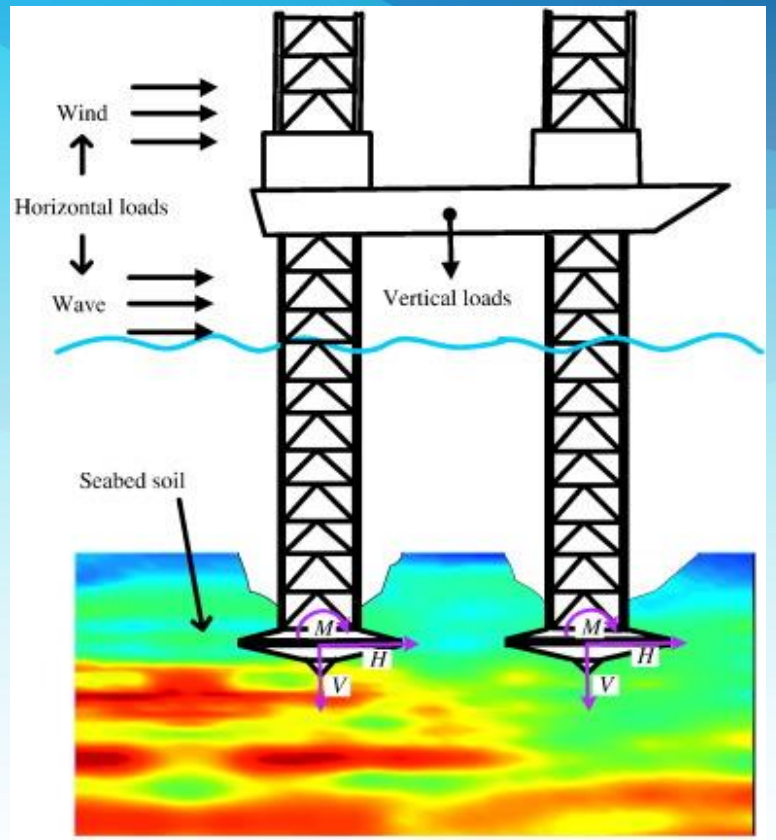






(Adaptative) Ground Model

A Jack-up is as Good as its Foundation!



Credit: The bearing capacity of spudcan foundations under combined loading in spatially variable soils, paper by Li Li, Jinhui Li, Jinsong, Huang, Hongjun Liu, Mark Cassidy

RISK	METHODS FOR EVALUATION & PREVENTION
Installation problems	- Bathymetric survey
Punch-through	- Shallow seismic survey - Soil sampling and other geotechnical testing and analysis
Settlement under storm loading/Bearing failure	- Shallow seismic survey - Soil sampling and other geotechnical testing and analysis - Ensure adequate jack-up preload capability
Sliding failure	- Shallow seismic survey - Soil sampling and other geotechnical testing and analysis - Increase vertical footing reaction - Modify the footing(s)
Scour	- Bathymetric survey (identify sand waves) - Surface soil samples and seabed currents - Inspect footing foundations regularly - Install scour protection (gravel bag/ artificial seaweed) when anticipated
Seafloor instability (mudslides)	- Side scan sonar, shallow seismic survey - Soil sampling and other geotechnical testing and analysis
Gas pockets/ Shallow gas	- Digital seismic with attribute analysis processing (shallow seismic)
Faults	- Shallow seismic survey
Metal or other object, sunken wreck, anchors, pipelines etc.	- Magnetometer and side scan sonar - Diver/ROV inspection
Local holes (depressions) in seabed, reefs, pinnacle rocks or wooden wreck	- Side scan sonar - Diver/ROV inspection
Legs stuck in mud	- Geotechnical data - Consider change in footings - Jetting
Footprints of previous jack-ups	- Evaluate location records - Consider filling/modification of holes as necessary

Table of GeoHazards from SNAME T&R 5-5A and needs updating!

Objectives

- **Establish target reliabilities for the jack-up while elevated to safely increase operability.**
- **Assess the uncertainties and risk in the planning and execution of operations to install and remove the jack-up.**

Deliverables

- **Guideline (early deliverable) – w/commentary and glossary**
- **SNAME J-REG Bulletin – CTRs, discussion groups**

OWF Jack-up in Transit

Courtesy DEME Offshore

Thank you for your attention this concludes the presentation

Questions?