



GeoSea

Geotechnical & Offshore Solutions

Member of the **DEME Group**

Foundation Design for Offshore Windfarms in India

Presenter: Aditya Narain Sinha

DEME GROUP at a glance

- ▶ Dredging, Environmental & Marine Engineering (DEME)
 - Almost **175 years** of experience; turnover of **Euro 2.4 billion**; **± 4,300 workforce**
 - Active in over 90 countries; **worldwide experience** and presence
 - Over **100 main vessels** backed by a broad range of auxiliary equipment
 - The DEME Group advocates a consistent partnering philosophy (herein advocating “**Make-in-India**”)

- ▶ DEME is a global solutions provider for
 - Dredging & Land Reclamation
 - Marine & Offshore Solutions (OWF installations + EPCI -> GeoSea)
 - Fluvial & Marine Aggregates
 - Environmental Solutions
 - Project Development (OWF concession -> DEME Concessions)
 - Related Services



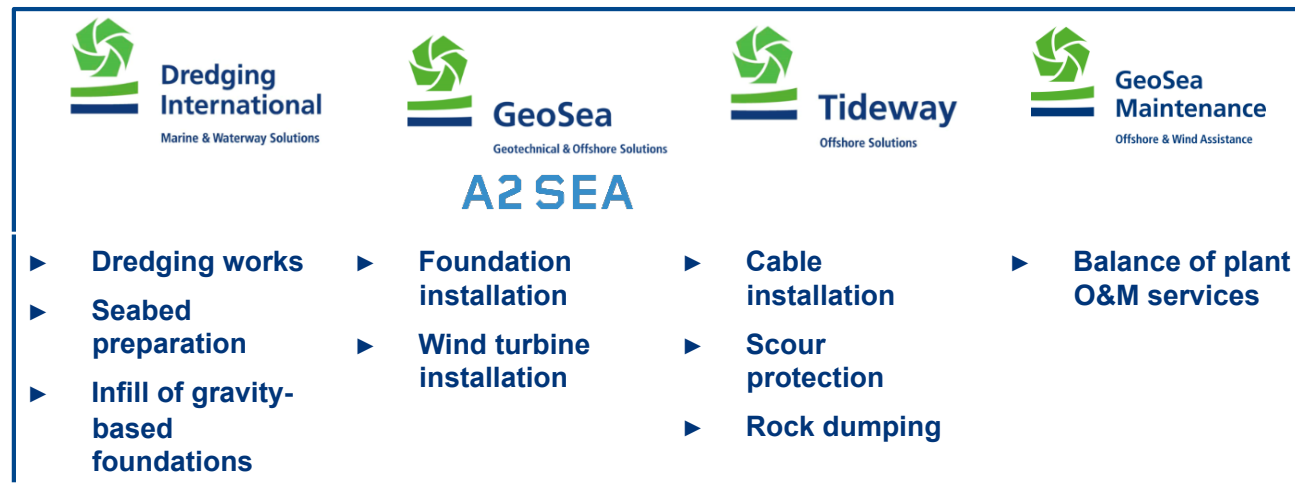
International Seaport Dredging Pvt Ltd



- **International Seaport Dredging Pvt Ltd (ISD)**, is based here in Chennai.
- ISD is a company fully incorporated in India in 2004.
- ISD is a subsidiary of **DEME Group**.
- Larsen & Toubro holds a minority stake in ISD.
- ISD is to date “one of the most qualified Indian dredging companies”



DEME's Renewables activities



GEOSEA NV



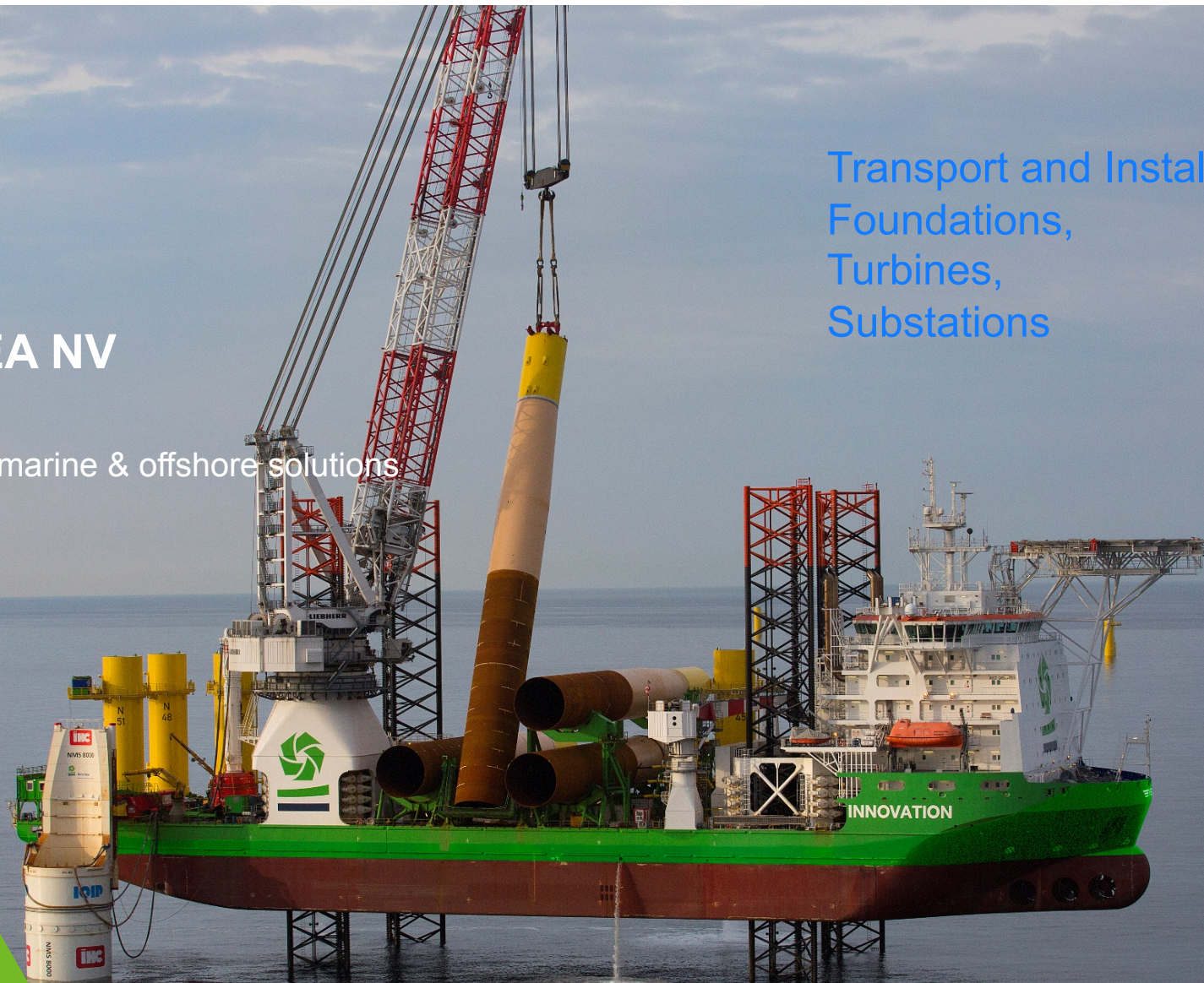
Innovative marine & offshore solutions

Transport and Installation of:
Foundations,
Turbines,
Substations



GeoSea

Geotechnical & Offshore Solutions



GeoSea N.V.'s activities



► GeoSea is DEME's specialist in complex offshore marine engineering projects; and its scope includes:

- Foundations (Monopiles, GBF, Jackets- pre-piling and post-piling)
- Transport and installation of WTG
- Operation and Maintenance
- Survey and soil investigation; amongst others.

► GeoSea undertakes contracts, such as, T&I, EPCI, BoP, etc.

► GeoSea has installed over **1800** foundations and many more in project execution stage.

► In-house engineering for the most efficient installation method.

- ✓ Naval Architects; Structural and Civil Engineers; Marine/Offshore Engineers; Geotechnical Engineers & Geologists.

► GeoSea continues to expand its fleet of own specialized equipment.



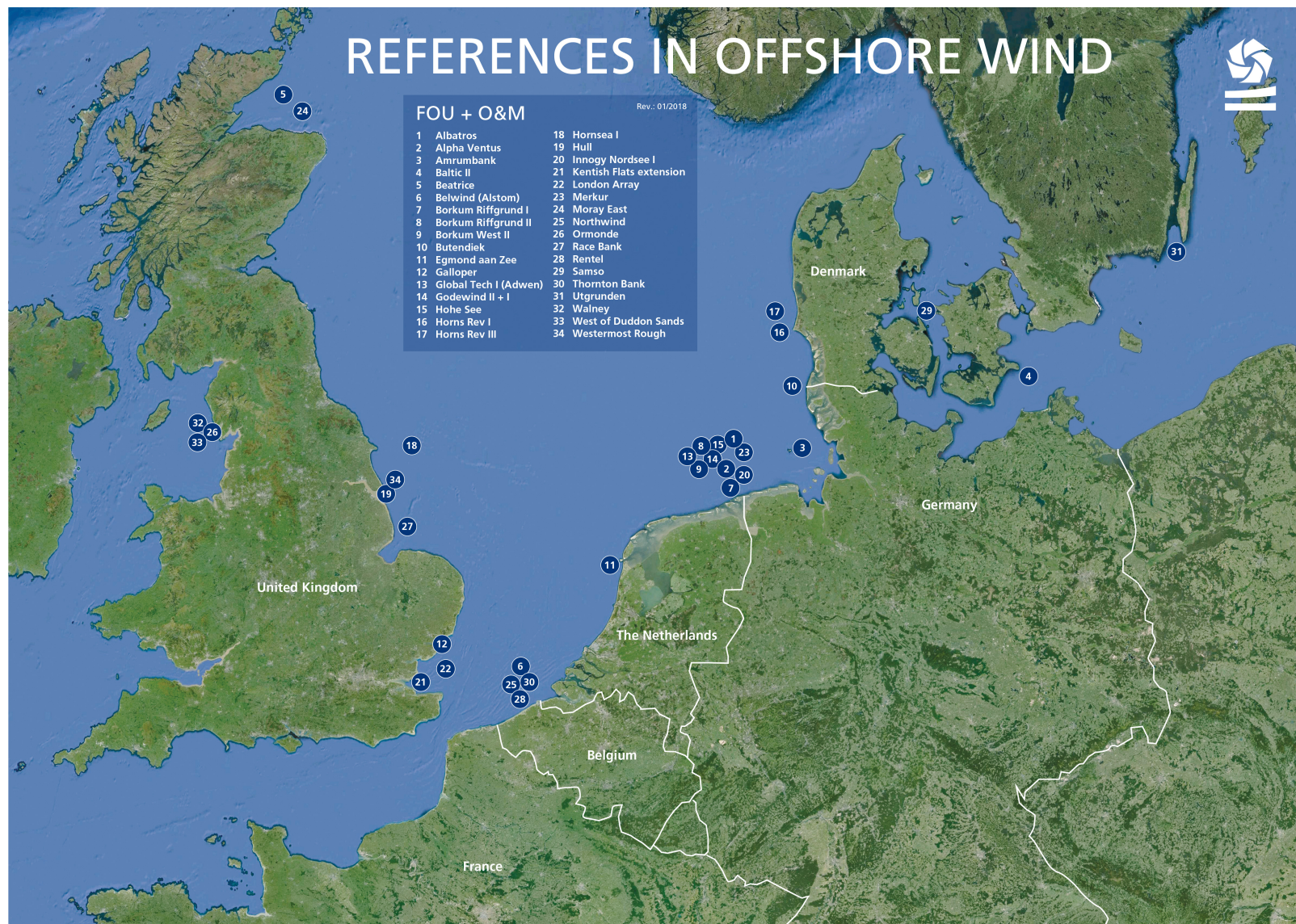
REFERENCES IN OFFSHORE WIND



FOU + O&M

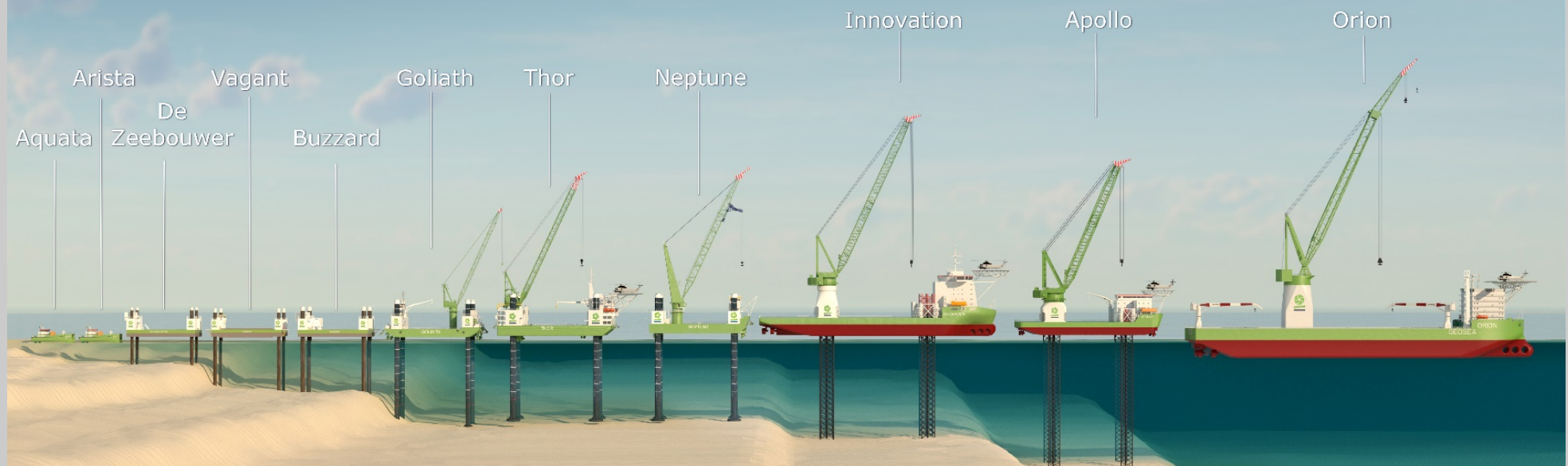
Rev.: 01/2018

- | | |
|--------------------------|----------------------------|
| 1 Albatros | 18 Hornsea I |
| 2 Alpha Ventus | 19 Hull |
| 3 Amrumbank | 20 Innogy Nordsee I |
| 4 Baltic II | 21 Kentish Flats extension |
| 5 Beatrice | 22 London Array |
| 6 Belwind (Alstom) | 23 Merkur |
| 7 Borkum Riffgrund I | 24 Moray East |
| 8 Borkum Riffgrund II | 25 Northwind |
| 9 Borkum West II | 26 Ormonde |
| 10 Butendiek | 27 Race Bank |
| 11 Egmond aan Zee | 28 Rentel |
| 12 Galloper | 29 Samso |
| 13 Global Tech I (Adwen) | 30 Thornton Bank |
| 14 Godewind II + I | 31 Utgrunden |
| 15 Hohe See | 32 Walney |
| 16 Horns Rev I | 33 West of Duddon Sands |
| 17 Horns Rev III | 34 Westernmost Rough |



UTURE





Vessels and specialist professionals

Latest investments in the DEME offshore fleet

“ORION”

- ▶ Heavy Lift Installation Vessel
- ▶ 3,000 tonnes crane capacity
- ▶ DP3 positioning
- ▶ 8,000 m² deck space



GULLIVER



“GULLIVER”

- ▶ Heavy Lift Vessel
- ▶ 4,000 tonnes crane capacity
- ▶ DP2 positioning
- ▶ Operating draft of 5m

“APOLLO”

- ▶ Heavy Lift Jack-up Vessel
- ▶ 800 tonnes crane capacity
- ▶ Ideal for wind turbine installation and oil & gas
- ▶ Extendable legs up to 100m



“LIVING STONE”

- ▶ Multi-purpose vessel
- ▶ Cable laying & rock dumping
- ▶ DP3 positioning
- ▶ 12,500 tonnes load capacity



Foundations

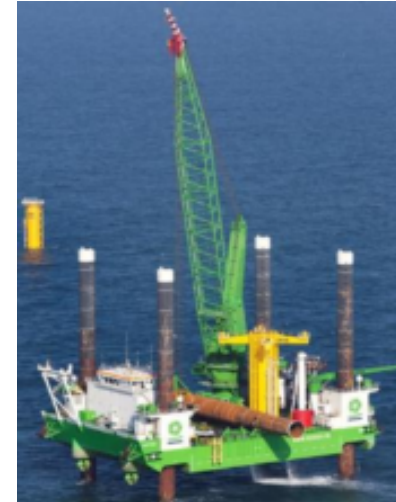


FOUNDATIONS



► Experiences with:

- Monopile Foundations
- Gravity Based Foundations
- Jacket Foundations (market leader in pre-piling technology)
- Suction Bucket Jackets
- *Floating (in planning stage)*



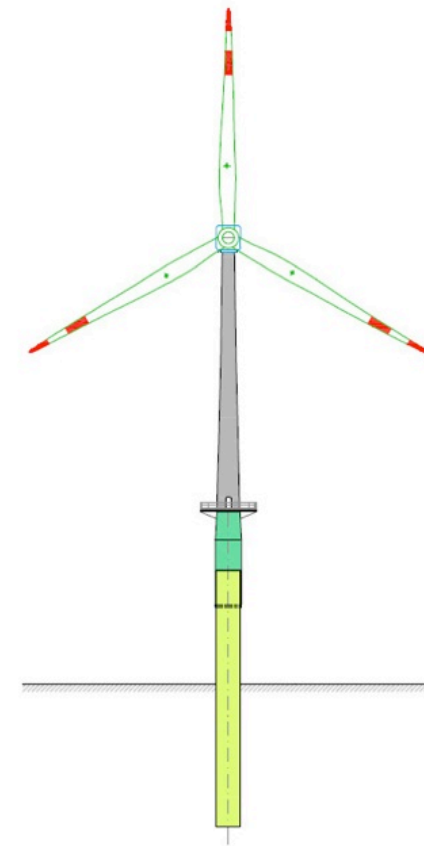
DEME | CREATING LAND FOR THE FUTURE



Foundations: Monopiles



- Material: steel
- Water depth: 0m - 45m
- Soil Conditions: no seabed preparations
all types of soil
- Weight: 150 - 1500 mT
(1700 mT in tender stage)
- Time to fabricate: 7 to 10 days
long procurement steel
- Logistics: road transport possible
barge - coaster
- Installation: Jack Up/Floating + HD Hammer



DEME | CREATING LAND FOR THE FUTURE



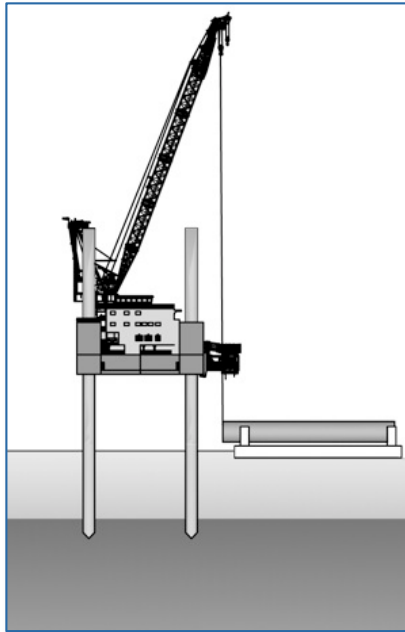
Foundations: Monopiles- Fabrication



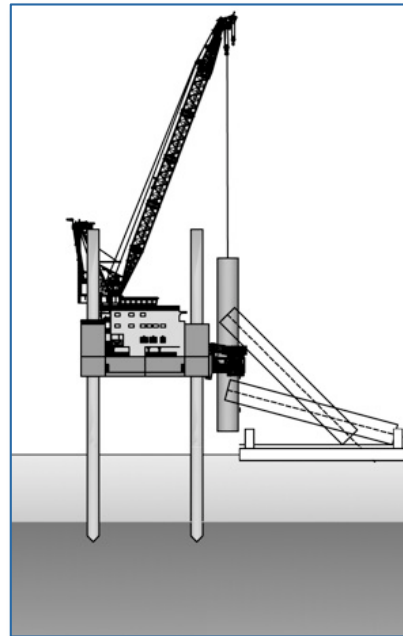
DEME | CREATING LAND FOR THE FUTURE



Foundations: Monopiles- Installation Method

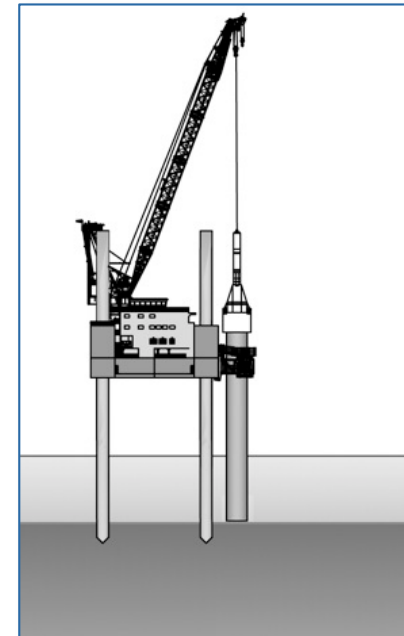


Position JU & MP barge



Upend MP

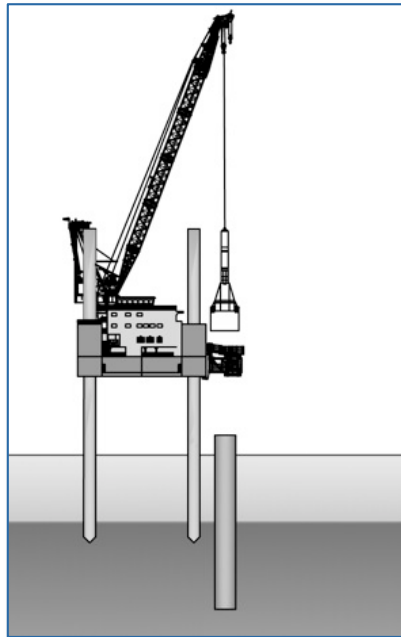
Depending on the weight of the MP it can be upended from the JU or with a shear leg vessel



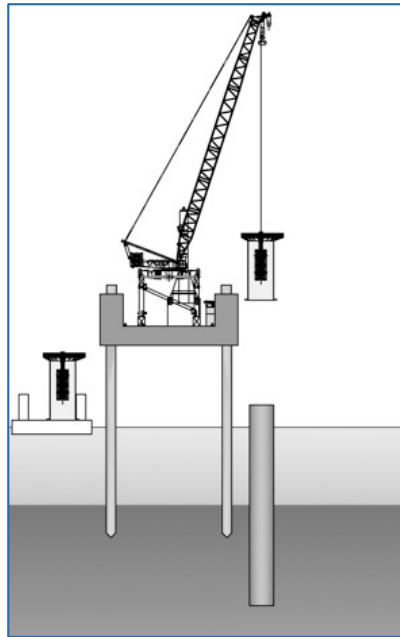
Position Hammer on MP



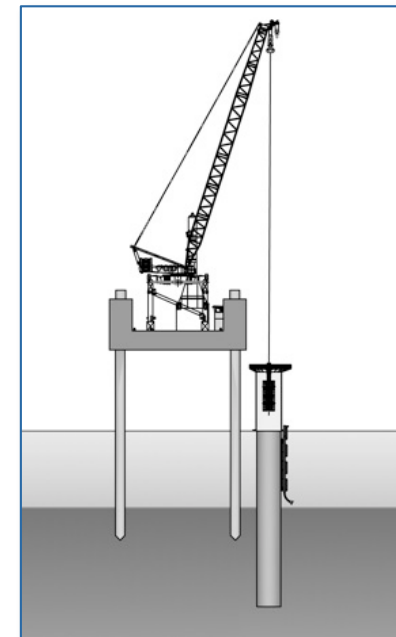
Foundations: Monopiles- Installation Method ...contd



Drive MP to depth



Lift TP



Position and grout TP



Foundations: Monopiles- Installation Method



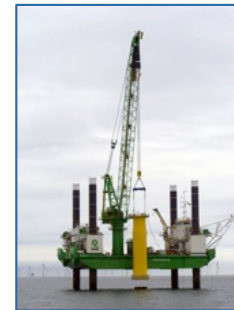
Upend MP



Position MP in frame



Place Hammer



Install TP



Foundations: Monopiles

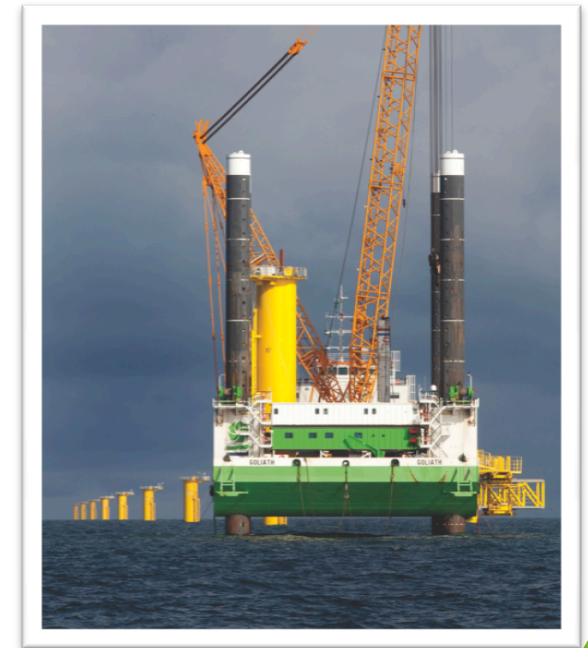


Foundations: Monopiles



► Some Examples

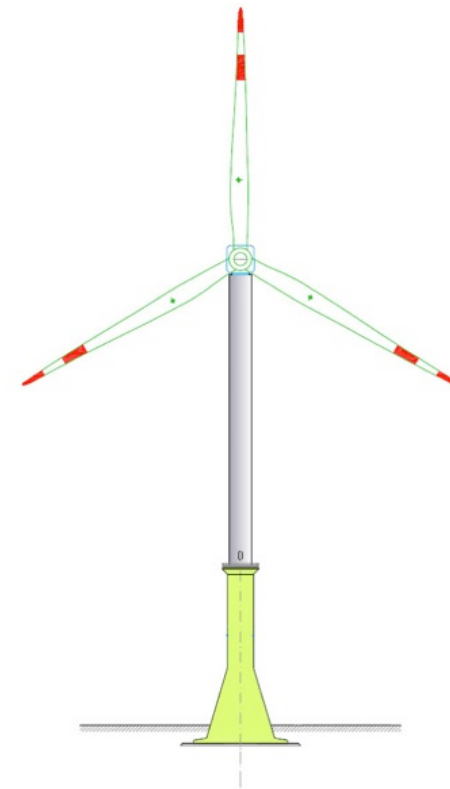
- Merkur
- Hornsea 1
- Samso
- Walney
- NorthWind
- Baltic II
- WODS
- GodeWind
- Westernmost Rough
- Borkum Riffgrund
- Kentish Flats Ext, *NordSee 1, Galloper, ...*



Foundations: Gravity Based



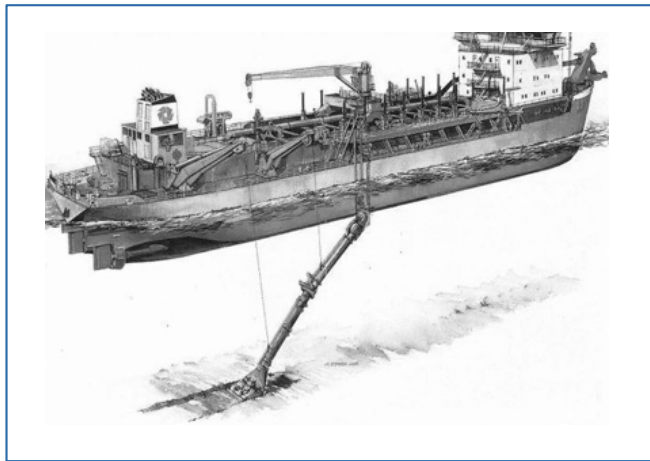
- Material: concrete and steel
- Water depth: 0m - 30m
- Soil Conditions: seabed preparations
no weak soil
- Weight: > 1000 mT
- Time to fabricate: several months
- Logistics: fabrication close to shore
- Installation: dredging vessel
rock dumping vessel
heavy lift vessel



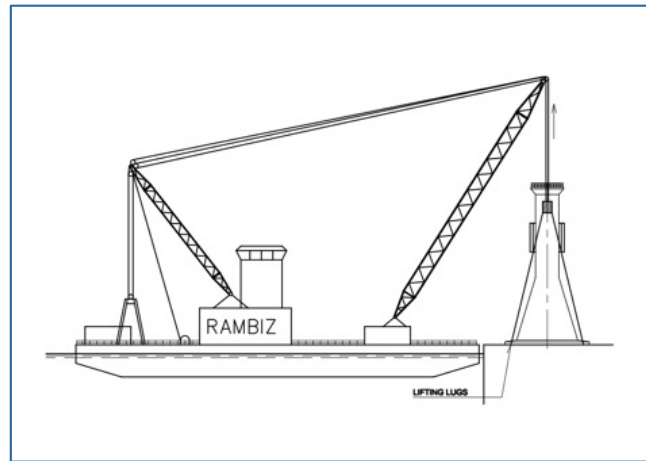
Foundations: Gravity Based- Fabrication



Foundations: Gravity Based- Installation Method



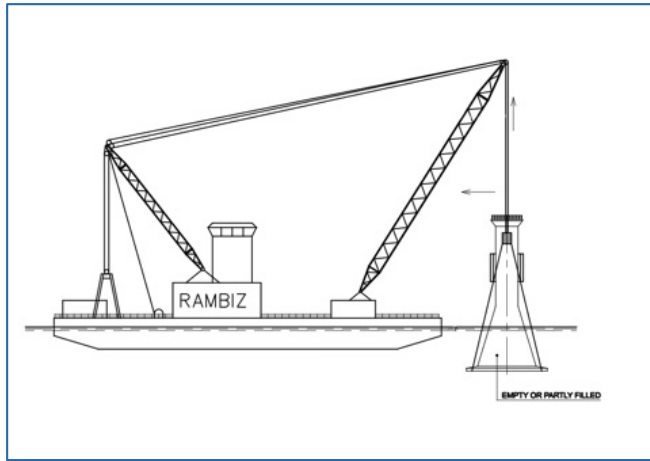
Seabed preparation



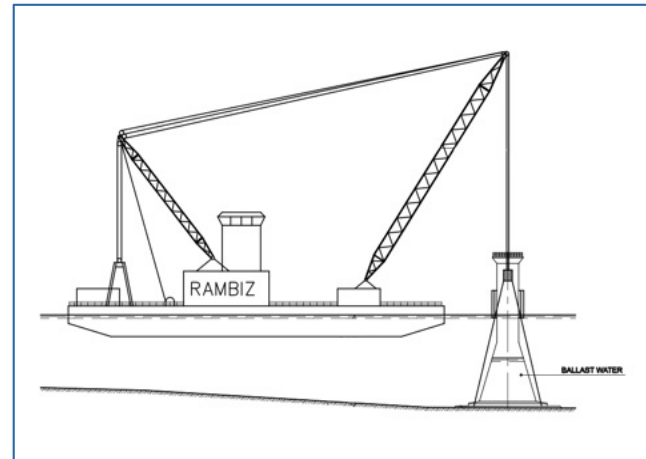
Lift GBF from quay wall



Foundations: Gravity Based- Installation Method ...contd



Transport to site



Position and lower GBF



Foundations: Gravity Based- Installation Method



Sea bed preparation



Lift GBF from quay wall



Transport to site



Position and lower GBF



Foundations: Gravity Based



Thornton Bank



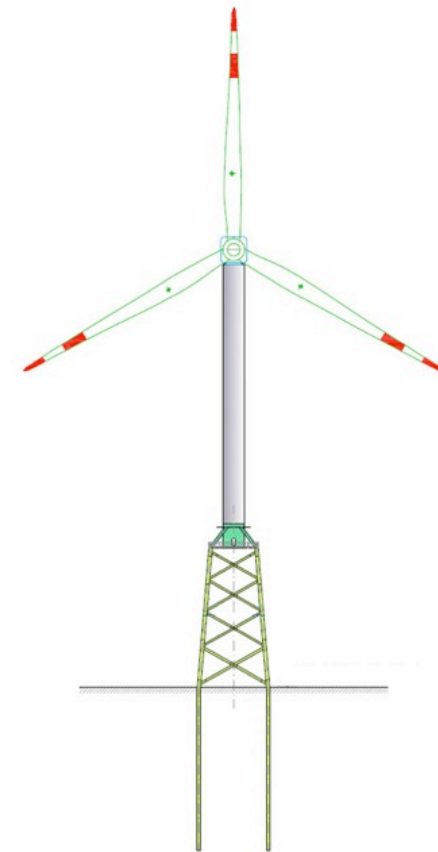
DEME | CREATING LAND FOR THE FUTURE



Foundations: Jackets



- Material: steel structure
- Water depth: 20m - 55m
- Soil Conditions: no seabed preparations
all types of soil
- Weight: 350 - 1300 mT
(1500 mT in tender stage)
- Logistics: road transport possible
- Installation: Jack Up/Floating + Hammer
Heavy Lift Vessel



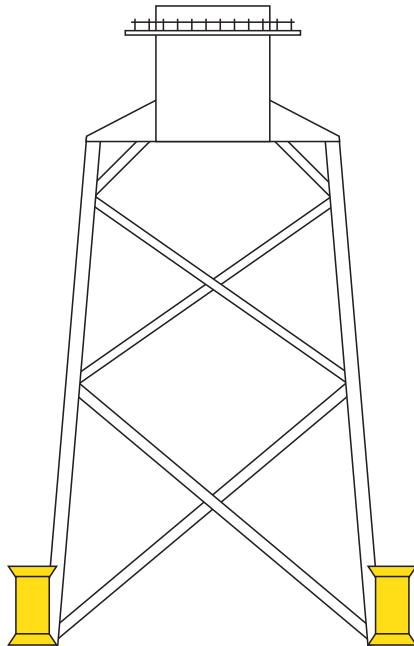
DEME | CREATING LAND FOR THE FUTURE



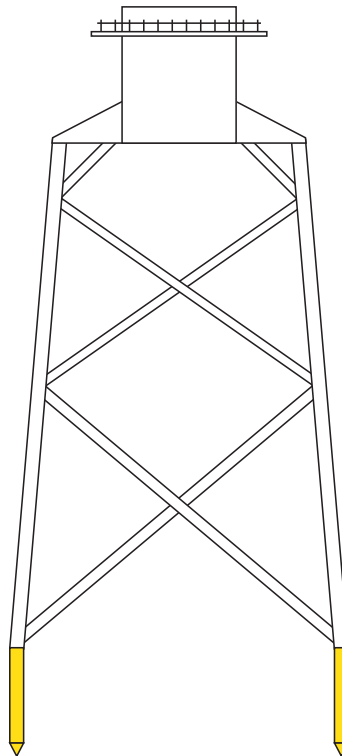
Foundations: Jackets- Types



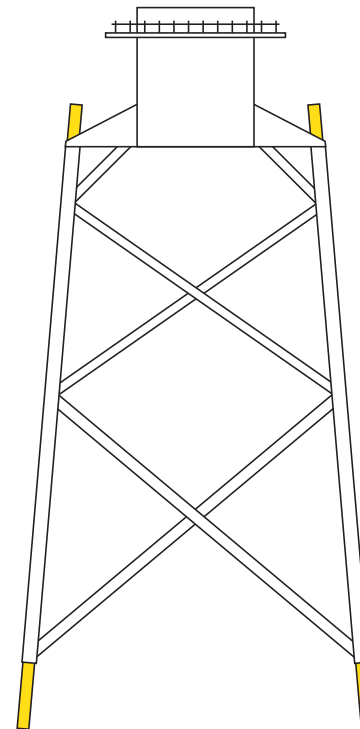
Post piling “short”



Prepiling



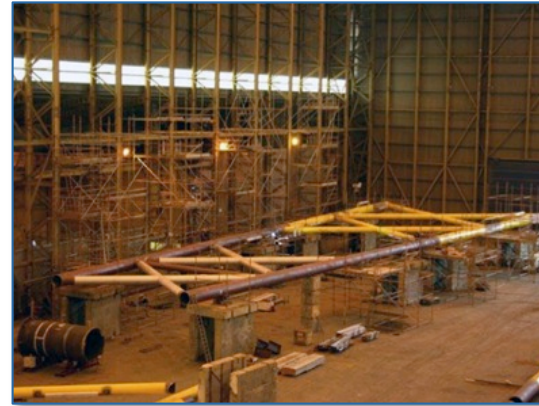
Post piling “long”



Foundations: Jackets- Types



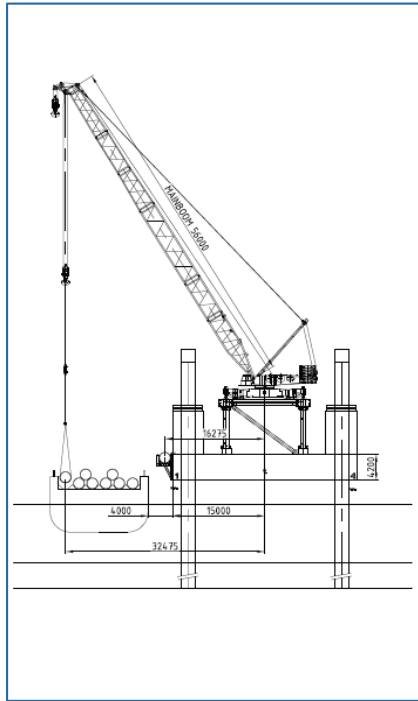
Foundations: Jackets- Fabrication



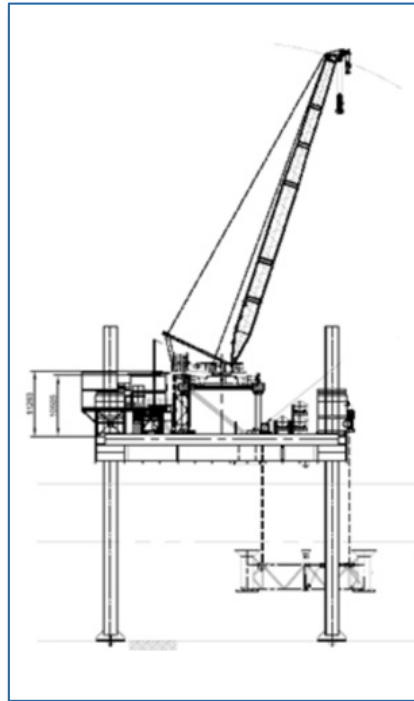
DEME | CREATING LAND FOR THE FUTURE



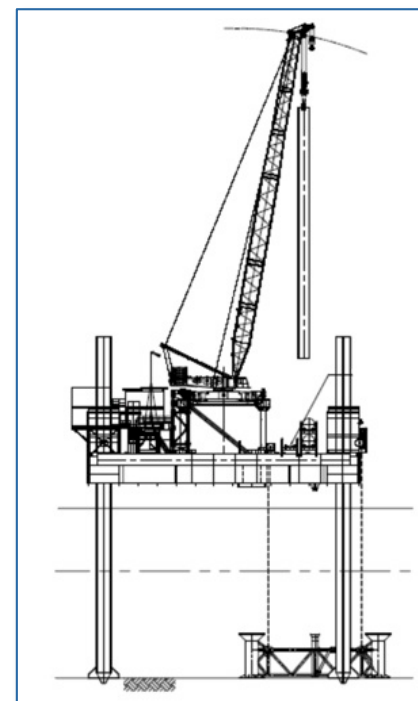
Foundations: Jackets- Installation Pre Pilling



Load piles



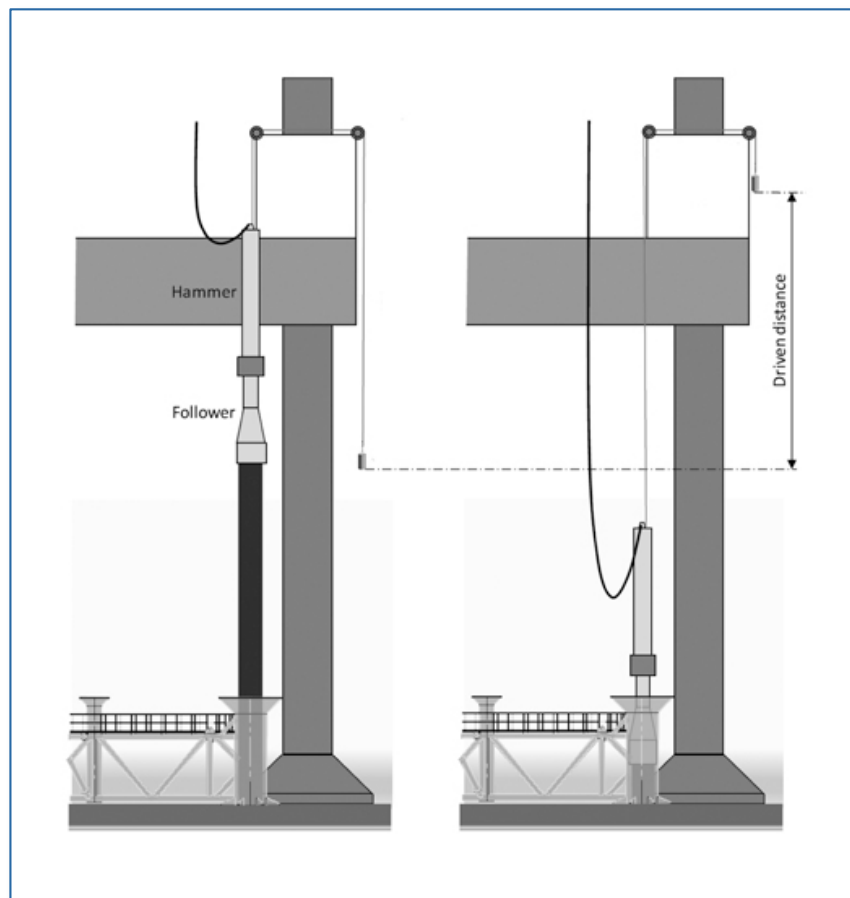
Lower frame



Upend pile



Foundations: Jackets- Installation Pre Pilling



Drive piles



Foundations: Jackets- Installation Pre Piling



Piling frame



Lowering frame



Load piles



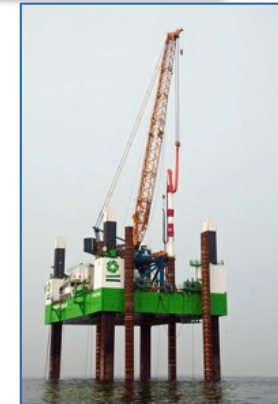
Upend pile



Position hammer



Driving piles



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Foundations: Jackets- Installation Pre Pilling



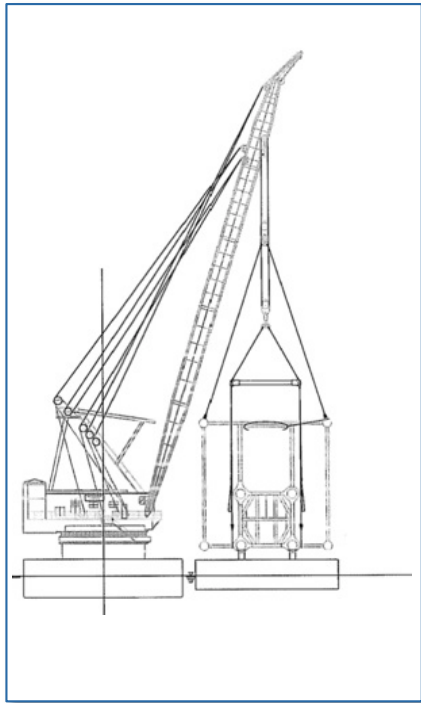
Lift and
install jacket



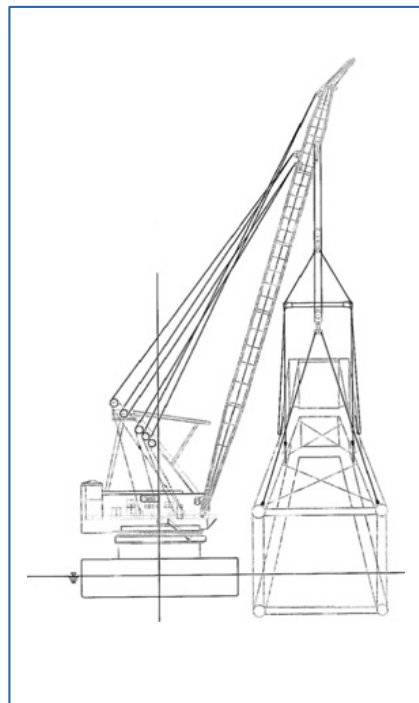
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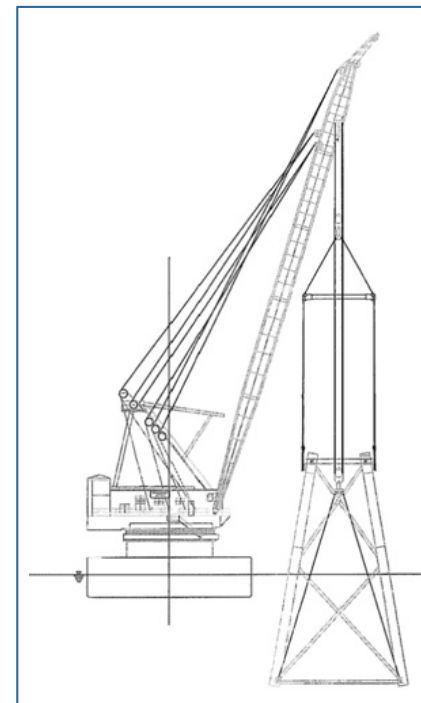
Foundations: Jackets- Installation Post Piling



Positioning Jacket and rig



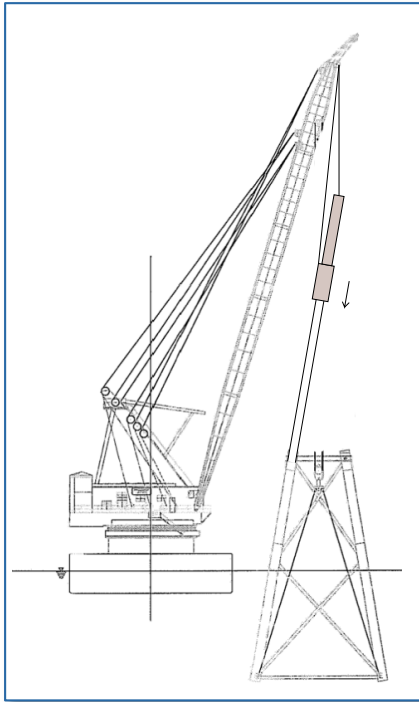
Upending jacket



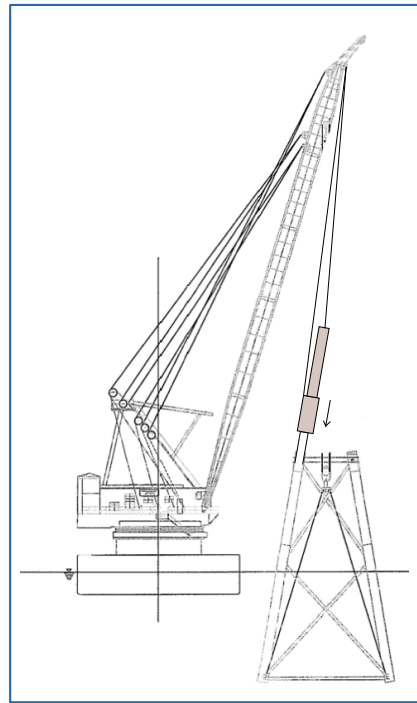
Positioning jacket



Foundations: Jackets- Installation Post Pilling ...contd



Positioning pile and hammer



Hammering pile



Foundations: Jackets- Installation Post Piling



Transport Jacket



Upending jacket



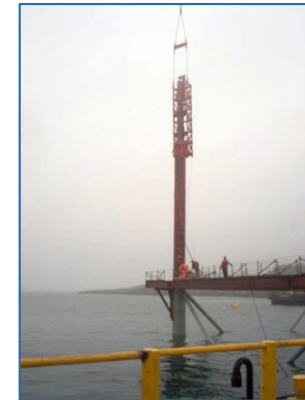
Positioning jacket



Positioning pile



Positioning hammer



Hammering pile

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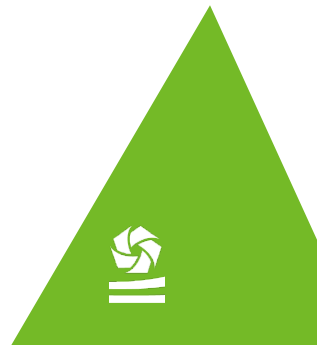


Foundations: Jackets



► Some examples:

- Alpha Ventus
- Ormonde
- Thornton Bank (in picture →)
- Belwind – Alstom demo
- Borkum West II
- Baltic II
- *NNG*



Foundations: Suction Bucket Jackets



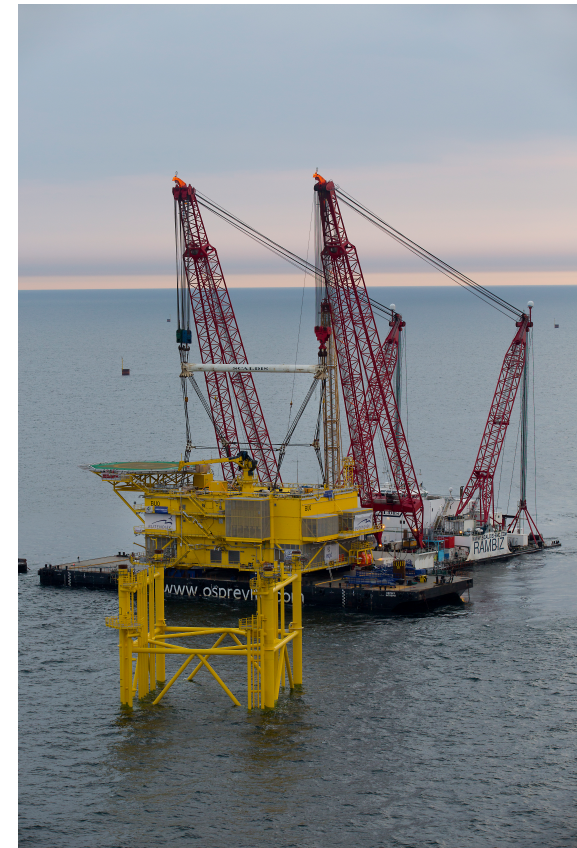
- Prototype installed in Borkum Riffgrund 1
- To install soon 20 in Borkum Riffgrund 2



Offshore Substations- Installation



Transport and Installation of OSS foundations and topsides.



Environmental concerns: Noise mitigation



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INDIA Focus



- ▶ GeoSea is looking forward to being an active part in the developments of the Indian Offshore Wind Market and is keen to discuss further on how to:
 - Maximize the local content
 - Locally made offshore WTG
 - Further reduce the cost of installation; as well as the overall cost
 - Minimize environmental concerns
 - Make-In-India

- ▶ **DEME** advocates local partner philosophy in countries worldwide. GeoSea has partnered with local companies in China and Taiwan respectively.





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