UMACK

Anchor

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 731200

CorPower Ocean UMACK

The UMACK Anchor

- Suitable for sand/soil seabeds
- Ultimate Tensile Capacity > 18MN with <43 Te Mass per pile
- Resistance to cyclic loading
- Simple/reliable design, no moving parts = easy and cheap to manufacure
- Installation Method Vibrohammer, Installation < 1 hour
- Minimised impact to Marine Mammals (20-30dB less noise compared with Impact Piling).
- Can be 100% De-commissioned (nothing left in seabed)

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CorPower has developed the UMACK – a novel pile anchoring solution for floating structures

Product overview

UMACK – a ”universal, mooring, anchoring and connectivity kit”

Pile anchor for multiple sea-bed types, developed to replace conditional gravety-based anchors and large monopiles

Low complexity Marine Operations, reducing deployment (<1hr) and retrieval time by enabling fast installation compared to impact hammer driven monopiles.

Low complexity manufacture, simple design, no moving parts and can be made locally to project site

Synergies with range of marine technologies, including wave energy and offshore wind

Strong market potential due to high projected growth in ocean technologies

Key benefits

>18MN vertical holding capacity at only 43 tons of mass

<1h installation with significantly reduced noice levels and impact on marine life enabled by vibrohammer technology

<30 min deployment and retrieval time through quick connector

Simplified cable routing, mitigating the need for long dynamic cables

100 % decommissionable with nothing left in the seabed, limiting environmental impact

UMACK offers several advantages compared to conventional solutions

	UMACK	Monopile	Gravity base
Description	Single point mooring system hammered to the seabed	Large diameter forming a foundation	Large concrete foundation placed on the seabed
Component and installation CAPEX, € mn	Component CAPEX Installation CAPEX 1-2 <1 1-2	3-7 <1 3-7	6-9 ~1 5-8
Environmental impact	Limited – reduced noise (20-30dB less) during installation compared to impact hammer; low seabed space footprint; no traces after decommissioning	Medium – high noise installation due to pile hammering, affecting marine animals	High – deterioration of seabed due to weight and space; traces after decommissioning
Weight, tonnes	<43	150-200	2000+
Seabed type	← Sand/Clay →		All types
Commercial readiness	Commercialization by 2026/2027[1]	← Commercialized →	

Source: CorPower Ocean

1. Current TRL: 7-8; installation and deployment have been tested; lower scale testing completed

Key UMACK benefits vs conventional solutions

Compared with Monopile and Gravity base, respectively

71-98% lower mass

65-95% lower component costs

63-86% lower in installation costs

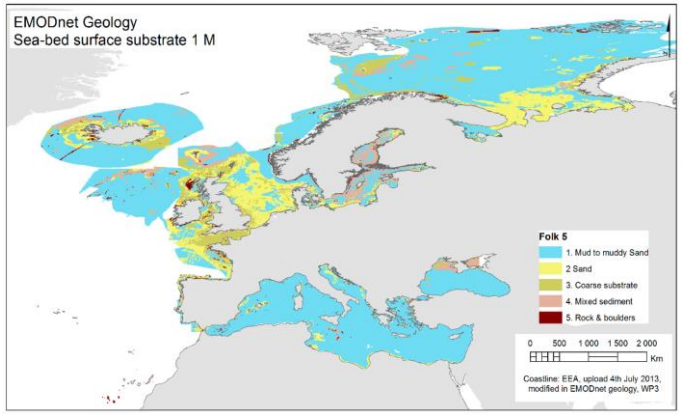
Reduced need for chains

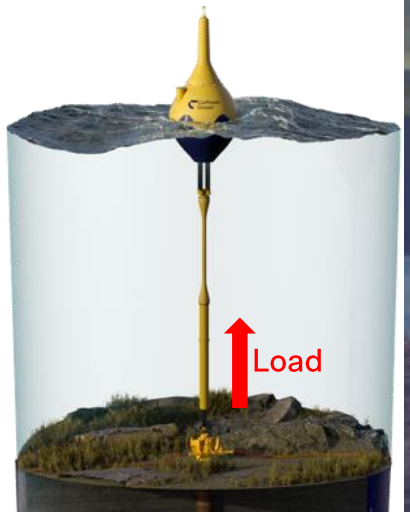
Reduced dynamic cable fatigue

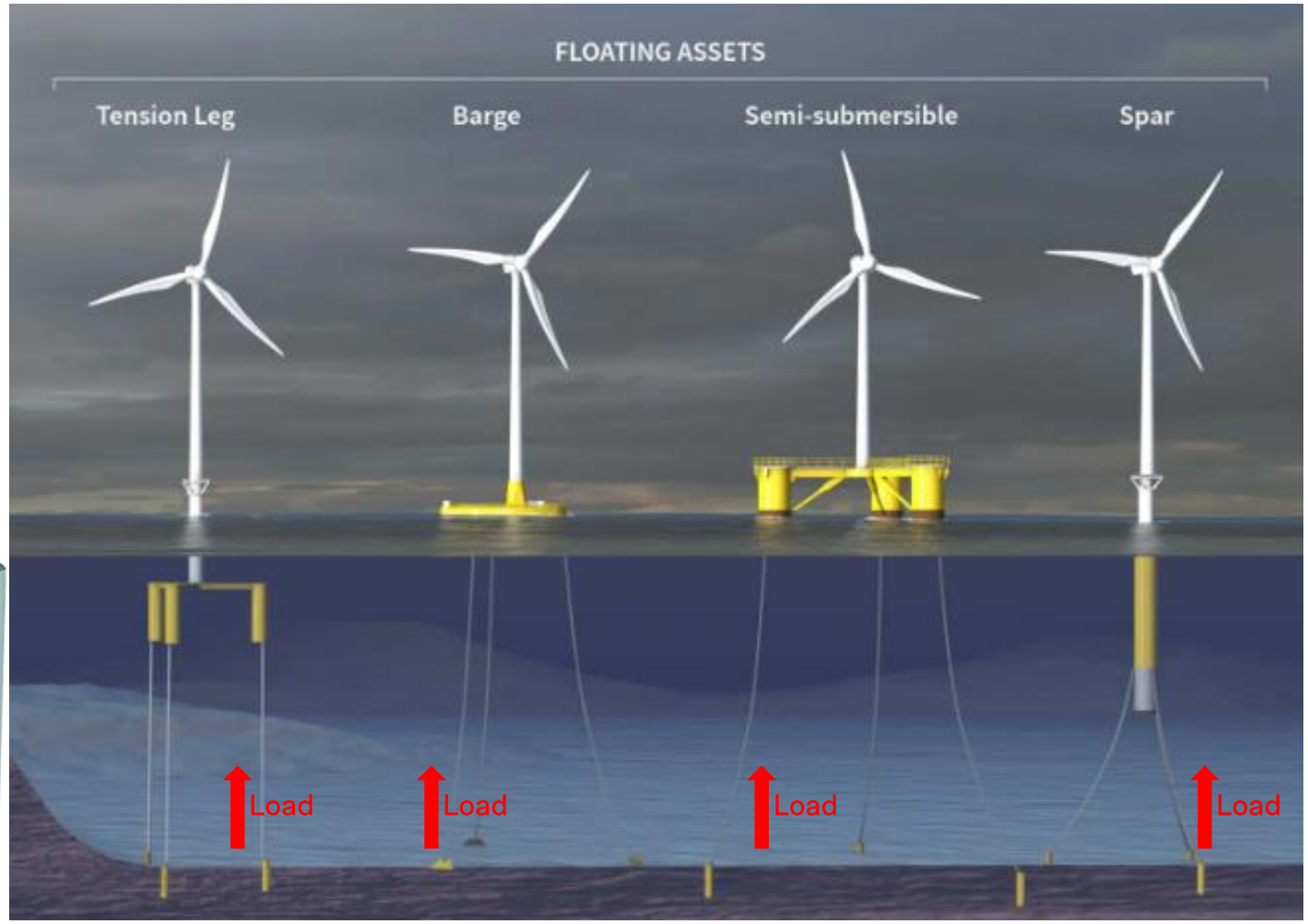
The Problem

Floating structures……

- ….require piles to resist large tensile loads
- ….require a cost-effective (high capacity to mass ratio) solution to help meet project financial targets
- …do not make best use of established pile solutions (more suited to compression) in a tensile use case
- …require a pile that performs well in sand/sediment type soils







Technical Anchor Design

Concept Evaluation

× **Gravity Base**

- Nuclear Option!

- High CAPEX

- Mass also induces large marine operations costs

× **Screw Piles**

+ Elegant solution

+ Excellent mass/capacity ratio via plate function in tension

- but **cannot be installed at required depths** for Wave or FOW capacity requirement (torque required to install to even 20m is around 2MNm!)

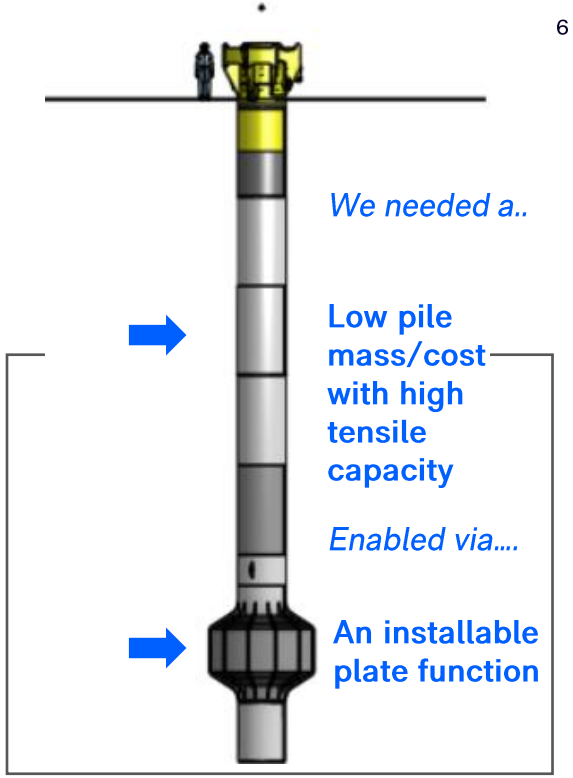
× **Monopile**

+ Well established solution

+ good mass/capacity ratio in compression

+ Can be installed to almost any depth (impact or vibrohammer)

- Possible for tension case but **very large pile needed**, complexed marine operations and costs too high for justification of deployment 1x WEC or 1 per each FOW mooring line



✓ **Monopile + Plate function? (UMACK Anchor?)**

+ Advantages in weight, cost, installability and handleability for marine operations.

+ Adding a plate function on the basic monopile added 4-5 times more holding capacity and

+ reduced main shaft diameter from 4.2m to 1.6m & mass from >160tonnes to <43tonnes compared to a plain monopile (base on wave use case).

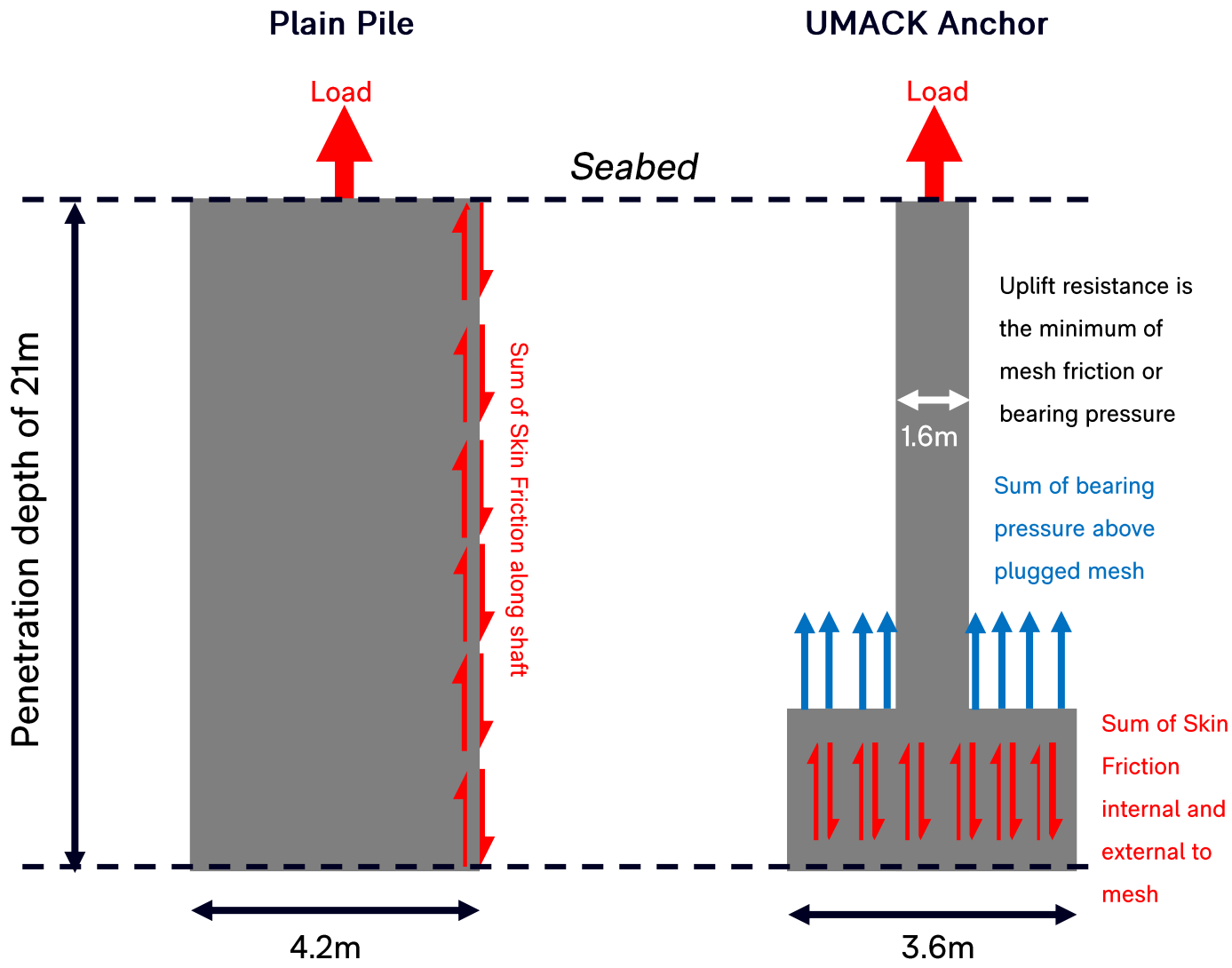
Technical Anchor Design

High Ultimate Tensile Capacity

Use case – Unfactored loads of 600t in tension // Factored design load of >1800t

Plain Pile - Pile uplift resistance is the sum of the skin friction developed along the pile length $\tau = \sigma_r \delta$. The outer diameter of the driven tubular pile required to resist the WEC uplift loads is 4.2m. End bearing lost in tension.

UMACK Anchor - Due to the efficiency of the mesh anchor much less steel is required. High bearing pressure over the “plate” or “mesh” crated reverse end bearing, missing from plain pile case.

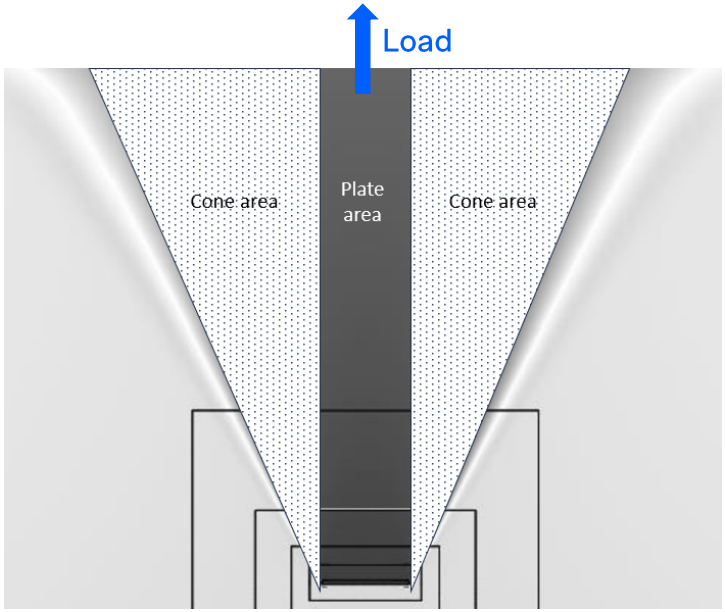


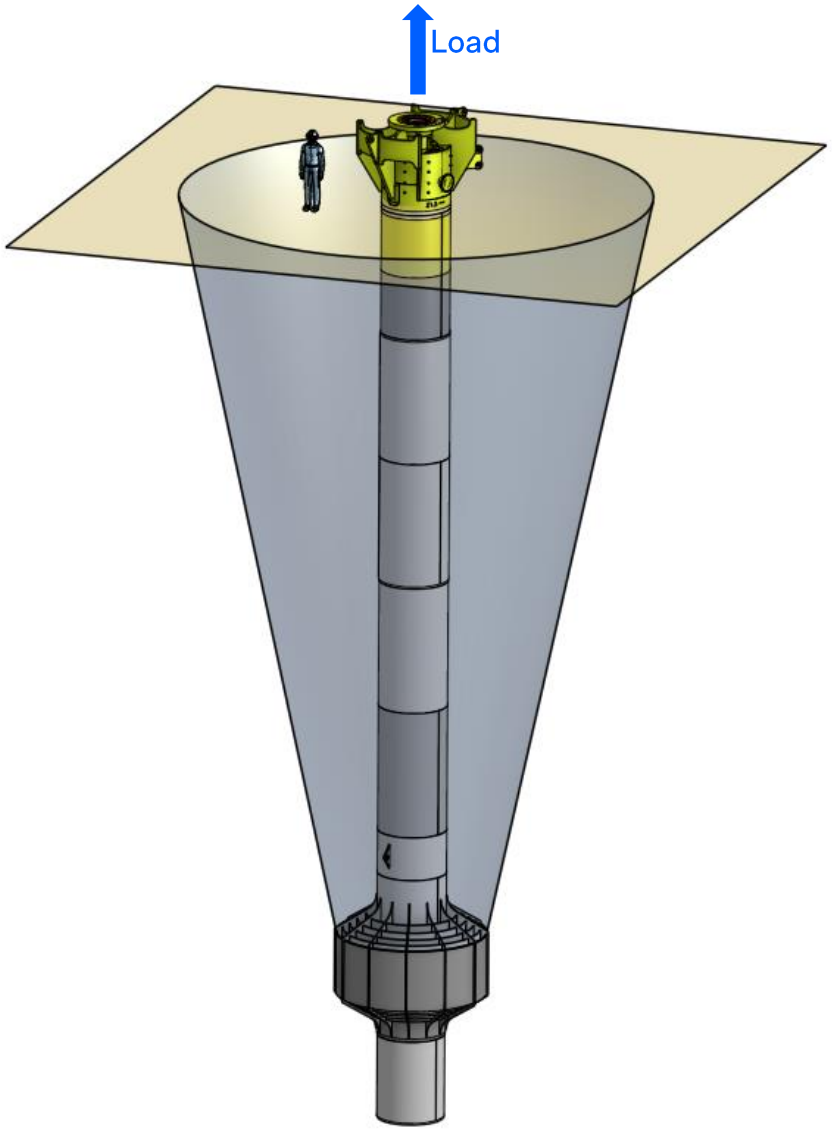
CorPower Ocean UMACK

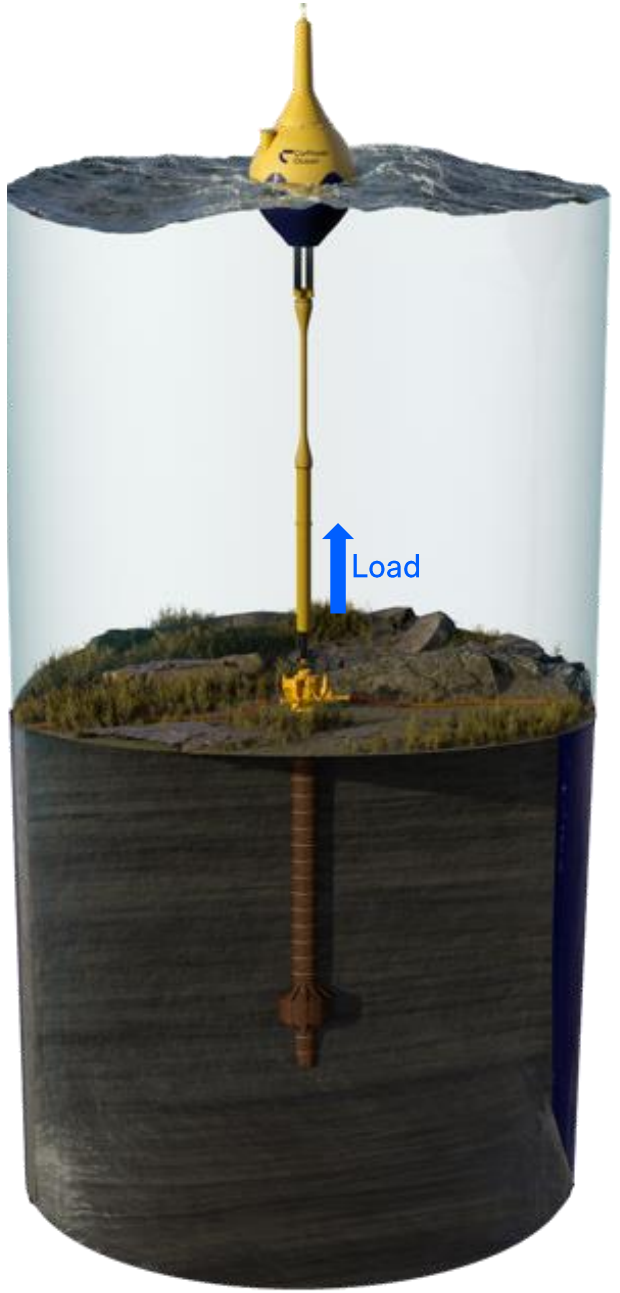
Technical Anchor Design

High Ultimate Tensile Capacity

- Mobilisation of large foundation cone for greatest capacity



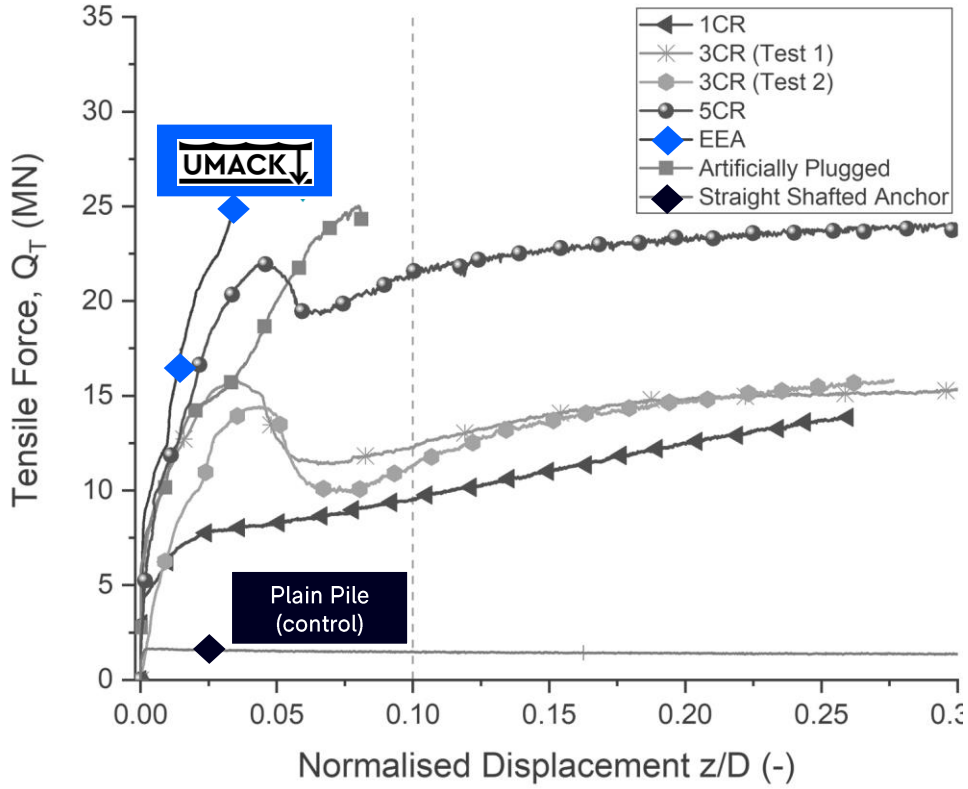


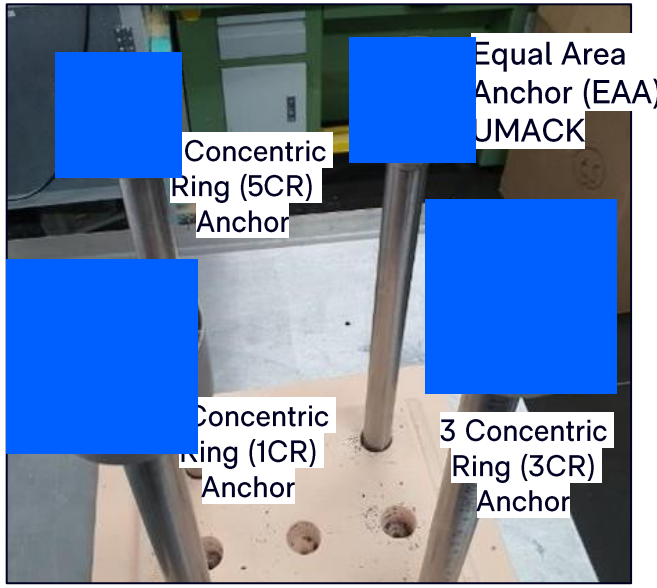


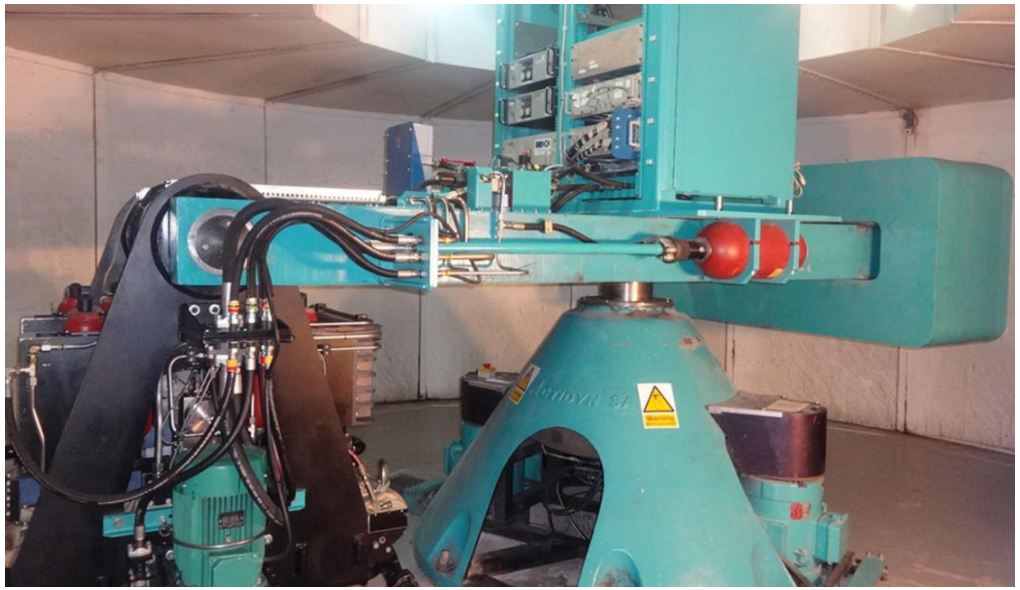
Capacity Verification Program

Centrifuge @ 1:50 Scale

The results showed a **significant increase in Pile holding capacity** as a result of the **innovative UMACK Pile** tip compared to a straight shafted Pile/Anchor





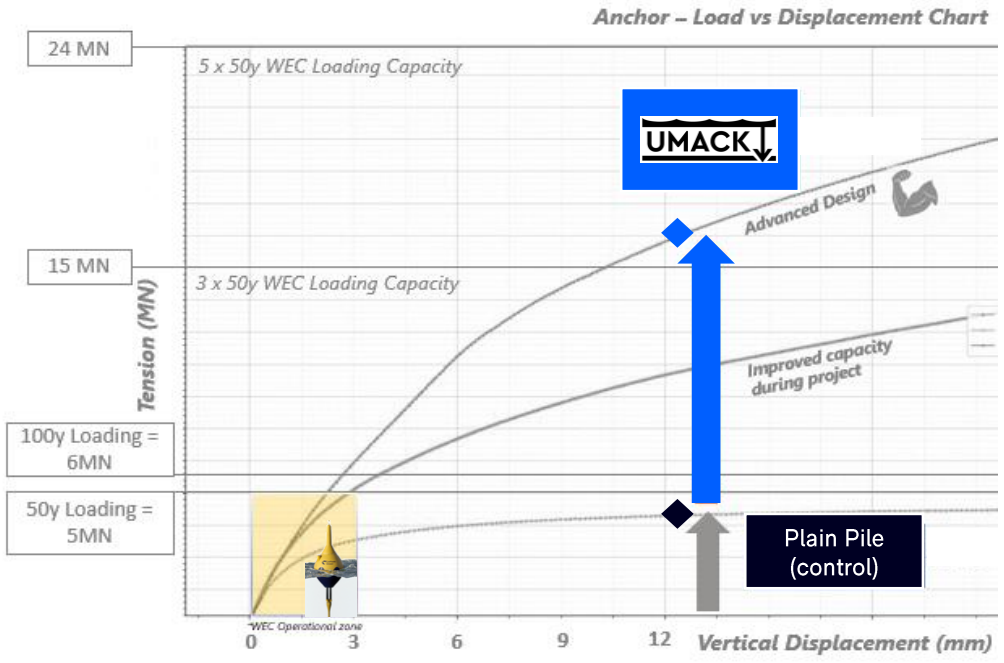


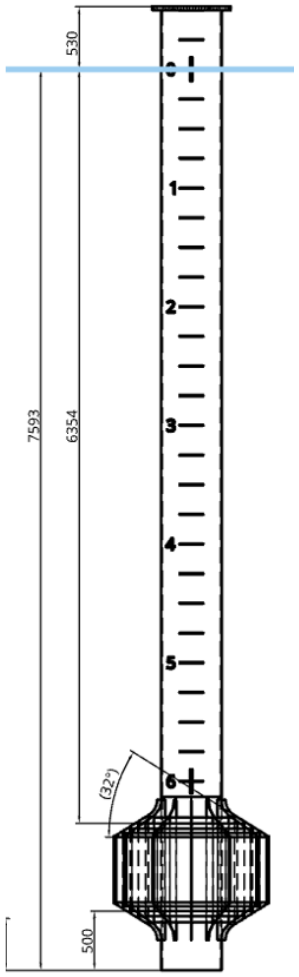
University of Dundee, Centrifuge testing of UMACK Anchors at 1:100 and 1:50 Scale

Capacity Verification

Field Trails & IWES Lab @ 1:2.75

Verified the performance of the Anchor design, load & cyclic tests were completed in controlled lab conditions at **IWES** and also repeated in the field close to the





Capacity Verification

Field Trails & IWES Lab @ 1:2.75

Able to successfully install with mesh via Vibrohammer

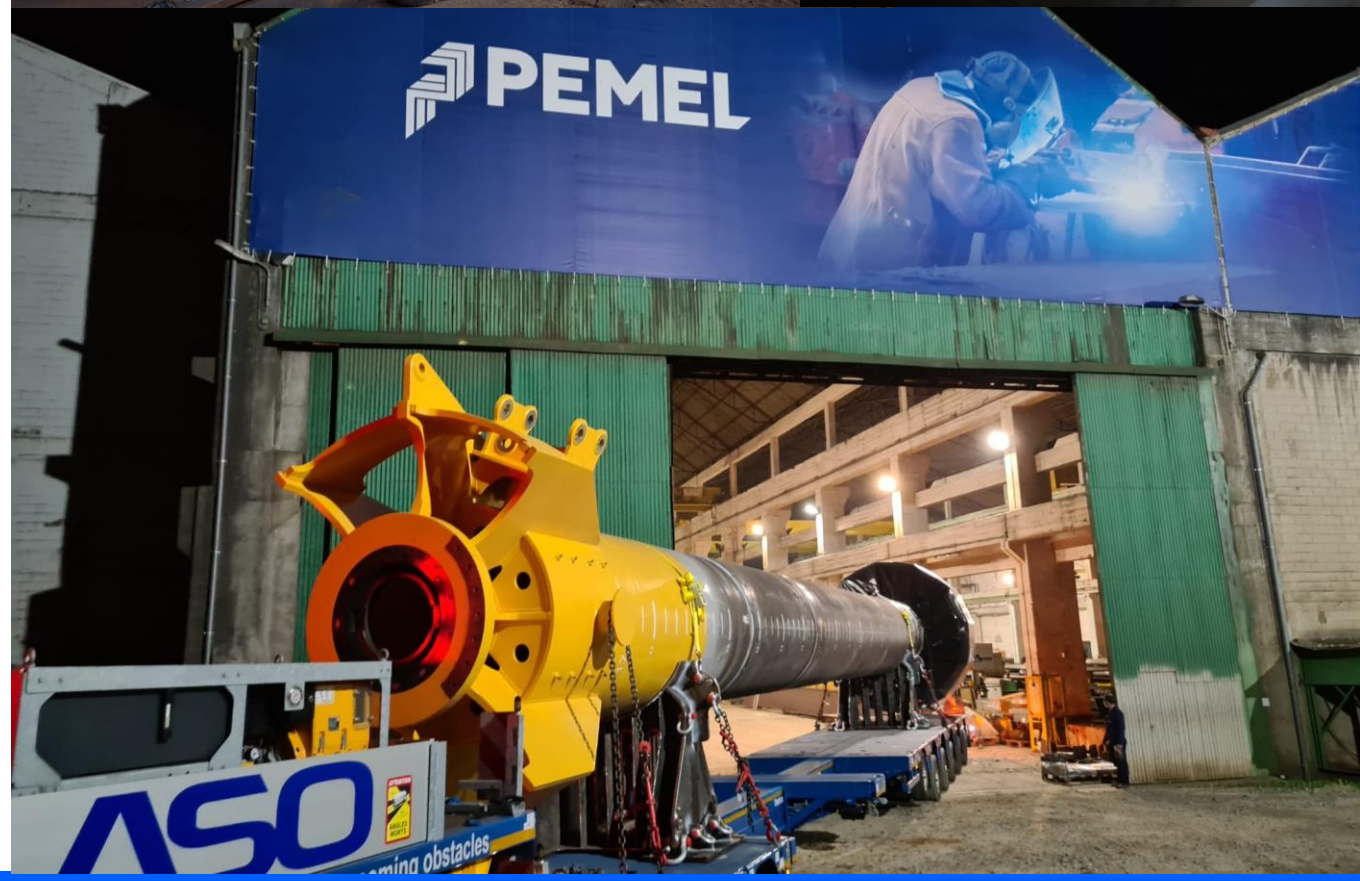
Able to fully remove pile by reversing the installation sequence – unlocking “plugging” in mesh via vibro

Fraunhofer IWES

Manufacturing

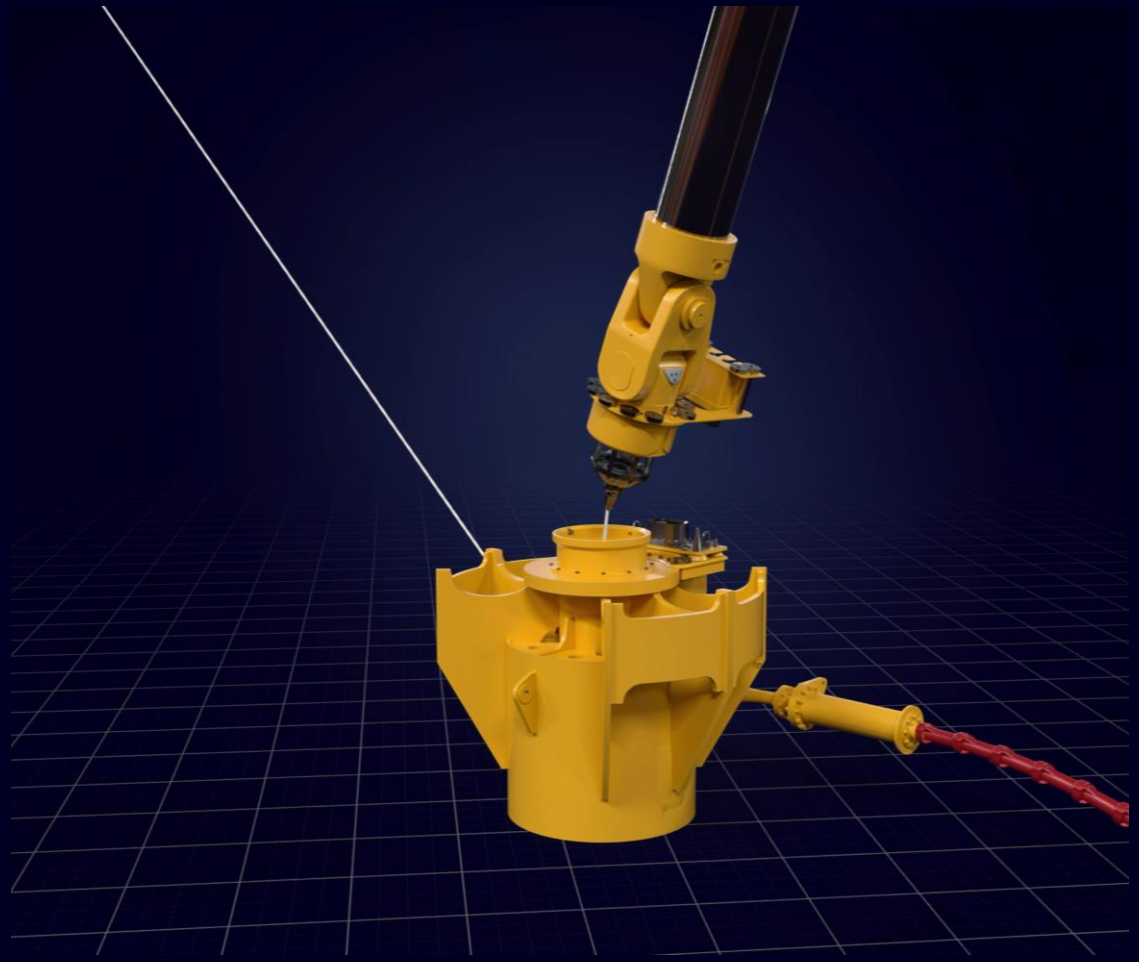
UMACK Anchor

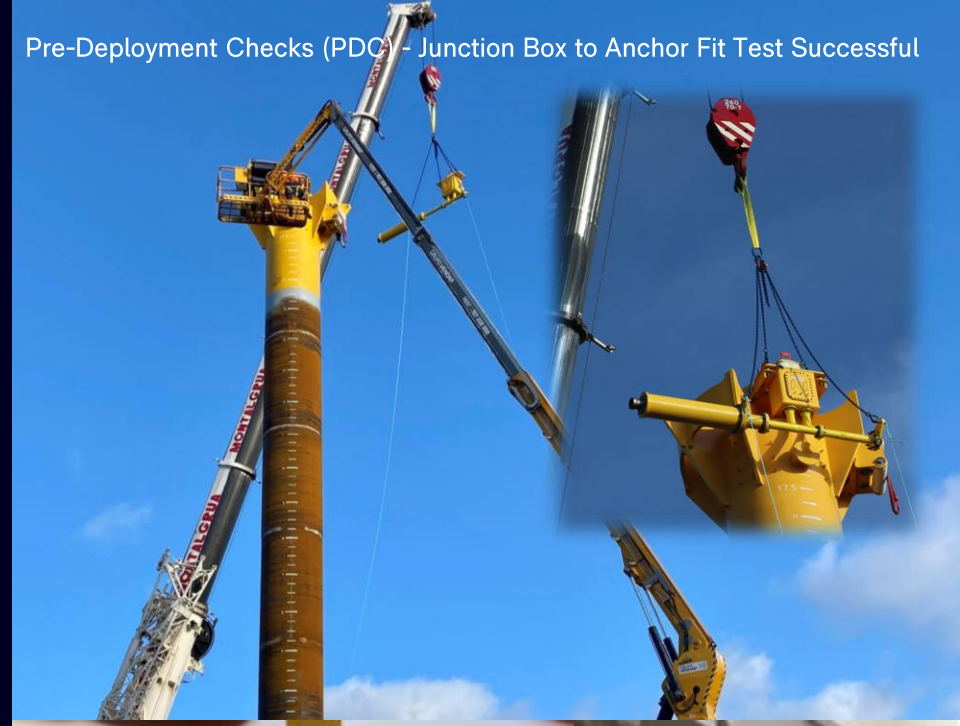
- No moving parts
- Easy to manufacture – a tube with some web and flanges
- The smart part was in the specification of the “mesh” layout but the complexity does not carry through to manufacture



System testing & Ocean Demonstration

UMACK Quick Connector





Pre-Deployment Checks (PDC) - Junction Box to Anchor Fit Test Successful

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Marine Operations

Successful Installation of the UMACK anchor


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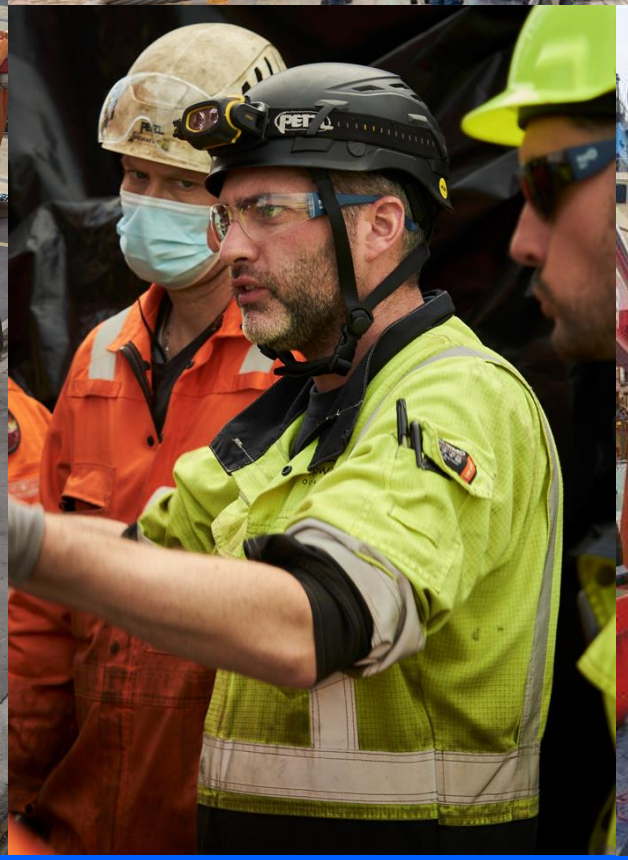
UMACK


500 MU
500MU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Next Steps: Adaptable to FOW Applications

Anchor loads scalable to FOW load requirements

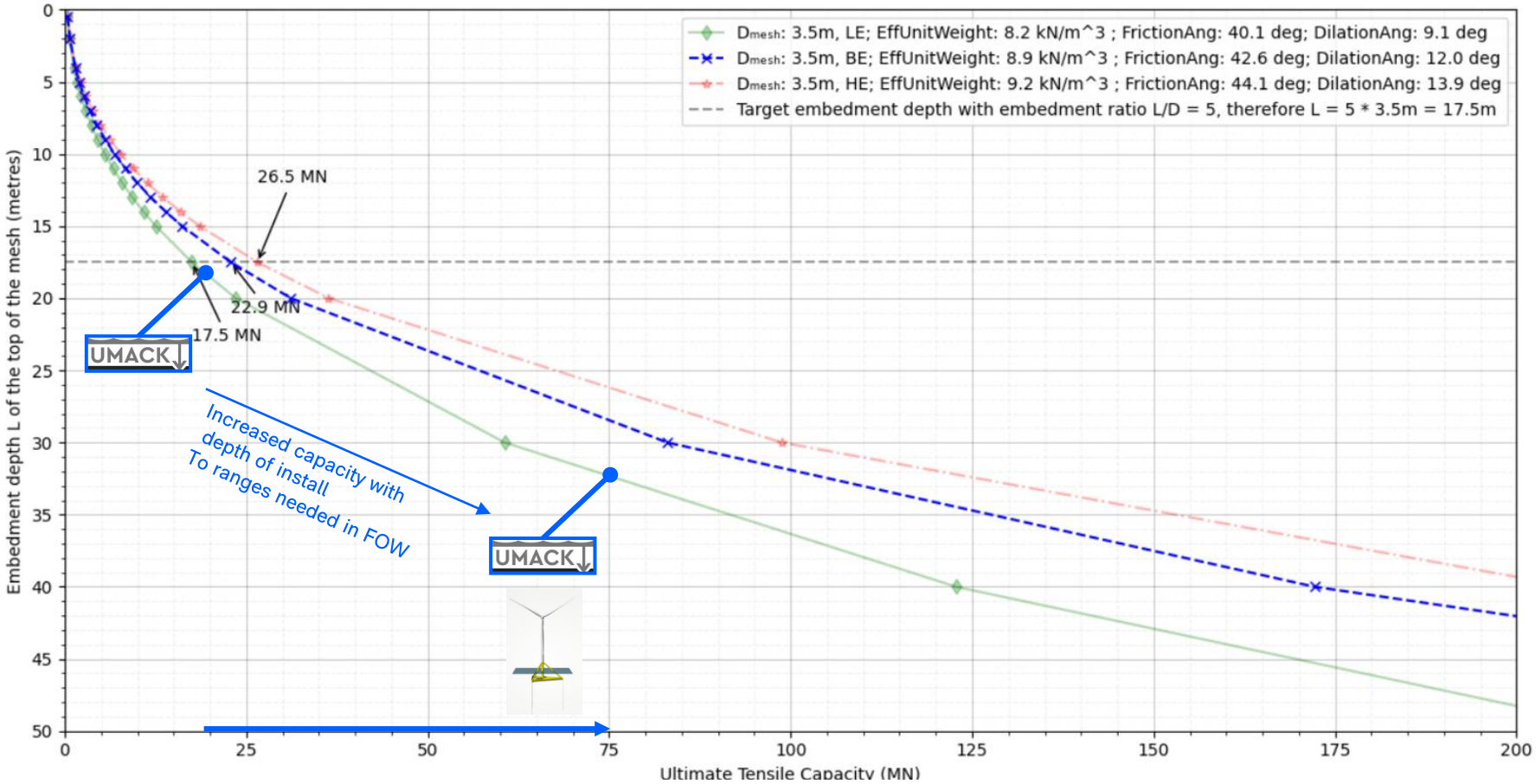
UMACK Anchor ultimate capacity **scalable to FLOW load requirements** by mainly **by varying install depth** at project site and other variable features of the anchor design.

Loading requirements for FLOW can be anywhere in range:

Capacity = 10 – 100+ MN

Depending on **mooring configuration** and **size of turbine** being considered for the FOW floating platform.

PreFEED/FEED studies available on request for your application.



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Client Initial Question Sheet

For initial screening so CPO can provide high level feedback.

Question #	Question	Client Answer
1	Project Location(s)	Please respond here
2	Project Seabed type (if known) (sand, clay, rock, etc)	Please respond here
3	Project Water depth(s)	Please respond here
4	# of units requiring anchoring & number of mooring lines	Please respond here
5	What are the high-level timelines for your project(s)? Particularly when you are planning to enter construction phase (anchor install / floater install etc)	Please respond here
6	Magnitude of the maximum loading units are putting on the anchor head. Both vertical and horizontal loads & angle of the mooring relative to the anchor/seabed. (unfactored loads are preferred so we can apply code geotechnical load factors)	Please respond here

Thank you

Matt Dickson CEng
Head of Projects
M: +46 734 293 864
<matt.dickson@corpowerocean.com>