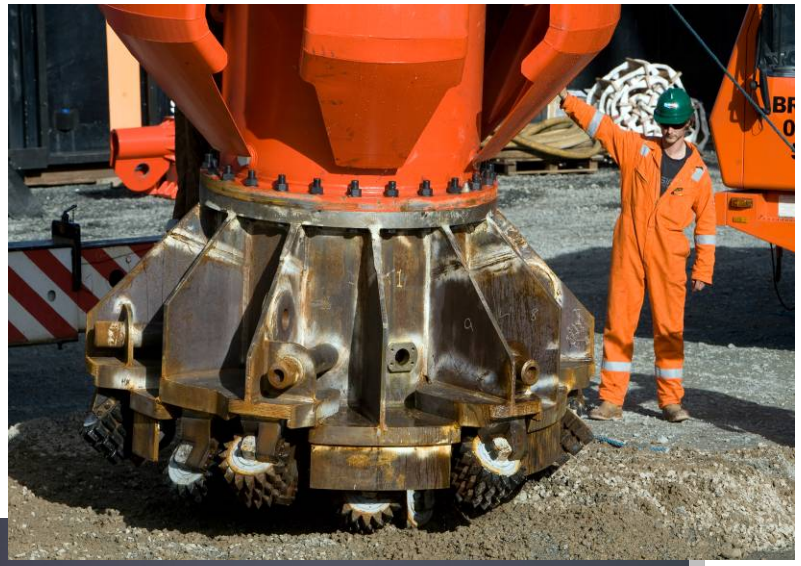
# Fugro Seacore Ltd

## Developments in XL Drilling for Monopiles/Shafts used in the offshore energy sector.

**June 2014**

# FUGRO SEACORE COMPANY PROFILE

- Seacore was formed in 1976
- Acquired by Fugro in 2007
- Approximately 500 employees
- Sales in 2013 were approximately £100m



# FUGRO SEACORE PROFILE

- We are a Cornish Company
- Built around local skill base - Mining, Fishing
- 7 acre purpose built facility in Falmouth
- Design, Build and Operate all our own equipment and plant.
- We are a Global business


# OVER 35 YEARS EXPERIENCE IN OVERWATER DRILLING


# Our fleet of pile top drill rigs

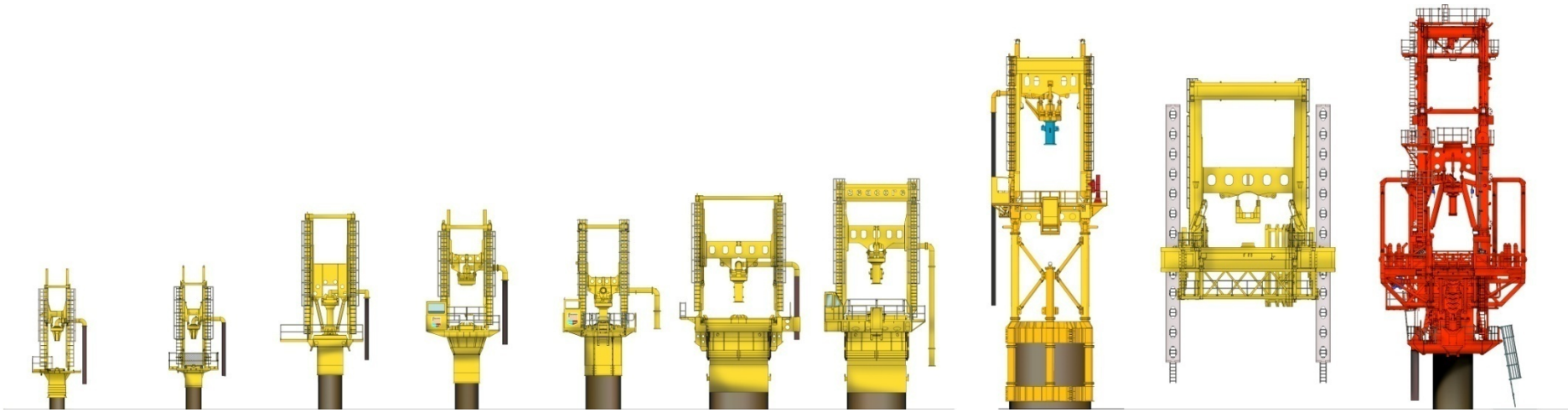
- We own and operate the largest known fleet of specialist pile top rigs within the market.
- All are fully containerised and modular.
- Flexible reconfiguration for each and every project.
- They provide cost effective solutions for a variety of marine drilling/piling requirements.
- Capable of drilling shafts from half a metre to seven metres in diameter.







# Fugro Seacore Drill Fleet



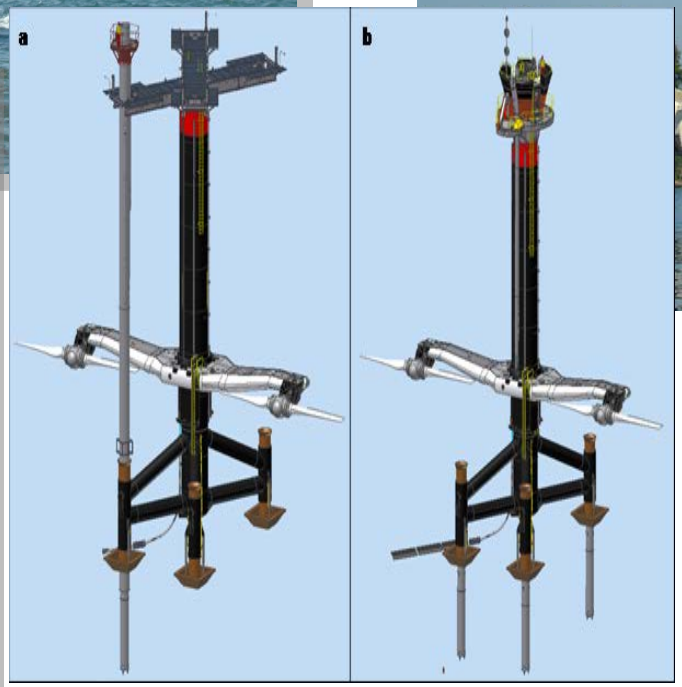
T3 T5 T8 T10 Mk 1 T10 Mk 2 T40 Mk 1 T40 Mk 2 T120 T90 Bespoke

# FUGRO-LARGE DIAMETER DRILLING RECORD

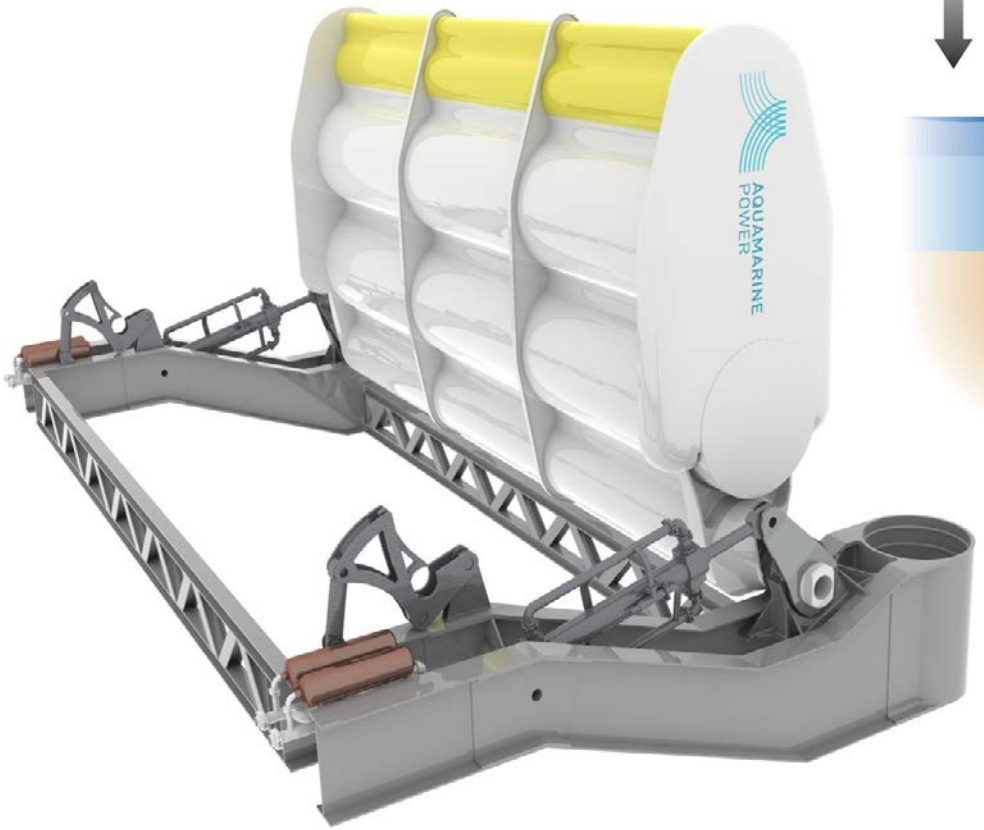

| Between 1987-2013 | Quantity |
|---|---|
| ▪0.5m Dia-2.0m Dia | 1358 |
| ▪2.0m Dia – 4.0m Dia | 245 |
| ▪4.0m Dia – 6.0m Dia | 102 |

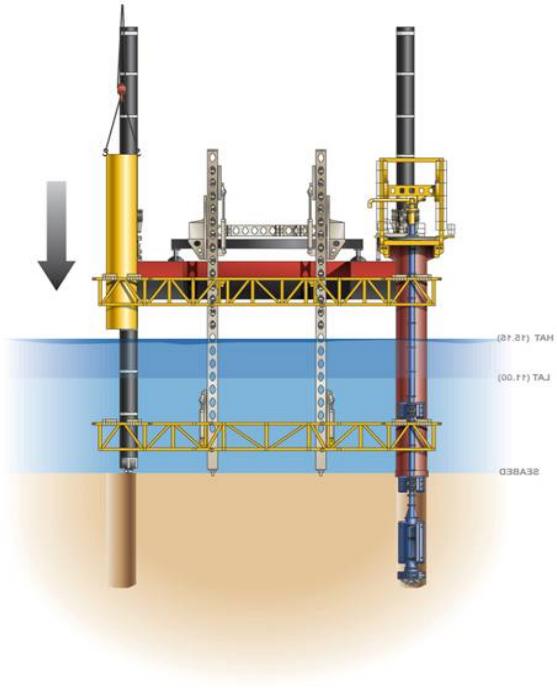
# Offshore Windfarms

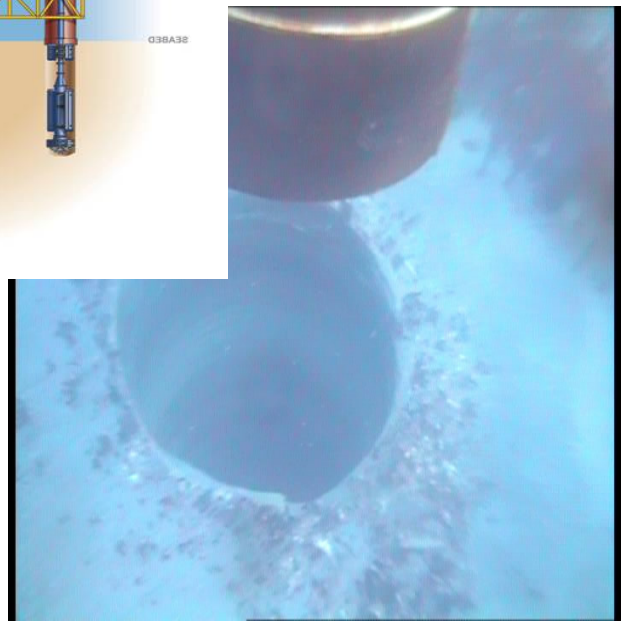
# Tidal Turbines



# Wave Energy Convertors



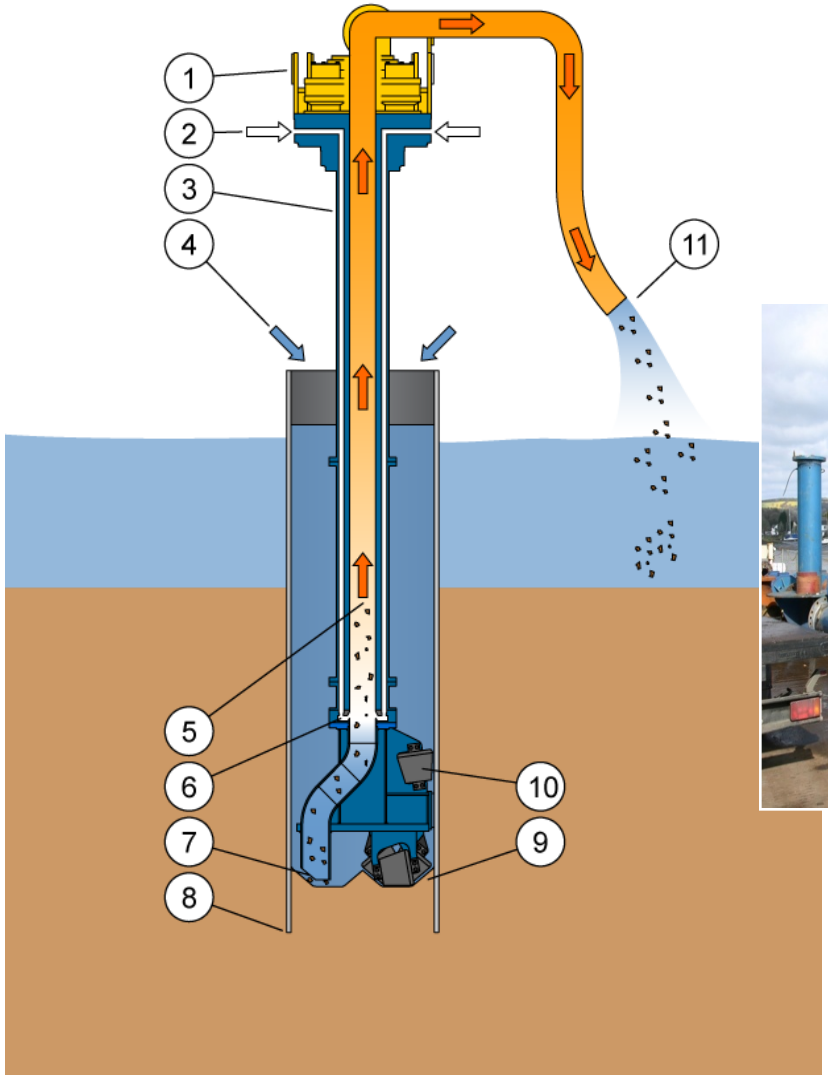


# COOLING WATER INTAKE/OUTFALLS

# What we do-Overwater Drilling

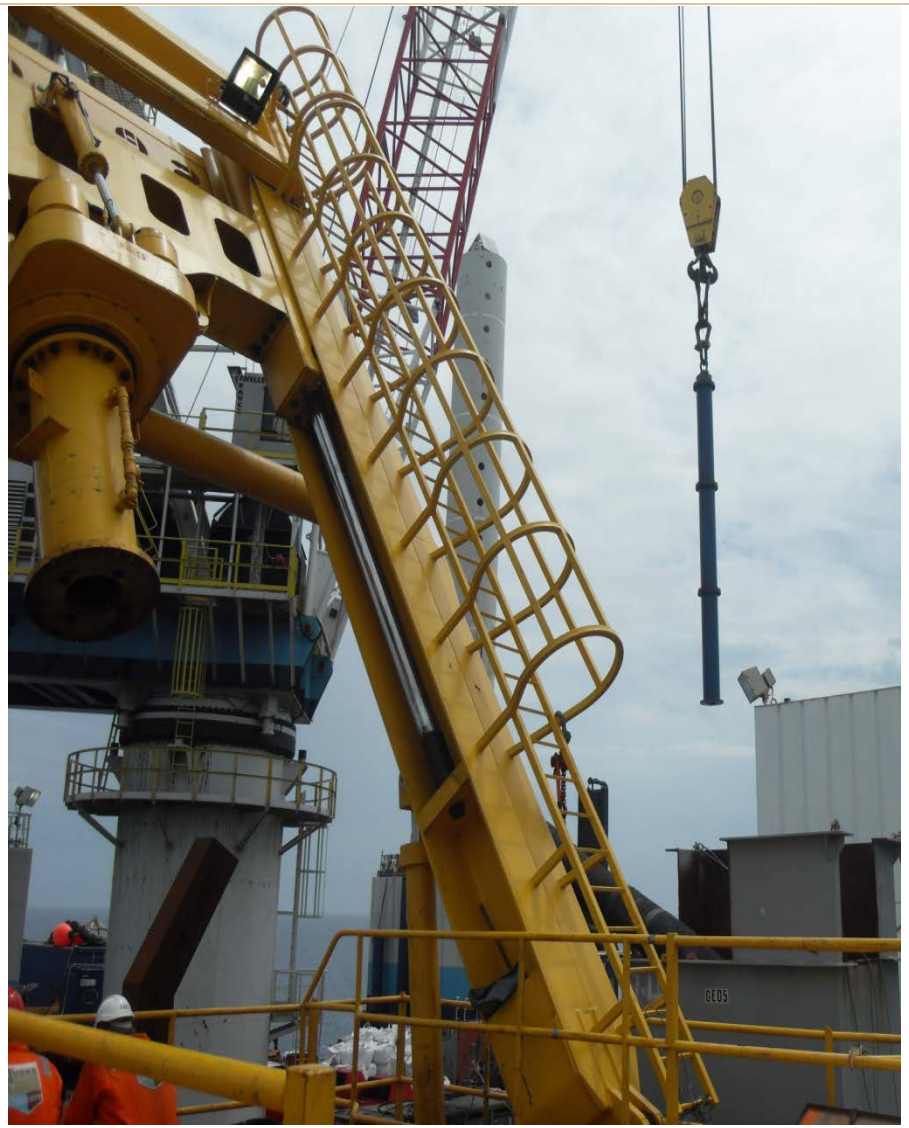
- Quick Guide to Reverse Circulation Drilling

# Principle of Reverse Circulation Drilling



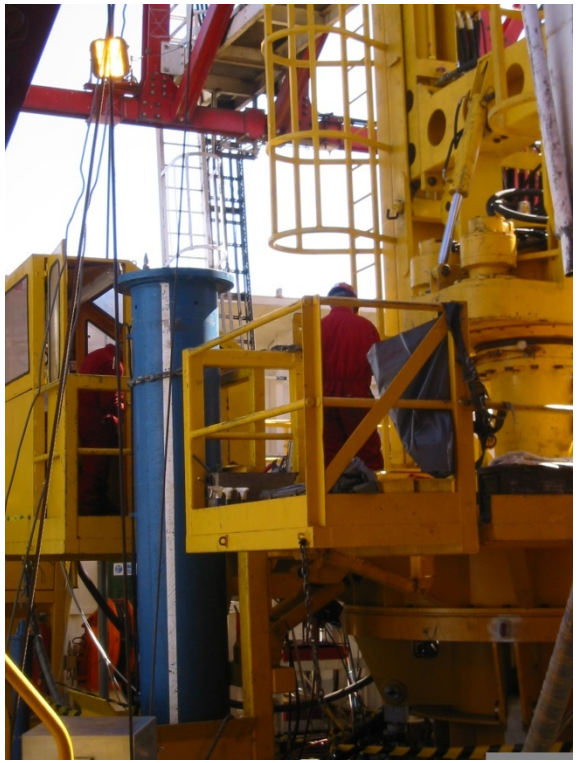

# Installing the Equipment

# Add weight and pipe



# Connect Power & Air-Commence Drilling

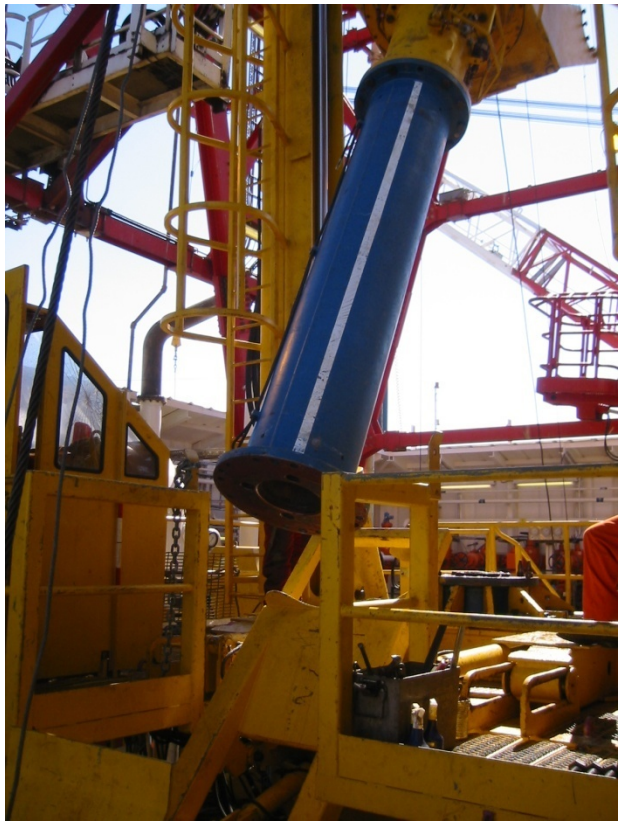
# Drill pipe added as drilling progresses



A drill pipe in the rod basket ..

connected to the swivel ..

and lifted out.



# To Create a Socket in the Seabed

# To Create a Socket in the Seabed

View of drill bit

Inside casing

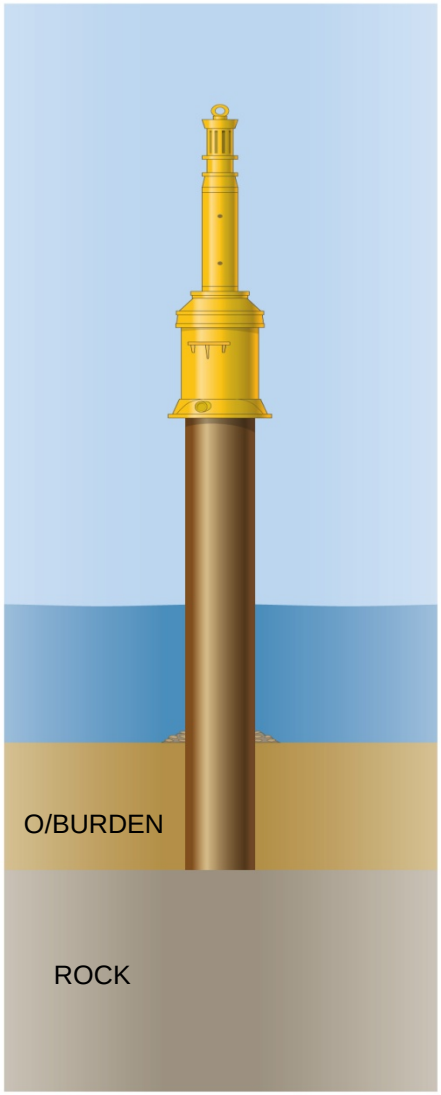


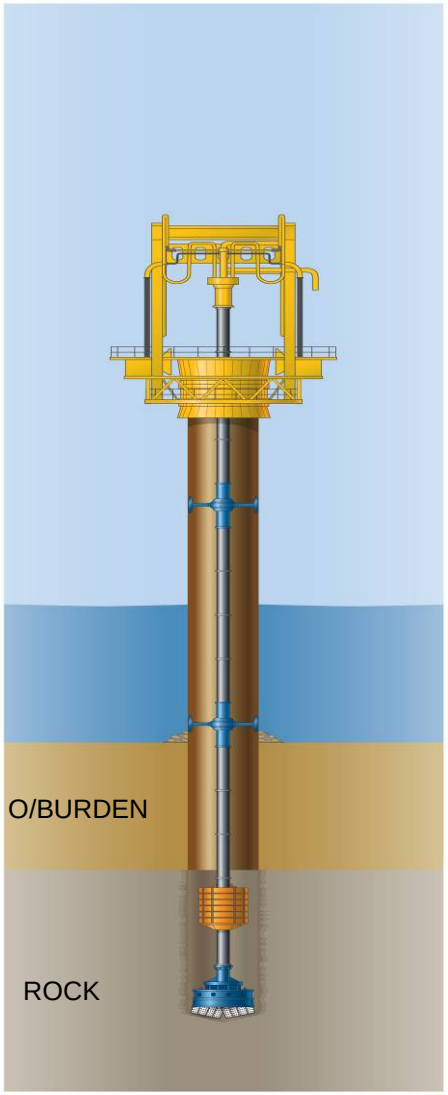
Drilled Socket in Rock

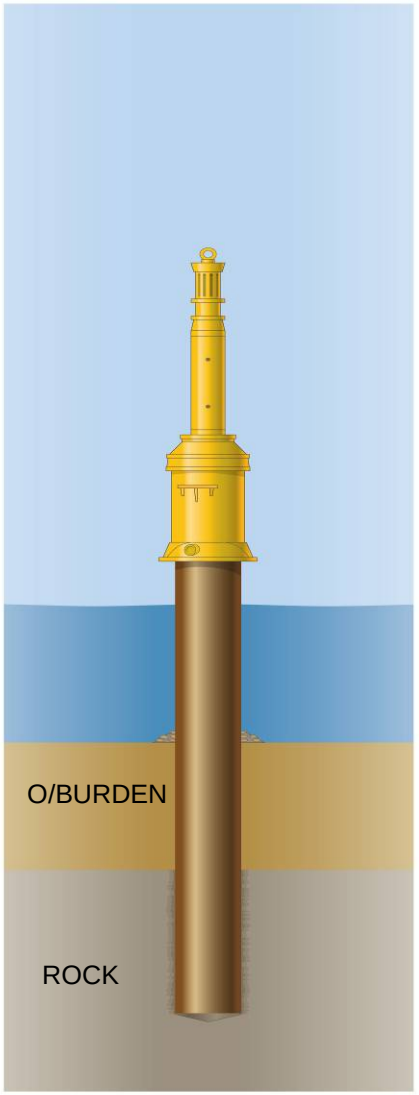
# XL Drilling for OWF foundation Installation

- Development of XL Drilling-4.0m Diameter and above
- Monopile Installation-Up to 30m Water Depth and beyond?
- Drive/ Drill/ Drive Methodology
- For European Offshore Wind Market

# Drive/Drill/Drive Technique for Monopile Installation



# BASIC INDUSTRY ECONOMICS-TIME IS MONEY

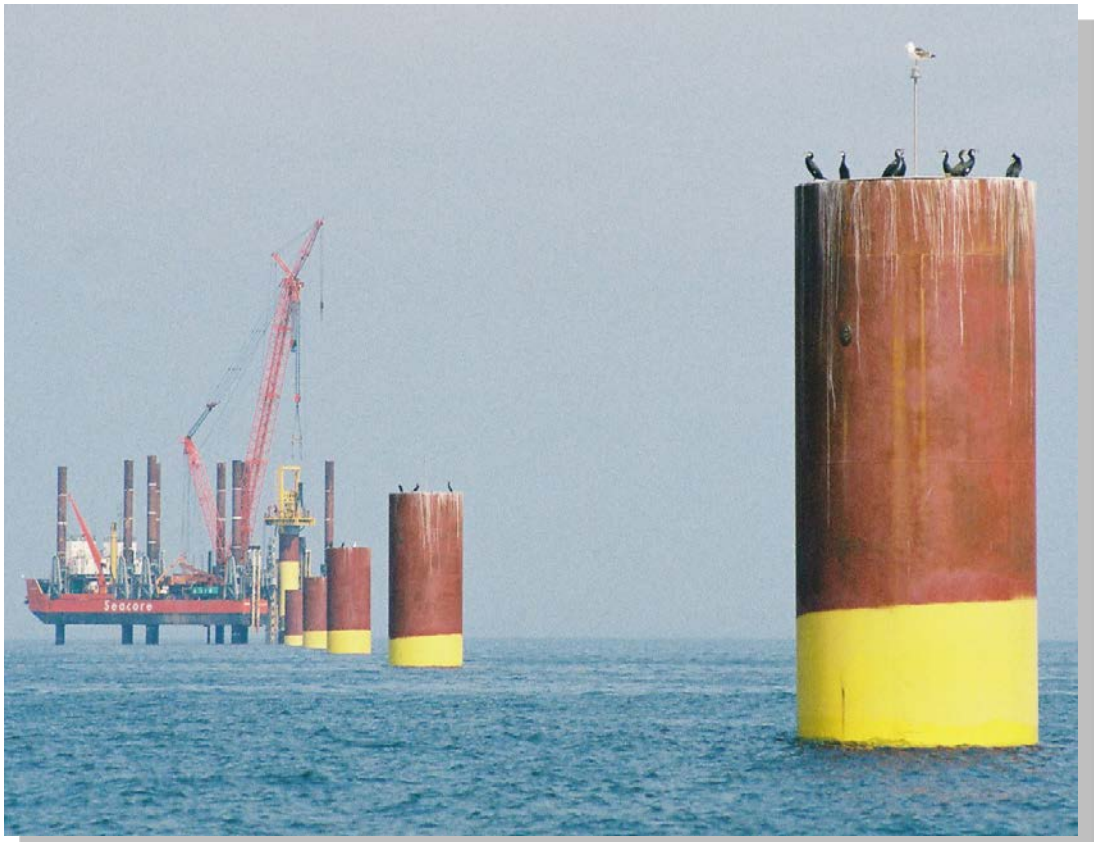
- **Typical Equipment Day Cost for Drive/Drill/Drive**

| | |
|---|---|
| Jack-up Barge | 50-100k |
| Marine Plant (tugs & Barges | 10k |
| Hammer | 20k |
| Drill | 10k |
| Other Equipment (lifting tools etc) | 10k |
| **TOTAL** | **100-150k** |

- Or £4,167/Hr  (£6,250/Hr)

# First Project-North Hoyle OWF-2003

- First Drive/Drill/Drive project
- 4m Diameter Piles
- Mudstone
- Average Drill Rates: 450mm/hr




# Drilling Cost relative to today's Plant & Equipment

- **<u>Based on 20m of Drilling</u>**

- 450mm/hr = 45hrs
- Mob = 6hrs
- DeMob = 6hrs
- **TOTAL** **57hrs**

- 57 hrs @ £4,167 =£237,520

**<u>Very sucessful project overall cost £125/MW/installed-going the right way</u>**
**<u>In 2003 the concern was that we need to scale up to 6.0m + Diameter</u>**
***(North Hoyle turbines 2.3 MW-the future 5-6 MW)***

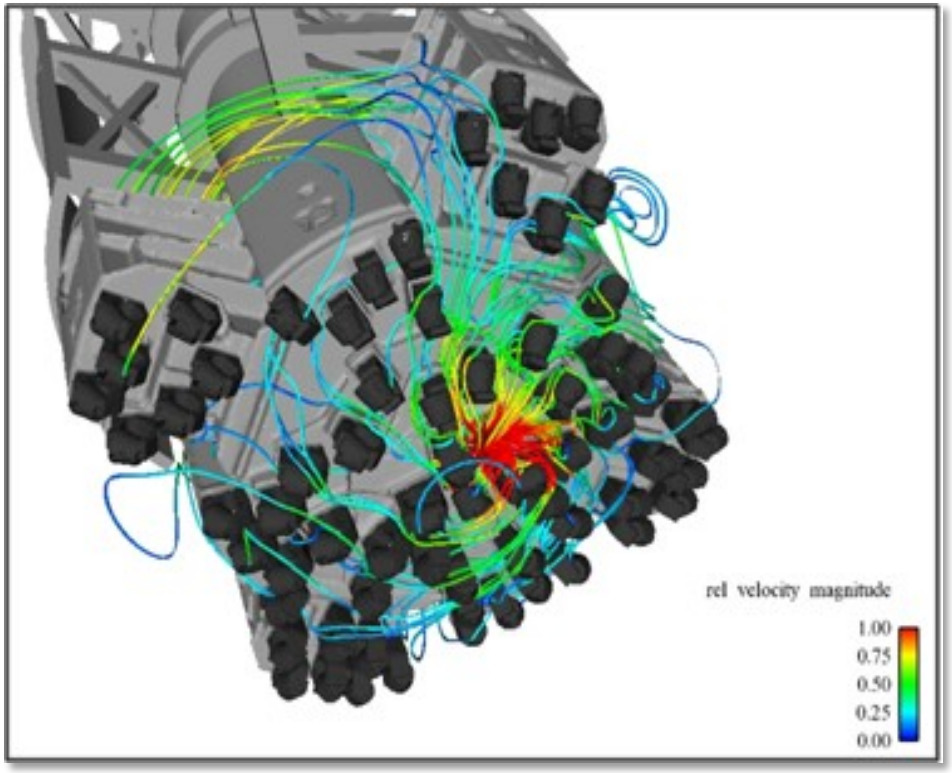
- This will be over 2.5 times the area drilled at 4.0m Diameter.
- Can cost effective drill rates be achieved at this scale.
- How can we prevent Mob/Demob times increasing due to larger heavier items lifted by larger slower cranes.

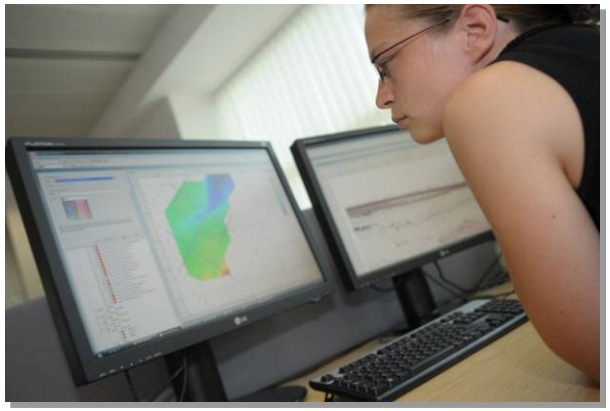
# Our next Challange: Flamanville EPR 2006

- Create a 5.85m internal diameter shaft 63m deep
- Ground: Iron infused rock
- Will require the worlds largest Reverse Circulation Drill
- Down hole equipment capable of drilling to a max of 6.45m dia

***Large Diameter Overwater Drilling, Casing Stabilisation, Innovative Solution, High Quality HSEQ standards***

# BACK TO THE DESIGN DEPARTMENT



■ Foundation Drilling ■ Jack Up design ■ Bespoke Equipment ■ Innovative Solutions
Project Specific Equipment ■ Continuous development through operation

# Fugro Seacore 6.45m Drill Bit

# Flamanville EPR-The Result

- Drilled 6.45m diameter socket ahead of a 6.3m diameter steel casing via under reaming
- Proceed to drill a 5.85m Diameter Shaft 63m deep.
- Average Drill Speed 300mm/hr

**<u>Important Lessons Learnt.</u>**

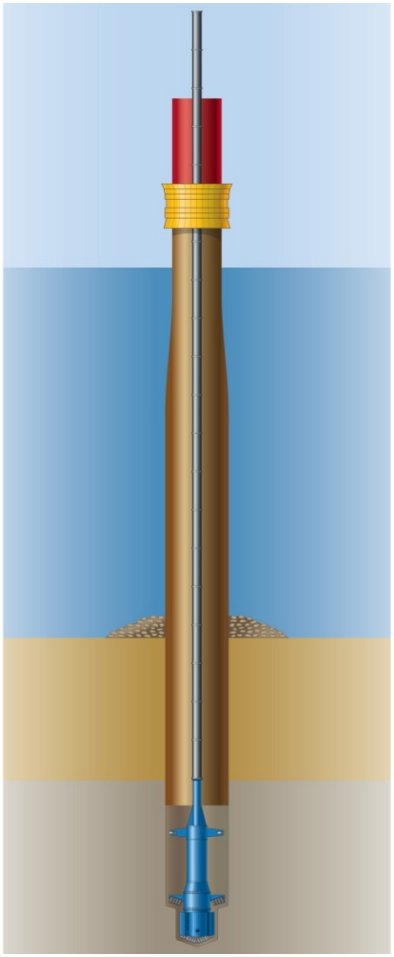
**We need:**

**❑Better Bit Face Flow/Cleaning.**

**❑Faster rotation**

**❑More weight & More Torque to cope**

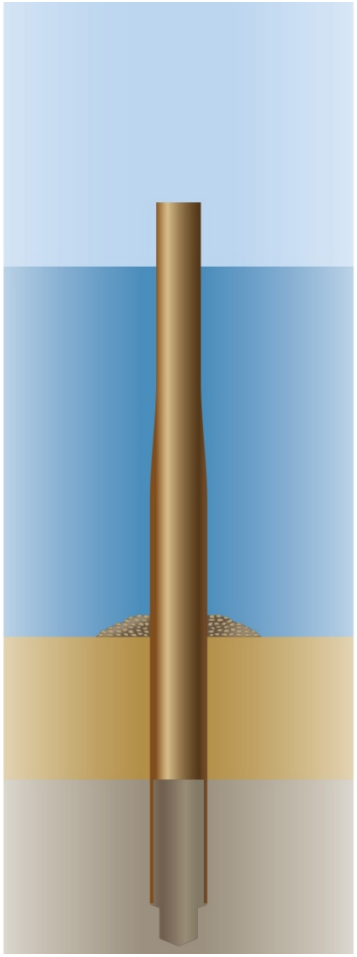
# Drive/Drill/Drive-Gyn-Y-Mor OWF, Irish Sea 2013



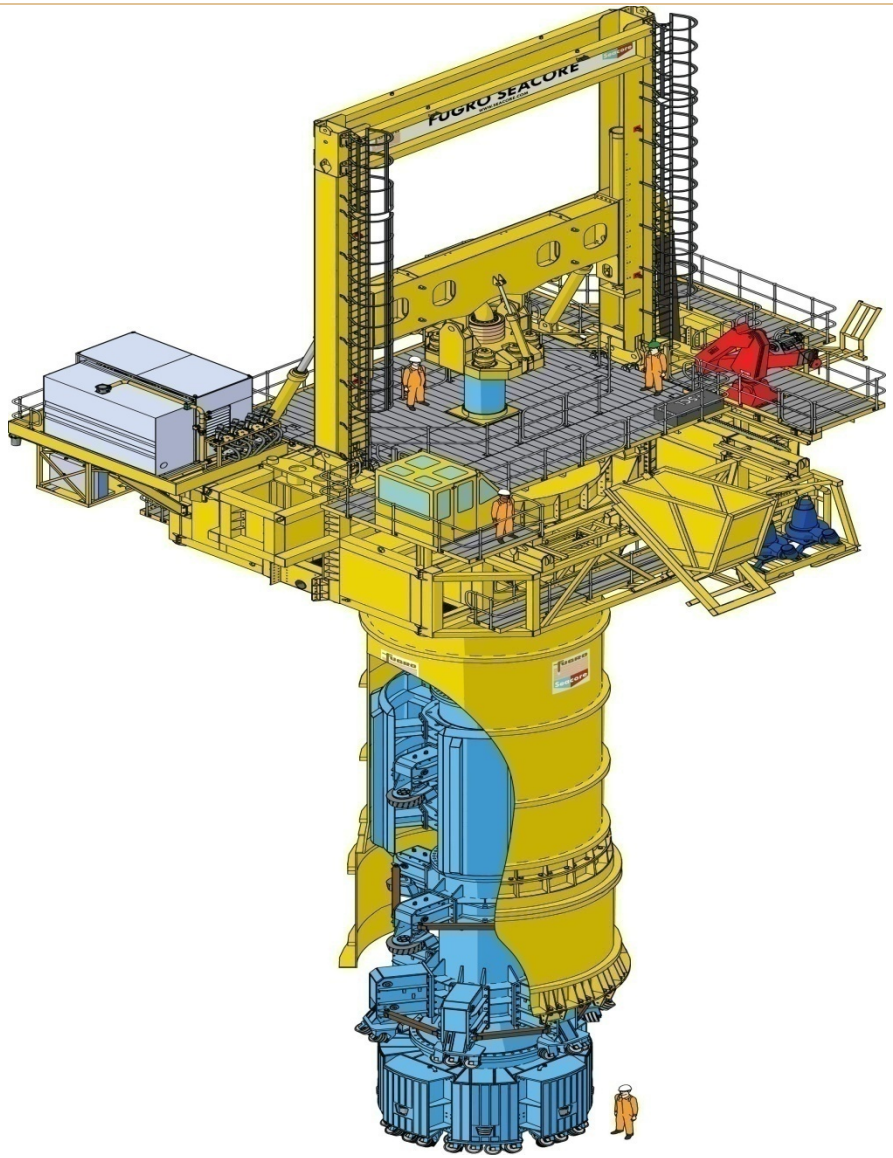
- 4.3 m Bit opening out to 6.5m.
- Ground- Mudstone similar to previous North Hoyle project

**<u>The Plan</u>**

- ❑Adapt the Flammanville Equipment
- ❑Add Water Jetting
- ❑Add Weight
- ❑Increase Speed, Torque
- ❑Improve Mob/DeMob times



# T90-GyM Drilling Equipment




# Gwynt Y Mor OWF 2013/14



GyM Bottom Hole Assembly

**The Results**

- **Faster drilling at 6.0m Dia than we had achieved at 4.0m Dia-Averaging 575mm/h**
- **Peak at 2.2m/hr in softer ground**

# Drilling Cost based on Plant & Equipment

- Based on 20m of Drilling

- 575mm/hr = 35hrs
- Mob = 6hrs
- DeMob = 6hrs
- TOTAL 47hrs

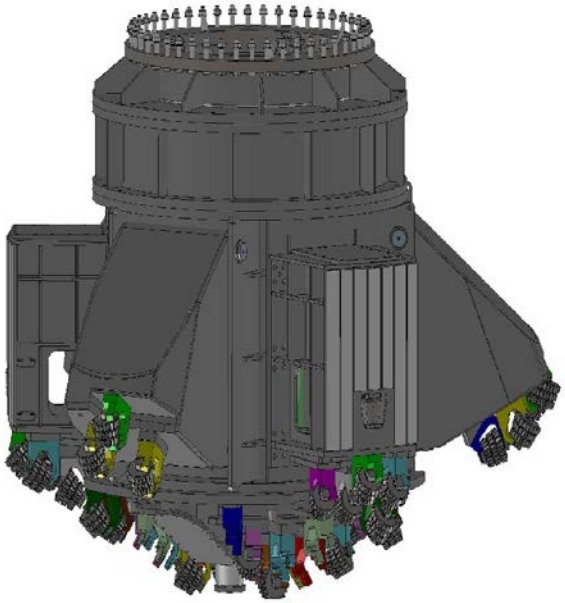
- 47 hrs @ £4,167 = £195,850

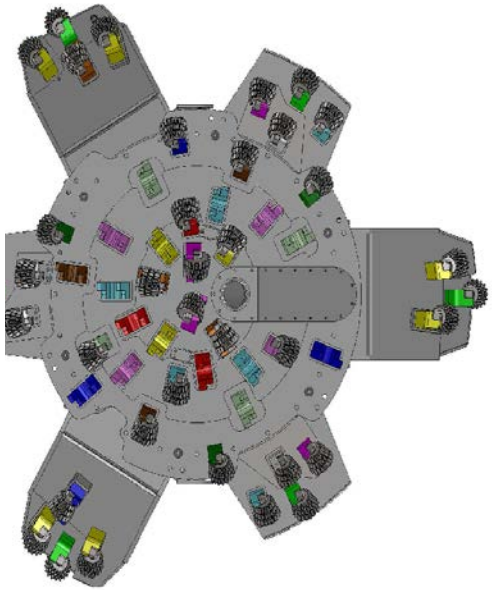
- This is approx. £40,000 less than the relative drilling cost in 2003 even though we are now over 2.5 times the diameter.

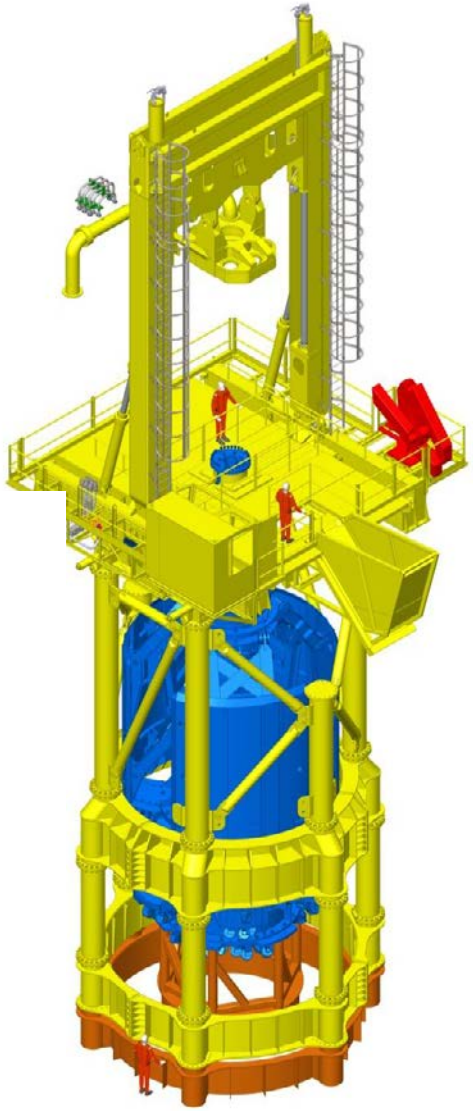
- But the engineering never stops.....

# WesterMost Rough OWF 2014

- New Drill-more powerful T120
- New 7.0m Bit design-improved spoil removal
- Modular Conductor-Road Transportable
- Conductor allows vertical storage of Drill bit
- Single mount/demount installation







# T120-Modular Conductor & 7m Diameter Drill Bit

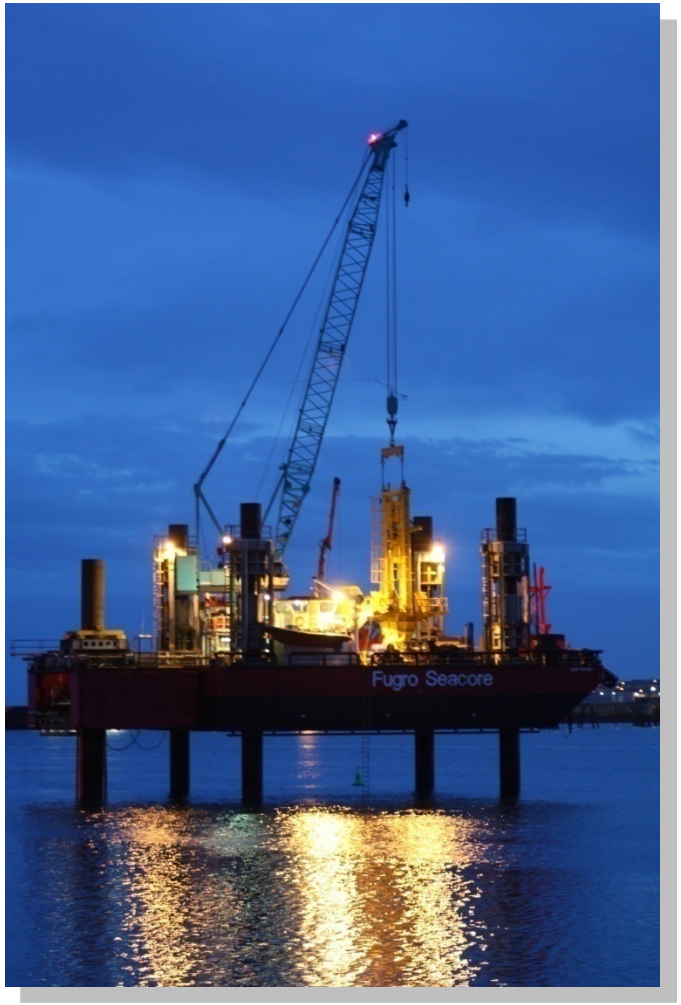

# The Current Offshore Wind Industry

- Aim-£100/MW installed
- Present-Approx. £150/MW
- Offshore Wind is still developing
- We need to keep engineering solutions……

# For Instance:-

**If drilling is included in the methodology from the start**

- Reduced hammer size required-this is a reduced day cost and gives more availability
- Reduced stresses on pile-less fatigue-longer life or reduced design.
- Less noise – always an environmental issue.
- OR YOU CAN:
- Install piles into drilled rock sockets-No hammer cost
- You will have shorter piles-less material cost
- Deliver the piles floating and buoyant lift-reduce crane and Jack-up size and cost.




# Thank You