

Dr.-Ing. Nils Hinzmann

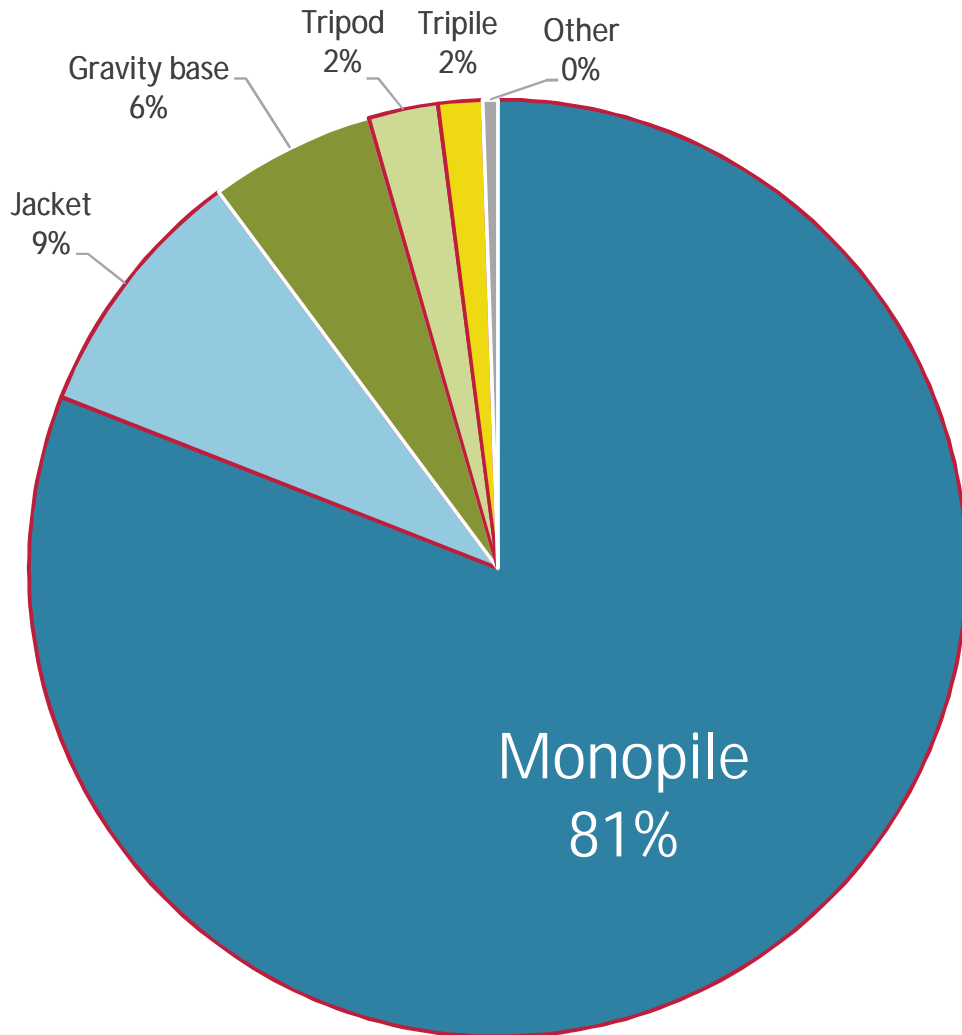
# Decommissioning of Offshore Pile Foundations: Current Practices and Future Research

**RAVE Workshop – Berlin**

Berlin, 13.03.2024

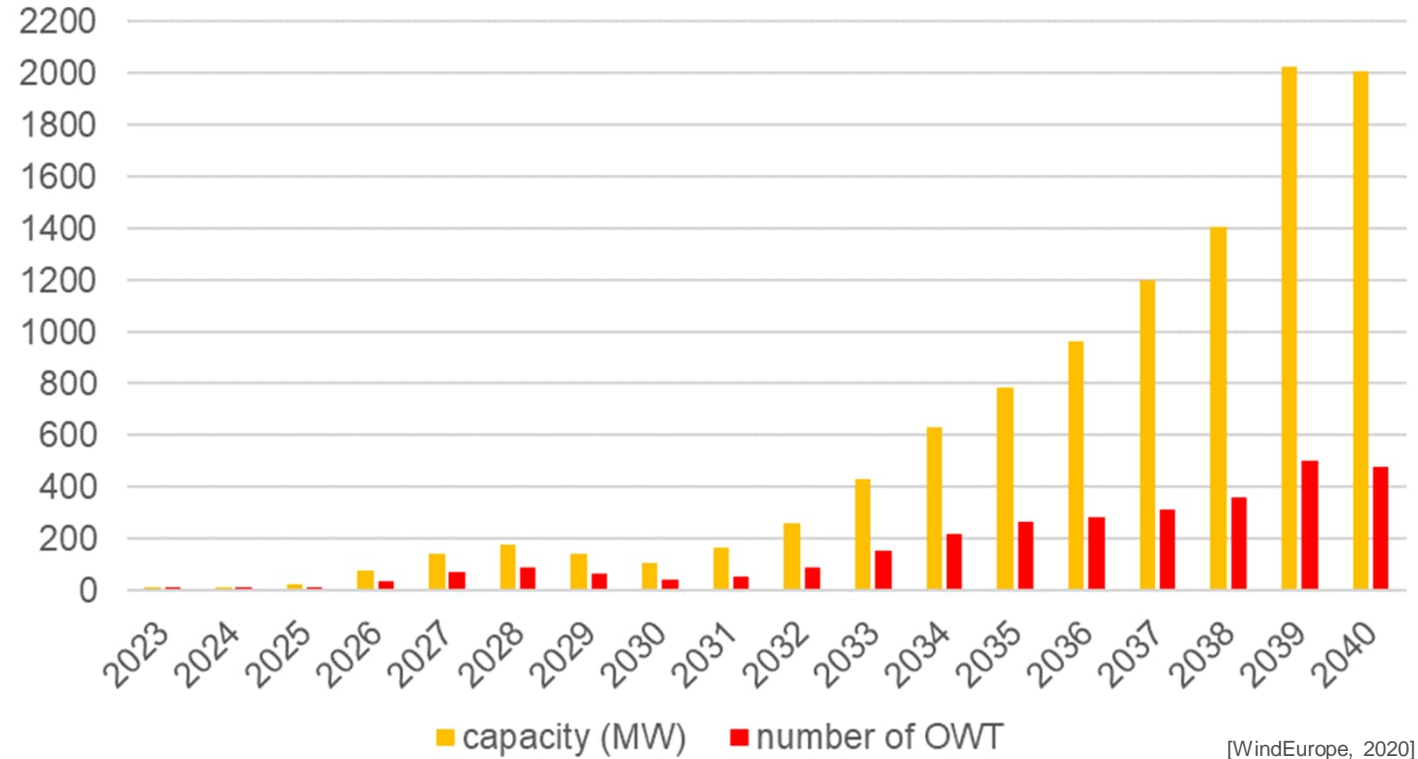
# Challenge and initial situation

current situation – laboratory test – test results – future research



[WindEurope, 2019]

- Pile foundations → 94%

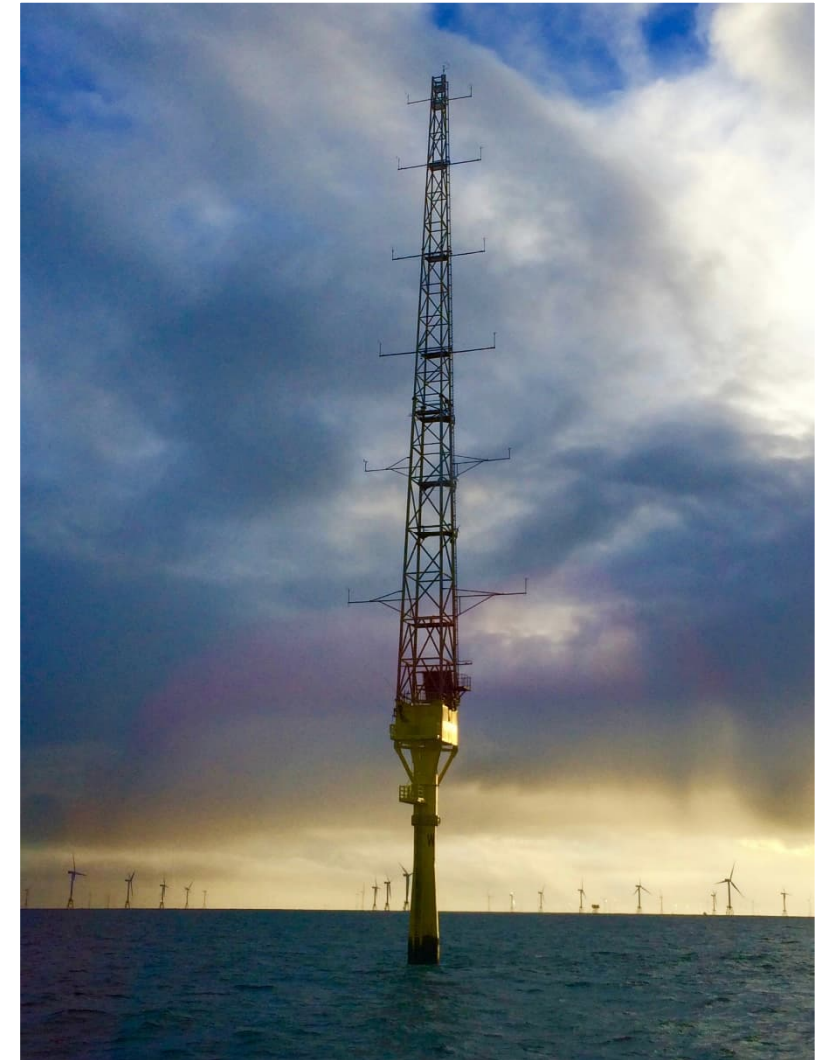
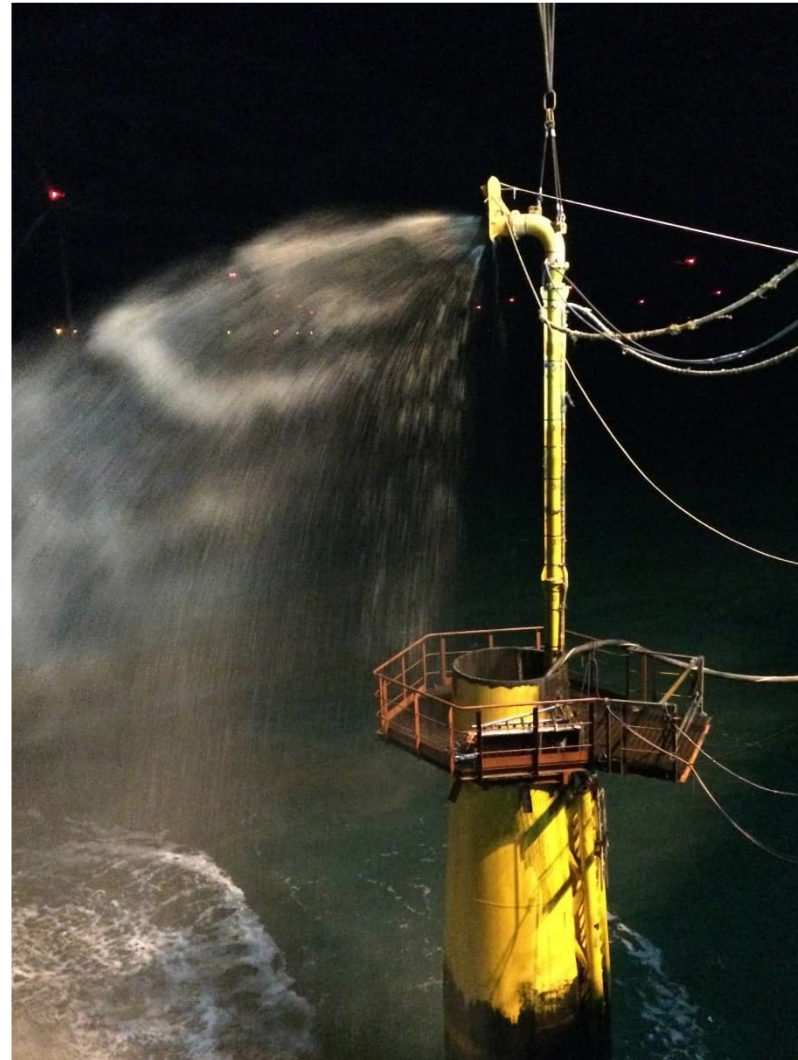
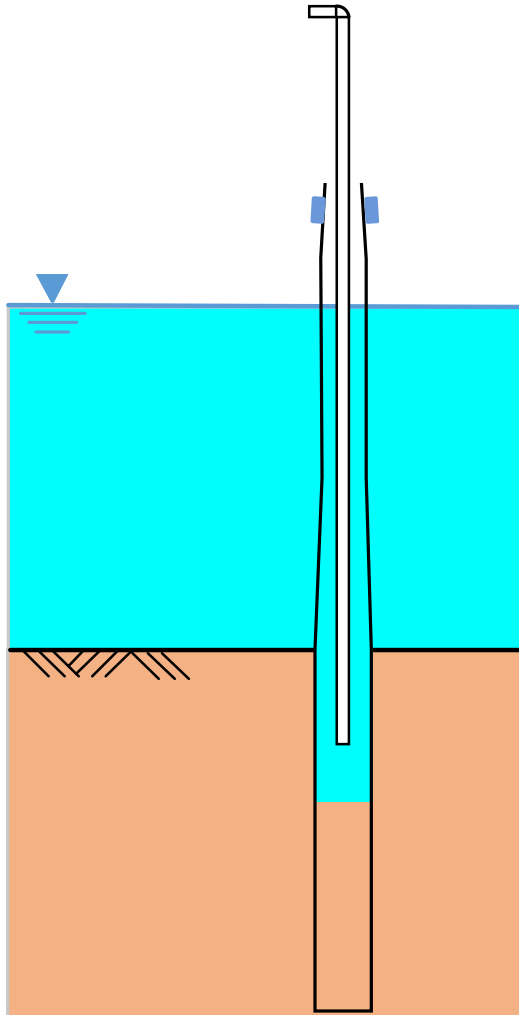


[WindEurope, 2020]

Predicted annual decommissioning of OWT

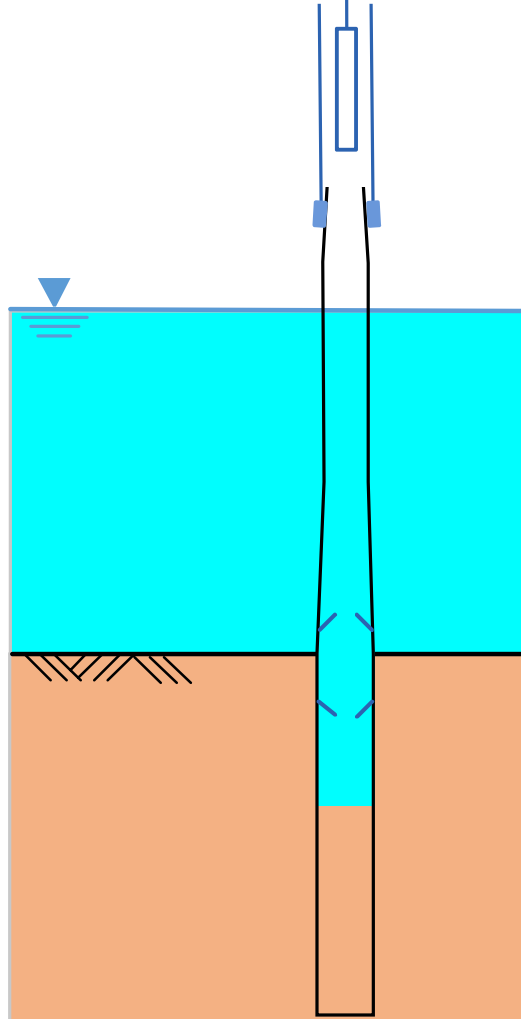
# Current practice – monopile decommissioning metmast Amrumbank West

current situation – laboratory test – test results – future research



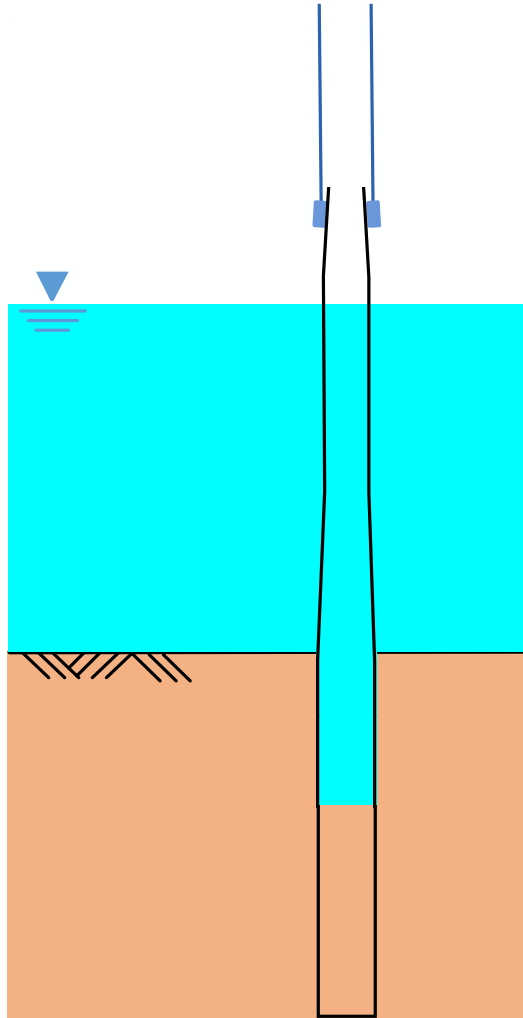
# Jet-Cutting

current situation – laboratory test – test results – future research



# Monopile recovery

current situation – laboratory test – test results – future research



# Scientific approach – research project DeCoMP

current situation – laboratory test – test results – future research



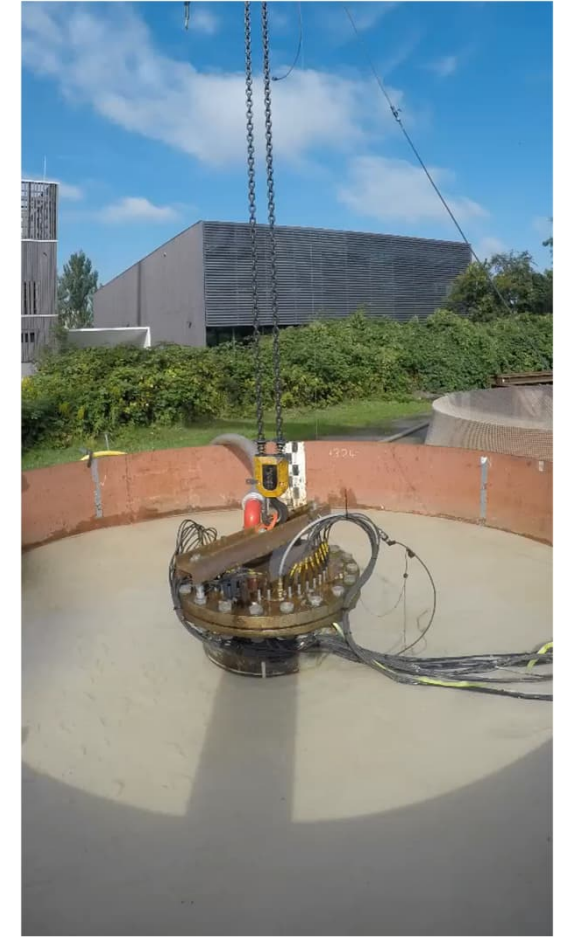
I. vibration



II. jetting



III. dredging

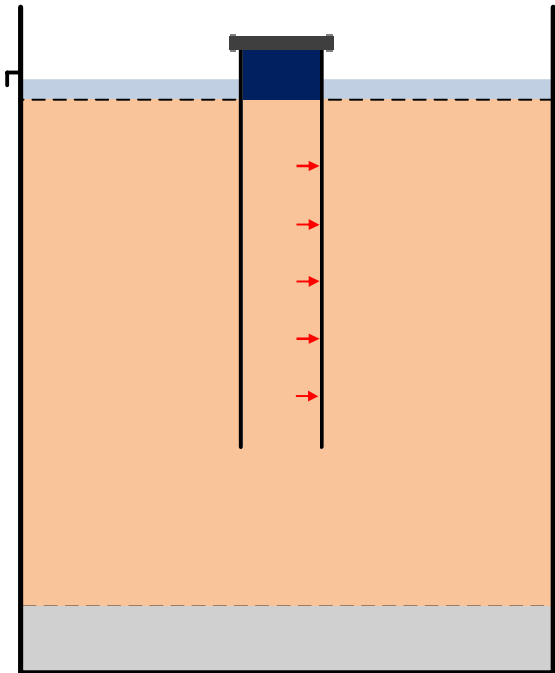


IV. hydraulic overpressure

# HO – hydraulic overpressure

current situation – laboratory test – test results – future research

$$R_{S,STT} = 107 \text{ kN} \sim F_{Pmax} = 370 \text{ kN}$$
$$R_{HO} > R_{S,STT} !!$$



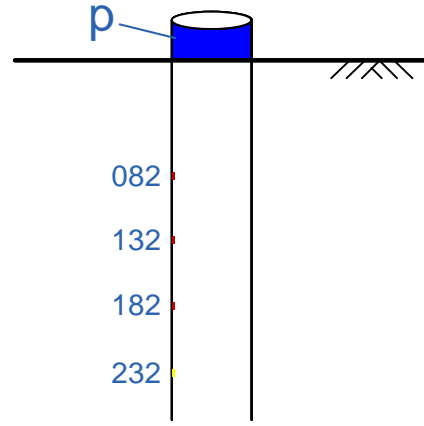
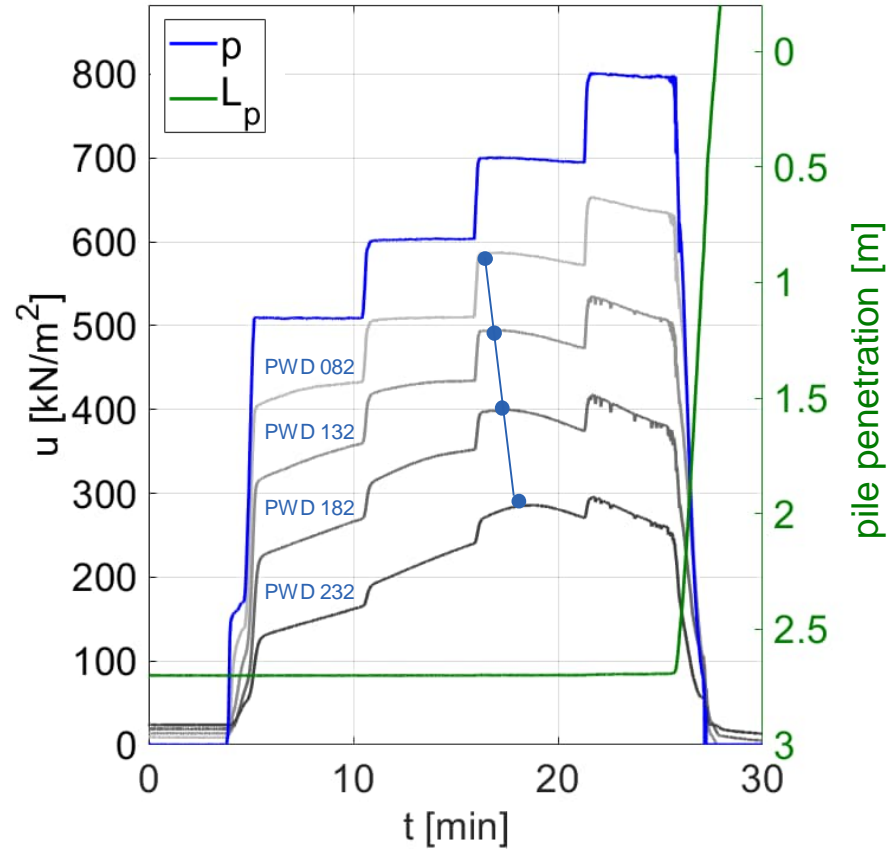
$P_{max} \approx 13 \text{ bar}$   
 $F_{Pmax} \approx 370 \text{ kN}$   
 $Q_{in(Pmax)} = 220 \text{ L/min}$   
 $F_{line\ pull} = 0 \text{ kN}$



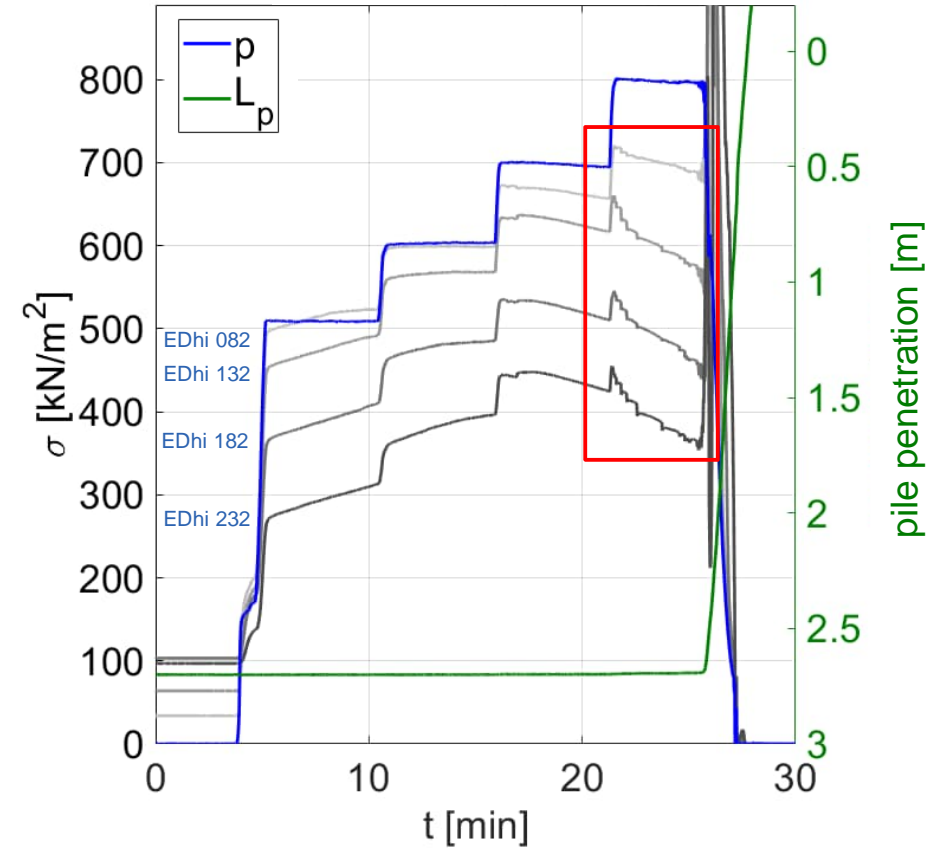
# Testserie no. 1: HO2 – stress development

current situation – laboratory test – test results – future research

### HO2 PWD



### HO2 total pressure

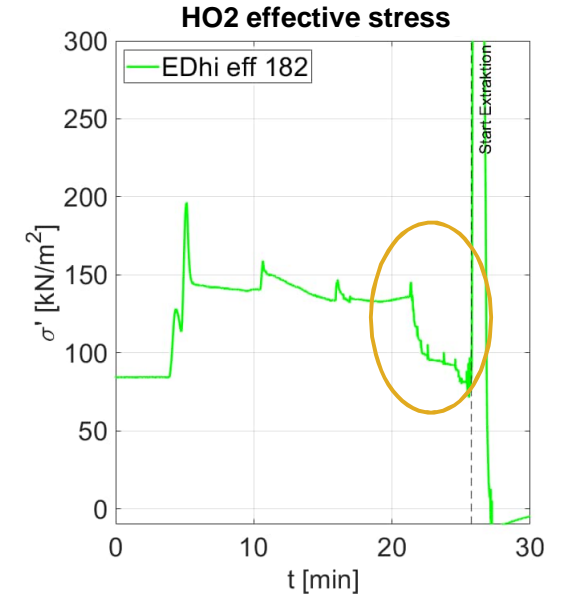
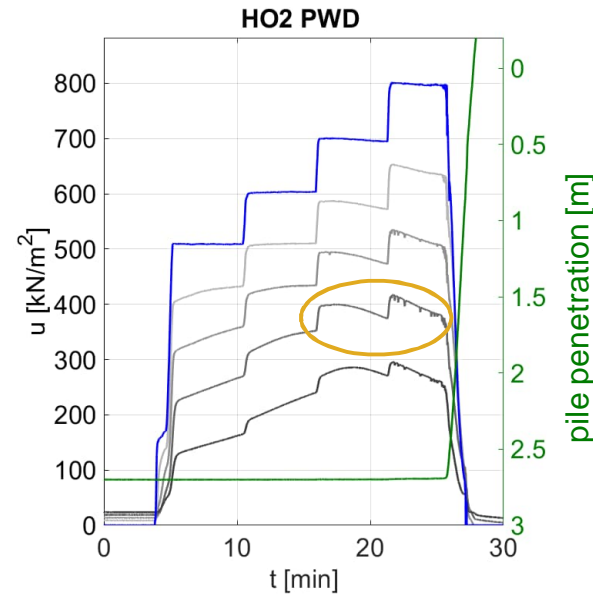




# Pile – soil – interaction

current situation – laboratory test – test results – future research

- Hydrodynamic soil deformation with grain rearrangement
  - Decrease  $PWD_i$
  - Decrease  $\sigma'_{eff(h),i}$
  - High time dependency
  - Effect on total resistance



series	loading duration	pressure load	up lift	load increase	soil
1	5 min/ stage	800 [kN/m <sup>2</sup> ]	230 [kN]	in stages	undisturbed
2	1 min	1320 [kN/m <sup>2</sup> ]	380 [kN]	linear	undisturbed
3	10 min	2000 [kN/m <sup>2</sup> ]	565 [kN]	linear	disturbed
4	/	/	107 [kN]	STT	/

# Comparison of the test results

current situation – laboratory test – test results – future research



STT  
 $R_s = 107 \text{ kN}$



Vibro  
- 92 % ✓



JET  
- 96 % ✓



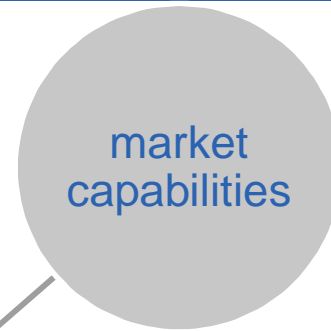
Dred  
- 74 % ✓



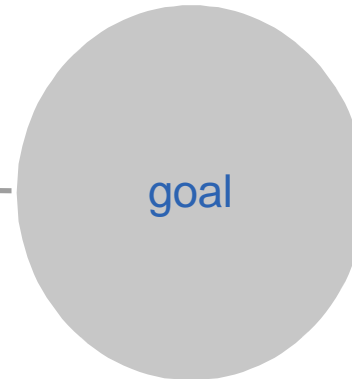
HOP  
 $P_{\text{max\_fast}} \approx 13 \text{ bar (370 kN)}$   
+ 195 % ✓  
 $P_{\text{max\_slow}} \approx 8 \text{ bar (220 kN)}$   
+ 80 % ✓

# Outlook and future research

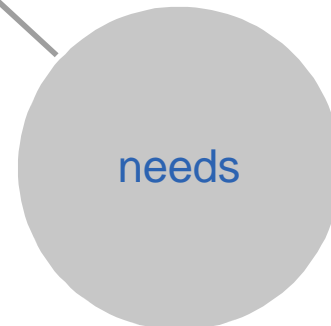
current situation – laboratory test – test results – future research



- Resources
- Logistic
- Infrastructure



- Partial decommissioning
- Lifetime extension
- Repowering
- Full removal



- Founding
- Political commitments
- Regulations



Thank you for your attention

Bundesanstalt für Wasserbau  
22559 Hamburg

[www.baw.de](http://www.baw.de)