The BLUE Hammer, Noise mitigation at source level

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Summary
The BLUE Piling Technology is a new technology for driving monopiles for the offshore wind industry. In the summer of 2018 a test will be executed whereby a full-scale monopile will be installed using this hammer. This test is part of the BLUE PILOT Project, an R&D project performed together with utilities E.ON, EnBW, Ørsted, Shell, Statoil and Vattenfall. The project aims to demonstrate that low noise installation of monopiles is possible.

1. Introduction

In most European countries strict limits apply on the maximum underwater noise levels that are allowed during offshore construction. In order to meet these limits currently high costs are made to reduce the underwater noise by use of bubble curtains and screens. These solutions however do not address the source of the underwater noise. The BLUE Piling Technology aims at reducing the underwater noise at the source by delivering a different blow to the pile which will lower the underwater noise levels. In summer 2018 an offshore test, the BLUE PILOT, will be conducted to measure the produced underwater noise during the installation of a monopile.

Fig. 1: The BLUE PILOT project aims at demonstrating a full scale monopile installation in the North Sea.

2. The BLUE Hammer

Instead of a steel ram, the BLUE Piling Technology uses a large water column to deliver the blows to the pile. The combustion of a gas mixture throws a water column in the air and under the force of gravity it falls back on the pile. The working principle can be seen in figure 2.

A conventional impact hammer delivers all its energy during a blow that typically lasts 4-8 milliseconds. Compared to a conventional impact hammer the blow duration of a BLUE hammer is much longer; typically, 100-200 milliseconds. The result is that the pile will feel a more homogenous loading which will reduce the vibrations of the pile wall. The reduction of the vibrations of the pile wall will drive down the produced underwater noise values. On top of the underwater noise reduction per blow the number of blows to reach target penetration is also reduced.

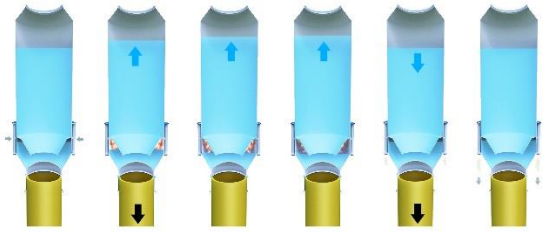

Fig. 2: Operating principle of the BLUE Hammer; from left to right: 1; Gas is fed into the combustion chamber, 2; Gas combustion creates a first blow and the water flows out of the combustion chamber, 3; Combustion continues and water column moves up, 4 Water column continues to move upward, 5; Water column falls back and delivers a second blow, 6; Exhaust gas is released through the exhaust valve.

Based on previous measurements [1] and modelling by Lloyds register [2] it is expected that a potential underwater noise reduction would be possible that is significant enough to allow pile driving without noise mitigation. The BLUE PILOT Project will deliver a full-scale measurement that will quantify these results.

During the BLUE PILOT a 6,5-meter diameter monopile will be installed offshore while ITAP and TNO will perform underwater noise measurements.

3. References

[1] Jansen, De Jong, TNO, TNO 2016 R10567, Second Acoustic Underwater Measurements BLUE Piling 2016
[2] Trimoreau, Lützen, Lloyds register, Modelling of BLUE Piling Hammer radiated noise, 2017