ABSTRACT
Old ammunition, commonly referred to as unexploded ordnance (UXO), poses a considerable threat during the construction of offshore wind parks. If activities surrounding the detection and clearance of UXO are executed erroneously, managed poorly or even overall omitted, UXO threaten the lives of construction workers, the construction schedule, marine fauna and the public image of the involved parties. At the same time, preserving comprehensively high quality during UXO operations has turned out to be a challenging endeavour for a number of reasons:
• Low entry barriers into an attractive market, resulting in cost pressure.
• Legal areas are manifold, often weakly regulated or regulations are not enforced diligently.
• No guideline for the validation of the appropriateness of applied technologies or for the qualification of appointed personnel exists.

The increase in knowledge about the potential impacts of the UXO legacy has led to an urgent need to address the problem on a strategic level. In order to tackle the challenges raised above, a quality guideline for the handling of UXO in the offshore environment was developed. This quality guideline serves as a normative reference framework for all stakeholders involved in UXO operations taking place during offshore wind park development.

METHODS
Key to the composition of a widely recognized quality guideline was the involvement of stakeholder groups relevant to the procedure of offshore UXO treatment. Figure 2 presents the steps that were performed in order to arrive with a comprehensive quality guideline.

RESULTS

Four Phases

Pre-Investigation

Technical Investigation

Investigation of Suspected Sites

Clearance and Disposal

Process Flow Charts

Responsibility Flow Charts

Figure 3: Content of the quality guideline

Figure 3 displays the structure of the quality guideline. It is divided into five sections – one section concerning all phases and four sections covering one specific phase each. Every phase is subdivided into individual processes. The quality guideline addresses each of these processes and provides guidance by giving the following information:
• Relevant legal and normative documents
• Involved actors, their requirements, responsibilities and competences, illustrated as responsibility flow charts (exemplified in Figure 2)
• Requirements for employed personnel and applied technologies
• Threshold values and cut-off criteria for environmental and technological conditions

Figure 4: Towards a European Quality Initiative for UXO Treatment

RECOMMENDATIONS
During the process of generating the quality guideline, it became apparent that a continuous effort is desirable. This continuation serves to maintain stakeholder dialogue and to update the quality guideline as regards technological, legal and other changes.

A European quality initiative, resting on four pillars, is therefore proposed as a framework for future research efforts and action items (Figure 4). Central to all these ways of quality endorsement is the internationalization of all upcoming efforts.

Figure 1: Moored mine. Photo by: Heinrich Hirdes EOD Services GmbH

Figure 2: Creating the quality guideline

By executing the process shown in Figure 1, the following matters were discussed and gradually defined:
• Comprehensive UXO detection and clearance process
• Involved actors
• Terminology
• Technologies and their way of application
• Quality influencing factors
• Management procedures