Netherlands Enterprise Agency

Webinar December 13, 2016
UXO Desk Study HKZ

Questions: from the audience
Answers given by: John Bakker (REASeuro), Erwin van den Berg (REASeuro), Björn van Vliet (Ministry of Defence), René Pouw (Ministry of Defence), Ben de Sonneville (BLIX), Frank van Erp (Netherlands Enterprise Agency)

Question: Could there be a possibility of finding full non-ferrous ordnance in this site? And what could the probability be (other than the Parachute mine Luftmine B (LMB) with a small ferrous charge content)?
Answer: REASeuro considers this as highly unlikely. Most UXO's contain some kind of ferrous material. The more modern types of non-ferrous ordnance are not used in the investigated area.

Question: What threshold do you recommend with regards to UXO size to be detected and removed (above which weight or calibre)?
Answer: The definition of survey thresholds is dependent on the design and installation methodologies of the wind farm zone. Reassessment of the UXO risk assessment based on the preliminary design is needed.

Question: What other techniques than magnetometers you are referring to for the Parachute mine with a small ferrous charge content like the Luftmine B (LMB)?
Answer: The ability to detect a non-ferrous UXO like the German LMB mine with magnetometers only is very limited since the total ferrous contents of the various components in this mine is assessed to be less than 10kg. The magnetometer needs to be very close to the mine (less than 2 metres) to even have a small "reading" on the sensor, if at all.

For the situations where these types of UXO may be expected it needs to be assessed if any burial of UXO is likely. If such is the case then currently the best system to detect non-ferrous UXO is an EM (Electro Magnetic) detection system. It needs to be highlighted though that the detection range of such systems may be limited and merely depend on output power and size of coil used.

If burial of UXO is assessed to be unlikely then use of sonar systems (Side Scan Sonar, Multibeam) may add value. The classification process needs to be based on the size, shadow, shape, structure and scatter of objects detected. Be aware: Any debris in the vicinity of the objects (e.g.: fishing nets) may foul the classification process.

In general one could say that the optimal way of detecting non-ferrous UXO like the German LMB mine is to use multiple data strings (magnetometer, side scan/multibeam sonar, EM) to enable a correlation of the data enhancing the classification of objects detected.

Question: Have the CIRIA guidelines been taken into account during UXO risk assessment and risk management?
Answer: The CIRIA guidelines have not been taken into account. The research was conducted according to Dutch legislation (Werkveldspecifieke certificatieschema voor het Systeemcertificaat Opsporen Conventionele Explosieven ((WSCS-OCE)).

Question: It would be helpful to receive an indication of the UXO size to be cleared for monopiles hammered into the seabed.
Answer: It is to be noted that the current Desk study results are preliminary and aimed as input for the basic design. A reassessment of the UXO Risk Assessment is advised once the exact design details are

determined. This may lead to an adaptation of the threshold levels to adapt for the UXO Risk to be reduced to ALARP.
Based on the current insight in the available data the UK 250 lbs General-purpose (GP) airdropped bomb is considered to be the smallest threat item for ALARP sign off when hammering of monopiles will be the selected method for WTG installation.

The charge to weight ratio of these bombs is dependent on the specific type op bomb. The ferrous mass of all types of 250 lbs bombs is > 50 kg. Therefore the magnetometer threshold is set on 50 kg ferrous mass. This threshold is sufficient to detect (ferrous) naval mines, depth charges, naval mine destruction charges, torpedoes. Also evidence is found indicating the possible presence of German air dropped bombs.

Potential UXO risks during hammering operations are:

- Direct contact between a UXO and jacks of the vessels installing the monopiles.
- Direct contact between a UXO and dredging equipment and/or gravel or rock during the removal of obstructions, the preparation of the seabed and/or gravel/rock dumping.

- Direct contact between a UXO and the monopile during the placement of the monopiles.
- Accelerations with an amplitude > 1 m/s2 in the surrounding soil during the placement or removal of the monopiles. These accelerations can occur up to >120 m around the monopiles.
- Accelerations with an amplitude > 1 m/s2 during operation of the turbines.
- Direct contact between a UXO and divers during cable connection operations.
- Direct contact between a UXO and divers/ROV's during inspections and as-built checks.

With the possible presence non-ferrous UXO, the Luftmine B (LMB) will be normative for the ferromagnetic weight threshold level for the modelling of anomalies detected by a magnetometer survey in the route corridor. These mines necessitate a ferromagnetic weight threshold under 10 kg for the magnetometer survey. Also the distance between the sensors and the mine needs to be < 2 m to be able to detect these types of sea mines.

Due to the amount of Net Explosive Quantity (NEQ) in LMB (excess of 1,000 kg of TNT equivalent) additional measures are required to reduce the risks to a level that is ALARP. In order to make the risk of encountering a LMB mine ALARP it is advised to preform additional survey operations with a spectrum of survey techniques, for example side scan sonar (SSS) and Electro Magnetic (EM) survey. As a minimum it is advised to survey the designed cable trenches with an EM survey system. To enhance the evaluation process it is advisory to correlate the SSS, EM and magnetometer data.

Thresholds Side Scan Sonar survey (SSS)
For the SSS the following thresholds are advised:
- Size: There were different types of LMB-mines in armament. All LMB-mines had a diameter of 0.66 m. The length varied from approximately 1.8 m to over 3.0 m. Based on these dimensions the size threshold is set to 1.5 x 0.5 m.
- Shape: All LMB-mines are cylindrical. Therefor the shape threshold needs to be cylindrical.
- Structure: LMB-mines were fitted with several small external features. These features may be noticed during evaluation of the SSS data.

Thresholds Electro Magnetic survey (EM)
EM detectors are capable of detecting ferrous as well as non-ferrous metals. The principle is based on the effect that the target metal responds on the magnetic field created by the detector, creating a secondary magnetic field. The magnetic field lines, caused by eddy currents, travel only in the top 0.4 mm of the metal skin. Therefore the surface area is more important for setting the survey threshold than the metal mass.
For EM survey methods the surface area of the UXO is the relevant parameter. Based on the different dimensions of LMB-mines the threshold for the surface area is set to objects with a minimum of 4 m2.