ETV
Verification statement

Technology: ODB system ®

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The verification process, whose results are summarized in this Statement, complies with the ISO Standard 14034 on Environmental Management: Environmental Technology Verification.

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Verified according to the ISO Standard 14034
on Environmental Management:
Environmental Technology Verification

Statement of Verification is available at:
https://www.etadanmark.dk/da/etv/gaeldende-etv-verifikater

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1. Technology description

The technology described in this document is a novel technique aimed at cleaning, extracting, and cleaning oil out of oil-filled underground cables. The ODB system® is shown in *Figure 1* and examples of cable geometries in Figure 2

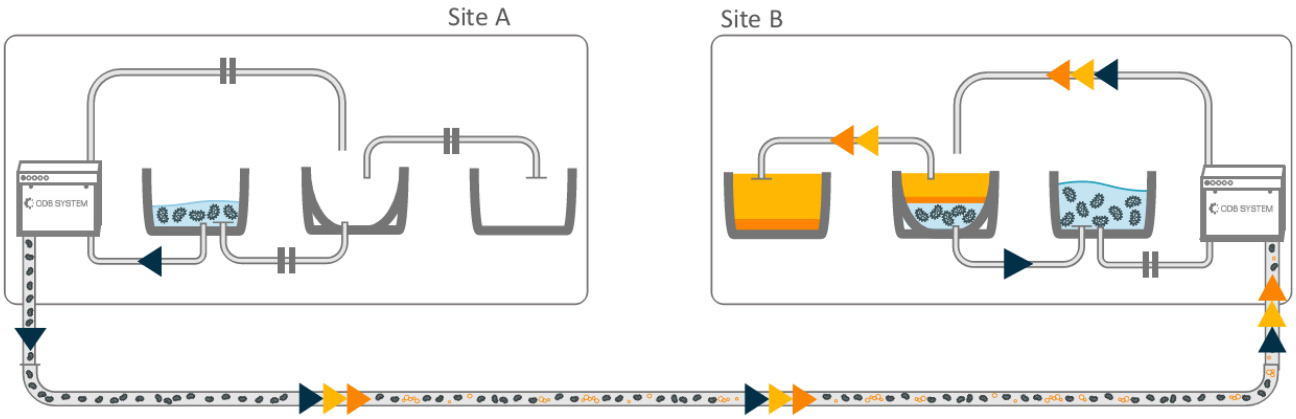

Figure 1 ODB System ® (source TIBIO SAGL)

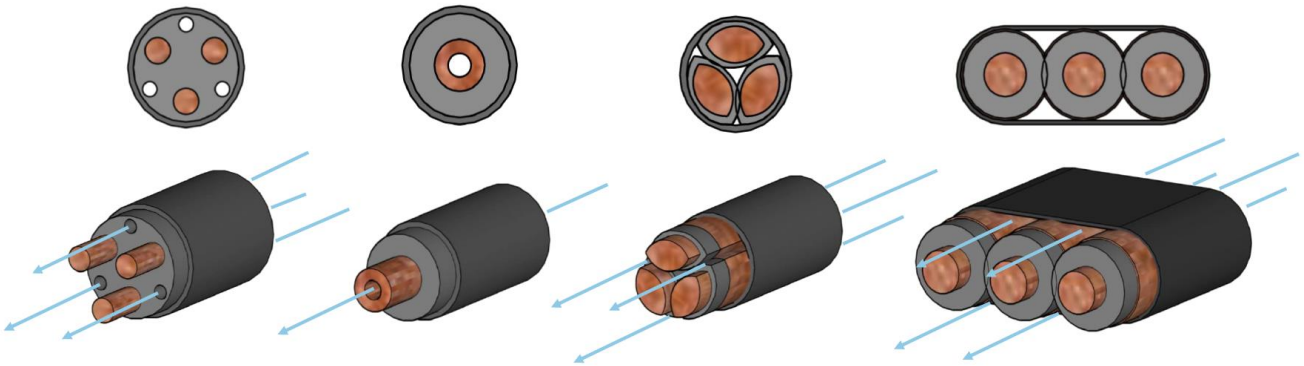

Figure 2 Examples different cable geometries (source TIBIO SAGL) - 1 phase and 3 phase cables.

The principle of operation is to inject a solution of bacteria into one side of the cable (side A) using a rather low pressure. Oil is collected on the other side of the cable (side B). After some time (a week) the injection and pressure is changed to side B and oil is collected from side A. This operation is continued until the cable is clean (At least 14 weeks). After this period the cable is sealed and can be left in the ground.

2. Application

2.1. Matrix

Underground or underwater oil-filled cables

2.2. Purpose

The purpose of the ODB System® technology is to "clean" cables from the inside while positioned underground. In this way expensive removal of old cables not in use by digging up the cables are avoided and the environment is protected against oil leaking out of old cables.

2.3. Conditions of operation and use

The conditions of operation in terms of pressure is adjusted to the cable type used. The system injects at low pressure and can therefore be adapted to each type of cable (the pressure can be set up to 7 bars depending on the cable characteristics).

2.4. Verification parameters definition summary

2.4.1.Performance parameters

Performance parameters are defined taking into account e.g. regulatory requirements, application-based needs, and state of the art performance. For the verification of the ODB System® technology the following performance parameters have been defined:

- Maximum potential oil leakage after cleaning (mg oil/m cable)
- Cleaning efficiency %

2.4.2. Operational parameters

The operational parameters evaluated as part of this verification are:

- Electricity consumption (kWh per km cable cleaned).
- Water consumption (m^3/km cable).

3. Test and analysis design

The test method is based on taking samples of cables before and after treatment with ODB system ®. Based on analysis of leakage of oil from samples to a specified soil, the oil leakage after cleaning is calculated (mg oil/m cable) as well as the cleaning efficiency.

3.1. Existing and new test data

No existing data has been accepted.

Data has been generated from a test site

3.2. Laboratory or field conditions

The test is a full scale test at a selected European test site with typical conditions for treatment.

The cables used were one-phase cables (see Figure 3)

Figure 3 Cross section of cables cleaned in test

3.3. Matrix compositions

The composition of oil in the cables may vary but is expected to consist of hydrocarbons in the used analysis range C10 to C35.

3.4. Test and analysis parameters

The major analysis parameters are oil content in cables before and after cleaning.

3.5. Tests and analysis methods summary

The analysis method for oil content is described in detail in the test report.

The major steps in the test and analysis method are

- Cutting of cable samples of cleaned and not cleaned cable of approx. 2 cm length
- Filling of Reference samples (not cleaned cables) with oil
- Migration of oil in cables to standardized soil from cleaned and not cleaned samples at room temperature for 48 hours
- Homogenization of soil from migration and subsampling for analysis
- Soil analysis of hydrocarbons C10-C35 of soil from cleaned, non-cleaned cables and of soil without cables (blind value)

3.6. Parameters measured

The analysis parameters for calculating performance parameters are soil content of oil (C10-C35) in mg/kg soil for cleaned, not cleaned cables and soil without cables.

The performance, operational and environmental parameters measured are shown in Table 1

4. Verification results (performance, operational and environmental parameters)

Table 1 Verified parameters and other parameters

Parameters total	***Unit***	***Value* ± uncertainty**	***Comment***
Performance parameters ´			
Cleaning Efficiency minimum (middle) Oil leakage after cleaning (maximum middle)	% g oil/m cable	95.77±0.64 11.48±1.74	Verified Verified -only valid for tested cable geometry.
Cleaning Efficiency minimum (end) Oil leakage after cleaning (maximum end)	% g oil/m cable	97.55±0.56 6.65 ±1.52	Verified Verified -only valid for tested cable geometry.
Operational parameters Electricity	kWh/km cable cleaned	1750	Not verified (value for proposer)
Water used in treatment	m^3 fresh water/km cable cleaned	1.76	Not verified (value for proposer)
Typical temperatures	Soil temperature in period °C	Not measured	See test report
Typical pressure on cables	Bar	3.5 bar in test	Dependent on cable see test report
Environmental parameters Water	¨	Total consumption 11.5 m^3 (3 cables of 2170m) i.e 11.5/2.17/3=1.76 m^3/km	Not verified (value from proposer-see test report)
Electricity		7,400 kwh for pumps and 4000 kwh for air con ie. 11,400 kwh used (3 cables of 2170 m) i.e 11,400/2.17/3=1750 kWh/km	Not verified (value from proposer-see test report)
Waste generated	Oil sludge for final treatment depending on cable type	666 l/cable	Not verified (value from proposers log-see test report)

5. Additional information, including additional parameters

None

6. Quality assurance and deviations

6.1. Quality assurance

Quality has been assured through participation in tests at the test site by the test body and through audits by the verification body.

A test system audit was performed by ETA-Danmark during the cable cutting at the middle section at the test site on august 8th, 2024 as well as at the Danish Technological Institute in Aarhus, Denmark for the soil test on September 17th, 2024

6.2. Deviations

The major deviations and amendments are shown in short form below:

Subject	Change	Consequences for test
Cables available for the test	Due to a different cleaning operation for cable 3, only 2 cables could be sampled on-site instead of the planned 3 cables	Higher uncertainty in the determination of cleaning efficiency
Cutting of subsamples (2 cm pieces)	Tibio stripped off the cables and removed the tar around the cable before cutting of subsamples	None
Amount of subsamples for soil test	The 2 End 1 cables (phases) was analysed in triplicate as planned The two End 2 cables was only analysed as single results (as stated as minimum). The samples for middle phase was increased from 3 to 5 analyses for one cable (phase) and 4 analyses for the other cable (4)	Higher uncertainty in the determination of cleaning efficiency for soil test End 2 samples, but lower uncertainty for middle phase
Reference sample (oil filled cable) preparation	Prior to filling the hollow space of the cable, the cable pieces were placed in oil over night to ensure saturation of the paper insulation layer of the cable.	Higher accuracy
Temperature during soil test	The temperature during soil test should be kept between 18 and 23 °C. Due to warm weather conditions, the temperature was between 23 and 25 °C.	Testing of worst-case scenario concerning temperature

Subject	Change	Consequences for test

Hydrocarbon analysis of soil samples	The proposed standard method C10- C40 (EN 14039:2004) for hydrocarbon analysis showed very poor recovery of spiked amounts of recovered oil from the cable remediation test at the test site in both high and low oil spiking concentrations. Subsequently, the analysis laboratory, Eurofins, employed an alternative standard method for hydrocarbon analysis designed for reference laboratories (Reflab method 1:2010, 2nd Edition – C10 – C35). This method successfully demonstrated that the spiked concentrations could be analyzed, why it was used for analysis of the test samples.	None. The analysis (Reflab method 1:2010, 2. Udgave, Bestemmelse af olie I jord, gaskormatografisk metode) was performed for C10-C35 instead of C10-C40 in the EN 14039:2004 method suggested in the test plan). Chromatograms showed no peaks above C35.
Electricity and water consumption	The electricity and water consumption could not be verified, as the ODB- system® was removed by the time of test visit	Electricity and water consumption is based on data provided by Tibio SAGL (not verified).
Performance parameter	In the test report and this verification report an extra performance parameter Cleaning efficiency % has been added. The parameter oil leakage after cleaning is calculated based on data for cleaning efficiency.	The extra parameter is an intermediate calculation for the oil leakage.