Operational Radar For Every drill string Under the Street

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Policy Document

Deliverable 7.26

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CO	Confidential, only for members of the consortium (including the Commission Services)	☐

Preface

This deliverable is prepared within the framework of ORFEUS project (Grant agreement no: 308356), supported by the 7th Framework Programme.
ORFEUS aims at progressing the prototype HDD bore-head radar technology that was developed under the preceding FP6 financed project entitled "Optimised Radar to Find Every Utility in the Street".

Horizontal directional drilling (HDD) offers significant benefits for urban environments by minimising the disruption caused by street works. Use of the technique demands an accurate knowledge of underground utility assets and other obstructions in the drill path. its aims is to design a prototype innovative ground probing radar (GPR) based real-time obstacle detection system to increase the safety margins of HDD to allow its use in the widest possible range of conditions.

Extensive testing and validation, as well as supporting the demonstration and exploitation of the final product, is proposed. The crucial testing and evaluation phase will assess the risks, confirm environmental benefits and increase end users' (public authorities and industry) confidence, awareness and uptake of this new technology. Technology transfer, training and standardisation, in cooperation with European standards organisations, will also be a significant element of the project.

Consortium

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Abbreviations

HDD – Horizontal Direction Drilling
PAS – Publically Available Standard
DIN – Deutsches Institut für Normung e.V.

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY

Utility services such as water, sewage, electric, gas, telephone, cable and other services to industry, business and homes are vital to the quality of life and the economic potential of society. There are more than 2 million km of underground utility services in the UK alone and each year across the world 483000 km of underground utilities are installed at a cost of more than €31 billion. The costs of installation, maintenance and replacement have significant economic impacts but also cause a significant social impact in terms of disruption to daily life through temporary loss of service, highway obstructions and high decibel noise. Furthermore, any accidental damage to existing services causes further impacts on society.

Existing methods of installation, management and repair to underground infrastructure involves trench-based examination based on existing maps, surface electronic mapping and operator experience. The cost of damage to buried assets caused by construction work in Germany alone is estimated to be more than €200 million per year. This is despite 93% of the work being performed following the most up to date information being made available regarding the location of underground services.

Within Europe a number of policy, standards and guidance documents have been produced relating to the installation, maintenance and replacement of underground utilities. These documents cover the majority of aspects associated with the specialised area of operations. However, with the advent of new horizontal directional drilling (HDD) techniques a range of new standards, policies and guidance documents are being produced at member state and European levels. The ORFEUS project has examined these documents and identified the need to seek a new Publicly Available Standard (PAS) which could ultimately provide the basis for a new European Standard relating to HDD applications.

The ORFEUS project developing a new HDD technology is seeking to establish the PAS to promote the development of a new standard around the technology in order to facilitate technology adoption and maximise exploitation of the project results.

This deliverable provides information relating to the current policies associated with HDD and the outline details of the new PAS that has been developed by the consortium partners in collaboration with the German standards authority (DIN) under DIN SPEC 91322 N 33.

2 INTRODUCTION

Utility services such as water, sewer, electric, gas, telephone, cable and other services to industry, business and homes are vital to the quality of life and the economic potential of society. There are over 2 million km of underground utility services in the UK alone; and each year across the world 483 000 km of underground utilities are installed at a cost of over 31 billion €. All these buried assets will need repair or replacement over time and this activity causes disruption [1].

The existing methods of installing, managing and repairing underground infrastructure are costly, very disruptive to the communities that they serve, have a negative impact on the environment and are poorly integrated. These problems are further compounded by a combination of lack of knowledge of what is already installed underground in a given area, difficulty in determining the precise position of such installed utilities and plant and, therefore, very real potential for damage to existing systems and a potential danger to those working in the street or living nearby.

In Germany it has been determined that the cost of damage to buried assets caused by construction work is, at least, 200 million € per year [2]. This damage was caused despite 93 % of the projects obtaining the best information possible prior to the commencement of the work. The majority of the damages were caused by excavation equipment and operator negligence.

Trenchless techniques, such as horizontal directional drilling (HDD), are currently used for less than 5 % of street works (with considerable variability from region to region), could, with greater use, deliver significant advantages in terms of cost and reductions in disruption.

The level of activity in underground excavation is already significant; a conservative estimate suggests that at the end of 2011, there were approximately 40 000 HDD rigs (of all sizes) in existence across the globe.

It is in relation to these problems and trends that trenchless technologies, such as horizontal directional drilling (HDD) using obstacle detection equipment will have an increasing impact. It provides a solution that is reliable, cost effective, environmentally attractive and is non-disruptive. Use of HDD technology combined with GPR (subsequently referred to as HDD-radar) offers significant benefits over conventional HDD in that it allows early detection of obstructions in the path of the drill whilst the drilling is taking place. This enables to operator to stop drilling and to plan an alternative drill path so reducing the risk of damage to other buried facilities by early identification of obstacles along the line of the drill path. The drill operator is thereby in a better position to avoid such obstacles and minimise disturbance or damage to such obstacles, be they natural (i.e. rock formations) or manmade (such as archaeological remains or utilities).

The continuous development of HDD equipment, including the incorporation of radar within the bore head, has led both to improvements in the detection of buried obstacles and to the development of this specification. To ensure a consistent quality standard in the use of HDD-radar, this document sets out the requirements, quality assurance, and testing methods and summarises the requirements according to today's technical standards. To meet accepted best practice, it is necessary to implement these standards when applying HDD-radar drilling methods. This document provides the basis for specifications for the procurement of these services.

Utilisation of HDD methods generally consists of the following 3 steps:

. 1) Pilot drilling and obstacle avoidance;

. 2) Bore enlargement by reaming;

. 3) Insertion by pull back.

All three steps are explained in detail in the DVGW document GW 321 "Horizontal directional drilling for gas- and water pipelines – requirements, quality assurance and inspection/ survey/audit".

References:

[1] No-Dig 2000 p.1, The Expanding Role of Trenchless Technology in Underground Construction, Prof. Raymond L. Sterling, Professor and Director, Trenchless Technology Center Louisiana Tech University

3 CURRENT STANDARDS AND GUIDANCE DOCUMENTS

The development of standards for HDD technologies has developed at member state and European level over a number of years. As discussed above, the process of HDD requires three main activities to ensure safety, protection of underground utilities and operator requirements. The main documents providing detailed information relating to these activities are found in the following:

BSI PAS 128, Specification for underground utility detection, verification and location BSI PAS 1192-2:2013, Specification for information management for the capital/delivery phase of construction projects using building information modelling DVGW GW 315, Hints for measures for the protection of supply plants in case of construction work

DVGW GW 329, Fachaufsicht und Fachpersonal für steuerbare horizontale Spülbohrverfahren — Lehr- und Prüfplan

DVGW W 400-3, Technical Rules on Wasserverteilungsanlagen (TRWV, Water Distribution Systems) — Operation and maintenance

DIN EN 16228-3, Drilling and foundation equipment — Safety — Part 3: Horizontal directional drilling equipment (HDD)

DIN EN ISO 6529, Protective clothing — Protection against chemicals — Determination of resistance of protective clothing materials to permeation by liquids and gases

Before HDD-radar techniques can be used, an accurate knowledge of the positions of utilities and other obstructions such as but not limited to foundations, cellars, underground tanks, piling is necessary. Hazards include energised and unused power cables, telecommunications cables (metal and fibre optic), steel and plastic gas pipes, potable water, drainage and sewers made from various materials including clay, iron, steel, various plastics, cement and concrete. Striking one of these assets can be extremely dangerous, and can also cause significant economic losses due to the interruption of services. Consequently, safe use of the technique demands an accurate knowledge of utility assets and other obstructions in the drill path. This information shall be obtained from the utility owners in the vicinity of the proposed work and if necessary confirmed and verified by survey work using services tracing and visual inspection. BSI PAS 128 details methodologies for carrying out this work and should be followed.

With HDD-radar technology, the first step, pilot drilling, includes the capture and review of the radar data and planning of subsequent actions to avoid any identified obstacles.

BSI PAS 128 provides information on the process that should be followed to identify and verify the location of underground obstacles before installation of new or replacement of existing services is undertaken. While the utility provider frequently has maps of the location of the underground services within a particular area it is often the case that the accuracy of these maps is not sufficient for the contractor. As the insurance is frequently with the contractor there is a requirement to undertake additional mapping work to confirm and update the utilitiy maps that have been provided. Even with this additional work there is frequently the possibility that some unforeseen event arises during the HDD activity causing delays in the work being undertaken. Most often this is the result of some undetected obstacle or an area of the sub-terrain that has not been possible to map effectively.

Once the contractor is content that the mapping work has been completed then the next step in the process is the pilot drilling. With conventional drilling if the pilot bore head approaches or touches an obstacle the drilling process is immediately suspended and the employer contacted for revised drilling instructions. During this suspension the location of buried utilities is rechecked using as much available information as possible. The revised drilling path takes time to determine and can be an expensive delay in the whole process. The ORFEUS system will have a significant impact in this area as the bore head radar will be able to alert the HDD operator to the presence of obstacles before they are encountered thereby allowing adjustment to the drill head to safely bypass the obstacle.

Safety of the operator, the equipment and the existing underground utilities is of immense importance and aspects of these considerations are discussed in:

DVGW W 400-3, Technical Rules on Wasserverteilungsanlagen (TRWV, Water Distribution Systems) — Operation and maintenance

DIN EN 16228-3, Drilling and foundation equipment — Safety — Part 3: Horizontal directional drilling equipment (HDD)

DIN EN ISO 6529, Protective clothing — Protection against chemicals — Determination of resistance of protective clothing materials to permeation by liquids and gases

With the development of the new technology from the ORFEUS project there is an opportunity to enhance the existing standards to incorporate the development of a bore head radar. We have carefully considered the existing standards, policies and guidance documents that are available. From this review it is evident that the development of a new PAS would be very beneficial for the HDD industry. Furthemore, utility and insurance companies would benefit greatly from the potential reduction in utility installation time and reduced insurance liabilities.

4 DEVELOPMENT OF A NEW PAS FOR HDD

At present there is no standard that covers the area of radar-enabled bore head HDD. In order to support the maximum exploitation and adoption of the ORFEUS project results, the consortium has worked closely with the German standards authority (DIN) to develop a new PAS in this area. While this document will not be recognised as a formal standard in this area, it is the first step to developing a European standard in this area. During the development of the PAS we have held discussions with other European groups associated with the development of European HDD standards. These discussions have identified that several of the current European Standards will be reviewed in the next few years. During the review process the new PAS will be examined and it is probable that it will form part of the revised European Standard in this area.

During the last year, a subgroup from the ORFEUS consortium has been working with DIN on the development of the PAS. The final workshop associated with this development took place in June 2015 and the document was published for consultation on June 26th 2015. Following this consultation process, and on the basis that there are no significant objections, it is expected that the PAS will be formally approved during August 2015. This will represent a significant achievement for the ORFEUS project.

DIN

DIN SPEC 91322 **N 33**

DIN SPEC (PAS, CWA) Dieses Dokument wurde durch die im Vorwort genannten Verfasser erarbeitet und verabschiedet.
DIN SPEC 91322 Workshop Bohrkopfradar für das Horizontal-Spülbohrverfahren (HDD-Radar) - Umfeld, Bedingungen und Einsatzgrenzen
E-Mail des Bearbeiters bei DIN: de-won.cho@din.de

Final Draft of DIN SPEC 91322

Datum des Dokumentes 2015-06-18

Aktion Abstimmung
Antworttermin 2015-06-26

Dear workshop members,

Attached to this document you will find the final draft of DIN SPEC 91322 "Bore head radar for horizontal directional drilling (HDD-radar) — Environment, conditions and limitations of use".

All workshop experts are kindly asked to take part in the final vote **until 26th June 2015** either by sending an e-Mail to de-won.cho@din.de or using the DIN LiveLink Voting Booth: https://livelink.din.de/livelink/livelink/open/24603894

Experts who agree to publish DIN SPEC 91322 will be named in the foreword. Experts who do not agree or abstain from voting will not be named in the foreword.

Thank you.

Best regards
De-Won Cho

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DIN 4022-3, Subsoil and groundwater — Designation and description of soil types and rock — Borehole log for boring in soil (loose rock) by continuous extraction of cores

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