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CELJE, SLOVENIA

The trials in Slovenia, for the first time, required a drill rig from a customer to be used in place of the TT equipment deployed at the earlier job sites. Before use, the customer's drill rig needed modification, and setup, with the special equipment required to service the radar system. Under the management of Vilkoograd, the tests were divided into a two stages, carried out on consecutive days. On the first day, the modified drill rig and radar system was commissioned, and tested, at a prepared job site close to the headquarters of Vilkoograd. Subsequently, the system was used to assist in laying a new pipe, 85 metres in length, in a planned operation near to the motorway-highway exit - AC Dramlje. Electrical and optical cables were known to be present in this area. The purpose was a renewal of the water supply network with installation of a PEHD water pipe, SDR17, 160mm diameter. At this job site it was difficult to find all the known pipes and cables due to the difference in depth between the pilot hole and the buried infrastructure, and the nature of the water-logged clay ground conditions. At the end of the drill path, however a cable could be detected.



STANDARDISATION

ORFEUS has agreed a cooperation with DIN (German Standardisation Organisation) and under their guidance and the leadership of Dr. Mike Farrimond of Wellington Associates, a series of Workshops took place in Berlin resulting in the development of "DIN SPEC 91322 - Bore head radar for horizontal directional drilling; environment, conditions, limitations of use". The work on the Standard was open to all specialists who we're encouraged to join the ORFEUS consortium members in these discussions. The standard was published in September 2015 and is available through the DIN website - www.din.de/en/about-standards/din-spec/current-din-specs.

UPCOMING EVENTS



ORFEUS consortium will organise a workshop session in the framework of the CzSTT-20th Conference on Trenchless Technology in Třeboň. The session is planned for Tuesday 15 September 2015, 2:30 pm - 4:30 pm.

For more information, please visit www.conskonference.cz or contact Maria Athanasopoulou at m.athanasopoulou@exergia.gr

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ORFEUS

Operational Radar For Every drill string
Under the Street

NewsLetter #3
September 2015

in focus

RADAR DEMONSTRATIONS

Since the previous issue of our project newsletter, the project has progressed from the purely research and development phase, into testing and demonstration. In terms of ground probing radar, HDD radar is relatively complex, requiring the coordination of technical contributions from four companies. This led to a lengthy integration and testing phase where components developed in Germany, Italy and the UK were brought together and worked up to functional and operational readiness in preparation for the practical trials, which took place in Germany, France and Slovenia during the summer months of 2015.



► ORFEUS field trial in Celje, Slovenia

During the trials, the equipment was deployed in commercial pipe laying projects, and proved to be robust, functioning as expected. Over the course of the trials, approximately half a kilometre of new pipes were laid, with the radar detecting an undocumented, live, electricity cable that was in the drilling path, and would have been struck but for the intervention of the radar team.

► Electricity cable detected by the ORFEUS HDD radar during the field trial on live site in Paris



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The performance of the radar is, of course, the most important issue to be investigated during the field trials, but of equal significance is the provision of power to the underground equipment, and the transmission, to the surface, of the radar data, in real-time. Both of these services are delivered, via slip rings and a centre conductor, along the drill string, which also carries the lubricating Bentonite fluid.



► ORFEUS HDD radar drilling during the field trials



► Real time radar imaging data transmitted to the surface during the trials

Real time radar data and power were successfully transmitted through the automatically-coupled drill rods, using specially developed power system, modems, and in-line electrical couplers. In addition to monitoring radar data and images, the system health was monitored through the performance of the communications and power system. As the operational environment is challenging, and rods can get damaged in service, the trials showed that damaged rods could be accurately detected and removed from the drill string, thereby improving the success of operations. Operational margins on both data and power that guaranteed good real-time performance were successfully achieved.

► LENNESTADT, GERMANY

Trials in the test facility of Tracto-Technik were carried out as a final preparation for the next stage of operational job sites. These trials have demonstrated, and proved, the reliability and robustness of the overall system. This consists of in-cab modem, slip-ring, drill rods, bore-head modem, radar antennas and their electronics including a rotation and tilt sensor.

For the tests, a well-defined bore path was established, with various obstacles, such as aluminium, copper and PVC pipes together with empty and filled holes of various diameters. This variety was designed to test as wide range as possible of the detection capabilities of the ORFEUS radar system.

During drill rod changes, the centre conductors and their connectors were automatically mated, thus making the job of the operator as easy as possible. The communication system, including the power supply serving the radar and communications modules, proved reliable in function and operation. Several trials under different conditions, such as distance to target, rotation speed, etc. were carried out and all the obstacles were detected. These trials allowed modifications and improvements to the system before starting work on operational job sites.



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► STUTTGART, GERMANY



The first operational job was carried out at the city of Stuttgart with the help and support of the company Leonhard Weiss GmbH & Co. KG. The customer was EnBW (Energie Baden-Württemberg) and the task was to place an empty PE pipe 160 * 14.6mm at a depth of between 0.9m and 1.60m along a distance of 65m, as a protection for a gas pipe. The soil consisted of marl and the debris of an earlier road. All known obstacles in the ground were identified from the street maps. Additionally, an extra pit

with samples of different pipes was prepared provide an additional test situation for the radar system. Although it was a difficult drilling operation, due to hard existing underground obstacles and difficult steering of the bore head, the total radar system worked properly and pipes could be detected. For better data collection and analysis, a low rotation and drilling speed was used. At a bore length of about 50m a change of the in-cab modem was necessary because of the anticipated transmission behaviour. A modified modem, with new configuration and better transmission properties, was used to complete the boring without any further problems. After completing the pilot boring the PE pipe was installed successfully.

► PARIS, FRANCE

The job site in La Courneuve, Paris was a significant challenge for the total ORFEUS team, because of the difficulties of operating in a dense urban environment. Organized by Engie, with the subcontractor BIR, a water pipe of 125 * 12.5mm had to be installed over a length of 75m. In this urban environment with many installed pipes and cables, several pits for prior investigations, were excavated. Due to planned variations in drilling depth between 0.78m and 1.60m requested by the customer it was difficult for the drill rig operator to steer the bore head because of the need to thread a route between many pipes and cables. Sometimes, therefore, the drill string had to be pulled back for some metres, to find an unobstructed bore path. During the drilling operation, the radar system collected large amounts of data which had to be analysed and thoroughly inspected checked by the team.

During the Paris trial, the radar detected an undocumented electricity cable in the path of the drill head (verified by excavation), and a collision was avoided. We believe that this may be the first instance of accidental damage being prevented by the use of HDD radar during a commercial drilling operation. The job resulted in the successful installation of a new water main in an urban situation.



► (Continued on Page 4)



HOWARD SCOTT
ORSYS TECHNOLOGY

ORSYS technology is acting as the Project Coordinator of ORFEUS. ORFEUS is a project that comes from quite a long line of partly EC funded projects, running from the EC FP5 through to FP7. We started in 2002 with a project called GIGA. Out of that, came the requirement for a radar that could be mounted on the tip of drill string for HDD machine. So in FP6, we defined a project, which looked at, among other things, putting a radar onto the tip of the drill string for HDD machine and we aimed to do some practical work in that area to test the feasibility which in fact proved quite good. So, we got to the end of ORFEUS I in 2010 and then we started to think about what would be the next stage for FP7 and we decided that instead of doing a general radar project, we would concentrate on drill string radar and we wrote a proposal for ORFEUS II.



CHRIS BARNETT
Euram

One of the things in ORFEUS project, is the fact that the time has come to pass where we look at the infrastructure and utilities which are now under the ground in many of our cities and towns, and has become a far more complex picture and so the ORFEUS project has been designed around the development of new technology which will aid the contractors that are involved in that industry. The role of EURAM within the project is to support that project management aspect, to make sure that deliverables are achieved on time and that we disseminate and exploit the results of the project.



GUIDO MANACORDA
INGEGNERIA DEI SISTEMI

Ingegneria Dei Sistemi, which is an Italian company dealing with radar and specifically with the GPR since 20 years ago, joined the ORFEUS with the specific task of designing a new radar for this application. And for this application, the use of radar is important because you are basically blind when digging into the ground. Can you imagine driving your car without looking ahead? That is what is happening with directional drilling machine.

So we put a radar there just to give the possibility to detect the objects and obstacles around the drilling head. And in this framework, IDS was designing the antenna, the microwave source and receiver, the controller and the data processing software. And the software has also required a great effort, because it is basically extremely different than the software used for ground penetrating radar when used on the surface.



PIERRE SALMONA
J&P GEO SARL

The ORFEUS radar increases the safety margins of the HDD technique by allowing an accurate knowledge of underground utility assets and other obstructions in the drill path. The general public is affected since they are frequently inconvenienced by the street works and traffic congestion caused by digging trenches, thus obstructing vehicle and pedestrian access. The ORFEUS radar decreases road works, facilitates traffic and ensures public safety by avoiding accidents from unsafe trenchless activities such as gas leaks and explosions. After all, significant injuries and/or casualties caused by gas or electricity lines being damaged during excavation are reported every year.



DEVIS DEI
FLORENCE ENGINEERING

Florence Engineering is involved in RTD activities concerning the bore-head radar prototype and data processing, and also in demonstration activities and analysis of results. HDD with the detection capability supplied by radar is surely a step ahead for the innovation of the process to install under-street utility services. As a matter of fact it will provide operators, local authorities and the general public with economic, environmental and safety benefits by reducing damages or destruction of infrastructures through a significantly more effective and accurate trenchless drilling.



VILHELM KOHLAR
VILKOGRAĐ

Vilkograd is a European company for construction and re-construction of pipelines using no-dig technologies. We participate in field demonstrations of the ORFEUS radar, we do drilling test with drill rigs, drill strings, communications module, radar electronics and antenna in order to test the system performance. The drilling procedure using HDD technology is economic and quick and does not impact the environment during and after implementation. The radar will increase HDD applications and will assist the insurance companies, the owners of infrastructure and the operators.