ORFEUS

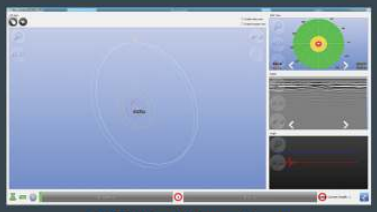
Operational Radar For Every drill string Under the Street

Within the ORFEUS project, demonstration field trials followed the research and development phase and were successfully carried out on operational sites. Activities started in the test site of Tracto Technik in Lennestadt, Germany with a test under controlled conditions of the equipment to calibrate the radar and verify the communications systems before committing to working with contractors on commercial projects. Three trials have been undertaken on live sites, in Stuttgart (narrow street in suburban area), Paris (dense high rise housing area) and Slovenia (motorway connecting road), where runs were completed resulting in the successful laying of new pipes and cables, without inconvenience to local traffic.

ORFEUS Test equipment - used during all tests

The performance of the radar in a range of real operational sites was the investigated during the field trials, but of equal significance was 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 drilling fluid.

Real time radar data and power were successfully transmitted through the automatically-coupled drill rods, using specially developed 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. Operational margins on both data and power that guaranteed good real-time performance were successfully achieved.

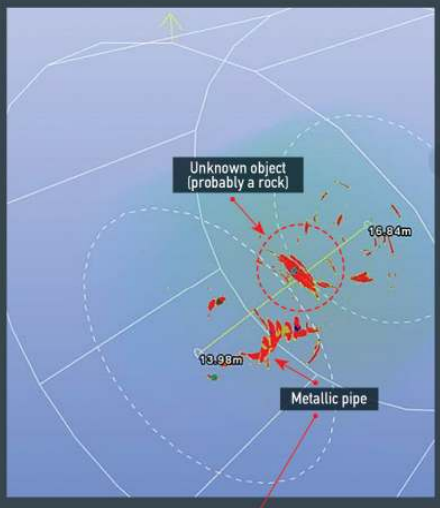

ORFEUS real time software

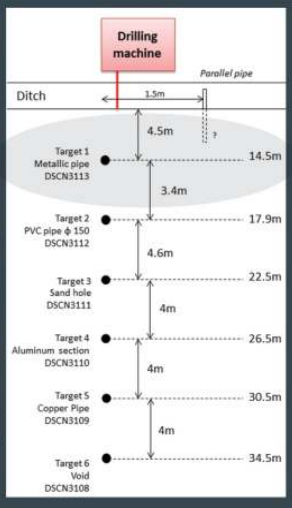
LENNESTADT, GERMANY

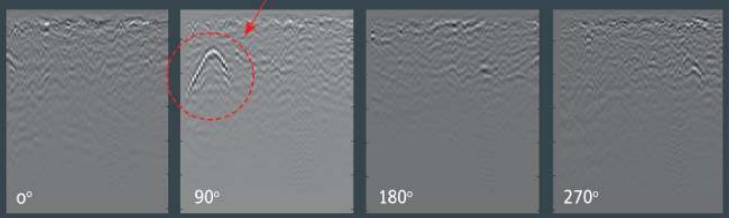
Trials in the test facility of Tracto-Technik were carried out as a final preparation for the next stage of operational job sites. These trials have demonstrated, and proved, the reliability and robustness of the overall system. This consists of in-cab modem, slip-ring, drill rods, bore-head modem, radar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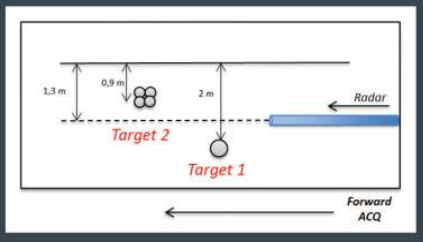
STUTTGART, GERMANY

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-Würtenberg) 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

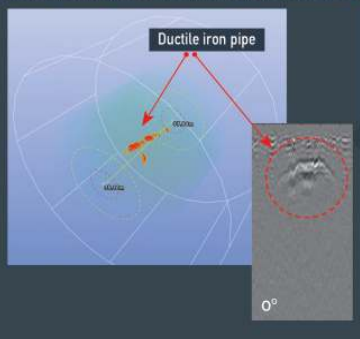
The job site in La Courneuve, Paris was a significant challenge for the total ORFEUS team, because of the difficulties of operating in a dense urban environment. Organized by Engie, with the subcontractor BIR, a water pipe of 125 * 12.5mm had to be installed over a length of 75m. In this urban environment 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.

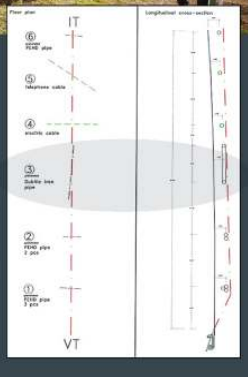
CELJE, SLOVENIA

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 Vilkograd, 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 Vilkograd. The following day, the system was used to assist in laying a new pipe, 85 metres in length, in a planned operation near to the 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 waterlogged clay ground conditions. At the end of the drill path, however a cable could be detected.





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