

DRY DIRECTIONAL DRILLING — A NEW CHALLENGE

In 1995, the necessity of installing optic fibre cables, pushed Telecom Italia (the main Italian Telecommunication Public Company) to promote the research of new operating technologies, by asking a small group of Italian companies to develop high productivity No-Dig technologies that had minimum environmental impact. At the same time a cabling project was considered. However, despite an international search it was shown that existing no-dig systems did not have the required capabilities to complete the work.

The objective was to create a technology for the installation of underground cables, which would be productive and efficient, even in case of compact rock strata, and able to reduce both environmental impact and job sites areas, when works are in progress.

It was a young entrepreneur from Naples, Giuseppe Esposito who first replied to Telecom Italia, providing their test engineers with a machine for Dry Directional Drilling, which operated without any bentonite drilling fluid.

In 1996, after the first successful trials were carried out on prototype units, Giuseppe Esposito's family business, F.Ili Esposito (of Nola-Napoli), became one of the leading contractors of Telecom projects for the installation of underground cables, using trenchless technologies.

Following on from this, the experience gained in the installation of underground mains by means of Dry Directional

Drilling became useful in other utility sectors, such as power supply cabling, gas, and drinking water networks, as well as in sewers.

On the basis of his wide and significant on-site experience, Giuseppe Esposito established SE in 1997, to specialise in the design and manufacture of machines and equipment for Dry Directional Drilling (DDD). To date SE is able to demonstrate the reliability of DDD with over 220 miles (350 km) of successful installations around the world, which have utilised SE's techniques and systems.

DDD

What does Dry Directional Drilling involve? First of all, air. SE Dry Directional Drilling technology is based on the use of compressed air at low pressure (175 to 360 lb/in² – 12 to 25 bar) instead of traditional bentonite mud. Down-the-hole percussive, air-powered tools are designed, patented and manufactured by SE. They have an impact frequency that ranges from 900 to 1,500 blows per minute, which means that they are able to successfully drill any kind of soil or hard rock strata, even when the rock has a compressive strength of more than 29,000 lb/in² (200 MPa). The rotation and percussive action exerted by the down-the-hole tool is extremely efficient even in presence of very hard rocks.

Moreover, it turns out to be very useful in presence of soft soils, since the percussive action generates a pre-consolidation of the soil, so that it facilitates the drilling/steering action.

Cooling of the tool and lubrication of the hole are sometimes improved by using a water-polymer-foam mixture which can also be useful in displacing drilling debris. This kind of mixture is vaporised in the flow of pressurised air, having a carrying capacity of 0.06 to 0.04 gal/min (0.25 to 1.5 l/min) compared to 3,900 to 4,500 gal/min (15,000-17,000 l/min) of air compressed by the air compressor.

When the ground is rock, the mixture is simply made up of fine atomised water, which has only the task of cooling the down-the-hole guidance sonde. Operating in hard rock ground means that the action exerted by the down-the-hole tool brings about the pulverisation of the rock which is then easily removed by the air flow. In presence of soft soils, however, some parts of the soil are displaced, and some others are removed by the air flow, and can be mixed with a water-polymer-foam mixture, if necessary.

SE rigs are designed in such a way that they combine compactness (reduced size), and a high power generation in terms of both pull back and torque. The most popular machine manufactured by SE, is the Scorpio 903 which has a pull back force of 55,000 lb (245 kN) and a maximum torque force of 6,900 ftlb (9,320 Nm). Its size is comparable to those of traditional mud-powered rigs having half the power in pull back and torque.

The Scorpio system consists of a drill rig, on models up to 55,000 lb (245 kN) pullback a separately mounted power source, and on machines with a pull back force of up to 120,000 lb-540 kN, an onboard motor, an air compressor, a small tank (130 gal/500 l capacity) carrying additives for mixtures, down the hole tools (drill pipes, sonde, down-the-hole percussive tools, heads, reamers, swivels, fishers, etc.). The locator used is of the walk-over type.

From the application point of view, SE's DDD system offers various advantages including:

- The technology makes it possible to operate on a wide range of soil conditions, without having to substitute or use expensive and special drilling tools, which means that it is always possible to rely on efficient drilling performance, even when the subsoil presents greatly



A Scorpio drill rig completing a pipeline pullback operation.

Soil conditions	Steerability			Equivalent bending radius	Drilling rate (in pilot boring) with medium incidence of curves along the drilling path	
	Deviation per drill pipe (3 m)				With down the hole tool DTH 4"	
	%	deg	rad	m	Wedge shaped drilling head m/h	Eccentric drilling head
very hard rock	2.0%	1.15	0.02	150	-	4
soft rock	6.0%	3.43	0.06	50	20	25
soft soil	7.0%	4.00	0.07	43	90 to 120	-
compact clay	10.0%	5.71	0.10	30	40 to 60	-

Table showing data of the average drilling rates and steereability, collected from a total of about 185 monitored miles (300 Km) of installations.



The Scorpio DDD drill head emerging after completing a pilot bore.

variable conditions (alternating of soft soils and compact or rocky soils; clayey soils and rocky strata etc);

- Rock drilling is easy, fast and cost-effective;
- Rigs are compact and robust, yet have high power generation in both pull back and torque terms. (also compact machines means the size of transportation required to move rigs and equipment around is greatly reduced, as are job sites areas);
- Operating DDD systems can cost 25% less than operating with traditional mud-powered HDD systems;
- The use of DDD technology eliminates mud-related damage (flooding of basements, and mud eruptions);
- Air does not generate any physical or chemical pollution, nor does it disturb existing water-bearing strata or surface streams and it is abundantly available. Air does not freeze, and it is not (as yet)

subjected to supply costs, it does not need to be stocked, and it does not undergo preliminary treatments to be recovered and filtered.

APPLICATIONS

DDD can be adapted for almost all no-dig underground utility installations. The systems are particularly suitable for the installation of telecommunication, power supply and gas distribution networks, as well as for water networks and sewers. The use of air also makes them suitable for soil decontamination works. Other new applications are also being developed and tested.

SE offers, at present, seven different systems for Dry Directional Drilling. Assistance and specialised field engineering are supervised by a special group, appointed by the Group Engineering Department (Application Engineers). This group guarantees prompt intervention (such as mechanical assistance or assistance in operation) within 24 hr from the customer call. An effective call centre has been activated for this service together with a highly advanced web site.

SE GROUP

The SE Group is composed, at the moment, of three companies: SE Srl (Italy), SE Industries Inc. (Quebec CANADA) and SE Leasing Inc. (Quebec CANADA).

At present, SE Group has a manufacturing plant in Italy, and a larger facility in Canada that is currently being completed. Using a large distribution network, SE products are available all over the world. SE's main dealer is Powermole International Ltd (part of the U.K.-based Euroiseki Group) that distributes SE systems to 36 countries.

by Renzo Chirulli

SE Group General Manager.

EQUIPMENT UPDATE

NEW PRODUCT RANGE

SE, the Italian-based group specialising in the design and manufacture of HDD machines and equipment, has announced its new range of Scorpio™ systems developed for Dry Directional Drilling™ (DDD™).

The Scorpio range includes the micro-rigs, Scorpio 250, which are available in Standard, Pit launched and Truck-Mounted versions; the Scorpio 503, Scorpio 903 and brand new models Scorpio 1203 and Scorpio 3003.

The Scorpio 250 model, with 5.5 t of pullback force (12,125 lb) and 2,550 Nm of torque (1,881 ftlb) is suited to the most restricted and congested urban areas where the installation or replacement of existing networks is required.

The Standard Scorpio 250 features both compactness and manoeuvrability thanks to a small frame mounted on a micro crawler.

The Pit-launched Scorpio 250 is 1.5 m (59 in) long and are more easily manoeuvrable because they do not have the power unit on board (a VM D 704 L – 51 kW engine).

The Truck Mounted Scorpio 250 comes with a compact vehicle (truck) specifically built to carry the rig and to house the power unit.

The Scorpio 503, delivers 13 t of pullback (29,321 lb) and 5,400 Nm of torque (3,983 ftlb) which gives this rig the handling and flexibility required during urban installations.

The Scorpio 903 is the most technologically-advanced SE model. It is a compact machine capable of developing 24 t of pullback force (53,351 lb) and 9,000 Nm of torque (6,657 ftlb) and is available with automated rod-loading system.

The Scorpio 1203, is a 7.1 m (280 in) long rig capable of delivering up to 36.5 t of pullback (80,467 lb) and 11,772 Nm of torque (8,683 ftlb), and was conceived for larger-diameter installations.

The Scorpio 3003 is a self-contained rig for very large diameter installations with a motor capacity of 194 kW which develops 55 t of pullback force (121,252 lb) and 30,000 Nm of torque (22,128 ftlb) and is believed to be the biggest Dry Directional Drilling™ rig ever built.

SE grants leasing operations for the purchase of its machines through SE Leasing Inc. Purchase of the Scorpio systems include a training course focused on the best use and maintenance methodologies



The Scorpio 903 Dry Directional Drilling system, from SE, delivers 24 t of pullback and 9,025 Nm of torque.

which are aimed at maximising the machine's performance on site.

Field assistance is also available around the clock thanks to an efficient call-centre and a highly advanced web-site. Field engineers will reach customers within 24 hrs from their call.

Details: SE Srl, C. da S. Elena Loc. Tamarete, 66026 Ortona (CH) Italy. Tel: (+39 085) 903 351, Fax: 903 35 210, Email: infoit@se-inc.com Website: www.se-inc.com

Circle RSC No. 201

PARIS LAUNCH

Swiss manufacturer Terra AG recently celebrated its 25th anniversary during the Intermat 2000 exhibition in Paris. All visitors to the company's stand were welcomed with a glass of champagne during this jubilee day. Terra exhibited a full range of underground piercing tools, steel pipe rams and horizontal directional drilling systems. Several new items were also shown.

The new Terra-Hammer Version K is now locked by means of a patented lock ring, and can be serviced within a few minutes even on site.

The Terra-Hydrocrack hydraulic cracking machine allows the renewal of old pipes from 75 to 250 mm i.d. in lengths up to 120 m. Nearly every pipe material can be cut by the specially designed roller cutting heads, including ductile iron or steel and repair collars. It operates with thrust and pullback forces of up to 60 t.



The Terra-Hydrocrack pipebursting system.

Depending on the hydraulic power pack, the thrust and pullback force is 450 kN (45 t) at 175 bar, or 600 kN (60 t) at 235 bar. The Terra-Hydrocrack pushes drill rods through the old pipe from the starter pit to the reception pit, where a special roller cutting head with expander is fitted to the rods. The new HDPE pipe is connected to the cutting head. The Terra-Hydrocrack pulls the roller cutting head with the drill rods back to the starter pit, cutting and expanding the old pipe while simultaneously pulling in the new one.

The Terra-Hydrocrack is integrated in a box 2.7 m long and 0.8 m wide. The total weight of the including 43 drill rods is 1,990 kg.

The Terra-Jet 2614 D is a self-contained horizontal directional drilling system. Any drilling fluid tank (1,000 to 10,000 l) can be connected. The operator sits in a comfortable cabin, and a joystick allows simple one-hand operation. The ADBS (patented Automatic Drilling and Backreaming System) adjusts the working speed of the HDD system automatically according to the ground conditions within a few milliseconds. The high drilling fluid volume of 130 l/min allows bores up to 420 mm diameter, and drilling lengths up to 300 m can be achieved with a pullback force of 14 t, depending on ground conditions.

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Circle RSC No. 202

MUD TREATMENT

Pigott Shaft Drilling Ltd (PSD) is one of the U.K.'s leading specialists in the rental of onshore mud cleaning equipment. The company operates an extensive range of high performance equipment, which is available for hire with or without operators on a worldwide basis. Applications include microtunnelling, pipejacking, slurry shield tunnelling, diaphragm walling, bentonite piling, directional drilling, exploration drilling, soil cleaning and de-watering of excavated spoil. PSD specialises in 'dry discharge' solids separation with flowrates of 10 to 1,200 m³/hr.

The hire fleet includes clayball separators, primary shakers, de-sanders, de-silters, ultra-fine de-silters, mud cleaners, hydrocyclone units, centrifuges, flocculation plants, mud mixers and mud storage tanks. Most machines are built to the dimensions of standard ISO containers for ease of transport and handling on site. The fleet ranges from small, lightweight, high performance shakers for small flowrates to the largest capacity containerised de-sander/de-silter in Europe (SS300DP). It