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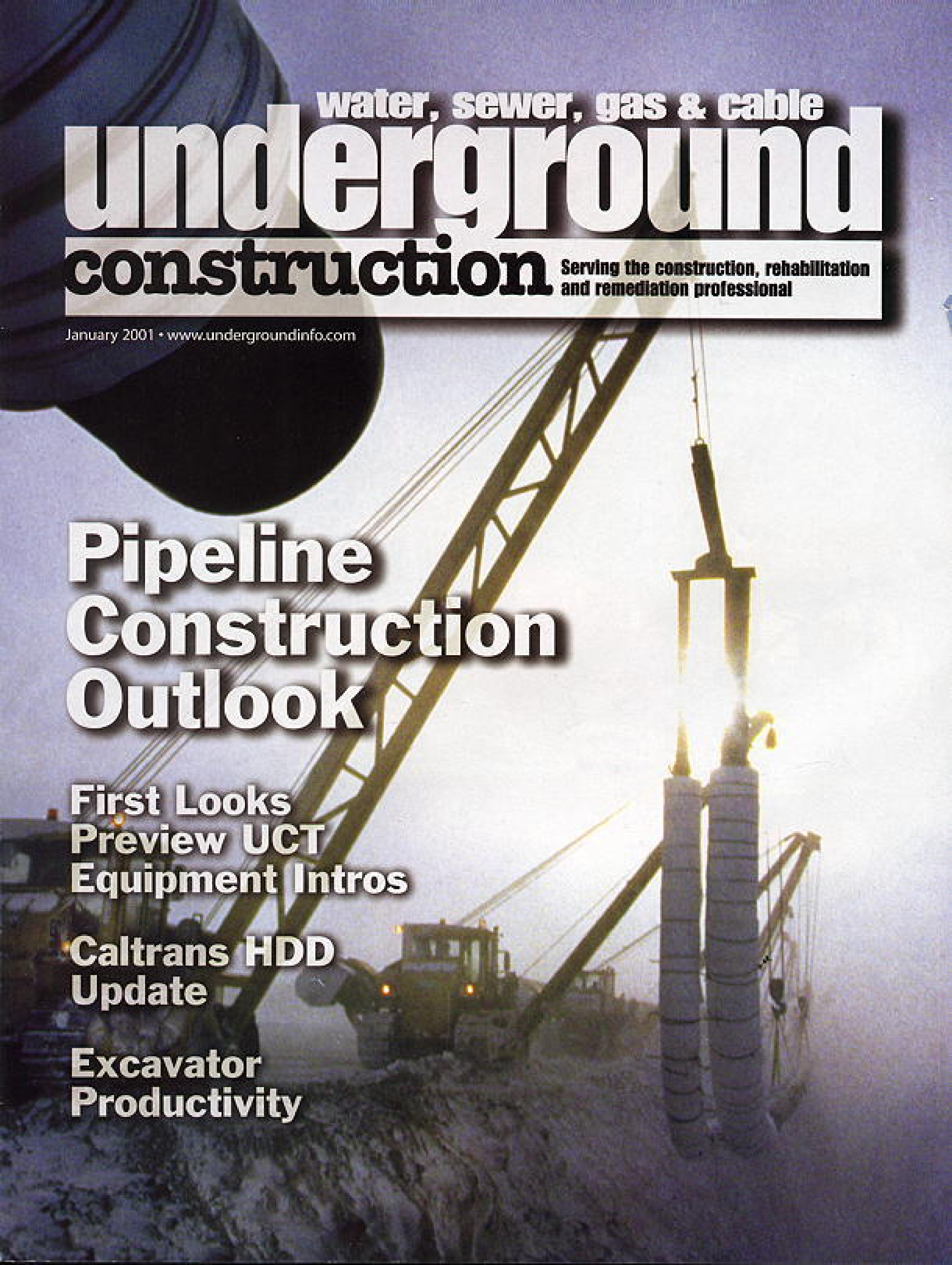

# Pipeline Construction Outlook

## First Looks Preview UCT Equipment Intros

## Caltrans HDD Update

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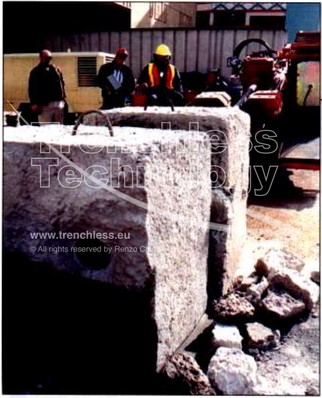


# SE Introduces Dry Directional Drilling To North

by Dr. Ing. Renzo Chirulli • SE Group General Manager

When the idea of using directional drilling for a pipeline river crossing first arose in the early 1970s, it was an experiment with an alternative technology to reduce the environmental impacts associated with the conventional method of digging the riverbed. Until then, directional drilling techniques were used exclusively by the oil industry.

Contractors and producers have used and improved directional drilling. Their main motivation being that the technology reduces the environmental impact and negative effects caused by the traditional technique of digging open trenches to install underground utilities.

Directional drilling makes it possible to substantially reduce or eliminate these negative effects and the associated costs. Such benefits impact the project economics and the entire community.

The technology involved in directional drilling, which evolved into horizontal directional drilling (HDD), has undergone inevitable changes from the days of the first experiments. It has essentially been driven by the need to adapt a technology that was originally designed for oilfields for use in far more sensitive surroundings, such as our modern cities.

The growth of computer networks and the development and expansion of the internet in the early 1990s further increased the use of directional drilling for installing fiber optic cables.

Along with the obvious advantages associated with eliminating open trenches, this extension of directional drilling had a number of disadvantages, which were basically related to the characteristics of the technology that was originally used in the oilfields.

## Muddy problems

This technology makes abundant use of drilling mud, which is necessary when boring at a depth of several hundred or several thousand feet. However, when the same technique is used for drilling horizontally just below the surface, as it is with HDD, the use of mud causes problems, which in some cases can become very serious.

The mud can actually erupt to the surface, fracturing the ground (frac-out phenomenon); flood underground spaces (garages, basements, storage areas); pollute groundwater, and make surface water (rivers, lakes, ponds) muddy, with serious environmental implications.

When directional drilling was used sporadically, the negative consequences of using drilling mud always took a back seat, because consideration was given solely to the often enormous benefits of eliminating the need to dig a trench. Today, with trenchless technology (and especially directional drilling) considered to be one of the best solutions for installing underground utilities, notably in urban settings, it is essential that directional drilling evolve a step further by eliminating the negative effects resulting from the use of mud.

A sample selection of 650 American contractors who specialize in HDD were asked to choose up to four characteristics, from a list of 10, that they felt were the most important for improving their own HDD systems.

- Rock drilling capability;
- Dependable drill pipes;
- Computer-aided operations;
- No use of mud;
- GPS on board;
- Compactness of the rigs;
- Assistance & engineering in the field;
- Lower operating costs;
- Underground utilities detection while drilling; and
- Others.

The survey found that more than 80 percent of the contrac-

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In addition to the above interesting specifications is the extensive range of rigs available today by SE for DDD. They are categorized, as usual, by pullback and torque.

From a performance standpoint, these systems can be used in a wide range of subsoil conditions, ranging from soft soil to hard rock, with no need to change tools or to use special equipment, as is necessary with drilling mud systems, which require mud motors for drilling through hard materials.

As mentioned previously, this results in significantly lower operating costs, which is due to four basic factors:

- No need to purchase, prepare, pump, recover, filter or dispose of bentonite mud;
- No increased costs related with the use of special equipment, like mud motors to drill through hard materials;
- No costs associated with damages that can result from the use of mud; and
- Greater overall productivity.

One final consideration relates to supporting the hole when the drilling operation hits soft soil. It is commonly accepted that the borehole walls, unless properly supported, tend to collapse in such cases.

While it is true that bentonite mud, if properly prepared, can support a drill hole, it is equally true that 95 percent of directional drilling operations today take place in urban areas where telecommunication, power lines, and gas system installations are concentrated and above all, where it is extremely rare, or absolutely anomalous, to find soils with characteristics that require support for the hole.

| Soil conditions | steerability | | | drilling rate | |
|---|---|---|---|---|---|
| | deviation per drill pipe (10 ft.) | | equivalent bending radius | with medium incidence of curves along the drilling using a 4" down-the-hole tool equipped with a 5" drilling head. drilling head | |
| | | | |   |   |
| | % | deg | ft. | ft/h | |
| hard rock (>10.000 psi) | 2,00% | 1,15 | 495 | - | 15-30 |
| soft rock (< 10.000 psi) | 6,00% | 3,43 | 165 | 65 | 85 |
| soft soil | 7,00% | 4,00 | 140 | 300-400 | - |
| compact clay | 10,00% | 5,71 | 100 | 130-200 | - |

Today's market for installing underground utilities is primarily concentrated in congested modern urban areas. As such, the fundamental requirement for directional drilling operations is to use a technology with low environmental impact, low cost and high productivity. Dry directional drilling is an innovation that meets these requirements. **Circle No. 340**

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tors queried believed that eliminating the use of drilling mud was the first step to improving HDD technology.

In the late 1980s, several companies attempted to develop HDD technology that made no use of bentonite mud. These efforts gave birth to the concept of "dry boring," and proved that it was definitely possible to develop a mudless HDD technology. However, this did not lead to the creation of machines capable of guaranteeing adequate performance on the jobs required by current applications of these systems.

## Birth of dry boring

The first dry-boring technology that was capable of delivering a performance with a strong potential for applications was developed in Italy in 1996 by SE Srl.

The technology emerged from a major experiment by a group of Italian companies deeply experienced in rock drilling using pneumatic rotary-percussion drilling systems. At the time, Telecom Italia, the country's leading telecommunications firm, undertook construction of the most extensive urban wiring project ever conceived in Italy (at a cost of approximately US$6 billion in current dollars). Telecom Italia requested that the group build a directional drilling machine that could be used for installing fiber optic cables without using any mud, while at the same time guaranteeing a high degree of productivity in the rocky subsoil that is common throughout the Italian peninsula.

This resulted in the birth of Dry Directional Drilling technology by SE, which is now referred to simply as DDD.

The basic concept of DDD is that drilling mud is replaced by low-pressure (12 bar - 175 psi) compressed air from a normal combustion-engine compressor, like those commonly used in civil construction.

A 15,000 l/min compressor at 12 bar (4000 gallons per minute at 175 psi) is usually used for a rig with 24 tons of pullback.

## Advantages

The most important fundamental advantages of using compressed air are:

- Zero supply costs, because air is a free resource;
- The supply is practically inexhaustible;
- It is non-polluting; and
- There are no disposal costs.

Compressed air handles all of the basic functions typically performed by a drilling fluid, including:

- Cleaning downhole;
- Circulating the debris; and
- Cooling the drilling tools (drilling heads, guidance instruments, etc.).

With DDD, the air also performs another basic function. It provides power to the pneumatic drilling and reaming tools that have been developed for use with this technology.

The use of rotational-percussive downhole drilling tools serves two important functions:

- The force required to drill or ream through the soil is largely produced in the hole where the energy of the pressurized air is converted into kinetic energy at the drilling head; this makes better use of the available energy and leads to lower costs;
- The rotational-percussive action, at a frequency reaching 1,400 blows per minute, is extremely effective in drilling through harder materials, such as limestone, lava rock, reinforced concrete, and walls.

Thanks to the efforts invested in research and development, these systems now deliver a highly respectable performance, as the accompanying table shows.