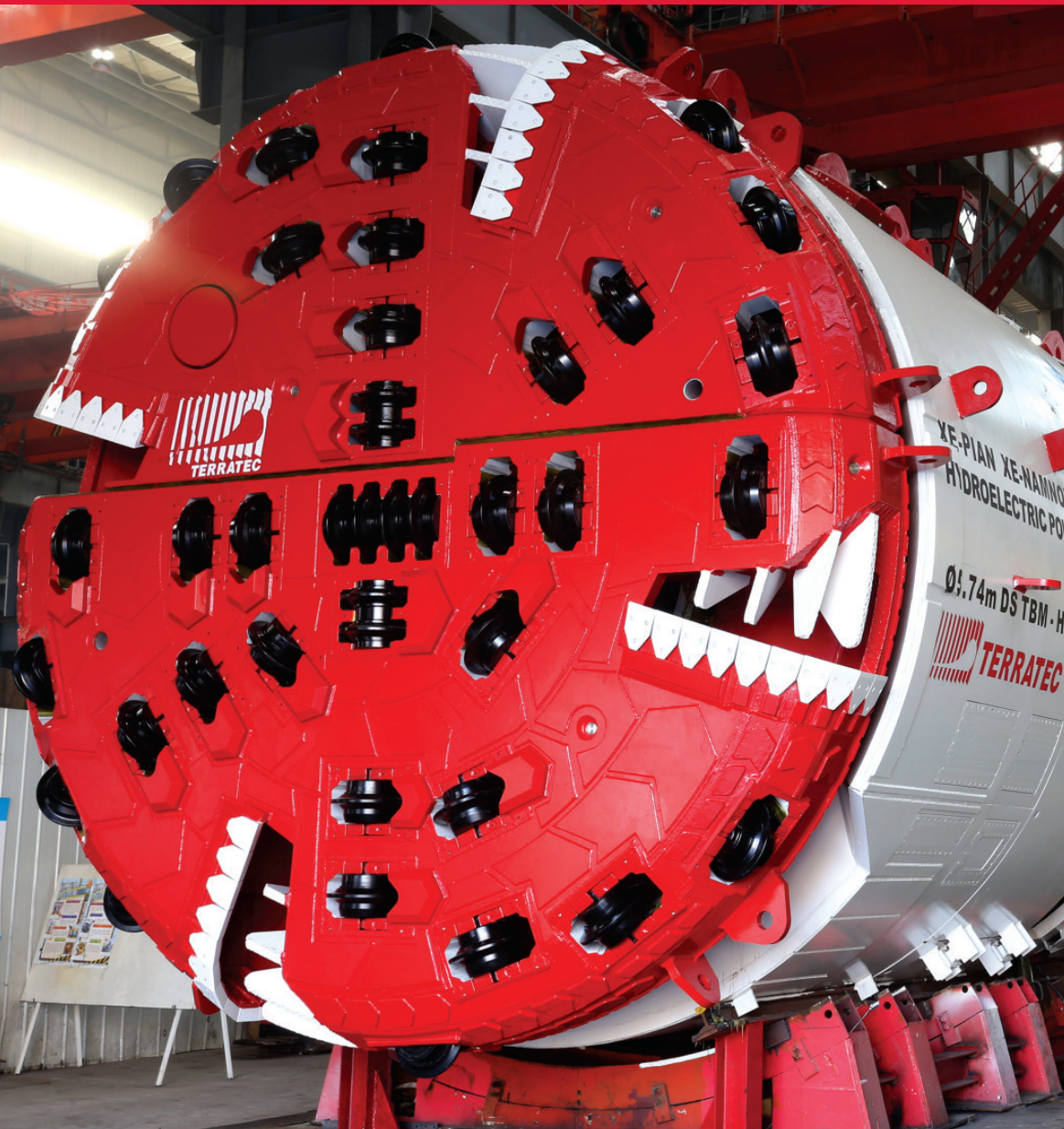


# ALWAYS ADVANCING

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 **TERRATEC**



## COMPANY PROFILE

Incorporated in 1990, TERRATEC is one of the world's leading designers and manufacturers of Tunnel Boring Machines, encompassing all ground conditions and diameters – ranging from 0.60 to over 16 metres – as well as TBM back-up equipment, Raise Boring Machines and other custom-engineered products for the tunnelling and mining industries.

TERRATEC's success is based on the experience and excellence of its engineering team. This team includes engineers with more than

40-years of experience in the design and manufacture of tunnelling and mining machines who have worked on some of the world's largest underground projects. TERRATEC is also fully managed by engineers enabling quick and efficient solutions that meet customer expectations.

TERRATEC products are well-known in the industry as Robust, Durable and Safe, basic principles that must prevail in the design of any equipment made to work in the

extreme conditions encountered underground. As a provider of Total Tunnelling Solutions, TERRATEC's scope of work extends to custom engineering, as well as the operation and maintenance of tunnel boring equipment and the supply of ancillary equipment.

Today, TERRATEC is well placed to meet the growing global market, demanding the highest quality and reliability of equipment for fast and efficient execution of projects anywhere in the world.



### TUNNELING PRODUCTION WORLD RECORD

The new TERRATEC concept of a continuously advancing conveyor system sets a production World Record on the Blue Mountains Project, which remains unbroken.



### WORLD'S LARGEST DOWN REAMING DRILL

TERRATEC supplies the world's largest down reaming production drill (TDR2000) to Mount Isa Mines, one of the largest mining companies in the world.



### FIRST EXPORT TO CHINA

TERRATEC obtains its first contract in China for the supply of a TBM and two Segment Erector Machines for the SSDS Project in Hong Kong.

Sept 1990

Jul 1993



### INCORPORATION OF TERRATEC

Tony Peach and Al Jones establish TERRATEC in Australia.



### FIRST EXPORTS TO USA

TERRATEC receives an Order from Stillwater Mining and BHP Copper for the supply of three Raise Boring Machines.

Nov 1996

Nov 1998

Apr 1999



### FIRST EXPORT TO EUROPE

TERRATEC receives the first order to export its equipment to Europe, consisting of a TBM and related Back-up System for a water transfer project in Portugal.

Dec 2002

Apr 2005



### FIRST EPB PROJECT

Together with Mitsubishi Heavy Industries, TERRATEC participates in the design and supply of the tunnelling equipment for the New Metro Rail City Project in Perth, Australia.

Aug 2009

Dec 2012

Feb 2013

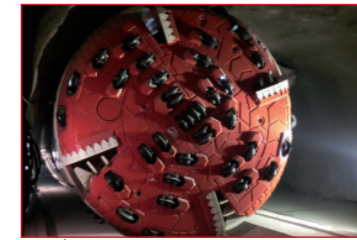
Aug 2016

Aug 2017

Oct 2018

### THE UNIVERSAL BOXHOLE BORER IS LAUNCHED

TERRATEC launches the Universal Boxhole Boring Machine. The UB1000, is designed to boxhole sections up to 1.06m diameter x 100m long.



### DOUBLE SHIELD TBM IN LAOS BREAKS PRODUCTION RECORD

A new 5.74m diameter Hard Rock Double Shield TBM achieves a record production rate of 1000m/month at the Xe-Pian Xe-Namnoy Hydropower Project in Laos.



### TERRATEC AND JIM TECHNOLOGY FORMALISE RELATIONSHIP

JIM Technology from Japan becomes a major shareholder of the company.



### FIRST OF SEVEN MUMBAI METRO TBMS DELIVERED

TERRATEC delivers the first of five Single Shield TBMs and two EPB TBMs to Mumbai Metro.



### FIRST OF EIGHT TBMS FOR DELHI METRO

TERRATEC supplies the first of eight 6.61m diameter EPB Shields with respective Back-up Systems for Delhi Metro Phase III in a record seven months from the receipt of order.



### FIRST TBM FOR LATIN-AMERICA

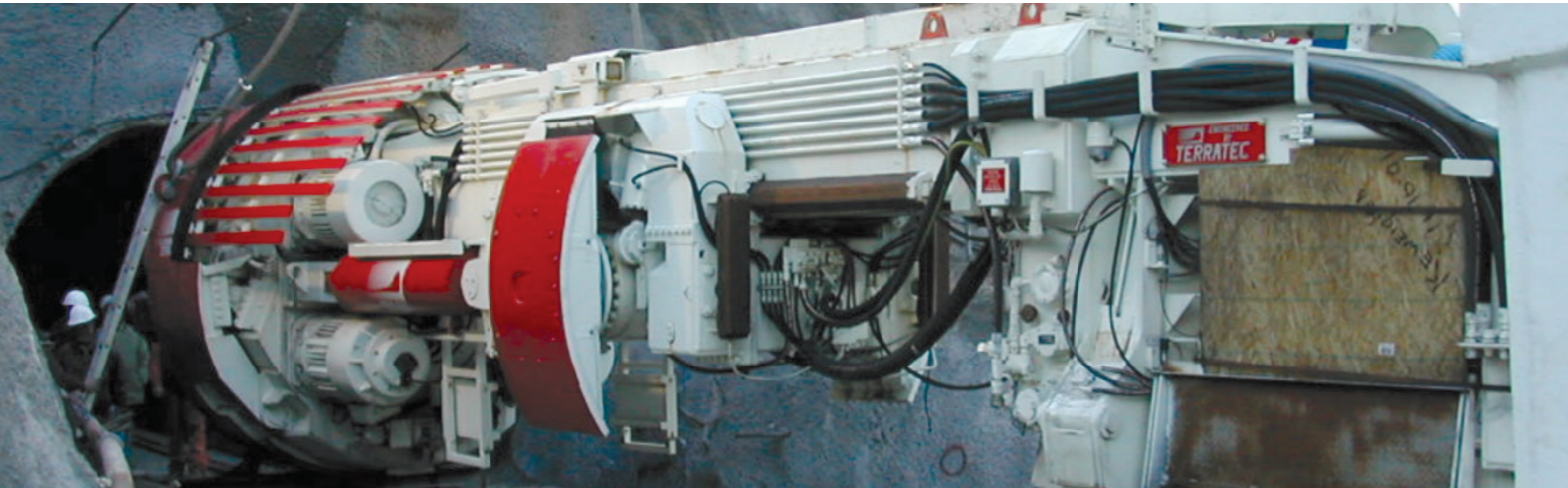
TERRATEC receives an order for the supply of a 9.56m diameter EPB-TBM, Conveyor System and Rolling Stock, for the construction of Metro Line 2 in Santo Domingo, Dominican Republic.



# TUNNEL BORING MACHINES (TBMs)

## HARD ROCK TBMS

For the last 30 years, TERRATEC has provided Hard Rock Tunnel Boring Machines for a full range of geological conditions, from soft shale to extremely hard and abrasive quartzite.



## OPEN TBMS

The Open TBM is the most traditional of the Hard Rock TBMs and is the fastest and most effective machine for boring tunnels in healthy hard rock formations.

During the boring operation, the rear part of this TBM, called the Gripper Device, is firmly anchored to the tunnel walls by two large gripper pads while the front part of the TBM, containing the cutterhead, is extended by the action of hydraulic thrust cylinders.

## DOUBLE SHIELD TBMS

For rock formations containing unstable or faulty zones, using a Double Shield TBM is the safest and most efficient way to excavate tunnels.

Double Shield TBM propulsion is also achieved using a Gripper Device, but in contrast to an Open TBM, the front and rear parts of the TBM are completely shielded and the TBM can install a concrete lining formed by precast segments to perfectly protect the tunnel from the surrounding ground, at the same time as the cutterhead excavates, allowing excellent advance rates.

## SINGLE SHIELD TBMS

When rock strength is weak and the tunnel walls cannot support the action of the Gripper Pads, excavation of the rock is carried out with a Single Shield TBM.

The Single Shield TBM pushes against the concrete lining rings to advance forward, and due to this, installation of segments and excavation is done in alternate stages.



## SOFT GROUND TBMS

For tunnelling projects in soft ground geology with shallow overburden – generally carried out in urban areas – the TBM has to control the pressure at the excavation face, which must be greater than the atmospheric pressure inside the tunnel boring machine. TERRATEC produces the following Soft Ground TBMs.

## EARTH PRESSURE BALANCE MACHINE

An Earth Pressure Balance Machine (EPBM) evacuates excavated material through a Screw Conveyor. The pressure at the front of the machine is controlled by balancing the advance speed of the TBM with the flow of excavated material through the Screw. The EPBM can work with or without pressure in stable layers.

## SLURRY SHIELD

The Slurry Shield TBM is suitable for excavating soils with high water content. This TBM is equipped with a Slurry System that controls the pressure at the excavation face by injecting pressurised slurry into the Cutter Chamber where the slurry is mixed with the excavated material and the mixture is pumped out of the tunnel to a separation and recirculation plant.



## MICROTUNNELLING

TERRATEC offers a wide range of Small Boring Machines (<2.5m) that do not require the presence of an operator inside the tunnel, as the excavation is fully controlled from the surface.

These trenchless solutions are in demand in large cities where conventional methods can cause unacceptable disruption to the daily life of citizens.



# RAISE BORING MACHINES (RBMs)

Over the years TERRATEC has developed its own series of Raise Boring Machines, which have become recognised as superior products due to their innovative high-performance design.

The following TERRATEC standard Raise Boring Machines are available:

## TDR SERIES

The TDR Series (Terratec Down & Raise) allows reaming conventionally upwards, as well as downwards, up to 2,000mm diameter shafts.

TERRATEC's design of the TDR Series is low profile and all the components can pass through the work table, allowing the user to work comfortably in confined spaces.

## TR SERIES

For the excavation of large shafts, TERRATEC's TR (Terratec Raise) Series offers an optimised design to ream upwards for shafts of up to 6,000mm in diameter.

## UB SERIES

The design of the Universal Borer (UB) Machine allows the Raise/Down/Boxhole drilling of shafts, which makes the UB the most versatile of the RBM's.

The standard model of the Universal Borer allows raise boring shafts of 1,500mm and Down or Box hole reaming up to 1,060mm.



## TERRATEC ALSO SUPPLIES ACCESSORIES FOR THE OPERATION:

- Drill Pipe
- Reamers
- Cutters
- Crawlers



## PROJECT REPORT: TR3000 FOR MEXICO

|                          |            |
|--------------------------|------------|
| RBM Type:                | TR3000     |
| Series Number:           | R15        |
| Location:                | Mexico     |
| Year:                    | 2012       |
| Customer:                | CAUSA      |
| Norminal diameter:       | 3,000 mm   |
| Norminal Hole Depth:     | 500 m      |
| Installed Power:         | 352 kW     |
| Torque:                  |            |
| Pilot Drilling           | 78,000 Nm  |
| Reaming Norminal         | 237,000 Nm |
| Reaming Maximum          | 266,000    |
| R.P.M.:                  |            |
| Pilot Drilling           | 0 - 57     |
| Reaming                  | 0 - 14     |
| Thrust:                  |            |
| Down                     | 1,600 kN   |
| Up                       | 4,500 kN   |
| Derrick Dip Angle:       | 0° ~ 30°   |
| Derrick Extended Height: | 4,490 mm   |
| Drill String Length:     | 2,300 mm   |





# CONVEYOR SYSTEMS

## PROJECT REPORT: BLUE MOUNTAINS PROJECT



The successful construction of a tunnel depends not only on the selection of the most suitable tunnelling machine but also the most efficient system to remove the spoil excavated from the TBM out of the tunnel. Interruption in the evacuation works very often leads to interruption to the boring availability of the TBM and subsequently, overall production.



Especially when tunnels are long, when slopes are steep or when space for unloading spoil is limited at the tunnel shaft or portal, the use of a Conveyor System has innumerable advantages over evacuation by rail-bound Muck Cars in terms of productivity, safety and operation and maintenance costs.



TERRATEC has designed and built sophisticated continuous conveyor systems specifically for individual tunnel and TBM conditions. These include continuous conveyor systems in the tunnel, transfer systems, vertical conveyors and stacker systems at the tunnel portal.



TERRATEC Conveyor Systems have been successfully installed on its own TBMs or TBMs made by other companies over the last 30 years with excellent results on more than 12 different projects.

This Australian Project was designed to collect sewage from the upper reaches of the Blue Mountains for transfer to a new treatment plant in the lower mountains.

This entailed the construction of three tunnels of approximately 3.4m in diameter each and totalling 18km in length, from which the majority (13.5km) was excavated by TBM. Construction was undertaken by a Joint Venture of McConnell Dowell Constructors (Australia) and the Obayashi Corporation (Japan).

TERRATEC designed and manufactured a Back-up System and a new patented Continuously Advancing Conveyor System for the TBM, which set world records in production for tunnels of this size. These records remain unbeaten.

|                   |  |
|-------------------|--|
| Project Name:     | Blue Mountains Sewage Transfer Scheme                |
| Location:         | New South Wales- Australia                           |
| Year of Contract: | 1993   |
| Customer:         | McConnell Dowell Constructors & Obayashi Corporation |
| Tunnel Diameter:  | 3.4m   |
| Tunnel Length:    | 13,500m  |

### WORLD PRODUCTION RECORD



|            |        |
|------------|--------|
| Best Day   | 172.5m |
| Best Week  | 703.3m |
| Best Month | 2,166m |

### BUNKER CONVEYOR

For mining applications or tunnelling by conventional methods, TERRATEC's Bunker Conveyor is the perfect solution to evacuate the muck due to its robust, simple and reliable design.

The TERRATEC Bunker Conveyor is designed to be pulled along a monorail as the tunnel advances. It is equipped with a telescopic hopper that facilitates loading of the muck onto the conveying system. The filling of each truck is radio controlled by the operator so the exact amount of muck can be loaded every time.





# OTHER PRODUCTS

In addition to TBMs, RBMs and Conveyor Systems, TERRATEC designs and builds other equipment and machinery for the tunnelling and mining industry. The following are some representative samples:

## MINING EQUIPMENT

### ORE BELLY DUMPER

The direct transportation by road of ore material from open mines to the sea ports in Western Australia has become a tried and proven method of transferring ore to port in the absence of rail infrastructure in remote locations.

TERRATEC Ore Belly Dumpers are a great choice to meet such needs for mining companies. Each Dumper has a capacity of 16m<sup>3</sup> and is specially designed to allow up to three units to be linked together to form a complete Ore Belly Dumper Train with a capacity of as much as 48m<sup>3</sup>.

Simplicity in design, durable wear resistant construction, and strict adherence to the Australian Road and Safety Standards, make TERRATEC Ore Belly Dumpers a cost-effective choice of transport.

### BLAST HOLE CLEANER

For mining applications, TERRATEC supplies robust and reliable Blast Hole Cleaner Systems of easy use and reliability.

TERRATEC Blast Hole Cleaner System are designed to accurately position a stored length of poly pipe over an existing blast hole and feed the poly pipe down the hole while the hole is flushed with water and/or air. The amount of poly pipe fed into the hole is monitored at the console (L.E.D. readout). Poly pipe feed pressure, air and water pressures are also monitored on gauges at the console.

The unique positive spring preloaded in the pipe pusher/tractor feed mechanism ensures that the poly pipe will be securely held while working and will not experience any slippage.

The TERRATEC Blast Hole Cleaner System allows mining and drilling contractors to complete blast holes in a safe, accurate and economic manner.



## TUNNELLING EQUIPMENT

### TUNNEL LINING EQUIPMENT

For tunnel projects bored by Open TBMs that need a separate final lining to ensure perfect tightness, TERRATEC designs and builds machinery to facilitate the process.

TERRATEC has successfully custom-designed and manufactured mechanised systems for the installation of shotcrete to support newly excavated tunnel walls, Segment Erecting Machines for the installation of precast concrete segments and special carriages to allow installation of waterproof membranes in tunnels.

### ROLLING STOCK EQUIPMENT

TERRATEC can specify, design and supply haulage equipment for any project.

Especially when the TBM and Back-up System are supplied by TERRATEC, the best option is to allow TERRATEC to design and supply the train that best suits the TBM and Back-up requirements, ensuring perfect synchronisation of the Total Tunnelling System.

Also, TERRATEC has a wide-range of experience in supplying auxiliary structures for rolling equipment such as rail crosses and complete rolling California Switches for usage in tunnels.





# SERVICES

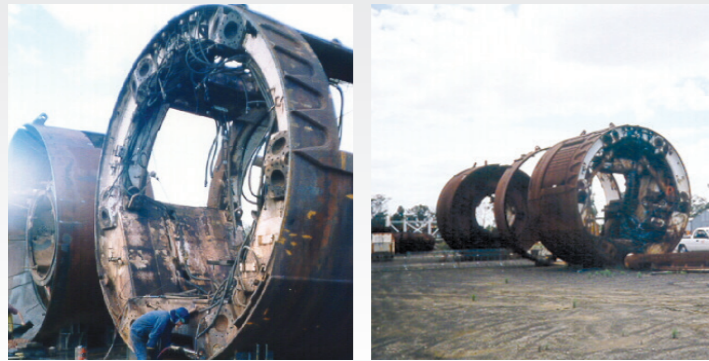
## REFURBISHMENT

For customers with existing TBMs who are intending to re-use them on a new project, TERRATEC offers reconditioning or complete refurbishment of equipment. Irrespective of whether the machine was originally produced by TERRATEC, or any other supplier, TERRATEC's engineering team can easily find a replacement for any part or overhaul any component to match the new desired specification.

Where budget and delivery time constraints exist, TERRATEC can also locate suitable second-hand TBMs, either from its own stock or through its network, and recondition or remanufacture them to meet the new project requirements.



### BEFORE



### AFTER



## AFTER SALES: SPARES AND FIELD SERVICE

With the acquisition of a TBM, it is recommended the customer obtain an initial package of spare parts and contract the supervision of the assembly of the TBM to TERRATEC's field service experts. This will guarantee smooth assembly and commissioning of the machine.

Even in cases where projects are operated without the assistance of TERRATEC personnel, customers can still enjoy an immediate response and quick supply of spares and field services through TERRATEC's worldwide network of representatives and its regional offices around the world.



## CONSULTING

TERRATEC's relationship with its customers is not limited to the Supply of TBMs. TERRATEC's extensive experience in the tunnelling industry allows customers to benefit from advice in following fields:

- Review of project requirements and TBM technology specifications
- Selection of suitable TBMs
- Design of suitable segment linings
- Development of Tunnelling Method Statements
- Cost analysis for equipment and tunnelling works

## ENGINEERING

Irrespective of having purchased a TBM from TERRATEC or from another Supplier, TERRATEC is always willing to support its customers in the design and/or supply of any custom-made equipment that may be needed for TBM assembly or operation, such as Reaction Frames, Launch Cradles, TBM Pulling Systems, etc.

TERRATEC can either supply the equipment, or where it may be more convenient, provide the manufacturing specifications for customers to arrange local fabrication.

## TOTAL TUNNELLING SOLUTIONS

TERRATEC's capacity to provide a wide range of services means that it is not only an equipment supplier but a qualified and experienced partner in the execution of tunnelling works.

As a result, it is becoming more and more common for TERRATEC to supply a Total Tunnelling Solution package consisting of the TBM/s, other main equipment in the tunnel (Trains, Conveyors, Segment Moulds and Ventilation), spares and consumables for the equipment and a team of TERRATEC field personnel who are responsible for operating and maintaining the equipment throughout the duration of the project.





# INNOVATION

Since its establishment, TERRATEC's innovative spirit and the consequent introduction of new ideas into the industry, have been a trade mark of the company. Today, TERRATEC continues to cooperate with various universities, government institutions and industry on the development of new tunnelling and mining technologies, working towards the next-generation of machine design.

An example of this is a patented design for an advancing tail piece on a continuously extending conveyor that allowed McConnell Dowell of Australia and Obayashi Corporation of Japan to achieve a world record advance of 172.4m in a day, 703.3m in a week and 2,067m in a month on the Blue Mountains Project in 1993, just three years after TERRATEC was established. This is still a record for this diameter tunnel.

Many other inventions and contributions to the industry have been introduced by TERRATEC's Research and Development, but the most progressive of all is perhaps the Oscillating Disc Cutter System. For this R&D project, a full scale prototype was designed and manufactured by TERRATEC in cooperation with the Centre for Mining Technology and Equipment of Australia (CMTE), in 1995, which proved their efficiency over conventional Disc Cutters.







#### **AUSTRALIA**

171 Davey Street,  
Hobart, Tasmania,  
7000 AUSTRALIA  
Tel. +61 362233282  
Fax. +61 362233268  
E-mail: [info@terratec.com.au](mailto:info@terratec.com.au)

#### **CHINA & SOUTH EAST ASIA**

11/F Wharf T&T Centre,  
7 Canton Road,  
Kowloon, HONG KONG  
Tel. +852 3169 3660  
Fax. +852 3169 3661  
E-mail: [info@terratec.com.hk](mailto:info@terratec.com.hk)

#### **INDIA**

4F, Ansal Chamber-2  
Bhikaji Cama Place,  
New Delhi, 110066 INDIA  
Tel. +91 11 46695021  
Fax. +91 11 26169111  
E-mail: [info@terratec-india.com](mailto:info@terratec-india.com)