

Summer 2009

## DOUBLE SHIELD LAUNCH AT VELIGONDA

**A** second 10.0 m (32.8 ft) Double Shield TBM has been assembled onsite in India. A total of three identical Robbins machines will excavate massive water transfer tunnels in the Prakasam district of Andhra Pradesh state.

The TBM was completed in May 2009 and is scheduled to begin boring the Pula Subbaiah Veligonda Tunnel no. 2 in summer 2009. The project, for Coastal Projects Pvt. Ltd (CPPL), of the CPPL / Hindustan Construction Company JV, includes the 7 m (23 ft) diameter tunnel No. 1, which will draw water from the same reservoir.

Using Onsite First Time Assembly (OFTA), the Double Shield was assembled in four months. OFTA allows TBMs to be initially assembled onsite, rather than in a manufacturing facility. "The real savings in using OFTA were time-related—the lead time between the TBM order and components arriving onsite was much shorter. The machine did not have to be assembled and disassembled at a shop prior to shipment," said Jim Clark, Robbins Field Service Project Manager.

Assembly went well despite harsh local temperatures,

which can climb to 45 degrees Celsius (113 degrees Fahrenheit) daily. In addition, some components could only be installed at night due to thermal expansion in the midday heat. Robbins is now providing a formal training program for contractor personnel, covering all aspects of TBM maintenance and operation prior to the launch.

A third 10.0 m (32.8 ft) Double Shield will be built using OFTA at the nearby Alimineti Madhava Reddy (AMR) Tunnel in June. The machine will join another Double Shield of the same diameter that has been boring at the opposite end of the tunnel since May 2008. Both AMR and Veligonda projects draw water from Srisaillam Reservoir and are part of the Andhra Pradesh government's extensive scheme to provide ample irrigation to the drought-prone region.

Muck haulage for the Veligonda tunnel will require one of the most extensive conveyor systems ever used in India. The Robbins continuous steel cable belt will extend 19.2 km (11.9 mi) and will require four main drives and three booster drives. All tunnels are scheduled to go online in 2014.



The 10.0 m (32.8 ft) Robbins TBM was launched in June 2009 after a four-month Onsite First Time Assembly (OFTA) process.



The crew stands proudly in front of the 3.0 m (9.8 ft) diameter Double Shield in Melbourne, Australia.

Photo: John Holland Group - Tunneling

## ROBBINS MEXICO OFFICE SUPPORTS LOCAL EPB PROJECTS

The Robbins Mexico office, located in Mexico City, opened its doors on March 1, 2009, providing support to two large-scale projects.

Project management services are being supplied for the Mexico City Metro Line 12 and Emissor Oriente Projects. The city's new metro line, which will utilize a 10.2 m (33.5 ft) diameter EPB on a 6.2 km (3.9 mi) long tunnel, is scheduled to begin in late 2009. Emissor Oriente, a 62 km (39 mi) long wastewater line requiring multiple TBMs, will see the launch of three Robbins EPBs in 2010.

"There is a lot of work coming up in Mexico, and it is an important new market. The office will serve as a center of operations for both current and future projects," said Roberto Gonzalez, General Manager-Robbins Mexico.

The subsidiary has been formed to provide project management, TBM field service, conveyor systems service, and sales functions. The office will also support activities in other Spanish-speaking countries in Latin America.

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## MELBOURNE DOUBLE SHIELD WRAPS UP FIRST DRIVE

Boring beneath Melbourne's suburbs, a 3.0 m (9.8 ft) Robbins Double Shield TBM has completed its first 2.1 km (1.3 mi) long tunnel drive in July. The machine was launched in the first quarter of 2009.

Heavy seasonal rains in the city can create the potential for hazardous wastewater overflows. Protecting the area's valuable streams and rivers is the primary priority of the city's five-year Northern Sewerage Project (NSP).

Split into two stages, the NSP involves the construction of several new sewer tunnels, located deep beneath Melbourne's densely populated northern suburbs. Each of the seven new tunnels is being constructed with TBMs.

Local contractor John Holland is using the Robbins machine, which is currently undergoing a short maintenance break, on a further 1.1 km (0.68 mi) section northwards of the first tunnel drive. Drill and blast and EPB tunneling operations are also underway, making a total 4.5 km (2.8 mi) of new tunnels on Stage 2 of the project.

The TBM was launched from a shaft at Newlands Road near residential homes, requiring acoustic noise mitigation. Structures include full sound-dampening enclosures for the three 24-hour construction sites located across the project. To date, the Robbins machine has tunneled under hundreds of residential properties, without any complaints from the residents above.

Geology along the alignment has varied from massive columnar basalt to a mixed face of weathered basalt with infilled clay seams. Roof conditions have thus far remained competent enough to allow installation of the split set rock bolts originally designed for the tunnel.

The NSP is part of the Victorian State Government's Yarra River Action Plan. Once completed in mid-2012, it will help protect several creeks and ensure the prolonged health of the city's iconic Yarra River. The project spans over 12.5 km (7.8 mi) of tunnels jointly delivered by Melbourne Water (Stage 1) and Yarra Valley Water (Stage 2).

## GEARING UP FOR CHONGQING METRO



Chongqing contractor CRTG visited the Robbins Kent, WA, USA office in July.

Two Robbins Main Beam machines are set to construct China's first ever TBM-driven rock tunnels for a metro line. Contractor China Railway Tunnel Group (CRTG) recently visited the Robbins Kent, WA, USA office in July.

Engineering of the 6.4 m (21 ft) diameter machines is complete and shop assembly will take place in Chongqing. The machines will bore parallel 12 km (7.5 mi) long tunnels for the Chongqing Metro Line 6, part of a network of nine monorail lines under construction. Chongqing, China's most populated city with over 35 million people, currently relies on buses for the majority of its public transportation.

Each machine will bore under low cover ranging from 10 to 60 m (33 to 197 ft) in mudstone and sandstone from 12 to 50 MPa (1,700 to 7,300 psi) UCS. The rock will require a ground support program of rock bolts, ring beams, and shotcrete.



Left: Four independent foam injection points evenly consolidate mixed ground. Above: The 6.3 m (20.7 ft) Robbins EPB was completed in April 2009 for the Samur-Apsheron Irrigation Project.

## ROBBINS EPB WILL TUNNEL NEW CANALS IN AZERBAIJAN

Insufficient water supply for irrigation and other uses has been a problem in Azerbaijan for centuries. A new system of canals in the capital of Baku will help to re-energize the city by drawing water from the Samur River.

The Samur-Apsheron Irrigation Project, for the Azerbaijan Government's Irrigation Department, consists of open canals and TBM-driven tunnels totaling 5.7 km (3.5 mi) in length. The network will convey water from the Samur River to use for both irrigation and the new Takhtakerpu hydropower station, which will provide power to the Cusar District in Baku.

A 6.3 m (20.7 ft) diameter Robbins Earth Pressure Balance Machine--the first ever TBM used in Azerbaijan--will bore the tunnel on the project.

Contractor Azerkorpu awarded Robbins the contract for the complete EPB boring system and back-up, as well as supporting elements, in June 2008. Major components of the machine including the main bearing, electrical, and hydraulic

systems were procured in the U.S., Europe, and Japan. Assembly of the EPB was completed in April 2009 by the Robbins EPB Division in Guangzhou, China.

The TBM is slated for a summer 2009 launch and is expected to bore for eight to nine months in hard clay, silt, sand, and mixed face rock. A mixed ground cutterhead will be used, featuring interchangeable disc cutters and carbide bits.

To safely navigate varying ground conditions, four independent foam injection points in the cutterhead will keep excavated material flowing smoothly and with reduced friction. Multiple detection systems provide electronic information about clogged ports, preventing unnecessary cutter and cutterhead wear.

The machine will excavate one tunnel of approximately 3.5 km (2.2 mi). As the TBM bores, it will line the tunnel with 300 mm (12 inch) thick precast concrete, universal type segments in a 5+1 arrangement. Once the tunnels are complete in 2010, Azerkorpu plans to use the EPB on several other projects in the country.

## TUNNELING COMPLETE AT OK TEDI MINE

In June 2009, a 5.6 m (18.2 ft) diameter Robbins Main Beam TBM polished off tunneling works at the Ok Tedi Copper and Gold Mine.

Located in Papua New Guinea, the jobsite receives up to 8,000 mm (315 in) of rainfall per year. High moisture levels have resulted in water collecting under the mine, which must be drained.

The 4.2 km (2.6 mi) long dewatering tunnel will allow water egress of up to 7 cubic meters per second (1,800 gallons/sec) into a river valley. Two raise bores of 1.1 and 1.2 m (3.6 and 3.9 ft) in diameter will allow drainage of the trapped water into the tunnel 250 m (820 ft) below.

The Robbins machine excavated a combination of siltstone, mudstone, and monzodiorite ranging from 20 to 300 MPa (2,900 to 43,500 psi) UCS. The variable conditions required continuous probe drilling ahead of the machine.

Advance rates reached up to 57 m (187 ft) per day despite broken, fractured ground and high water inflows up to 150 liters per second (40 gallons/sec).

Ok Tedi Mine is one of the world's largest suppliers of copper and gold ore, but its supplies are forecasted to run out by 2014. The new dewatering tunnel will extend the life of the mine by several years.

## ROBBINS SBU-A BREAKS WORLD RECORD

Ohio contractor Turn-Key Tunneling Inc. has pushed the Robbins Small Boring Unit (SBU-A) to new lengths. Their trenchless crossing beneath Louisville, Kentucky, USA's Interstate Highway 265 was completed at a world-record length of 352 ft (107 m). The 1.4 m (54 inch) diameter SBU-A edged out other records in its size class, including a previous record of 350 ft (106.7 m) set by C.B. Services of Texas in 2000.

"We are confident, even after testing the limits of the 54 inch SBU, that we could bore longer lengths given the right rock and project specifications," said Deborah Tingler, Vice President for Turn-Key Tunneling, Inc. Typical jobs for the SBU-A are below 300 ft (90 m) in length, though smaller diameter SBU-As have successfully excavated crossings up to 500 ft (150 m).

The Robbins Small Boring Unit (SBU-A) is a type of trenchless boring attachment for use with standard Auger Boring Machines (ABMs). The SBU-A, in diameters from 24 to 72 inches (600 mm to 1.8 m), consists of a circular cutterhead fitted with rolling disc cutters. The disc cutters are capable of excavating rock from 4,000 to over 25,000 psi (25 to over 175 MPa) UCS. In mixed ground, the cutterheads are fitted with a variety of tungsten carbide bits and single or multi-row disc cutters.

Turn-key Tunneling launched the SBU-A on January 22, 2009 in conjunction with a 60-1200 ABM. The rock, consisting of limestone up to 20,000 psi (138 MPa) UCS, and the 2.91% grade presented challenges, including cutterhead drift.

"We continued to make progressively smaller adjustments and the SBU responded very well. The last 200 ft we bored were very true and required little fine-tuning," said Roger Lewis, Project Superintendent for Turn-Key Tunneling. The machine broke through on March 11, just 0.17 in (4.3 mm) off of line and grade.

The method proved highly successful compared to other trenchless techniques. "Excavating a 54" tunnel with drill and blast would produce about three to four feet per shift in production. On this crossing, blasting was not permitted so hand mining would have been no more than a foot or two per shift. Given these project restrictions, the SBU was at least five times faster than hand mining," said Lewis.



Left: The 1.4 m (54 in) Robbins SBU-A bored a world-record 352 ft (107 m).

Middle: Small Boring Units are more typically used on crossings under 300 ft (90 m) long.

Bottom: The Robbins SBU-A broke through in March 2009, just 4.3 mm (0.17 in) off of line and grade.



### EVENTS CALENDAR

**Robbins will exhibit at the following trade shows:**

#### 2009

**Trenchless Australasia**  
September 20 - 22  
Melbourne, Australia

**ICUEE**  
October 6 - 8  
Louisville, Kentucky, USA

**STUVA**  
December 1 - 3  
Hamburg, Germany

#### 2010

**UCT**  
January 19 - 21  
Tampa, Florida, USA

**Bauma**  
April 19 - 25  
Munich, Germany

**NASTT No Dig**  
May 2 - 7  
Schaumburg, Illinois, USA

