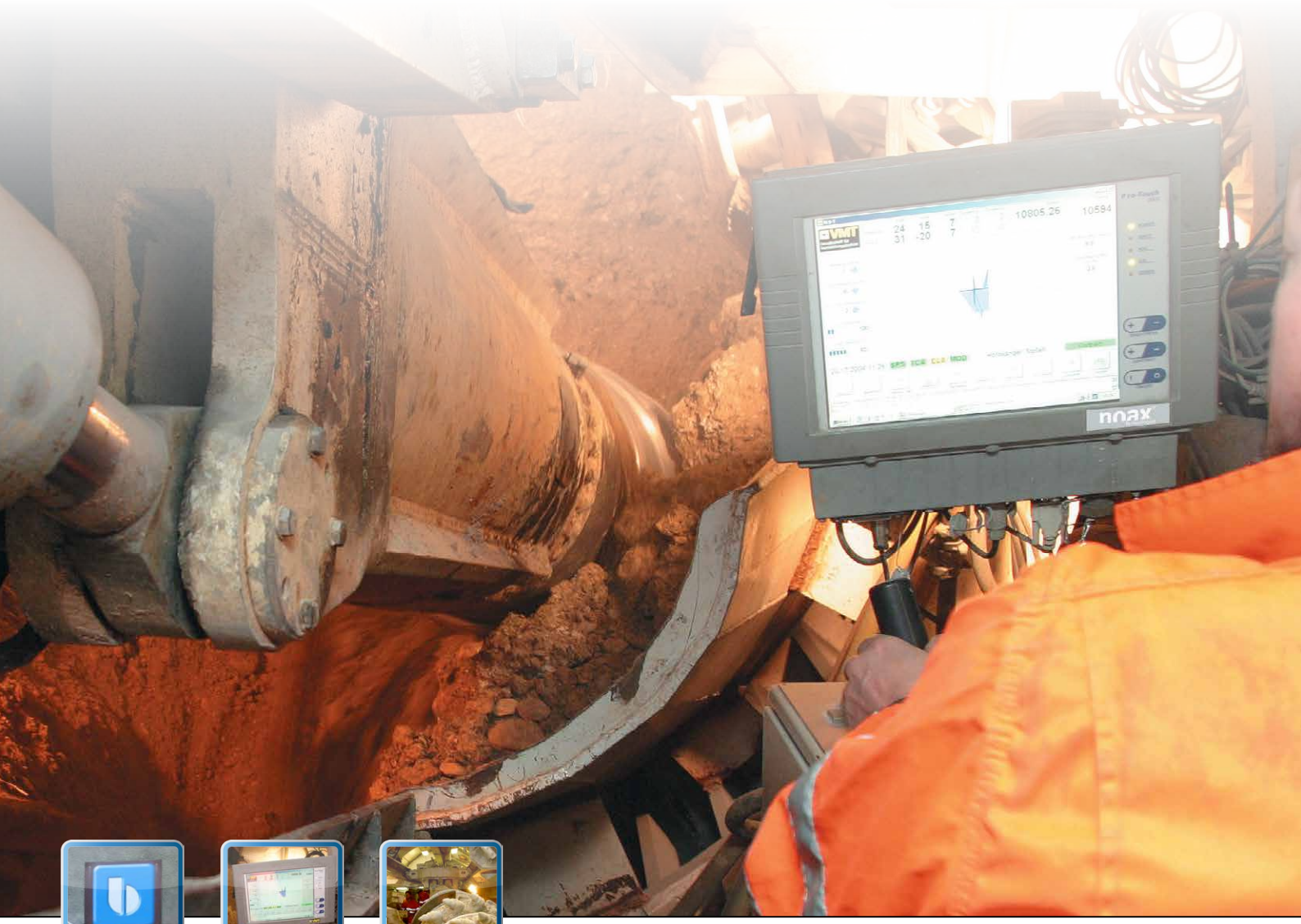
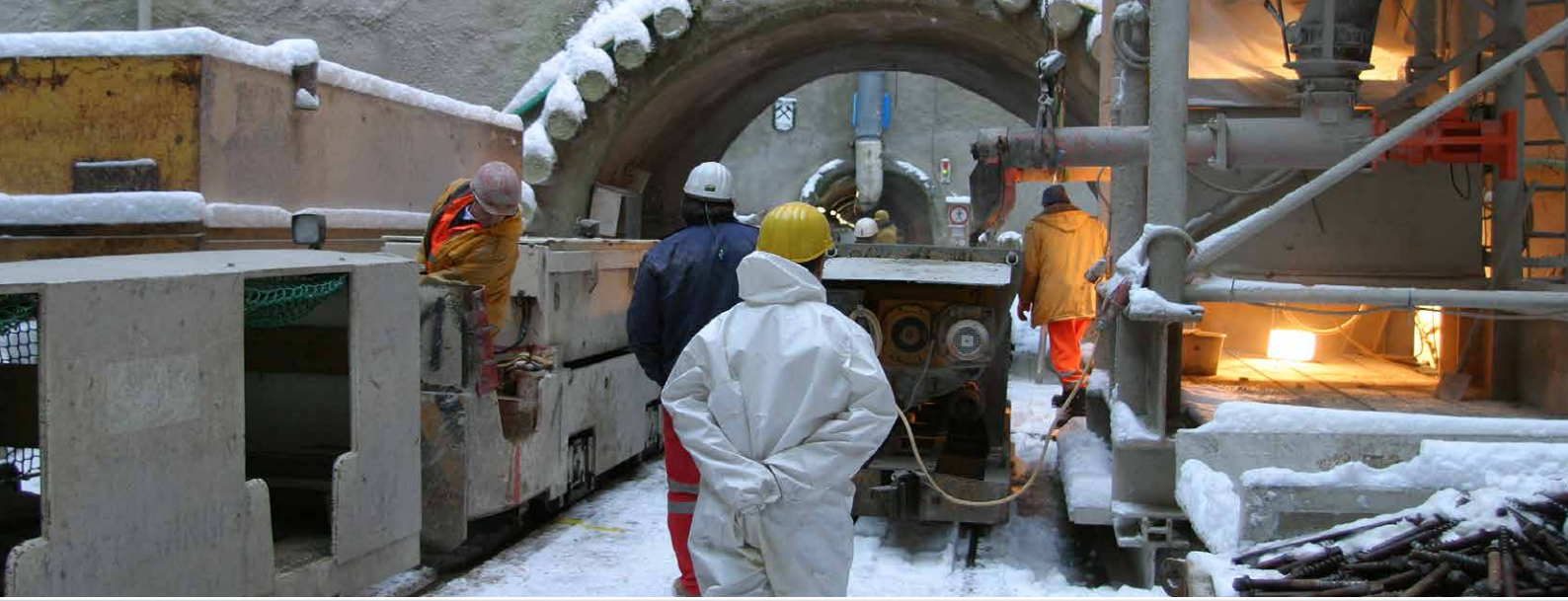
noax® Technologies



Case Study

Bilfinger Berger AG

Completely enclosed – IP65
Industrial PC's for
extreme environments



noax industrial PCs defy vibration and debris on the tunnel boring machine at Bilfinger Berger AG

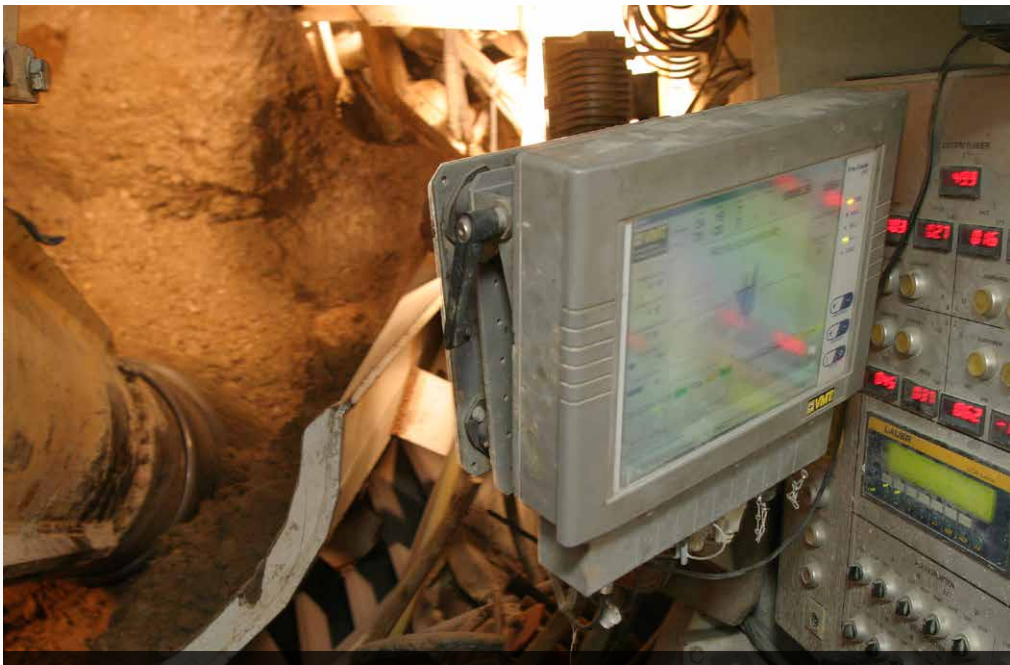
Industrial PCs help navigate underground

In the dim glow of a mining light, you can see the man in the cockpit shaking from the machine vibrations. His eyes are glued to the cutting head, moving along a wall of gravel and sand, carrying the material away. A vibrating conveyor belt transports it to the back of the machine. 72 feet below the surface, the operator must continuously look at the computer screen to acquire all the data pertinent to the position and movement of the machine. The rugged C12 industrial PC, made by noax Technologies, with a Siemens SPZAS S7 and the software produced by VMT, is the control and switching center for the tunnel-boring machine, which is digging underground in the Hofoldinger forest in Germany. The Bilfinger Berger construction company is creating a new water pipeline from the Mangfalltal to the Bavarian capital, about 12.4 miles south of Munich. Bilfinger Berger relies on the rugged noax industrial PCs.

> "An entire day full of vibrations and shocks from the machine, and right next to all the dirt"

Fresh water for 1.3 million people

The municipality of Munich is replacing drinking water pipelines at Mangfalltal that are more than 120 years old, with this investment. The new pipelines will cover about 80% of the total drinking water to Munich. In August 2002, Bilfinger Berger began work on the 11 mile long section. The total length is about 18.6 miles. Since then, the tunnel-boring machine, with the noax IPC have been working 20 hours a day, five days a week. During machine operation, all workers and equipment in the tunnel are subject to strong vibration and severe jolts. There is no effect on the noax panel PC, even with dust created by tunnel boring and splashing water used to moisten the dirt. Welding work less than 3 feet from the rugged computer does not affect the unit. Traditional computers cannot stand up to such extreme conditions. Bilfinger Berger requires industrial PCs, designed specifically for use in its advanced tunnel operations. A basic request for computer operation in the tunnel is an entirely sealed and waterproof construction according to safety standard IP65, which guarantees that humidity, dust, oil and dirt will not get into the computer. Externally, a shock-resistant enclosure protects the electrical components of the computer. The components are exclusively developed and produced by noax, so they can upgrade them as needed. Hard drives are rigidly mounted, just like other components, so they can function without disruption. Even the most severe shock from the tunnel-boring machine will not affect the touch panel IPC or its electrical components. Noax does not bundle cables or use external fans, which often causes problems for traditional PCs. From the start, noax engineers took care of the heat that the units produce. Any excess heat still generated by the unit is dissipated into the environment via the enclosure and the specially designed cooling fins. Data is easily entered on the touch screen proving that the screen not only must be easy to operate but that all data and graphics have to be clearly legible, particularly because of poor lighting conditions in the tunnel. In addition, it must be designed so dirt, dust and machine oil cannot cause any damage. The resistive touch screen will not react from water splashed all over or a soiled display, a significant safety factor in tunnel construction, therefore excluding inadvertent entries.



Front right: Vibration and dirt do not affect the noax C12 IPC

When you turn on the faucet, you rarely think about where that precious wet comes from - it is easily available. Although most people in the Bavarian capital know they are drinking some of the best tap water in Europe, few people know where and how it gets to Munich. In order to ensure supply, international companies like Bilfinger Berger AG are building kilometers of underground tunnels, and they primarily rely on noax industrial PCs.

The industrial PC indicates the direction: The diamond-studded milling head digs forward as instructed to ensure water supply

VMT software and noax PCs – a strong team underground

Tunnel-boring machine operators require constant updating on the actual axis of the machine, in relation to the desired axis. In order to keep the machine as close to the desired axis as possible, the machine driver has to receive a direct response about how he is maneuvering the machine, because it moves forward more than 3 feet per hour. The VMT Company, a leading worldwide control and guidance systems company, provides the SLS-T APD software for operating the tunneldriving machine. The control and guidance system continually keeps the driver informed on the exact location of the tunnel-boring machine. A universal surveying instrument (a theodolite) is rigidly attached to the wall and, with a laser beam, provides basic references with the control and guidance system. This makes it possible for the driver to keep the unit within a relatively small tolerance of the desired axis. The VMT program is based on the Windows 2000 operating system, which makes it significantly easier for the machine driver to adjust to unfamiliar surfaces. The program provides graphic and numeric data the position of the tunnel-boring machine. When there is a deviation from the desired axis, the software will calculate the correction, and bring it back to the desired axis. It also documents the path of the tunnel-boring machine, and determines the type and position of concrete rings which line the tunnel. In order to secure the tunnel from the inside, Bilfinger Berger uses a tubbing procedure, consisting of diagonal concrete rings, where one side of the rings is longer than the opposite side. The concrete rings are made up of individual segments, connected to each other at the back by a gripper arm via the tunnel-boring machine. Because of the diagonal cut and offset mounting of the tubbing, it is possible to follow a straight tunnel axis as well as a curved one. The VMT program calculates exactly how the individual rings will be set on each other, so the tunnel can continue on the projected line, and will not allow the tunnel-boring machine to veer outside the tolerance line.

17.4 km long, the drinking water tunnel extends under the Hofoldinger forest

noax IPCs – rugged, tough and reliable

As the system control and guidance provider, VMT has decided to use noax IPCs because the high reliability of the computers convinced not only Bilfinger Berger, but also the surveying specialist. The units warrant safe and trouble-free operation under extreme environments in the tunnel. Intense shocks, nor constant vibrations can make the unit fail, not only because of its sturdy industrial enclosure but also because of the extremely shock-resistant electrical components inside the unit, and the sparse use of internal connectors which meet all the requirements of the industry. Compact construction and simple operation make them very user-friendly. Data can easily be entered into the system on the resistive touch screen, even with gloves. The 12" display, with a resolution of 800 x 600, offers excellent legibility, and is bright enough to display all graphics and numbers clearly and easily, even in the tunnel. In addition, the computer can be expanded by adding hardware, such as plug-ins or on-board modules. In this manner, laser theodolites, which determine the exact position of the tunnel-boring machine, are connected to the computer by WLAN connections. The brief repair times and excellent technical support from noax Technologies were also deciding factors for VMT. Tunnel construction succeeds or fails because of its computers. If the tough industrial computer doesn't function, the tunnel-boring machine can't operate and downtime of the system will have enormous financial consequences. Since the performance of all the units, as well as noax support, meet the expectations of VMT, the company is also planning to employ noax rugged NEMA IPCs with safety standard IP 65 in the coming years. The computers will support convergence measurement and provide current data to large diverse tunnel projects, using tubbing, within Germany and abroad. Even Bilfinger Berger employees seem to be convinced by the quality of the noax rugged industrial computer. The surveying engineer Mader Waldstein brings his enthusiasm down to this: "An entire day full of vibrations and shocks from the machine, the computer is right next to all the dirt and runs without problems. I'm continuously amazed."

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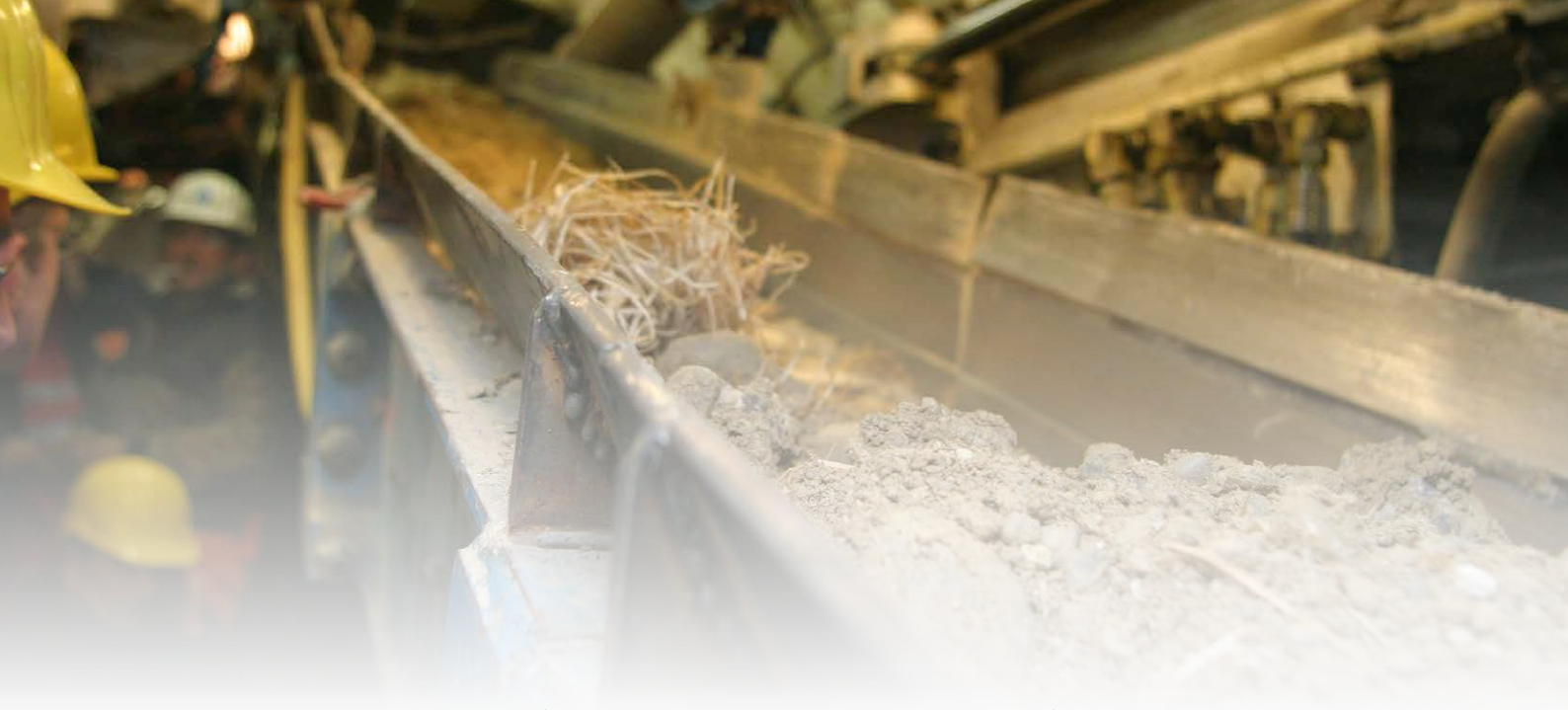

Bilfinger Berger AG

Company Profile:

Bilfinger SE is an internationally listed active construction and service performance company. It was traded as Bilfinger Berger AG until Fall 2012. The company provides consulting, development, planning and financing , engineering, manufacturing, maintenance and operation. As a result of numerous acquisitions and sales, Bilfinger has not been a regular construction company for several years, but mostly a provider of services for Industrial plants, power plants and real estate. In 2010, the company contributed around 80 percent of its output Services and 20 percent in the construction sector.

For more information please visit:
www.bilfingerberger.de

VMT GmbH – A survey technology company – Specialists in creating tailored monitoring and navigation systems for use in tunnel construction.

For more information please visit:
www.vmt-gmbh.de

Specifications and Applications

Objectives:

- ✓ Determine positioning of the tunnel boring machine in real time
- ✓ Documentation and tracking of the entire project
- ✓ Transmits data via modem to management and the company headquarters
- ✓ Synchronizing all data streams

IPC Requirements:

- ✓ Durable and Reliable
- ✓ Professional service and support
- ✓ Resistant to splashing water, dust and EMC radiation
- ✓ Integrated, resistive touch panels to ensure simple and reliable operations
- ✓ Compatible with Windows 2000
- ✓ Interfaces to various peripheral devices
- ✓ Resistant to shock and vibrations
- ✓ High-contrast display, readable in poor lighting conditions

Overview of Components

Hardware:

- C12 Compact Industrial PC
- In-house developed noax all-in-one motherboard
- Input: particularly robust touchscreen
- Bright, high-contrast TFT display
- Protection class IP65 (NEMA 4)
- Completely sealed, no external fan

Software:

- Operating system: Windows 2000
- Application Program: VMT GmbH SLS-T APD control system

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