SIEMENS

Portrait

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Fire safety for the Gotthard Base Tunnel

“Run-of-the-mill projects aren’t my thing”

The Gotthard Base Tunnel (GBT) is the centerpiece of the new transalpine railway link in and through Switzerland. This tunnel of superlatives is not only the world’s longest railway tunnel, it is also a prestige project that showcases Swiss engineering at its best. The extraordinary circumstances of this project required ingenious technical modifications and adjustments. It was the right kind of challenge for Marco Pradera, project lead at Siemens. The tunnel expert shares his experiences from working underground at Switzerland’s most fascinating construction site.

Marco Pradera loves the vast expanses of Finland as much as he does the Swiss Alps. It does not matter to him whether he covers the large distances and the many hundreds of meters in altitude in his marathon-tested running shoes, on cross-country skis or on a mountain bike. That is one side of Pradera. The other side is drawn to the deep: As an electrical engineer for the Siemens Building Technologies Division, Pradera works on fire safety in tunnels. Not just in any tunnel but the showpiece of state-of-the-art tunnel engineering: the Gotthard Base Tunnel, the longest and deepest railway tunnel in the world. Scheduled to open in 2016, it is at the heart of Switzerland’s NRLA (New Railway Link through the Alps) project.

The Gotthard Base Tunnel (GBT) runs for an impressive 57 kilometers from the north portal in Erstfeld, Canton Uri, south to Bodio, Canton Tessin. To create the two single-track main tubes and the safety, ventilation and cross tunnels, 28.2 million tons of rock have been removed since the first blast 17 years ago – a truly remarkable feat of Swiss engineering.

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“The coolest construction site in Switzerland”

The numbers alone illustrate the huge difference to the existing Gotthard Tunnel. Riding a train today bound for the southern Alps, you notice very clearly how the trains makes a tortuous climb on a winding track and through helical tunnels to cross the Alps at an elevation of 900 meters above sea level. There are “only” 1,100 meters of mountain above you – a relatively modest weight compared to the new GBT. Its maximum elevation is 550 meters above sea level; it makes only minor climbs and it does not have any tight curves. However, it leaves 2,300 meters of rock above your head. This takes some getting used to. But it is worth it because the trip from Zurich to Lugano will take only two hours (45 minutes less than before), and Milan will be just three hours away. These figures have been received with a great deal of enthusiasm – not only by the Swiss public, which loves rail travel, but also by the technicians and engineers who got to work at what Marco Pradera, overall project lead for fire safety solutions in the tunnel, calls “the coolest construction site in Switzerland.”

Safely barreling through the tunnel at 250 km/h

Pradera’s first contact with the Gotthard Base Tunnel project was via telephone. “At first I thought they were calling me because of the Gotthard Road Tunnel,” he remembers. He had been a project lead there as well, in charge of fire monitoring in the tunnel, the ventilation stations, the two road maintenance depots and the buildings for the police and fire department. It was obvious that Pradera had done a great job on that earlier project because he was picked to work on the GBT. This has not been an easy project – not only because of the technical challenges but also because many different companies are working simultaneously on a variety of subprojects. Unexpected surprises popped up as early as during the detailed calculation phase, not to mention the actual implementation on site. Pradera does not seem to be fazed: “I like projects like that. You need to work with the customer to find the best solution. It always works out in the end. Run-of-the-mill projects aren’t really my thing.”

It goes without saying that safety is paramount in a tunnel where in the near future more than 200 trains a day will barrel through the tubes at speeds up to 250 km/h. The tubes are connected every 300 meters by crosscuts that allow train passengers to escape to the other tube in case of a fire. “The biggest danger isn’t fire, it’s

suffocation," explains Pradera. Each tube has two emergency-stop stations 600 meters in length which allows the evacuation of up to 1,000 passengers. To prevent disasters from ever happening, the tunnel is equipped with a myriad of sensors, monitoring devices and controllers which are connected to the control centers at the north and south portal via thousands of kilometers of optical fiber cables.

Fire detectors in cages

Fire detection in the four emergency-stop stations is handled by three different detection systems, which control the air dampers directly if an evacuation becomes necessary. The controllers check and record the monitoring data every few milliseconds to ensure the history can be traced and the trigger parameters optimized. The installation of the Fibrolaser fire detection technology from Siemens required special modifications. Typically, Fibrolaser cables are mounted at a distance of 5 cm from the wall because this ensures optimal transmission of temperature readings. For technical reasons, however, they were mounted directly against the concrete wall in the GBT. In addition, Fibrolaser sensors on the floor watch for initial signs of danger. "A stuck wheel on the train, for example, or leaking fluid can catch fire," adds Pradera. For Fibrolaser floor installations, armored cables were used to ensure protection against water spray and mechanical stress. For ceiling installations, cables without metal were used to avoid interferences with the 15 kV overhead lines.

In addition to Fibrolaser, the Gotthard Base Tunnel is equipped with thermal imaging cameras and smoke detectors which continuously measure the temperature and check the air for smoke particles. To protect them against the harsh environmental conditions in the tunnel, they were enclosed in cages – another custom design for the GBT. Everything is built for trains which can achieve speeds up to 270 km/h, with a little extra room to spare.

No access without a stress EKG

Working in the tunnel is anything but child's play. Each person has to pass a heat test and stress EKG required by the Swiss Accident Insurance Agency (SUVA), followed by safety training: People without training are not permitted access. Only those who pass the test are allowed on site. At all times, they are required to wear reflective safety clothing, a helmet, heavy-duty mountain boots and a heavy

backpack that weighs 15 kg. The backpack contains life-saving gear – a face mask, balloon and oxygen cylinder – which ensures 50 minutes of survival in a smoke-filled environment. This kit alone weighs three kilos and costs over 1000 Swiss francs, but nothing is too expensive when it comes to saving lives. Other items in the backpack include a radio, notebook PC, lamp, ear and wind protection, a folder with writing materials – as well as enough food and drink for an entire day at 40°C because the nearest supply station is too far away. In the morning, a train takes the technicians into the mountain; in the evening, they return on another train.

Even though Pradera and his colleagues were well prepared, it doesn't come as a surprise that a few unexpected things happened. "At BT we have a lot of experience with road tunnels, not quite as much with railway tunnels. In a road tunnel, you simply put everything you need in the car, and if you forget something, you jump in the car and get it. In a railway tunnel, you have to carry everything yourself and are dependent on the departure times of the train," explains Pradera. "When working on the cameras, we hit our heads on the overhead lines more than once. But that's what helmets are for."

Finally in the home stretch

The overhead lines have been connected since October 2015. During the day, an elaborate test phase is being carried out in two shifts; it will continue until February 2016. Time slots for service tasks, for example cleaning the cameras or optimizing the parameters, have to be requested 28 days ahead of time, and the actual work has to be performed during the night. "That's why long-term planning is so important. Fortunately, I now have remote access, which allows me to take care of a lot of things. Still, I'll be glad when testing shifts to the nighttime hours beginning in March 2016 and we'll be able to work during the day again," says Pradera.

He is very proud to be a part of this project, he adds, even though he was always happy to "get away from the noise and dust in the evening. Access is difficult and the air is bad. Working below ground is extremely strenuous." Swimming in Lake Urner and having a cold beer from Stiär Biär, the local brewery, helped Pradera cool off in the summer.

When regular rail service begins in December 2016 after thousands of test runs, BT's Gotthard Base Tunnel expert will finally be able to take it a bit easier. Asked whether he plans on ever taking a train through the tunnel, Pradera says: "Never say never. But if I have a choice, I prefer to go over the mountain instead of through it. Not for safety reasons, but simply because you see a lot more."

This portrait is available at
https://tag.siemens.com/content/dam/mam/tag-siemens-com/dlc/bt/press/portrait-engineer-siemens-bt-gotthard.pdf
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Image 1: Gotthard Base Tunnel

Image 2: Marco Pradera

Image 3: Fire detection by Siemens: thermal imaging cameras, smoke detectors, and Fibrolaser

Image 4: Smoke detectors are protected by cages

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Siemens AG (Berlin and Munich) is a global technology powerhouse that has stood for engineering excellence, innovation, quality, reliability and internationality for more than 165 years. The company is active in more than 200 countries, focusing on the areas of electrification, automation and digitalization. One of the world's largest producers of energy-efficient, resource-saving technologies, Siemens is No. 1 in offshore wind turbine construction, a leading supplier of gas and steam turbines for power generation, a major provider of power transmission solutions and a pioneer in infrastructure solutions as well as automation, drive and software solutions for industry. The

company is also a leading provider of medical imaging equipment – such as computed tomography and magnetic resonance imaging systems – and a leader in laboratory diagnostics as well as clinical IT. In fiscal 2015, which ended on September 30, 2015, Siemens generated revenue of €75.6 billion and net income of €7.4 billion. At the end of September 2015, the company had around 348,000 employees worldwide. Further information is available on the Internet at www.siemens.com.