

Equipping Rosshäusern Tunnel west of Bern

George Raymond

On 20 October 2017, 22 members and guests of the IRSE Swiss Section visited the new 2.1 km Rosshäusern Tunnel on the BLS line between Bern and Neuchâtel. The tunnel's concrete shell is complete and railway equipment is being installed. The tracks will go in last and trains will start running through the tunnel from September 2018.

BLS is Switzerland's second-largest standard-gauge railway after the Swiss Federal Railways. Switzerland's standard-gauge railway network comprises 3846 route-km of lines. From its dispatching centre in Spiez, the BLS infrastructure division supervises train movements on 520 route-km of lines in the Bern region and to the south through the Lötschberg and Simplon tunnels to Domodossola in Italy.

Markus Sägesser, BLS project manager, his colleague André Schweizer and Markus Hertnagel of Rhomberg-Sersa were our hosts.

Rationale

Rosshäusern Tunnel will replace 2.4 km of sinuous single track, including a 1 km long tunnel, that opened in 1901 and sees three BLS trains an hour in each direction. Speed is limited to 90 km/h on the segment, which until 2013 hosted Paris-Bern TGVs. The line shares a narrow valley with the Flüelebach, a troublesome stream. BLS and its predecessor railways have struggled with water both along the line and in the tunnel. Both need major repairs. Building a new tunnel lets BLS avoid these repairs and attendant service interruptions.

BLS expects the new Rosshäusern Tunnel to last 80 to 100 years. The new tunnel will straighten the line, shorten it by 300 m and accelerate trains to 160 km/h. It is part of a 4.1 km track-doubling project whose biggest impacts will be better timetable stability and – combined with future upgrades further west – more capacity.

The project was initially budgeted at 200 million Swiss francs, including 7.5 million to upgrade Rosshäusern station.

Evacuation by design

A focus of the tunnel's design was evacuation in an emergency. A 50 metre-high shaft at the tunnel's midpoint, about 1 km from each portal, will let passengers and train crews escape via stairs and a lift.

In an emergency, passengers will detrain onto one of the walkways along the tunnel's walls. A permanently lit handrail will guide passengers to the nearest portal or the escape shaft. Passengers on the south walkway will descend onto a level crossing to reach the escape shaft on the tunnel's north side. Ventilators will keep air pressure in the shaft higher to repel tunnel smoke.

BLS has built roads to the tunnel portals for first responders, who can cut off power in the tunnel if appropriate.

Construction

The first part of the track-doubling project was rebuilding Rosshäusern station, east of the tunnel, which was complete in October 2013.

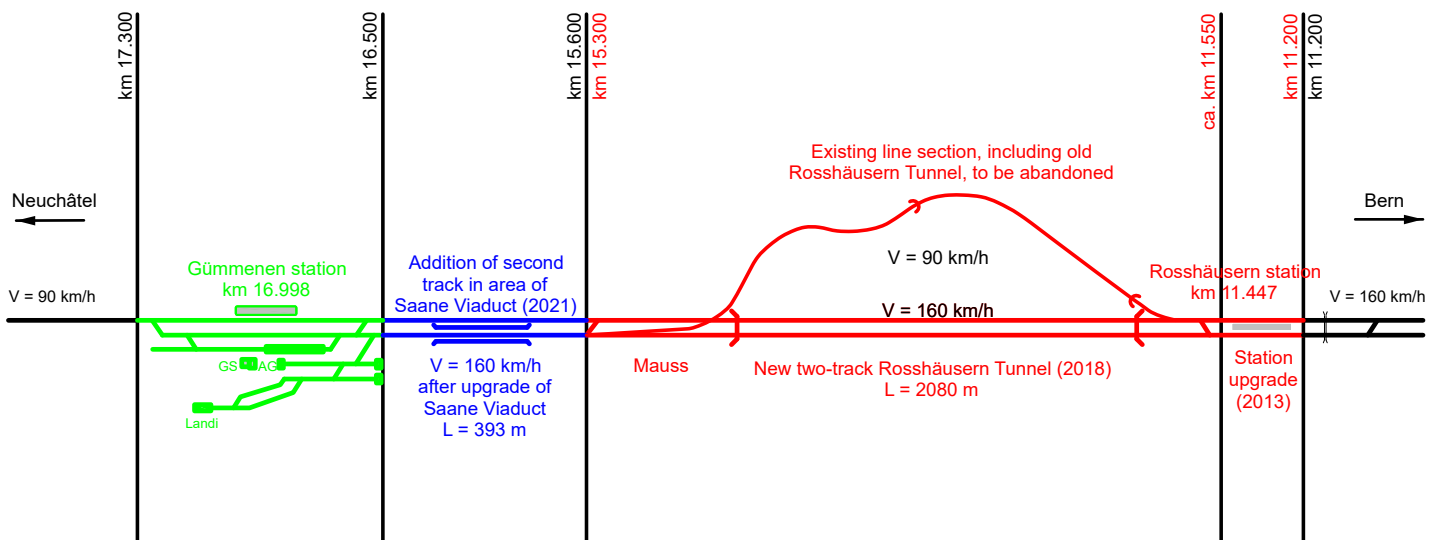
The tunnel – with up to 57 metres of overburden – was dug through molasse deposits and sandstone containing thick layers of marl, which is lime-rich mudstone containing clays and silt. Springs can run through this material, which decomposes into clay-filled sand. The construction spoil was of such poor quality that it could not be used in concrete or even as fill.

When workers began to dig the tunnel in May 2013, they blasted the tunnel's full cross-section as they proceeded. But the ground's stability was even worse than expected: Left alone, the weak rock would encroach into a newly excavated tunnel section within 3 to 4 hours instead of the usual 3 to 4 days. Workers had to spray concrete immediately to stabilise the rock. They also encountered more springs and water than expected.

From January 2014, BLS therefore adopted new methods: workers excavated only the arched top half of the tunnel initially, drilled more stabilising rods into the hill and immediately



The new Rosshäusern Tunnel passes under semi-rural hills west of Bern. Diagram BLS.



Today's sinuous single track and the double-track green tunnel that will replace it. *Diagram BLS.*



BLS rebuilt Rosshäusern station but retained its Siemens Domino 67 interlocking and the signals for the since-lifted points of a third track that served industries here. Eastbound drivers thus see three sets of signals within 530 metres.



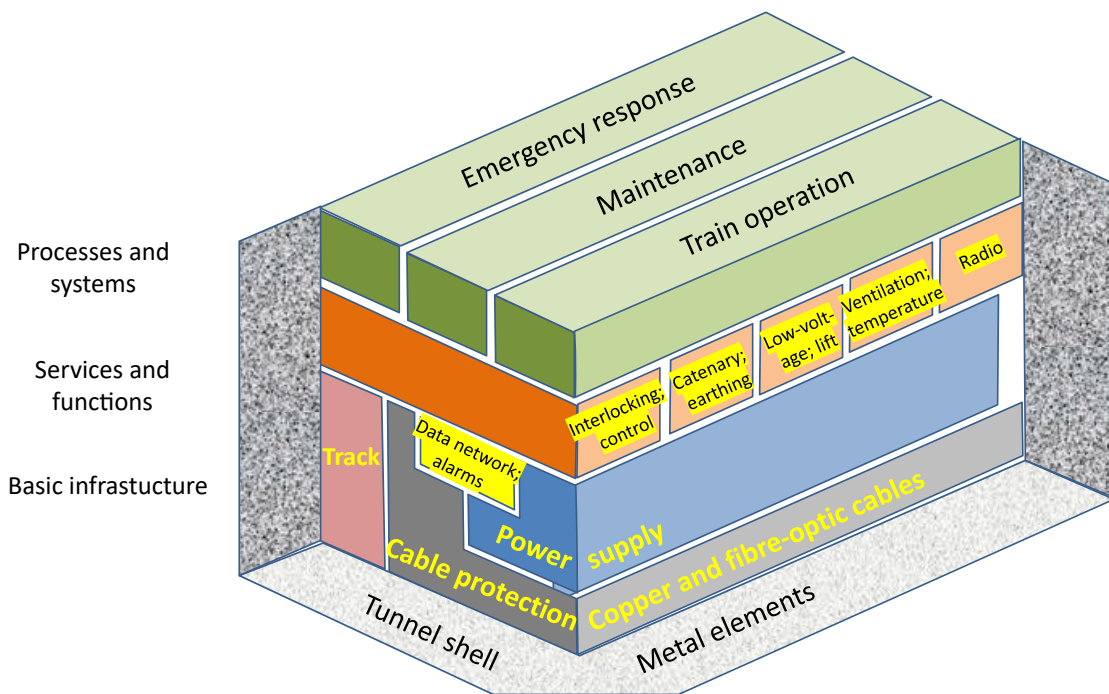
Trains on the existing line run through a deep and sinuous cut that they share with the Flüelebach, a troublesome stream.



At the east portal, Markus Sägeser describes the challenges of the still-trackless Rosshäusern Tunnel. The existing line, which sees six trains per hour, is on the right.



The tunnel has not received its tracks, but the access door to the 50 m high escape shaft at the tunnel's midpoint already bears labels in three languages. *All photos George Raymond.*



Project interfaces for Rosshäusern Tunnel. Diagram BLS.

Phases >>>	Planning: Preliminary design	Detailed design	Materials supply	Installation	Commissioning	System integration; Acceptance	Emergency drills
Work packages:							
WP1: Track							
WP2: Signalling equipment				1)			
WP3: Traction power supply							
WP4: Low-voltage equipment							
WP5: Telecommunications, radio							
WP6: Ventilation, temperature							
WP7: Interior installation							

1) Except interlocking ■ BLS ■ ARGE RS

Division and sharing of labour between BLS and its general contractor, ARGE RS. Diagram BLS.



Signs will show passengers the distance to the nearest portal and the escape shaft. Photo BLS.

installed a reinforced-concrete liner after each digging step. These measures cost an extra 65 million Swiss francs.

The breakthrough in the tunnel's top half came on 2 June 2015. The tunnel's bottom half was then dug out, with no further blasting. Final work on the tunnel's concrete walls began in spring 2016 and installation of railway equipment in summer 2017. Train service through the new double-track Rosshäusern Tunnel will start in autumn 2018, and BLS will return the old right-of-way to a natural state by 2020.

Install the tunnel equipment first, then the tracks

A consortium led by Rhomberg-Sersa (ARGE RS) is installing the tunnel's railway equipment, including track, catenary and signals but also power supplies for lighting, ventilation and the escape shaft's sliding door, lift, and cables for telecommunications and signalling, together with fire hydrants. A central supply powers all functions except the interlocking, which BLS is installing itself. The escape shaft and the two portals are equipped with antennas, and a leaky-feeder cable runs through the tunnel.

Most cables run along the tunnel's north wall. The tunnel's concrete liner feeds water to a drain pipe running along the south wall. The tunnel is on a 2% downgrade westward, the same direction as the Flüelebach, whose bed the tunnel will liberate.

Originally, BLS had planned to install track in the tunnel first, but ARGE RS argued that installing track last would allow using road vehicles to install the other equipment. Workers are thus installing cables first, then the tunnel's technical rooms and equipment, and finally the track.

BLS plans to activate the south track through the tunnel on 3 September 2018. Materials from the old line will then be evacuated via Rosshäusern station's north track. The north tunnel track is to enter service on 14 October 2018.

Interlockings from two makers

The tunnel's interlocking, a Thales Elektra, will be in the upper floor of technical rooms built into the tunnel's east portal and control Swiss type N signals of the newest generation, including six in the tunnel. BLS sought to keep equipment out of the tunnel, but the escape shaft has an equipment room at its base to control the shaft's sliding access door, lift, lighting and ventilation. At Rosshäusern station, BLS decided to retain the Siemens Domino 67 interlocking, which controls older type L signals, considering it too recent to replace.

Maintenance

In a departure from practice in longer Swiss tunnels, catenary is wire (not a fixed rail) and track is ballasted (not cast in concrete). This avoids special installation and maintenance equipment.



The 2.1 km Rosshäusern Tunnel will replace an existing line segment, 300 m longer, whose 116-year-old infrastructure needs major repairs.

Photo BLS.

For inspection or maintenance work, one track will close and trains will run at restricted speed on the other. The tunnel walls contain no refuges for workers, but each worker will carry a device providing visual and acoustic warning of approaching trains. The devices and their permanently installed activation system will be supplied by Schweizer Electronic.

Restoration to a natural state

Once both the tunnel's tracks are in service, BLS will return the abandoned railway line, project access roads and worksites to a natural state. Piles of topsoil removed at the start of the project are visible and ready.

Viaduct next

A next project, which BLS plans to complete by 2021, is to fit the 400 m Saane Viaduct just west of Rosshäusern Tunnel with a second track. Further west, however, beyond Gümmenen, the track will remain single and limited to 90 km/h. So BLS can look forward to more projects.

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Managing Editor, IRSE NEWS

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Harry Ostrofsky (Africa)
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e-mail: mark.glover@irse.org

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London Office

IRSE, 4th Floor, 1 Birdcage Walk, Westminster, London, SW1H 9JJ, United Kingdom

Enquiries

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Tel: +44 (0)20 7808 1180

Fax: +44 (0)20 7808 1196 e-mail: hq@irse.org

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