

# Robinson Creek Tunnel Fire

By Randy Zeiger, Gabrielle Cadieux, Denis Laviolette, Nick Laviolette, Justin Laviolette, and Edward D. Sparks II

**O**n the eve of Saturday, April 26, 2014, an arson fire engulfed a CSX Transportation railroad tunnel near Robinson Creek, KY, cutting off service to two active coal mines in the area. The biggest and most productive mine is TECO Coal in Myra, KY, which employs approximately 500 personnel, and produces around 2 million tons (1.8 million metric tonnes) of coal per year. Normal track speed for this branch line is 25 mph (40 kph), and train traffic consists of two to three coal trains per week. The tunnel is 742 ft (226 m) in length, most of which was timber lined.

When ignited, the coal seams that outcropped in the tunnel roof and walls, along with the creosote-laden timbers and ties that lined the tunnel, effectively turned the tunnel into an oven, causing

much of the walls and roof to collapse. The timber lining system burned for several days before both of the portals were able to be plugged with fill material to suffocate the fire and to address community air quality concerns (refer to Fig. 1).

CSX Transportation responded to this emergency, focusing on safely restoring service to their customers. This task was wrought with various technical, environmental, and health and safety challenges, including firefighting, managing air quality, and reducing personnel risks while working in a hazardous work environment. AMEC was asked by CSX Transportation to respond to this emergency. AMEC worked with CSXT's Engineering and Environmental departments, HAZMAT, local Division personnel, and LRL Construction Company to manage the incident, address environmental concerns, evaluate the tunnel, and restore rail traffic. HEPACO provided environmental remediation and firefighting expertise. LRL Construction Company performed tunnel exploration and remedial repairs.

The AMEC tunnel engineering design team concluded that an "exploratory investigation" was needed once the fire was brought under control to assess tunnel conditions and determine what was needed to return the tunnel to full service.

Originally, the plan was to remove the earthen plugs at the portals and advance back through the tunnel using a "top heading" approach with hand scaling and rock bolting of the tunnel roof and arches to assess the condition of the tunnel interior. However, the extent of the damage and air quality issues caused by the fire did not permit this type of advance. Temperatures upwards of 3000°F (1650°C) were recorded in the debris pile along the invert of the tunnel, which was up to 15 ft (4.6 m) thick in some places. The debris had to be "mucked" out of the invert to safely advance. This presented a significant challenge due to the extreme temperatures and dangerous atmospheric conditions. With coal seams continuing to burn, it was difficult to create the proper ventilation needed in the tunnel for workers to progress. Fresh air was forced into the tunnel from one portal and withdrawn from the other. The exhaust smoke was routed through a field-fabricated "scrubber" to remove particulate matter before discharge to the environment.



*Fig. 1: Scene of the fire at the west portal on April 26, 2014*

(Photo credit: Pike County, KY, newspaper)

As crews advanced into the tunnel, shotcrete was used to establish the initial structural support and safely assess the condition of the tunnel interior (refer to Fig. 2).

LRL advanced through the tunnel in about 30 ft (9 m) long reaches. This was done by pulling invert muck back toward the open portal with a trackhoe and removing it with a front loader (refer to Fig. 3). Crews then moved forward safely scaling the roof and sidewalls. When ground temperatures and air quality conditions allowed, ACI Certified Nozzlemen placed shotcrete on the ceiling/walls with hand nozzles and a robot to establish initial support. When applied to the coal seams, the shotcrete effectively halted degassing and extinguished visible flare-ups. The high temperatures and CO levels within the tunnel diminished as the shotcrete was applied. As workers cooled down the muck pile and hydroscaled the ceiling and walls, the ground kept “popping” due to rapid cooling. The shotcrete significantly slowed down the cooling process of the rock, and enabled workers to safely press on. LRL workers used an off-track rubber tire shotcrete operation for the exploration phase because the rail inside the tunnel was deformed. Equipment included a robot tractor mounted arm manufactured by Shotcrete Technologies, a batch plant, and a concrete pump. LRL and the balance of the project team worked 24 hours a day for 24 days to complete this exploration. In this time, LRL installed three-hundred thirty-two 8 ft (2.4 m) long CT-bolts supplied by DSI Underground and placed 100 yd<sup>3</sup> (76 m<sup>3</sup>) of shotcrete.

Based on the findings from the exploration, the tunnel engineering design team developed a final liner solution that involved additional rock bolts and shotcrete. Once initial roof support was installed, CSXT crews replaced the track through the tunnel and resumed revenue rail service to the mines on June 10, 2014. Then LRL worked around rail traffic using its rail-mounted shotcrete operation for final liner construction.

LRL was able to place 100 yd<sup>3</sup> (76 m<sup>3</sup>) of shotcrete per 12-hour shift. LRL loaded 50 yd<sup>3</sup> (38 m<sup>3</sup>) of shotcrete onto their shotcrete train, mobilized 1/4 mile (1/2 km) to the tunnel, placed 50 yd<sup>3</sup> (38 m<sup>3</sup>) of shotcrete, flushed hoses, cleaned out the pump, and then cleared the track for a coal train to pass. This process was repeated two times per shift. Final liner construction took approximately 2 weeks. A total of one-hundred seventy-five 13 ft (4 m) and three-hundred seventeen 8 ft (2.4 m) long CT-bolts and 1270 yd<sup>3</sup> (970 m<sup>3</sup>) of shotcrete were installed in the tunnel. The shotcrete included 80 lb/yd<sup>3</sup> (47 kg/m<sup>3</sup>) of steel fiber reinforcement and yielded a 28-day unconfined compressive strength of 6000 psi (41 MPa).



*Fig. 2: Initial shotcrete roof support*



*Fig. 3: Muck removal with loader*



*Fig. 4: ACI Certified Nozzelman applying shotcrete to east portal*



Fig. 5: Fifty bulk bags loaded on a flat car for final liner installation



Fig. 6: View of final liner from west portal



Fig. 7: West portal—final liner



Fig. 8: East portal—final liner

The QUIKRETE Companies supplied pre-mixed 3000 lb (1360 kg) bulk bags for this project. A total of 1370 bulk bags were used to complete both phases of this project. Using the premixed bulk bags for a job of this caliber guaranteed the materials were uniform and to contract specifications.

Use of the aforementioned construction techniques and materials resulted in rail service restoration 45 days after the fire and full project completion 10 days later. The final product is a reliable, sound tunnel that will support vital railroad service for many years to come (refer to Fig. 4 through 8).

## The Outstanding Underground Project

### *Project Name*

Robinson Creek Tunnel Fire

### *Project Location*

Robinson Creek, KY

### *Shotcrete Contractor*

LRL Construction Co. Inc.\*

### *General Contractor*

LRL Construction Co. Inc.\*

### *Architect/Engineer*

AMEC\*

### *Material Supplier/Manufacturer*

The QUIKRETE Companies,\*  
Shotcrete Technologies\*

### *Project Owner*

CSX Transportation

\*Corporate Member of the  
American Shotcrete Association



**Randy Zeiger** has over 23 years of engineering design and consulting experience on a wide variety of projects for Class 1 Railroads, local and state government agencies, and mining industries. He currently serves

as a Senior Project Engineer for AMEC Environment & Infrastructure, Inc. For the past 10 years, he has been focused on railroad services primarily related to tunnel construction, rehabilitation, and monitoring; emergency tunnel and landslide response; roadbed stabilization; and capital improvements such as siding extensions and intermodal yards. For local and state government agencies, Zeiger has experience in the design and permitting for bridges and FEMA Regulated Rivers. For the mining industry, he has experience in the design and permitting for coal refuse impoundments and has investigated, evaluated, and designed many small and large freshwater dams.



**Gabrielle Cadieux** is a Civil Engineer with approximately 2-1/2 years of relative field engineering, design, and consulting experience on a wide variety of projects for Class 1 Railroads, and the U.S. Army Corps of Engineers. She currently serves as a Geotechnical Professional for

AMEC Environment & Infrastructure, Inc. For the past year, Cadieux has been focused on railroad services primarily related to roadbed stabilization, slope stability, sinkholes, soft soil improvements, tunnel construction, rehabilitation and monitoring, emergency tunnel and landslide response, and capital improvements such as siding extensions and intermodal yards. Previous experience was with Bauer Foundation Corporation, where she was a Field Engineer at the Center Hill Dam Rehabilitation project in Silver Point, TN, for approximately 11 months.



**Denis 'Dan' Laviolette** is the sole owner of LRL Construction Co., Inc. and has over 40 years of tunneling experience. Laviolette started his company along with two business partners in 1996 and has since taken a

small family-owned company into an empire. He takes pride in the specialized work that his company has come to master and is known for fast, safe results when needed most. His extensive knowledge and expertise in tunnel repair, shaft development, tunnel fires, and emergency collapse repair stems back to his mining days and have evolved over the years from working all over the world.



**Nick Laviolette** is LRL Construction's Senior Project Manager and the son of the remaining founder of LRL Construction Co., Denis Laviolette. With over 18 years of experience in tunnel construction for both highways and

railways, Laviolette has led his team to complete several large railway clearance projects for multiple rail line owners, as well as various other emergency and reconstruction projects. Laviolette is also responsible in part for LRL's Micro Tunnel and Jack and Bore division.



**Justin Laviolette** is a Project Manager for LRL Construction and has over 15 years of experience in tunnel construction for highway and railways. Laviolette is the son of the remaining LRL Construction founder, Denis Laviolette, and

has learned his vast array of experience in mining and tunneling from him. Laviolette has managed and worked many large scaled projects for LRL throughout the United States.



**Edward D. Sparks II** has over 20 years of railroad engineering and maintenance experience on a wide variety of projects in roles of increasing responsibility for CSX Transportation. He currently serves as Assistant Chief Engineer of

Structures, responsible for inspection, maintenance, design, and construction of bridges, culverts, and tunnels across the CSX network, which spans 21 states, two provinces, and 21,000 route miles.