CASE STUDY

Mining Controls Incorporated—Beckley, West Virginia

Relay's Event Reports Prevent Unnecessary Losses in Materials and Production

SEL-587 Current Differential Relay generates precise event reports that enable managers of electric power systems to make informed decisions after an equipment failure or system outage has occurred.

With the high cost of gas and oil fueling the demand for coal, some coal mining operations are straining to achieve higher production capacities. In addition to vigilance about safety, this situation underscores the importance of supplying and distributing reliable electric power to operate mining equipment and support the needs of personnel above and below ground.

The reliability of such electric power systems depends on the devices that monitor and protect them, including relays. However, in the event of a fault, it is also vital to mine safety and production that power systems engineers know what happened. This information is now available in the form of event reports that are generated by some of today's microprocessor-based protective relays.

"In many cases, you have only 15 minutes before you would have to evacuate a mine section if an electric power system goes down," says Jim Goble, Manager of Engineering at Mining Controls Inc. (MCI), a manufacturer of electrical equipment for the mining and industrial markets. Located in Beckley, West Virginia, the heart of coal mining country, MCI is involved in the custom design and manufacture of electrical power distribution equipment and controls for both surface and underground mining installations in the coal, precious metals, and other metal/nonmetal mining industries. MCI also designs and manufactures specialty equipment for the tunneling industry.

"Event reports can instantly provide a snapshot of power system conditions when a fault occurred," Goble continues, "which can be a crucial aid in post-fault analysis and help determine quickly what should be done about it." Additionally, event reports can improve an engineer's understanding of both simple and complex protective scheme operations and also aid in testing and troubleshooting relay settings and protection schemes.

Figure 1—With the high cost of gas and oil fueling the demand for coal, some coal mining operations are straining to achieve higher production capacities while remaining vigilant about safety. This underscores the importance of supplying and distributing reliable electric power to operate mining equipment and support the needs of personnel above and below ground.

Goble recently experienced the value of event reports when commissioning a transformer for one of MCI's many coal mine customers. For monitoring and protection,

MCI used the SEL-587 Current Differential Relay, a sophisticated yet economical device from Schweitzer Engineering Laboratories, Inc. (SEL) based in Pullman, Washington.

Typically used for transformer and motor protection applications, the SEL-587 Relay provides oscillographic event reports (up to ten 15-cycle reports) and metering functions that reduce or eliminate external recorder and metering requirements. Because SEL is an innovator in microprocessor-based relays with wide acceptance among electric power utilities, products such as the SEL-587 are becoming popular in industrial applications where advanced metering, monitoring, reporting, and protection features are becoming increasingly important.

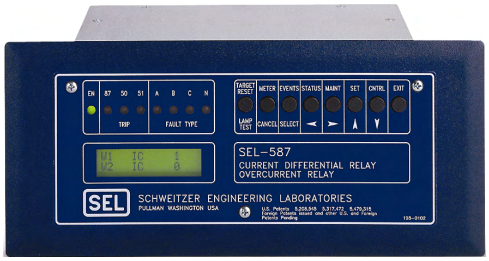

Figure 2—For monitoring and protection, MCI used the SEL-587 Current Differential Relay, which provides oscillographic event reports and metering functions that reduce or eliminate external recorder and metering requirements.

"This transformer commissioning project was the first time we ever used the SEL-587 Differential Relay," Goble explains. "We were simply doing a soak, energizing the transformer without a load. So at first, we were concerned that it might not have been a fault with the new transformer but actually a problem of the relay tripping, possibly due to improper settings."

To confirm that the problem was indeed with the transformer, MCI contacted Derek Ashby, a sales engineer at Robinson Sales, the SEL representative in nearby McHenry, Maryland. Ashby assured Goble that the SEL relays and reports were highly reliable but suggested that he email the event report data to SEL.

"The event report clearly indicated that there was a fault in the transformer," says Greg Hataway, an SEL Field Application Engineer. "And later when they opened up the transformer, they located the problem."

Hataway adds that event reports show what went wrong on both sides—the transformer and the relay, for example. "If you don't have that information, you have to make your best estimate. In this case, you would have to decide whether you would try the transformer again without knowing for sure that it was even a transformer problem."

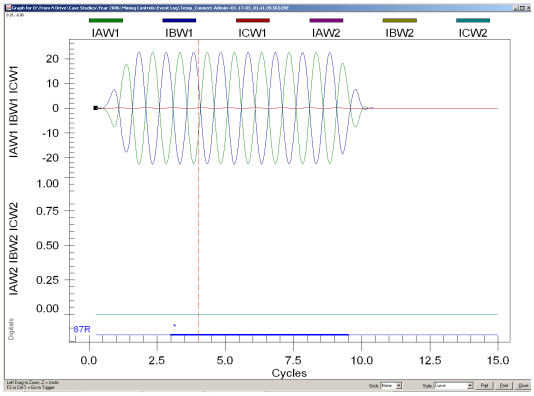

Figure 3—Displaying the SEL-587 event report graphically with the ACSELERATOR® Analytic Assistant SEL-5601 Software quickly indicated that there was a fault in the transformer.

"With an electromechanical relay," Hataway explains, "you would know that the relay tripped, but it doesn't give you any indication of the level of currents or how they distribute in the transformer windings. There are tests that can be performed, such as dissolved gas, to detect a transformer fault."

"But at some point, you have to decide if you are going to energize the transformer again and risk catastrophic damage or an emergency shutdown once the transformer is in service," says Hataway. "Conversely, with the event report, you have good information from which to make a good decision."

Lee Underwood, another SEL Field Application Engineer, helped Mining Controls set the SEL-587 installation on the MCI transformer. Underwood says that this fault was a classic that he uses as an example of the value of event reports.

"What we notice immediately from the Mining Controls event report is that the transformer event has the classic signature of a phase-to-phase fault, in that the A- and B-phase currents are exactly the same magnitude and exactly 180 degrees out of phase," Underwood says. He adds that MCI did all the right things when the event occurred.

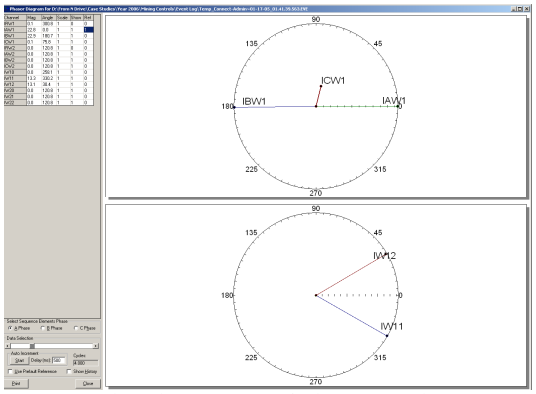

Figure 4—The phasor view of the captured event was another tool available in the investigation, which showed that the Winding 1 A- and B-phase currents were exactly the same magnitude and exactly 180 degrees out of phase.

"They took the time to set the relay properly for the application so that the relay was able to do what it was designed to do," he says. "When the relay operated, they had enough confidence in their settings and in the relay to consider that something could actually be wrong in the transformer. There is a tendency within the industry to assume that relay trips during commissioning are due to improper relay settings or relay problems, and all too often we hear of situations where settings are changed more or less randomly in an attempt to 'fix' what is perceived to be improper operation. This event serves as an excellent reminder that we should always take advantage of the event reporting capability within modern relays to analyze operations before deciding what action to take. The event report will almost always reveal either that an actual fault has occurred or will tell us exactly which setting needs to be changed. In this case, taking the time to use the tools available to do a thorough analysis likely saved the transformer from the even more significant damage which would have occurred if they had just closed the breaker back in."

Derek Ashby of Robinson Sales adds that while coal mining operations are a good example of how industry can benefit from "industrial grade" power system protection such as that provided by the SEL-587, there are many other industrial applications that could benefit in similar ways.

"We've had problems in the past in different industries that use rock crushers and similar applications where motor protection is important," Ashby says. "These are applications where they get premature tripping in their motor protection relays because the loads are very cyclical. SEL's motor protection relay, because it has a 'true' thermal model and not an overcurrent-based thermal model, solves that problem. The result is prevention of premature tripping and, consequently, avoids unplanned stoppage in production. That's the name of the game in industry—don't stop the process."

Ashby adds that he sees many instances where critical motors are involved in manufacturing processes. If these motors are tripped early, there's a possibility of losing an entire batch of a process.

"In the aluminum industry or chemical industry, certain things have to be processed at certain times and under certain conditions such as temperatures," Ashby says. "It is therefore critical that you don't lose power during those processes or it will cost you severe losses in materials and production. And maybe it will also leave a mess on your hands that is expensive and time-consuming to clean up."

In the coal mining industry, perhaps the greater emphasis on power system reliability would be placed on safety. In its Best Practices on Fire Protection (Card No. BPFP-14), the U.S. Department of Labor Mine Safety and Health Administration reminds: *Equipment safety depends on proper selection, installation, and maintenance.*

Under adverse conditions, the energy supplied to the equipment can become uncontrolled, often appearing as extreme heat leading to a potential deadly fire.

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About Mining Controls Inc.

Mining Controls Inc. (MCI) is a custom manufacturer of electrical equipment for the mining and industrial markets. Situated on 16 acres at the Airport Industrial Park in Beckley, West Virginia, MCI is involved in the custom design and manufacture of electrical power distribution equipment and controls for both surface and underground mining installations in the coal, salt, precious metals, potash, trona, and other metal/nonmetal mining industries. In addition, MCI is also involved in the custom design and manufacture of specialty equipment for the tunneling industry, as well as power factor correction and harmonic filter packages, which provide reliable and guaranteed solutions to plant problems associated with power factor and harmonic distortions of the power system.

About SEL

Schweitzer Engineering Laboratories, Inc. (SEL) has been making electric power safer, more reliable, and more economical since 1984. This ISO 9001:2000-certified company serves the electric power industry worldwide through the design, manufacture, supply, and support of products and services for power system protection, control, and monitoring. For more information, contact SEL, 2350 NE Hopkins Court, Pullman, WA 99163-5603; phone: (509) 332-1890; fax: (509) 332-7990; email: info@selinc.com; website: www.selinc.com.

SCHWEITZER ENGINEERING LABORATORIES, INC.
2350 NE Hopkins Court • Pullman, WA 99163-5603 USA
Tel: +1.509.332.1890 • Fax: +1.509.332.7990
www.selinc.com • www.selindustrial.com
Email: marketing@selindustrial.com

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