CASE STUDY

Conway Corporation—Conway, Arkansas

Relay's Event Reports Offer Powerful Data for Diagnosing Power System Problems

Use of the powerful event reports can increase system reliability, lower maintenance costs, and reduce the potential for system damage and resulting outages. At Conway Corporation, analysis of an SEL relay's event report helps prevent possible transformer fire.

Conway, AR—Today's microprocessor-based relays collect and save event reports during faults and other problematic conditions. The event report and Sequential Events Recorder (SER) capability of advanced relays offered by Schweitzer Engineering Laboratories, Inc. (SEL) of Pullman, Washington, enable protection engineers to gain a better understanding of faults and disturbances on transmission line systems through analysis of event reports. This analysis frequently leads to better line parameters, more accurate fault locating for complex faults, and improved understanding of electric power system operations.

Event reports are very useful in determining fault resistance and explain otherwise inexplicable events. They also aid in testing and troubleshooting relay settings and protection schemes that protect costly equipment critical to consumer and industrial services.

The importance of event report records was demonstrated at the city of Conway (Corporation), Arkansas, 20 miles north of Little Rock. Conway's city-owned power system includes two feeders out of its substation, one supplying an industrial customer, and the other supplying the balance of the small city's business and residential customers.

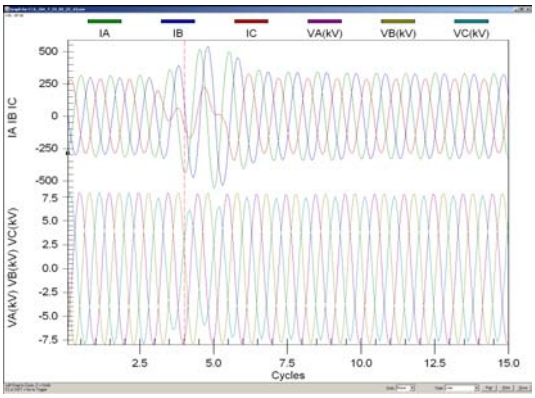

Figure 1—The customer detected a voltage problem and reviewed the SEL event report records using ACSELERATOR® Analytic Assistant SEL-5601 Software. The associated oscillograph (above) shows a problem with the three-phase voltage and current.

"The industrial customer had detected what they considered a voltage problem," said Emery Perry, an SEL field application technician called in to consult on the situation. "Yet when technicians from the Conway Electric Department went to inspect the substation, they noticed that there was no trip on the breaker. However, the technicians at Conway Electric had received training on SEL equipment,

enabling them to take full advantage of the event report records in the SEL relays. The technicians decided to check the event history in the SEL relays to learn if there were any relevant event reports on the feeder in question."

The technicians found that existing event reports seemed to indicate a voltage issue. So they consulted Perry to confirm what was evidently an unusual problem. "From the oscillograph readings, it appeared that the problem could be in the source—and in this case the source was a transformer," Perry said.

Figure 2—The SEL-351S Protection and Breaker Control Relay is deployed by Conway Corporation's Electric Department for feeder protection and recloser applications. The SEL-351S recorded the event report used to determine the source of the voltage and current problem.

The Conway Electric Department uses SEL-351S-7 and SEL-351S-6 Protection and Breaker Control Relays and SEL-551 Overcurrent/Reclosing Relays in its distribution substations. The SEL-351S-7 Relay is used on the feeder main, with the SEL-551 as backup. The SEL-351S-6 Relays provide feeder protection as well as reclosing.

Perry said the event records showed a decrease in C-phase current (IC) and C-phase voltage (VC), while A-phase and B-phase currents increased. "This occurred on two feeders. I suggested testing their transformer, which was a tap changer. When we inspected it, we found that the rotary tap changer contacts were severely worn.

Figure 3—Inspection of the utility transformer revealed the damage caused to the rotor assembly (shown above) and the rotor of the tap changer (shown below) caused by arcing.

"What was causing the problem was that the C-phase on the utility transformer was opening up, and the industrial customer was in single phase," he added. "It wasn't a complete opening; actually, the moving contacts in the transformer were arcing. That's why the event report oscillograph showed the collapsed C-phase voltage and the collapsed C-phase

current, just as if you were removing the voltage off of the load C-phase. There was a three-phase system within the industrial facility that was actually single-phasing, which could cause equipment damage. And of course, the arcing of the transformer caused damage to the contacts."

Although transformers are generally among the most dependable components in an electrical system (failure rates are estimated at a minimal 76 failures per 10,000 years of transformer life), when failures occur, they can result in costly outages, considerable downtime, and expensive replacements.

"In this case, I would say that early analyses of the event record helped prevent a possible transformer fire and a sustained power outage, and also possible damage to the industrial plant equipment from a continued single-phasing condition," Perry said.

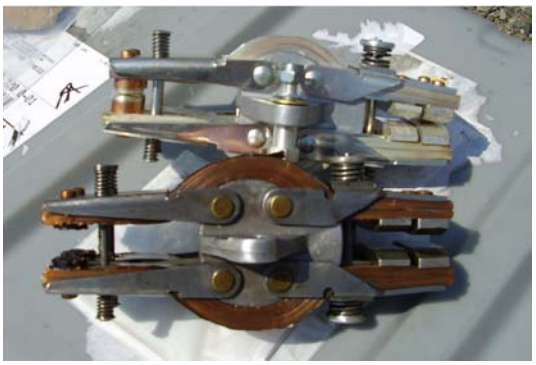

Figure 4—The old bridge contact is shown in the lower portion of this on-site photo. The contacts at both ends are severely worn. The new bridge contact at the top of the photo clearly shows what the contacts should look like.

Each time an SEL relay generates a standard event report, it also generates a corresponding event summary. This is a concise description of an event that includes such information as relay/terminal identification; event type, date, and time; fault location; and more. Event summaries can be viewed using the front-panel LCD or front-panel serial port of the SEL-351S. The date and time of each transition are available in event reports, downloadable to any PC. The chronology helps technicians determine the order and cause of events so that comprehensive troubleshooting is facilitated. With an appropriate setting, the relay will automatically send an event summary in ASCII text to one or more serial ports each time an event report is triggered.

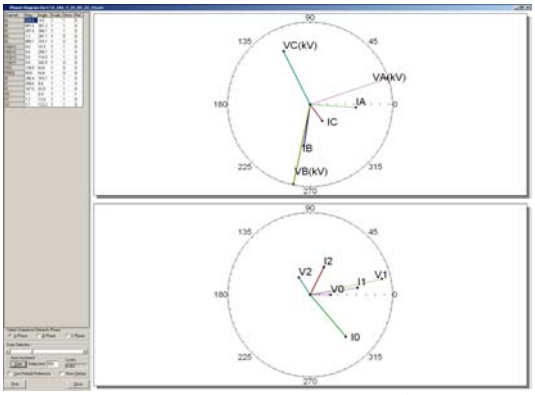

Figure 5—Each time an SEL relay detects a fault condition, the relay generates a standard event report and an event summary. Shown above are the associated phasor and sequence diagrams from the event report data. The phasor diagram clearly shows the decrease in C-phase voltage. This same condition occurred on two feeders.

In addition to storing event summaries and full-length event reports, SEL relays can track the pickup and dropout of protection elements, control inputs, and contact outputs.

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About Conway Corporation

Conway Corporation operates the city-owned electric, water, wastewater, and cable television utility services for the citizens of Conway, Arkansas. Conway Corporation has been a part of the Conway community since 1929 when the Conway City Council first franchised the corporation to operate the city's electric light plant. For more information, con-

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About SEL

Schweitzer Engineering Laboratories, Inc. (SEL) has been making electric power safer, more reliable, and more economical since 1984. This ISO 9001-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 about SEL products, locate the SEL representative nearest you by visiting our website at www.selindustrial.com, or contact the SEL Industrial Solutions Group, phone: (615) 507-2184; fax: (615) 507-2188; mail: 130 Seaboard Lane, Suite A7, Franklin, TN 37067.

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