

Fault Data Recorder and Power Quality Monitor for Oil Field Wellhead and Tank Battery Installations

David Costello

INTRODUCTION

The SEL-849 Motor Management Relay provides complete motor protection for low-voltage motors. However, the relay can also be used as a very economical meter, fault data recorder, and power quality monitor for oil field wellhead and tank battery installations.

The SEL-849 is compact, measuring just 6.0 by 5.0 by 2.8 inches in a solid-surface or DIN rail-mounted case. The SEL-849 directly measures ac currents from 0.5 to 128 A and has a dynamic range of 2,350 A for fault recording. External current transformers (CTs) extend the current range for larger loads. The voltage inputs support 690 Vac, thereby eliminating the need for external potential transformers (PTs) in low-voltage applications.

The SEL-849 can operate directly from an 85 to 264 Vac power supply and track power system frequencies between 12.5 and 72.5 Hz. Alternatively, a 24/48 Vdc battery can provide power to the SEL-849 to ensure that the relay continues to communicate in the event of a power outage.

The relay (shown in Figure 1) is designed to operate in extreme conditions, with an operating temperature of -40° to $+85^{\circ}\text{C}$ (-40° to $+185^{\circ}\text{F}$). It is also designed and tested to exceed all applicable standards, including vibration, electromagnetic compatibility, and adverse environmental conditions.



Figure 1 The SEL-849 Motor Management Relay

PROBLEM

Hydraulic fracturing and horizontal drilling have led to a boom in oil and natural gas production. A typical wellhead and tank battery site (shown in Figure 2) may produce hundreds of barrels of oil and tens of thousands of dollars of revenue per day.

Typically, three-phase 480 Vac service is supplied from a set of distribution transformers through a manual disconnect switch. Downstream from the switch is a phase-shifting transformer, a harmonic filter, a variable frequency drive (VFD), a step-up transformer, and a submersed pump. Telemetry at the site is typically provided to remote operators through wireless Ethernet communication.

VFD controls and protection can be sensitive to voltage dips and power quality problems. When a wellhead goes offline, it is critical to determine why very quickly. Without a permanently installed data recorder, it is common for temporary data recording devices to be installed to troubleshoot and determine root cause. Because oil fields can be quite large, this can mean many hours and thousands of dollars spent to install a temporary device after the event has occurred, with the hopes of capturing a similar event in the future.



Figure 2 A Typical Wellhead and Tank Battery Electrical Supply System

SEL SOLUTION

The SEL-849 is an economical meter, fault data recorder, and power quality monitor for oil field applications. Continuous metering includes phase currents and voltages, current and voltage unbalance, system frequency, harmonic metering, and total harmonic distortion. The SEL-849 also includes a load profiling function. The relay automatically records selected analog quantities into nonvolatile memory every 5 to 60 minutes. If the relay is set to monitor 10 values at a rate of every 15 minutes, it can store 41 days worth of data. These data can be continuously reported with Ethernet communication using Modbus[®] TCP or IEC 61850 protocols.

Analog voltages and currents during system faults and abnormal events are captured by a fault data recorder with a 1 to 4 kHz sampling rate (up to 4,000 samples per second), a programmable trigger condition, continuous record lengths of 15 to 120 cycles, and a total of up to 360 cycles of nonvolatile memory. In addition, the SEL-849 stores the latest 1,024 digital sequential events to nonvolatile memory with 1-millisecond resolution.

Events and data collection can be synchronized to a satellite time source via Simple Network Time Protocol (SNTP) through the relay Ethernet connection.

Fault data records can be viewed graphically (as shown in Figure 3) using ACSELERATOR Analytic Assistant® SEL-5601 Software, which is available to download for free at <http://www.selinc.com>.

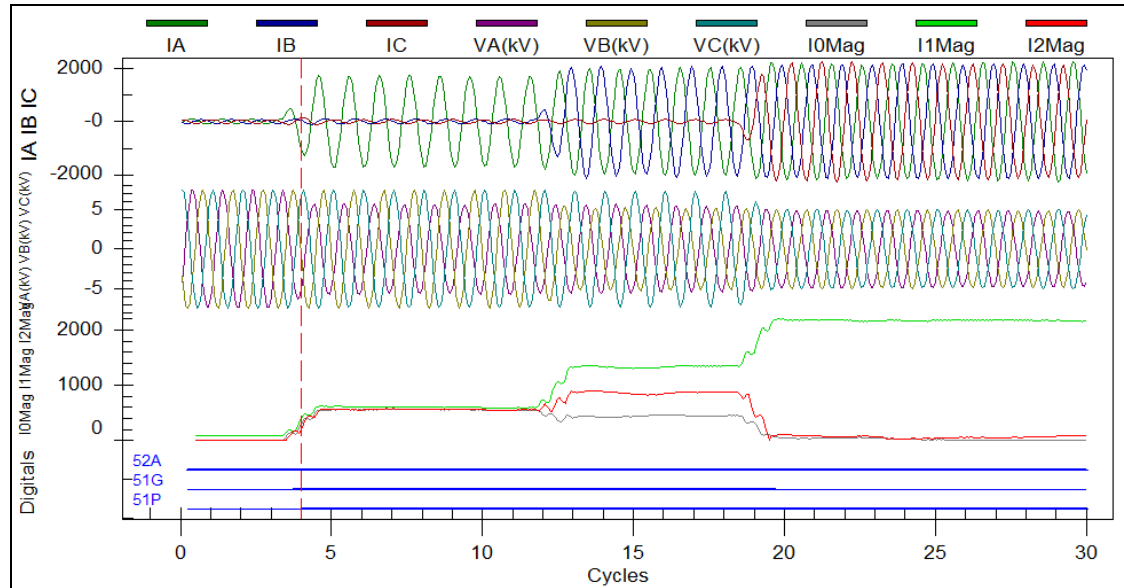


Figure 3 Example Fault Data Record From an SEL Relay

CONCLUSION

The SEL-849 can record and transmit data instantly to operators at a remote location through Ethernet communication. The SEL-849 is an ideal choice for wellhead applications because of its size, compatibility with direct current and voltage measurements without requiring external CTs and PTs, and ability to meet and exceed rugged industry specifications. For about \$1,000 per wellhead, the SEL-849 can be installed as a permanent data recording device. If the data help immediately solve just one power system problem, the installation of many SEL-849 relays is paid for in saved troubleshooting and lost production costs.

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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 • info@selinc.com