BY WALTER LINDENBACH

Power, power everywhere but nary a watt to blink

DANIEL VASCONCELLOS

Oil fields—often miles in diameter—dot the farmland around Calgary, Alberta. Some fields contain more than 200 pumps. Although some people consider them picturesque, these pumps can produce an environmental disaster. The three-phase, 550V-ac electric motors that typically drive these machines pump thousands of gallons per minute of an oil-brine mixture through miles of pipe to the processing plant. If the processing plant fails, a reservoir stores the flow from the wells for eight hours. After that, pumping would cause the oil-brine mixture to flood the surrounding farmland. The only remedy would be to replace the land at astronomical cost. Turning off the power would stop the pumps but leave a large farming area in the dark. In winter, snow makes driving to the wells impossible.

An engineer at an oil company, Rick, had an idea: Interrupt power for 10 seconds, restore it for 20 seconds, and interrupt it again for 10 seconds. A sequence decoder at each well site could turn off the pumps until an operator manually restarted them. The power company's managers initially vetoed this approach. But when Rick described a scenario of oil fields at the ends of snowed-in roads producing oil and brine that had to go somewhere at −40°F, they quickly changed their minds.

The request for proposal specified a device that would operate on three-phase, 550V-ac power and continue operating during the power-interruption sequence; operate over −40 to +100°F; and detect a power-interruption sequence of 10 seconds off, 20 seconds on, 10 seconds off, and then on again indefinitely. The device would then leave the pump-motor contactors off until an operator manually reset them.

In those days, there were no supercapacitors, and capacitors with the required ratings were too large and too expensive. Batteries at this temperature range would unacceptably compromise reliability and increase maintenance costs. It occurred to me that the energy a capacitor stores is proportional to the square of the capacitor's voltage. So, with relatively small capacitance requirements and a little two-transistor regulator, we could charge the capacitor to 60V dc with a power resistor and one diode, and the regulator could provide 10V dc for longer than one minute.

Now, we had to consider how to control a 550V-ac contactor solenoid. When the device detected the power-off sequence, it had to turn off power until someone manually reset it. The peak value for 550V ac is approximately 780V, so, in the worst case, the control device would have to sustain 1000V peaks—and inductive spikes—not a job for a CMOS device! A magnetic circuit breaker and an SCR (silicon-controlled rectifier) would do it: When the SCR triggered, it would briefly apply 10V to the breaker coil, and the breaker would trip, opening the SCR and the motor-control contactor-solenoid circuits. The contactor would open and stay open until an operator reset the breaker. But we were still concerned about the 1000V peaks and inductive spikes on the circuit-breaker contacts. An engineer at circuit-breaker manufacturer ETA (www.e-t-a.com) told me that the breaker that I was considering would survive in this application.

After Rick awarded the contract, he told me that a competitor had phoned him for a clarification of the specifications. He asked, "How are we supposed to keep this thing going during the power-off periods? Should we use a battery?"

Rick replied, "No."

"Well then, what are we supposed to do?" he asked.

Rick replied, "Think!" EDN

Walter Lindenbach founded and operated Calgary Controls Ltd and is now retired. Share your Tales from the Cube and receive $200. Contact edn.editor@reedbusiness.com.