

Coil Hold-In Device Solves One Plant's Sag Problem

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Voltage sags and momentary interruptions plague power quality professionals worldwide. No business can afford the costly production losses that sometimes occur when small control relays de-energize during these events. This was the case for one facility in Marietta, Ohio. The plant, which produces polyvinyl styrene pellets for end-use processing at other facilities, found the control power circuits for its cooling water systems were particularly susceptible to voltage variations. Plant personnel wanted a cost-effective solution that would fit inside their existing control center and avoid the need for an extensive motor control redesign.

The pellet plant houses 3-phase AC induction motors for pumps, compressors, agitators, extruders, vacuum systems, and cooling water systems. Adjustable-speed drives (ASDs) control some of the critical motors, and an emergency generator is available in case of a power failure.

During deep voltage sags (like the one shown in Fig. 1) and momentary interruptions, nearly all of the plant's process equipment would trip offline. In addition, plant personnel noticed that, during minor voltage sags, the cooling water controls were more sensitive than the rest of the process con-

trols. In fact, they would trip offline when everything else stayed online. If the cooling process was unavailable, then the manufacturing process would have to be stopped, resulting in out-of-spec product and lost revenue.

Motor Control Problem

The cooling process at the plant operates by a series of motor-driven pumps, fans, and cooling-tower fans with various controls for temperature and flow rate. It may implement ASDs and almost always uses standard motor control circuitry. The process control is the same for the plant's pumps and fans.

To understand how voltage variations impact motor control circuits, take a look at Fig. 2. It shows a typical start/stop circuit where the start button closes the loop to allow the coil of the control relay (CR) to energize and close the CR contacts.

When the contacts close, coil M energizes and the M contacts close, *Continued on page 40*

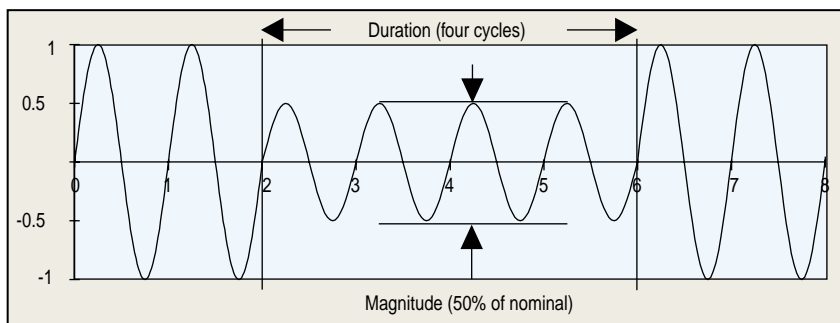


Fig. 1. Typical voltage sag to 50% of the normal electric service voltage with a duration of four cycles (1/15 second).

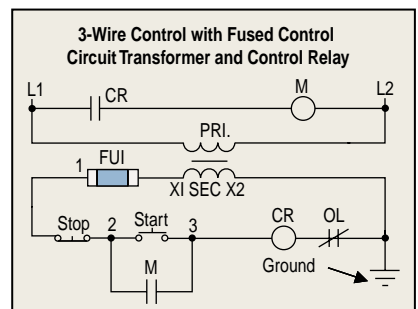


Fig. 2. A typical motor control circuit diagram (distributed control system components not shown).

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 completing the path required to bypass the start button. The M contacts causing the 3-phase, motor-driven pump process to start are not shown. At this point, they are closed and the pump starts.

Everything works fine until someone presses the stop button and de-energizes the CR coil. When the CR coil de-energizes, the CR contacts open. Then coil M opens the contacts going to the pump, thereby stopping the process and shutting everything off until the start button is re-energized either manually or remotely. There are a multitude of variations on this theme, depending on safety philosophy, preferred control strategy, and other considerations. The basic start/stop concept, however, is similar.

If most start/stop controls are designed this way, then what's the big deal? Let's assume that everything is running smoothly and the process is delivering high-quality product. If a squirrel runs across a transformer in the substation 10 mi from the plant, the control circuit may experience a voltage sag. Although no one pushed the stop button, the sag causes coil CR to de-energize and the cooling water pumps to shut down. This leads to a chain reaction of safety shutdowns, all because of a disturbance that lasted less than 1/15th of a second.

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Holding "In" for a Solution

To achieve these ends, engineers chose a coil hold-in device (see the **photo**). The coil hold-in device im-

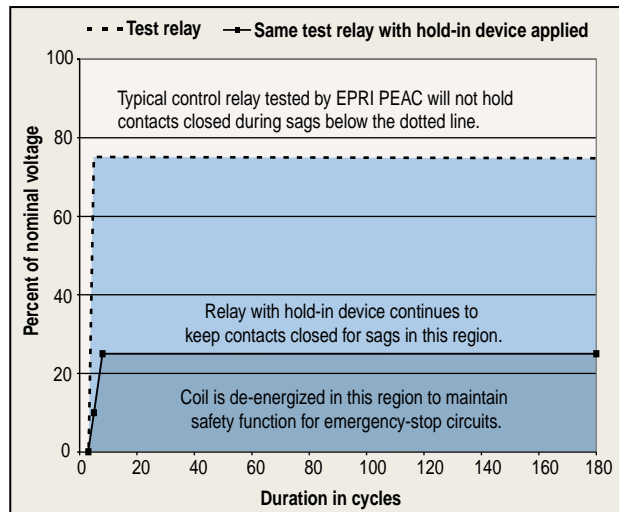


Fig. 3. Coil performance with and without a coil hold-in device installed.

proves the voltage-sag and interruption tolerance of relays, contactors, and motor starters. You connect it between the AC source voltage and the coil of the relay or starter you want to protect. During voltage sags, the device maintains a current flow through the selected relays, contactor coils, or motor starter coils—with sufficient coil energy to hold in the 3-phase, power-circuit electromechanical device's contacts.

Reliable hold-in devices provide a



Photo. Typical coil hold-in device designs: traditional and miniaturized. The miniature device can be customized for specific termination or configuration requirements or hard-to-fit locations and integrated into a relay coil assembly.

controllable current for the coils of sensitive relays and starters, and they enable coils to be virtually unaffected by voltage sags. If electric power fails, or if someone pushes the emergency stop button, the coil hold-in device immediately disengages the selected coils. In addition to the sag ride-through benefit, preferred hold-in devices also provide surge protection that prevents damage to the coils from high-energy transients.

Fig. 3 compares the coil performance with and without a hold-in device installed.

Conclusion

Use of a coil hold-in device at the polystyrene processing facility significantly reduced cooling-system dropouts. Plant personnel had previously estimated production losses at \$5,000 per dropout. They spent approximately \$14,000 to improve the control ride-through for all of the pumps' cooling tower fans and the instrument air controls. The majority of this dollar figures went to engineering costs for the development of new control-circuit drawings. With an average dropout rate of 13 per year, plant personnel should see payback on their investment in less than four months.

Coil hold-in devices provide a cost-effective solution for applications at the control-circuit level. The key to these devices, or any other common control-level solutions, is to know the exact causes of the nuisance-tripping problems and their affected components. Once you've gained a clear understanding of the problem, you must follow through to ensure personnel safety and equipment protection. PQ

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