Russell Schneider

The wrong kind of feedback

Locking Out and Isolating Dispenser STP Control Circuits

Editor's Note: Service personnel are among the few in our industry who appreciate the need to prevent electrical feedback through dispenser control wiring. Feedback occurs when power energizes dispenser control wires that share a common bond, usually at the submersible pump relay. Power from a circuit that is turned on is fed back through the common bond to all of the connected wiring.

A problem occurs when a dispenser is being serviced or removed and its wiring is exposed or disconnected: feedback from other dispenser STP control circuits may energize the control circuit for the exposed wire, creating a potential ignition source or electrical shock. In some cases, the service activities also result in spillage, so free product and vapors are present.

One method of preventing feedback during servicing is to cut off power to all dispensers and submersible pumps (STPs) until the work is completed. However, this can be hard to do because station owners and managers do not like being put out of business, even temporarily. As a result, they allow turning off the power only to dispensers being worked on.

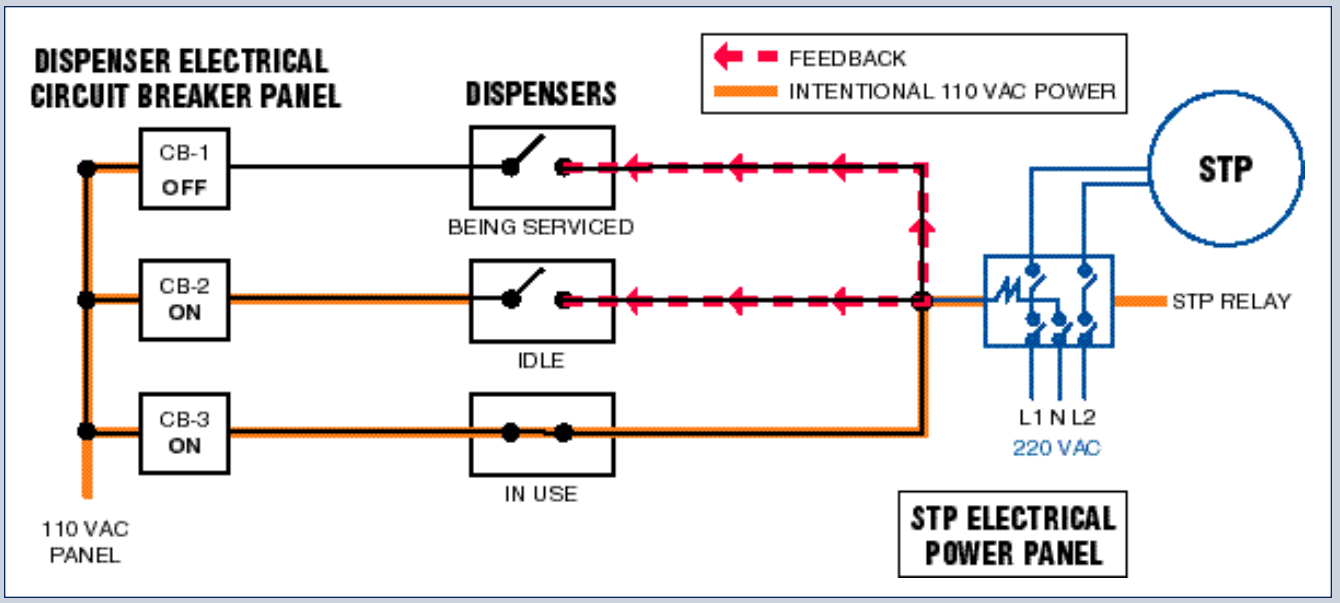
In such situations, servicemen unknowingly work with the power on—unaware that they are working in a dangerous situation. The serviceman is working virtually on top of the point of ignition with fuel present, so accidents resulting from feedback typically result in severe burns. A practical solution is to provide a means of isolating dispenser STP control circuits.

- Following are actual cases (taken from past issues of PEI's *SafetyLetter*) that illustrate what can happen when steps are not taken to properly lock out the electrical power to dispensers being serviced.
- Three men were removing a gasoline dispenser. As the dispenser was being lifted, the disconnected wires sparked because of feedback when another dispenser was turned on. Fortunately, the spark did not ignite the gasoline vapors.

(At a very busy service station, a dealer reported that an Unleaded dispenser could not be used because it would not reset. Other Unleaded dispensers were working normally and the station manager refused to turn the power off to all Unleaded dispensers. The serviceman shut off the circuit breaker to the dispenser

Below The illustration shows how feedback occurs in a system of three dispensers connected to the same STP.

How Feedback Occurs in a Dispenser System with a Shared STP



to be serviced and started to open the power reset. Before he could get the cover completely off, an explosion occurred. The power reset was blown apart, the serviceman's glasses were shattered and the dispenser was engulfed in flames.

Isolating dispenser control circuits can also prevent other electrical problems created by improper installation. The following case (taken from actual project files) is illustrative:

Four dispensers were replaced in a newly remodeled service station. No means of isolating dispenser control circuits was provided. When the dispensers were started up, three worked fine, but the fourth one had been wired out of phase with the others. The fourth dispenser was turned on while one of the other dispensers was already on. Thus, the control circuits received 240 VAC, twice the normal voltage, and all of the dispenser relay boards were burned out along with part of the electronic leak detection system.

Let's get technical

The preceding drawing indicates how feedback occurs in a system of three dispensers connected to the same STP. The building electrical panel provides 220 VAC to the STP relay activated by a dispenser handle switch for each hose. These control circuits are typically bonded (joined, spliced) together at the STP relay, creating the opportunity for feedback.

Here's how feedback would occur. A technician working on dispenser #1 would first turn off the corresponding circuit breaker (CB-1) inside the dispenser's electrical breaker panel. He could proceed safely; that is, unless someone turns on either dispenser #2 or #3. If either of these were turned on, 110 VAC of power would flow (feedback) through all connected wiring to dispenser #1 because all of the wires from the dispenser handle switches for a given product are connected at the STP relay.

As previously stated, feedback can be prevented in the above wiring scheme only by disconnecting the power from all of the dispensers and the breaker providing 110 VAC power to the STP control circuit. Even this is not foolproof, because there are situations where a line pressure leak detection system tests the tightness of an idle product pipe by starting the STP without outside intervention. This leak detection system has its own circuit breaker connected to the STP relays and the dispenser control wiring. Accordingly, power would be fed back to all connected control circuits when the test commences.

What's in the Code?

The National Electrical Code (NFPA 70) sets the standards for electrical wiring materials and methods. The current edition of NEC does not require isolation or lock-out of individual dispenser control circuits. NEC requires a two-pole neutral breaking circuit breaker on the 220 VAC circuit that supplies power to the STP motor and a single-pole, neutral-breaking 110 VAC circuit breaker for each dispenser and for the control circuit power.

Currently, Underwriters Laboratories, Inc. does not require isolation of individual dispenser control circuits as prerequisite to listing dispensing equipment. Thus, manufacturers are not required to provide for such iso-

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lation. NFPA has addressed this issue in its last three *Automotive and Marine Service Station Code* (NFPA 30A) revision cycles. Paragraph 4-2.9 of the1996 edition of NFPA 30A, which will become a part of the next edition of the NEC (Part 500), states that when maintenance to a dispenser might allow the accidental release or ignition of liquids, the following precautions shall be taken:

a. Only persons knowledgeable in performing the required maintenance shall perform the work.

b. All electrical power to the dispensing devices, to the pump serving the dispensing devices and to all associated control circuits shall be shut off at the main electrical disconnect panel.

c. The emergency shutoff valve at the dispenser, if installed, shall be closed.

d. All vehicle traffic and unauthorized persons shall be prevented from coming within 20 feet (6 m) of the dispensing device.

Following the procedures as quoted above will prevent feedback. But doing so means that all dispensers serviced by the same STP will be shut down and all other dispensers and devices within 20 feet will be off limits to customers. Station owners and operators may not be willing to forego sales from the dispensers until the maintenance service is completed. Turning off only the circuit breaker for the dispenser being serviced violates the NFPA 30A provisions and puts the service technician at risk. This quandary can be eliminated by locking out and isolating the circuit for each individual dispenser.

Achieving isolation

The isolation can be achieved in different ways, including installing relays, photo-isolators or programmable logic controllers into the equipment itself, or providing them in a relay panel near the power source. Neither is generally being done.

You could provide a relay or manual switch in each control circuit. With the exception of the ground, this would break all connections to the dispenser. Rotary switches could be used to shut down specific units so that service and maintenance can be completed.

Another method of isolating control circuits employs an electronic device, usually a photo-isolator, which acts as a normally open switch, closed to complete a circuit to the STP relay only when the selected dispenser's handle switch is activated. Systems incorporating LED status lights also facilitate the diagnosis of service problems.

Whichever method is selected, feedback, and its associated risks should be eliminated.

Russell Schneider *has 35 years experience in the petroleum equipment industry as an installer and service provider. He is president of R.S. Electronics, Inc., located in East Troy, WI.*