

Tank-nically Speaking

by Marcel Moreau

Marcel Moreau is a nationally recognized petroleum storage specialist whose column, *Tank-nically Speaking*, is a regular feature of LUSTLine. As always, we welcome your comments and questions. If there are technical issues that you would like to have Marcel discuss, let him know at marcel.moreau@juno.com.

The Car That Went Bump into the Dispenser

It was a dark and stormy night in the peaceful hamlet of Fort Edward, in upstate New York, some 50 miles north of Albany, when...

Courtesy of Derek Pruitt, The Post-Star, Glens Falls, NY.



Emergency responders on the scene at Cumberland Farms in Hudson Falls, New York. The NYDEC estimates up to 1,200 gallons of gasoline leaked from a pump at the store on the night of December 27, 2011, after a car bumped the pump.

It sounded like a bomb...My dog jumped, and in the kitchen my dishes fell out of the cupboard, and some of them broke...They told me I had to get out of here...I was petrified. My God, my heart was beating so fast I thought I was going to have a [heart] attack.

Elaine Pagana, Fort Edward resident
Interview with Christine O'Donnell, News10abc, 12/28/11

For a few brief moments, it sounded like a war zone out here.
Randy Diamond, Hudson Falls Police Chief
Interview with Matt Hunter for YNN News, Hudson Falls, NY

I get out of the shower and here comes a BOOM!! It raised me right off the floor. About 15 minutes later we get another BOOM!! Things are shaking, falling off the shelves, falling off the walls. My boyfriend looked out the window and he said it looked like smoke just lifted this manhole cover right up. When he saw that, he jumped back and that's when the glass shattered, and he says, "let's get the...heck out of here!"

Cerise Dingman
Interview with Matt Hunter for YNN News, Hudson Falls, NY

There was a lot of flames coming out of the ground, a lot of smoke, it was very loud. It really got our attention.

Mark Hurlburt, Fort Edward Fireman
Interview with Christine O'Donnell, News10abc, 12/28/11

What Can Go Wrong Did Go Wrong

For terrified residents, it was a chilling night to remember. The chain of events began with a minor encounter between a vehicle and a gasoline dispenser, followed closely by a fractured shear valve that failed to close, a runaway submersible pump, and a delayed response by employees. The end result was the release of 1,200 gallons of gasoline that flowed directly into the adjacent storm drain. Add an unidentified source of ignition for the gasoline vapors in the Fort Edward combined storm/sanitary sewer system, and you have an instant war zone, with pillars of flame and smoke launching hundred pound manhole covers over the roofs of houses.

For a Cumberland Farms gas station some two miles away in Hudson Falls, New York, it was the beginning of a nightmare that is not likely to be over any time soon.

Here's what I have pieced together from news reports of the incident. A man stopped at a Cumberland Farms store in Hudson Falls to buy some beer. It was about 7:15 on the evening of December 27, 2011. It had been raining heavily. The man was the only customer at the store. After completing his purchase, he backed his recently purchased car out of his parking spot, nudging a gasoline dispenser in the process. He said the radio was playing. He swore he did not know he'd hit the dispenser and that if he had known, he would have stopped and told someone.

All indications are that this was in fact a minor accident. His car showed a barely noticeable narrowing of the joint between the bumper and the fender. There were no dents. The paint was intact. The dispenser showed an obvious dent on a front panel, but one that looked like it could have been inflicted by a solid kick with a booted foot, not a significant encounter with an automobile. I can imagine that many a distracted driver talking on a phone or tending to a crying infant could have caused the same damage without noticing.

The impact of the car, though minor, was sufficient to move the dispenser slightly. This movement was sufficient to fracture the shear

section of at least one shear valve. But the movement of the dispenser was not sufficient to cause the trip mechanism of the shear valve to operate, so the shear valve remained open. This is not exactly a common occurrence with shear valves, but it is a known issue.

When properly installed, dispensers are firmly bolted to the concrete island on which they sit. Because such a relatively minor impact had such severe consequences, it is my suspicion that this dispenser may not have been properly anchored.

Under normal circumstances, the shear valve would have begun to leak when the next customer arrived to pump the grade of gas that flowed through the valve. The leak rate would have been substantial, so a mechanical leak detector would have put the dispenser into slow flow, and an electronic line-leak detector would have shut down the pump at the end of the dispensing cycle. With appropriate response from the personnel involved, the release would have been relatively minor.

But there was an additional problem. News reports make it clear that fuel was gushing out of the dispenser even though no customers were pumping gas. With all of the nozzles hung up, the submersible pump should have been off. Why was the pump on? I believe the most likely answer is that the pump relay was stuck in the "on" position.

Submersible pump motors are generally energized only when a customer removes a nozzle and pushes a button to select a specific grade of fuel. The switch mechanism at the dispenser typically operates on low current that activates a heavy-duty switch (known as a relay) inside the facility that directly controls the current to the pump motor. The heavy current loads on these relay switches sometimes cause the switch contacts to weld together. When this happens, the switch becomes stuck in the "on" position, and the pump motor runs continuously. Because the pump motor is always "on," there is no immediate indication that there is a problem because customers are able to get fuel just as they normally would.

If you are an astute UST person, you will immediately be saying "uh-

oh," because you realize this means that the line-leak detector, which requires the pump motor to be cycled "on" or "off" depending on the type, would not be able to detect this leak. Even worse, because the pump would always be on, the fractured shear valve would begin to leak immediately, even though there were no customers at any of the dispensers.

Some Time Later...

It was a dark and stormy night, so the Cumberland Farms facility was not exactly a beehive of activity. At least several minutes after the beer customer left the facility, another customer rushed into the store announcing that gasoline was pouring out of a dispenser. News reports indicate that an employee followed procedures to shut down all gasoline dispensing but that the fuel kept flowing.

A likely scenario is that the employee activated the "all stop" button on the point-of-sale system. This button stops dispensing activity by closing valves in all the dispensers. The "all stop" button would be effective if there were a defective nozzle spewing gasoline all over the forecourt, but this button does nothing to turn off the power to the submersible pump motor. What was needed was an emergency stop switch. This store either did not have one or the employee did not know where to find it.

Emergency stop switches have been part of fire codes for decades. Fire codes generally specify the location of these switches and that they must be clearly identified and easily accessible. Emergency stop switches are intended to immediately stop all fuel-pumping activity by cutting power to all of the pump motors present at the site. Since 2000, the NFPA fire code also specifies that activating the emergency stop switch should also de-energize all electrical circuits in any area where flammable vapors may be present. This would eliminate electrical sparks as a source of ignition for fuel vapors. Emergency stop switches are a critical component of gas station safety.

Having no success in stopping the flow of gasoline out of the dispenser, a store employee called the Cumberland Farms "help desk" and left a message. The employee did not

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receive a call back. At some point, an employee called the fire department. Eventually, an employee succeeded in turning off the pumps, apparently by shutting down circuit breakers at the main electrical panel. By this time, fuel had been flowing from somewhere between 15 minutes to a half hour and some 1,200 gallons of gasoline had been released. The gasoline flowed a short distance across the facility driveway and directly into a storm drain.

Journey Through the Storm Sewer

The short surface pathway the gasoline took may have prevented a major conflagration. On a similarly rainy night in Biloxi, Mississippi in 1998, gasoline from a tank overflow incident flowed to an intersection where vehicles were stopped for a traffic light. When the gasoline ignited, five people burned to death.

The combined storm/sanitary sewer system in Hudson Falls was flowing nicely because of the recent rain. The 1,200 gallons of gasoline flowed some two miles within the sewer system to the community of Fort Edward. Somewhere in the sewers of Fort Edward, gasoline vapors in the flammable range encountered a source of ignition and several explosions ensued.

Flames belched from sewer openings as some 25 manhole covers were blown into the air, in some cases over the tops of houses, and came crashing back to earth. Windows were broken, dishes crashed to the floor, and pavement was cracked. The sewer



Debris from the sewer explosion lies in the middle of Satterlee Lane in Fort Edwards, December 28, 2011.

Courtesy of Derek Pruitt, The Post-Star, Glens Falls, NY.

treatment plant was flooded with gasoline. Not knowing exactly what was going on or what was to come, police and fire crews evacuated hundreds of residents. Miraculously, there were no injuries, except for an individual who was blown into some bushes and twisted his knee.

Stay Tuned

That's the story of "the car that went bump into the dispenser" as ascertained primarily from news reports of the incident. I have also deduced information presented in this article from my own knowledge and experience with UST systems and corroborated some information with personnel from the New York

Department of Environmental Conservation who are familiar with the investigation.

As might be expected, there is enforcement action simmering over the events that happened in Hudson Falls and Fort Edwards. Luckily, the damages involve primarily sewer lines and a sewage treatment plant, not death or serious bodily injury. Because of the pending enforcement action, however, there are still some details of the incident that have not been made public. I don't expect that additional information will change the general picture of what occurred as described in this article, but if this happens, corrections will appear in a future *LUSTLine*. ■

From Our Readers

Shear Valves Did Their Job in Recent Kentucky Tornadoes

I found the "Extremes" articles in *LUSTLine* #69 quite interesting. On March 2, 2012, tornadoes tore through West Liberty and Salyersville in Eastern Kentucky. These two towns both experienced EF3 tornadoes. Though stronger tornadoes hit elsewhere in the state, these were the only two areas where gas stations were severely walloped.

I am happy to say that out of the eight UST facilities destroyed during the tornadoes, none experienced releases to the environment. At seven of these eight UST facilities, the shear valves all closed properly when the dispensers were ripped off. At the one facility where this didn't occur, the dispenser lines were not severed to cause the shear valves to trip, so there was no release.

Many times we wonder if our compliance efforts are doing any good. It was gratifying to see the equipment operate the way it should to prevent releases and protect the environment in the aftermath of such a tragedy. ■

Leslie Carr, Kentucky DEP

What Can We Learn from the Hudson Falls Incident?

by Marcel Moreau

Incidents such as the one in Hudson Falls, New York, are not commonplace. But when they occur, they present “teachable moments” for all who own, operate, service, or regulate fueling facilities. This incident illustrates just why it is we have codes, regulations, manufacturer’s instructions, and industry recommended practices. Here’s what I see as the lessons to be learned from this incident.

Don’t Forget the Little Stuff

Whether the dispenser in this event was bolted to the concrete is a detail that has not yet been made public. But regardless of whether this dispenser was properly anchored, now is a good time to reflect on the importance of dispenser anchoring. Bolting a dispenser may seem like a trivial aspect of installing today’s complex multiproduct dispensers (MPDs). After all, MPDs are heavy, and gravity is a pretty reliable force for keeping them in place. But an unanchored dispenser can be easily budged by a slight collision with a vehicle, an event that is not that uncommon. It is exactly this minor movement of the dispenser relative to the rigidly anchored shear valve that can cause the shear valve to crack but not to trip, as may have been the case in the Cumberland Farms incident.

In addition, dispensers nowadays should have breakaway couplings installed on dispenser hoses designed to separate when customers drive off with a nozzle still in the fill opening of the vehicle. It takes a very substantial force to separate a breakaway coupling, and that force will be pulling at the very top of the dispenser cabinet. If not solidly anchored, the dispenser may tip over before the breakaway separates.

Anchoring is not an optional step in dispenser installation.

The Shear Valve Can Save the Day

Shear valves are among the wall-flowers of the UST world, waiting patiently and inconspicuously at the base of the dispenser cabinet for the one heroic moment when they can save the day. They were developed in the 1950s, shortly after the introduction of submersible pumps. They

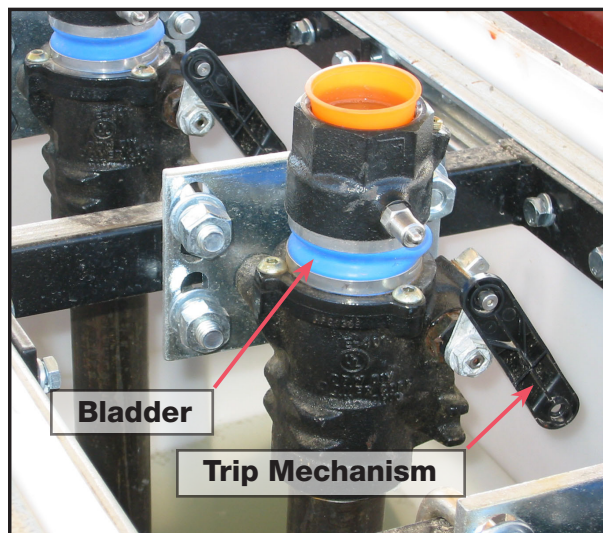
are a critical safety component of pressurized pumping systems. The type of failure that occurred in the Hudson Falls incident has been recognized for some time, and there is now a shear valve on the market that has addressed this problem (Figure 1). The shear section of this valve is enclosed in a flexible bladder that is inflated by the gasoline leaking from the shear section. As the bladder inflates, it trips the shear valve and closes it. The Cumberland Farms incident illustrates why a shear valve with this feature can be cheap insurance against catastrophic releases.

While I’m on the subject of shear

ground piping with a single-valve mechanism (or poppet) (Figure 3). Gasoline in the dispenser piping is not contained and generally flows out of the dispenser when the shear valve operates. Double-poppet shear valves have an additional poppet that closes off the dispenser piping so that the substantial amount of fuel present in a typical MPD is not allowed to flow out when the dispenser is hit.

Fires codes have not favored double-poppet shear valves for fear that the gasoline trapped in the dispenser piping would create a “bomb” should there be a fire

FIGURE 1. This shear valve is designed to operate even when only minor impacts occur. The shear point is enclosed in a liquid-tight flexible bladder (shown in blue online). When the shear point fractures and fuel leaks out, it inflates the bladder. The bladder presses against the trip mechanism, which, in turn, unlatches the arm holding the poppet open, and the valve closes—regardless of whether the top part of the valve moves relative to the bottom part. The valve will also operate in the traditional manner if a major impact occurs. The trip mechanism in this photo is disengaged and the valve is closed. Note the heavy-duty bolts and steel framework used to fasten the shear valve. The bottom part of every shear valve must be rigidly anchored for the mechanism to operate as designed.



valves, let me pull up my soapbox. I think it’s time to look seriously at double-poppet shear valves (Figure 2). Traditional single-poppet shear valves only close off the below-

when the dispenser is knocked over. Some 15 years of experience with double-poppet shear valves shows that the “bomb” fears are ground-

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less, because double-poppet shear valves are effective in containing the fuel and preventing fires from occurring in the first place. Single-poppet shear valves, on the other hand, are commonly associated with significant fires when subjected to a major impact. People die in these fires. It's time to recognize that double-poppet shear valves can save lives, and their use should be encouraged, not discouraged.

Like all mechanical devices, shear valves should be periodically operated and tested to be sure they will function appropriately when their big heroic moment comes. Fire codes have specified an annual test of shear valves for as far back as I can tell, which is some 30 years. A specific procedure for testing the operation of shear valves is described in PEI/RP500, Recommended Practices for Inspection and Maintenance of Motor Fuel Dispensing Equipment.

Emergency Shutoff Switches Are Not Optional

When bad things happen, personnel at a fueling site need to have a simple, effective, convenient, easily recognized way to shut-off all possible flow of fuel and minimize electrical sources of ignition. This is what emergency shutoff switches do. Like seat belts, airbags, and fire extinguishing systems, you hope you never need them, but you sure are grateful to have them do their job when you do need them. Such equipment is insurance against catastrophe. And just like any insurance policy, this equipment has to be in place *before* the accident happens. And once the switch is installed it must not become a convenient place to hang your jacket, nor must all those display cases of beer be stacked in front of it. Emergency shutoff switches are crucial pieces of equipment.

Although usually more colorful and located in a more obvious location than shear valves, emergency shutoff switches are also among the wallflowers of the UST world, waiting patiently for their turn to dance. They too should be tested annually for proper operation. Refer to PEI/RP500, *Recommended Practices for*

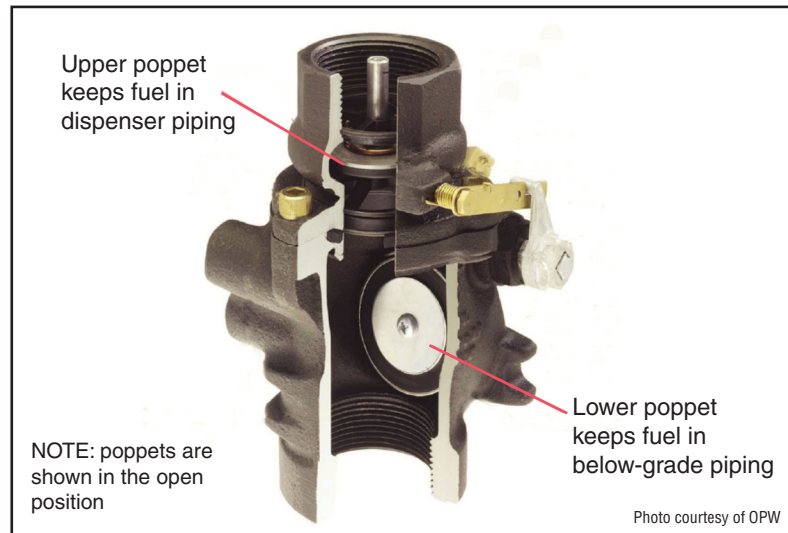
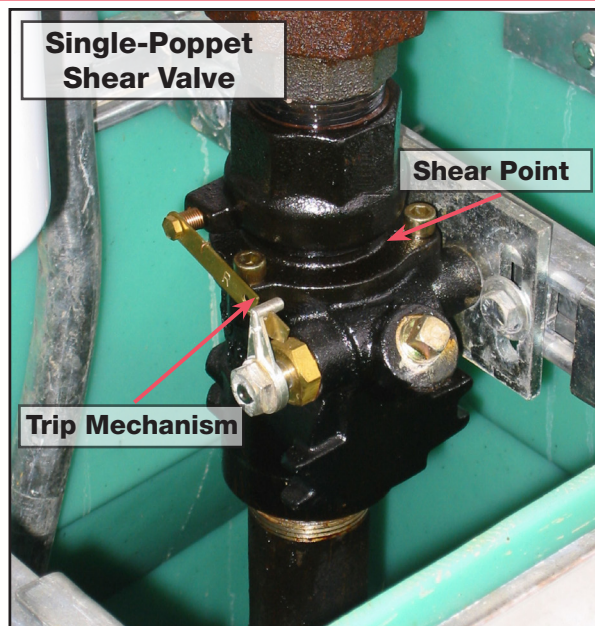


FIGURE 2. This cutaway shows the internal workings of a double-poppet shear valve. When the shear valve “trips,” the lower poppet rotates upward and closes off the flow of fuel, while the upper poppet moves straight down and closes the opening so that fuel cannot drain out of the dispenser piping.

FIGURE 3. Shear valves get their name from the shear point, a thin part of the metal casting designed to break when the top part of the valve above the shear point moves relative to the bottom part. The valve mechanism includes a hefty spring that closes the poppet, the disk that closes off the flow of fuel (see Figure 2). The poppet is held open by a trip mechanism, a thin bar of metal with a notch in it. An arm on the outside of the shear valve sits in this notch and holds the poppet inside the valve in the open position. When the top part of the shear valve moves relative to the bottom part, the arm slips out of the notch and the spring closes the poppet, stopping the flow of fuel. In the Hudson Falls incident, the top part of the shear valve moved enough to fracture the metal at the shear joint, but there was not enough movement to cause the trip mechanism to operate, so the poppet remained open.



Inspection and Maintenance of Motor Fuel Dispensing Equipment, for a description of the test procedure.

Employee Training Is Imperative

The frequent turnover in convenience store industry personnel means that inexperienced operators are commonplace. This

incident points to the importance of providing emergency response training before handing over responsibility for a facility to an employee. I don't know the details of the training provided to the personnel on duty at this Cumberland Farms facility, but it seems to me that they took an inordinately long time to shut off the flow of fuel.

Proper training should emphasize knowing the location and function of the emergency stop switch and understanding the distinction between the “stop” button on the point-of-sale console and the emergency stop switch. Learning the location and the purpose of these switches and when to use them should be the first thing new employees learn about their new workplace.

Pump Relay Failure Should Be Monitored

Pump relays that are permanently “on” are a problem that garners little attention in the retail fuel industry because the switch failure does not interrupt fueling operations and has little effect other than increasing the electric bill. But such failures effectively disable line-leak detection and can contribute significantly to the severity of releases resulting

from cracked-but-not-tripped shear valves, as well as typical piping and dispenser leaks. These days, there are pump controllers and some electronic line-leak detectors that can monitor the operation of the pump relay to be sure that it is cycling properly and provide an alarm signal when a stuck relay is detected. It seems to me that it is about time for the industry to acknowledge and implement solutions to this problem. ■