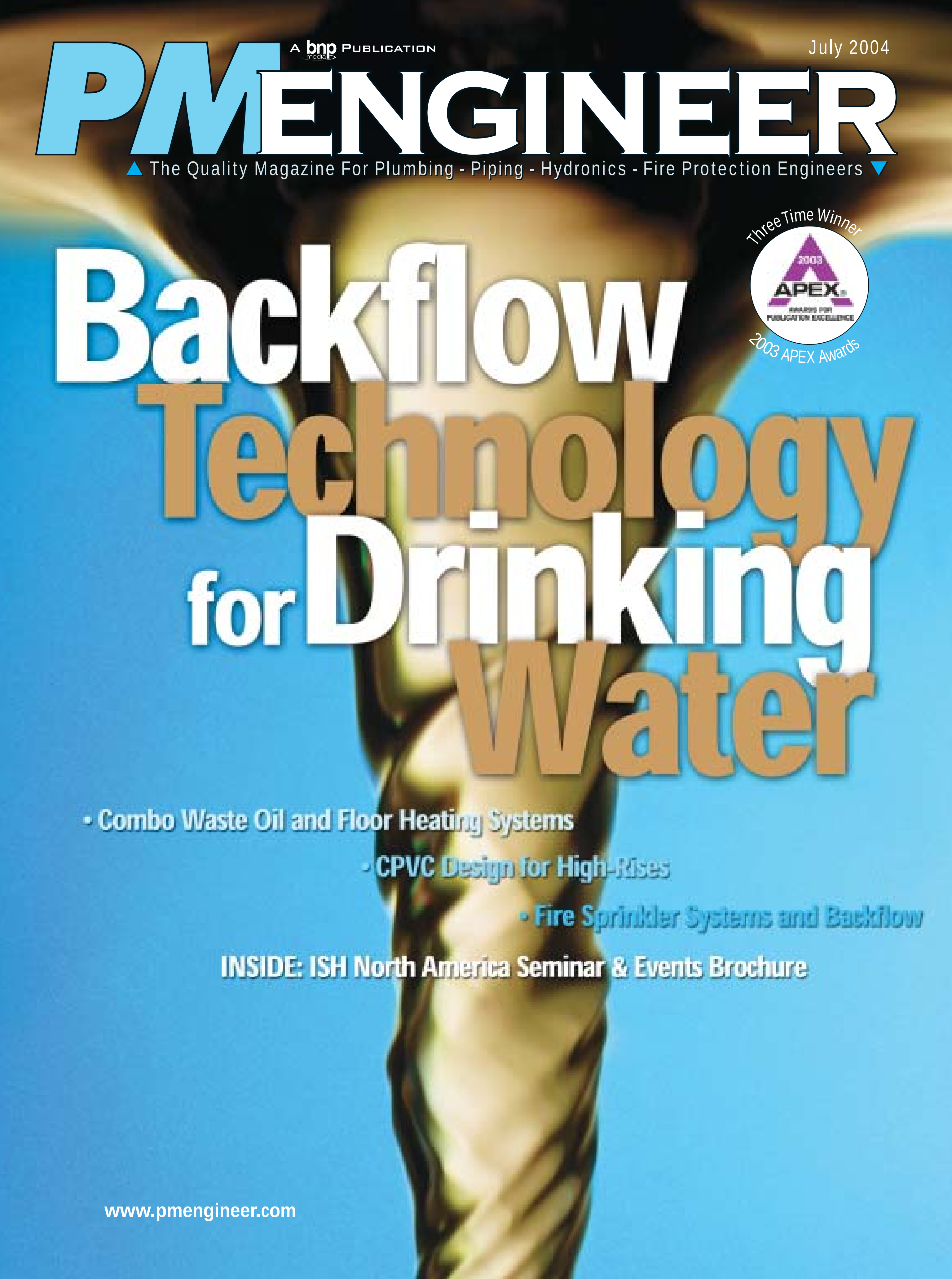

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Backflow Testing, Application and Technology

Backflow prevention is the ultimate in plumbing system safety.
Yet, who's watching the lion tamer?

By Bernard "Bernie" Clarke

Contaminated water is like a ravenous lion. We've chained it heavily and watch safely at a distance. For the most part, technology, technique and testing keep the "lion" at bay. But as our infrastructure grows, and as old systems are pushed to fulfill their role, the links in our once sturdy chain weaken and are at greater risk.

But our key concern is the "lion tamer." He or she is the tester whose role it is to verify system safety at the most critical link—the backflow assembly designed to protect drinking water supplies from contaminants.

As plumbing and mechanical engineers, many of you have engineered superbly designed plumbing, process, irrigation or fire protection systems. No doubt, backflow prevention factors into these substantially. And some of you—especially professionals working with municipal water departments—are involved in the daily rigors of cross-connection control. No doubt you, too, are concerned about this situation.

As we all know, by design, water is *expected* to flow in one direction within piping systems—from the water supply to the point of delivery. Yet, danger lurks when pressure in the piping system exceeds that of the water supply. Any time pressure in the system drops, even momentarily, the system is subject to backflow, back-pressure or back-siphonage—opening the door to sources of contamination. This can happen all too easily when a water main is shut off, a fire hydrant is hit, or water demand surges in a specific area.

Ultimately, it's rigorous backflow prevention and competent, thorough testing that guards against the possibility of cross-contamination. As designers of complex piping systems, you know the value of eliminating the potential of cross-connections. But it's an elusive goal. Especially when we consider the vastly more complicated connections to water at sites with medical and diagnostic equipment, photo processing centers, research facilities, exterior fire sprinkler systems with glycol antifreeze, and recycled water car washes.

A retrofit of an old regulator station within the Los Angeles Unified School District. Pictured are dual, parallel regulator stations with 4" galvanized lines.

The Good, the Bad and the Ugly…Ugly and Bad, First

Is the risk real? Should the possibility of contamination be taken seriously?

Consider the case of a plywood mill in Oregon from several years ago. After a week in which a large number of employees stayed home from work with similar complaints of nausea and severe diarrhea, the county health department was called in to test the drinking water supply. It was quickly discovered that fecal coliform was present in unusually high levels.

As the health department looked for clues, it was found that—though the mill's water came from the city supply and appeared to be clean, and with the proper levels of chlorine—the mill also drew water from an adjacent river to supply its fire system. Booster pumps maintained fire system pressure at about 125 psi. The water from the city entered the mill at about 70 psi.

The mill's maintenance staff examined the piping system for cross-connections, and indeed, three were found (with open gate valves) between the fire and potable water systems. The mill's recent use of water had been unusually low—10 cubic feet per month, instead of the 7,000 to 9,000 cubic feet used by comparable mills. Mill employees had been drinking untreated river water via cross-connection.

A single check valve was located at the mill's connection to the city. It's assumed that this prevented further contamination. No doubt, without it, the mill would have supplied more of the contaminated water into the city's mains.

And, this from the American Water Works Association "Summary of Backflow Incidents," fourth edition, published in 1995:

> For some time, nurses at a Michigan hospital complained about rusty water coming from a hospital drinking fountain. When maintenance personnel finally looked into the matter, they discovered it was actually blood that the nurses were encountering at the drinking fountain. Blood had backflowed into the hospital's potable water system from an autopsy table.
>
> Hospital autopsy tables have a sump to collect blood and washing from the autopsy procedure. These tables also have a hose-spray unit for washing off organs, etc. On an autopsy table at the Michigan hospital, there was no hook to hang up the hose-spray unit, so pathologists placed the unit in the table sump when they were not using it. There also was no vacuum breaker in the water supply line to the hose-spray unit on this table; ergo, the hospital had severe back-siphonage problems. Blood and other washing from the autopsy table were sucked into the hospital's potable water system. The drinking fountain where the nurses were drinking the blood-contaminated water was about two doors from the autopsy room.

A dual 3" regulator station retrofit of an old station. Previously, the old station created a huge pressure drop in the line. But with this retrofit, the problem has been fixed.

I'm not blaming either of these problems on the persons responsible for backflow testing. But the stories illustrate a key point: the risks are indeed very real, and can be life-threatening.

So where are the weak links in the chain? Inconsistent accountability to agencies of jurisdiction. Insufficient training of testing personnel and—too often—lack of experience when handling anything out of the ordinary. Loose requirements for testing procedures. And a cross-connection control (CCC) policy without specific needs or demands for the water company above minimum standards, permitting far too much flexibility.

The answer to all of these problems, really, is for water companies to set a baseline for performance and verification and to enforce them. We should insist on:

• A policy or guidance document that verifies the tester's

The old station at Fulton Junior High School. The facility had struggled with a 90% loss of water design volume, chiefly because of cast iron lines and valves terribly occluded with rust.

The retrofitted station has twin 3" lines in a configuration referred to as "six by three by three," meaning a single 6" supply line with twin 3" parallel split with 3" regulators on each side for continuous water supply during times of maintenance, testing or replacement.

presence and establishes that all components are functioning properly, and as designed.

- A pressure reading.
- A main water meter reading.
- The time of day.

We should force accountability and not permit arbitrary, voluntary verification of backflow testing.

That's why I feel testing protocol should be more rigorous and verifiable, and that the CCC programs be much more dynamic and designed around the specific needs of each application, unique need, and water department. Also, that testing personnel be more thoroughly trained and more experience be gained before they "go solo" on plumbing systems.

What's To Be Done? Where to Begin?

The test form polices the CCC program. *Water pressure* is a very important factor and should be noted on the form. These key facets apply:

a) In some areas, water pressure can be excessively high. This places a lot of stress on the backflow device, and, by the way, negates a manufacturer's warranty.

b) The customer should be informed if the pressure is regulated or not. The pressure regulator is a key component of safety to the water piping system.

The tester *must* come in contact with the valve to get the pressure reading, and the data must be recorded that verifies this.

Requiring a *water meter reading* forces intelligent contact with the backflow assembly. The tester must verify what water meter he is shutting off prior to the test. The water meter reading also helps to police the program because:

- It keeps the tester from holding the form past its return time.
- The water company can see how much water went through a meter if a tester's results are re-tested or verified. If new tests find that the backflow failed, the water meter reading becomes a valuable "fingerprint."
- It tracks time and water volume between tests. Tester's results need to be audited.

Unauthorized connections are important. If a tester is going to be at the backflow assembly, then have the tester verify what you want him to see, and look for, and to note it on the form. If there's a stipulation that unauthorized connections should be looked for, it's rather amazing what problems can be averted.

Gauge calibration should be in the policy. When you test behind a tester, it's important that both your gauge and the tester's gauge be calibrated in their time frame. If the gauges are calibrated accurately, the only remaining sources of inaccuracy, really, are technique, test procedure or erroneous recording.

Verification of forms and data helps to focus the tester on getting the job done. It also tells the water company when the form was ready to be released to the tester. Other advantages:

- Dates provide a tracking record. And testers know when they must a) complete the test, and b) return the form to the water company.
- The owner/agent can't say they never got the form because they would need to sign and date it, confirming receipt and review of the information.
- The water company receives a validated test form just as it was validated by the witness stamp (with signature and date).

Two 2" strainers and four stainless steel butterfly shutoff valves were pre-assembled (and pre-certified and pre-tested) in parallel to match existing flange-to-flange dimensions for uninterrupted water flow. This underground "bunker" installation is located in the middle of a play area and could not be moved to an aboveground location.

Previously, this was a rusted-out, 20-year-old system. In the retrofit, both vertical supply headers and all of the old regulators were replaced with a state-of-the-art stainless steel dual regulator station that includes two 2" Automatic Control Valves (ACVs) in parallel with new in and out, flanged NRS-RW gate valve shutoffs—an LAUSD requirement.

In this application, a 4" double check valve and a 4" single check valve were replaced with fire department connections. This station now serves the main domestic water supply to part of Van Nuys High School and the sprinkler systems, with a 4" and 2" domestic water supply station (four by two by two), backflow prevention and pressure regulator combinations, and a 4" direct connection below for supplying water to five sprinkler systems through separate double-check valves and strainer (with no regulator). This installation eliminated 18 remote regulators and maintains a constant 75 psi throughout the school.

Noted plumbing, irrigation and fire system specifics add valuable context to the tester's actions. Before water service is turned off—a top priority—the tester acknowledges what it is the backflow assembly is attached to, and (hopefully) considers the impact of his immediate actions. And, of course, some information about the system should be noted on the form.

The value of customer identification. Though I've made some overall complaints about the industry's reliance on quantitative information—favoring *qualitative* information—there is value to data that simplifies customer ID. Alphanumeric identification (e.g. APR007-DEC121-F), can show the date, what device is being serviced, and is a quick reference to test due dates. It becomes a very sensible way to sort forms with easy combinations of information of value to you. Coding within the number, for instance, might use F for fire, D for domestic, and I for irrigation.

The risk of cross-contamination in drinking water systems continues to expand. And though the sources of contamination haven't changed over the years, fortunately new technology has risen to meet the challenge. PME

Bernie Clarke owns Clarke Sales and Backflow Prevention Device Tester, based in Valencia, CA. He has been a licensed plumber in the Los Angeles region for more than 40 years. Backflow prevention has been the focus of his work and research since 1975. He is widely recognized as one of the country's leading backflow experts, and is also a noted writer and guest speaker. Clarke was involved with development of the first polymer-coated backflow preventer and is currently doing test sites with USC-FHH&CC for manufacturers on new backflow assembly designs. He also helped to develop the first cross-connection control program for Valencia Water Company. For more information, e-mail Clarke Sales at clarkesales@sbcglobal.net, or visit the Clarke Sales Web site at www.clarkesales.com, or call (661) 294-1175.