

NAVFAC EXWC Develops Cross-connection Survey Expertise

Capability Helps Installations Mitigate Risks to Potable Water Systems

ENGINEERS FROM THE Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC) in Port Hueneme, California, have developed and demonstrated a capability for identifying and assessing potentially hazardous cross-connections in plumbing systems at Navy and other Department of Defense (DoD) installations worldwide.

Cross-Connections

A cross-connection is a point at which drinking water within the potable water system connects to nonpotable water. (Note: Nonpotable water is water not suitable for drinking.) Under everyday circumstances, water flows outward into a sewer system. However, under backflow conditions, there is a danger of nonpotable water entering the drinking water supply. Introducing pollutants or contaminants to the drinking water system via backflow degrades the water quality, resulting

in adverse effects. These effects can range from aesthetically displeasing changes (in taste, odor or appearance) to serious health hazards.

Backflow events are caused by an imbalance of pressure in the water distribution system. Backflow occurs by one of two means:

1. Back-siphonage. Back-siphonage occurs when there is a negative or reduced pressure in the potable supply piping.
2. Back pressure. Back pressure occurs when the pressure within a building's system is higher than the positive pressure in the distribution system.

Whenever a great deal of water is removed from the distribution system (during fire fighting, hydrant flushing and water main breaks) conditions may become susceptible for back-siphonage or back pressure, causing a backflow event to occur.

Building in an air gap is a common way to prevent backflow. But where air gaps are impractical, plumbing systems must have mechanical backflow preventers (BFP) installed to prevent pollutants or contaminants from backflowing into the drinking water supply. These BFPs must be regularly inspected and tested, and may require maintenance and replacement over time, to ensure that they are functioning correctly and continue to protect the potable water system against backflow.

To minimize the risk posed by unprotected cross-connections, various regulatory agencies at the federal, state, and local levels require Cross-Connection Control and Backflow Prevention (CCC&BP) programs to be adopted and implemented.

Cross-connection Surveys

The Chief of Naval Operations Environmental Readiness Program Manual (OPNAV M-5090.1) outlines Safe Drinking Water Act Ashore

Under backflow conditions, there is a danger of nonpotable water entering the drinking water supply.

requirements and guidance for Navy installations. It requires installations that own or operate a water system to develop and implement a CCC&BP program that includes procedures and mechanisms to:

1. Find and eliminate existing cross-connections and prevent new cross-connections.
2. Install, inspect and test backflow preventers when cross-connections cannot be eliminated, or as required by state and local regulations.
3. Keep an inventory of all existing backflow preventers.
4. Certify all backflow preventers as required by the state regulatory agency. If there is no regulatory requirement, then all backflow preventers should be certified at least once every six months for high hazards and once every 12 months for low hazards by a state or local water authority certified tester.

5. Promptly repair or replace defective backflow preventers, and retain cross-connection and backflow preventer inspection and maintenance records for at least five years.

Tasks one through three above can be accomplished through a comprehensive cross-connection survey. The purpose of the survey is to inventory and assess existing BFPs, identify actual and potential unprotected cross-connections to the potable water system and provide corrective action recommendations.

During the cross-connection survey, all exterior connections to the potable water system are inspected. Surveyors look for unprotected connections to irrigation systems, fire suppression systems and vehicle wash areas. Interior spaces are also checked for unprotected connections to boilers, chillers and cooling systems, laundry facilities and other equipment connected to the potable water system. A determination is also made as to whether the facility or building as a whole represents a cross-connection hazard to the potable water distribution system, and therefore would require protection at the service connection (also referred to as 'premises isolation').

The other element of the cross-connection survey involves creating or updating an inventory of all BFPs installed throughout the installation. Features and characteristics of existing assemblies and devices are examined and catalogued. Where unprotected cross-connection hazards are identified, surveyors evaluate opportunities for mitigating them. Comprehensive inventory information on each BFP and unprotected cross-connection finding is entered into a database, along with photos and maps pinpointing exact locations.

Data Management

The cross-connection survey team at NAVFAC EXWC has developed a Microsoft Access™ database tailored to meet the requirements for specific survey locations.

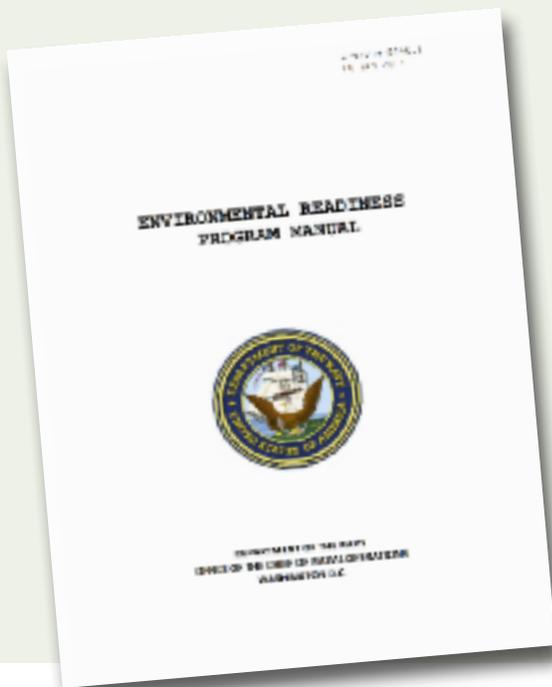
The Cross-Connection Survey (CCS) database application provides detailed and summary reports on BFPs and reports the findings noted during the site survey, ranging from discrepancies to recommended corrective actions.

The user-friendly database can be used not only to manage current BFPs and survey findings, but also to efficiently organize future monitoring, testing and management aspects of an installation's CCC&BP program.

For More Information

To download the most recent version of the 5090 instruction, visit <https://doni.documentservices.dla.mil/SECNAV%20Manuals/5090.1.pdf>.

Requirements for cross-connection surveys are discussed in section 21-3.9. Cross-Connection and Backflow Prevention.



The Basics About Backflow Preventers

THERE ARE MULTIPLE BFP types and configurations available to protect drinking water systems from backflow events. Common BFPs include:

- Reduced Pressure Principle Backflow Assemblies (RP)/Reduced Pressure Principle Detector Assemblies (RPDA)
- Double Check Backflow Assemblies (DC)/Double Check Detector Assemblies (DCDA)
- Pressure Vacuum Breakers (PVB)/Spill-Resistant Vacuum Breakers (SVB)
- Hose Bibb Vacuum Breakers (HBVB)
- Atmospheric Vacuum Breakers (AVB)
- Dual Check Valves (DCV)/Dual Check Valves with Atmospheric Vent (DCAV)



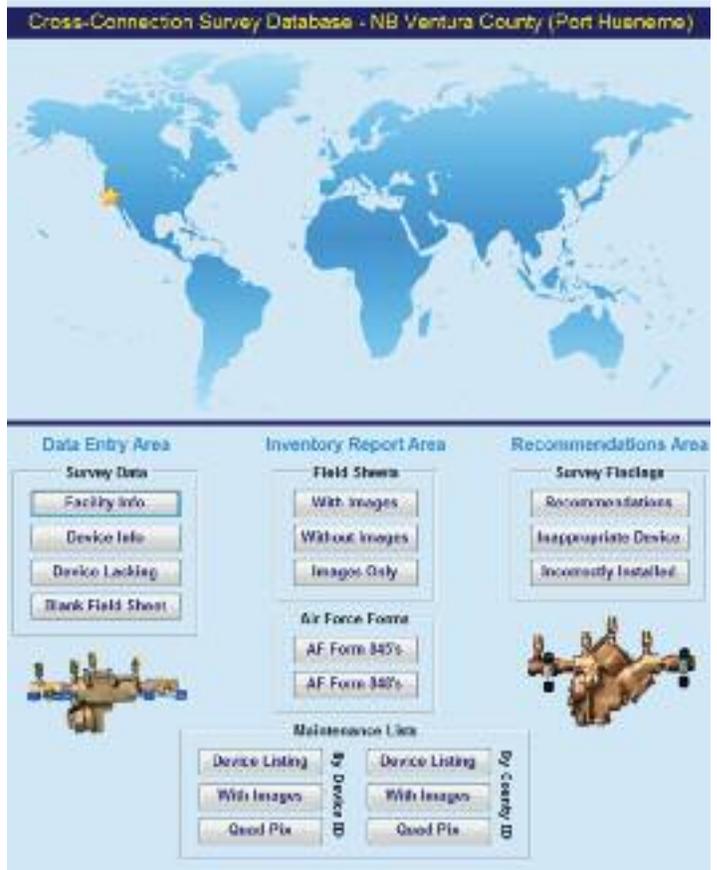
Various types and configurations of BFPs.

When NAVFAC EXWC engineers perform a cross-connection survey at any DoD location, the database application as well as the associated BFP photos, maps and Geographical Information System (GIS) layer, are provided to the installation as a deliverable. The installation can then update the database and use it to manage their respective program.

The database catalogs BFPs inventoried at buildings and facilities throughout the installation and identifies additional locations where backflow protection is recommended. Once the database has been populated with field data, photos and facility site maps collected and developed during the site survey, various output reports can be generated. Custom database reports can be tailored to an installation's specific needs.

In addition to BFPs, the database incorporates survey findings ranging from observed 'discrepancies' to 'recommended corrective actions.'

Discrepancies are instances where BFPs may be in need of repair or modification, out of code or have other observed issues that do not pose a major public health risk. For instance, a BFP may otherwise appear functional or intact, but be located more than five feet above ground with no platform for access, have insufficient air gaps or access for testing and maintenance or be lacking isolation shutoff valves.



Main menu of the CCS database application.



In this example finding, the bypass line circumvents the BFP, creating an unprotected cross-connection to the potable water system.

Eric Friedl

Recommended corrective actions are instances where backflow protection for an actual or potential cross-connection is absent or lacking or where backflow protection is present but is not commensurate with the degree of hazard present. An example of lack of protection would be a lawn sprinkler system directly connected to the water supply without any BFP. An example of inappropriate protection would be a DC type BFP protecting a fire suppression system that employs fire-fighting foam (RP type required due to the presence of chemicals).

For both discrepancies and recommended corrective actions, priority or high concern findings are clearly distinguished in database output reports.

Program Management

Although Navy regulations do not currently mandate intervals for cross-connection surveys, it is prudent to perform a comprehensive installation survey at least every five years. Facilities and potable water connections are constantly undergoing construction, renovation, retrofit and demolition, and a recent cross-connection survey is often the best resource for the CCC&BP

program to tap into for comprehensive understanding of the current status and any existing risks or vulnerabilities that need to be mitigated. Cross-connection survey reports will:

- Recommend the correct sizes and types of BFPs needed to mitigate the unprotected cross-connections identified during the survey.
- Recommend extraneous BFPs installed on water lines no longer in use be removed and stricken from testing and maintenance requirements.
- Identify newly discovered or unknown BFPs not receiving the required periodic testing and maintenance.
- Identify discrepancies associated with incorrect or problematic installation or configuration of BFPs as well as any maintenance or repair issues requiring immediate attention.
- Generate reports for recommended corrective actions and discrepancies that cite the requirement or regulation and quantify the cost of repair or retrofit.

- Provide the program with valuable mapping and photographic tools and GIS data to assist with asset management, testing and maintenance.

An up-to-date cross-connection survey is the best way for Navy installations to understand and quantify the risks to their potable water system. Additionally, the survey report will help steer activity planning and prioritization for implementing recommended corrective actions and mitigating discrepancies where backflow protection is lacking or inadequate.

For more information regarding EXWC and the cross-connection survey process, contact Eric Friedl. Examples of various output reports from the CCS database application can also be provided to installations to help them conduct their own cross-connection surveys. [📄](#)

Eric Friedl
 Naval Facilities Engineering and Expeditionary Warfare Center
 805-982-3688
 DSN: 551-3688
eric.friedl@navy.mil