Water Security Test Bed

Research tool can bolster municipal water security

The WSTB can be used for research related to detecting and decontaminating chemical, biological or radiological agents following a man-made or natural disaster.

People use water every day to meet domestic, industrial, agricultural, medical and recreational needs. Yet Americans often take for granted the availability of clean, safe water, which is crucial for the nation's health and prosperity.

To help ensure our water security, the U.S. Environmental Protection Agency built the Water Security Test Bed (WSTB) at Idaho National Laboratory to improve America's ability to safeguard our water systems, and to train workers to respond to contamination incidents and natural disasters.

Research at the WSTB is focused on developing methods for decontaminating pipes and equipment and designing better, more resilient infrastructure. A community with disrupted water for any amount of time is going to have great difficulty recovering, from both health and economic perspectives.

For example, when a tank at Freedom Industries in Charleston, West Virginia, leaked 7,500 gallons of methylcyclohexane methanol (a chemical used in cleaning coal) into the nearby Elk River in January 2014, up to 400,000 people in nine counties were without access to potable water for several days. Industries that relied on clean water, such as the food and beverage industry, were also affected.

REAL-LIFE CONDITIONS, CONTROLLED ENVIRONMENT

The WSTB is available for research related to detecting and decontaminating chemical, biological or radiological agents following an intentional or natural disaster. Cybersecurity research focused on securing automation in water distribution infrastructure is also of interest.

Research at the WSTB takes place at INL's Critical Infrastructure Test Range Complex. The test bed area measures 600 feet by 300 feet and uses 8-inch ductile iron pipe that was weathered under real-world conditions — the more than 40-year-old pipe was recovered from a decommissioned INL facility.

INL
Idaho National Laboratory

Researchers are testing elevated concentrations of chlorine and other disinfectants to decontaminate pipes.

The test bed is constructed to replicate real-life conditions in a controlled environment. The cement mortar-lined iron pipe used in the WSTB is typical of the type of pipe found in U.S. cities. On the inside it may have biofilm, mineral deposits and could be corroded where the cement lining has chipped away. These factors are important because old pipe tends to absorb contaminants differently than newer pipe.

All the fittings, valves, hydrants, sensors and telemetry equipment were assembled from full-sized, off-the-shelf commercial products to simulate conditions within existing drinking water utilities. The test bed also features a water service line connected to a room in an adjacent building that simulates residential water use. A water heater, refrigerator, dishwasher, clothes washer and sink are plumbed into the room.

RESEARCH SCENARIOS

One experiment might involve contaminating household appliances with specific pathogens to see what kind of decontamination methods, materials and systems are needed to clean them.

Researchers could also model what would happen if terrorists launched a cyberattack that spoofs water quality sensors, thereby giving false water quality data to water infrastructure control systems.

Other research aims to address concerns about crude oil, transported via rail, contaminating waterways. Initial tests are examining contamination persistence and decontamination methods for drinking water infrastructure. Another project analyzed the persistence of contamination in a simulated large municipal system using Bacillus spores that behave much like anthrax but are otherwise benign.

So far, researchers have found that results observed in pilot-scale tests do not necessarily match results from the full-scale test bed, which further informs research and decontamination recommendations EPA would provide to communities. The research lets EPA actually simulate what could happen in real water infrastructure.

For example, highly corroded pipe can rob a system of the residual chlorine needed to prevent regrowth of bacteria and pathogens. With the pipe system at the test bed all above ground, researchers are testing elevated concentrations of chlorine and other disinfectants to decontaminate the pipes. They are also testing portable treatment units to treat water collected in a 30,000-gallon lagoon built adjacent to the pipe system.

WHAT'S NEXT

The first test bed experiments were completed in September and October 2014. Additional experiments have been conducted every summer since then. EPA and INL are planning new experiments using the current setup, and they have additional excavated water pipe to expand the system's configuration. They are seeking collaboration with other federal partners and water sector researchers and would like to design the next phase of the WSTB to meet collaborators' needs.

FOR MORE INFORMATION

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