OFFICE OF RESEARCH AND DEVELOPMENT

National Homeland Security Research Center

Advancing Our Nation's Security Through Science

MISSION

The National Homeland Security Research Center (NHSRC) develops and delivers reliable, responsive expertise and products based on scientific research and evaluations of technology. Our expertise and products are widely used to prevent, prepare for, and recover from public health and environmental emergencies arising from terrorist threats and incidents.

ADVANCING OUR NATION'S SECURITY THROUGH SCIENCE

AUTHORITY

The Public Health Security and Bioterrorism Preparedness and Response Act (the Bioterrorism Act) of 2002, together with Homeland Security Presidential Directives 7, 9, and 10, charge EPA with protecting our nation's critical water infrastructure; monitoring for chemical, biological, and radiological terrorism threats to public health and the environment; and supporting decontamination efforts in the event of an emergency.

THE PROBLEMS WE FACE

How do you prevent a chemical, biological, or radiological attack? How do you determine that an attack has occurred? How do you contain contamination and mitigate its impact? How do you measure and communicate risk? How do you decontaminate a contaminated area? How do you dispose of contaminated materials? A part of the EPA's Office of Research and Development, NHSRC is developing solutions to these and other similar problems.

FINDING THE SOLUTIONS

Research Solutions are found in research. Guided by principles of quality assurance, our research is peer reviewed by scientists, engineers, and intelligence specialists. We are focusing on:

- Rapid detection of contaminants
- Containing the contaminants and reducing their effects
- Cleaning up contaminated areas
- Disposing of contaminated materials
- Assessing risk and communicating that risk to the public and response personnel
- Testing and evaluating technologies
- Improving response capabilities

Stakeholders NHSRC's research includes consulting with stakeholders—utility operators, building owners and managers, emergency responders, state and municipal governments, other federal departments and agencies, and the general public. Finding solutions means knowing what our stakeholders actually need.

Products A goal of our research is to create products for our stakeholders. For example, we have developed an online decision support tool that provides guidance for disposing of residues from the cleanup of contaminated buildings and water systems. Other products include analytical methods, computer models, and databases.

SECURITY THROUGH RESEARCH: CLOSING THE KNOWLEDGE GAP

To protect the general public, we need a better understanding of how to assess the risks to human health from chemical, biological, and radiological contaminants.

We know that there are many contaminants that could pose threats to the public. It can take many years to fully determine the risk to human health from these contaminants. By combining sound science and the dedication of experienced researchers, NHSRC is developing methods to rapidly assess risk. These methods will yield fast and reliable answers in emergency situations.

Methods and equipment for quickly and accurately detecting contaminant threats are under development. NHSRC is devising creative, innovative tactics for containing dangerous contaminants. Testing and evaluation of numerous decontamination methods is underway. This analysis will assist in the selection of safe and cost effective decontamination approaches.

Training sessions keep NHSRC's researchers up to date on all the latest advances in scientific methods and technologies.

NHSRC RESEARCH PROGRAM DEVELOPMENT

Research and development begins with determining what kind of research is actually needed. Of course, our first concern is homeland security. As part of that concern, we are looking for ways to safeguard the environment in case of a terrorist attack that could harm our water or our indoor and outdoor environments.

Our concern includes chemical, biological, and radiological contaminants and their effects on human health. Working to identify gaps in our knowledge about these contaminants helps us define our research focus. With this focus, we are able to develop potential research programs and identify key stakeholders. All of this information helps us decide what kind of research is needed and helps us develop research plans.

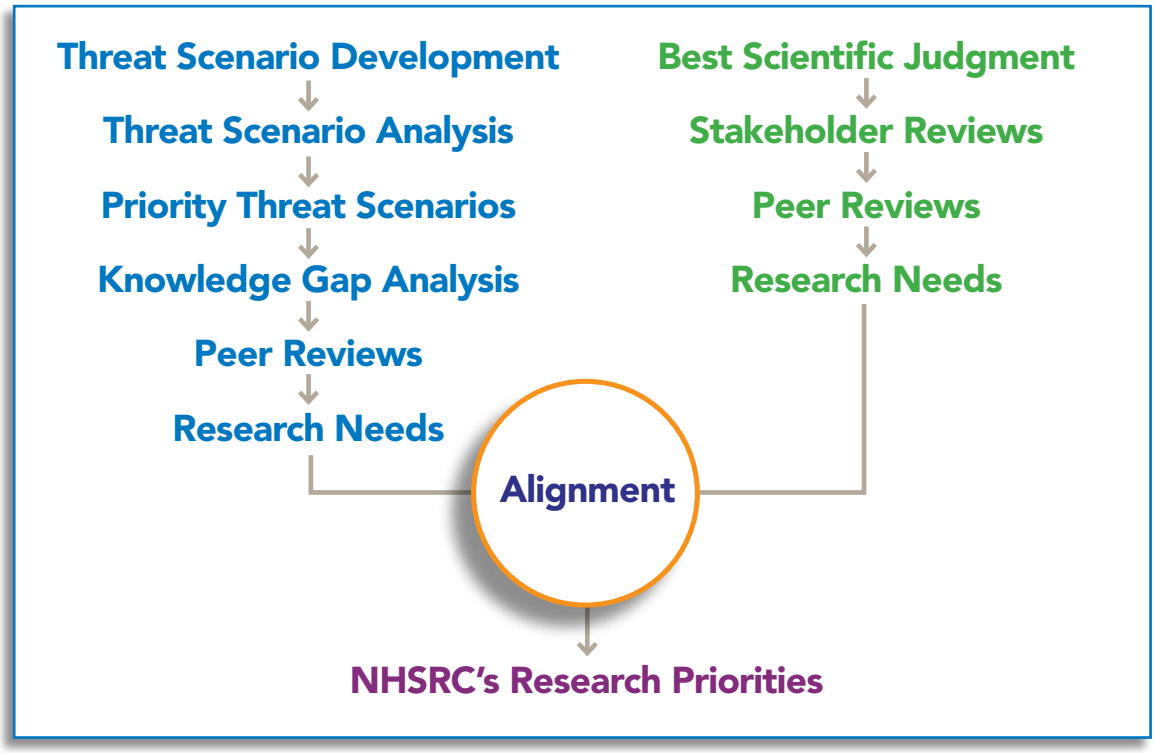
NHSRC's RESEARCH PRIORITIZATION PROCESS

Threat Scenario We follow two paths to find out what kind of research is needed and how to prioritize that research. One path is the threat scenario path. A threat scenario is a possible sequence of events that make up a terrorist attack. When we develop a threat scenario, we consider a specific type of attack in a specific situation. As a result, we must evaluate thousands of possible combinations of facility types and methods and means of attack. The priority scenarios are those that are considered more likely to happen than others or that are more likely to cause widespread or significant harm.

Once the priorities are determined, we do a knowledge gap analysis. This means we look at our ability to detect a problem, contain the contamination, and decontaminate the environment. We then focus our research on expanding our ability to rapidly and effectively respond to an attack. The research then goes through a peer review; that is, it is evaluated by experts who do the same type of research.

Best Scientific Judgment The other path relies on best scientific judgment. Following this path, we go directly to the stakeholders. Engineers, scientists, and other practitioners who would be directly affected by a threat or attack tell us about their research and technology needs.

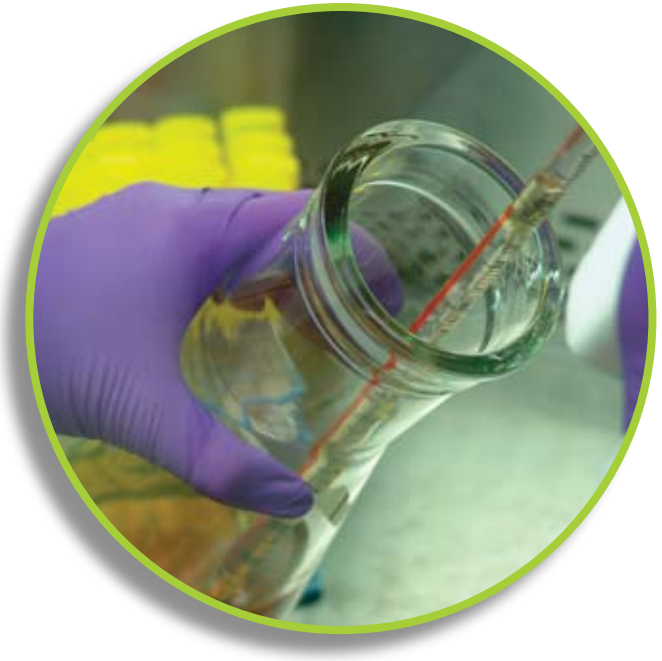
The results of both paths are finally aligned and used to identify NHSRC research priorities.



Collaboration with many other organizations is vital to NHSRC's ability to achieve its goals.

PRIORITIES AND RESOURCES

Our Priorities The staff of NHSRC recognizes that securing our nation's infrastructure in the face of threats and attacks is a critical part of EPA's mission. Because security-related research is an urgent priority, results are often expected within a short time frame. NHSRC's highly skilled and experienced staff began producing results within the first months of the organization's formation in September 2002.



NHSRC research and development focuses on seven areas:

1. *Rapid detection of contaminants*
2. *Containing the contaminants and reducing their effects*
3. *Cleaning up contaminated areas*
4. *Disposing of contaminated materials*
5. *Assessing risk and communicating that risk to the public and emergency responders*
6. *Testing and evaluating technologies*
7. *Improving response capabilities*

The Stakeholder as a Resource

We work to ensure security by conducting reliable, proactive, and responsive scientific research and by providing expertise to our stakeholders. The stakeholders, in turn, provide us with continual feedback on the value and utility of our work. We adjust or adapt our research programs on the basis of the feedback we receive. In doing so, we create lasting partnerships that advance the quality, relevance, and impact of our research.

Other Resources NHSRC improves its efforts by combining unique talents both inside and outside EPA to develop usable solutions to increasingly complex interdisciplinary challenges.

We actively collaborate with many organizations to garner the critical advice and necessary input that make these creative solutions possible.

Biological contamination

By testing sensors and determining minimum detection levels, NHSRC's research is helping to establish crucial detection limits for all contaminant types.

RAPID, RELIABLE CONTAMINANT DETECTION

The ability to respond quickly to contamination events requires rapid detection and identification of chemical, biological, and radiological contaminants. NHSRC's research makes possible this rapid detection and identification.

NHSRC is advancing security through:

- Testing and evaluating commercially available detection technologies
- Developing and testing drinking water contaminant warning systems
- Developing real-time chemical and biological agent monitoring
- Evaluating health surveillance networks that may help to identify symptoms related to contamination of water
- Modeling threats to water distribution systems

Computer models can simulate the transport and fate of both airborne and waterborne contaminants. The models' results enable NHSRC researchers to provide guidance on how best to contain contaminants and mitigate their effects.

CONTAINMENT AND IMPACT MITIGATION

Containment and mitigation research identifies and develops the best available technologies and procedures for limiting a contaminant's reach. To protect decontamination crews, the general public, and the environment, these technologies and procedures must be appropriate for use within buildings, as well as in outdoor areas.

Dispersion of an airborne contaminant in an office.

NHSRC is advancing security through:

- Testing and evaluating air filtration systems
- Developing emissions, transport, and fate models for air releases
- Designing and evaluating residential and commercial building safe havens
- Modeling contamination events in drinking water distribution systems
- Developing guidelines for:
  - Managing contamination events
  - Retrofitting buildings to increase protection from chemical or biological attack
  - Determining the fate of biological, chemical, and radiological contaminants in water
  - Designing heating, ventilation, and air conditioning (HVAC) systems that minimize contaminant spread
  - Ensuring continued delivery of safe water

Decontamination crews in the Hart Senate Office Building in 2001 (large photo above) and a training exercise participant (inset) testing for contaminants.

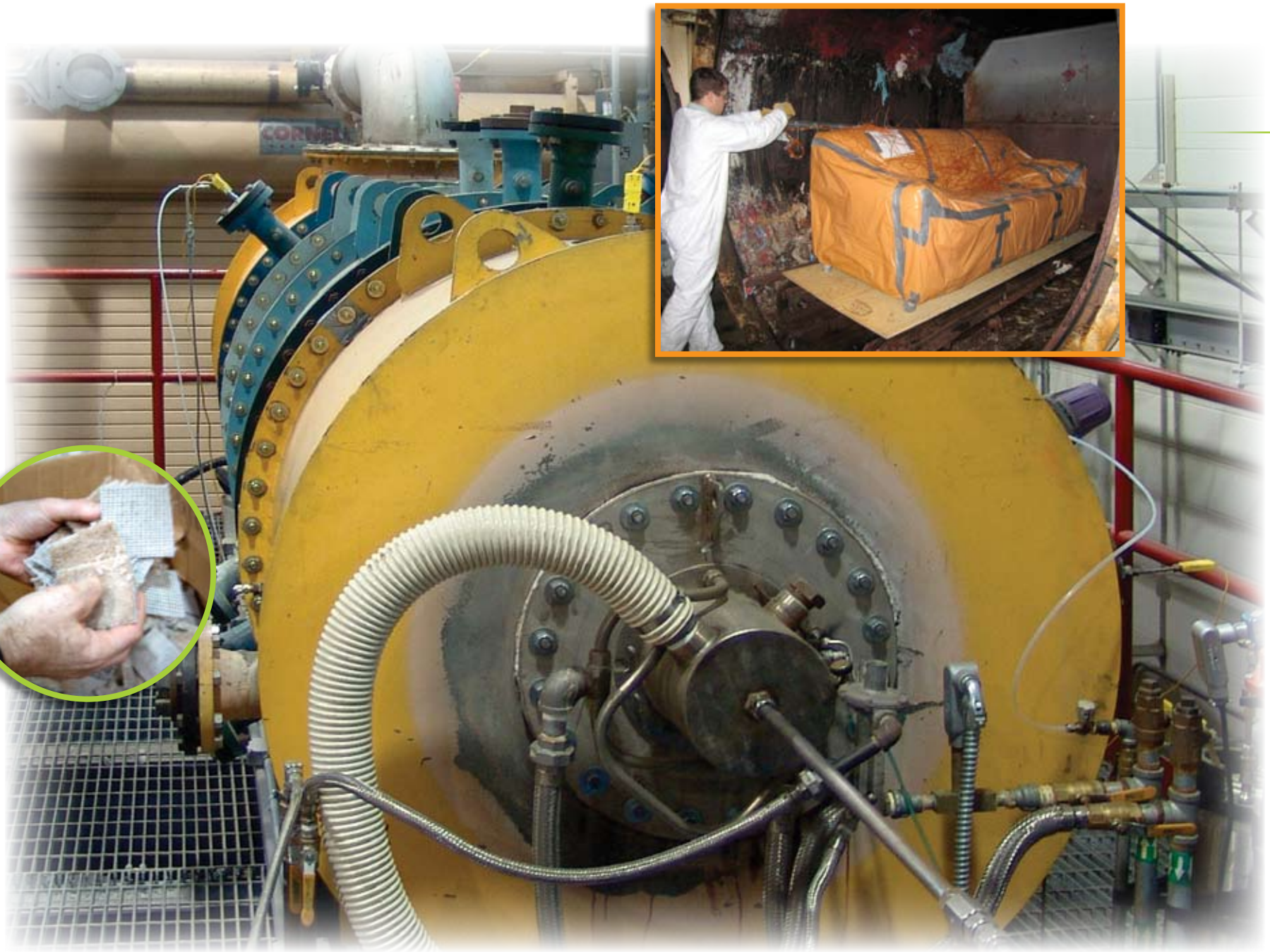
DECONTAMINATION AND TREATMENT

Decontamination and treatment research focuses on methods for safe and cost-effective remediation and for restoration of indoor and outdoor areas after contamination.

Studies conducted with pilot-scale water distribution systems such as this clear pipe loop allow researchers to observe the behavior of contaminants within the pipe system.

NHSRC is advancing security through:

- Testing and evaluation of:
  - Commercial decontamination methods
  - Point-of-use treatment
- Developing guidance documents for building decontamination
- Conducting studies to optimize chemical decontamination methods
- Developing methods for decontaminating special materials
- Performing engineering and economic analyses of decontamination options
- Evaluating lessons learned from building decontamination experiences
- Developing a resource document for decontaminating appliances that use water
- Conducting inactivation studies for biological contaminants in water
- Determining the effectiveness of chlorine against bacterial agents in water
- Producing a database of methods for treating drinking water



A rotary kiln (large photo) is one of the thermal destruction options being tested for decontamination of building materials such as carpeting (inset at left). The decontamination effectiveness of an autoclave (inset at upper right) is being tested for upholstered furniture.

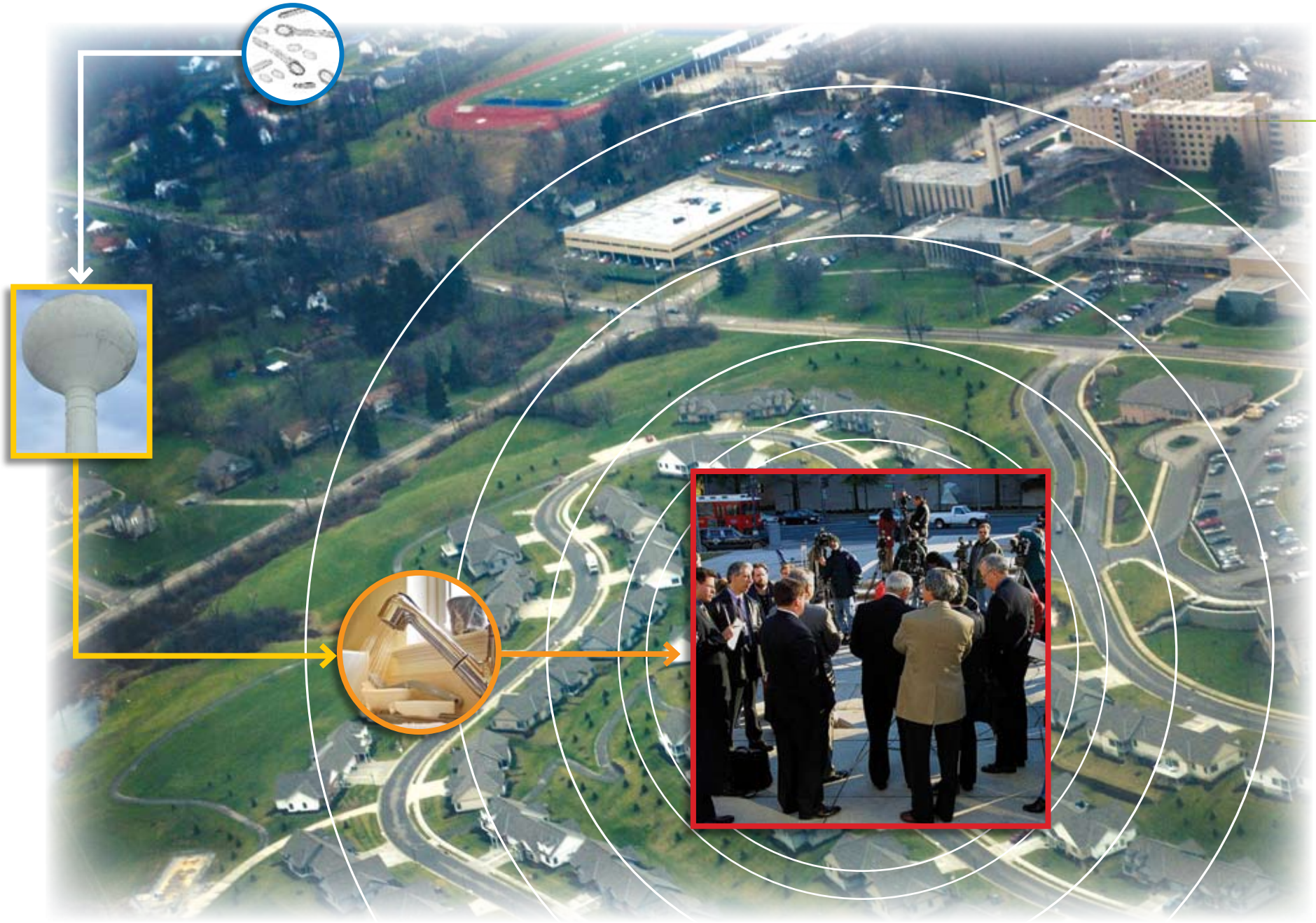
DISPOSAL OF CONTAMINATED MATERIALS

NHSRC is developing tools, techniques, and technologies appropriate for the safe removal, packaging, transport, and disposal of contaminated materials and decontamination waste following an emergency. These materials could include protective equipment, rinse water, and both porous and nonporous materials.

A training exercise participant disposes of contaminated material.

NHSRC is advancing security through:

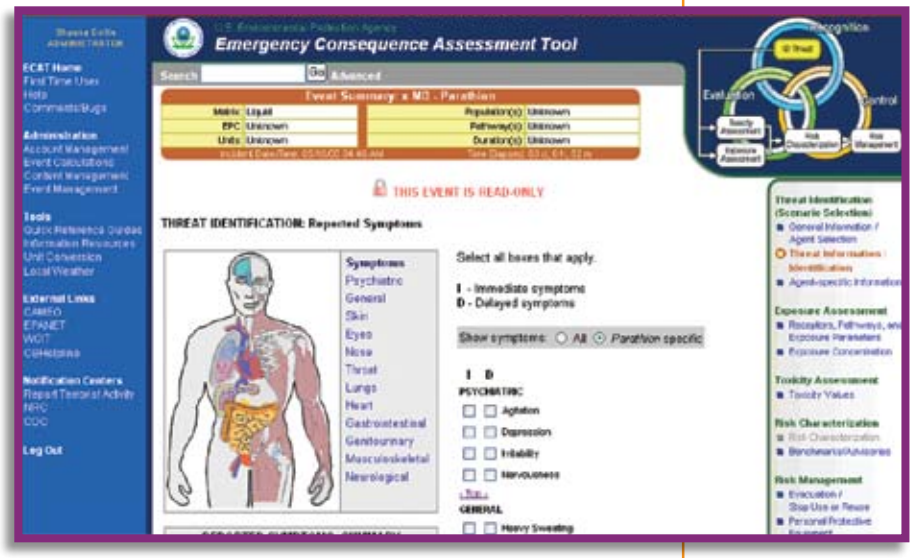
- Testing and evaluating technologies for treating wastewater and residuals
- Conducting studies of thermal destruction of contaminant agents
- Evaluating the safety of landfilling decontamination waste
- Investigating migration of biological agents from landfills
- Developing a guidance document for thermal treatment of building decontamination residue
- Constructing a Web-based disposal decision support tool on potential landfill/thermal treatment facilities for building and water system decontamination residue
- Sponsoring and publishing proceedings from a disposal workshop to identify disposal issues associated with weapons of mass destruction



Researchers are developing tools to aid in rapidly assessing risks and quickly communicating those risks to affected communities.

RISK ASSESSMENT AND COMMUNICATION

Assessment and communication research provides tools and expert guidance to help decision makers prepare for and respond to terrorist attacks.



The Emergency Consequence Assessment Tool (ECAT) is designed to guide users through a series of questions that will help them quickly assess risks to human health.

NHSRC is advancing security through:

- Identifying and using methods for concisely and accurately communicating risk information
- Constructing a computer tool for quickly assessing risks to human health
  - Developing acute, subchronic, and chronic exposure levels for agents of concern
  - Expanding E-Plan, a comprehensive resource for local "right to know" information
  - Constructing a database of chemical toxicity information
  - Establishing methodologies for assessing the risks from biological agents to human health
  - Evaluating unique methods for predicting health and risk information in the absence of contaminant-specific data
  - Supporting development of chemical and biological cleanup levels for air and water
  - Assessing exposure from various contaminant sources and pathways

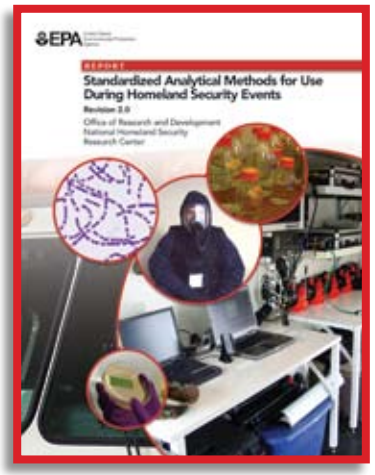
NHSRC supports emergency responders by participating in simulation training exercises, offering contingency planning tools, and providing laboratory support. The top inset photo shows a participant being decontaminated by showering during a training exercise.

IMPROVING RESPONSE CAPABILITIES

NHSRC is dedicated to ensuring that its research products are used effectively by our stakeholders. Analytical methods are being compiled into a manual to be used during a response. NHSRC also has City of Cincinnati firefighters on staff to ensure that our products are useful and meet their needs. They, in turn, disseminate information on our products through their own professional networks. We work with the Office of Water to release products through the Water Information Sharing and Analysis Center (Water ISAC).

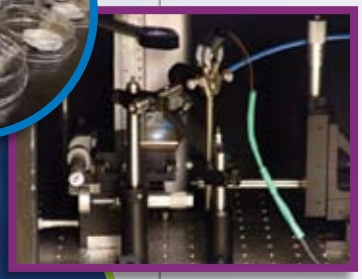
NHSRC is advancing security through:

- Expanding the nation's lab capability and capacity
  - Development of standard sampling and analytical methods
  - Establishment of a network of laboratories capable of analyzing chemical, biological, and radiological agents in environmental samples
- Transferring homeland security technology and tools to stakeholders such as EPA's National Decontamination Team and Environmental Response Team, as well as local and state emergency responders



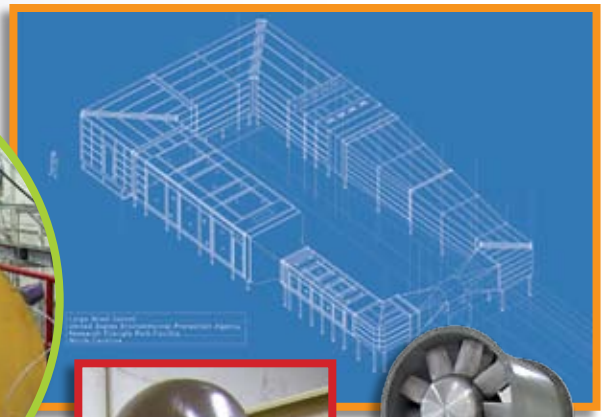
HIGH BAY FACILITIES
RESEARCH TRIANGLE PARK, NORTH CAROLINA

Research Triangle Park, North Carolina, is home to one of EPA's high bay facilities. NHSRC research at this location is conducted in the facility's advanced aerosol and combustion laboratories.



Rotary kiln used in combustion studies.

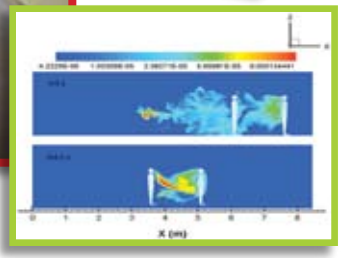
Diagram of large wind tunnel used in aerosol studies.

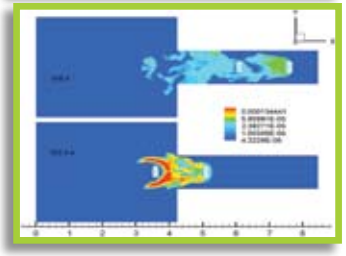


Small aerosol testing chamber.

Laser-Induced Breakdown Spectrometry (LIBS) detection device and samples.

An Open Path-Fourier Transform Infrared (OP-FTIR) detector is being tested as a real-time sensor in large building spaces.

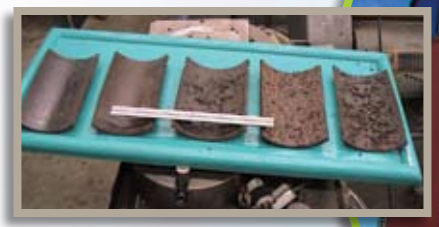




Digitally captured data (right) from wind tunnel aerosol studies using heated, breathing, adult-sized manikins (above).

TEST AND EVALUATION FACILITY
CINCINNATI, OHIO

The Test and Evaluation (T&E) Facility is located in Cincinnati, Ohio. T&E is a multipurpose, high-bay research facility. Some experiments are performed under laboratory conditions (bench-scale), while others are conducted in large system simulators or in the field (pilot-scale).



Examples of interior pipe corrosion and sediment deposition, which can inhibit decontamination efforts.

Clear pipe loop water distribution system simulator.

Various sensors being tested for their ability to detect contaminants.

"Once through" water distribution system simulator, with sampling points (right).

SELECTED EXTERNAL COLLABORATORS

EPA enters into collaborative relationships to leverage resources to solve problems facing multiple organizations. For example, EPA has formed the Distribution System Research Consortium (DSRC), comprised of 14 partnering organizations. The DSRC is an EPA-led national umbrella organization made up of member federal agencies and water organizations dedicated to the advancement of science, technology, and research to protect drinking water distribution systems from terrorist attacks. Other organizations NHSRC collaborates with include:

Canadian Food Inspection Agency
Centers for Disease Control and Prevention
Central Intelligence Agency
Department of Agriculture
Department of Defense
Department of Energy
Department of Health and Human Services
Department of Homeland Security
Department of State
Department of Transportation
Food and Drug Administration
National Institute of Standards and Technology
National Academy of Sciences
National Counterterrorism Center
National Institute of Occupational Safety and Health
Office of Science and Technology Policy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