



National Institute of
Environmental Health Sciences
Worker Training Program

Small Business Innovation Research E-Learning for HAZMAT Program

Program Overview

The National Institute of Environmental Health Sciences (NIEHS) [Small Business Innovation Research \(SBIR\) E-Learning for Hazardous Materials \(HAZMAT\) Program](#) funds small businesses, or grantees, to develop innovative applications or technologies that are used for health and safety training.

These technologies aid in the mission of the broader [NIEHS Worker Training Program \(WTP\)](#) – to prevent work-related harm by providing training for emergency responders, skilled support personnel, and workers involved in the cleanup, removal, or containment of hazardous materials.

This fact sheet describes how the NIEHS SBIR E-Learning for HAZMAT Program has:

- Impacted worker training in various occupational sectors.
- Provided opportunities for commercialization and patents.
- Facilitated partnerships among small businesses that develop technologies and WTP consortiums that deliver training.

Technology Enhances Worker Training

Proper training can mean the difference between life and death for workers who handle hazardous materials or respond to manmade or natural disasters. Although training for such workers has traditionally taken place in physical classrooms, recent technological advances have facilitated more accessible and interactive training through electronic platforms. Technology-enhanced training products can help workers safely assess, respond to, and protect themselves and others from harmful exposures on the job.

In 1997, WTP began conversations to establish an electronic learning (e-learning), or technology-enhanced training products, initiative. These conversations led to the development of a formal [e-learning guidance document](#) and the beginning of the NIEHS [SBIR E-Learning for HAZMAT Program](#) (SBIR HAZMAT).

In 2001, WTP examined the technological divide for workers in diverse sectors, as well as protocols to aid in knowledge transfer through blended learning techniques. These blended learning techniques include the delivery of training content through a variety of combined methods, such as face-to-face classroom instruction and digital instruction through online, mobile, or virtual activities. WTP has since adopted many [best practices in using technology for HAZMAT training](#).

At the turn of the 21st century, the worker training community witnessed a technology revolution that would enable workers in high-risk environments to better prepare for hazardous incidents and emergencies.

SBIR HAZMAT grantees demonstrate a commitment to technological innovation and dedication to improving worker health and safety.

Benefits of Innovative Products and Technologies

SBIR HAZMAT grantees are encouraged to partner with WTP-funded organizations that deliver health and safety training across [various program areas](#) – from hazardous waste, to nuclear weapons sites, to disasters, and more. Grantees have revolutionized methods to deliver training to workers through the development and use of online and web-based learning, mobile applications, video games, virtual reality, and immersive learning systems.

Many grantees have developed mobile applications that allow accessibility to health and safety information in areas with limited Internet connection. Others have developed learning management systems that store training modules that can

be adapted based on the end-users focus and need. Grantees have also implemented cutting-edge technologies, such as augmented reality (AR), virtual reality (VR), cloud based computing, and big data algorithms into their learning platforms. While AR allows the user to experience computer-generated images overlaid on top of a real-world environment, VR allows the user to experience a completely simulated environment.

The use of AR and VR-based technologies for training continues to grow significantly, especially in the sphere of disaster and emergency preparedness. These technologies can help workers prepare for disasters in several ways. For example, when immersed in a virtual environment, workers:

- Have a realistic and controlled setting to practice their skills so their actions will be automatic during a disaster event.
- Can engage in more strategic training operations, which require high levels of critical thinking.
- Can engage in exercises that present a series a mental challenges, which will force them to think of the most sensible solutions while being under pressure.



Participant wearing VR goggles during breakout session at 2018 WTP Trainers' Exchange held in Phoenix, Arizona.

Workers Reap the Benefits of E-Learning

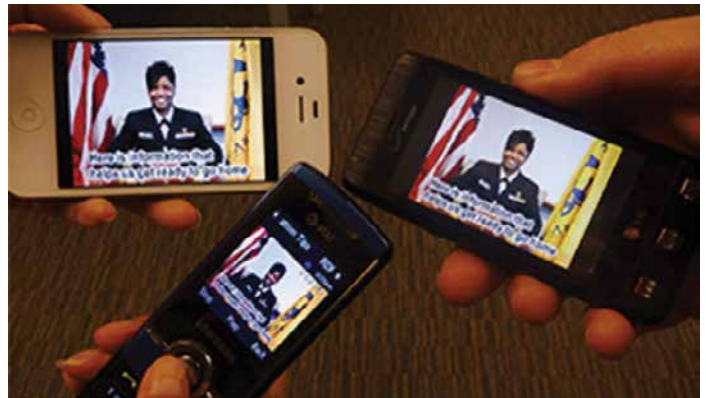
Workers involved in critical, high-risk fields have and continue to reap the benefits of e-learning products and technologies developed by SBIR HAZMAT grantees. A few examples are highlighted below.

Site-Specific Disaster Training for Skilled Support Personnel

Cell Podium developed [Just in Time Training for Emergency Incidents System](#) (JITTEIS) to provide onsite health and safety training to responders and skilled support personnel deployed to sites after emergencies.

JITTEIS is a video processing technology that is compatible with newer and older model cell phones. Using the JITTEIS, an incident commander can select relevant training videos from an

online dashboard then instruct the system to send them to cell phones of skilled support personnel. Once the videos are copied onto the phone's memory, the cell phone user can play the videos at any time. The process is like text messaging and does not require the user to download any additional applications.



JITTEIS is compatible with messaging on newer and older cell phones. (Photo courtesy of Cesar Bandera).

The JITTEIS was used by skilled support personnel during the Ebola virus epidemic (2014), Hurricane Sandy (2012), Cholera epidemic (2010), and many other HazMat-related incidents and exercises.

Illicit Drug Exposure Training for First Responders

Gryphon Scientific developed a series of videos to train law enforcement, emergency medical services personnel, fire fighters, and other first responders on how to recognize and manage risks of opioid exposure on the job. The training platform – Preventing Opioid Exposure Training (POET) for First Responders – includes a series of informative, concise, and visually appealing videos.

The videos cover topics such as routes of opioid exposure, personal protective equipment, situational awareness, and recognizing and responding to exposure events. The videos are [available on YouTube](#) and can be integrated into existing programs for just-in-time or refresher trainings for first responders.

In a [recent study](#), the POET videos were pilot tested with 18 first responders to evaluate knowledge gain and retention following completion of training. After watching the videos, the median score in the post-video knowledge checks across the 18 first responders was 90%, showing a median improvement of 10% from the pre-video knowledge check. Overall, the videos were well-received by first responders; they agreed or strongly agreed that the videos made them more confident in carrying out their duties on the job.

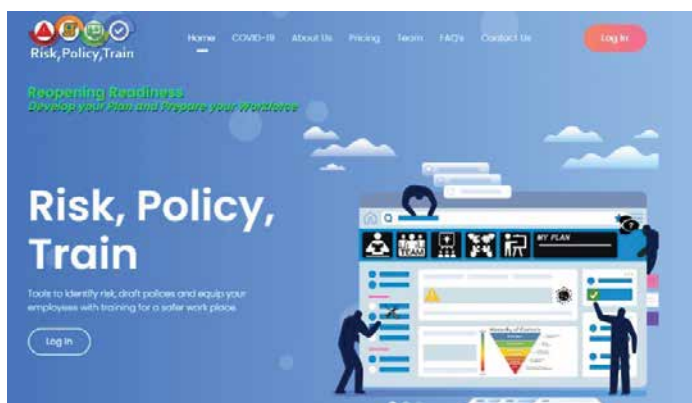


Screenshot from POET videos. (Image courtesy of Cerles AA et al., 2021, *New Solutions*).

In 2020, Gryphon Scientific received a supplemental grant to develop a training video series featuring topics related to prevention of COVID-19 for first responders. Like POET, these videos are also [available on YouTube](#).

Infectious Disease Response and Preparedness

As part of a pilot project, inXsol developed the [Risk Policy Train portal](#) to assist business owners in reducing the risk of COVID-19 in their workplaces. The portal provides a virtual solution for businesses to identify and mitigate risks, develop policies, and communicate these policies to all employees.



Screenshot of Risk Policy Train portal. (Image courtesy of inXsol, LLC).

The Risk Policy Train portal is cloud-based and uses domain knowledge from health and safety professionals coupled with the O*NET database to create a risk profile for businesses. Notably, inXsol relied on guidance from experts with WTP grantee the [Prevention, Preparedness, and Response \(P2R\) Consortium](#) to develop the portal. The portal guides a new user with a personalized recommendation engine that suggests a set of initial risks and mitigation policies based on the user's business occupation.

The portal includes a custom-designed workspace for business stakeholders and allows users to collaborate and electronically

approve risks and risk mitigation strategies. It also allows users to generate an automated policy document (in PDF format) based on data collected regarding both risks and mitigation strategies. This policy document can serve as a helpful tool for training business employees, educating them on risks and mitigation strategies.

The portal offers businesses and their employees with training on risk identification and the hierarchy of controls and provides a toolset to refine control measures. While the training is self-paced, the portal provides a pathway for individuals to voice concerns or suggested improvements to policy. So far, the Risk Policy Train portal has been used by the P2R Consortium to help businesses in El Paso, Texas safely navigate staff returning to work amidst concerns about COVID-19 transmission. This work is a part of [P2R Consortium's COVID-19 Recovery Center](#), which is funded by WTP.

Overall, the portal has demonstrated its value and feasibility to aid organizations with risk analysis and mitigation efforts. InXsol is actively seeking interested parties to expand the portal's reach and explore broader applications.

Hazardous Materials Awareness and Response

Spectral Labs developed an immersive videogame-based training program called the Realistic Adaptive Immersive Learning System (RAILS) which merges radiation physics and chemical transport models with video game engine technology. Spectral Labs' new training package, Virtual HAZWOPER (formerly known as First Responder Operational Specialized Training or FROST), is a virtual training platform that offers unique enhancements to traditional lecture training and allows students to practice real-world skills in a simulated real-world operational environment, with accurate chemical and radiological hazards and representative readings from instrumentation.

Virtual HAZWOPER is a computer software program that was developed by a team of video game programmers and 3D artists. Training content was designed with support from an award winning, state certified hazardous materials response instructor who has more than 35 years of experience training and certifying fire, law enforcement, industry, and environmental professionals who respond to chemical emergencies.

Virtual HAZWOPER was adopted by WTP grantees to deliver training for HAZMAT workers involved in emergency response, site characterization, waste removal, and site remediation including a module focused on extensively contaminated sites on the National Priorities List. So far, Virtual HAZWOPER has been deployed for use in the 2021 and 2022 virtual California

Unified Programs Association Conferences (CUPA), training over 200 people total. Student surveys reported a very positive learning experience and valuable training on HAZWOPER concepts. Spectral Labs recently released the Virtual HAZWOPER software [online](#) following successful participation at the 2023 CUPA Conference. Virtual HAZWOPER runs in most modern web browsers without installation required. Users choose a module pertaining to topics that they are interested in, and they are then presented information by a virtual instructor and engaged by visual effects and player interactions.



Participant demonstrating use of RAILS during WTP 2018 Trainers' Exchange in Phoenix, Arizona.

Leveraging Partnerships

By leveraging partnerships with WTP-funded nonprofit organizations and other entities, SBIR HAZMAT grantees can pilot test, refine, and improve their e-learning products. A few examples of partnerships are described below.

Cell Podium and the Atlantic Center for Occupational Health and Safety Training

Cell Podium and the Atlantic Center for Occupational Health and Safety Training (based at Rutgers University) have been in partnership for nearly 20 years and have deployed numerous training products to protect the health and safety of HAZMAT workers. For example, in 2017, they worked together to develop an [AR system to simulate hazardous environments](#). The AR system provides realistic scenarios of HAZMAT training exercises, which helps trainees learn to use equipment to find, classify, and isolate chemical and radiological hazards. Learn more about the partnership between Cell Podium and the Atlantic Center in a recent podcast, [Combining Technology and Training to Protect Workers' Health](#).

Commercialization and Patents

By supporting small businesses, the SBIR HAZMAT Program provides opportunities for commercialization or patents for different products. This encourages small businesses to bring their products to the market, and fosters competition, productivity, and economic growth.

Dosimulation Meter

Q-Track Corporation successfully commercialized Q-Rad, a radiation dosimulation meter with a real-time location system. Q-Rad may be planted in a duffle bag or another object to emulate a dirty bomb or another radiation source in training exercises. The technology can be used to train radiation workers in commercial and military applications.

In 2014, Q-Track Corporation sold the \$96K Q-Rad to the Y-12 National Security Complex in Oak Ridge, Tennessee. Y-12 is a manufacturing facility that plays a vital role in the U.S. Department of Energy's nuclear security enterprise. Y-12 used the system for several years to train emergency personnel on how to respond to radiological incidents. In 2019, Y-12 commissioned an upgrade and refurbishment of the system to extend service life.

Value of Leveraging Partnerships with SBIR HAZMAT Grantees

"We've had the opportunity to collaborate on just-in-time training delivered through cell phones, and providing augmented reality simulating hazardous materials in our 40-hour hazardous waste courses. The SBIRs provide a valuable resource for NIEHS grantees to develop technological solutions that can be incorporated into our training programs."

*Quote from Mitchel Rosen, Ph.D.,
principal investigator of the Atlantic Center for
Occupational Health and Safety Training*

FOR MORE INFORMATION

Contact

- **Kathy Ahlmark** (ahlmark@niehs.nih.gov)
- **Jim Remington** (remingtonj@niehs.nih.gov)
- **Sharon Beard** (beard1@niehs.nih.gov)

NIEHS Worker Training Program

<https://www.niehs.nih.gov/wtp>

NIEHS SBIR E-Learning for HAZMAT Program

https://www.niehs.nih.gov/careers/hazmat/training_program_areas/att/index.cfm

**The National Clearinghouse for Worker Safety and Health Training
Operated by MDB, Inc.** • Website: <https://tools.niehs.nih.gov/wetp>
Phone: (202) 331-7733 • Email: wetpclear@niehs.nih.gov

*This publication was made possible by contract number 47QRAA20D0028,
task order number 75N96020F00102 from the National Institute of
Environmental Health Sciences (NIEHS), NIH.*