

# DHS Science and Technology Directorate

## Wildland Firefighter Respiratory Protection

### Wildland Fires Pose Respiratory Risks

Wildland firefighters are exposed to many of the same naturally occurring respiratory hazards as structural firefighters: the myriad byproducts of wood pyrolysis and combustion, including carbon monoxide (CO), acrolein, polycyclic aromatic hydrocarbons, aldehydes and ketones and acid gases.

The main problem is wildland firefighters do not use an effective form of respiratory protection. For many wildland firefighters, a cotton bandanna remains the state of the art in respiratory protection, and the protection afforded is minimal.

The greatest inhalation hazard is CO because it is present in the largest concentration. Peak exposures of CO as high as 179 parts per million (ppm) have been measured in some controlled burns, whereas the Occupational Safety and Health Administration permissible exposure limit for CO is only 35 ppm for an eight hour exposure. The 15 minute short term exposure limit is 150 ppm. Another problem is most air purifying respirators (APRs), especially bandannas, cannot protect against the extremely fine (and most hazardous) particles present in smoke aerosols from the wildland fire environment.

### Scarf-type Protection from Airborne Hazards

The Department of Homeland Security Science and Technology Directorate (S&T) has awarded a contract to TDA Research to develop a scarf-type respiratory protection system. TDA is teaming with Avon Protection for this project. They envision that this system will be used instead of bandannas, but will provide respiratory protection for firefighters against chemical vapors, CO and particulate hazards for over 12 hours during wildland firefighting operations. The new system will be much lighter ( $\leq 7$  ounces) and more comfortable than the traditional APR and powered air purifying respirators, while protecting against airborne hazards. The scarf system will also incorporate an end-of-service-life indicator (ESLI). The system will meet the National Fire Protection Association (NFPA) 1984 Standard, while other program goals include HEPA level filtration with the breathing resistance of 50 percent of an N-95 mask.

Wildland firefighters need a new, small, lightweight device that is easy to don and doff, and that can be carried in a cargo pants pocket or a small pouch. S&T's project team proposes to develop a scarf-type respiratory protection system capable of removing airborne hazards present in the wildland firefighting operating environment. The system is composed of a filter module that will remove very fine particulates, while the charcoal sorbent will be optimized for removing the toxic chemical vapors and an ambient temperature catalyst will remove the CO. An ESLI will let the firefighter know when it is time to replace the media cartridges.

### Leveraging New Respiratory Protection Systems and Customizing for Wildland Firefighters

This project leverages recent investments in a new generation of Integrated Respiratory and Eye Protection Scarf respiratory protection system being developed for the military, as well as the respiratory protection system that is currently being developed by TDA and Avon for use by firefighters during overhaul operations. These projects will serve as the basis for developing the wildland firefighter respiratory protection system, which reduces technical risk and development costs. Certification from the National Institute for Occupational Safety and Health and the NFPA is planned. This 18 month effort is estimated to be completed by November 2019.

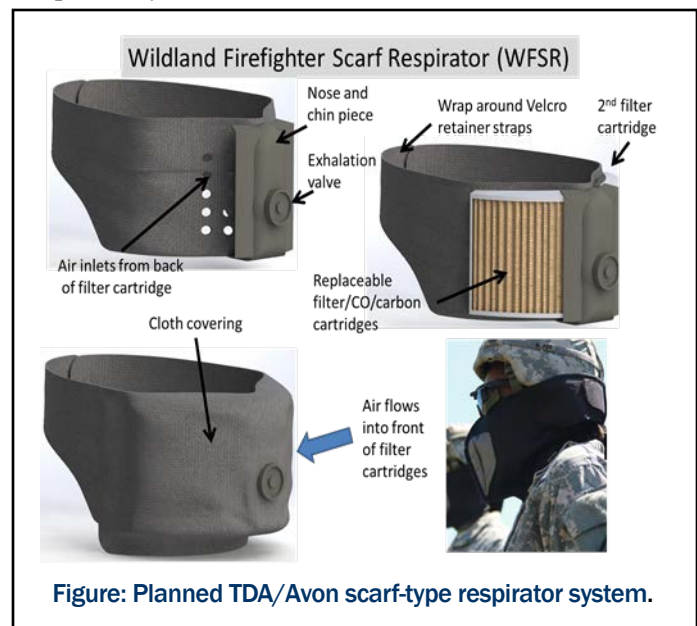


Figure: Planned TDA/Avon scarf-type respirator system.

