Protection of Fire Fighting Vehicle Crews

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Abstract

Bushfires cause significant property and human loss, disruption and trauma in Australia annually. Each year thousands of Australian fire fighters manage and suppress bushfires in rural and forest areas, and the bushland urban interface. Fire fighter injuries and deaths cost fire management agencies significant amounts each year.

The majority of Australian bushfire fire fighters are volunteers working from water tanker vehicles. Fire fighters working from vehicles can be exposed to intense radiant heat, flame contact and smoke when bushfires entrap and burnover vehicles. Little research has been done in the protection of fire fighter crews when vehicles are entrapped and burnt over.

As part of a program of research to evaluate fire fighter safety on the fire ground, the Country Fire Authority of Victoria and the New South Wales Rural Fire Service commissioned the Commonwealth Science and Industrial Research Organisation (CSIRO) to evaluate fire tanker crew protection during burnover. The goal of the bushfire burnover research was to develop vehicle crew protection systems for the safety of fire fighters during bushfire suppression.

The research involved laboratory testing to assess existing water spray systems, and the combustion and toxicology of vehicle components. A prototype water spray vehicle protection system was developed as a result of the laboratory testing.

The prototype water spray vehicle protection system was evaluated using a large-scale (12 x 12 m) gas-fired bushfire burnover simulator. The simulator subjected the prototype system to multiple levels of radiant temperatures and flame durations simulating fire line intensity ranging between 2500 and 10 000 kW/m (~725-2900 Btu/sec-ft). The simulator evaluation resulted in the development and implementation of a vehicle crew protection system that consists of:

- Water sprays;
- Radiant heat curtains;
- Metal protection panels; and
- Engine metal air intake pre-cleaners.

Validation of the bushfire simulator test results occurred in bushfire burnover field experiments of moderate intensity flank fire of 2000 kW/m (~575 Btu/sec-ft) approaching the tanker.

The following conclusions from the bushfire burnover simulator tests were validated:

- Radiant heat entry into the cabin and crew areas is critical factor in limiting crew survival.
- Tyres, mud flaps, and hoses are a source of toxics and flame if exposed to radiant heat and not protected.

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- Windows are durable under radiation and flame contact at moderate intensity.
- Total truck protection is required to provide survivable conditions for crews at moderate bushfire intensity.
- Radiant heat curtains are effective in reducing cabin and crew area radiant heat and high temperatures.
- Well-designed water spray systems will provide useful gains in fire fighter safety at moderate bushfire intensity.
- Fire fighting vehicles are not designed to provide survivable conditions in ***high*** intensity bushfire burnover situations.

The research has resulted in a vehicle crew protective system to improve crew safety up to a fire intensity of 7500 kW/m (~2175 Btu/sec-ft) that is well below the intensity of major bushfires. The results will be incorporated in fire fighter safety training programs to ensure avoidance of entrapment and burnover. The findings provide improved crew safety in burnover incidents if crew protection systems are designed with the purpose of protection against radiant and convective heat and to prevent the entry of flames into crew areas.

The Presenting Author

David Nichols has been with the Country Fire Authority Victoria, Australia since 1995 and is currently the Manager of Operations Research and Development. Current research interests include wildfire behaviour, fire fighter safety, fire fighting vehicle and equipment design improvements, fire weather, and emergency management data systems. David has been involved with fire research on an Australian national basis through his work on the development and implementation of the Bushfire Cooperative Research Centre (CRC). He currently is the project leader for two separate projects within the Bushfire CRC. Prior to 1995, he was a Technical Group Supervisor of the Visualisation and Earth Science Applications Group at National Aeronautics and Space Administration's Jet Propulsion Laboratory (JPL) in Pasadena, California and as a Senior Scientist at NASA's Johnson Space Centre (JSC) in Houston, Texas. David received a B.Sc. (1971) from Fresno State University and a B.Sc. and M.Sc. (1977) from San Diego State University. He has published over two-dozen articles on wildland fire technology, fire detection and mapping, image processing, risk management, fire behaviour, and data systems development in various journals and scientific publications.