The Interface Fire Problem – An Urban Fire Service Perspective

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Abstract

FEMA's 1992 Report of the Operation, Urban Wildfire Task Force noted the trend for people to move from cities to forested areas in the USA. The Task Force considered that this introduced three factors that worsen the fire problem: increased frequency of fires, increased severity of fires, and increased difficulty for firefighters. The trends noted by the Task Force are not confined to the USA, and have been observed in Australia and other countries. Since the damaging USA and Australian fire seasons of 2002 there has been much discussion about the need for urban fire services to equip themselves with the knowledge, equipment and capabilities necessary to fight fires in the urban / wildland interface. Much of the discussion has focussed on technical and operational factors such as design of fire appliances, personal protective equipment, and firefighter training. However urban fire services in the most fire-prone areas of the world, such as Southern California and Australia, have long been confronted with an interface fire problem and the issues raised above are not new to them. This paper briefly discuses fundamental differences in the operational ethos and strategic focus of urban and rural fire services that can be cause for misunderstandings, and suggestions are made about some factors that urban fire services need to deal with so that they can integrate more effectively into major wildland fire suppression operations. However the main contention is that to be most effective, fire services should form partnerships with the community, develop self-help programs that educate and empower citizens, and lobby for proven safety measures to be mandated for new building construction and town planning. The success of the Community Fire Unit and Static Water Supply programs initiated by the New South Wales Fire Brigade after the devastating 1994 fires in Sydney, Australia is used to illustrate the success of community partnerships by urban fire services.

Urban fire services provide a range of services to the community including fire prevention and education, fire suppression, hazardous materials handling, technical rescue, and in some jurisdictions, emergency medical services (EMS). Vehicles, equipment, personal protective equipment (PPE), training and organisational structures are designed to support an ethos of rapid response and usually short-term, but intense, operational deployments. The firefighting paradigm of an urban fire service is usually based upon the requirement to fight structure fires (DeGrosky 2002). Structure fires spread rapidly, often entrap people, and wherever possible need to be fought from the inside. PPE is therefore designed to offer high levels of thermal protection, and limits dissipation of metabolic heat (Terwilliger 2003). Fighting a structure fire is usually a relatively short operation, and when compared to a major wildland fire, is more a tactical than a strategic operation. The strategic considerations at a structure fire are usually confined to decisions on whether to fight the fire and conduct rescues from inside the structure (offensive

strategy), to protect exposures from the outside when a building is heavily involved in fire (defensive), or to mount a desperate rescue attempt in a heavily fire involved structure (marginal). The strategic imperative will usually be relatively straightforward; eg rescue, fire confinement, protect exposures, etc; and from then on the operation will be largely tactical in nature. For example, considerations such as deployment of major equipment such as aerial appliances and master streams, deployment of search and rescue teams, fire attack and ventilation teams, breathing apparatus and accountability controls, etc. Incident command has to be put into place rapidly, and is almost always conducted on-scene. While the Incident Command System (ICS) framework is used, there are some fundamental differences between the type of system needed at a wildland fire. It is rare for a Planning or Logistics Chief to be needed at a structure fire, and geographic Divisions and Sectors are usually close together, simplifying communications.

A wildland fire, on the other hand introduces a whole range of variables that are often not factors at structure fires (Terwilliger 2003). Because an interface fire can cover large geographic areas, incident commanders need to have a good grasp of topography, fuel types and condition, previous fire history, climatic and weather conditions (Teie 1994). The strategic choices are far more varied than with most structure fires. Strategies need to take into account all of the above factors as well as accessibility, fire behaviour, the time of day or night, availability of water, assets under threat or likely to come under threat, and likely path of the fire (Luke & McCarthur 1978). Other factors in terms of command and control include the presence of a variety of fire suppression and support agencies, communication issues, topographical features and distance, logistics support, and the need for a large team of people to process data and turn it into useful information. This complexity generally means that at a major fire every component of ICS will be needed, that there will usually be a need for some form of unified command, and that there will be need for either mobile or static command and control facilities.

These differences do not mean that urban fire services cannot cope with a large wildland fire. Indeed, many such services around the world confront this problem every summer, and are well accustomed and adapted to the operational differences. It does mean however, that a different modus operandi is needed compared to the structure fire paradigm. Following is a list of issues that urban fire and rescue services need to consider if they find themselves becoming increasingly involved in interface firefighting operations:

- **PPE**: structural firefighting PPE is too hot and bulky for wildland firefighting (Terwilliger 2003). It does not enable the release of metabolic heat, and can quickly lead to heat exhaustion. Some pull-on boots provide insufficient support to the ankle for walking over uneven ground and rocks, leading to injury. Helmets can be too heavy for prolonged wearing, leading to fatigue, neck injuries, and headache. Lighter, double layered PPE specifically designed for wildland firefighting is necessary (Terwilliger 2003).
- **Water supplies:** urban firefighters usually work on the assumption of a ready supply of reticulated water. This is often not the case during interface fires. Homes most at risk are often built in elevated positions and on ridge-tops (Webster 2000). Reticulated water supply systems are generally designed with peak domestic flow, and short-term fire flow requirements in mind. They often cannot cope with the sustained high usage that results from firefighting operations, as well as increased use by homeowners wetting down their

properties (Webster 2000). It is therefore relatively common for water supplies to fail at critical times, particularly in the most at-risk elevated locations. Firefighters need to be taught to use water sparingly, and to pre-plan for alternative supplies (Bisbee 1993). Booster tank supplies need to be conserved for emergencies.

- **Training:** Urban firefighters need to be taught about safety considerations, and "watch out" situations (Bradford 2001). There are also established techniques for protecting homes under the onslaught of a wildfire (Teie 1994). Some wildland firefighting tactics are poorly understood by urban firefighters. Backburning and burning out operations can offend the ethos of urban firefighters – after all, they extinguish fires, not light them. There have been instances in Australia where urban firefighters who had not been properly briefed on the incident action plan proceeded to extinguish backburns required for strategic advantage.

- **Communication:** The situation described above shows why there is a need for a comprehensive communication plan, which ensures that everybody involved in the operation fully understands the incident action plan (Terwilliger 2003). Urban fire services need to plan for inter-agency communication, which in day to day operations may not be a consideration.

- **Equipment:** Urban fire services need to invest in equipment such as smaller diameter hose (38mm (1.5"), and 25mm (1")), Class A foam (both of these conserve limited water supplies), macleod tools, knapsack sprays, and driptorches (Terwilliger 2003). A decision needs to be made about whether they are carried as standard items of equipment, or are issued on an as-needs basis.

- **ICS:** Senior officers need to be trained in wildland ICS, and how to operate from a control centre, rather than on-site at the fire. The principles of ICS are the same, however the application is considerably different. It is imperative where there is unified command, that the urban fire service place people in the Operations and Planning sections. These are key areas where property protection issues need to be well understood and articulated, so that they are prominent in the incident action plan. While the urban service ethos is usually based on rapid response, action, and saving life and property above all else, the ethos of other agencies with fire management responsibilities may be more aligned to the overall strategies of fire containment. This can result in property protection issues being given insufficient weight unless there is proper advocacy.

- **Mapping and pre-planning:** Urban fire services rarely have a well- developed geographic information (GIS) capability that can be used operationally. Land management and rural fire services on the other hand, often have very sophisticated GIS capabilities that can assist the Planning and Operations functions. If there is a growing interface fire problem in a jurisdiction, pre-incident planning will be facilitated and enhanced by development of an operational GIS capability. Areas of high risk, fire history, refuge areas, water supplies, and fuel types, can all be mapped and made available for pre-incident planning. During a fire, fire spread needs to be accurately mapped during each operational period.

- **Partnerships:** This is an area sometimes overlooked by operational services, because they often have an in-house mentality – "we have to be able to cope with anything that comes our way". This is inappropriate and counter-productive in the wildland fire context. The different operational ethos of the various groups are complementary, and it is vital that different operational opinions and approaches be identified, discussed and resolved BEFORE a fire, not during. Agencies can gain a great deal from integrated pre-incident planning, joint exercises, and joint training.

The main purpose of this paper is not to discuss in any further depth the operational issues outlined above, as they have been widely discussed in other forums. The experience in New South Wales (NSW), Australia, is that seamless integration of fire agencies is a must, and that urban firefighters will be called upon regularly to fight interface fires. It is also the experience in NSW that despite the best equipment, training and systems in the world, property losses will continue to occur unless there is an integrated approach that encompasses fire service capability and planning, community education and self-help, and mandated safety standards (Jasper 1999).

Australian research has identified that houses generally burn down from the inside out (Leonard & McArthur 1999). The processes by which houses catch fire are now fairly well understood and documented (Webster 2000). A number of consistent factors have emerged from the research:

- Reports of houses "exploding" have no basis in fact;
- Fires generally start due to the entrance of flame, embers, and burning debris through openings such as ventilators, eaves and windows; and
- Where able-bodied people remain with a house, the chances of house survival increase significantly.

(Leonard & McArthur 1999)

Because of the above, Australian fire agencies seek to educate the public about preparation of their homes before fire arrives, and encourage them to stay and protect their asset provided that it is properly prepared and defensible (NSW State Emergency Management Committee [SEMC] 2002).

Research suggests that people who live in the urban / wildland interface have a significantly lower level of knowledge about what to do before and during a fire, compared to rural populations who generally have a better knowledge of fire behaviour and precautions (Leonard & McArthur 1999). This means that populations who are the most prone to interface fires are also those who potentially have the least knowledge about survival.

A study conducted by the Australasian Fire Authorities Council (AFAC) in 2002 targeted suburbs in and around Sydney that had been heavily impacted by fires during Christmas 2001. It was assumed that the targeted populations would have high levels of knowledge of what to do during a fire, due to their recent experiences, and due to targeted promotions of fire safety information prior to the fires. It was found however that this was not the case. Knowledge about fire safety was found to be lacking in many areas, such as when to make an evacuation decision,

and in pre-planning and preparation (Odgers & Rhodes 2002). The study found, however, that levels of knowledge were higher in areas where the NSWFB had established Community Fire Units (CFU). Specifically, homeowners were far more likely to have a plan, and to have taken measures to protect themselves from fires if there was a CFU established in their locality, whether or not they were a member of the CFU (Odgers & Rhodes 2002). This finding reinforced the observations and perceptions of firefighters during the 2001 and 2002 bushfires in areas where CFUs had been established after the 1994 fires.

In 1994 more than 800,000 ha of land was burnt and 205 houses were destroyed when more than 800 fires burned out of control for several weeks in and around Sydney and other parts of NSW (Sesta Publishing 1994). In one area where 17 homes were destroyed and many more were damaged, residents using equipment from a World War II era "Hose Post", successfully defended their homes despite the absence of fire services at their particular location. The NSWFB noted the levels of frustration within the community at the inability to help themselves. Arising from this, the Community Fire Unit Program was established.

The program involves provision of a trailer or fixed cabinet containing firefighting equipment to groups of local householders in fire-prone interface areas. The residents are issued with basic PPE, and receive regular training from the their local urban fire service. In 1997, a CFU at Menai in Sydney's southern suburbs successfully defended every home in two adjoining streets, while 10 homes were destroyed nearby. In 2001 and 2002 when fires again entered Sydney's suburbs and destroyed many houses, CFUs were directly responsible for the saving of dozens of homes. The program now involves 225 units with more than 3,500 volunteers, and the NSWFB is having difficulty keeping up with community demand.

At a time when volunteerism is on declining generally, the CFU Program is rapidly growing. The secret seems to be that the program is based on self-help, and empowers people to look after their own assets. It has strengthened links between the fire service and the community, and as identified by the research, has resulted in better penetration of fire safety education (Odgers & Rhodes 2002).

Static Water Supply Program

A NSWFB firefighter, frustrated during the 1994 fires by a lack of reticulated water while houses were burning down, suggested a simple but effective solution. Hydrants in NSW are located below ground, and are accessed by standpipes carried by the fire services. Distinctive plates on telegraph poles, buildings and fences indicate the location of hydrants. The firefighter suggested that a similar indicator plate, with the letters "SWS" (Static Water Supply) be placed by homeowners outside houses that have swimming pools. Thousands of homeowners participated in this program, and the simple measure simplified the task of locating and sourcing additional water supplies during the 2001 and 2002 fires, helping to save many houses (NSW Fire Brigades [NSWFB] 2002). Some local government bodies are now making it mandatory for swimming pool owners in fire-prone areas to display the plates.

Case studies

It has been demonstrated that there is considerable value in involving the community in self-help programs (Bibby 2003). Two brief case studies illustrate how such programs can engage and help to educate them at-risk communities about interface fires.

The Lane Cove River National Park fire in Januray 1994 destroyed 17 homes and damaged dozens more. Lane Cove River National Park is a relatively small area surrounded by urban development, and comes within 5 km of Sydney's central business district. In 1994, the incident commander ran out of resources due to the need to secure recently burned areas from ember attack, as the fire spread through the river valley. A point came where there were no more firefighting resources, and the head of the fire ran at will. This was the point at which properties started to be lost.

On New Years Day 2002, a fire started in an almost identical location to that in 1994, and the same incident controller as in 1994 took charge of operations. The fire, if anything, burnt with greater ferocity and speed than the 1994 blaze. The difference on this occasion was that there were a large number of CFUs surrounding the river valley, and all of these were activated and ready for the fire's approach. The fire services were able to leave recently burned areas to the CFU volunteers, and stay ahead of the fire fronts. There were no property losses, despite direct flame impingement and sustained ember attack on many houses. The deciding factor was the efforts of the CFUs, not only in the firefighting role, but prior to the fire. Firefighters commented on how well prepared homes in the area were, with defensible space cleared, openings covered, and roof gutters blocked and filled with water (NSWFB 2002).

Firefighters in the Blue Mountains, just west of Sydney, made similar observations in the suburb of Warrimoo, where a number of houses were destroyed. The houses were destroyed when water supplies failed at a critical time, although many more were saved when CFU volunteers led firefighters to pre-planned static water supplies that had been clearly identified with "SWS" plates (NSWFB 2002).

Clearly, community engagement is a key factor in mitigating the effects of inevitable interface fires. Fire services can play a key role in this respect, as evidenced by the successful CFU and SWS Programs initiated by the NSWFB.

Building standards

Another key factor is regulation of infrastructure. If we are to accept, as identified by the Urban Fire Task Force, that fire is a natural part of the environment, we must also accept that when people choose to live amongst the trees, they should expect to be compelled to take actions to save themselves and their assets from the inevitability of fire (Federal Emergency Management Agency [FEMA], 1992).

The mechanisms by which houses catch fire and burn down are now well understood. Embers or burning debris enter via ventilation spaces and other openings, often well before, or well after, a fire front arrives (Webster 2000). Other factors include large expanses of glass in the direction of fire approach – usually the most picturesque outlook that homeowners like to maximise, openings beneath the house, and timber decking attached to the house.

Simple construction modifications can help to eliminate or reduce the vulnerability of houses in interface areas (NSW Rural Fire Service [RFS] 2001). Australian Standard 3959 details construction methods that can be included by regulating bodies in fire-prone areas. Introduction of the standard has taken many years of lobbying by the fire services, similar to the experience with the banning of wood shingle roofs in Southern California. In NSW it took a firestorm (2001) to raise public awareness sufficiently to enable passage of new laws. This mirrors the Californian experience.

Town planning

It has been demonstrated that good town planning is also a factor in house survival in interface areas. Because new communities are being established in many areas, it is possible to mandate protective measures, such as perimeter roads between houses and vegetation, establishment of fuel-free zones, and inclusion of mandatory construction measures to mitigate against fire (RFS 2001). In 2002 the NSW Government implemented new legislation that in time will considerably reduce community vulnerability to fire in interface and other areas.

Conclusion

It has been the experience of the NSWFB that the frequency and severity of interface fires appears to be increasing. This seems to be a worldwide trend. Despite this, since the early 1990s, losses of houses have arguably decreased, when the size, location and ferocity of the fires in Australia are compared historically. There would appear to be three factors that have assisted in this regard:

1. Improved fire service capabilities,
2. Better education and engagement of the community, and
3. Introduction of town planning and building construction standards that mitigate the fire risk to buildings.

Urban fire services will continue to play a vital role, and will continue to improve their approaches to suppressing and mitigating interface fires. However such measures can only go so far in dealing with the overall problem. It is incumbent on fire services to also develop programs of community involvement and education, and to influence regulators and legislators to mandate fire-safe infrastructure and development in interface areas. Such preparation will complement and increase the effectiveness of the fire services when the increasingly frequent interface fires occur.

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