The fire service deserves better

1 The problem

Cancer is a big problem in the fire service. In some departments, in some countries you could almost call it an epidemic. More and more research is being done in this field. People want to know how cancer is caused and what we can do to fight it.

It also seems that there are large differences between various fire departments. The question that needs answering is "How did that happen?" Why is it, that some types of cancer occur more frequently for firefighters than in the rest of the general population. The reason for this, is not known.

So many different hypotheses are formed in response. We know for a fact that fires produce a large quantity of harmful substances that are carcinogenic.

2 The fire service deserves better

The fire service is operating in a society that is changing at very fast pace. It is a daunting task for us to keep up with these changes.

There is so much that we don't know. The fire service deserves better! We need more knowledge in these areas. Specific research in firefighter related fields is required. Not just in regards to cancer among firefighters.

The problem of cancer in relation to protective measures (nitrile gloves, dust masks, decontamination, CO^2-cleaning) is just one of the areas where we need independent research.

2.1 Scientific research into fire ground operations

In a number of countries, scientific research is being done into firefighting operational fields. The best known example of this is of course the Underwriters Laboratories Firefighter Safety Research Institute (UL FSRI). Their website, www.ulfirefightersafety.org, hosts a very large amount of material. Over the past years, they have invested millions of dollars into research. The results of that research are freely accessible from their website.

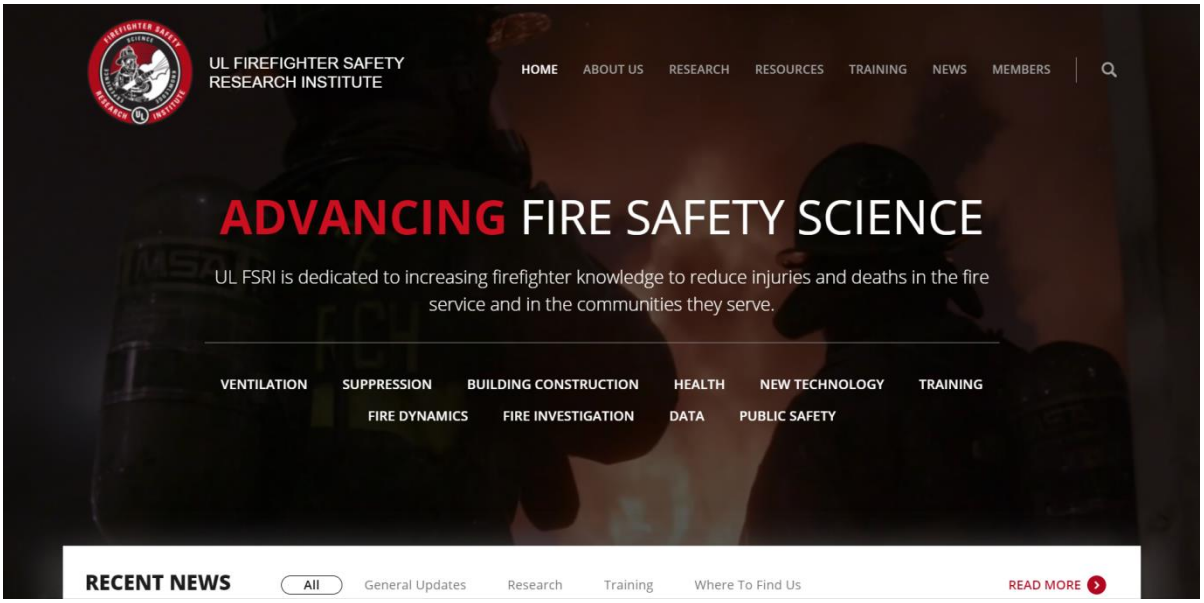

figure 1 The website of UL Firefighter Safety Research Institute contains a lot of very interesting information. *(www.ulfirefightersafety.org)*

All of their research however, is done from within a North-American context. There are many differences between American and Belgian firefighters. This means that someone who wishes to use the American research here, has to thoroughly think this through first. Which differences are there between Belgium and the US? Which of the differences would have an impact on the research results? After all, just because there is a certain difference, does not mean that that particular difference would lead to a different result in the research.

Some key differences with our American colleagues are:

- The American colleagues use an older design for their firefighter helmets. These helmets tend to protect the bottom part of the head and the neck a bit less. Often there is no flap attached to the helmet to protect the neck. American studies specifically list contamination in the neck area. Would this also be the case here with our European helmets which have a large encircling neck flap?
- In North-America, large flow rates are used for firefighting. An interior fire attack using 800 liters per minute is no exception. How do studies on this topic relate to our 45 mm attack lines (400 to 500 lpm) and high pressure reels (200 lpm)?
- Many of their nozzles operate at 3,5 bar. This leads to differences in droplet size as well as droplet distribution (in regards to diameter). We know that droplet size is a very important parameter when it comes to heat transfer. What would be the effect of the other droplet size on some of the research results?
- Gas cooling is virtually nonexistent in North America, although there are some initiatives coming to life in order to teach these techniques. American colleagues primarily use a solid jet stream where as we often use a fog pattern as well (indirect extinguishment). What would this mean for the research?

- In the US, a lot of single family dwellings are made of wood. In Belgium, bricks are more commonly used. This means that the thermal inertia of houses differs immensely. What kind of impact would this have on research? And is that impact meaningful?

So there is a need for Belgian (European?) research into firefighter fields. Such research can be done starting from our own method of operating. And since this research can be started from within our own context, we would not have to analyze afterwards any factors that are radically different between reality and the research.

In the Netherlands, the IFV does research through the fire academy. Over the past years, they have done studies on numerous topics. The offensive exterior attack, a new way of operating, was evaluated. Different ways to apply this tactic were compared to one another. Aside from that, research on gas cooling was done using several different extinguishing agents. On top of that, theoretical research was also done. Recently the IFV presented *Renewed views on firefighting*, in which they summarized a new approach that takes into account all of the recently gained knowledge.

figure 2 The Dutch colleagues implement new knowledge into firefighter training. Information is passed on to all active firefighters. *(www.ifv.nl)*

3 Problems in the future

We know that our society is changing. One of the things that has become very well understood in the fire service, is the more rapidly evolving fire development due to synthetic materials in homes. Steve Kerber of UL has described this in great detail.

The use of double glazed windows caused a second major change in fire behavior. Suddenly, under ventilated fires became more common. After 7000 years of ventilated fire development, we suddenly started seeing something entirely different. The Dutch Fire Academy (again!) did practical experiments in family dwellings in Zuthen and wrote down its findings in *Het kan verkeren, Beschrijvend onderzoek naar brandontwikkeling en overleefbaarheid van woningbranden.*

Where are the Belgians? What have we contributed to the scientific research on firefighter operations? After all, there is ample choice of problems that we need to deal with:

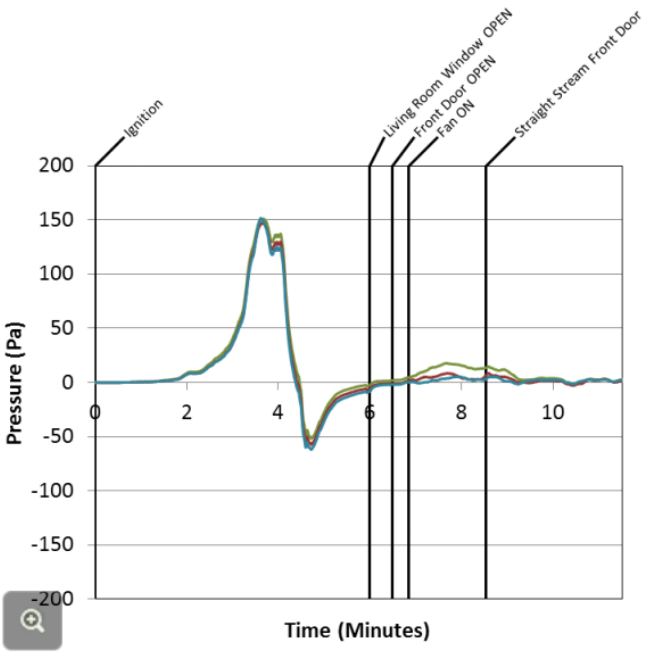

figure 3 Graph from a UL study that shows pressure buildup in a living room. *(© Figure: UL FSRI)*

After the introduction of double glazed windows, we also started to make our homes more and more airtight. This causes pressure to build up in the early stages of a fire. Because homes are increasingly becoming airtight, the pressure buildup is increasing as well.

Figure 3 shows a single experiment done by UL FSRI. The left part of the graph illustrates the fire before any actions are undertaken by firefighters. The fire involves a couch in a living room. All doors and windows leading to the outside, are closed. The pressure builds up to 150 Pa. The unit of Pascal is not that well known by the general public. But this number represents a weight of 15 kg per m². This means that a 2 m² door is being pushed upon by a force of 30 kg. There are reports of people waking up at night during a fire and being unable to flee because they could not open the door.

Experiments conducted in Finland caused pressures to rise up to 1600 Pa (or 160 kg/m²). An entire window (frame and glass panes) was pushed out of the building. It goes without saying that these pressure buildups hold serious risks for fire crews. That is why we need more knowledge and understanding of pressure buildup **in our types of houses**. Aside from pressure buildup, we also need to look at how our construction elements are reacting. How are our type of windows reacting as opposed to those used in Finland? In Belgium, windows are typically placed behind the outer brick layer. This means that the out brick layer usually has a 5 cm overlap on the window frame. This makes it unlikely that the window will fall outward. Unless the window frame has been structurally weakened by the fire? How do PVC window frames react to the elevated temperatures? Do they maintain structural integrity? How will the glass pane beading react? Figure 3 shows that after the pressure buildup, there is an under pressure phase. When the beading on the inside has melted away, the glass panes may fall inwards. In either of the cases described above, the fire will have created a very large opening through which it can draw in fresh air. The fire will then have access to high temperatures and a fresh air supply just when firefighters are least expecting it. All the signs are present for a disastrous outcome on the fire ground. Even now in 2018, the fire service has a rather limited insight into the underlying mechanics of these scenarios.

Reports of fires involving electric cars are slowly accumulating in the fire service. More and more people have seen a video on YouTube, in which such a fire turns out to be very difficult to put out. The car factory of Audi in Vorst has a large container on-site which can be filled with water. Whenever a battery pack starts burning in a vehicle, the entire vehicle is simply submerged in water.

Tesla may well be one of the most innovative companies in the car industry. Companies want to make a profit. One of the ways Tesla is trying to achieve this is the Power wall. This is a large battery (115 x 76 x 16 cm) for every day household use that allows electricity gained by solar panels to be stored. During the day, solar panels produce a lot of electricity when there is little need for it. During the evening, the demand for electricity is much higher, but then the panels produce far less or even nothing at all. Most homes at the moment dump the excess electricity on the power grid to negate the imbalance between production and usage. This costs money however. For now, the Power wall is too expensive and connecting to the power grid is what most homes with solar panels opt for. Technology has a habit of becoming cheaper and cheaper. As the price of the Power wall continues to drop, and as taxes for electricity from the grid continue to rise, more and more people will choose something like the Tesla Power wall. Strictly speaking this is an amazing innovation in regards of *cleaner and greener energy*. Sooner or later however, fire crews will be facing a house fire with one of those Power walls in it. Will firefighters have to find out on the spot what the consequences of such things are for our tactics, the efficiency of our nozzle techniques, our safety?

figuur 4 Tesla brings a number of applications on the market to store large quantities of electricity. The fire behavior of these devices will probably be problematic in the same way as the fire behavior of the batteries of electric vehicles. *(Picture: www.mcelectrical.com.au)*

Lightweight wooden housing is a new way of constructing buildings in our parts. In North America, this construction method has been popular for decades. It allows for the quicker and cheaper building of houses. The 36th article in this series was dedicated to the risks and problems that these types of constructions pose for the fire service. Basically it means that firefighters will be unable to determine whether they are dealing with a lightweight wooden construction. Firefighters will therefor operate just as they would in a classic brick home. The fire resistance rating of these wooden buildings however, is extremely low. In the US, this has led to many fatal accidents involving firefighters. Will we blindly import the accidents along with the construction method or will we try to examine how we can deal with this differently and safely?

4 Spreading knowledge and compelling the application thereof

Generating scientifically based knowledge by means of research is one thing. Next, the results of the research have to be shared in such a way that they are comprehensible to everyone. Lastly, it is extremely important that recommendations are implemented at the fire service. After all, if everyone understands both the problem and the solution, but the fire departments do not implement them on the fire ground, then we have gained nothing.

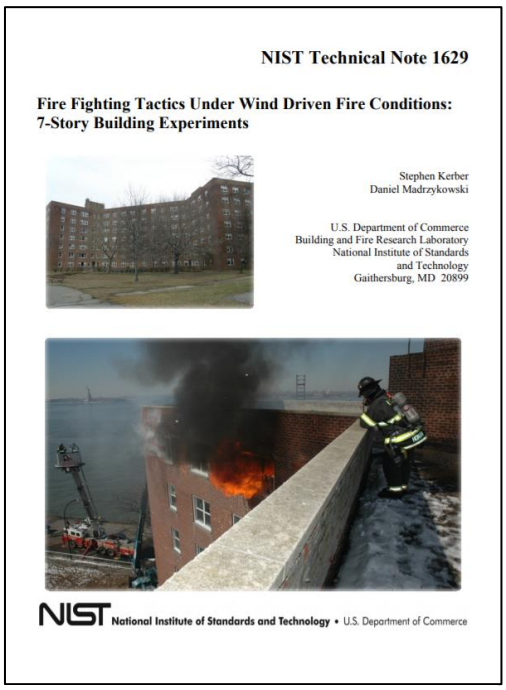

figure 5 Report by NIST on firefighting tactics at wind driven fires *(© NIST)*

In 2009, NIST of the US published a report on firefighting tactics at wind driven fires. The report came after about ten experiments were performed in an abandoned apartment building in New York the year before. During the time leading up to those experiments, NIST researchers had discovered that wind could have a terribly dangerous influence while fighting a fire. The report described things such as *Wind control devices* and *Floor below nozzles*.

The September issue of *De Brandweerman* in 2010, listed the third article in this series which discussed these solutions at length. The same was done in the book *Fire dynamics: technical approach, tactical application*, which was published the year after. The sharing and spreading of this knowledge – first in English, and afterwards in Dutch – has not resulted in the implementation of any solutions for fighting wind driven fires.

Yet wind driven fires do happen on occasion in Belgium. The previous issue of *De Brandweer M/V* had a section on this: Geert Phyfferoen and Wim D'haeveloose described their experience with such a fire in Waregem. Bart Gielen faced a similar fire in Antwerp. The fire service of Antwerp has recently added the smoke stopper to their engines. During the wind driven fire, Bart Gielen utilized the smoke stopper with success. Both fires however, proved to be a challenge for the crews and were not without risks for the safety of the firefighters involved. All three of the company officers who wrote the articles and were at the fire, are all of them CFBT instructors. On top of that, they are known in the firefighter community as excellent officers. It may be safe to say that they have more knowledge of fire behavior and firefighting tactics than the average company officer. Even though they properly recognized the dangerous fire conditions as wind driven, none of them had access to the tools described in the NIST report of 2008. Ten years after valuable experiments that are also relevant to our context, the Belgian fire service has done nothing.

5 Conclusion

Something is happening worldwide in the area of fire behavior and firefighting. Several different countries have realized that a change is needed. We need more knowledge and expertise. Substantial funds are allocated towards firefighter research. But not so much in Belgium. Our Ministry of Domestic Affairs has to take up its responsibility. Funds and resources should be made available for this. This article therefor calls on minister Jambon to do what is necessary.

All of the research worldwide is generating results. Some of these results are readily applicable in Belgium, others need to be thoroughly reviewed first because some of the parameters differ immensely from our situation. There need to be people working on this.

Knowledge first has to be shared among the Belgian fire service. Then there has to be some form of obligatory compliance, so that fire departments innovate and implement the scientific knowledge into practice.

The NIST report on wind driven fires is an excellent example of research that was very costly, has perfect relevance for the Belgian fire service, but so far has been implemented nowhere. So again, we need initiatives for this…

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Karel Lambert