

1. Fire behaviour regarding new building materials and inventory composition

Introduction:

Recent studies in the United States from Underwriter Laboratories and NIST show that fire behaviour in modern family dwellings have changed over the past decades due to a change in use in materials used. Over the past decades the use of artificial materials like PUR and EPS has increased, inside the home as well as for building materials. Fire behaviour has therefore changed, and has introduced new dangers for fire fighters. Ventilation controlled fires may more often occur, and the use of sandwich panels introduced the new phenomenon of the building itself being on fire.

The standard temperature-time curve for fire development is not valid to describe modern fires nor can it be used to determine intervention or tenability. We believe that this curve should be replaced by a more realistic model to predict fire and smoke spread.

Field of interest / working on:

In The Netherlands we would like to know more about this, and we will use the knowledge to innovate our fire fighting techniques.

Therefore we plan to carry out research into standard fire scenarios, and look at fire spread, the effect of various fire fighting techniques, and tenability of occupants and fire fighters.

We will combine information from field experiments (our own as well as those carried out in other countries), Fire safety engineering (simulations) and real fire investigations.

We are working on a model to describe fire and smoke spread in buildings which is based on a combination of risk models and the bow tie model. We call it the "cascade model".

An abstract of the proof of concept of the cascade model is available (1)

2. Fire investigation and evaluation results

Introduction:

In the Netherlands we have an active fire investigation team which is collecting a valid set of data on fire causes and fire spread. Focus lies on domestic buildings, but also fires of special interest are investigated. We work according to a research plan.

Field of interest / working on

We are interested in fire investigations and evaluations of fires where special phenomena were involved regarding fire fighter safety and prevention measures.

A report on the evaluation of the fire in De Punt where three fire fighters died is available in English

3. Fire fighting tactics and techniques

General Introduction :

As the fire behaviour has changed over the past decades, fire fighting techniques may have to be innovated based on the newly gained knowledge. The trend can be observed that smoke constitutes a bigger danger to fire spread, occupant tenability and to fire fighters. The fire itself seems to be less interesting than the smoke. New fire fighting techniques and tactics can be developed.

a) Tactics; development of new doctrine and new tactics

Introduction:

After a major fire in a boat shed where three fire fighters died, the statement was made that the predominant tactics of inside offensive attack might not always be the most safe and effective way to approach a fire.

Field of interest/ working on:

At the moment The Dutch Fire Service Academy and Fire Services are in the process of developing a new doctrine, in which there are four predominant fire approach tactics: offensive outside (new), offensive inside, defensive inside (new) and defensive outside. All four tactics can be viewed in relation to newly obtained knowledge and new possibilities of fire fighting.

b) Fire Fighting Techniques

Introduction:

To support the development of the new fire fighting tactics we are carrying out experiments into new fire fighting techniques.

Field of interest / working on:

We are investigating the effect for use in an offensive outside attack of (e.g. a combination of) fog nails, cold cutting techniques, ventilation techniques and pressurised foam.

A first series of experiments has already finished . A next series of field experiments is planned, en over the next two years we have planned 5 series of field experiments. We plan to combine these experiments with simulations. We would like to have simulation models that are able to predict fire behaviour in relation to our new intervention techniques.

The report of the first set of experiments is available in English

c) Reducing the effect of Smoke clouds from major fires

Introduction:

Over the past, nobody was really interested in the smoke clouds. The Fire Service would perform measurements and it is known that only the combustion gases would be measured, and not the particles or aerosols. Communication to citizens would be: no harm expected. We would just follow where the smoke cloud goes, and advise to stay inside or close windows. Nowadays, especially after a big fire in a chemical plant, we know that the environmental effect of trying to extinguish the fire or smoke deposition can be tremendous, and the subjective safety of citizens might not be in proportion with the real danger.

Field of interest / working on:

we started an investigation into the possibilities of reducing the extent of the smoke cloud. To keep it as small as possible, or to let the smoke raise towards the inversion layer as long as possible. Possibilities we are looking at:

- a) can we blow oxygen or air into the fire with turbines (small and big ones) to keep it hot (and plume rising) and limit partial combustion;
- b) can we deposit the smoke using turbines with water injection (like the Turbolöscher)
- c) can we extinguish the fire quickly by putting sand or ice on it
- d) can we direct the smoke or confine the smoke by placing curtains
- e) can we deposit the smoke by applying electromagnetic fields

We expect to have a first result of this studies end of 2012.

d) Variation of unit staff

Introduction:

In the Netherlands we have a standard first attendance unit (pump) with 6 fire fighters. In some rural regions where we work with retained fire fighters, it is very difficult, especially in daytime, to have these 6 fire fighters available. Therefore it is of interest to find out if it is possible to work with less fire fighters on the first unit. It is already shown, that most of the incidents require less staff, but ofcourse the discussion is about building fires related to inside attack. We think that innovation of our SOP's and using modern techniques, the same work can be done with less staff. During the experiments we found out that there may be a large difference between the objective quality of the tasks being performed and the subjective experience of safety of the fire service personnel.

Field of interest / working on:

In many places in NL experiments are being performed with 2 or 4 people staffed rapid intervention vehicles. We are interested in experiments in other countries, and we are interested in SOP's which need less staff.

We plan to carry out scientific experiments into task versus risks at different scenario's, taking into account new techniques and tactics. We also plan to do research into the basics of objective and subjective safety felt by fire service personnel.

4. New phenomena

Field of interest:

We are interested in research into new fire phenomena. The phenomena we know of now are:

a) solar panels.

How to fight fires, how to improve safety aspects for fire fighters but also what kind of regulations are necessary at the national as well as the European level to improve fire fighter safety and fire initiation in these kind of new consumer products;

b) plastic pressurized containers:

these kind of containers are increasingly used, we do not know how they behave in a fire and how to maintain fire fighter safety. We have had some first fires involving these containers and they seem to tear faster than metal pressurized containers;

c) electrical cars:

we have had some first fires, and it seems that extinguishing lithium batteries is a challenge.

d) Sandwich panels:

we have seen that the application of sandwich panels which are built up from metal sheets with PUR or EPS as an insulation material can cause the building itself to catch fire. Also we have had some fires where EPS is used as an insulation material in the roofs, in combination with roof structure. Pyrolysis products from EPS seem to spread throughout the building and can cause fire spread in unexpected places. Fire fighting in this situation seems to be more dangerous. However, we have discussions with industry about the question if fire spread in this situation is caused by these materials. We are interested in information about this, and we plan to do experiments.

e) The Risks of using LNG as a fuel for trucks:

Proposal for this study is being written at the moment.

f)

5. Fire fighter safety and health

Introduction:

In general our aim is to improve fire fighter safety. We do not accept more fire fighters to die in a fire or in the line of duty as being a risk accompanying the job. Therefore we would like to know more, and are developing methods to predict dangers like Bleve's and smoke gas explosions. Also we would like to know more about human factors related with the job. Right now we are working on or would like to have more information about:

Field of interest / working on:

a) health issues related to inside attack,

preventive measures related to life style regarding the work load;

We finished an overview article on this subject with predominantly English literature.

An abstract of this article is available (2)

b) contra measures like rehabilitation

measures to be performed after inside attack to prevent heat effects on humans, and practical measures

c) effect of fire extinguishing water:

There have been several fires recently in The Netherlands in industrial buildings where fire fighter gear was contaminated. Also questions were put regarding the effect of environmental pollution of this water to fire fighters working in that area. From this point we think that fires in industrial buildings (and maybe even every fire, regarding the change in use of materials) should be seen as a hazardous materials fire, which means that the doctrine should be changed, and decontamination is necessary after every fire. We would like to know more about the effects of polluted water.

d) sensors to predict fast fire spread phenomena

We are working together with private parties in order to develop a sensor which can be used by the first responding unit to a fire to predict if it is safe to enter the building. We

use the CFBT model to develop this. The project is called "Kerry the firedog".

We expect first results at the end of 2012.

e) sensors and option to predict BLEVE from a safe distance

We have had a major hazardous materials fire on a railway emplacement. One of the trains could have contained LPG, so there was a real change of BLEVE. Fortunately it went ok, but our fire fighters felt a moral duty to act, while they knew it could be dangerous. To prevent this kind of situation in the future, we investigated options to measure the probability of a BLEVE from a safe distance. The investigation report is finished.

At this moment we have planned meetings with industry to work out the recommendations of this report.

An English abstract is available. (3)

f) sensors and options to predict building collapse and fire spread from a safe distance

The same we did for possible fire spread and collapse of complex buildings.

An abstract of this investigation is available (4)

g) unmanned intervention

Introduction:

We think that a shift of paradigm is necessary and possible. Over the passed decades the fire service always reacted on new dangers by improving or extending the personal safety gear of fire fighters. We think that regarding new technologies, we should try to find ways to keep our personnel away from possibly unsafe situations. Unmanned equipment could be used for this purpose.

Field of interest / working on:

We are developing robots and unmanned flying vehicles to go into unsafe areas. We are interested in developments in other countries.

h) Influencing behavior of car drivers when confronted with emergency vehicles'

In 2011, NIFV conducted an exploratory study into the current and desired behavior of car drivers, when they are confronted with emergency vehicles. In this project, preliminary advice for car drivers were stated. It was also found that there are different opinions between and within police, fire and ambulance organizations on how a driver of an emergency vehicle should behave in specific situations.

In 2012, NIFV conducts a follow-up study on how the interaction between car drivers and emergency vehicle drivers can be improved.

An abstract on this topic is available (10)

i)

6. Tenability and statistics in the home environment

Introduction:

The Dutch Fire Academy has carried out statistical research into fatal domestic fires to find out causes and main factors of interest to reduce the number of fatalities. This research is continued since 2008 and still going on.

Furthermore, a literature study is written with research from abroad.

An abstract of this studies, as well as a report in English is available (6)

7. Fire safety engineering and application to fire suppression

Introduction:

In the past, Fire Safety engineering and models are predominantly used to predict fire prevention measures in complex buildings.

Field of interest:

We would like to apply and adapt the models to predict also inhabitant tenability and the effect of fire fighting interventions. This seems to be a rather new field of interest.

8. Underground parking lot fire spread

Introduction:

There is a lot of discussion about fire spread in underground parking lots. New materials applied in mobile industry induced questions about the validity of the models presently in used, and consequently about the fire prevention and fire spread measures that are presently used for underground parking lots.

Field of interest:

We are interested in research about this topic, and it seems that The Netherlands is not the only country where this topic is of interest.

An abstract of a study into fire scenario's in parking lots is available in English (8)

9. Command and control procedures

Introduction:

In The Netherlands we have a hierarchal command and control system with one headed leadership. During major incidents it shows that this system is in fact defective and is adapted momentarily. Informal surplus officers arrive at the scene and are assigned to tasks. It is felt by the officers in charge that during major incidents, especially when the comprise large areas, the tasks of the leader are to large, overview is difficult to keep overview, and tunnel vision is hard to prevent.

Field of interest:

Are these problems felt in other countries, and how can we solve this problem by adapting the command and control structure.

10. Culture and cultural aspects of implementation of new techniques

Introduction:

In many countries new knowledge, tactics and techniques is developed for practical use by our fire fighters. We see that even in those countries that are most active, it is very difficult to implement this new knowledge, and in fact fire fighters keep on working according to ancient methods, which are taught not by the educational system,

but by social learning processes.

Field of interest / working on:

We would like to know more about the dominant learning and educational processes in the fire service. We think that culture is a major factor in this, and we plan to investigate this. We are carrying out some experiments within the frame of implementing our new vision of the fire service, by storytelling, bringing people together to talk about innovations and creating new stories.

11. Citizen behaviour and resilience in case of CBRNE contamination

Introduction:

At the moment research programs regarding major CBRNE contamination is mainly focussed (even at the European level) to find out how to decontaminate large groups of people. We can see containers with showers and tents everywhere. Large investments are made into purchasing this equipment. We believe that public will not wait for the showers to be ready, and we think that in reality another process will show than is anticipated.

Field of interest:

How will people in reality behave in circumstances of large containments and how can we anticipate this.

12. Public resilience and citizen participation in general

Introduction:

We believe that in major crisis situation emergency organizations will need the help of the public. From research we know that citizens will act, and not flee. Besides we believe that citizens will have to act more independently of emergency organizations in case of domestic fires. Furthermore we would like to enhance citizen participation in normal incidents and communication with special risk groups. We think that a bottom up approach towards citizen initiatives may help improve safety awareness.

This will also need a different approach of fire service personnel, who until now tend to send away the public.

Field of interest:

We would like to know more about how to improve public resilience and how facilitate this process. We are also interested in knowing if there is experience on the subject of connecting to citizens to improve participation and safety awareness.

13. Risk groups regarding fire in the home environment and how to communicate with these groups

Introduction:

We would like to reduce the number of fires, the number of fire death and casualties. We think that fire discriminates. Certain groups have a higher probability of domestic fires than others. Social factors may be more important than physical factors regarding the probability of fire. We also think that these groups need special communication strategies to reach them for educational and preventive measures.

Field of interest / working on:

We are performing research into the groups that are most at risk in different environments and how to communicate with them. Also we carried out some experiments into the effectivity of communication and stimulate fire safe behaviour of

youth, students, elderly people and socially deprived people as well as how to inspire our fire fighters to do community safety activities.

[We expect a first report on this: domestic fire social risk map at the end of 2012](#)

14. Domestic sprinklers

Introduction:

We believe that domestic sprinklers in every home in NL would introduce a new era in fire safety. Eventually we would like every home in The Netherlands equipped with a fire sprinkler, but at least all homes where people who are most at risk to die in a fire live (elderly people and people who mentally or physically disabled) The trend in The Netherlands is that there will be an increase of this group living independently. We expect that fire casualties will increase, unless we equip the home with sprinklers. However, sprinklers are still expensive, and difficult to retrofit. A specially designed sprinkler head which can work on low pressure and low volume could help.

Field of interest / working on:

We are working on developing new sprinkler systems with the objective to make them easily applicable to the domestic environment. A first research into this subject has been carried out in cooperation with technical university and private parties.

[An English abstract is available, and also the report is available in English \(7\)](#)

15. Fire resistant upholstered furniture (and mattresses)

Introduction:

From the results of our research into fatal domestic fires a clear relationship between fire spread (and the cause of fatalities) and upholstered furniture appears. This is confirmed by research in the UK. We would like to implement European or national regulations on the fire resistance of upholstered furniture.

Field of interest / working on:

We are interested in more data on this relationship from other countries, and experiments on this topic. We are working on a public and political campaign at the national level as well as European level to achieve regulations to be made.

16. Volunteer / retained fire fighters now and in the future

Introduction:

In The Netherlands we see that finding and binding retained fire fighters is increasingly difficult due to increasing demands and educational loads, but also due to the increasing average age. We are working on finding new ways to find and motivate citizens to join the fire service or to carry out activities connected to the fire service (e.g. community safety activities). We believe that retained and volunteer fire service personnel will improve resilience and safety awareness. In our vision we try to differentiate in tasks (e.g. by recruiting new people only for specialist tasks, and thus reducing the number of tasks for the general fire fighters) and find new people for new tasks.

Field of interest / working on:

We are working on a new vision on volunteer / retained fire fighter personnel. We are doing research into the “psychological contract” of existing and possible new groups of people already employed by the fire service, or maybe employed or maybe even not be employed, but just connected to the fire service. We are interested in results and visions

of other countries that may help us fill in our questions.

17. Risk based fire prevention

Introduction:

In our new vision of fire safety we say that we have to pay more attention to the fire prevention, and reduce the probability of fires to ignite. In addition, presently we predominantly check if building regulations are being met in building plans. Our fire prevention is rule based. We would like to make a shift towards risk based fire prevention, and at the same our fire prevention officers developing from inspection towards knowledge based advisors and directors of fire safety . We think Fire Safety Engineering can play a dominant role in this process. However, the actual process of adopting and implementing the risk based philosophy seems to be hard.

Field of interest:

We would like to know more about experiences in other countries in this field.

18.