Report
Evaluating the use of a
Fire Fighting Helicopter
in the Netherlands
This report, evaluating the use of a Fire Fighting Helicopter in the Netherlands, was carried out by the Netherlands Institute for Fire Service and Disaster Management (Nibra) at the request of the Fire Fighting Helicopter Project Group in the Netherlands. The report is a translation of the Dutch report ‘Evaluatie van de pilot ‘Helikopterblussing Nederland’.

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Preface

The Netherlands Institute for Fire Service and Disaster Management (Nibra) provides a key source of expertise, developing and sharing knowledge in both fire service operations and disaster management. Evaluation projects in both areas form an important part of the activities of the Nibra research team.

Innovative ideas regarding fire fighting, could form an important contribution towards improving the way we currently deal with fires. New methods of extinguishing fires more quickly could improve efficiency and decrease the risk to personnel.

In addition, risks in society are rapidly changing, fires in complex and high-rise buildings are increasingly more difficult to deal with. This prompted the Project Group in 2000 to evaluate the use of a Helicopter equipped with the IFEX-system, to establish whether its use would add value when fire fighting in buildings that are complex or with difficult access.

Nibra contributed to this project by evaluating the results of the tests undertaken during the pilot project.

We trust that this evaluation will provide a useful and constructive contribution when considering the implementation of a fire fighting helicopter in the future.

Arnhem, May 2002
Table of contents

Abbreviations 06

1 Introduction 07

2 Aims and objectives of the pilot project 09

3 Outline of the evaluation 11

4 Evaluation of each attack 13
   4.1 Exercise at Nederhorst den Berg 15
   4.2 Fire in a warehouse containing paper 17
   4.3 First real attack at the fire at Leusder Heath 19
   4.4 Fire in office building Ballast Nedam 22
   4.5 Dune fire in Velsen 22
   4.6 Roof fire VNU building in Hoofddorp 23
   4.7 Barn fire in Oterleek 25
   4.8 Fire in the restaurant of Hotel Akersloot 27
   4.9 Three exercises in the ‘Bijlmer’ 28

5 Technical evaluation 31

6 Overall evaluation 35

ATTACHMENTS

Attachment 1 Background information 49
   B.1 The extinguishing effect of water 49
   B.2 The IFEX-system and the helicopter 50
   B.3 The development and lead in to the project 50
   B.4 Preparation of the pilot project 52
   B.5 Carrying out the pilot project 53
   B.6 The fire fighting helicopter 55
   B.7 The Operational tactics and procedures 58

Attachment 2 The Attacks 63

Attachment 3 Participants 73

Attachment 4 The trial area 75

Footnotes 77
Abbreviations

The following abbreviations will be used in the report:

IC  Incident Commander (Fire Officer in charge of fire fighting operations at the scene)
KLPD  Korps Landelijke Politiediensten (National Police Services Agency)
OPS  Operations (The National Police Aviation Authority)
PLD  Politie Luchtvaardienst (National Police Aviation Authority)
1 Introduction

In 1997 an innovative way of fighting fires was devised. This involved equipping a helicopter with an experimental extinguishing system (IFEX-system, developed in 1994) and provided a new way to fight fires in high-rise or complicated locations. Having been equipped, the helicopter was technically fit for fighting fires but had yet to be operationally tested.

By the end of 1997 the Chief Fire Officer of the Maarssen Fire Brigade took the initiative to set up a pilot project for the fire fighting helicopter. The objective of the fire fighting helicopter was “to provide support to the fire service when dealing with fires in high-rise buildings or fires in locations which are difficult to access” (see protocol attachment 1, section B.7).

The pilot project was unique as it was the first to assess this combination of equipment in operational situations. Many participants were involved in the project providing financial resources, specific expertise, equipment and by creating support for the practical benefits of the helicopter.

The participants were:
- The College of Chief Officers of Regional Fire Brigades (CCRB)
- European Commission
- Royal Netherlands’ Association of Fire Brigades (KNBV)
- Police Aviation Authority of the National Police Services Agency
- Fire Service and Crisis Management Directorate of the Ministry of the Interior and Kingdom Relations
- Orgainfo Advies en Management (consultancy)
- Maarssen Fire Brigade
- The Civil Aviation Authority of the Transport and Water Management Inspectorate
- Royal Naval Institute (Academy) in Den Helder
- AMEV Nederland (Insurance company - main sponsor)
- the Elf Provinciën (property developer)
- Waterleidingbedrijf Midden-Nederland (Water company)
- Netherlands Institute for Fire Service and Disaster Management (Nibra).

Their input, together with the co-operation between police force and fire service, has made this an exceptional pilot project.

By the end of 1999, which was later than originally planned, nine of the representatives above signed an agreement to co-operate in the pilot project. In the agreement they formally declared their commitment to take part in the project that became known as the ‘Fire Fighting Helicopter Netherlands’. The pilot project commenced on 3 April 2000 and was concluded on 3 October 2001.
The Netherlands Institute for Fire Service and Disaster Management (Nibra) evaluated the pilot project and has presented the resulting conclusions in this report. This evaluation sets out to establish whether the use of a fire fighting helicopter is an effective way to support fighting fires in high-rise buildings and whether it could form a useful addition to fire fighting equipment in the future.

It has to be emphasized that research has been done the fire fighting helicopter concept as a whole. That is to say the combination of the helicopter and the IFEX-system. The operation of the IFEX-system on its own has not been a part of the research carried out by Nibra. Therefore an opinion has not been given regarding the system in this evaluation.

The evaluation was carried out in co-operation with the Police Aviation Authority of the National Police Services Agency (PLD).

**Structure and contents of the report**

The evaluation consists of three parts

- Evaluation of operational use (chapter 4 and attachment 2)
- Technical evaluation (chapter 5)
- The overall evaluation of the pilot project (chapter 6).

Chapter 6 contains the overall conclusions of the evaluation and can be read in isolation as a summary.

Chapter 2 deals with the objectives of the pilot project.

Chapter 3 describes the methodology of the evaluation.

Attachment 1 contains background information and details about significant aspects of the pilot project. This information might be useful when reading the evaluation.
2 Aims and objectives of the pilot project

The basic principle behind the pilot project is that the fire fighting helicopter would support the fire service in extinguishing fires in high-rise buildings and locations that are difficult to access (see Operational tactics and procedures – attachment 1, section B.7). Support in this context means that the fire fighting helicopter (in theory) will be able to control the fire in first instance until the fire service take over. It was not originally assumed that the fire fighting helicopter would extinguish the fire completely. This aspect is not included in the in the Operational tactics and procedures.

The participants and others were aware before the project began that the fire fighting helicopter would not always be able to provide effective support. The IFEX-system is based on the cooling and smothering effect of water vapour and this system has proved to be more efficient in a confined space than in the open air (see attachment 1, section B.1 en B.6) these circumstances would not always exist.

It was agreed that the National Police Aviation Authority (PLD) would adopt a flexible approach regarding requests for the fire fighting helicopter. This meant that requests not entirely meeting the aims of the project could still be acknowledged, even in circumstances where the IFEX-system could perhaps not operate at its optimum level (see introduction of chapter 4). By adopting a flexible approach it was anticipated that the fire service would be encouraged to request the fire fighting helicopter. This would enable sufficient mobilization opportunities for the pilot project to be successful.

The evaluation intends to support decision-making regarding the possible introduction of the fire fighting helicopter in specific situations mentioned. Consequently the ‘central question’ in the evaluation is whether the fire fighting helicopter demonstrates added value in cases of fire in high-rise buildings or locations that are difficult to access.

‘Designated’ attacks
In this evaluation a ‘designated attack’ is an attack that meets the objective of the pilot project. Namely the fire fighting helicopter had to support the fire service during (suppressive) fire fighting in high-rise buildings or fires which were difficult to access. Only designated attacks are of importance when determining whether its operational use has been successful. The decision whether to introduce the fire fighting helicopter should be based on the objectives of the pilot project. If the fire fighting helicopter proves to be successful for different reasons, the project group will have to determine whether
the benefits identified make use of the fire fighting helicopter desirable.

The project group may gain valuable information from attacks which do not meet the criteria or are unsuccessful.
3 Outline of the evaluation

Questionnaires
Two different questionnaires were designed for the evaluation. After each attack the questionnaires were sent to the Fire Officer requesting the helicopter and the Pilot and Operator of the National Police Aviation Authority (PLD). At the commencement of the project the questionnaires were sent to the National Police Aviation Authority and several Fire Officers for comment. The demonstration of the fire fighting helicopter in Nederhorst den Berg (see section 4.1) was used by Nibra to validate the questionnaires which, after minor amendments, were ready for use at the first operational deployment on 12 May 2000.

The five main topics for the fire service and the National Police Aviation Authority (PLD) in the questionnaires were:
- Alarm, mobilization and deployment of the helicopter
- Type, location and severity of the fire at the time of the request and during the attack
- Communication, coaching and provision of information
- Use of the helicopter (e.g. influence of the ‘down-wash’ — that is the draught caused by the rotors)
- Opinions regarding the use of the helicopter in general

In the questionnaires for the National Police Aviation Authority (PLD) some additional categories were included:
- Landing zones
- Water intake/re-filling
- Shots using the IFEX-system.

Interviews with Fire Officers at random
Nibra interviewed approximately fifty Fire Officers in general terms regarding the use of the fire fighting helicopter during the pilot project as well as after each attack. The Fire Officers, who where chosen at random, had not made a request for the fire fighting helicopter themselves. The purpose of the interviews was to get an overall impression of the fire service’s opinion regarding the fire fighting helicopter. This was important because it was the fire service who had to make a request for the helicopter. The image the fire service formed of the helicopter, for example through the media, may have an influence on the project’s outcome.

Police Aviation Authority
As already pointed out the evaluation is also based on the experiences of the Police Aviation Authority (PLD). They were closely associated with the project (see attachment 1, sub section B.5.2). The PLD evaluated each attack internally, on some occasions together with the Fire Brigade concerned. The PLD included the
results of their evaluations in the Nibra questionnaires. In addition to the questionnaires Nibra personnel interviewed the pilots, in some cases, after the attack.

Attendance at demonstrations
A number of Nibra researchers attended demonstrations and tests with the fire fighting helicopter in Nederhorst den Berg on 2 May 2000 and in Amsterdam on 18 October 2001 amongst others. By attending the demonstrations the researchers gained a clear understanding of operation of the fire fighting helicopter and practical procedures used.

Video recording
During some attacks video-recordings were made and footage has been used for the evaluation.
4 Evaluation of each attack

In this chapter, divided into sections, the most important conclusions for each attack are provided. The conclusions are based on the questionnaires completed by the Fire Officer, Pilot and Operator, additional interviews with the people involved and available video-recordings.

If a decision is be made to continue using the fire fighting helicopter through a second pilot project or by incorporating the helicopter in to the service, important information could be extracted from the evaluation report to amend and improve the Operational tactics and procedures.

For a more detailed abstract of the attacks see attachment 2. During the pilot project the PLD received many requests from the fire service for demonstrations of the fire fighting helicopter at 'Open Days'. The PLD never agreed to these requests. The exercises and demonstrations that took place outside the pilot project were held at the air base in Den Helder or at locations where there were no risks to spectators.

However, the exercises held on 18 October 2001 were an exception. These exercises were originally planned to take place on 13 September 2001 but were cancelled as a mark of respect following the terrorist attacks in America on 11 September 2001.

Diagram 4.1 contains a list of the attacks included in the evaluation. Column 3 indicates whether or not an attack can be regarded as ‘designated’. As previously explained a ‘designated attack’ is an attack that meets the criteria of the pilot project. Namely, the fire fighting helicopter had to support the fire service during fire fighting in high-rise buildings or fires which were difficult to access. The designated attacks are particularly important for the pilot project to be successful.

It should be re-emphasized that valuable information may be gained from attacks which do not meet the criteria or are unsuccessful.
Diagram 4.1: outline of the attacks

Five ‘designated’ attacks were carried out during the pilot project but only one of them was not simulated.

The following conditions were of importance for a successful ‘designated’ attack:

- The fire fighting helicopter must be functioning correctly, specifically the IFEX-system.
- Optimum conditions are required for the IFEX-system to function correctly. The specifications of the IFEX-system require:
  - The seat of the fire must be accessible and the fire should not be surrounded by obstacles. The fire fighting helicopter has to be able to get sufficiently close for the water cannon to reach the seat of the fire. The extinguishing capacity of the system is based on the fact that the shots of water will reach the seat of the fire effectively.
There should only be short intervals (a few seconds) between each shot. With every shot the fire will be slightly reduced and the next shot must follow quickly. Otherwise the fire will flare up again.

The IFEX-system is based on the cooling and smothering effect of water vapour and this system has proved to be more efficient in a confined space than in the open air.

(see attachment 1, section B.1 and B.6).

4.1 Exercise at Nederhorst den Berg

Description of the fire
On 2 May at approximately 1900hrs, one day before the official start of the pilot project, an exercise with a helicopter took place in Nederhorst den Berg. The area contains a large amount of water (lakes) and the Brigade considered that sailing boats and leisure craft could be classified as risks with difficult access. They wanted to establish whether the fire fighting helicopter could be a useful asset to their fire fighting equipment in such circumstances. The exercise was carried out on the Spiegelplas (lake) and took approximately one hour. The target of fifteen shots was not achieved and the Nibra researchers present at the time decided to include this attack in the evaluation.

A pleasure yacht of approximately 8 meters was set on fire, although initially the fire did not develop large quantities of smoke were produced. The Fire Brigade’s diving team rescued a simulated casualty from drowning near the yacht and shortly after the rescue an explosion on board resulted in a well developed fire. The windows of the yacht were mainly melted away and the hatch was open giving free access to the cabin area. The yacht was moored by two anchors approximately 30 meters off shore.

The fire fighting helicopter was already on its way when a request was made by the Fire Brigade. After six shots the down-wash of the helicopter caused the stern mooring to snap. Shortly after this the second mooring snapped allowing the burning vessel to drift in the direction of the observers. A fire boat, present in case of emergency, quickly extinguished the fire producing large quantities of smoke.

Main conclusions

- ‘Designated’ attack?
The fire fighting helicopter supported the fire service during an attack on a fire that was difficult to access in the suppression phase. The criteria of the pilot project were met and the attack can be regarded as ‘designated’.

The circumstances allowed for optimum use of the IFEX-system. The seat of the fire was accessible as the windows of the yacht were
mainly melted away and the back of the yacht was open. However, the fire took place in a reasonably confined space.

- **Communications between the IC and Helicopter crew**
  During the attack there was no direction given by the IC. According to the Operational tactics and procedures extinguishing a fire may only take place under the direction of the IC, who is in charge during the operation. While the fire being extinguished the IC and the Helicopter crew must maintain direct communication with each other (see attachment I, B.7).

  However, the Helicopter pilot pointed out that it was not useful for the IC to direct the shots carried out by the Operator during the attack.

  The Helicopter pilot was of the opinion that the IC on the ground did not have a view of the location or the fire that could assist the Pilot or Operator. The Pilot suggested that the assessment was best left to the Pilot and Operator in the cockpit to decide how and where shots should be applied. The system is fitted with a camera and display for the Operator to see were the shots had to be fired and the Pilot is too pre-occupied during the attack to communicate with people other than the Operator. (Nevertheless, before the attack the IC should brief the Pilot about the attack strategy, see section 4.6.)

  After the project was finished Helicopter pilots were asked if they shared this opinion. Their response was that they did. This would mean that the attack strategy has to be adjusted to avoid false expectations on the part of Incident Commanders, who would expect to direct operations themselves.

- **Refilling speed versus smothering effect**
  According to the PLD, the refilling speed of the water canons (approximately 10 – 20 seconds) was too slow, this led to a reduced effectiveness of the IFEX-system. With every shot the fire will be slightly reduced in size and the next shot must follow quickly otherwise the fire will flare up again. It was not possible to re-fill quickly enough to reduce the time between shots. This, together with the down-wash of the helicopter, allowed the fire to re-ignite.

- **Distance between helicopter and target**
  The helicopter approached the target at low “taxi” speed when approximately 10 meters away to minimize down-wash. An alternative method was to apply shots from the hover position although this produced a greater down-wash effect.

  The shots were not powerful enough because of the low pressure in the IFEX-system, this meant that the helicopter had to quickly approach the target and to hover approximately 5 meters away. The seat of the fire must be reached to extinguish the fire effectively. According the specification of the IFEX-system the effective
extinguishing distance is a maximum of 50 meters from the target. The helicopter had to stay close to the yacht and there was an adverse down-wash on the fire and the yacht. The beneficial effects of the low speed approach method was not achieved in practice.

The other attacks have proved that the effective distance is a maximum of 15 meters, in which case there will always be a negative effect caused by the down-wash of the helicopter.

Apart from the IFEX-system and the Helicopter crew there was still some carrying capacity left for water/additives and fuel: 50% fuel, 200 litres of water and 25 litres of additives (see attachment 1, sub section B.6.2). The limited amount of fuel had an effect on the flight time. The helicopter could not be permitted to stay in the air any longer than was strictly necessary (see also section 4.6).

- Opinion of Fire Service personnel
After the exercise the fire service personnel involved were interviewed with regard to the attack. Their opinion was not a very positive one. It became clear that they expected the fire fighting helicopter to put the fire out after a few shots. As this did not happen this raised doubts about the effectiveness of the extinguishing method.

4.2 Fire in a warehouse containing paper
On 12 May 2000 a blaze took place in a warehouse containing paper in Purmerend. The Fire Brigade dispatched a company of 8 fire engines. The warehouse burnt down completely. At 4am the Fire Brigade made a routine request for the ‘heat’ helicopter. This helicopter is used to locate the seat of the fire or to establish the development of the fire. The request was made between midnight and 6am and during this period the PLD personnel are not physically present at the air base, but are on call. This meant that it would take at least an hour before the helicopter could leave the air base. After discussion with the IC it was decided to cancel the request, as by this time the fire was practically under control.

At 6.40am a message was sent that the fire was under control. The IC decided to make a second request for the fire fighting helicopter to test the penetrating ability of the IFEX-system on the paper mass (actually the Fire Brigade wanted to test the IFEX-system and not the fire fighting helicopter). The PLD complied with this request despite the fact that the attack would not meet the criteria of the pilot project (no high-rise building or location with difficult access). Also the circumstances for an optimum use of the IFEX-system were not present (accessible location, enclosed fire). The reason why the PLD complied with this request was that it would be an opportunity to test the Operational tactics and procedures. There was no emergency at the time the helicopter was requested and the helicopter did not immediately turn out to the fire.
When the helicopter arrived at the scene the paper mass was still smouldering. The mass was about 6 meters high with a surface of approximately 40 meters by 70 meters.

The Fire Brigade allocated and prepared the landing zone where the helicopter had to touch down after arrival. After arrival of the helicopter the crew and the IC discussed the attack strategy and it was decided to apply two shots with pure water, two with additives (Coldfire) and two 'double shots' (this means that two shots from both canons were applied at the same time).

Main conclusions

- 'Designated' attack?
The attack in Purmerend shows that the PLD adopted a flexible approach regarding mobilization (see chapter 2). As it was clear that the attack did not meet the criteria of the pilot project. There was no fire in a high-rise building or on a location which was difficult to access. Also there was no open fire still burning. The helicopter has only been used to test the penetrating ability of the IFEX-system and not to assist during the suppressive phase of a fire.

At the commencement of the attack the PLD and the IC suspected that the fire fighting helicopter would not add value in this situation. This was confirmed during the attack.

Consequently the attack could not be considered as 'designated'.

- Down-wash versus effectiveness
The effect of the shots was mainly noticeable in the centre of the burning surface area, especially when the shots with the additives were applied. The fire flared up again after the shots, even in places where before the shots the paper was only smouldering. This was caused by the down-wash of the helicopter. As a consequence, the beneficial effects of the shots were not achieved.

The IC observed that the down-wash restricts the usefulness of the fire fighting helicopter.

- Withdrawal of personnel
The IC pointed out that the use of the fire fighting helicopter in an emergency situation in the future will have a negative effect on the continuity of operations because of the need to withdraw personnel when it is in use. This will slow down the operation.

- Publicity
The media were not very positive in the way they reported the attack, omitting a few essential principles. It was not clear in the news coverage that it was an exercise enabling the fire brigade to test a few aspects of the fire fighting helicopter. It had been established that this exercise was not a 'designated' attack according to the aim of the pilot project. However, the media conveyed the
impression that the attack was real: “the helicopter was used to speed up the extinguishing process.” This was a totally wrong assumption (for example: “the test in the open air went all wrong”) and was not viewed in the proper context. It is remarkable that the press at the scene did not attempt to interview the participants.

It could be questioned whether it is desirable to carry out attacks when it is obvious beforehand that the fire fighting helicopter will not add any value. Perhaps it would be preferable to regard this attack as an exercise. The participants, who were clear about the aim of the exercise, would probably agree. During the attack in Purmerend it was demonstrated by the PLD and the IC that the fire fighting helicopter had nothing to add when used for extinguishing a smouldering fire in the open air. Such results can, however, be of importance for the pilot project. In addition to an opportunity to practice the operational and strategic tactics the attack produced important technical data for the PLD.

It is questionable if the experience gained from the exercise is outweighed by the negative publicity. This will not improve the perception held by the fire service who, in general, is very sceptical about the fire fighting helicopter. This became clear during the interviews held. The fire service sees its suspicions proved, however for the wrong reasons: “the fire fighting helicopter has no additional value.”

• Additives
As will be discussed in relation to the attack at the Leusder Heath, the use of additives proved to have a more positive effect compared with pure water. Nevertheless, it was decided fairly shortly from the start of the pilot project to stop carrying additives. As a whole, the benefit of additives proved to be limited. It became clear that the additive ‘Coldfire’ and also the ‘ox blood’ had a negative influence on the effectiveness of the IFEX-system (see chapter 5, technical evaluation). In view of the fact that the balance between the fuel, water supply and additives had an effect on the available flight time it, was decided to stop carrying additives but more fuel and water instead. After the third attack (the heath fire at the Leusder Heath) the fire fighting helicopter no longer carried additives (see attachment 1, B.6.2).

4.3 First real attack at the fire at Leusder Heath
On 12 May 2000 the fire fighting helicopter was used for the first real attack. At the end of the afternoon there was an outbreak of fire at the Leusder Heath. While en route to the incident, the first commanding officer from the Leusden Fire Brigade requested the attendance of a specialist unit of vehicles designed for forest and heath fires.

After a discussion between the IC from the Leusden Fire Brigade and the Senior Fire Officer of the Amersfoort Fire Brigade, at 1718 hours a request was made for the fire fighting helicopter. The request
asked for the fire fighting helicopter to locate the seats of the fire and to extinguish them immediately. The Senior Fire Officer made this request as it was difficult to gain access to the area, particularly for heavy fire appliances. Also, there were no accessible water supplies for fire appliances in the area. The PLD were informed at the time of the request that there was forest/heath fire with a surface of one kilometer square consisting of several seats. The request was accepted by PLD.

When the fire fighting helicopter reached the location (at 1742hrs) the indicated area turned out to be far smaller than reported. The affected area was 150 by 150 meters. The “fire under control” message had not been sent but the fire was quite manageable due to natural features of the area having a positive effect. The fire was surrounded on three sides by areas of sand causing a natural break and preventing the fire from spreading. There fire itself was quite small but produced large quantities of smoke.

At the scene a request was made for the helicopter to land, to enable the IC to make a reconnaissance flight. As the fire was almost out by this time it was no longer necessary to use the fire fighting helicopter to extinguishing the seats of fire. However, the IC pointed out that the Fire Brigade was not able to reach the tops of trees and it was decided that the helicopter would be used to keep the tops of the trees wet as a preventive measure.

**Main conclusions**

• ‘Designated’ attack?
Ultimately the fire fighting helicopter was not used according the original request. The fire fighting helicopter did not support the Fire Brigade during the suppressive attack (the request: “to immediately extinguish the seats of the fire”) but only during the damping down phase. Therefore, it is still not clear what contribution can be made or restrictions apply during forest/heath fires or how to slow down or prevent ‘crown burning’. This was not a ‘designated’ attack within the scope of the pilot project. Despite the fact that useful information was gained.

• Effectiveness IFEX-system
It is difficult to make comment with regard to the effectiveness of the IFEX-system during the damping down phase. According to the PLD all applied shots were successful, which meant that they reached the trees. However, this was refuted by the IC. He found that the shots did not reach the trees sufficiently. It is questionable however if the IC was able to draw this conclusion considering the distance fire personnel had to remain during the attack. The preferred attack strategy (applying two shots at the same time) caused a lot of smoke and the PLD was unable to establish the effectiveness of the shots.
• Communication
At the request of the regional control room, radio communication took place via channel 7 instead of channel 10 (this is not in accordance with the Operational tactics and procedures). Initially this led to problems. It must be established in the first instance that communications take place via channel 10 and only switched to another channel later at the scene if necessary.

During the attack it became clear that the PLD and the fire service worked with different geographical co-ordinates when referring to the landing zone. The PLD used the geographic co-ordinates while the fire service worked with the so called ‘RDM co-ordinates’. This explains why the Helicopter pilot could not find the landing zone in first instance. This confusion led to a ten minutes delay.

In the IC’s opinion the Helicopter crew ignored his instructions especially with regard to the approach and location.

• Landing zone
In the first instance it is the fire service who decides the landing zone. In general it is the fire service who are at the scene first (and initiated the fire fighting helicopter project). However, it is the Helicopter pilot who eventually decides whether the landing zone is acceptable or not.

The attack at the Leusder Heath and the attack in Purmerend (see attachment 2, section B.2.2.) have shown that it is hard for the fire service to decide where the landing zone should be and to prepare the zone for the helicopter to land. The fire service is not familiar with the manoeuvrability of the helicopter and the amount of space required. Consequently, the first landing zone identified by the fire service was declined by the Helicopter pilot as it was deemed to be too small and had insufficient space for take-off which could lead to damage.

• Down-wash versus effectiveness
It is remarkable that during the incident at the Leusder Heath, in contrast to all the other attacks, the PLD reported that there were no negative effects brought about by the down-wash. This is probably because the fire had already been extinguished and was too cool to be re-ignited. The down-wash did cause some damage to one of the landing zones during landing and taking off (external seating area of the pancake restaurant, see attachment 2).

• Validity of the initial request
After the incident the IC expressed doubts regarding the validity of the request for the fire fighting helicopter, mainly due to the changing circumstances. As previously explained the fire fighting helicopter was not used for the purpose stated in the original request i.e. extinguishing the seats of the fire.
4.4 Fire in office building Ballast Nedam
On 3 May 2001 – a year after the attack at the Leusder Heath, a request for the fire fighting helicopter was made by the Utrecht Fire Brigade. It concerned a fire in a Ballast Nedam office building under construction (approximately 7 floors, 60 meters high) at the ‘Liebosch’ industrial estate. The seat of the fire was located in the technical area in an extension on the roof.

The fire crew and the IC have a different opinion with regard to the status of the fire at the time of the request. According to the IC it was a severe fire, while the fire crew stated that it was a minor fire already under control. The crew commander managed to reach the fire via the roof. According to the fire crew the fire service wanted to use the fire fighting helicopter regardless of the need, to enable tests to be undertaken.

Ultimately the fire fighting helicopter was not used. The pilot decided against the use of the helicopter at this incident because of the presence of high tower cranes and loose building materials close to the scene.

Main conclusions
The decision not to use the fire fighting helicopter for safety reasons was an easy one to make. The fire service was able to extinguish the fire from the roof, making the use of the fire fighting helicopter unnecessary, there was no emergency. However, this raises the following question: would the risks have been acceptable if the fire service had not been able to extinguish the fire themselves via the roof? In such circumstances the risks for the fire fighting helicopter would have been the same.

4.5 Dune fire in Velsen
On 14 May 2001 there was a small outbreak of fire in the dunes near Wijk aan Zee. At approximately 1500 hours the control room of the ‘Kennemerland’ police made a request to the PLD for the ‘tele helicopter’ to record video footage of the fire. The PLD advised the use the fire fighting helicopter instead. On arrival at the scene the situation was discussed with the Fire Officer. It was not possible to agree on an attack strategy but it was decided that the fire fighting helicopter would assist during the damping down operation. The fire was suppressed and had covered an area of 50 by 50 meters. The fire fighting helicopter applied water for ten minutes, until the supply was used, and left as agreed.

Main conclusions
There are two important conclusions to be drawn. Firstly, the attack can not be classified as a ‘designated’ attack. The fire was already extinguished at the time of the attack and the use of the fire fighting helicopter was not urgent.

Secondly, the fire fighting helicopter was involved in this incident somewhat by chance. The fire service had not requested the fire
fighting helicopter, but instead the PLD had initiated its use. This demonstrates that it is not automatically the fire service who considers the possibility of using the helicopter. On the other hand it is questionable if this was a fire where the fire fighting helicopter should have been used. It was not clear from the information gained from the completed questionnaires whether the fire was difficult to access.

4.6 Roof fire VNU building in Hoofddorp
On 9 July 2001 there was a fire on the roof of the fitness area of the VNU office building in Hoofddorp. The fire, probably caused by roofers who were working there at the time, was accompanied by three explosions (three gas cylinders filled with propane) and was quickly designated a “severe fire”. Two fire appliances and an aerial platform were used to attack the fire suggesting that this was an “average”¹² and not a “severe” fire. It was difficult to gain access to the fire which was in a high-rise building of approximately 25 meters in height.

However, the PLD initiated the use of the fire fighting helicopter. At approximately 1645 hours the PLD “Operations” spotted a substantial plume of smoke. After gathering information at the control room of the ‘Kennemerland’ police the PLD offered assistance with the heat helicopter and fire fighting helicopter. The PLD decided to prepare the helicopters for take off in case they were required by the fire service. Thirty minutes after arrival of the IC (approximately at 1700 hours) a formal request was made for assistance of the fire fighting helicopter and at 1705 hours the helicopter was ready for take off from the air base.

Main conclusions
The circumstances present at this incident were not ideal for achieving the optimum use of the IFEX-system. The location was hard to access as it was in a high-rise building, but at the same time the fire was very ‘exposed’ (see also section 4.2). This meant that a successful attack was difficult to achieve.

• Communications/instructions
There was very little communication between the Helicopter crew and the IC. The IC had asked the crew (via a police officer) to start the attack at the northern side of the building and to move from there towards the southern side. According to the Helicopter crew they were forced to follow these instructions as the fire service is in charge. The Helicopter crew suggested that they had not been able to discuss the attack method with the IC initially, due to the fact that communication with the IC had not been established. This was not without risk. The wind direction at the time of the attack would make the fire move towards the northern side of the building and according to the Helicopter crew was “too strong for the tail”. The IC was discontent about the way the Helicopter crew had carried out his instructions and was of the opinion that they had not done what was required.
It has previously been established that the Helicopter crew does not need instructions from the IC during an attack (see section 4.1). However, the IC must brief the Helicopter crew regarding strategy before the attack commences. Although the fire service is in charge it is important that this is discussed and agreed with Helicopter crew. The attack strategy or the fire fighting tactics may be obvious for Fire Officers but they might not be possible for the Helicopter crew to achieve. In addition, it became clear during earlier attacks that the Helicopter crew has a better view of the fire, particularly when it is difficult to access for the fire service, and consequently is better informed than the IC present.

To exploit the full potential of the helicopter, achieve optimum fire fighting efficiency and discuss the risks involved simultaneously, good communications between the IC and Helicopter crew is absolutely essential.

- Time span between arrival of the helicopter and actual attack
  As previously discussed in section 4.1 the helicopter is capable of carrying a fixed supply of water/additives and fuel: 50% fuel, 200 litres of water and 25 litres of additives (see attachment 1, sub section B.6.2). The limited amount of fuel obviously restricts the flying time. It will not be possible for the fire fighting helicopter to stay in the air any longer than necessary. This issue has been discussed during the instruction days for Incident Commanders.

  After arrival of the fire fighting helicopter the IC required 25 minutes to decide whether the helicopter was needed or not. When the IC had taken the decision to use the helicopter it took a further 15 minutes to enable fire crews to retreat before the helicopter could apply its first shot. The fire fighting helicopter, which had taken off with 50% fuel supply and water for 8 – 10 shots, had been in the air for 40 minutes before applying the first shot and wasted valuable fuel.

  It is clear from the video footage that the fire crew did not make any attempt to extinguish the fire while the fire fighting helicopter was present at the scene. The fire service was pre-occupied with the preparations. This would have been a good opportunity to establish the added value of the helicopter against the objectives of the pilot project despite the fact that this was an open fire. In the Operational tactics and procedures ‘providing assistance’ is intended to mean that the fire fighting helicopter will stabilize the fire, allowing the fire service to extinguish it fully. This is not explained in more detail in the Operational tactics and procedures. However, according to the PLD this implicit assumption was communicated to the fire service during the instruction days (see also attachment 1, section B.7).

- Withdrawal of the fire crew
  After the decision was taken to use the fire fighting helicopter the fire crew withdrew from the building apart from two attack units.
The fire crew received the order to withdraw from the roof and building with disbelief. It was against their natural instincts to let to allow somebody else to do the job and to be on the sideline. Consequently the withdrawal took 15 minutes.

- Technical malfunction of the IFEX-system
  During the attack the Operator had difficulties filling the water canon. Consequently only every other shot was under sufficient pressure. This meant that every other shot had insufficient power and therefore did not reach the seat of the fire. According to the PLD the effectiveness decreased by approximately 70%. The loading time was too long. Loading the water canon should takes approximately 10 – 15 seconds and in this case it took 30 – 45 seconds.

- Down-wash versus effectiveness
  The down-wash of the helicopter caused the fire to spread through wall cavities to the stores below.

- Familiarity with the Operational tactics and procedures
  It is of importance that the fire service and its crew are familiar with the Operational tactics and procedures. The IC wished to be on-board the helicopter during the attack. The Helicopter crew suspected that the IC was not aware of the Operational tactics and procedures (especially where the RLD exemptions were concerned) and had not been trained, as this was discussed during training sessions. This could not be verified with the IC.

- ‘Designated’ attack?
  It has to be emphasized that for various reasons, whether or not deliberately, the fire fighting helicopter was not used to its full capability during the attack.

  However, it could have been a ‘designated’ attack as the fire was in a high-rise building and the helicopter could have assisted the fire service during the suppressive phase of the fire. The failure was mainly due to poor communications (deployment of the helicopter was too late and the fire had the chance to flare up) and intermittent technical problems (one of the conditions for a ‘designated’ attack is a correctly functioning system). There had not been many ‘designated’ attacks thus far and this could have been a valuable chance which was missed.

The Fire Officer eventually decided to let the fire fighting helicopter depart as the down-wash caused the fire to spread to the store below. The fire fighting helicopter did not make a positive contribution towards extinguishing the fire.

4.7 Barn fire in Oterleek
On 3 August 2001 there was an outbreak of fire in a packed barn in Oterleek, municipality of Schermer in the province of North Holland. Nearby, to the east, there was a residential property and on the
north western side, a farm. The barn was surrounded by farmland which was impassable because of standing crops.

There was a severe blaze in the barn and the direction of the wind (southerly, later veering south westerly) increased the risk of fire spread through flying sparks to the farm.

In the first instance four fire appliances and an aerial platform were mobilized to the fire later assisted by a further four appliances. According to the IC it was difficult to gain access, and there was a lack of open water to re-supply the appliances. A request for the fire fighting helicopter was made early in the evening.

It took a long time for the fire fighting helicopter to arrive at the scene, more than an hour after the request was made, and by this time there was no longer an acute situation. This emergency was further reduced by the changing wind direction (south west) meaning that the farm was no longer directly at risk. The barn eventually burned down completely.

**Main conclusions**

- **‘Designated’ attack?**
  The attack did not meet the aim of the pilot project. When the fire fighting helicopter arrived at the scene (more than an hour after the request was made) a message had been sent that the fire was under control. The helicopter could not assist the fire service during the suppressive phase of the fire. It was not, therefore, a ‘designated’ attack.

  Also, the metal roof of the barn had collapsed making it virtually impossible for the fire fighting helicopter to reach the seat of the fire. After four shots it was decided to cease the attack.

  It is questionable if the fire fighting helicopter would have been able to assist if it had arrived earlier. The chances were very slim because of the size and the severity of the fire (see photograph in attachment 2, sub section B.2.6). The priority of the fire service was to prevent the fire spreading to the farm. According to the IC the farm was not damaged because of the use of 8 fire appliances and due to the fact that the direction of the wind changed. Assistance of the fire fighting helicopter would not have been useful during this stage as the 8 appliances and crews would have had to cease their activities to allow the helicopter to operate.

- **Withdrawal of the fire crew**
  A part of the fire crew was withdrawn by order of the Fire Officer. As there was still a small chance that the fire would spread to the farm, the fire service maintained a water curtain between the barn and the farm and kept the surrounding buildings cool. During this operation the risk to the remaining crews increased.
• **Down-wash versus effectiveness**
There were a lot of small burning particles in the air which increased the risk of fire spread and also re-ignition. Consequently, there was an increased risk for the fire crew.

• **Expertise of the crew**
The IC complimented the expertise and skills of the Helicopter crew with regard to their flying and fire fighting expertise.

### 4.8 Fire in the restaurant of Hotel Akersloot
The last request for the fire fighting helicopter during the pilot project was made on 5 August 2001. There was a fire in the restaurant area of Hotel Akersloot. The building was approximately 17 meters high and consisted of four floors. The top floor had a gabled roof. The severe blaze was on the third floor and in the roof space.

Priority was given to the evacuation of the building. Fire appliances and an aerial platform were used. It was difficult to gain access to the fire from the inside and consequently it spread to the floor below. Because of the construction of the gabled roof the fire was also difficult to access from the outside using the aerial platform.

The fire service control room initiated the request for the fire fighting helicopter 30 minutes after arrival of the IC, who was also in charge during the incident in Oterleek.

When the helicopter approached the scene (over a meadow with grazing cows who panicked and started to run) it appeared to the crew that the fire was dying down. However, the IC pointed out that the fire was in fact spreading inside the building and was hard to suppress because of the high temperature.

After discussion with the IC five shots were applied into the opening in the roof which largely extinguished the fire. Subsequently the Fire Brigade was able to damp the fire down.

**Main conclusions**

• **‘Designated’ attack?**
This was the first attack during the pilot project where the fire fighting helicopter supported the fire service during the suppressive phase of the fire at a location with difficult to access. Because of the nature of the fire and the circumstances (i.e. fire in a confined space) the IFEX-system was used to its optimum.

This attack can be classified as ‘designated’ and the fire fighting helicopter provided a positive contribution to fire fighting.

However there are two qualifications.
Firstly, the IC pointed out that the effect would have been the same (although later) without the support of the fire fighting helicopter. If there had been a risk of further fire spread the added value of the fire fighting helicopter could have been better demonstrated.

Secondly, it was not the Senior Fire Officer on scene who thought of making a request for the fire fighting helicopter but the control room of the fire service. The IC, who had received instruction in the use of the helicopter, of all people, should be aware of a possible contribution of the fire fighting helicopter could make in such circumstances.

- Request
  The request has not been made according to the agreed operational procedure on two points. This did not have a negative influence on the attack.

Firstly, it was not the IC who made the request for the fire fighting helicopter but the control room.

Secondly, the request was not complied with by the Flight Commander but by Operations. There was little time left before sunset and the standby crew decided to comply with the request (i.e. a fire in a high-rise building). During the preparations for take off, Operations informed the Flight Commander who decided that the deployment could take place.

- Withdrawal of the fire crew
  During the attack the fire crew had to cease their activities and as a result the fire threatened to spread further through the building.

- Instruction during the attack
  Instruction was been given during this attack which is unlike the other attacks. The crew informed the IC about the results of the shots and the IC was able to correct where necessary. This was a positive experience for both parties.

- Expertise of the Helicopter crew
  The IC praised the expertise of the Helicopter crew once again.

4.9 Three exercises in the ‘Bijlmer’
Unfortunately insufficient ‘designated’ attacks occurred during the pilot project. Therefore, it was decided by the project group ‘Fire Fighting Helicopter in the Netherlands’ that it would be desirable for another exercise to be undertaken by the end of the trial. It was hoped that this exercise would be a useful contribution the pilot project.

On 18 October 200113 three exercises were produced. The simulated incidents took place in three different residences on the 7th floor of a block of flats in the Bijlmer14. All fires consisted of a standard ‘fire load’ (using wooden pallets) of approximately 50
kilograms per square meter, which is similar to an average fire in a living room. An objective of the exercise was to enable the fire fighting helicopter to suppress the fire, bringing it under control and allowing the fire service to damp the fire down. With this in mind all attacks could be regarded as ‘designated’.

The exercises concentrated on simulating the suppressive, fire fighting attack only. Consequently, there were a few issues\(^{15}\) that had not been dealt with and therefore could not be evaluated (alarming, instruction, withdrawal of fire crews, etc). This means that not all of the aspects described in earlier attacks will be mentioned here.

**General remarks:**
- The location was rather difficult to access because of the high trees on the approach route.
- The weather conditions were favourable, there was a light/moderate breeze.
- The area was evacuated.
- The local residents were involved in the preparations for the attack by the fire service.
- A water intake had taken place before the start of the exercise.
- Technically the IFEX-system did not work to its optimum. There were problems with the filling of the canons.
- The distance between the fire fighting helicopter and the building was approximately 10 meters (all exercises).
- Additives were not used.
- There was no effect on the fire caused by the down-wash. The smoke however was blown away by the down-wash.

**Main conclusions**

**First exercise**
The first fire was reported as a minor blaze. It took the fire fighting helicopter two shots to extinguish the fire shortly after it was lit. It has to be said that the IFEX-system did not work well. The time span between the two shots was approximately one minute. It should be emphasized that this was not a realistic situation. Normally, the fire fighting helicopter would not be able to arrive at the scene so quickly after the outbreak of fire. The fire had not yet fully developed in this exercise.

In the evaluation, the IC pointed out that the fire service would have been able to extinguish the fire immediately by normal means.

**Second exercise**
The second fire was also reported as a ‘small blaze’ on two sides of the residence. This fire was more developed than the fire during the first exercise. The fire fighting helicopter applied seven shots of which four shots were successful. This meant that four shots were under sufficient pressure and hit the seat of the fire. After the
successful shots the intensity of the flames decreased immediately. However this was only a short-lived effect.

After seven shots it was decided to cease the attack as there was no visible positive effect (caused by technical problems amongst others).

The IC, as well as the Helicopter crew, were of the opinion that the attack did not have the desired effect. It was the fire service who eventually extinguished the fire with a 38mm low pressure hose line.

*Third exercise*

The third fire was also reported as a ‘small blaze’. The fire fighting helicopter was only allowed to attack the fire after it was well developed. The Helicopter crew tried to apply a shot at the back of the building but this turned out to be impossible because of the large quantities of smoke produced.

After two shots the fire was no longer showing on the outside of the building. Seven shots out of ten were sufficiently powerful to reach the seat of the fire. The fire visibly decreased in size where the shots were applied. The attack was ceased after it became clear that the fire fighting helicopter could not control the fire any further.

The IC and the Helicopter crew regarded the last two attacks as not particularly successful during the suppressive phase of the fire. According to the crew this was probably due to technical faults in the IFEX-system.
5 Technical evaluation

The PLD has carried out a technical evaluation of the fire fighting helicopter in addition to the Nibra evaluation. The PLD evaluation is described in this chapter.

After operating the IFEX-system for 1 year and 6 months the following statistics can be quoted:
- 628 shots have been applied during exercises and attacks.
- The compressor has been operational for approximately 100 hours.
- The helicopter has flown more than 100 hours for training and attacks.

It can be concluded from the above that the system has had sufficient operational use to draw up a well-founded technical evaluation. The following conclusions will mainly reflect the technical results. This part of the report highlights operational considerations that will be of important to the technical conclusion, although opinions have been formed with regard to the actual use of the cannon.

The continuous thread running through the 18 months of the pilot project was the fact that the installation was not user-friendly. In particular the immediate use of the installation seemed to cause difficulties. This appears to be due to two main causes:

- First cause
  The installation’s computer generated very little information regarding its status. This could be partially improved by providing more intensive training during the use of the machine.

  However, an adjustment to the computer system itself could improve the supply of information to the Operator.
  - The Operator is not provided with information while the tanks are filling. As a result, the pump switches off before the tanks are full.
  - It is not possible to see which of the two cannon barrels is loaded. If an empty barrel is loaded whilst the other is full, the system will empty itself and consequently, pressure will be lost.
  - The system can be switched off while the barrels are still loaded. However, it is possible for the system to discharge whilst it is switched off (which happened on one occasion). This is potentially dangerous to anyone situated in front of the helicopter when such an event occurs.

- Second cause
  The design and the construction of the system does not reflect the requirements for use on a helicopter. The level of vibration was such that the following problems occurred in use:
o Detached couplings, low pressure air system (25 bar).
o Detached couplings, water filling system.
o Cracked couplings near the water canon selector.
o Cracked cable on the compressor.
o Aluminum suspension to the front of the installation cracked.
o The barrel locking mechanism caused recurring problems.

Installation weight in combination with the Ecureuil AS-350 B2 helicopter
Apart from the issues listed above, the installation as it stands is not
technically suitable and the combination of the installation with the
chosen helicopter is far from perfect. Particularly in view of the fact
that the installation turned out to be heavier than initial specification
indicated. This meant that a difficult decision had to be made
regarding the ratio of fuel and water that could be carried. It
transpired that operating with a half full tank meant that a maximum
of 6 shots could be applied. After that, fully loading the water canon
(without air) would be difficult. A twin-engine helicopter with a
greater carrying capacity could be a solution under the given
circumstances.

Compressor - installation
The choice of the compressor on the installation is also far from
perfect. The use of a combustion engine (petrol) that is not visible
to the pilot or crew, with no warning indicators, does not fit in the
current philosophy of aviation authority requirements. Furthermore,
the inefficiency of the compressor is such that fully charging the air
tanks (300 bars) takes approximately 45 min – 1 hour. The capacity
needed to keep the large water tanks under pressure was also
significant and, as a consequence, the pressure decreased rapidly
with every shot applied. Because of the decreasing pressure, arming
the canons becomes less efficient.

It should also be mentioned that it is not advisable to start the
compressor from the cockpit, which is theoretically possible. The
cockpit starter quickly malfunctioned as the ‘loading pressure’ in the
compressor had not been relieved. This caused the starter to
overload.

“Snorkelling”
From an operational point of view “snorkelling” might be desirable.
However, in practice this may not be feasible. The tanks have to be
entirely de-pressurized. In view of the fact that it will take a lot of
time to re-charge the entire system, it is uncertain whether
“snorkelling” and the use of a compressor adds any value. Perhaps,
changing or refilling the pressure cylinders while the fire service is
filling the water tanks could be a solution. This would also yield a
considerable reduction in weight.

Additives
The use of additives did not prove to be very effective. It was
reported that an additive suitable for the IFEX-system would be
developed, but this was never achieved. The use of the additive
'Coldfire' turned out to have an influence on the effectiveness of the installation i.e. too much foam was produced. Other additives, e.g. Ox blood, clotted in the separate tanks and consequently influenced the performance of the installation.

**Conclusion**
Technically, the installation must be upgraded to be suitable for use in an aviation environment. There are too many technical deficiencies which adversely influence the usability of the fire fighting helicopter. The installation requires high maintenance. This could be reduced by adopting a higher standard of quality during manufacture. Increasing the quality level could also have a positive effect on the durability (and corrosion resistance) of the entire system. This, in combination with an increased carrying capacity could also improve the helicopter’s usability and effectiveness.
6 The overall evaluation

This chapter provides the overall evaluation of the 'Fire Fighting Helicopter in the Netherlands' project. The objective is to reach a conclusion, assessing the value of the fire fighting helicopter in the situations mentioned in the aim of the pilot project: i.e. to assist during the suppressive phase of fire fighting in high-rise buildings or locations where the fire service has difficulty gaining access. The information gathered during the pilot project will be used to come to an informed conclusion.

This overall evaluation is meant to reach a conclusion. Consequently only the relevant details will be discussed and it is not intended that the evaluation will form a summary analysis of the report. The evaluations of each attack will be referred to (see chapter 4 and attachment 2) as well as the technical evaluation (see chapter 5). Also, the results of the interviews held with the Fire Officers, the Helicopter pilots and Operators of the PLD are incorporated in this chapter.

It has to be emphasized that the fire fighting helicopter as a whole will be evaluated and no opinion will be given with regard to the capability of the IFEX-system on its own.

The overall evaluation can be read independently (which may lead to a slight overlap with the previous chapters).

'Designated attacks'
During the pilot project period (3 April 2000 until 3 October 2001) a total of seven requests were made for the fire fighting helicopter. Six of them were actually responded to. In addition, the helicopter was used four times shortly before the project began to support an exercise (2 April 2000) and at a further three exercises (18 October 2001) after the project had finished. The four mentioned attacks are also incorporated in this evaluation (see also chapter 4). This means that there were ten attacks in total (from 7 requests) and all evaluations were used for this report.

To answer the research question only the 'designated' attacks are of importance. In this report a 'designated' attack is defined as an attack which meets the aim of the pilot project. That is to say that the fire fighting helicopter would provide support to the fire service when dealing with fires in high-rise buildings or fires in locations which are difficult to access. This objective is incorporated in the Operational tactics and procedures (see attachment 1, section B.7).

It was intended that the fire fighting helicopter would provide support and, in theory, would stabilize the fire enabling the fire service to damp the fire down. It was not assumed that the fire fighting helicopter would extinguish the fire. This objective was not incorporated in the Operational tactics and procedures.
During the pilot project the fire fighting helicopter was mainly used to provide assistance, which was not an objective of the pilot project. On three occasions the fire fighting helicopter was used for damping down, which was not an emergency situation. Examples are the attacks in Purmerend, at the Leusder Heath and the dune fire in Wijk aan Zee. The fire fighting helicopter has also been used in fire situations where it was known that the extinguishing capacity of the IFEX would not achieve its optimum effect. (see also paragraph ‘IFEX-system: the circumstances’). Examples are the attacks at the Leusder Heath, the fire in the roof of the VNU building and the dune fire in Wijk aan Zee amongst others.

The fire fighting helicopter was used for the fires mentioned above as the steering committee, as well as the project group, wanted the helicopter to be as accessible as possible. This would motivate the fire service and add to the requests for the helicopter enabling sufficient attacks to be carried out and data gathered. Further to the two first attacks in Purmerend and at the Leusder Heath it was pointed out in newsletter no. 2 (July 2000) that “exceptionally the fire fighting helicopter could be used for different attacks as well if the PLD regarded the attack concerned as a useful experience”. The PLD has always been flexible with regard to requests for the fire fighting helicopter.

**Conclusion**

It has to be concluded that in many occasions that fire fighting helicopter was used for fires where it was clear beforehand that the helicopter could not contribute to the suppression of the fire. On a few occasions the attack did not meet the objective of the pilot project and/or the right circumstances necessary for the IFEX-system. This was confirmed during the operations (see chapter 4, evaluation per attack). Consequently, the attacks received a negative assessment, not just from the Fire Brigade, who were involved in the attack, but also by the media.

Therefore, in hindsight, it is questionable whether requests that did not meet the objective of the pilot project should have been accepted. Despite this fact it is understandable that they were. It is possible that the attacks did not contribute to a positive image of the fire fighting helicopter where the senior officers of the fire services were concerned (see also heading ‘Limited amount of requests’).

The project group estimated that at least five representative attacks could be carried out in high-rise buildings during the pilot project. This figure was based on the geography of the trial area. Eventually, only one ‘designated’ attack was carried out. If the exercises and trainings, which took place outside the pilot period, are included, then five ‘designated’ attacks were achieved (for more details see diagram 4.1).
Diagram 6.1: Number of requests, attacks and ‘designated’ attacks.

<table>
<thead>
<tr>
<th></th>
<th>Excluding training/exercises</th>
<th>Inclusief training/exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requests</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Attacks</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>‘Designated’ attacks</td>
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<td>5</td>
</tr>
</tbody>
</table>

**Diagram 6.2:** Breakdown of the requests per attack during the pilot project.

**Requests** (that is to say excluding training/exercises)

<table>
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<tr>
<th>Purpose</th>
<th>Request made by</th>
<th>Number</th>
<th>Request accepted</th>
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<tr>
<td>Suppressive attack</td>
<td>IC</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Suppressive attack</td>
<td>Fire Service Control Room</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Suppressive attack</td>
<td>PLD</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Test</td>
<td>IC</td>
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<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

**Conclusion**

It can be concluded that the number of ‘designated’ attacks carried was insufficient to give a thorough opinion regarding the possibilities of the fire fighting helicopter providing support during fire fighting.

Useful information was gained from the pilot project to amend and improve the Operational tactics and procedures (and therefore the use of the fire fighting helicopter). However, this will only be relevant if it is decided to continue using the fire fighting helicopter by a second pilot project or by using the helicopter on a structural basis. Sufficient information may then be gained from the evaluations of each attack to improve the Operational tactics and procedures.

Ultimately, two attacks out of ten contributed in a positive way to suppressive fire fighting. This was the real attack in Akersloot and one of the three exercises in the Bijlmer. Both attacks can be regarded as ‘designated’. During both attacks the circumstances were right for an optimum use of the IFEX-system with the seat of the fire accessible but in a confined space. However, the fire service pointed out that the same effect would have been achieved by the fire service without the assistance of the fire fighting helicopter.

**The IFEX-system: the technique**

An important condition for a successful ‘designated’ attack is a fully operational fire fighting helicopter (i.e. with an effective IFEX-system). Under optimum circumstances:

- the shots have to be applied with high velocity at the seat of the fire and of course must reach the seat of the fire
• the shots have to be applied at short intervals of only a ‘few’ seconds. (See also attachment 1, section B.6).

However, the IFEX-system did not operate to its optimum capability during the pilot project. Particular problems included filling the canons and maintaining adequate pressure (see also technical evaluation and the evaluations per attack). This had consequences for reaching the seat of the fire and for quickly applying the shots.

It was assumed that the effective distance between the object and the IFEX-system (see also Operational tactics and procedures) was a maximum of 50 meters. The attacks during the pilot projects made clear that under the current circumstances this was not correct. The average distance during the attacks was approximately 10 – 15 meters from the target. Considerable capacity was needed to keep pressure on the water tanks and this happened at the expense of the shots, which became less powerful. Under these conditions the fire fighting helicopter had to apply shots from less than 15 meters from the target and needless to say, this was not without risk.

On a few occasions difficulties with the power on the system caused a delay refilling between the shots (varying from 10 – 20 seconds up to approximately 60 seconds). In some cases the shots could not bridge the distance between the helicopter and the target and consequently the seat of the fire was not reached. As previously explained, according to the specification, a fire can only be extinguished effectively if a few shots are applied in quick succession that reach the seat of the fire. When a shot reduces the size of the fire, another shot has to be rapidly applied (according to the specifications after 6 – 7 seconds and according to the PLD after approximately 10 seconds) otherwise the fire will get the chance to re-ignite.

Conclusion
The IFEX-system is an essential part of the fire fighting helicopter. A correctly operating IFEX-system is necessary before one can arrive at an objective opinion about the capabilities of the fire fighting helicopter.

In general, it can be concluded that the system did not operate at its optimum during the pilot project. Due to technical deficiencies in the system it was necessary for the helicopter to work in close proximity to the target, which increased the risks (see also heading ‘Safety aspects’). This was not in accordance with the specifications of the system. Due to the technical deficiencies the system could not operate to its optimum. This is one of the conditions for an attack to be successful and could not be met.

Given the amount of attacks and the deficiencies of the IFEX-system it could be said that it is not possible to reach a sound conclusion.
about value of the fire fighting helicopter when assisting during fires. Even so, the pilot project has provided sufficient information to come to a sound conclusion with regard to the added value of the fire fighting helicopter when assisting during fire fighting in high-rise buildings or locations which are difficult to access.

Listed below are few observations and conclusion which must be considered to reach a final judgement.

The IFEX-system: the circumstances
A ‘designated’ attack can be successful if the fire fighting helicopter is working well and if the circumstances are right for the helicopter to operate to its optimum. This has already partially been pointed out under heading ‘IFEX-system: the technique’. An other important aspect of the extinguishing capability of the system is that it is based on the cooling and smothering effect of water. The extinguishing effect is more effective in a confined space than in the open air. This has been confirmed during the pilot project. In the sixth newsletter (August 2001) this was also ‘announced’ to the public: “extinguishing fires with the fire fighting helicopter has a ‘bigger’ effect when the fire takes place in a confined space.”

It is essential that the shots are powerful enough to reach the seat of the fire (see also attachment 1, section B.6). The seat of the fire has to be accessible and consequently should not be shielded by obstacles. This was proved during the fire in the barn in Oterleek. For an optimum extinguishing effect, the fire has to take place in a confined space but where the seat of the fire is accessible. Clearly, these conditions are contradictory and as a result not commonly encountered.

The pilot project demonstrated that the fire fighting helicopter could only successfully deal with fires of a limited size (exercise in Nederhorst den Berg, fire in VNU building Hoofddorp and the three exercises in the Bijlmer). The preparation time required before the fire fighting helicopter could depart (at least 30 – 45 minutes) enabled the fire to develop into a severe blaze. Under such circumstances the use of the fire fighting helicopter is not suitable.

Conclusion
For the pilot project to be successful the fire has to meet the following three conditions:
• the fire has to be small
• in a confined space
• the seat of the fire has to be accessible.
It would be extremely rare for all of these conditions to be met at the same time.

Opinion of the fire service
As previously explained, Nibra interviewed approximately 50 Fire Officers, some of whom had been trained in the use of the helicopter, in general terms with regard to its value. The interviews
took place during the pilot project. The purpose of the interviews was to examine, in broad terms, the fire service’s view of the helicopter formed by factors including media coverage. After all it is the fire service who would make use of the helicopter and their view could influence the project and therefore its future use.

The Fire fighters, who were selected at random, had never made a request for the fire fighting helicopter themselves. Only one indicated that he once thought about making a request for the helicopter but eventually had decided against it. All the others had the opinion that no incidents under their command had occurred where the fire fighting helicopter could have been of value.

It became clear in general that the interviewees were sceptical about the fire fighting helicopter and that they probably would not consider using it. Not even for fires in locations with difficult access. The safety risks being the main reason for them not to use the helicopter. The interviewees expressed doubts about the safe use of the helicopter particularly in city areas. The risks of extinguishing fire by helicopter outweigh the risks of extinguishing a fire in a conventional way (in high-rise buildings). As will be pointed out below their doubts appear legitimate (see heading ‘Safety aspects’).

Another reason for the interviewees to be restrained in their enthusiasm was that, in their opinion, their authority would diminish if somebody else took over control during the attack. By this, they did not mean the command and control during the fire, but the withdrawal of the fire crew when the helicopter commenced operation. For most of the interviewees it was hard to accept to “walking away from the fire and waiting on the sidelines.” It was believed that withdrawal would lead to unnecessary delay.

(As a result of the attacks during the pilot project it became clear that withdrawal was not only regarded by the fire personnel as unnatural but in a few occasions, was also irresponsible (see evaluation of the attack VNU building Hoofddorp). It proved to be irresponsible to let the fire service cease their activities while they were trying to stop the fire from spreading. This has not happened on a few occasions and is against the Operational tactics and procedures (for example during the attacks in Oterlee, Akersloot and Hoofddorp). 'Withdrawal of fire personnel' will require serious consideration if it is decided to use the helicopter for fighting structural fires in future.)

**Conclusion**

The fire service was one of the key participants in the project. Not only because the fire fighting helicopter is meant to assist the fire service, but also because the fire service has to make a request for the helicopter. It can be concluded that the fire service for various reasons, had only a moderate enthusiasm for extinguishing fires by helicopter. Although it would be hard to prove, it can be assumed that the negative attitude had an influence on the
Limited amount of requests

It is an obvious question to ask why only five requests were made by the fire service during the pilot project (1 year and 6 months). One of the five requests was even made by the fire service control room and not by the Fire Officer (see diagram 6.2). A possible cause could have been that there were no fires in the Netherlands during this period which met the objective of the pilot project (fires in high-rise building or locations with difficult access). The researchers do not have any facts at their disposal about the fires in the Netherlands during this period. However, the PLD pointed out that there have been several fire where the fire fighting helicopter could have been used. During meetings of the project group some members reported that a few fires had taken place in high-rise buildings and in some cases their statements were supported by newspaper articles. Also the fires in Wijk aan Zee and Hoofddorp, where the PLD initiated the request for the fire fighting helicopter, confirm this. If the PLD is right, this would suggest that the fire service was not always aware of the potential use of the fire fighting helicopter. This could be caused by the lack of enthusiasm or that in the tense circumstances of fire fighting the officer19 just does not think of using the fire fighting helicopter.

The latter is actually hardly surprising. Since 1735, when the ‘fire hose and branch’ was invented, the fire service has focused on attacking fires from inside the building (offensive fire fighting), little has changed since then. The advent of motorized vehicles and breathing apparatus did not cause a fundamental change. The principle is still the same: enter, locate the seat of the fire and extinguish20 . This implies that innovative methods of extinguishing fires, like the helicopter, will not be easy to implement. Especially when the fire service, in general, has no faith in the idea.

Recent research with regard to ‘Naturalistic Decision Making’21 has shown that fire commanders tend to make their decisions under pressure by recognizing a situation that they are used to and applying known methodology. Deviating from the norm, for example requesting the fire fighting helicopter during the suppressive phase of the fire, does not fit into this model easily. Two out of the five requests during the pilot project were made in the suppressive phase and three in the aftermath of the fire. Interestingly, the fire service has made many requests for the fire fighting helicopter to perform during ‘Open Days’. Consequently, it will take a lot of education and exercises22 to teach fire commanders to make decisions that are outside their normal range of experience. This has not been satisfactory for the pilot project. The trained Fire Officers received only one morning or afternoon instruction. No practice was provided or exercises undertaken23.
This contrasts with the education, training and exercises the crew of the PLD received. No less than 14 pilots and 8 Operators (who operated the IFEX-system during the attacks) of the PLD received distinctive and substantial training (see also attachment B.5).

The PLD was very involved in the pilot project, not only during the project but also during the preparatory time. The PLD got closely involved from the inception of the idea for a new extinguishing method (1998). Throughout the pilot project the PLD has been very constructive and enthusiastic. A few Fire Officers pointed out that they had a lot of admiration and respect for the knowledge of the Helicopter crew. Not only because they were able to skilfully manoeuvre the helicopter but also because of their knowledge with regard to fire fighting. It can be concluded that the PLD has done everything within their power to make this pilot project a success.

**Conclusion**

It can be concluded that the fire service has not made many requests for the fire fighting helicopter during the pilot project. The most obvious reasons were the limited training and education given and the fact that using the fire fighting helicopter deviates from the ‘normal’ routine method of operation.

Innovation and change with regard to the performance of the fire service will be difficult to implement if:

- The way fire commanders take decisions under pressure is not acknowledged
- There is limited involvement, training and education.

**Down-wash**

During most of the attacks (‘designated’ or not) the down-wash of the helicopter had a negative effect on extinguishing the fire. The down-wash is the wind caused by the rotors during flight. On some occasions the fire did not only flare up again, but the down-wash also made the fire spread through the building.

There was also a negative effect of the down-wash when the helicopter was forced to approach the building because of the range of the canon (see heading ‘IFEX-system: the technique’). The effective range, according to the specifications should be 50 meters, instead 15 meters was found to be practical. Achieving the specified range could possibly diminish the difficulty with the down-wash.

**Safety aspects**

This sub section will briefly go into the risks encountered during the flights with the fire fighting helicopter. The safety risks with regard to the IFEX-system only are pointed out in the technical evaluation.

- Single-engine helicopter

The IFEX-system was prepared and certified in Canada for only one type of helicopter, the single-engine Ecureuil AS-350 B2 (see also attachment B.5). However, the PLD expressed an opinion that
another type of helicopter would have been more suitable for safety reasons, namely the twin-engine Bölkow Bo-105. At the time of the pilot project the PLD had the twin-engine Bo-105 in its fleet and therefore this option was considered first. The fact that this helicopter is equipped with two engines means that it can operate above residential areas. If one engine fails it will be possible to make a safe landing with the remaining engine. At the start of the pilot project the possibility of equipping the Bölkow with the IFEX-system was considered. However, it emerged that flying the Bölkow helicopter equipped with the IFEX-system would also have disadvantages (see attachment 1, section B.6.1). Therefore, it was decided to fly with the Ecureuil during the pilot project as the limited number of operations meant that the risks were deemed acceptable by the PLD. Sufficient evaluation data could be gained from the pilot project to produce a conclusion about the value of the system as a part of an (unspecified) helicopter.

If it is decided to use the fire fighting helicopter in the future for structural fire fighting, it will be necessary to convert to a helicopter with at least two engines. This will involve new investment to make the IFEX-system suitable for a twin-engine helicopter.

An exemption was obtained for the Ecureuil to be able to fly lower and closer to ‘built-up’ areas during the pilot project, but only if it was necessary for the actual attack.

- Flying close to ‘built-up areas’
A student at the Technical University of Delft has carried out a ('preliminary study') research project to establish the effects of turbulence on helicopters when flying round high-rise buildings. Her dissertation is entitled “Helicopter response to the flow field induced by high-rise buildings”. The research points out that the turbulence round high-rise buildings has an effect on the stability of the helicopter and therefore has consequences for a safe attack. As a result the helicopter could hit the building. One of the student’s conclusions is that for safety reasons a helicopter has to keep a distance of at least 20 meters from a building.

As already described under heading ‘The IFEX-system’ the distance between the object and the helicopter had to be less than 15 meters during all attacks (contrary to the IFEX-system specifications of 50 meters) due to the low pressure in the system. This has not led to any difficulties during the pilot project as only the exercises in the Bijlmer took place in a high-rise building. The remaining fires during the pilot project could be categorized as ‘locations that are difficult for the fire service to access.’

It has been stated that this research is only introductory and further work will be necessary to come to a well-founded conclusion with regard to the danger of turbulence around buildings. To conclude that operations during the pilot project were carried out dangerously close to buildings based on existing research would be
premature. However, it can be concluded that the risks could be
reduced if the IFEX-system operated effectively at the specified
range of 50 meters.

Notwithstanding the above, flying close to buildings will always
involve extra risks particularly when applying shots from an
extinguishing system. The effects of a recoil induced by use of the
IFEX-system when in close proximity to buildings could have serious
implications.

Conclusion
Flying with the fire fighting helicopter during the pilot project was
not without risks and this cannot be eliminated in operations
involving structural fires. Therefore, the key question is; does the
value added by the fire fighting helicopter in this type of operation
outweigh the risk?

Recap
As already stated there have not been enough ‘designated’ attacks
to come to a well-founded opinion about the added value of the fire
fighting helicopter during fire fighting in situations described in the
objective of the pilot project.

However, it has been proved that the fire fighting helicopter in its
current form has not been able to add significantly to operations in
high-rise buildings or locations with poor access. This conclusion is
based on the facts gained from the pilot project. A number of
attacks have not been successful and on a few occasions the fire
service has been of the opinion that the outcome would have been
the same if they had taken care of the fire themselves. A number of
reasons are apparent:
• The down-wash had a negative effect on fire fighting
• The Helicopter crew had to deal with technical faults in the
  extinguishing system
• The circumstances were not ideal for optimum performance of
  the IFEX-system.

It is uncertain whether these factors alone establish that the fire
fighting helicopter will not have any added value in the future.
Without any adjustments, the answer will certainly be yes. For a
successful fire fighting helicopter it will be essential to improve the
IFEX-system, otherwise the many technical faults will continue to
have an adverse effect on its use.

Does that mean that an improved fire fighting helicopter with an
IFEX-system operating efficiently will add value to fire fighting? This
question is difficult to answer on basis of the data gained from the
pilot project. Many aspects will remain theoretical. For example
with an efficient IFEX-system the effective distance between
helicopter and target could perhaps be extended. This means that
problems caused by the down-wash on almost all of the attacks
during the pilot project would diminish. A decreased down-wash
and an IFEX-system operating at its optimum might lead to a successful attack.

Further consideration suggests that the technical question may not be the decisive factor. The perfect circumstances for the IFEX-system (and consequently for the fire fighting helicopter as a whole) will not change. For an attack to be successful the fire should not be too severe and the seat of the fire must be accessible. This means that the target should accessible and free from obstructions. Conversely, the extinguishing method works at it best when the fire is burning in an enclosed space. This set of circumstances will not occur very often.

In addition, the evaluation points out that the senior Fire Officers interviewed were not inclined to make use of the fire fighting helicopter. For a variety of reasons, they expressed a limited degree of enthusiasm and this could not be changed during the pilot project. The method of using the fire fighting helicopter deviates from the ‘conventional’ method of fighting fires. The attitude shown by fire service officers will have to change if the fire fighting helicopter is to become a normal method of operation. This might be achieved by providing the fire service with better information and a fire fighting helicopter with an efficient and reliable extinguishing system. Training and exercises would be necessary to enable fire commanders to become accustomed to the helicopter and to consider its use when under pressure in a crisis situation, confident that the alternative tactics employed would be effective.

A decision will have to be made balancing the additional investment needed for training the fire service bearing in mind that the circumstances in which the fire fighting helicopter can operate successfully will not occur very often. This is without considering:

- The costs for training the PLD Helicopter crew
- The purchase of a (new) twin-engine helicopter
- A suitable and improved IFEX-system
- The maintenance of the helicopter.
BIJLAGEN
Attachment 1  Background

B.1 The extinguishing effect of water
The fundamental principle of fire fighting is based on eliminating one or more of the three elements essential for a fire to exist namely: fuel, oxygen and heat. This is known as the Triangle of Fire.

The extinguishing effect of water is mainly based on cooling, as water has the capacity to absorb a vast amount of heat. This explains why water has been used for centuries to put out fires.

When water is exposed to the burning material, the heat energy released during combustion will be absorbed by the water changing from the liquid to the vapour-state. The heat absorbing capacity results in the cooling effect. When sufficient water is applied, the temperature of the burning material will decrease and will eventually drop below the ignition temperature. At that stage heat has been eliminated from the Triangle of Fire and the fire ceases to burn.

The energy absorbed by the water causes it to evaporate and convert into steam. In addition to the cooling effect, the plume of steam created mixes with the burning gases displacing the surrounding air. This will lead to an additional suffocating effect as the oxygen supply to the flames blocked. As steam is lighter than air the suffocating effect will be more effective on a fire burning in a confined space than in the open air.

An important factor is the amount of water that reaches the fire. Extinguishing water that is applied from too far away will evaporate due to the high temperatures involved. The steam created will immediately be pushed away by the radiated heat, significantly reducing the cooling and suffocating effect. Also a lot of water will not reach the fire. Consequently, a lot of unused water will be drained away without evaporating.

Using a device that converts the water stream into a mist or spray can increase the combined cooling and suffocating effect. By doing this many water particles are produced creating a far greater capacity to absorb heat due to their increased surface area. This means that more water will turn into steam. By using such a device, a greater cooling effect will be achieved, producing more steam and consequently a greater suffocating effect.

The IFEX-system is designed to maximize the cooling and suffocating properties of water by converting water into a fine mist before it is applied to the fire reducing the amount wasted and unused. Frans Steur, a Dutchman, developed the system in 1994 (see sub section B.5.3). In this evaluation no comments are made with specific regard to the IFEX-system as a fire fighting method.
B.2 The IFEX-system and the helicopter
The helicopter has been used in the Netherlands for emergency work since the 1950’s. From that time on the Search and Rescue Units (SAR) of the Air Force mobilized their helicopters for rescue operations at sea and also for transporting patients from the West Fresian Islands to the mainland. Additionally, “Trauma helicopters” are an integral part of the Dutch Health Care System used for mobilizing specialized medical teams to the scene of accidents, where they can provide care beyond the capabilities of ambulance personnel. While it is not intended to use this system to transport patients by helicopter, this can be achieved if necessary.

Last year (2001) a pilot project examined whether it may be possible to use two types of Army helicopter26 to assist with fighting fires in forests, heath and grassland. It was proposed that the two helicopters were equipped with “water baskets” enabling large amounts of water to be carried. The water baskets would be attached under the helicopter and can used to release water in an accurate way on to the fire.

After the IFEX-system was introduced in 1994 a variety of applications were devised. Different types were developed to use as hand extinguishers and these were carried over the shoulder or could be fixed to cars, motor cycles or other vehicles (used by the former Yugoslavian army).

Steur, the designer of the IFEX-system, attempted to make the system suitable for use in helicopters. His first attempt was unsuccessful. By accident, Steur discovered a Dutch pilot living in Canada who adopted the technique, offered support, funding and the perseverance necessary to realize his project. In co-operation Steur and the Dutch pilot developed the so-called “IFEX skid” for a single-engine helicopter, the Ecureuil AS-350 B2 (see section B.6.1). The IFEX skid is a gantry for attaching the IFEX-system to the helicopter.

B.3 The development and lead in to the project
When it appeared to be technically possible to equip a helicopter with the IFEX-system (in this report referred to as a ‘fire fighting helicopter’) the journey to a new, innovative idea for fighting fires had begun. There were no records of a similar fire fighting helicopter elsewhere in the world and consequently scarce information available with regard to the operational possibilities.

By chance, Steur met the Maarsen Fire Brigade’s Chief Fire Officer and explained the concept of the fire fighting helicopter. From that moment on, the idea had found a breeding ground in the Netherlands as a result of an increasing number of high-rise buildings. The fire fighting helicopter provided a possible means for assisting fire fighting in such locations.
By the end of 1997 the Chief Fire Officer of the Maarssen Fire Brigade had approached industry, the business world and the Air Force to assist in making his idea a reality. However, they were not interested. As the police and fire service co-operate at the scene of an incident, the Chief Fire Officer approached the PLD and KLPD with the same request. The PLD was willing to co-operate which meant that the fire service would lead the project and the PLD would lend support.

In December 1997 the Chief Fire Officer of the Maarssen Fire Brigade announced his idea for the first time during a seminar.

The experimental phase
In the first instance, the fire service and PLD co-operated to establish whether it would be technically feasible to attach an IFEX-system under a helicopter. Three members of the PLD traveled to Canada where an IFEX skid had been developed for a single-engine helicopter, the AS-350 Ecureuil.

While in Canada, the three PLD personnel received the training in the use of the IFEX-system/helicopter combination. This was the first time that any such training had taken place anywhere in the world. Operators, (those who operate the IFEX-system in the helicopter) from Asia, America and Europe also attended the training. However, there were no exercises with fire involved.

The following issues (amongst others) were considered during the visit to Canada:
• the technical aspects, construction and the consequences for flying
• ‘weight and balance’ (configuration: crew, fuel and water)
• operational aspects of the flight (establishing necessary amendments to the flight manual)
• processing and feasibility of the ‘Supplementary Type Certificate’
• training of crew, including exemptions from existing Aviation Law.

As a result of this visit to Canada the PLD stated that the idea of using a fire fighting helicopter could be viable. The experimental phase went on to prove that it was technically possible for the fire fighting helicopter to become operational and the IFEX skid was returned to its manufacturer in Germany. The PLD drew up a list of alterations and improvements that needed to be carried out before the start of the second phase.

The test phase
After the experimental phase, the PLD and the fire service entered into an agreement with each other for a second, test phase. During the test phase a demonstration of the fire fighting helicopter was organized at Crailo for a large party of representatives from the fire service, police, press, Royal Air Force, sponsors related to the
sector (AMEV amongst others) and the RLD. A number of ‘training targets’ were set on fire and these were attacked by the fire fighting helicopter. This demonstration can be regarded as a success, despite some technical faults concerning the pressure in the extinguishing system.

B.4 Preparation of the pilot project

Partially as a result of the successful demonstration in Crailo it was decided to start a pilot project. The aim being to establish whether the fire fighting helicopter could add value to extinguishing fires in high-rise buildings and other locations that are difficult for the fire service to access. The pilot project would have to prove whether the fire fighting helicopter would be a possible asset to the existing fire fighting equipment.

In May 1998, preparations for the start of the pilot project were made. The Mayor of Maarssen Chaired the Steering Committee. This consisted of representatives of the Ministry of The Interior and Kingdom Relations (BZK), CCRB, Nibra, AMEV and PLD. The members were concerned that procedures were properly followed in respect of finance and the preparation of contracts amongst other issues. By the end of 1999 the participants, later than planned, signed an agreement in which they formally declared their commitment to take part in the project known as ‘Fire Fighting Helicopter Netherlands’.

A project group was also founded under Chairmanship of the Chief Fire Officer of the Maarssen Fire Brigade. The Members of the project group were representatives from BZK, PLD, the Ede Fire Brigade, The Civil Aviation Authority of the Transport and Water Management Inspectorate, Nibra and AMEV. Also representatives of the Amsterdam Fire Brigade joined the meetings of the project group at a later stage.

The project group was occupied with a variety of issues including:
• Who has to purchase what?
• When will the fire fighting helicopter be used?
• Under what conditions will the pilot project proceed?
• What legal exemptions are necessary and who will take responsibility?

“OrgaInfo Advies and Management” provided the secretariat resource for the pilot project and were represented on both groups.

Potential sponsors were approached for financial backing with the main sponsor being AMEV, an insurance company. Other sponsors included ‘de Elf Provinciën’ (property developer), ‘N.V. Waterleidingbedrijf Midden-Nederland’ (a water company). The European Commission of the European Union was also prepared to contribute financially.
Initially, it appeared that the project, officially planned to go ahead in 1999, was not financially viable. Eventually there were sufficient sponsors prepared to contribute and the pilot project could proceed on 3 April 2000. The duration of the pilot project was scheduled to be 18 months or a maximum of 15 attacks.

Attachment 2 outlines the contribution made by the various participants to the pilot project.

Operational and strategic tactics (see section B.7), a training procedure and a ‘crew concept’ (for the PLD crew) were also drawn up.

**B.5 Carrying out the pilot project**

The fire service (Incident Commander who makes the request for the fire fighting helicopter) and the PLD (pilots, Operators and engineers/technicians) played a very important role throughout the pilot project.

**B.5.1 The fire service**

One of the main reasons for the pilot project was to test the fire fighting helicopter’s ability to support the fire service when fighting fires in locations that have poor access. Despite the fact that the PLD is responsible for the actual attack (see sub section B.5.2) the IC remained in charge with regard to the overall performance. Consequently, the fire fighting helicopter was used under authorization of the IC. Initially, it was the IC who instructed the Helicopter crew with regard to the tactics to extinguish the fire (see also section B.6).

**Training for the fire service**

The Netherlands has approximately 500 municipal fire brigades. Not every IC was authorized to request or to use the fire fighting helicopter during an incident. Only those ICs who had received safety instructions and training were allowed to do so. For this reason a number of training days were organized.

On 25 January 2000 the first training session took place at Nibra. After that, another two days were organised in Den Helder on 28 and 29 February 2000 for the IC’s who had not been able to attend the instruction at Nibra. The actual training took approximately 2 hours.

Training syllabus:

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.30p.m.</td>
<td>Status of the pilot project</td>
</tr>
<tr>
<td>1.50p.m.</td>
<td>Helicopter extinguishing methods and techniques</td>
</tr>
<tr>
<td>2.30p.m.</td>
<td>Helicopter attack and emergency procedures</td>
</tr>
<tr>
<td>3.10p.m.</td>
<td>Nibra evaluation of the pilot project</td>
</tr>
<tr>
<td>3.30p.m.</td>
<td>Discussion and questions</td>
</tr>
<tr>
<td>4.00p.m.</td>
<td>Viewing of the KLPD-helicopter</td>
</tr>
</tbody>
</table>
Fire Officers, based in the regions, gave training to a wider group of ICs at various fire brigade locations, a total of 241 Fire Officers received instruction.

The Operators from regional control rooms were also provided with training in respect of “deployment procedures”.

B.5.2 National Police Aviation Authority
The Netherlands is divided 25 regional police forces. There is also one national force: the National Police Services Agency (KLPD). It is the task of the KLPD to support the regional police forces when they are carrying out their duties. This is achieved by providing staff, equipment and technology.

The KLPD is divided into twelve operational departments, of which one is the PLD. The PLD supervises compliance with Aviation Law, investigates aircraft accidents and takes action with regard to criminal use of airspace. The PLD also takes aerial photographs when requested by the regional police forces and assist during search operations (for missing persons or criminals).

These duties are carried out by means of helicopters and fixed-wing aircraft. The PLD is operational 24 hours per day.

The PLD fleet consists of:
• 2 twin-engine aeroplanes (BN2T Islander)
• 2 twin-engine helicopters (Bölkow Bo-105)
• 3 single-engine aeroplanes (Cessna 182R)
• 2 single-engine helicopters (AS-350 Ecureuil).

In section B.3 it was explained that since the end of 1997, the PLD was closely involved in the preparation of the pilot project. The PLD did not only play an important role in this phase, but also made an enormous commitment by offering its entire ‘flying platform’ for the duration of the pilot project. This meant that the helicopter, pilots, Operators and engineers for the maintenance of the IFEX-system were all available on stand-by. This required a great deal of effort and the PLD fulfilled a tremendously important role during the entire project.

Despite the fact that the PLD only facilitated, no less than 14 pilots, 8 Operators (who operated the IFEX-system during an attack) and engineers of the PLD underwent special, modular training. This consisted of theoretical and practical parts all of which were assessed.

At the start of the pilot project a number of exercises and training sessions were carried out to test the fire fighting helicopter as well as to train the Helicopter crew. Further practical training was held for the crew at the training centre of the Royal Navy in Den Helder.
B.6  The fire fighting helicopter  
The fire fighting helicopter consisted of two main components: the helicopter itself and an extinguishing system. Both will be discussed in this section.

B.6.1 The Ecureuil AS-350 B2  
As discussed, only one type of helicopter of the PLD fleet was suitable for operating as a fire fighting helicopter: the single-engine Ecureuil AS-350 B2. The IFEX-system was developed for this type of helicopter only. The helicopter, manufactured by the French company ‘Aerospatiale’, is generally suitable for carrying a maximum of 6 passengers during a 3 hour flight with a maximum speed of 220 km/ph. The maximum starting weight of the Ecureuil AS-350 B2 is 2,250 kg and the fuel capacity is 427 kg.

During the pilot project the helicopter was based at Schiphol Airport. This allowed the helicopter to arrive at the scene of an incident in the Randstad between 10-30 minutes after take-off. The Ecureuil AS-350 B2 received an exemption for the duration of the pilot project allowing it to operate at lower levels and closer to residential areas if necessary to enable training or an actual extinguishing attack.

The PLD was of the opinion that a different type of helicopter would have been more suitable, namely the twin-engine Bölkow Bo-105. Because of its 2 engines, the helicopter is able to operate over residential areas. For the pilot project the suitability of the Bölkow was considered but proved to have a number of disadvantages (in comparison to the Ecureuil). Firstly, the payload of the Bölkow was less than that of the Ecureuil. The payload is the maximum weight that can be carried in flight including: the weight of the pilot, Operator, the IFEX-system, water, additives and mission fuel. As a consequence of this restriction, the amount of water and additives available for an attack would be severely restricted and major adjustments would be required to increase this. Also the ‘auto rotation’ capability of the Bölkow is poorer than that of the Ecureuil. ‘Auto rotation’ enables the helicopter to “glide” in a controlled way to a safe landing in the event of engine failure.

The twin-engine configuration of the Bölkow would have been more suitable, but it was decided for the reasons mentioned above to use the Ecureuil. As a consequence, the number of attacks carried out over residential areas had to be kept to a minimum. The figure of 15 attacks was deemed to be acceptable by the PLD. This is why training and exercises were carried out over non-residential areas.

B.6.2 The heli-IFEX-system  
The heli-IFEX-system consists of two ‘extinguishing’ canons, two water tanks and a cylinder containing compressed air.
A water tank can contain a maximum of 155 litres of water and each canon has a capacity of 18 litres (18 litres of water will be released per shot). The compressed air cylinder is charged to a pressure of 300 bars and this enables an operating pressure in the canon of 25 bars. According to the specifications the maximum total weight (without external load) of the installation is 280 kg.

The system can be mounted to the helicopter in approximately 20 minutes. In case of emergency the Operator can jettison the IFEX-system with a single press release button.

During an attack the Operator can direct the shots using a colour camera/monitor and the system is actuated by an automatic firing mechanism. The canons can be depressed to a maximum of 90°.

As mentioned in section B.1 the principle of the IFEX-system is based on the cooling and smothering effect of water. This effect is optimized if the water particles are extremely fine. The IFEX-system is able to produce water droplets of between 2-200 microns.

When the Operator activates the system, by pulling the trigger, the water will leave the canon at a velocity of approximately 120 meters per second. The shot of water will reach the seat of the fire with
minimum waste. The shot is accompanied by a loud report as the mist “shell” breaks the sound barrier when released.

One shot of water (18 litres) has a cooling surface of 1,000 square meters and creates a ‘steam blanket’ of approximately 1,700 litres. The steam interrupts the oxygen supply and consequently the fire will smother the fire (see also section B.1). The next shot should be applied when the ‘steam blanket’ has evaporated, which will take a few seconds. The system specification suggests that the canon can be refilled in 6-7 seconds\(^3\) and the maximum effective range is 50 metres\(^3\).

A critical part of the operating theory is that the shot has to reach the seat of the fire. If this is not achieved the system will not be effective. In practice, this is difficult and will be challenging for an Operator in a fire fighting helicopter, trying to reach the seat of the fire via an open window in a high-rise building (an objective of the pilot project).

An important point to note is that the penetrating ability of the heli-IFEX-system is almost non-existent. After the open fire is damped down the seat will continue to smoulder at a high temperature, water applied at this stage will immediately be converted into steam. The heli-IFEX-system will hardly have any effect\(^3\) at this point as the water particles will be converted directly into steam and cooling of the seat itself will not take place. A solid jet will be required to penetrate the core. In theory this means that the fire fighting helicopter will only be able to bring the fire under control, but the fire service, using a solid jet, will have to finally extinguish the fire. The fire fighting helicopter will therefore only be used for support (as outlined in the objective of the pilot project).

**Configuration**

Apart from the fixed weight of the IFEX-system and the two crew, more weight can be added in terms of water, additives and fuel. It was decided to opt for the following configuration:

- 50% fuel (as it is harder to obtain fuel than water) 216 kg Jet A1 kerosene.
- 200 litres of water (100 litres of water per tank – both tanks half full). Each shot will take 18 litres of water so effectively 10 shots can be applied (during re/filling approximately 20 litres of water will be wasted). After 10 shots the amount of fuel will be reduced significantly. This means that the canons can be refilled up to 100% in most cases.
- 25% litres of additive, carried in 2 containers.

This configuration was later amended. It turned out that the fire service did not require any additives (see section 4.2) and the IFEX-skid was 70 kg heavier than the certificate of airworthiness indicated. Therefore it was decided not to carry additives. Also, the percentage of fuel was reduced to 45% and the amount of water to 180 litres.
B.7 The Operational tactics and procedures
During one of the demonstrations the operational and strategic tactics were designed and agreed. The operational and strategic tactics will be outlined below to provide an understanding of the use of the fire fighting helicopter.

1 Aim
The aim of the fire fighting helicopter is to support the (regional) fire services in the Netherlands during fire fighting in high-rise buildings and on locations where access is difficult.

2 Availability
The duration of the pilot project was 18 months (3 April 2000 – 3 October 2001) or 15 attacks. In principle the fire fighting helicopter was available for 7 days per week with the following restrictions.
• Initially the fire fighting helicopter was only available during daylight.
• One helicopter was available during the pilot project.
• Weather circumstances can affect the ability to deploy. The PLD makes the final decision.
• Based on availability and on the priorities of the PLD.

3 Operational command and authorization
The fire service has the operational command during the use of the fire fighting helicopter and decides whether the helicopter should be deployed. Also the fire service decides how the fire has to be extinguished using the fire fighting helicopter. However, the Flight Commander of the PLD is authorized and responsible for the decision whether the fire fighting helicopter can comply with the request or not. Operations will only be carried out according to the operational and strategic tactics. The Flight Commander of the PLD has to be notified of each attack as soon as possible. Only the IC who has been trained and who is present at the scene of the incident and trained PLD pilots and Operators are authorized to carry out an operation with the fire fighting helicopter.

4 Fire ground and attendance time
The fire fighting helicopter was based at Schiphol Airport. The target attendance time is approximately 10 minutes, with a maximum of 30 minutes, taken from the time of the first telephone call between the trained IC and the Flight Commander of the PLD. Attachment 3 shows a map of the area where the fire fighting helicopter could be deployed.

5 The decision to make a request
The decisions to make a request for the fire fighting helicopter will be taken by the trained IC at the scene of the incident based on the following criteria.
• A fire in a high-rise building (28 meters or more) access difficult with equipment available.
• Other fires in locations with difficult access.
For an effective and safe use of the fire fighting helicopter the trained IC has to be able to establish that:

- the burning object is reachable within a radius of 50 meters, the maximum distance for the effective use of the water canon
- there is no substantial risk of explosion
- there is no danger of hazardous emissions when the fire has to be approached by the fire fighting helicopter in to wind.

6 The request for the fire fighting helicopter
The trained IC makes a request for the fire fighting helicopter via the fire service Control Room. The Control Room passes the request for the fire fighting helicopter on to PLD, Operations (OPS, +31 (0) 20 5025635) stating the location of the incident and the name of the IC involved. If required, the Control Room can pass on further details via the above telephone number. The Control Room also alarms the Police Control Incident Room. They will agree and secure the landing area necessary for landing and take-off.

In addition, before take-off, the Control Room passes the following details on to the PLD pilot and Operator.

- Exact location of the fire and relevant details with regard to the location (residential area, approach/return route).
- Type and dimension of the fire, possible emissions, danger of explosion, etc.
- First briefing with regard to the extinguishing tactics and the possible use of additives.
- Wind direction at the scene.
- 'Open water' sources for refilling the water tanks or landing zone for refilling.
- If possible at this stage: landing zone near the fire and its cordon.

7 Cancelling of the fire fighting helicopter
If the trained IC at the scene establishes that the use of the fire fighting helicopter will not be required or, if its use is not feasible then the fire fighting helicopter has to be cancelled via the Control Room.

8 Daily operational activities of the PLD
The PLD (OPS) checks one hour before sunrise whether a Helicopter pilot and Operator are available. They are appointed by their direct supervisor and are trained to use the fire fighting helicopter. The OPS notifies the Technical Department (TD) of the availability of the Helicopter crew. The TD will then start preparing the helicopter for its immediate use. The preparation involves:

- the daily checks/inspection of the helicopter
- supplying the helicopter with water and additive
- supplying the helicopter with a standard amount of fuel
- making sure there is sufficient air pressure in the system
- filling up the compressor with fuel (ready to be switched on)
- confirming that all systems have been checked.
OPS notifies the Helicopter pilot and the Operator during their daily briefing that operations for the fire service can be carried out.

9 Action by the PLD when a request for the fire fighting helicopter is made
• OPS alarms the Helicopter crew and notifies the TD. TD ‘wheels out’ the helicopter and prepares it for take off. This involves starting the air compressor, allowing the system to load (the helicopter will then be ready to take off).
• OPS carries out a first check and verifies the name of the IC at the scene of the incident against the list of Fire Officers who have received training with regard to the fire fighting helicopter.
• OPS calls the Helicopter pilot and Operator and establishes with them whether or not they can comply with the request.
• Before take off the crew monitors fire service channel 10.
• During the approach the Helicopter crew gets in touch with the IC at the scene of the incident (or with somebody on behalf of the IC, for example the Control Room). Communication takes place via fire service channel 10. The IC (or Control Room) reports to the Helicopter crew which channel they should use. In principle this has to be one of the ten ‘disaster’ channels allocated to the regional fire service (relating to the ‘5 TVO Code’ system which provides a unique identifying code for each region and unit in the Netherlands Fire Service).
• During the entire operation the helicopter keeps in touch with the PLD in the usual way.

10 Safety at the fire ground
• The police and fire service are primarily concerned with safety at the fire ground. Members of the public will not be allowed to be present, in the open air, within a 50 meter radius of the target.
• On the helicopter’s approach route a strip of 20 meters wide must be free of ‘emergency service workers’ (fire fighters, police, ambulance personnel).
• ‘Emergency service workers’ within 15 meters of the approach strip must wear appropriate protective clothing. All emergency service worker near the landing strip must to be familiar with the use of the fire fighting helicopter.
• No fire fighters are allowed to be near the seat of the fire during an attack.
• The instructed IC (or somebody on behalf of the IC) has to notify the helicopter if there are any fire fighters present on the other floors in the building. Fire fighters present in the building must be notified that an attack will be carried out by the fire fighting helicopter.

11 Actual attack of the fire fighting helicopter.
• After arrival of the fire fighting helicopter, the pilot contacts the trained IC at the scene via the established communication
channel. If communication is not possible the Helicopter pilot will communicate face to face with the IC after landing.

- If requested, a reconnaissance flight can be carried out to enable the trained IC to observe the fire from the air. It is the task of the IC to establish the desired attack method with the Helicopter pilot. The following will be discussed:
  - The nature of the fire and the possible use of additives.
  - The accessibility and safety of the approach route and fire ground.
  - The angle from where the helicopter has to carry out the attack.
  - Exact location the burning object which has to be extinguished.
  - During the attack only the Helicopter pilot and the Operator are on board the helicopter. The Operator is the only person who is authorised to operate the canon.
  - The actual fire fighting will only take place under the direction of the trained IC. The IC leads the operation.
  - During the operation the IC and Helicopter crew will always be in direct contact with each other.

12 Evaluation
- Each attack carried out by the fire fighting helicopter will be evaluated. For this purpose the trained IC, the Helicopter pilot and Operator will complete an evaluation form directly after the operation. Completed forms have to be sent to Nibra. If necessary Nibra will approach the people involved for an interview.
  - In the light of the evaluation report, the PLD Chief of ‘Helicopter’ Operations will personally debrief the PLD-personnel.
  - The evaluation report may lead to an amendment of procedures during the trial period.
Attachment 2  The Attacks

This attachment provides the key results of the questionnaires. The information was taken from the Incident Commander (IC), the Helicopter pilot and Operator. The specifications/descriptions of the incidents and the main conclusions can be found in chapter 4.

<table>
<thead>
<tr>
<th>B.2.1 Training on the 'Spiegelplas' at Nederhorst den Berg – 2 May 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attack</strong></td>
</tr>
<tr>
<td><strong>Reason for request</strong></td>
</tr>
<tr>
<td><strong>Time of arrival IC at the scene of the incident</strong></td>
</tr>
<tr>
<td><strong>Time helicopter requested by IC</strong></td>
</tr>
<tr>
<td><strong>Status of fire at the time the request was made</strong></td>
</tr>
<tr>
<td><strong>Time helicopter took off from Schiphol Airport</strong></td>
</tr>
<tr>
<td><strong>Time of arrival at the scene – helicopter</strong></td>
</tr>
<tr>
<td><strong>Time of departure from the scene – helicopter</strong></td>
</tr>
<tr>
<td><strong>Status of the fire at the time the helicopter carried out the attack</strong></td>
</tr>
<tr>
<td><strong>Weather circumstances</strong></td>
</tr>
<tr>
<td><strong>Attack strategy</strong></td>
</tr>
<tr>
<td><strong>Distance between helicopter and object(s)</strong></td>
</tr>
<tr>
<td><strong>Number of applied shots (according to the Operator)</strong></td>
</tr>
<tr>
<td><strong>Number of successful shots (according to the Operator)</strong></td>
</tr>
<tr>
<td><strong>Added additives</strong></td>
</tr>
<tr>
<td><strong>Intervals between the shots</strong></td>
</tr>
<tr>
<td><strong>Landing (zone)</strong></td>
</tr>
<tr>
<td><strong>Water intake</strong></td>
</tr>
<tr>
<td><strong>Communication between IC and the Helicopter crew</strong></td>
</tr>
<tr>
<td><strong>Effect of the IFEX-system on the fire</strong></td>
</tr>
</tbody>
</table>
Effect of the helicopter on the fire
The fire flared up again mainly caused by the down-wash of the helicopter.

Reason for withdrawal of the helicopter
Water supply had been used and the down-wash caused the stern mooring to snap. This made the yacht turn and extinguishing the fire became almost impossible.

View of the Fire Brigade on the attack
After the training Nibra researchers asked a number of fire fighters involved for their opinion on the attack. In general the Brigade found it quite incomprehensible that the fire fighting helicopter had not been able to extinguish a minor fire. It was agreed that the fire fighting helicopter could be useful for cooling purposes. The helicopter will never be able to extinguish the fire.

View PLD on the attack
The fire diminished as a result of the attack. There were also a few restrictions/limitations:

- The loading speed of the canons was too slow and the loading time therefore too long
- The reach was too small (9 metres) caused by the low pressure in the system
- Balance between fuel (endurance/weight) and the water supply was a restriction

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### B.2.2 Test Attack during Fire in a Paper Warehouse, Purmerend, 12 May 2000

**Attack**

No 'designated' attack

The circumstances did not meet the criteria of the pilot project: there was no open fire (no emergency). The attack has to be regarded as an experiment requested by the Fire Brigade.

**Reason for request**

The Fire Brigade wanted to test the penetrating ability of the IFEX canon on a thick layer of smouldering paper. The PLD wanted to check the Operational tactics and procedures during a practical exercise.

**Time of arrival of IC at the scene of the incident**

A second IC was employed for the attack with the helicopter

**Time helicopter requested by IC**

0640 hrs

**Status of fire at the time the request was made**

Fire under control

**Time helicopter took off from Schiphol Airport**

0821 hrs

**Time of arrival at the scene – helicopter**

0830 hrs

**Time of departure from the scene – helicopter**

0949 hrs

**Status of the fire at the time the helicopter carried out the attack**

Smouldering fire in paper mass after a fire in a warehouse. Message 'Fire under control' was sent

**Weather circumstances**

Light cloud, no precipitation and bright. Wind speed 10 knots (18 km/ph)

**Attack strategy**

Shots were only applied from one position (at the top, from the side, in one corner of the paper mass). The shots were applied from hover position

**Distance between helicopter and object(s)**

5 – 10 meters

**Number of applied shots (according to the Operator)**

- Two with pure water
- Two with additives (Coldfire)
- Two double shots (Coldfire)
### Evaluation of Fire Fighting Helicopter

#### (Continuation of test attack during fire in a paper warehouse)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of successful shots (according to the Operator)</td>
<td>6 (that is to say that the intensity of the fire decreased – glowing)</td>
</tr>
<tr>
<td>Intervals between the shots</td>
<td>Not reported</td>
</tr>
<tr>
<td>Landing (zone)</td>
<td>The helicopter landed prior to the attack so that the attack strategy could be discussed with the IC. The helicopter did not land for water intake. The Fire Brigade regarded the preparation of the landing zone as difficult.</td>
</tr>
<tr>
<td>Water intake</td>
<td>n.a.</td>
</tr>
<tr>
<td>Communication between IC and the Helicopter crew</td>
<td>According to the PLD the communication went well. The Fire Brigade pointed out that the approach route was not properly discussed. The Fire Service’s request to chose a particular approach route was denied</td>
</tr>
<tr>
<td>Effect of the IFEX-system on the fire</td>
<td>The fire went out where the IFEX branch hit the target. The effect of the shots was especially visible in the centre of the surface (certainly when the shots with additives were applied)</td>
</tr>
<tr>
<td>Effect of the down-wash on the fire</td>
<td>Places in the mass which were only smouldering flared up again because of the down-wash. Because of this the effect of the IFEX-system (fire extinguish) was negative.</td>
</tr>
<tr>
<td>Reason for withdrawal of the helicopter</td>
<td>The test was finished. The set target of 6 shots as reached</td>
</tr>
<tr>
<td>View of the Fire Brigade on the attack</td>
<td>In the terms of the fire fighting the attack was unsuccessful. They had to cease the usual fire service deployment. But this was not felt to be a problem during this operation. It was assumed that in case of emergency the support of the fire fighting helicopter would have slowed down the operation and possibly would have caused some difficulties.</td>
</tr>
<tr>
<td>View PLD on the attack</td>
<td>The assumption that the fire fighting helicopter would not add any value during such an attack has been confirmed during the operation. The attack was useful however, as a lot of (technical) experience was gained</td>
</tr>
<tr>
<td>Report media</td>
<td>“Fire fighting helicopter fans the fire” (...)To speed up the extinguishing process it was decided yesterday morning for the first time to make a request for the fire fighting helicopter equipped with two water canons. The test in the open air took a wrong turning. The extinguishing water landed mainly next to the burning bales whilst the rotors of the helicopter caused so much turbulence that the situation deteriorated.</td>
</tr>
</tbody>
</table>

#### B.2.3 Forest/heath fire at the Leusder Heath – 12 May 2000

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attack</td>
<td>No ‘designated’ attack: the helicopter was used for damping down</td>
</tr>
<tr>
<td>Reason for request</td>
<td>Large forest/heath fire in area which is hard to access. There are no water intake locations in the area. The request was to trace the fire and to extinguish the fire immediately.</td>
</tr>
<tr>
<td>Time of arrival IC at the scene of the incident</td>
<td>1700 hrs</td>
</tr>
<tr>
<td>Time helicopter requested by IC</td>
<td>1718 hrs</td>
</tr>
<tr>
<td>Time helicopter took off from Schiphol Airport</td>
<td>1728 hrs</td>
</tr>
<tr>
<td>Time of arrival at the scene – helicopter</td>
<td>1742 hrs</td>
</tr>
</tbody>
</table>
**Continuation of forest/heath fire at the Leusder Heath**

| Time of departure from the scene – helicopter | 1850 hrs |
| Status of the fire at the time the helicopter carried out the attack | Large forest/heath fire with various seats. It was reported to the PLD that the surface concerned was one square kilometer. |
| Weather circumstances | Clear with a wind speed of 10 knots (18 km/h) |
| Attack strategy | The IC was picked up at the scene of the incident to make a reconnaissance flight in the affected area (this took 5 minutes). It was decided that the helicopter would keep tree tops wet as a preventive measure (this took approximately 15 minutes in total). Two attack methods were applied: hovering and slowly taxiing above the trees |
| Distance between helicopter and object(s) | Hover: 10 meters |
| | Slow taxi speed: 5 – 10 meters |
| Number of applied shots (according to the Operator) | 12 shots which included ‘runs’. That is to say that two shots were applied rapidly after each other |
| Number of successful shots (according to the Operator) | 12 shots (that is to say the shots hit the top of the trees) |
| Intervals between the shots | Two shots were applied rapidly after each other and the interval between the 1st and 2nd shot was 5 - 10 seconds, between the 2nd and 3rd shot 20 – 30 seconds, etc. |
| Landing (zone) | Three landings were made: to pick up and take back the IC and one for water intake. In the first instance the landing zone was allocated by the Fire Brigade at the edge of the heath. This caused the following difficulties: |
| | • The fire service and PLD worked with different co-ordinates (respectively the ‘RDM’ co-ordinates and geographical co-ordinates) which made it hard for the Helicopter pilot to find the location. This caused a delay of approximately 10 minutes |
| | • The fire fighting helicopter was not able to touch down as there were too many trees in the surrounding area |
| | Two landing zones were used: |
| | • A landing zone was marked by the local police along the motorway Amersfoort–Doorn, near the fire service command-car. This was not an optimum location. There was too much tail wind and there were too many people present on the landing zone. The helicopter could hardly take off because of the street lights nearby. Damage was caused to the outside seating area of a pancake restaurant. |
| | • The second landing zone was near the scene at the heath. The landing zone was easy to access and was not marked as this was not necessary (a lot of space and few spectators) |
| Water intake | After 12 shots, water intake took place from a water carrier from the fire service. However, the carrier did not have a usual Pump and consequently decreased the effectiveness of the water intake. The water intake took approximately 15 minutes. The fire fighting helicopter was not used again after the water intake. |
| Communication between IC and the Helicopter crew | On request of the regional fire brigade the communication took place via channel 7 (instead of channel 10). This caused some difficulties in the beginning which were resolved at the scene of the incident |
### Evaluation of Fire Fighting Helicopter

**Effect of the IFEX-system on the fire**
According to the Fire Brigade the water did not reach the top of the trees sufficiently. According to the PLD each shot caused a lot of smoke. Because of the runs it was hard to establish the effect of the operation.

**Effect of the helicopter on the fire**
- Hovering: moderate/nil
- Slow taxi speed: none

The down-wash caused the spread of smoke and dust and damage had been done to the outside seating area of a pancake restaurant during touch down.

**Reason for withdrawal helicopter**
The fire was out (extinguished by water tenders). The message ‘fire under control’ was sent.

**View of the Fire Brigade on the attack**
The fire fighting helicopter was not used for the actual fire fighting but for damping down. However, it is still not clear what contribution can be made or restrictions apply during forest/heath fires and to slow down or prevent ‘crown burning.’

**View PLD on the attack**
The water carrier at the scene of the incident contained only 1,000 litres and the area was hard to access for heavy fire appliances. In this respect the deployment was successful.

### B.2.4 Dune fire near Wijk aan Zee

<table>
<thead>
<tr>
<th>Attack</th>
<th>No ‘designated’ attack: there was no open fire as the fire was already extinguished. The fire fighting helicopter was used for damping down</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reason for request</td>
<td>The control room of the Kennemerland police made a request for the ‘tele’ helicopter to record video footage of the fire. The PLD advised to also use the fire fighting helicopter</td>
</tr>
<tr>
<td>Time of arrival IC at the scene of the incident</td>
<td>Unknown</td>
</tr>
<tr>
<td>Time helicopter requested by IC</td>
<td>n.a. About 1500hrs the helicopter was offered by the control room of the police</td>
</tr>
<tr>
<td>Time helicopter took off from Schiphol Airport</td>
<td>1520 hrs</td>
</tr>
<tr>
<td>Time of arrival at the scene – helicopter</td>
<td>1530 hrs</td>
</tr>
<tr>
<td>Time of departure from the scene – helicopter</td>
<td>1545 hrs</td>
</tr>
<tr>
<td>Status of the fire at the time the helicopter carried out the attack</td>
<td>There was only smoke visible</td>
</tr>
<tr>
<td>Weather circumstances</td>
<td>Light cloud, good visibility, light wind</td>
</tr>
<tr>
<td>Attack strategy</td>
<td>After discussion with the IC it was decided that the helicopter would apply its shots for damping down and would then take off again (without load)</td>
</tr>
<tr>
<td>Distance between helicopter and object(s)</td>
<td>20 meters</td>
</tr>
<tr>
<td>Number of applied shots (according to the Operator)</td>
<td>6</td>
</tr>
</tbody>
</table>

The penultimate shot got stuck in the barrel (for unknown reasons). A few hours later this shot was released spontaneously. The technical department did not find any faults.
(Continuation of dune fire near Wijk aan Zee)

<table>
<thead>
<tr>
<th>Number of successful shots (according to the Operator)</th>
<th>5 (the amount of smoke created by the initial down-wash, visibly decreased)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervals between the shots</td>
<td>30 seconds</td>
</tr>
<tr>
<td>Landing (zone)</td>
<td>The helicopter landed for discussions with the IC. This took place without any difficulties</td>
</tr>
<tr>
<td>Water intake</td>
<td>n.a.</td>
</tr>
<tr>
<td>Communication between IC and the Helicopter crew</td>
<td>Before fire fighting there was a brief discussion. This was sufficient considering the agreed attack strategy</td>
</tr>
<tr>
<td>Effect of the IFEX-system on the fire</td>
<td>The smoke decreased visibly</td>
</tr>
<tr>
<td>Effect of the helicopter on the fire</td>
<td>The smoke increased caused by the down-wash</td>
</tr>
<tr>
<td>Reason for withdrawal helicopter</td>
<td>This was agreed before the attack</td>
</tr>
<tr>
<td>View of the Fire Brigade on the attack</td>
<td>-</td>
</tr>
<tr>
<td>View PLD on the attack</td>
<td>-</td>
</tr>
</tbody>
</table>

**B.2.5 Attack on the fire at the VNU building in Hoofddorp – 9 July 2001**

<table>
<thead>
<tr>
<th>Attack</th>
<th>Real attack, but not ‘designated’ (see attachment 5.6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reason for request</td>
<td>The fire on the roof was hard to access</td>
</tr>
<tr>
<td>Time of arrival IC at the scene of the incident</td>
<td>1630 hrs</td>
</tr>
<tr>
<td>Time helicopter requested by IC</td>
<td>1700 hrs (at 1645hrs the PLD initiated preparations to get everything ready for the helicopter to take off)</td>
</tr>
<tr>
<td>Time helicopter took off from Schiphol Airport</td>
<td>1705 hrs</td>
</tr>
<tr>
<td>Time of arrival at the scene – helicopter</td>
<td>1708 hrs</td>
</tr>
<tr>
<td>Time of departure from the scene – helicopter</td>
<td>1800 hrs</td>
</tr>
<tr>
<td>Status of the fire at the time the helicopter carried out the attack</td>
<td>Severe blaze (according to the report of the fire service36)</td>
</tr>
<tr>
<td>Weather circumstances</td>
<td>No significant cloud, no precipitation and good light. Wind speed is unknown but there was a strong wind. The buildings nearby caused a lot of mechanical turbulence.</td>
</tr>
<tr>
<td>Attack strategy</td>
<td>At the request of the IC, the attack was started at the northern side of the building and moved from there towards the southern side.</td>
</tr>
<tr>
<td>Distance between helicopter and object(s)</td>
<td>10 – 15 meters</td>
</tr>
<tr>
<td>Number of applied shots (according to the Operator)</td>
<td>8 – 10</td>
</tr>
<tr>
<td></td>
<td>The first shot was applied at 1749hrs. The IC needed 25 minutes to decided whether the use of the helicopter was actually necessary. After that, it took at least another 15 minutes for withdrawal of the fire service personnel and other emergency services personnel.</td>
</tr>
<tr>
<td>Number of successful shots (according to the Operator)</td>
<td>All shots were fairly powerful with an extinguishing effect</td>
</tr>
<tr>
<td>Intervals between the shots</td>
<td>30 – 45 seconds</td>
</tr>
<tr>
<td>Landing (zone)</td>
<td>No landing was been made</td>
</tr>
</tbody>
</table>
EVALUATION OF FIRE FIGHTING HELICOPTER

(Continuation of attack on the fire at the VNU building in Hoofddorp)

<table>
<thead>
<tr>
<th>Water intake</th>
<th>The helicopter departed with 50% of fuel and water for 8 – 10 shots. An additional water intake did not take place.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction and communication between IC and the Helicopter crew</td>
<td>Fire service: according to the IC no communication had taken place. The instruction with regard to the attack strategy took place via a police officer at the CTPI (co-ordination team at the scene of an incident) but is not reported as such by the crew (see also ‘view of the PLD’ below)</td>
</tr>
<tr>
<td>Helicopter crew:</td>
<td>The communication via channel 10 was difficult during the initial alarm(^7) phase and during the fire fighting. The communication improved when switched over to the control room of the police. The direction by the IC was minimal. It was indicated when (1749hrs) and how (northern side) the helicopter could start with its operation and when it had to cease again.</td>
</tr>
<tr>
<td>Effect of the IFEX-system on the fire</td>
<td>Where the shots were applied the fire extinguished reduced but flared up again shortly after</td>
</tr>
<tr>
<td>Effect of the helicopter on the fire</td>
<td>The down-wash of the helicopter caused the fire to spread through wall cavities to the stores below</td>
</tr>
<tr>
<td>Reason for withdrawal of helicopter</td>
<td>• The negative effect of the down-wash (caused the fire to spread through wall cavities to the stores below)</td>
</tr>
<tr>
<td>• Successful result had not been achieved</td>
<td></td>
</tr>
<tr>
<td>View of the Fire Brigade on the attack</td>
<td>• The helicopter had a negative influence on the fire: the fire flared up again and spread to the store below</td>
</tr>
<tr>
<td>• The final result was nil benefit</td>
<td></td>
</tr>
<tr>
<td>• The actual attacks of the helicopter took too much time</td>
<td></td>
</tr>
<tr>
<td>View PLD on the attack</td>
<td>• According to the PLD the northern side (leeward/sheltered side) was not a good place to start the attack. The wind would just make the fire spread fire in that direction. Nevertheless the PLD reported to have acted upon the advice of the IC</td>
</tr>
<tr>
<td>• The use of an additive had a positive effect</td>
<td></td>
</tr>
<tr>
<td>• As the helicopter was used unnecessary the attack did not result in a positive contribution</td>
<td></td>
</tr>
</tbody>
</table>

B.2.6 Fire in barn, Oterleek – 3 August 2001

| Attack | No ‘designated’ attack: the message ‘fire under control’ was already sent |
| Reason for request | The fire was surrounded by farmland which was impassable because of standing crops |
| Time of arrival IC at the scene of the incident | 1940 hrs |
| Time helicopter requested by IC | 1957 hrs |
| Time helicopter took off from Schiphol Airport | 2045 hrs |
| Time of arrival at the scene – helicopter | 2101 hrs |
| Time of departure from the scene – helicopter | 2140 hrs |
| Status of the fire at the time of the request | (Very) severe blaze with risk of spreading to buildings nearby |
| Status of the fire at the time of the attack | According to the fire service: severe blaze According to the PLD: the message ‘fire under control’ was already sent |
(Continuation of fire in barn, Oterleek)

| Weather circumstances       | A beautiful summer evening  
|                            | Wind force 3 – 4            |
| Attack strategy             | Unknown                     |
| Distance between            | 10 – 15 meters              |
| helicopter and object(s)    |                            |
| Number of applied shots     | 4                           |
| (according to the Operator) |                            |
| Number of successful shots  | 0 (that is to say that the shots did not reach the seat of the fire as the metal roof was collapsed but mainly still intact) |
| (according to the Operator) |                            |
| Intervals between the shots | 1 minute                    |
| Landing (zone)              | The helicopter touched down as the Helicopter crew had to discuss the strategy. |
| Water intake                | n.a.                        |
| Instruction and communication between IC and the Helicopter crew | It was reported that the communication during the attack was satisfactory |
| Effect of the IFEX-system on the fire | Nill |
| Effect of the helicopter on the fire | The down-wash caused a lot of small burning particles in the air which increased the risk of fire spread and also re-ignition. |
| Reason for withdrawal of helicopter | It was not possible for the helicopter to extinguish the fire and was also not assisting |
| View of the Fire Brigade on the attack | • It took long before the helicopter arrived  
|                                       | • The attack was perfect/excellent. This type of fire is less suitable for extinguishing by a helicopter equipped with an IFEX-system  
|                                       | • There was a lot of respect for the expertise and skills of the Helicopter crew |
| View PLD on the attack         | • The extinguishing operation had no effect at all on the fire. |

B.2.7 Fire in the restaurant of the Akersloot Hotel – 5 August 2001

| Attack                        | ’Designated’ attack  
|                              | After 5 shots the fire was extinguished and the fire was further damped down by the fire service |
| Reason for request           | Fire in the roof space of the gabled roof which was hard to access (from the inside as well as from the outside) |
| Time of arrival IC at the scene of the incident | 2008 hrs |
| Time helicopter requested by IC | 2036 hrs (initiated by the control room of the fire service instead of the IC) |
| Time helicopter took off from Schiphol Airport | 2105 hrs |
| Time of arrival at the scene – helicopter | 2128 hrs |
| Status of the fire at the time of the request | Severe blaze |
| Status of the fire at the time of the attack | Severe blaze |
| Weather circumstances        | Clear visibility, high cloud and dry, moderate wind |
| Attack strategy              | The shots were applied in the roof space while the helicopter was taxiing over the hotel |
**EVALUATION OF FIRE FIGHTING HELICOPTER**

<table>
<thead>
<tr>
<th><strong>(Continuation of fire in the restaurant of the Akersloot Hotel)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance between helicopter and object(s)</td>
<td>10 – 15 meters</td>
</tr>
<tr>
<td>Number of applied shots (according to the Operator)</td>
<td>5</td>
</tr>
<tr>
<td>Number of successful shots (according to the Operator)</td>
<td>3, that is to say that the shots reached the seats of the fire and largely extinguished the fire. (The were no obstacles surrounding the gabled roof and the opening in the roof was large enough)</td>
</tr>
<tr>
<td>Added additives</td>
<td>None</td>
</tr>
<tr>
<td>Intervals between the shots</td>
<td>1 minute</td>
</tr>
<tr>
<td>Landing (zone)</td>
<td>The helicopter touched down on a grass area near the building without difficulties. The approach route was over a meadow with grazing cows. The entire herd panicked and started to run. A number of cows stumbled over. Contact was established with the owner of the cows and the veterinary surgeon. The event had no adverse consequences.</td>
</tr>
<tr>
<td>Water intake</td>
<td>n.a.</td>
</tr>
<tr>
<td>Instruction and communication between:</td>
<td></td>
</tr>
<tr>
<td>1. IC and the control room</td>
<td></td>
</tr>
<tr>
<td>2. IC and Helicopter crew</td>
<td></td>
</tr>
<tr>
<td>Effect of the IFEX-system on the fire</td>
<td>The flames were largely extinguished</td>
</tr>
<tr>
<td>Effect of the helicopter on the fire</td>
<td>By the chosen attack strategy (taxing) there was hardly any negative influence caused by the down-wash</td>
</tr>
</tbody>
</table>
| Reason for withdrawal helicopter                              | • The flames were largely extinguished  
• Dusk falling |
| View of the Fire Brigade on the attack                        | • The helicopter arrived fairly quickly at the scene (compared with the attack on 3 August)  
• The attack could not have been better. However, it was pointed out that the attack would have been more effective if extinguished via the hole in the outer wall instead of from above  
• Without the use of the helicopter the same result would have been achieved, although more slowly  
• The fire service were complimentary about the expertise and the skills of the Helicopter crew |
| View PLD on the attack                                        | • For a better result the request should have been made earlier |
Attachment 3 Participants

In this attachment, an overview is given of the organizations who made an important contribution to the project 'Fire fighting helicopter in the Netherlands.'

With a background as large 'fire damage' insurer, ‘AMEV Nederland’ made an important contribution as the main sponsor making the project 'Fire fighting helicopter in the Netherlands' possible. Their support included, amongst other things, the provision of knowledge, experience in launching projects, and provided finance to help draw up a communication strategy.

The Fire Service and Crisis Management Directorate of the Ministry of the Interior and Kingdom Relations (BZK), was one of the representatives who signed the agreement to co-operate in the project. They supported the project with political, technical and legal advice together with expertise, manpower and subsidies. The Directorate also did pioneering work to obtain funding from the European Commission.

The members of the European Union and the European Commission unanimously supported the project by providing a subsidy.

The National Police Aviation Authority of the National Police Services Agency made a significant contribution to the trial by providing personnel (Pilots, Operators and Engineers), equipment and technology.

The Maarssen Fire Brigade supported the project by offering facilities, including administrative support to the project team.

The Netherlands Institute for Fire Service and Disaster Management (Nibra), one of the representatives who signed the agreement to co-operate in the project, took care of the operational and safety training for the Fire Officers and the evaluation of the pilot project.

The Royal Navy Training Institute made the facilities at the School of the NBCD, in Den Helder, available for further training in the use of the fire fighting helicopter and additional instruction for Fire Officers.

Consultants of ‘OrgaInfo Advies en Mangement’ supported the project by providing advice and by leading the project secretariat. ‘OrgaInfo Advies en Mangement’ also supported the project by financially contributing to the communication program.

The College of Chief Officers of Regional Fire Brigades (CCRB), as a representative of regional Chief Fire Officers and participant in the
agreement, took responsibility for creating a positive image within the regional fire brigades.

The Royal Netherlands’ Association of Fire Brigades (KNBV) participated in the agreement as a member of the Board. Also the KNBV administered the financial affairs of the project.

Property developer ‘De Elf Provinciën’ contributed financially to the pilot project. ‘De Elf Provinciën’ is the owner of a shopping centre in Maarssen.

Because of the water saving effect of the fire fighting helicopter compared with other extinguishing techniques the ‘N.V. Waterleidingbedrijf Midden-Midden (WMN) supported the test with a financial contribution.

PR and Communication consultancy Paul Kok Consultants (PKC), were responsible for the communication strategy from the start of the project.
Attachment 4  The trial area

White area: do not participate in the pilot project
Coloured areas: participate in the pilot project
Footnotes

1 In this evaluation report this combination will be called ‘fire fighting helicopter’

2 See attachment 1, section B.6

3 This is also based on the fact that the penetrating ability of the IFEX-system is very limited. To extinguish the glowing seat of a fire (the flames are almost out) a powerful solid jet is required. When the fire fighting helicopter has stabilized the fire, the fire service will always have to damp down (with a solid jet). The fire fighting helicopter can only be used to assist during fire fighting operations (see also attachment 1, section B.6).

4 The Flight Commander of the PLD decides whether a request from the fire service to use the helicopter can be accepted or not (see Operational tactics and procedures, attachment 1, section B.7).

5 The questionnaires were completed under supervision of the Flight Commander.

6 The reason was that the fire fighting helicopter had to be available within the agreed response time.

7 In Canada the so-called heli-IFEX-system was adapted for only one type of helicopter, the one-engine Ecureuil AS-350 B2. To fly with a single-engine aircraft is not entirely without risk. A different type of helicopter would be more suitable, namely the twin-engine Bölkow Bo-105. The fact that this helicopter has two engines means that it can operate with less risk over residential areas. For the pilot project the capabilities of the Bölkow were considered equipped with IFEX-system. However, to fly with the Bölkow equipped with the IFEX-system would have had various disadvantages (compared with the Ecureuil, see attachment 1, section B.6.2). Eventually it was decided to use the Ecureuil during the pilot project. The reduction of risk was mainly achieved by a number of safeguards:
   • A flight was only permitted for an actual (or expected) IFEX-attack over built-up/residential areas. It was not allowed to prolong the attack if this was not necessary.
   • No more than 15 attacks will be carried out during the entire trial period.
   • The approach route had to be chosen so that the risks were reduced to an absolute minimum.

8 The effect of the down-wash on a fire in a confined space is very limited. Restriction of the down-wash can also be achieved by approaching the fire at ‘slow taxi speed’ (see also section 4.1).

9 The system ‘Rijks Driehoeks Meting (RDM)’ (co-ordinate system) is only applicable in the Netherlands. The ‘RDM grid’ is also known as ‘TOP grid’. The ‘TOP grid’ is very simple to use and therefore the disaster relief organization in the Netherlands decided to use this system.

10 It has to be stressed that this information is extracted from the questionnaire completed by the IC. The PLD pointed out that the attack was evaluated with the fire service. The fact that the PLD ignored the IC’s instruction/directions was not discussed according to the PLD.
11 The method required for the fire service to create a landing zone is not explained in the Operational tactics and procedures. However, this did come up during the training session for the fire service (see attachment 1, section B.5). It was pointed out that a landing zone has to be at least 25 by 25 meters, free from obstacles, emergency workers and other people and also the landing zone has to be cordoned.

12 The PLD reported that it was a moderate fire.

13 In first instance the exercises would take place on 13 September but as a mark of respect after the terrorist attacks in the USA on 11 September the exercises were postponed to 18 October.

14 In the Bijlmermeer a large number of flats were due to be demolished to improve the area and to create more variation between high-rise and low-rise buildings. It is hoped that this will improve the living environment. The housing association was prepared to provide one of the blocks of flats (due for demolition) for exercise purposes.

15 As a consequence the evaluation forms completed by the people involved were very brief.

16 This is also based on the fact that the penetrating ability of the IFEX-system is very limited. To extinguish the glowing seat of a fire (of which the flames are mainly put out) a powerful, solid jet is required. When the fire fighting helicopter has stabilized the fire, the fire service will always have to damp down (with a solid jet). The fire fighting helicopter can only be used to assist during an fire fighting operation.

17 The training and exercises are not included in the requests.

18 Based on the interviews held.

19 Crew Commanders and IC's are intended here.

20 Extracted from: “En steekende de Spuitpyp door de deur” by E. Oomes (Nibra essay prize 1999).

21 One of the main pieces of research in this field is the theory of the ‘Recognition-Primed Decisions (RPD), developed by R. Klein. Klein has done research from 1985 onwards to investigate the way professionals take decisions in stressful situations and under time pressure.

22 This philosophy was implemented in the ‘Leidraad Oefenen’ (training guide) for the fire service.

23 However, the Fire Officers were kept informed on a regular basis during the pilot project via news letters.

24 According to the manufacturer: “the smaller the size of the water droplets, the greater their absorption capacity.”

25 According to the manufacturer: “the higher the droplet velocity, the greater the amount of water that reaches the base of the fire.”

26 The Cougar and the Chinook.
They were: the Chief Pilot - Helicopters, a Quality Insurance Inspector (specialized in aviation techniques) and a maintenance/operational Helicopter pilot.

For example the ‘load factor’, knowledge of the system, description of the system, safety criteria with regard to the pressure cylinders that are part of the IFEX-system (for example decreasing the air pressure in case of a crash).

To use the helicopter in combination with the IFEX-skid an ‘optional’ certificate was required. The Canadian Aviation Authority provided a temporary certificate. At that time they were trying to obtain a full ‘Supplementary Type Certificate’ (a certificate of airworthiness).

During the trial period the IFEX-system was mounted under the helicopter and was therefore operationally available on stand by.

The mist particles shot from a distance of 4 metres will be approximately 100 microns, those shot from 6 metres will be 5 microns in size (research The Fire Research Station in London).

The attacks proved that this was not feasible.

The attacks proved that the effective distance is not presently 50 meters, but somewhere in the region of 10 to 15 meters.

This was also confirmed after the attack in Purmerend.

RDM co-ordinates = ‘Rijks Driehoeks Meting – grid (only applicable in the Netherlands).

The PLD reported a moderate fire. Considering the equipment used by the fire service (2 appliances and an aerial platform) this suggests a moderate fire.

During alarming, mobilization and take off, all happened at the same time, the PLD tried to contact the IC. This proved to be difficult.

According to the PLD’s report this was approximately 2110 hrs – 2115 hrs).