DUTCH
SAFETY BOARD

# Crash NH90 helicopter, Aruba, 19 July 2020

## Findings initial investigation

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*The Hague, May 2021*

*The reports of the Dutch Safety Board are public and available on www.safetyboard.nl.*

*(Source cover photo: Royal Netherlands Navy HMS Groningen)*

## The Dutch Safety Board

When accidents or disasters happen, the Dutch Safety Board investigates how it was possible for these to occur, with the aim of learning lessons for the future and, ultimately, improving safety in the Netherlands. The Safety Board is independent and is free to decide which incidents to investigate. In particular, it focuses on situations in which people's personal safety is dependent on third parties, such as the government or companies. In certain cases the Board is under an obligation to carry out an investigation. Its investigations do not address issues of blame or liability.


**Dutch Safety Board**

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N.B. This report is published in the Dutch and English language. If there is a difference in interpretation between the Dutch and English version, the Dutch will prevail.

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# 1 INTRODUCTION

## 1.1 The investigation

On 19 July 2020, an NH90 helicopter of the Royal Netherlands Navy unexpectedly ditched in the sea during an exercise in the Caribbean. As a consequence of this occurrence, two of the four crew members on board were killed and the aircraft suffered irreparable damage. Together with the Defence Safety Inspectorate (Inspectie Veiligheid Defensie, IVD), the Dutch Safety Board launched an initial investigation on Curaçao, because it was an aviation occurrence with fatalities and the course of events was uncertain.

In this context, assisted by the Defence Helicopter Command, in collaboration with the IVD, the recorder of the aircraft was read out, under the responsibility of the Safety Board[1].

Based on the findings of this initial investigation, the Safety Board has reached a number of conclusions about the course of the events relating to the occurrence itself, and the course of the rescue operation following the occurrence. The Safety Board also indicated that a number of aspects require further and more in-depth investigation at system level, in order to learn lessons and to minimise the risk of reoccurrence.

Based on its own authority[2], the IVD will be carrying out the further investigation into this accident. The IVD investigation will offer an opportunity for further verification and examination of the results that emerged from this initial investigation. As a consequence, the Safety Board will limit its activities to the initial investigation, and will conclude its own investigation by publishing this report. However, the Dutch Safety Board adds that it may in still decide to reopen its own investigation in the future. The yardstick to be employed will be the extent to which safety lessons can actually be learned from the occurrence, that will result in relevant points for preventing similar occurrences in the future.

1 Article 69 of the Dutch Safety Board Act.
2 Article 2 of the Regulations concerning the methods and authorities of the Defence Safety Inspectorate.

# 2 THE OCCURRENCE

To perform its Kingdom tasks, the Defence organization permanently maintains a station ship[3] in the Caribbean. This vessel also performs tasks for the Caribbean Coastguard service. The vessel has an NH90 helicopter on board, for task support. Since the end of April, HNLMS Groningen was operational in the area, with a crew that had been fully redeployed in Den Helder, due to measures relating to the COVID-19 pandemic.

Following a patrol flight around Aruba on Sunday 19 July 2020, the NH90 helicopter (registered as N-324) was performing a series of deck landing exercises.

During the eighth exercise, while flying at low altitude (<100 feet) across the bow of HMS Groningen, with the intention of taking photographs of the foredeck, the NH90 helicopter suddenly lost height rapidly and hit the water, after completing the downwind turn. The floats were automatically inflated, and the helicopter rotated immediately along its longitudinal axis to an inverted position, after which it remained floating in the water. The pilot and tactical coordinator were killed in the occurrence. The two other crew members were able to free themselves, with minor injuries. Within 24 hours following the ditching, the helicopter had sunk entirely.

*Figure 1: One of the rescue attempts close to the wreck of the NH90. (Source: Royal Netherlands Navy)*

3 Holland class, OPV: *Oceangoing Patrol Vessel*, successor to the corvette available for deployment in the low spectrum of force.

A number of crew members on board HNLMS Groningen witnessed the helicopter ditching in the water. A rescue operation was launched immediately, and visual contact with the helicopter was maintained.

Immediately following the initial report of the occurrence, the Dutch Safety Board consulted with the Defence Safety Inspectorate (IVD) and, together with the IVD, travelled to the Parera Naval Base on Curaçao, in order to carry out an initial investigation on site. Simultaneously, at the direction of the Dutch Public Prosecution Service, a team from the Royal Netherlands Marechaussee launched a preliminary criminal inquiry.

As part of the preliminary criminal inquiry, the Public Prosecutor decided not to exercise the option to have a post-mortem carried out on the bodies. To nonetheless clearly determine the cause of death, the Safety Board commissioned an immediate post-mortem examination of the two deceased crew members on Curaçao, after having informed the next of kin.[4]

For the purposes of this report, use was made of the findings and analysis from the initial investigation and (first) supplementary investigation in the Netherlands.

On the basis of the initial findings, the Safety Board and the IVD concluded that the aircraft showed no technical defects. The aircraft experienced problems during the final run from the moment that the indicated airspeed on the downwind section (with tailwind) fell to zero knots. From that moment on, the aircraft lost height and subsequently entered a high, vertical accelerated descent. Data analysis revealed that the pilot did attempt to escape the situation and to compensate for the fall, but this intervention was bound to fail due to the low flying altitude. None of the occupants suffered high-energy injuries from the impact with the water.

The two occupants in the back of the aircraft (back seaters) were able to free themselves, albeit with difficulty. These individuals, surrounded by fuel from the helicopter, quickly floated away from the aircraft, but at no time did the crew of HNLMS Groningen lose sight of them.

The rescue operation involving a Frisc[5] launched from the HNLMS Groningen immediately focused on the pilot and the tactical coordinator (tacco), but its efforts were hampered by the height of the waves and swell. The pilot was found underwater, outside the aircraft, by one of the crew members of the Frisc, but she proved to still be connected to the aircraft. Once she was freed - 21 minutes after the helicopter crash - she was transported directly to HNLMS Groningen where the already initiated resuscitation attempts were continued under the supervision of the ship's doctor and nurse. Following the launch of the first Frisc, a second Frisc and the FRB[6] were also launched. The crews of these craft concentrated on the tacco. He was eventually discovered inside the aircraft, with an inflated lifejacket, still held in his restraining straps.

4 Both the Public Prosecution Service and the Dutch Safety Board have this authority, on the basis of article 72 and 73 of the Burial and Cremation Act.
5 Frisc: fast raiding interception and special forces craft.
6 FRB: fast rescue boat.

The tacco was eventually freed from the aircraft by the crew of the second Frisc that had also picked up a specialist from the on-board flight crew and, after being underwater for fifty minutes, was also taken to HNLMS Groningen. Because the resuscitation attempt was still ongoing in the first Frisc at the boat landing place, the second Frisc, containing the taco, was hoisted up alongside the ship and members of the medical response service, headed by the nurse, continued the resuscitation efforts in the suspended Frisc.

In parallel to the attempted rescue of the pilot and the tacco, the two other crew members of the crashed NH90 had been picked up by the second Frisc fifteen minutes after the accident. They were directly brought on board the HNLMS Groningen where they underwent a medical examination. They had escaped from the aircraft with minor injuries.

As yet, there is no explanation of why the pilot and tacco were not released from the aircraft. Despite the resuscitation attempts, they died as a result of drowning.

# 3 FACTUAL INFORMATION

## 3.1 The flight

The NH90 helicopter is manufactured in Italy by NHIndustries, an international joint venture headed by Airbus. The NH90 used by the Defence organization is a maritime version of the type NATO Frigate Helicopter (NFH). The aircraft in question, with registration number N-324, had been operational since April 2015 and during this period was stationed on the station ship HNLMS Groningen.

On board the NH90, which in the Netherlands is flown by a single pilot, were four crew members: in the front, on the right-hand seat the pilot and on the left-hand seat the tactical coordinator, and in the back the swimmer/ rescuer and the sensor operator.

After a rest day for the flight crew, after the flight briefing at 12.00 hours[7], the NH90 took off from the HNLMS Groningen at 13.00 hours to carry out a one-hour patrol flight around Aruba.

The planned second part of the flight, between 14.00 and 15.00 hours, consisted of a series of deck landings, known as the deck landing procedure (DLP). The DLP exercise was provided for training purposes and to keep the qualification of the second flight deck officer (FDO) current.

*Figure 2: Archive photograph of a deck landing by the NH90. (Source: Ministry of Defence)*

7 Local time.

Landing and take-off both require intensive interaction between the ship and the helicopter. The ship must sail a heading within the operational framework and is also dependent on the wind strength and sea conditions. An aircraft is only allowed to land or take off after permission has been issued by the duty officer on the bridge and the command and control centre. The VDO instructs the pilot and deck crew during final approach and on departure, until the helicopter is clear of the ship.

During the practice runs, standard take-off procedures were followed on all occasions. After clearing the ship's deck, the helicopter manoeuvred sideways to the port side of the ship before flying away. On five occasions, a counter clockwise run involving a port turn was practised, followed by three clockwise manoeuvres, and finally one flying forward of the ship to the starboard side. In all cases, the helicopter then approached the ship from the rear, before taking up a position to starboard, alongside the flight deck, hovering stationary in relation to the ship, before moving sideways to place the helicopter above the deck, and then landing.

During these practice runs, HNLMS Groningen maintained a heading into the wind at a measured ground speed[8] of approximately 3 knots on an average heading of 108o. During the final run of the NH90, the wind was blowing from a direction of 100°, at a speed measured on the ship of between 20 and 25 knots[9] (wind force five to six Beaufort (Bft)).

During the eighth practice run, the aircraft once again took off and flew along the port side of the ship, to pass across the bow. During this run the aircraft was flying at an altitude of less than 100 feet, which was lower than during previous flights. The purpose of this run was to take photographs of the foredeck of the ship through the right side door, where preparations were being made for the planned barbeque on the forecastle. Preparations were not yet at an advanced stage, so the decision was made to take the photographs during one of the later runs. For that reason the side door remained.

As the helicopter completed its turn to starboard to pass the bow of the ship, and it eventually passed to the starboard side of the ship, the aircraft found itself in a downwind situation (with tailwind). The aircraft then suddenly lost height very rapidly and crashed into the sea. Upon impact, the tail cone broke off and the aircraft immediately rotated around its longitudinal axis placing the cabin and its occupants under water. Fuel released by the impact also immediately flowed outward, around the aircraft. The helicopter remained floating upside down, suspended by the automatically inflated floats.

8 Speed corrected for current flow rate.
9 1 Kt (knot) ≈ 1.852 km/h.

## 3.2 The crew

When the NH90 was introduced in the Netherlands, a single pilot concept was chosen. The helicopter is only flown by two pilots during training; at all other times, as standard, a single pilot controls the aircraft.

Below is a summary of the level of training and experience of the crew of the crashed NH90 (see also Appendix A):

- Pilot: flying experience of the pilot totalled approximately 1679 hours on helicopters, of which 719 flying hours on NH90 helicopters and 306 hours as pilot in command (PIC), plus 310 hours experience in the NH90 simulator.
- Tactical coordinator (tacco): in addition to other flying hours as tactical coordinator, the tacco had 281 hours of NH90 experience and 206 hours of experience in the simulator. He had received no pilot training.
- Sensor operator (sensop): The sensop had 167 flying hours in the NH90 and 57 hours in the simulator.
- Rescue Operator Airborne Marksman: the swimmer/rescuer had a total of 526 flying hours on helicopters and 375 hours on the NH90.

## 3.3 Weather

During the flying exercises, the weather conditions in the area were as follows[10]:

| | Direction | Speed | Temp. | Pressure | Cloud coverage | Distance | Height |
|---|---|---|---|---|---|---|---|
| Wind | 100° - 150 ° | 20 - 25 kts | | | | | |
| Temperature | | | 31 °C | | | | |
| Dew point | | | 24 °C | | | | |
| Air pressure | | | | 1010 HPa | | | |
| Cloud | | | | | 1/8 | | |
| Visibility | | | | | | >10 kilometres | |
| Seawater | | | 29 °C | | | | |
| Waves | | | | | | | 3 metres |

10 Source: Meteorological survey HNLMS Groningen, Meteorological Department Curaçao.

## 3.4 The helicopter

At the time of the occurrence, the aircraft had completed 890 flying hours. The aircraft is equipped with two Rolls Royce gas turbine engines. The engines had total time of 596 and 567 operating hours respectively. The aircraft was airworthy.

The logbook recorded a single outstanding complaint. This related to the faulty power pressure fuel valve. This valve makes it possible to increase the refuelling rate under pressure. Because the valve was defective, the aircraft had to be refuelled by siphoning.

The helicopter underwent pre-flight inspection and was found to be in good order. Prior to the flight, fuel was taken on board, making the total volume of fuel available approximately 1900 litres. The total weight of the helicopter upon departure was approximately 8700 kilograms, well below the maximum permitted take-off weight of 10,600 kilograms. At the time of the accident, there was still sufficient fuel available (approximately 900 litres) for almost one hour's flying. The total weight at the moment of the accident was approximately 7700 kilograms.

## 3.5 Data recorder

The NH90 is equipped with a Voice and Flight Data Recorder (VFDR) on which the last two hours of voice and last ten hours of flight data are recorded. The data is stored on a Crash Survivable Memory Unit (CSMU) located in the aircraft. The aircraft was also equipped with an external recorder. This Recorder Beacon Airfoil (RBA) also has a VFDR memory unit and is fitted with two Emergency Locator Transmitters (ELT), which transmit on the frequencies 121.5 MHz / 243.0 MHz and 406.028 MHz. The RBA is designed to release under high g-forces or if immersed in water. Following the ditching in the water, the RBA broke free from the aircraft and started transmitting the emergency signal. The emergency signal was also received at the coastguard centre in Den Helder. Assisted by the crew of HNLMS Groningen, the Coastguard helicopter and the Coastguard aircraft (both stationed on Curaçao), eventually located the RBA the next morning.

Following conditioning, the RBA was transported urgently to NHIndustries in Germany for readout. The RBA was read out under Dutch responsibility by a team at NHIndustries, in the presence of a pilot-psychologist of the Ministry of Defence and a recorder/data specialist from the Dutch Safety Board.

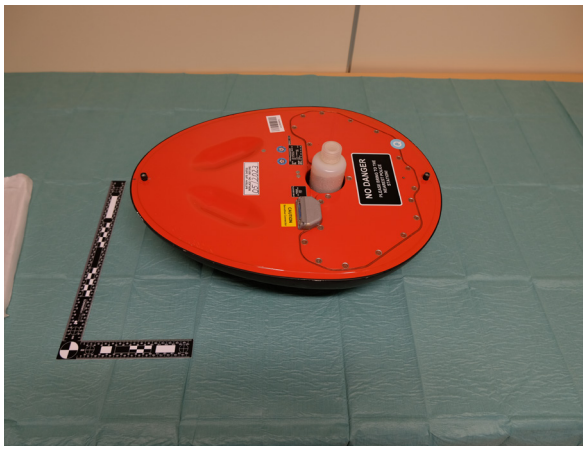




*Figure 3, left:Position of the RBA on the outside of the reference aircraft. (Source: Dutch Safety Board)*
*Figure 4, right: The RBA upon transfer at the Parera Naval Base. (Source: Dutch Safety Board)*

# 4 ANALYSIS

This chapter deals with the following aspects investigated in the initial investigation:
- the condition of the aircraft;
- the flight deck exercise;
- the immediate cause;
- the consequences for the crew;
- the death of the pilot and the tacco;
- the rescue operation.

Following the occurrence, in addition to providing all necessary care, the commander of the HNLMS Groningen instructed all parties directly involved to record their findings and observations in writing that same evening. These records proved a valuable source of information for the investigation team.

## 4.1 Single pilot

In the Netherlands, the NH90 is flown by a single pilot. This configuration differs from other Defence helicopters; which are flown with two pilots. In addition to monitoring the required flying conditions and parameters, the pilot of the NH90 is also responsible for visual contact with the tactical target; in this case, the station ship.

## 4.2 Analysis of VFDR data

The analysis of the data in phase one of the investigation did not reveal any technical non-conformity with regards to the aircraft. In this investigation, during the first inspection,[11] besides the logbooks, essential parameters, such as the engine speeds and temperatures of both gas turbines, the input from the collective and the required ratio with the delivered torque, were observed. The readout values matched the values expected during a flight, and revealed no deviations in respect of previous flights (see example graph 1 in Appendix B).

Based on the logbooks and the initial analysis of the essential parameters, it has been determined that the aircraft revealed no technical non-conformities.

11 These findings were subsequently confirmed in the second inspection by the NLR, on behalf of the IVD.

## 4.3 Flight deck exercise

As part of ongoing training and maintaining the currency of the authorization of the second flight deck officer, deck landing procedures were trained. During a deck landing, the pilot is dependent on the landing indicators on board the ship, including the fixed landing indication lamps. Additionally, the flight deck officer (VDO) indicates whether the aircraft is correctly positioned in respect of the landing point, because - unlike on land - the vessel demonstrates forward speed and makes rolling motions, such that the landing site is moving. During the first seven runs, the helicopter flew at an average altitude of approximately 150 feet. During the sixth run, the aircraft also flew in a wider loop and at greater altitude, approximately 400 feet.

During the eight and final run, following take-off, the pilot flew sideways to port, before initiating a climb (see graph 2 in Appendix B) in order to obtain a clearer view of the foredeck (the forecastle). The aircraft did not ascend higher than approximately 89 feet. During this run, both the Ground Speed (GS) and Indicated Airspeed (IAS[12]) were considerably lower than during the previous flights (see graph 3 in Appendix B), a situation which is both permitted and non-problematic.

After take-off, the aircraft flew forward, parallel to the ship, at the same height as the bridge. After passing the ship, the helicopter made a wide turn passing in front of the ship, so as to turn to starboard. Initiating the right-hand turn meant that the wind direction relative to the helicopter changed from initially diagonally forward to subsequently a tailwind (downwind). Because the helicopter flew past the ship at relatively low speed, from the moment that the aircraft entered the downwind situation the Indicated Air Speed, IAS) fell to zero knots.

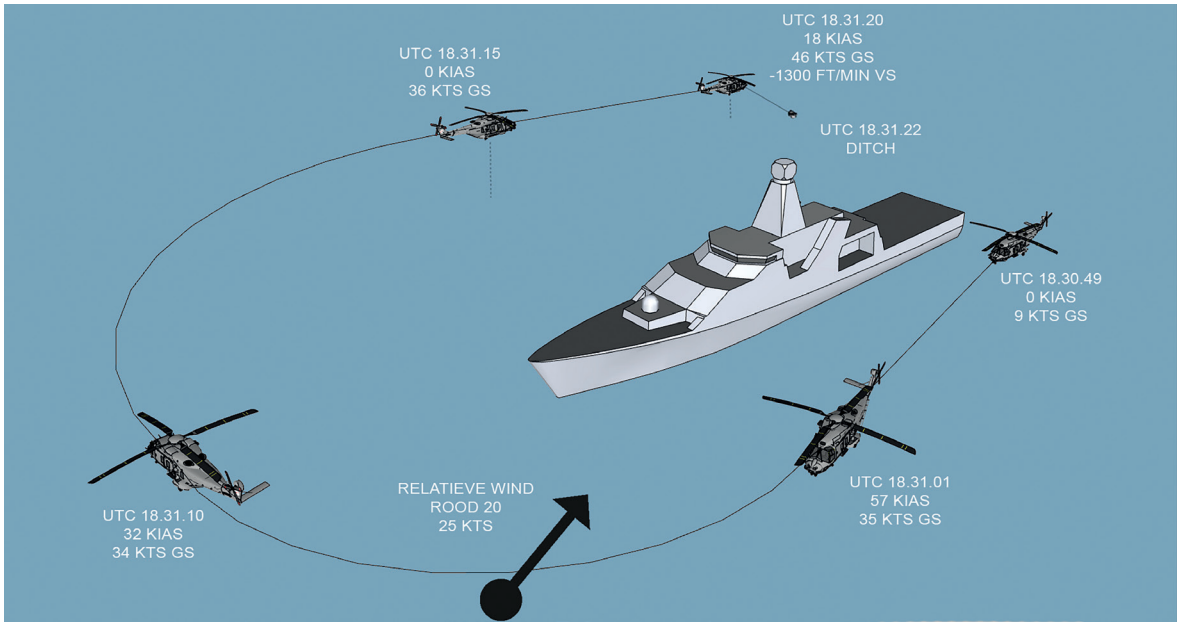
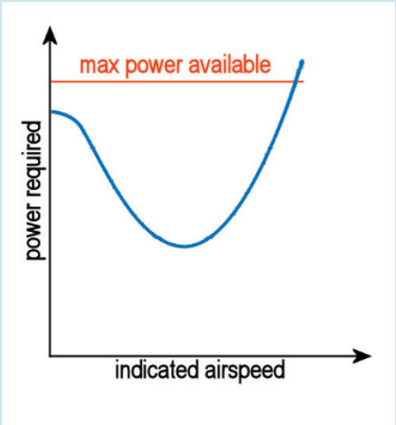



*Figure 5: Positions and speeds of the aircraft following take-off through to the moment of impact (Source: IVD)*

12 IAS or KIAS both stand for Indicated Airspeed, whereby the K stands for knots (kts).

## 4.4 Immediate cause

In general terms, at lower airspeeds helicopters require more power and hovering in the air requires a great deal of power. For the NH90 helicopter, the power curve indicates that when flying lower than approximately 80 knots airspeed, more power must be selected in order to maintain the same altitude. The NH90 had more than sufficient power available to maintain a hover in the conditions prevalent at the moment of the occurrence. The interplay of power in relation to speed, while maintaining altitude is more than a matter of merely selecting more power (pulling on the collective). The forward or backward movement of the cyclic pitch control also influences the behaviour of the aircraft.




The figure shows how the required power relates to the speed of the helicopter.

The y-axis shows the required engine power, while the x-axis (in this case) shows the forward (indicated) speed.

The blue line shows the required minimum power appropriate to the current airspeed. The orange line shows the maximum engine power available.

Following the initial analysis of the data, it has been determined that the Indicated Air Speed of the aircraft fell to zero knots as a result of the downwind turn. As a result of this manoeuvre, although the aircraft was flying forward relative to the Earth, relative to the surrounding air it was stationary. As already stated, this situation (a hover) requires a great deal of power. It has been determined that given the airspeed at that moment, the selected amount of power was insufficient to maintain the helicopter at altitude. As a consequence, the helicopter initially started to lose height slowly.

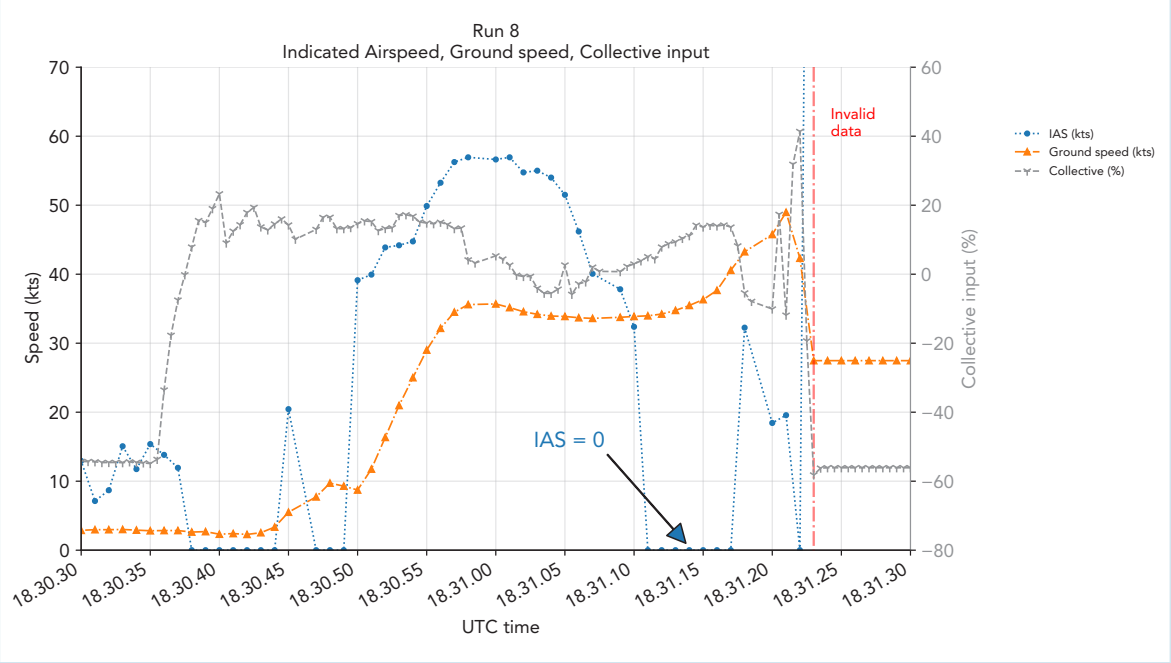



*Figure 6: Analysis of the speeds of the aircraft following take-off and input collective. (Source: Dutch Safety Board)*

The unexpected downward movement of the helicopter increased considerably over a period of three seconds, and subsequently very quickly transitioned into an accelerated descent. The downward movement was experienced by the crew members in the rear of the aircraft as a drop.

Analysis of the data from the flight recorder and the statements of the occupants lead to the first conclusion that at the last moment, shortly prior to impact, the pilot attempted to mitigate the blow. However, due to the low altitude, this proved impossible.

The uncontrolled descent was initiated by the combination of decreasing speed and the insufficient engine power setting selected at the moment.

## 4.5 Consequences for the crew

The statements revealed that the main wheels of the aircraft entered the water with a considerable velocity. As a result of the force of that impact, one of the occupants - the sensor operator who was only restrained by a safety line and was sitting on a chest in the cabin - was thrown forwards into the corridor, towards the cockpit. The hoist operator, also restrained by a safety line, was able to brace himself against the gun carriage by the right-hand door. As a result of the impact, the tail cone of the aircraft broke off completely, allowing fuel to escape from the aircraft. Immediately following the ditching, the aircraft rotated 180 degrees around its longitudinal axis, and filled with water.

*Escape of crew members in the back of the aircraft*

As a rule, if they are physically capable of doing so, helicopter crew members are expected to be self-reliant in the event that the aircraft ditches (unplanned landing) in the sea. This means that if not prevented from doing so by any impact damage to the aircraft or any injury they may have suffered themselves, they should be able to escape from the aircraft on their own. Crew members undergo training for this eventuality in a swimming pool, whereby they are required to escape independently from the mock-up. This training, known as helicopter underwater escape training, must be repeated periodically.

Although the ditching of the NH90 in the water was immediately followed by the complete rotation of the aircraft, leaving it positioned completely upside down, this did not result in any serious injury among the occupants, or any deformation of the fuselage of the helicopter. Because after ditching at sea the occupants can find themselves under water, all crew members are provided with an emergency bottle of compressed air with a mouthpiece in their lifejacket, sufficient to survive under water for several minutes.

Despite their initial disorientation, the two crew members in the back of the aircraft, known as backseaters, attempted to open one of the doors, but their attempt was unsuccessful. They then decided to employ an alternative escape method, by extracting the wire from the window rubber and pushing the window out. They were then able to escape. Both men were wearing a personal lifejacket of the type recently introduced, but for which they had not yet received training. The use of these new jackets caused difficulties for both men. During the initial investigation, the following two problems were identified.

The jacket is fitted with a quick release mechanism, which makes it possible to disconnect the safety line intended to prevent the wearer falling out of the aircraft in flight with the door open, from the jacket instead of from the side of the helicopter. Neither crew member succeeded in opening the fastener on the front of the jacket, therefore requiring them to release the snap hook from the line in the cabin. This led to a loss of valuable time. Another problem was that the position of the emergency compressed air bottle on the jacket had been switched from the left to right side, as compared to the old jacket model.

It was also stated during the investigation that the type of lifejacket used in training is not the same as the personal lifejackets used during the flight.

The personal lifejackets - the use of which had not been trained - worn by the by the backseaters obstructed their rapid escape and reduced their chances of survival.

## 4.6 Decease of the pilot and tacco

The two backseat crew members in the helicopter escaped from the helicopter practically without injury. This suggests that despite the aircraft ditching in the sea, the impact with the water took place at relatively low vertical speed. These findings are backed up by the data, which reveal that the pilot attempted to reduce the descent rate at the last moment, and by the damage observed on the helicopter.

The post-mortem examination revealed that both the pilot and the tacco had suffered minor external injuries and that there was no evidence of life-threatening high-energy injury. Furthermore, no demonstrable medical indication was found that the pilot and tacco had been unable to escape from the aircraft due to injury or entrapment. It has been determined that the death of both the pilot and tacco was caused by drowning.

Following the impact, the pilot was able to independently escape from the aircraft, but she was subsequently discovered unconscious under water, outside the aircraft. She turned out to have been entangled with the helicopter by a connecting line (see Figure 7).

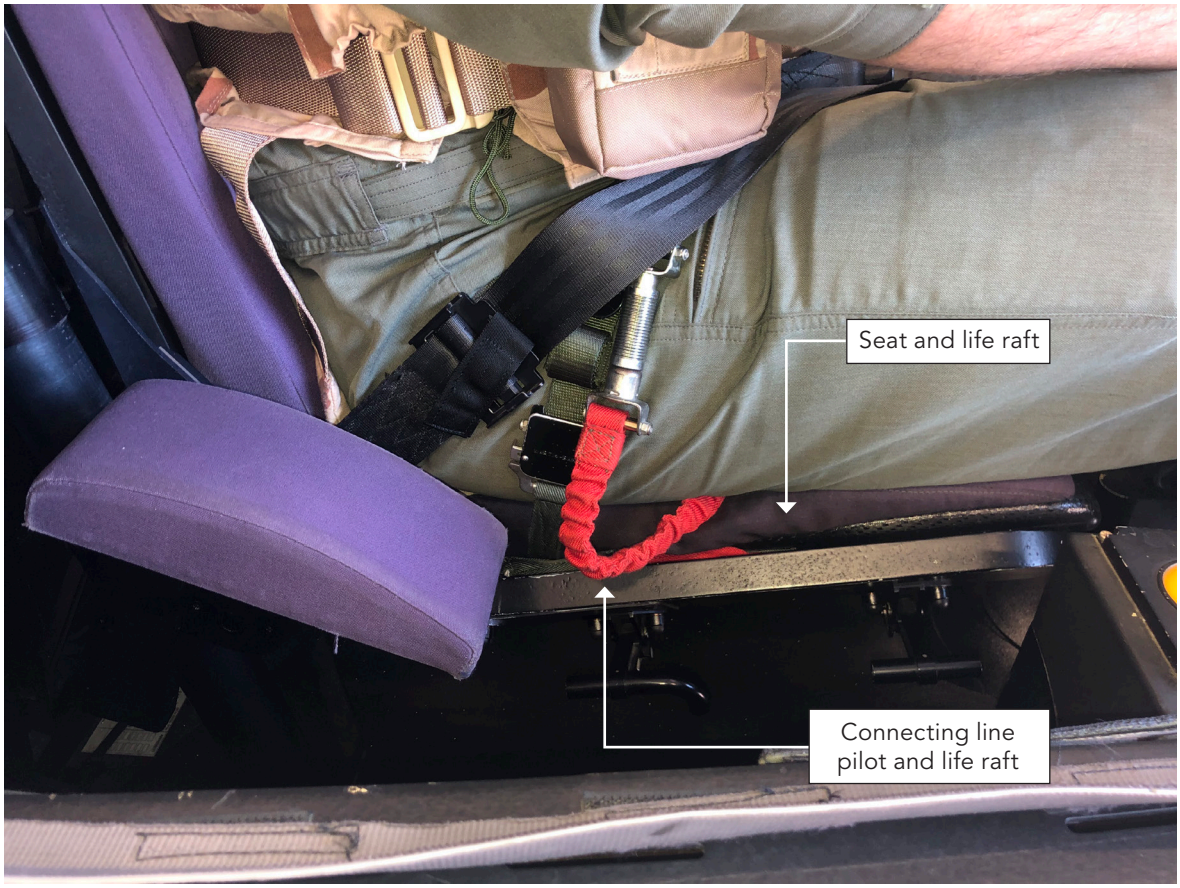



*Figure 7: Example of the seating position of the pilot on the seat and life raft with connecting line. (Source: Dutch Safety Board)*

Photographs taken ten minutes following the crash from HNLMS Groningen (Figure 8) show that the pilot's life raft did deploy but remained in position since it was joined to the pilot. The life raft will in fact only be activated if the connecting line between the pilot and the life raft is pulled with some force.

It was not until the connecting line between the pilot and the life raft was cut (approximately 21 minutes after the accident) that the life raft floated away, and the pilot was released from the helicopter.

Following the impact, the tacco was not able to independently evacuate the aircraft. The tacco was located seated and restrained by his straps. It was noticeable that the tacco's lifejacket had inflated. These lifejackets are not self-inflating. It is therefore possible that he himself inflated the lifejacket. After the belt release mechanism was pressed, which was achieved problem-free, the tacco was immediately released. He was brought on board the Frisc after fifty minutes.


*Figure 8: The aircraft, floating upside down, approximately 10 minutes after the impact. (Source: Royal Netherlands Navy)*

Following the impact, the pilot was able to escape from the aircraft following the impact, but remained entangled under water. The tacco was unable to free himself.

Both died as a result of drowning, but the physical injuries as a result of the impact were limited. As a consequence, there is no medical explanation for the inability to escape from the helicopter.

## 4.7 Rescue operation

Following the helicopter ditching in the sea, a large-scale rescue operation was launched. The operation was initiated from HNLMS Groningen and supported by the Coastguard. As well as deploying ships, a helicopter and an aeroplane, the Coastguard flew in a medic[13] and divers. The Coastguard also later contributed to the search operation for the RBA.

HNLMS Groningen is an Ocean Going Patrol Vessel (OPV) of the Holland class, and its operational task is that of station ship. For the Holland class, a modular crewing concept was chosen, whereby the size and composition of the crew is dependent on the operational task. The training programme and equipment are also adapted to the task set. All roles are undertaken in teams with the crew allocated to specific teams in advance. In other words, crew members are allocated to multiple teams. This form of organization meant that during the rescue operation, crew members were forced to make choices between the different roles to be fulfilled. Although these choices in no way influenced the level of effort, it did mean that rapid situational decisions had to be taken in making choices.

The crew demonstrated huge efforts and dedication, but it did also emerge that the capacity of the station ship to take effective action in the event of disasters such as undertaking a rescue from a wreck, is limited. This applies to a rescue following a helicopter ditching at sea, but would certainly also apply in the event of disasters involving other aircraft or shipping-related accidents. Deployment in the Caribbean area means that the station ship is operational in an area in which, given the nature of the operational task, there is an increased probability of deployments of this kind. The initial investigation revealed that for example the swimmers are trained to rescue a man overboard, but are not trained to rescue victims from a helicopter or aeroplane. The autonomously operating station ship HNLMS Groningen does not have divers on board to perform this task.

The ship does have its own medical staff, including a doctor and a nurse. In the event of escalation, there is also a medical response service, according to which additional crew members are deployed to provide medical assistance. To provide care to the four victims, the teams had to be redistributed: two teams for resuscitation at two different locations and one team for the medical examination of the two survivors. The teams subsequently received support from the experienced medic flown in by the Coastguard.

During this initial investigation, it emerged that crew members of HNLMS Groningen put a lot of effort in their attempts to rescue the helicopter crew. However, it is questionable whether a risk assessment was carried out in advance of whether the station ship was sufficiently capable of carrying out a rescue operation of this kind, in terms of crew size, composition and role distribution.

13 Nurse with operational field experience.

It has been determined that the ship lacked sufficient resources, for example the absence of divers. The question also remains whether a careful assessment was carried out in advance in preparing for a disaster with multiple victims. The modular crewing concept on the ships of the Holland class, at least during this deployment, did not foresee this situation.

Were the station ship and its crew sufficiently equipped and prepared to rescue the crew members of the NH90 helicopter floating in the immediate proximity of the ship?

# 5 CONCLUSIONS

The following conclusions can be drawn on the basis of the initial investigation.

Based on the logbooks and the initial analysis of the essential parameters, it has been determined that the aircraft revealed no technical non-conformities.

The analysis of the history and data in phase one of the investigation did not reveal any technical non-conformity in respect of the aircraft. The engine speeds and temperatures of both gas turbines, torque delivered and rotation speed of the main rotor revealed no non-conformities.

The uncontrolled descent was initiated by the combination of reduction of the IAS and the engine power setting selected at the moment.

During the course of the flight, during the downwind turn, the aircraft found itself in a situation in which it was hovering stationary in relation to the surrounding air. It has been determined that given the airspeed at that moment, the selected power was insufficient to maintain its height. As a consequence, the helicopter slowly lost height.

At the moment when the rapid descent occurred, the flying height was insufficient for a realistic possibility of recovery from the situation described above.

The personal lifejackets worn, the use of which had not been trained, hindered the rapid escape of the backseaters and reduced their chances of survival.

The backseaters escaped successfully, but were seriously hindered by their inability to open the quick release mechanism, and the changed position of the emergency oxygen bottle on the new model lifejacket. The crew had received no simulator or other training in the use of these lifejackets.

After ditching in the water, the pilot was able to exit the aircraft, but remained connected to the aircraft. The tacco was unable to free himself.

Both died as a result of drowning, but the physical injuries as a result of the impact were limited. As such, there is no medical explanation for the inability to escape from the helicopter.

The cause of death of both pilot and tacco was drowning. Following the impact, the pilot was able to exit the aircraft, but became entangled underwater. The tacco was unable to free himself, and was found still fastened to his seat. The initial investigation revealed no indications that suggest that the tacco would have been unable to escape on medical grounds, as a result of injury or entrapment.

Were the station ship and its crew sufficiently equipped and prepared to rescue the crew members of the NH90 helicopter floating in the immediate proximity of the ship?

During this initial investigation, it emerged that crew members of HNLMS Groningen made every possible effort in their attempts to rescue the helicopter crew. Nonetheless, the question remains whether the station ship was sufficiently trained in terms of crew size, composition and role distribution system to carry out a rescue operation of this kind. It has been determined that the ship was under-resourced for this task; there were, for example, no divers on board.

These conclusions led the Dutch Safety Board to pose a series of follow-up questions (see Chapter 6). The Safety Board recommends that the Defence Safety Inspectorate includes these questions in its investigation into the accident involving the NH90.

# 6 FOLLOW-UP QUESTIONS

In this initial investigation, the Dutch Safety Board has made a number of findings and has drawn conclusions focusing primarily on the course of events surrounding the accident. The results of the initial investigation by the Safety Board reveal a number of follow-up questions that will have to be answered, in order to learn lessons from this accident and to bring about safety improvements.

The Dutch Safety Board assumes that in its investigation, the Defence Safety Inspectorate will offer further verification and investigate the various issues in greater depth. The Dutch Safety Board would like to draw attention to at least the following subjects and questions.

**Training**
Previous investigations by the Dutch Safety Board into occurrences within the Defence organization determined that policy choices in respect of capacity and training have contributed to the occurrence of serious incidents. Whether that was also the case here, will have to be investigated.

The course of events surrounding this occurrence also raises questions about the structural nature of the training provided:

- To what extent are the training in and the use of equipment by the crews of the NH90 helicopter realistic and sufficient to improve chances of survival following a ditching?
- To what extent are pilots sufficiently trained to improve chances that they do not find themselves in such a situation?
- To what extent are training and use of equipment by the ship's crew realistic and sufficient to carry out rescue operations, for example involving a crash or the loss of a ship in the proximity of the station ship?

**Choice for single pilot configuration**
When the NH90 helicopter was introduced to the Netherlands, the Navy decided on a single pilot configuration for the helicopter.

- To what extent was the assessment of safety risks in the event of multitasking taken into account in the choice of a single pilot configuration?
- To what extent would a second pilot provide redundancy in task implementation, and could this make a difference in a similar situation?

**Modular crewing concept**
When ships of the Holland class were introduced, a modular crewing concept was chosen, whereby the size and composition of the crew is dependent on the operational task.

- To what extent was the assessment of safety risks in the event of rescue operations taken into account in the choice of the modular crewing concept?

- To what extent is a risk assessment (preparation of crew and resources on the station ship for rescuing people from a crashed aircraft or ships in distress) also made in respect of the task setting in the Caribbean?

# APPENDIX A

## GENERAL DETAILS

| | |
|---|---|
| Classification | Accident |
| Date and time of occurrence | 19 July 2020, 18.30 UTC |
| Location | 10 Nm west of Aruba |
| Aircraft registration | N-324 |
| Type classification | NH90 |
| Aircraft type | Helicopter |
| Flight type | Deck landing training for flight deck officer |
| Phase of the flight | Outward flight following take-off, eighth run |
| Damage to the aircraft | Total write-off |
| Number crew members | 4 |
| Number of passengers | 0 |
| Personal injury | 2 dead, 2 survivors (physically unharmed) |
| Other damage | Psychological impact on part of crew of HNLMS Groningen |
| Light conditions | Daylight |

| | |
|---|---|
| Manufacturer | NH Industries, Tessera (Italy) |
| Model | NH90 NATO Frigate Helicopter (NFH) |
| ICAO-Type | NH90 |
| Year of manufacture | 2015 |
| Serial number | 1324 |
| Handover date | 08-04-2015 |
| Engine(s) | 2x RR Turbomeca RTM322-01/9 turboshaft, 1,662kW |
| Aircraft flying hours (hr) | 890.6 |
| Engine 1 (hr) | 595.5 |
| Engine 2 (hr) | 566.8 |
| Number of landings | 2510 |
| Seats | 4 crew members |
| Weight (empty \| kg) | 6400 |
| Weight (max \| kg) | 10600 |
| Maximum speed (km/h) | 300 |
| Air speed (km/h) | 260 |
| Length (m) | 19.56 |
| Width (m) | 3.63 |
| Height (m) | 5.23 |
| Main rotor diameter (m) | 16.30 |
| Tail rotor diameter (m) | 3.20 |

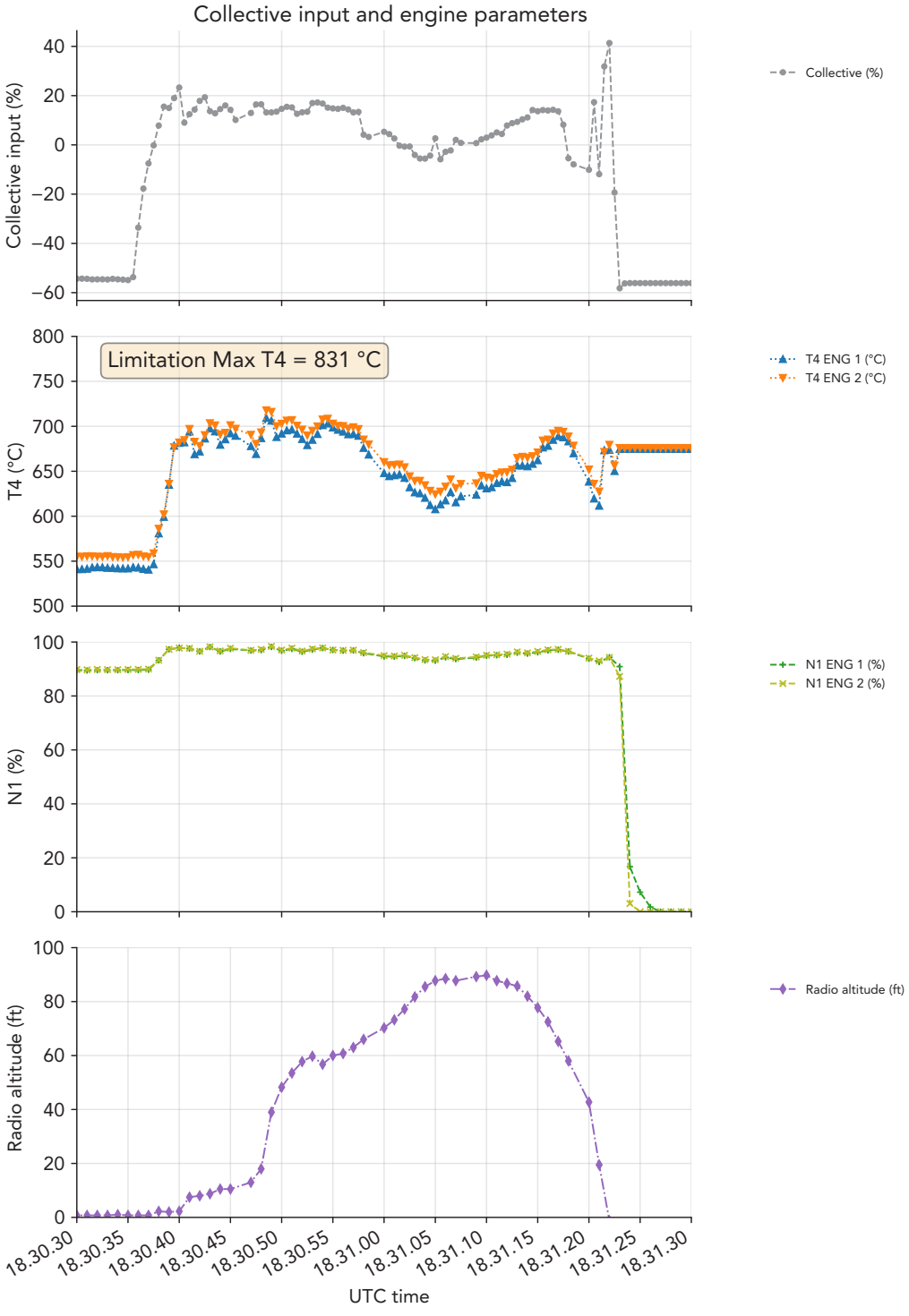
| Pilot | |
|---|---|
| Pilot | PIC |
| Age (years) | 34 |
| Total flying hours (hr) | 1679 |
| NH90 flying hours (hr) | 724 |
| PIC NH90 flying hours (hr) | 306 |
| Flying hours simulator (hr) | 310 |
| Last 90 days (hr) | 41.3 |
| Last 28 days (hr) | 18.5 |
| Last 24 hours (hr) | 1.5 (day of the fatal flight) |

| Tacco | |
|---|---|
| Age (years) | 33 |
| Flying hours COP NH90 (hr) | 0 |
| Total flying hours | 295 |
| Flying hours NH90 | 281 |
| Flying hours simulator | 206 |

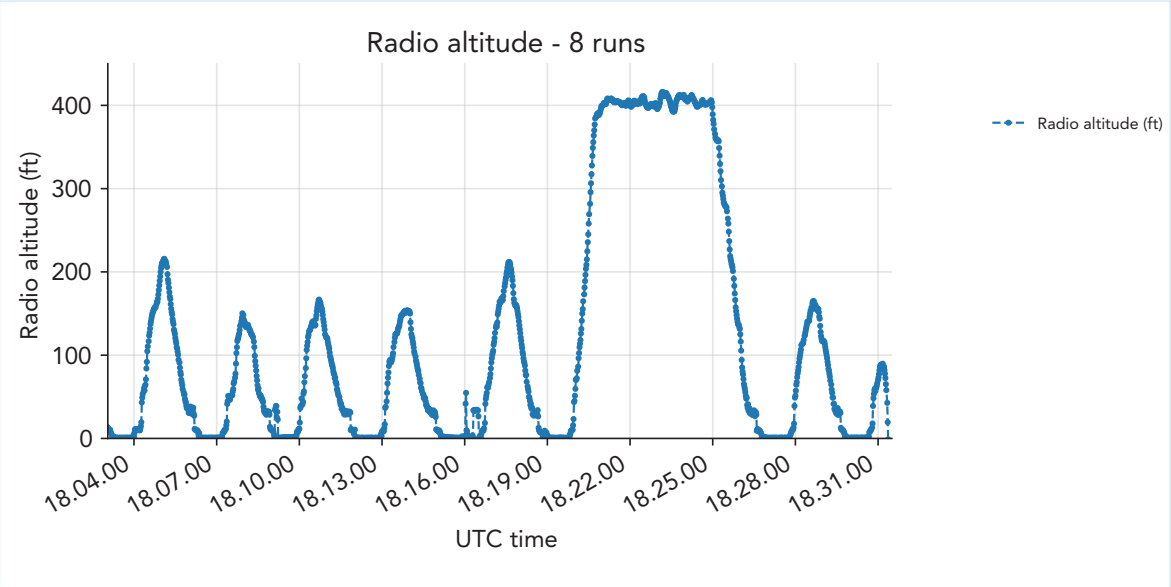
| Sensop | |
|---|---|
| Total flying hours | 167 |
| Flying hours NH90 | 167 |
| Flying hours simulator | 57 |

| Rescue Operator Airborne Marksman | |
|---|---|
| Total flying hours | 525.9 |
| Flying hours NH90 | 375 |
| Flying hours simulator | 0 |

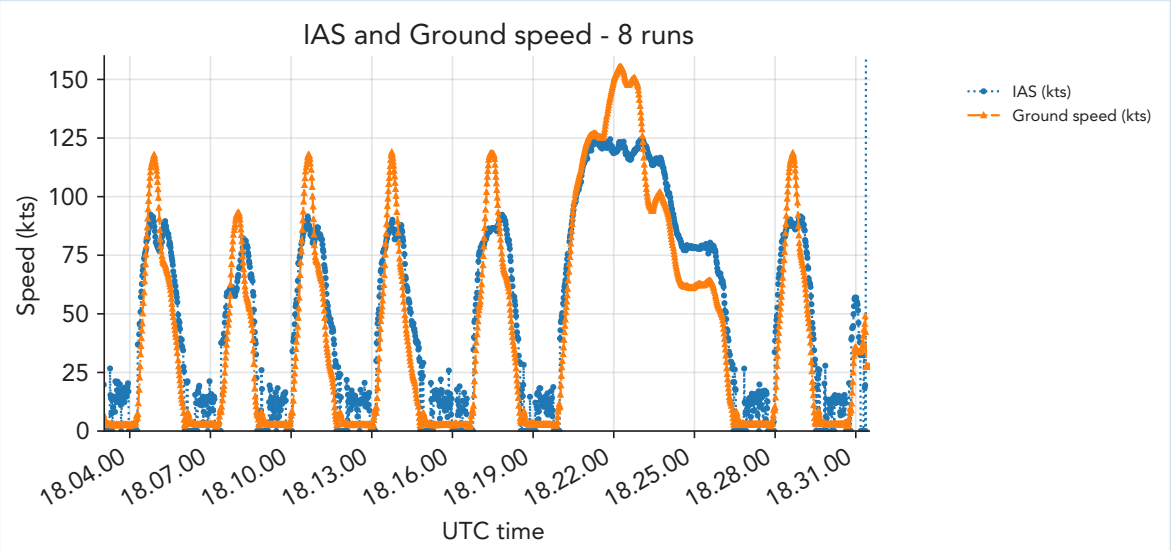
## GRAPHS




*Graph 1: Example of a number of technical parameter readouts during the last run. Time in UTC. (Source: Readout of data recorder by Dutch Safety Board)*




*Graph 2: Outward flying altitude eight runs. During run 8, the maximum flying altitude was 89 ft. Time in UTC. (Source: Readout of data recorder by Dutch Safety Board)*




*Graph 3: Indicated Air Speed versus Ground Speed during the eight runs. Time in UTC. (Source: Readout of data recorder by Dutch Safety Board)*

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