

Investigation Report

Identification

Type of Occurrence:	Accident
Date:	22 August 2009
Location:	Hamburg Harbour
Aircraft:	Airplane
Manufacturer / Model:	Cessna Aircraft Company / Cessna T206H
Injuries to Persons:	Two passengers fatally injured, pilot suffered minor injuries
Damage to Aircraft:	Aircraft seriously damaged
Other Damage:	None
Source of Information:	Investigation by BFU
State File Number:	BFU 3X131-0/09

Factual Information

History of the Flight

The pilot took-off with a Cessna T206H amphibian airplane at Hamburg-Fuhlsbüttel Airport towards Hamburg Harbour at 1245 hrs ¹ with two passengers on board.

¹ All times local, unless otherwise stated

The pilot stated that Fuhlsbüttel Tower instructed him, to perform an immediate left turn after take-off, in order to clear the runway for landing traffic. According to radar data, the seaplane made a turn in southerly direction towards the Alster after leaving runway 23 in Fuhlsbüttel. An altitude of approximately 1,300 ft was reached at that point. After passing the Alster, the seaplane proceeded toward the “Landungsbrücken” to the river Elbe. South of the Norderelbe the plane flew a kind of left hand traffic pattern in order to land in the Baakenhafen in westerly direction. According to radar data, the ground speed was between 70 to 80 kt during the flight.

The pilot stated that he wanted to land in the Baakenhafen in south-westerly direction. He checked the suitability of the landing area during the crosswind and downwind leg and reported the intended landing to his seaplane station. He performed the first “pre-landing check” during the downwind leg. According to his statement he checked whether the water rudder were retracted, opened the cooling flaps for the engine, set the landing flaps to 10 degrees, adjusted the mixture to “rich”, set the propeller to low pitch, checked the landing gear control lights and the mechanical landing gear indicator on the left float. The pilot stated that the indication wire was not visible on the float. In the base leg he repeated the “pre-landing check” and set landing flaps to 20 degrees.

Witnesses saw the aircraft at 1252 hrs with extended landing gear approaching for a water landing in the Baakenhafen. After the flare, the floats touched the water surface and the aircraft immediately nosed over.

The pilot was able to rescue himself from the aircraft floating upside down and by diving several times tried to rescue the two passengers from the cabin. Only the rescue divers from the fire services, who arrived a short time later, were able to rescue the passengers. The passengers did not survive.

Personnel Information

The 42-year-old pilot held an Airline Transport Pilot License (ATPL (A)) valid until 19 May 2010, first issued on 10 November 1999. The license included instrument rating and the ratings as pilot in command for the types C500/550/560, C525, SE piston (land) and SE piston (sea). He held a Class 1 Medical Certificate without

limitations, valid until 28 August 2009. Furthermore, the pilot held a Commercial Pilot License Helicopter (CPL(H)).

The pilot's flying experience was:

On 10 August 2009, total:	approx. 7,141 hours
Airplanes:	approx. 5,340 hours
Water airplanes:	approx. 34 hours
On Cessna 206:	approx. 60 hours
Helicopter:	approx. 1,801 hours

Since 1996, the pilot held a certification about good knowledge of harbour traffic law and maritime law, navigation buoys and signals, light guidance, traffic rules and behaviour under certain conditions.

During his seaplane training, the pilot flew approximately 9 hours on Piper PA18 and performed 53 landings on water. During instruction on Cessna 206 he flew approximately 6 hours and performed 36 landings on water. During his familiarization on site in Hamburg, the pilot flew 18 hours and 40 minutes under supervision and performed 73 landings on water. After the end of the supervision, from 15 August 2009 until the day of the accident, the pilot flew 30 times as pilot in command with the Cessna T206H and performed 25 landings on water.

The pilot worked as a freelance pilot for the operator.

Aircraft Information

The Cessna T206H, serial number T20608740, was a high-wing aircraft with 6 seats, built in 2007. The airplane was equipped with a Lycoming TIO-540 AJ1A engine, a Garmin-G1000-avionics system with two screens, and amphibian floats for landings on water and on land. The maximum take-off mass of the airplane was 1,724 kg. The airplane was built as an amphibian aircraft. The Cessna T206H had a total of three doors: One cabin door on each side in the front, and a double freight compartment door on the rear right side for the passengers of the middle and back rows. With extended flaps it was impossible to open the front double freight compartment door. The aircraft was airworthy and had a valid German certificate of registration. The last annual inspection was performed on 19 May 2009, and the last 25-hour check on 2 August 2009 at a flight time of 142 hours and 19 minutes. The total operating hours were approximately 170 hours. The hobbs meter showed 318.7 hours.



Airplane with extended landing gear

Photo: Trede

The used floats of the type Wipline, model 3450 A were manufactured by Wipaire. Each was equipped with two retractable wheels for landings on solid surfaces. These wheels were extended and retracted hydro-mechanically. The position of the wheels was indicated to the pilot by means of four blue lights (retracted position for landings on water) and four green lights (extended position for landings on solid surfaces). Additionally, each float was equipped with a mechanical indication for the position of the landing gear.



Electrical landing gear indicator in the cockpit and mechanical landing gear indicator on the floats

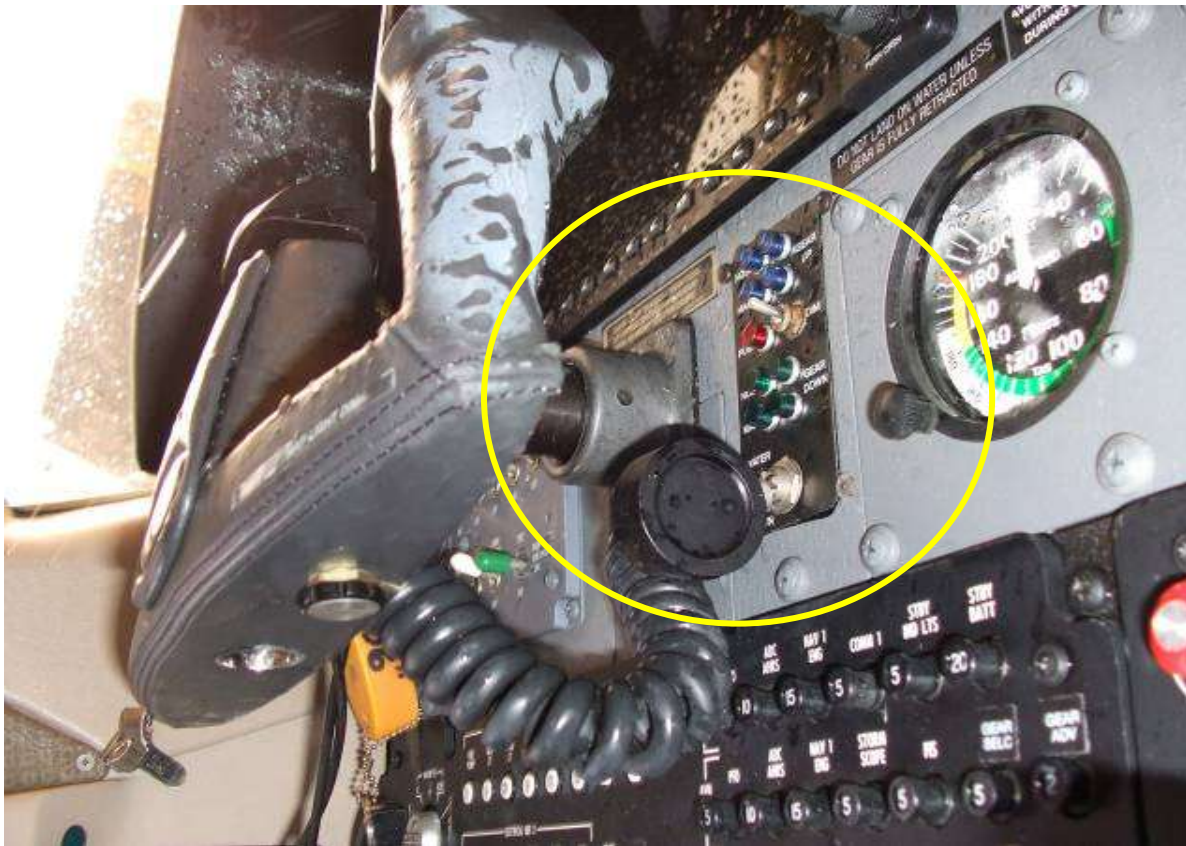
Photos: BFU

In addition, the airplane was equipped with an Amphibian Landing Gear Position Advisory System (audio announcement) as a reminder for the actual position of the landing gear.

When the air speed falls below 80-85 kt, this system is activated and continuously repeats the sentence: “Gear is up for water landing” or “Gear is down for runway landing”. This announcement is made until the pilot switches it off by pressing an orange-coloured push switch on the instrument panel.

The lever for operating the landing gear was on the right side behind the pilot’s control column. The lever was black; the instrument panel was grey or black, respectively.

The European and American Construction Specifications (CS23 and CFR 23, respectively) require in paragraph 23.777, Cockpit Controls, that the landing gear control lever must be located to the left of the throttle levers.



Landing gear operating lever on the right side behind the control column

Photo: BFU

Meteorological Information

According to the Meteorological Aviation Report (METAR) of Hamburg-Fuhlsbüttel Airport, at the time of the accident there was a visibility of more than 10 km, wind from 250° with 10 kt, light clouds (FEW) in 4,000 ft GND, and a temperature of 10°C with a dewpoint of 10°C. Air pressure (QNH) was 1,022 hPa.

Communications

The radio communication with Hamburg Airport was recorded and made available for the investigation. For technical reasons, radio communication was recorded as soon as a carrier wave was received. The air navigation service company could not provide a chronologically uninterrupted recording from the start of the aircraft until it left the radio frequency.

Radio communication with the seaplane station was not recorded.

Aerodrome Information

The aircraft took-off from Hamburg Airport (EDDH). This airport is located in the north of the urban area of Hamburg at an elevation of 53 ft MSL. It has two crossing concrete runways in the directions 05/23 and 15/33.

The landing was planned on the water aerodrome Hamburg-Norderelbe in the Hamburg Harbour, in the western part of the Baakenhafen. The water aerodrome extends from river kilometre 620.5 to 622.0 on the Norderelbe, including the water surfaces up to the half of the Baakenhafen, measured from the entrance to the inner harbour. The water aerodrome Hamburg-Norderelbe is located within the control zone (Airspace D) of Hamburg Airport.

Flight Recorders

The aircraft was neither equipped with a cockpit voice recorder nor a flight data recorder. These recording devices were not mandatory.

The flight path was recorded by radar and radio communications with Hamburg Airport electronically.

Wreckage and Impact Information

The aircraft floated upside down in the Baakenhafen next to Warehouse 29. After the recovery with the help of a crane, the following findings were made: The cabin doors and the front freight compartment door were open. The control system was free, the flaps retracted, the water rudders at the floats were up, and the engine cooling flaps in the engine cowling were open. The engine power levers were set at maximum power, the ignition key was set to the position "Both", the elevator and rudder trim was in neutral position. All electrical fuses were pushed in. The cabin ventilation lever was pulled. The tank selector switch was set to "Both" and the landing gear lever to "Land Down". The switch for the brightness of the landing gear lights was set to bright. The mechanical landing gear indications in form of coloured steel wires were not visible. After opening the covers, the indicators flipped out and indicated "Gear down". The wheel landing gear was extended. The emergency actuator for the wheel landing gear was set to neutral. The hydraulic lines for landing gear operation were continuously connected from the reservoir up to the cylinders and did not show any

signs of leakage. The engine and the propeller did not show external damage. The wind screen was broken. The airbag safety belts were not activated; the seat belt buckles were open.

Fire

There was no fire.

Survival Aspects

The persons on board did not wear life jackets. These were below the seats during the flight. How to don and operate the life jackets was explained prior to the flight to Hamburg-Fuhlsbüttel. Live saving appliances were provided at the seaplane station, located in a distance of approximately 1.8 km from the accident site.

The aircraft nosed over and the wind screen broke. The cabin was immediately filled with water. The persons hung upside down in the safety belts of their seats. The water of the river Elbe had a temperature of approx. 21°C and was very muddy.

Rescue divers of the fire services recovered the two passengers 37 minutes and 40 minutes, respectively, after the accident.

Organisational and Management Information

The flight was a commercial sightseeing flight over the Hanseatic City of Hamburg.

The operator held a certificate for commercial sightseeing flights according to Federal Aviation Act, paragraph 20 (Luftverkehrsgesetz, LuftVG) issued by the Regional Council Stuttgart. The company operated several seaplanes from different locations.

The flight operation at the water aerodrome Hamburg-Norderelbe, the sightseeing flight routes to be adhered to and the minimum altitude over Hamburg of 2,000 ft were determined and approved by the Municipal Authority Economy and Labour Free Hanseatic City of Hamburg. The flight operation approval required, among other things, the provision of live saving appliances at the seaplane station, the wearing of life jackets aboard the airplane, and certain physical requirements of the pilot with respect to his ability of saving passengers from a capsized airplane. Furthermore, 10

flights under supervision as well as 30 take-offs and landings were required. The successful instruction of the pilot was certified on 14 August 2009.

Moreover, radio communications between the seaplane station and the aircraft were required. In daily flight operations, the pilot reported the take-off and the intended landing during the approach; the seaplane station was responsible for keeping the main flight log.

The operator and the aircraft in question held a special permission issued by the harbour police for take-offs and landings in the area of Hamburg Harbour, valid until 31 December 2010.

The operator stated that a female employee of the seaplane station gave the passengers safety instructions prior to the flight. It was demonstrated how to don the life jackets and how to use the safety belts. The pilot explained the functioning of the doors prior to the flight.

The checklist found aboard the aircraft in the left side pocket beside the pilot (see Appendix) included four yellow Din A 5 pages duplex printed for “Normal Procedures” and four pages duplex printed for “Limitations”. The pages were loosely connected by two key rings. After take-off the climb check instructs the pilot to retract the landing gear. During the pre-landing check, the landing gear has to be extended according to requirements. The checklist did neither include an instruction for checking the landing gear indications nor a note to the correct position of the landing gear for water or ground landings, respectively.

The Operations Manual (OM) of the operator did not specify standardized procedures for using the checklist during the flight.

All of the company’s aircraft equipped with amphibian floats were additionally equipped with the “Amphibian Landing Gear Position Advisory System”.

Additional Information

According to an evaluation of the Seaplane Pilots Association (SPA), of the 465 flight accidents notified to the National Transport Safety Board (NTSB) from 1995 to 2004, there were 20 accidents with extended landing gear.

The Transport Canada publication “Flying with Floats“ lists landing on water with extended landing gear as one of the ten most common causes for accidents with amphibian airplanes.

In Germany, there was one flight accident in 1985 and another in 2002 with amphibian airplanes due to an extended landing gear during water landing.

Analysis

The pilot held the required licenses and ratings. He had a very good, long-time professional and overall flight experience. However, his experience with respect to the specifics of seaplane operation was low.

The amphibian aircraft was as good as new. It had a valid certificate and was properly maintained. There were no indications of technical problems. The centre of gravity was within limits; the maximum take-off mass was not exceeded.

The flight weather was good and did not influence the flight except for the landing direction to be chosen.

The findings on the wreckage, the pictures of the airplane during approach and the witness statements showed that the landing gear was extended during the landing on water. The resulting deceleration and the high centre of gravity of the airplane caused an immediate nose-over after contact with the surface of the water.

Accidents with seaplanes fitted with amphibian floats occurred time and again in the past due to extended landing gears. This seems to be comparable to the observed frequency of land airplanes performing landings with retracted landing gears.

Publications on the topic of human performance and of flying aircraft with retractable landing gear discussed repeatedly that the extension of a landing gear, or retraction of a landing gear in case of amphibian aircraft, can be forgotten, resulting in a belly landing or a nose-over, respectively, with an intact airplane in spite of all warning devices. In general, routine in the always re-occurring checks was stated as the cause, leading to a distraction of the pilot and thus resulting in the incomplete processing of the check. In other cases there was a distraction of the pilot due to multiple tasks during the flight, in the course of which the landing check and the landing gear were completely forgotten.

In order to avoid similar incidents, it is common on military airports of the German Federal Armed Forces and stipulated in the air traffic control procedures (BesAnMilFS 2-100, paragraph 466, item 7) that the pilot of an airplane in final approach to land is asked by the Tower via radio communication whether the landing gear is extended and locked. The change in procedure occurred due to experiences with landings of military aircraft with retracted landing gears in spite of check lists, warning devices and, partially, two-man crews in the cockpit.

The seven minutes long accident flight was a commercial sightseeing flight for visitors over the Hanseatic City of Hamburg. Therefore, the pilot had - apart from piloting the plane - the role of city guide and customer care service. The take-off was performed on a frequented airport with corresponding procedures. The flight took place in a control zone in which several aircraft flew at the same time, using the same control frequency. Radio contact had to be established to the seaplane station during the approach, because there were frequent radio communications problems after the landing due to the buildings in the harbour. During landing, shipping traffic had to be observed and a sufficiently free surface chosen while taking wind conditions into account. After the take-off in Hamburg-Fuhlsbüttel the airplane had to be reconfigured, which means retracting the flaps, closing the engine cooling flaps, retracting the landing gear and trim the airplane. The pilot stated that he was interrupted during the climb check, because immediately after take-off he was instructed via radio to turn left to make room for approaching traffic. It was not possible to confirm or exclude a corresponding instruction, because an uninterrupted radio communication recording of the air navigation service company was not available for investigation. During the short flight, the aircraft was reconfigured for the approach, even before reaching the minimum altitude over the city of Hamburg. For this, the pilot performed the "pre-landing check". These tasks and activities in the short time span of seven minutes led to a multiple workload of the pilot.

In aviation, checklists are used in order to process complex situations and to reduce workloads. Checklists support aircraft crews in particular in situations under time pressure or during a decision-making process when a multitude of information has to be evaluated.

The operator in question used a self-made checklist. The layout of this checklist was monotonous; the significance of the correct landing gear position did not become clear in the pre-landing check under the item “gear – as required”.

In general it is common to differ between water landing and ground landing and to prepare two different checklists according to the landing type. This procedure is specified in the Aircraft Flight Manual (AFM) Supplement of the Cessna Amphibian Model T 206H (see Appendix). The AFM required as control item for water landings “Landing Gear – UP, Landing Gear Lights – 4 BLUE (check on)” and “Landing Gear Position – CONFIRM VISUALLY”, and for ground landings: “Landing Gear – DOWN, Landing Gear Lights – 4 GREEN (check on)” and “Landing Gear Position – CONFIRM VISUALLY”.

From the BFU’s point of view, it is questionable whether the pilot used the checklist, because during performance of the required tasks of the individual check items no hand was free, on top of piloting the aircraft with one hand and operating levers and switches with the other, to hold the loosely tacked check list. The operator did not have standardized procedures with respect to the use of this checklist.

The expected workloads during flight operation were known to the operator. Therefore, a pilot with a high total flying experience was used and adequate numbers of supervised flights were conducted. Furthermore, the aircraft used by the operator were equipped with an additional warning device with respect to the landing gear, the acoustic announcement over the headphones.

It must be assumed that the four green lights of the landing gear indication were on. The position of the entire landing gear control device behind the control column is disadvantageous. However, the position complied with the specifications of the design requirements. The landing gear indicator lights were below the large, multi-coloured displays for attitude, navigation and engine monitoring and were compared to the displays quite unobtrusive. The big, obtrusively shaped landing gear lever did not stand out too much from the instrument panel due to its black colour. Due to standardisation purposes for the layout of cockpit controls, a safety recommendation concerning the position of the landing gear lever was not considered.

The pilot stated that the mechanical indication on the left float was not visible; this was confirmed after recovery of the airplane. The pilot and representatives of the operator stated that in the past it had happened that the indicating wire was pressed into the float by embarking passengers if they happened to step onto the wire. It is

also possible that the water pressure forced the indicating wires into the floats during the nose-over since the wires on both sides were found inside the floats. The pilot could not remember the acoustic announcement about the actual landing gear position. It is highly probable that this equipment was not activated, because - according to the radar recordings - during the entire flight the airplane was flying in a speed range below the activation speed.

The pilot stated that he was not aware of the fact that the landing gear was extended until the seaplane nosed over. Had he been in doubt about the correct position of the landing gear or doubted the indicators, he could have looked along the floats where the respective retracted nose wheel would have been visible. During the performed checks, it is highly probable that the green lights of the landing gear indication gave a false sense of safety to the pilot, who had a high flying experience on landplanes with retractable landing gears. Even more so because the colour green usually suggests something is correct.

Immediately after the nose-over, the persons hung upside down in their safety belts. It is highly probable that the passengers could not find the safety belt buckle in the muddy water and orientate themselves in the cabin.

Conclusions

The accident is due to a water landing with extended landing gear. After take-off from land the gear was not retracted; this was not noticed until the landing.

Contributing factors to the accident were:

- a high work load
- unsuitable control points in the used checklist and unsuitable procedures in the company
- the low flying experience of the pilot concerning the specifics of seaplanes

Safety Recommendations

Actions by the operator:

Due to the accident, the operator issued a Flight Operation Instruction (01/2009). The instruction requires the pilots of the operator to inform the passengers of the

beginning of the approach to land, to cease all conversation with the passengers and to inform the seaplane station of the landing gear position via radio communications. The seaplane station then confirms the reported position of the landing gear and asks for verification.

The operator also introduced new checklists with colour coded check points in blue for water operation and green for land operation. For better handling of the checklists the format was also changed. The content of the checklists was changed according to the Aircraft Flight Manual; the Operations Manual now stipulates the use of the checklists.

Due to these actions by the operator the BFU has not issued any safety recommendations.

Investigator in charge: Axel Rokohl
Assistance: Uwe Berndt
Field investigation: Axel Rokohl, Ludik de Jelski

Appendices

CLIMB		BEFORE LANDING	
Gear	- up	Cabin	- secure
Wing Flaps	- up	Briefing	- completed
Airspeed	- 95 - 105 KIAS	Mixture control	- rich
Throttle	- 30 in.hg.	Propeller	- set
Propeller	- 2400 rpm	Gear	- as required
Mixture control	- 20 GPH or fully rich	Lights	- set
Cowl Flaps	- open	Autopilot	- off
Lights	- set	Cowl Flaps	- set
		Water rudders	- up
CRUISE		LANDING	
Power	- set	Airspeed	- 70 - 80 KIAS (FULL Flaps)
Cowl Flaps	- as required	Cowl Flaps	- open
		Gear	- rechecked
DESCENT			
Power	- adjust (Mixture, Prop, Throttle)		
Cowl Flaps	- closed		
Instruments / Ah	- set		
Lights	- set		
Fuel selector	- both		
Wing Flaps	- set (0° - 30°)		

Check list found in the airplane

Photo: BFU

**AMPHIBIAN
MODEL T206H**

AIRCRAFT FLIGHT MANUAL SUPPLEMENT

BEFORE LANDING

BEFORE LANDING ON WATER

1. Landing Gear – UP.
2. Landing Gear Lights – 4 BLUE (check on).
3. Landing Gear Position – CONFIRM VISUALLY.
4. Water Rudders – UP.
5. Wing Flaps – AS DESIRED (30° for short approach) (10° below 140 KIAS, 30° below 100 KIAS).
6. Airspeed – 85-95 KIAS (flaps up), 75-85 KIAS (flaps down). With restricted landing area approach at 76 KIAS with flaps 30°.

BEFORE LANDING ON LAND

1. Landing Gear – DOWN.
2. Landing Gear Lights – 4 GREEN (check on).
3. Landing Gear Position – CONFIRM VISUALLY.
4. Water Rudders – UP.
5. Wing Flaps – AS DESIRED (30° for short field approach) (10° below 140 KIAS, 30° below 100 KIAS).
6. Airspeed – 85-95 KIAS (flaps up), 75-85 KIAS (flaps down). With obstacles approach at 76 KIAS with flaps 30°.

LANDING

LANDING ON WATER

1. Touchdown – SLIGHTLY TAIL LOW.
2. Control Wheel – HOLD FULL AFT as amphibian decelerates to taxi speed.

NOTE

With forward loading, a slight nose-down pitch may occur if the elevator is not held full up as floatplane comes down off step.

LANDING ON LAND

1. Touchdown – SLIGHTLY TAIL LOW.
2. Control Wheel – LOWER NOSEWHEELS to runway.
3. Braking – USE AS REQUIRED.

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FEB 25, 2000

FAA APPROVED

Excerpt from the Aircraft Flight Manual

This investigation was conducted in accordance with the Federal German Law on the Investigation of Accidents and Incidents Associated with the Operation of Civil Aircraft (*Flugunfall-Untersuchungs-Gesetz - FIUUG*) of 26 August 1998.

The sole objective of the investigation is to prevent future accidents and incidents. The investigation does not seek to ascertain blame or apportion legal liability for any claims that may arise.

This document is a translation of the German Investigation Report. Although every effort was made for the translation to be accurate, in the event of any discrepancies the original German document is the authentic version.

Publisher

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