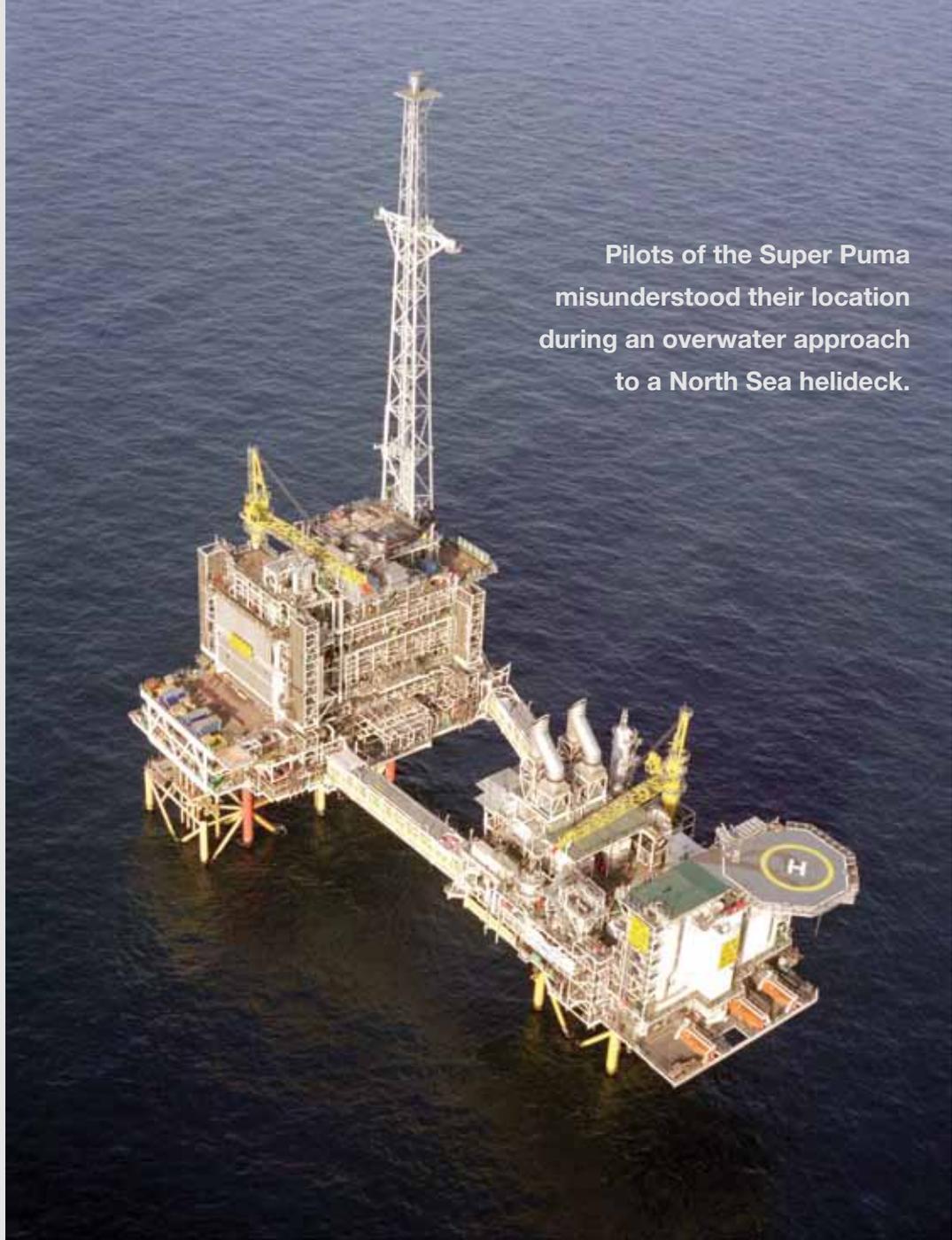


BY LINDA WERFELMAN

# Watery Illusions



Pilots of the Super Puma misunderstood their location during an overwater approach to a North Sea helideck.

Pilots of a Eurocopter EC225 LP Super Puma were afflicted with visual and sensory illusions and may have been confused by the reflection of an energy production platform on the water when their helicopter descended to the surface of the North Sea during an approach to the platform, accident investigators say.

The helicopter's flotation devices inflated automatically, keeping it on the water's surface, and all 18 people in the helicopter evacuated without injury, the U.K. Air Accidents Investigation Branch (AAIB) said in its final report on the Feb. 18, 2009, accident. The helicopter was destroyed by the

impact, the prolonged exposure to salt water and damage incurred during salvage operations.

The AAIB cited three causal factors:

- "The crew's perception of the position and orientation of the helicopter relative to the platform during the final approach was erroneous," and neither pilot realized that the helicopter was descending toward the water. "This was probably due to the effects of oculogravic and somatogravic illusions, combined with both pilots being focused on the platform and not monitoring the flight instruments."<sup>1</sup>

- Reduced visibility, probably because of fog or low clouds, “degraded the visual cues provided by the platform lighting, adding to the strength of the visual illusions during the final approach.”
- “The two radio altimeter–based audio-voice height alert warnings did not activate. The fixed 100-ft audio-voice alert failed ... due to a likely malfunction of the terrain awareness and warning system (TAWS), and the audio-voice element of the selectable 150-ft alert had been suspended by the crew. Had the latter not been suspended, it would also have failed to activate. The pilots were not aware of the inoperative state of the TAWS.”

Fog or low clouds during the approach probably degraded the visual cues provided by platform lighting, accident investigators said.

The AAIB cited as contributory the fact that “there was no specified night visual approach profile on which the crew could base their approach and minimum heights, and stabilized approach criteria were not specified.” A second contributory factor was that the crew’s “visual

picture on final approach was possibly confused by a reflection of the platform on the surface of the sea.”

The accident occurred at 1837 local time, about one hour after the helicopter’s departure from Aberdeen, Scotland, on a scheduled flight to the Eastern Trough Area Project (ETAP) central production facility platform, about 125 nm (232 km) east. That first leg of the flight was to have been followed by a second leg, to the Galaxy 1 rig, 13 nm (24 km) east-northeast

of the platform, and then by a return flight to Aberdeen (Figure 1).

The accident flight had been scheduled to allow the transfer of 16 passengers and cargo to the ETAP platform and the oil rig. It was the second flight of the day for both pilots, who at 1600 had completed a round trip of more than three hours between Aberdeen and an oil production vessel west of the Shetland Islands.

They began their preparations for the accident flight shortly after their return.

After starting the helicopter’s engines, they found that the airborne collision avoidance system (ACAS) was unable to complete a preflight test; it was turned off before the takeoff at 1742.

The helicopter climbed to 5,500 ft, and at 1755, the commander — the pilot flying — turned the ACAS back on; as he did, a TAWS caution caption was displayed. The caption cleared soon afterward, the AAIB report said, and there was no indication on the multi-function displays of a system failure.

At 1812, ETAP platform personnel told the crew that the cloud base had lowered to 600 ft, down from the 800 ft reported 10 minutes earlier, and that visibility was decreasing from 6 nm (11 km). The commander briefed for a straight-in airborne radar approach to the platform, to begin at 1,500 ft.

The crew saw what they believed to be the ETAP platform, about 13 nm (24 km) away. ETAP personnel, however, reported visibility at the platform of 0.5 nm (900 m). The copilot, who was conducting a passenger briefing, was unaware of the ETAP visibility report.

At 1828, the helicopter descended through 1,500 ft, and at 1831, it was 7 nm (13 km) from the ETAP and descending to 300 ft. Low clouds caused a loss of visual contact with the ETAP, and the crew climbed to 400 ft, regained visual contact and continued the approach.

At 1835, the helicopter descended to 300 ft, and the copilot announced, “just one mile to go.” The pilots could see a glowing flare on the platform but had difficulty seeing the platform’s lights.

At 1836, when the helicopter was 0.75 nm (1.39 km) from the platform, the commander

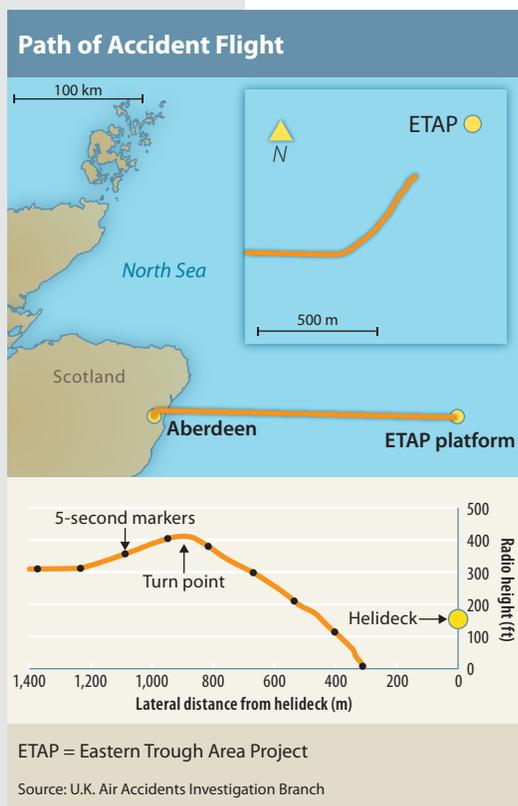


Figure 1

said, “OK. We’ll just stay on this heading, then go up,” and the copilot responded, “OK. ... If we make a second approach, I reckon we’ll get in.”

At 350 ft, the crew could again see the flare and diffused platform lights, and at 415 ft, the copilot could also see the green perimeter lighting on the helideck, 166 ft above sea level.

“The commander decoupled the upper modes of the AP [autopilot] and suspended the ‘CHECK HEIGHT’ aural alert that would have been activated as the aircraft passed through a height of 150 ft,” the report said. “However, the selected 150 ft height alert remained in the form of visual warnings displayed on each pilot’s primary flight display (PFD).” The report said that company procedures — spelled out in the final approach checklist for other helicopter models but not for the EC225 — called for setting a warning height of 150 ft for offshore approaches and suspending it after the pilots had visual contact with the platform in order to prevent nuisance warnings.

The commander began a 20-degree-banked left turn — a descending turn, the copilot said — and he told the copilot that, although he could see the flare and lights on the platform, he could not see the helideck. The copilot initially said that he could “see the deck right in front of us”; seconds later, he lost — and quickly regained — visual contact.

As the helicopter descended through 150 ft — the height at which the “CHECK HEIGHT” alert would have activated had it not been suspended — the commander “had the sensation that his approach was fast and high,” the report said. The indicated airspeed was 49 kt, and the descent rate, 1,096 fpm.

At 100 ft, the “ONE HUNDRED” aural alert failed to sound, the report said, noting that — unlike the aural alert at 150 ft — this warning cannot be suspended while TAWS is operating.

“Following this, both pilots’ attention was fully focused on the external visual picture,” the report said. “The copilot, believing that they were above the height of the deck and in close proximity to it, checked the radar for its range. He then advised the commander, ‘OK. Still

visual with the deck. Can you see, it’s right in front of you, to your right.’

“The commander could not see the helideck and started to ask the copilot ‘Who’s la... (nding),’ but his question was interrupted as the helicopter impacted the surface of the sea.”

After the flotation equipment inflated and the helicopter settled on the water, the commander shut down the engines, telling passengers not to evacuate until the rotors stopped. All passengers and crew exited and waited in life rafts for rescue personnel.

On the platform, the helicopter landing officer heard the splash of the helicopter hitting the water and “raised the alarm,” as did another platform worker.

At 1957, using radar, a “very weak” signal from a personal locator beacon, forward-looking infrared and visual guidance from platform personnel, the first search-and-rescue helicopter to arrive on the scene located the two life rafts, about 400 m (1,312 ft) from the platform. Other search-and-rescue helicopters arrived, and by 2028, both pilots and all 16 passengers had been rescued.

### Navy Training

The commander, 55, had 17,200 flight hours, including 3,018 hours in type, and an airline transport pilot license. He had been trained as a pilot in the Royal Navy, and, after leaving the navy, he flew for more than two decades for commercial operators, primarily in the offshore energy industry; he was hired by the operator in 2007. He completed a night deck competency check in January 2008 and was current in night deck landing practice.

The copilot, 32, had 1,300 flight hours, including 808 hours in type, and a commercial pilot license. He was a flight instructor before he began flying in North Sea offshore energy operations in 2007. He completed a night deck competency check in March 2008 and was current in night deck landing practice when the accident occurred.

Both pilots had completed all mandatory training and testing requirements.

The helicopter, which had accumulated 597 hours before the accident occurred, was

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manufactured and delivered to the operator in 2008, with modifications for North Sea operations. Later in the year, TAWS and ACAS were installed.

On Feb. 11, a pilot reported the ACAS inoperable, but a self-test was conducted and no problems were found. On Feb. 18, the accident crew flew the helicopter and reported heating and ventilation problems, which were corrected by maintenance personnel before the accident flight.

The report said that, although the helicopter's enhanced ground-proximity warning system (EGPWS) was equipped with the most current database, the investigation found that positions of some oil and gas rigs "might be inaccurate or out of date because they are occasionally moved. This had resulted in 'nuisance warnings.'"

The report also said that EGPWS alerts sometimes are triggered when helicopters approach platforms in high winds. As a result, to reduce the number of nuisance warnings, some operators exclude oil and gas platforms from the database, the report said, noting that the ETAP platform was not included.

### Extensive Offshore Experience

The operator had extensive experience in offshore helicopter operations. The company's operations manual did not include a specific night visual approach profile or monitoring procedure, the report said, adding that "the operator relied upon the minimum weather criteria providing sufficient visibility for a visual landing. If these criteria could not be maintained, an [airborne radar approach] was to be carried out."

Company procedures called for an audio warning and visual indications on the PFDs when the helicopter descended below 150 ft, although the audio warning could be suspended before activation. An additional audio warning was generated by TAWS when the radio altimeter showed the helicopter had reached 100 ft; this warning could not be suspended or canceled.

Company trainers had developed "detailed lesson plans" on the importance of using flight instruments and the specific illusions associated with the helicopter pitching up; neither pilot

could recall that this information was included in their training, however.

### 'Judgmental Exercise'

The sun set at the platform at 1701, about 90 minutes before the accident, which occurred in dark night conditions with no visible horizon, the report said. The moon was still below the



horizon, and overcast clouds obscured any illumination in the sky.

The report noted that an approach to an offshore landing area could be conducted visually, or as an instrument approach to a specified minimum descent altitude followed by a final segment to be flown visually.

"There are significant differences between the visual element of an approach carried out by day in good weather and an approach conducted at night," the report said. "By day, the visual cues afforded by the natural horizon and the disrupted surface of the sea provide good visual references to assist with pilot orientation and closure rate. At night, these visual cues become degraded or are nonexistent, depending on the level of celestial illumination."

The report described the approach to an offshore platform as "a judgmental exercise based on maintaining a height above the installation

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or vessel until adequate visual perspective of the helideck or structure is acquired to determine a sight-picture of the pilot’s required descent angle.”

In reduced visibility, pilots also rely on flight instruments, weather radar and/or global positioning system (GPS) equipment.

Pilots typically rely on the elliptical shape of the helideck to assess their approach angle, the report said.

“An optimum approach angle, when combined with a constant reduction in groundspeed, ensures that the helicopter arrives at a committal point from which the pilot can maneuver to a hover above the helideck for landing,” the report said.

**‘Can You See the Deck?’**

The report said that the commander had been flying the helicopter and maintaining visual contact with the platform while the copilot monitored flight instruments. However, after the commander asked, “Can you see the deck? That’s the problem,” the copilot switched his attention away from the instruments to look at the platform.

“Both pilots were focused on the external visual picture and, not appreciating that the helicopter was descending rapidly toward the surface of the sea, thought they were still above the helideck elevation,” the report said. “The commander was progressively pitching the helicopter’s nose up. This had the effect of maintaining the platform in the correct position in the windscreen, giving the impression that the descent angle was constant.”

If the pilots had been able to measure the helicopter’s changing height, range and groundspeed against a specific night visual approach profile, they would have been better able to evaluate their approach, identify an excessive descent rate and maintain a stabilized approach, the report said. Instead, without a visible horizon or other cues, the approach path appeared to be normal until about the last five seconds, when the helicopter appeared to become high and fast.

The report said that nonvisual cues, including the balance system of the inner ear, “would have been inadequate to support detection of the change in helicopter attitude, [and] the helicopter would have continued to feel level.”

In addition, “the appearance of the platform and its reflection on the surface of the sea, diffused by the fog/reduced visibility, could have been confusing,” the report said. “Orientation and position cues that might have been gleaned from details in the sight-picture were degraded, and the platform could have appeared nearer and lower than it actually was.”

The report also characterized a nighttime visual approach to an offshore helideck as “a demanding task that requires a combination of visual and instrument flying,” with a final approach track — flown “as close as possible into wind” — that may cause the helideck to be obscured by part of the installation.

“Improvements in the conspicuity of helidecks, using additional lighting to further assist crews in determining the shape and, consequently, an appreciation of their approach angle, is currently being undertaken by the CAA [U.K. Civil Aviation Authority],” the report said. The report added that a proposed light pattern was under consideration.

The report included 23 new safety recommendations from the AAIB, including calls for the CAA to review operator procedures to determine when a flight crew should suspend aural or visual height warnings associated with a radio altimeter and to “ensure that an appropriate defined response is specified when a height warning is activated.”

The AAIB also recommended that the European Aviation Safety Agency review the frequency of nuisance warnings from TAWS equipment in offshore helicopter operations and act to improve system integrity. 🌀

*This article is based on AAIB Aircraft Accident Report 1/2011, “Report on the Accident to Eurocopter EC225 LP Super Puma, G-REDU, Near the Eastern Trough Area Project (ETAP) Central Production Facility Platform in the North Sea, on 18 February 2009.” Sept. 14, 2011.*

**Note**

1. The report defined an oculogravic illusion as a “visual illusion that affects the apparent position of an object in the visual field.” A somatogravic illusion was defined as a “non-visual illusion that produces a false sensation of helicopter attitude.”

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