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Incident Over London Leads ATC to Reconsider Radar-vectoring Policy

When a flight crew communicated concerns about three operative engines after failure of the no. 1 engine on their Boeing 747 cargo aircraft, air traffic controllers' responses reflected unresolved issues in judging risks to people on the ground, said the U.K. Air Accidents Investigation Branch.

FSF Editorial Staff

A team of air traffic controllers — dealing with simultaneous risks to the flight crew of a disabled cargo aircraft near London, England, and to the people under its flight path — successfully provided emergency assistance despite incomplete information, according to the final incident report by the U.K. Air Accidents Investigation Branch (AAIB).[1]

"The aircraft diverted to the only airport that the flight crew considered suitable and, in the process, flew over some of the most congested parts of London in a gliding configuration from which a safe landing was not reasonably assured," the report said.

The flight crew of the Boeing 747-100, operated by Evergreen International Airlines, initially received air traffic control (ATC) radar vectors from the London Area Control Centre (LACC) to return to their departure airport, then for an emergency approach and landing at London Heathrow Airport at 1048 local time April 24, 2004. There were no injuries to the four people aboard the aircraft, and the aircraft was not damaged.

Addressing ATC risk definition and policy for vectoring an aircraft crew under circumstances comparable to this incident could enhance safety, the report said.

"It must be considered where the proper balance of safety rests when considering the plight of persons [aboard] an aircraft in difficulties in relation to persons on the ground in densely populated and congested areas such as those of central [London] and greater London," the report said. "The balance between delaying an aircraft's landing by routing it around a congested area, versus the aircraft's condition deteriorating and possibly leading to an accident outside the congested area, should be considered. Moreover, circumstances under which the condition of the aircraft, through damage or technical failure, may pose an unacceptable danger to persons on the ground requiring nonstandard routing, should be defined. Although this incident was safely resolved, it raises again the need to review under what circumstances an aircraft in difficulty should be permitted to fly over congested urban areas. Resolution of this issue may require regulatory action."

The flight was being conducted from Ramstein, Germany, to New York, New York, U.S., when failure of one of the four engines[2] occurred soon after the crew began the cruise phase at Flight Level (FL) 360 (about 36,000 feet).

After confirming failure of the no. 1 (left outboard) engine and performing engine shutdown according to the operator's standard operating procedures, the crew told LACC controllers about the engine failure. ATC approved the crew's request for descent to FL 310, and the crew unsuccessfully attempted to restart the engine. The crew communicated with the airline's maintenance control staff and then planned to return to Ramstein for maintenance support.

ATC approved a left 180-degree turn and a descent to FL 210. During this descent, however, the commander observed several anomalies in the indications for the operative engines. The maintenance control personnel were unsuccessful in resolving the anomalies.

"Using the autopilot in the vertical speed mode … [the commander] became aware that the thrust levers were positioned in the 'no. 6 position,' well forward of the normal position for such a descent, yet the [engine pressure ratio (EPR)] indications were at idle," the report said. "When the aircraft was leveled at FL 210, the airspeed began to decrease significantly, which the copilot drew to the attention of the commander. The crew discussed the anomaly of the forward thrust lever position and low engine power indications and … agreed that if normal thrust were not available, an immediate diversion to London Heathrow would be the safest option."

During the diversion, the commander advanced thrust levers for two of the engines, one at a time, but the EPRs remained unchanged, no acceleration was detected and the exhaust-gas temperature indications increased.

"Further operation of the thrust levers was considered, but the commander did not wish to compound his problems by possibly flaming out the remaining engines," the report said.

The crew was unfamiliar with major airports of the United Kingdom and was not carrying approach charts for Heathrow, but Heathrow continuously remained in sight and clear of clouds. After receiving the declaration of emergency and becoming aware of problems with the three operative engines, the LACC controller began planning emergency routing and a vertical profile, and handed off the flight to a London Terminal Control Centre (LTCC) radar coordinator.

"The assigned [LTCC] controller took up a radar console adjacent to the [London Terminal Control Area (TMA)] controller who was managing all the other aircraft in or transiting that area of the London TMA below FL 200," the report said.

The ATC group supervisor then decided that a Heathrow approach controller would handle the final vectoring, and the approach controller occupied a radar console adjacent to the TMA controller. The terminal control watch manager also joined the ATC team formed to handle the approach of the incident aircraft. The original plan for the approach was to use a track of 35 nautical miles (65 kilometers) and a heading of 315 degrees to vector the flight crew from the left base position onto the final approach course for Runway 27R.

"At that stage, the controllers believed that the aircraft was capable of reduced thrust and [was] not suffering a total loss of thrust on the three remaining engines," the report said. "It was only when the copilot transmitted [a] warning that there may not [have been] enough power to make the landing [that] the full extent of the problem [became] known. … The controller [had] informed the crew that the aircraft was still too high for the approach, to which the copilot informed the controller, 'We're just not sure we're gonna get enough power to land.'"

The approach controller then instructed the crew to conduct a 270-degree turn to the right to increase descent rate and reduce speed.

"The flight crew accepted this instruction and the maneuver was flown, rolling out on an intercept heading of 305 degrees for the extended centerline of Runway 27R," the report said. "This maneuver took the aircraft over the center of London."

Without changing the radio frequency, responsibility was handed over to the Heathrow approach controller, who told the crew to slow the aircraft to improve the accuracy of radar vectors and to reduce the radius of turns.

"The approach controller was still concerned at the height and speed of the aircraft in relation to the [remaining distance]," the report said. "The [approach] controller obtained a landing clearance from the tower [controller] and passed it to the crew. He also knew that the last opportunity for an orbit was at about six [nautical] miles [11 kilometers] from touchdown and after that, with no thrust, the aircraft [crew] would be committed [to the landing]."

The controller then asked the crew about radar-observed flight maneuvers that seemed to be positioning the aircraft on the extended centerline of Runway 27L instead of Runway 27R. The crew said that a series of S-turns were being conducted to descend to the assigned runway.

The controller saw the aircraft roll out of the left turn onto the final approach track at 2.0 nautical miles (3.7 kilometers) from the runway threshold; he then told the crew that the aircraft altitude and airspeed were reasonable from his vantage point and reconfirmed that the aircraft was cleared to land.

"While the aircraft was high for a conventional approach, the commander used his knowledge of the aircraft's handling qualities and performance, in the configurations into which it would be placed, to judge an approach path such that if no thrust was available, the aircraft would touch down on the runway," the report said.

The flight path was based on the commander's experience and judgment; the operator's 747 operations manual did not contain gliding airspeeds, profiles, performance or characteristics.

"[The commander] used turning maneuvers, flap and gear selections to reduce speed while conserving height," the report said. "Only in the final stages of the approach with flaps set at 30 degrees was thrust instinctively added, to which the engines responded and the forward acceleration was detected by the crew."

The landing was conducted within the normal touchdown zone, at 145 knots calibrated airspeed (CAS) with medium autobrakes, spoilers and reverse thrust used to decelerate.

"The aircraft initially descended at about 2,000 feet per minute [over London] before continuing to descend at about 2,500 feet per minute until 30 seconds before touchdown," the report said. "The approach [glide path] into Heathrow was calculated at just over 6.0 degrees, reducing to 2.7 degrees when the aircraft was 1.5 nautical miles [2.8 kilometers] from touchdown. The recorded airspeed during the latter stages of the approach was approximately 160 knots CAS."

AAIB found that ATC responses were appropriate.

"The service provided by the National Air Traffic Services (NATS) in supporting the crew … complied with the guidance and procedures in place, which were flexible and permitted interpretation," the report said. "The aircraft had not suffered any damage and the only hazardous material on board was an engine being carried as cargo, although ATC did not know this at the time. Importantly, the stated requirement of the aircraft commander to land at London Heathrow was facilitated."

During the investigation, which included examination and testing of each engine, AAIB could not determine why the no. 1 engine had failed during flight or why the crew perceived that the operative engines were not delivering the selected thrust.

"[The no. 1 engine's] failure to relight was explained by the faulty no. 1 igniter," the report said. "The apparent lack of performance of the remaining three engines is perplexing, since, in the absence of any anomalies with the fuel quantity or quality, it is difficult to conceive of any common factor which could affect three (or four) independent systems."

Investigators concurred with the commander's assessment that the safe outcome likely would not have been possible if instrument meteorological conditions had prevailed (i.e., conducting an instrument approach would have increased the risk of a forced landing before arriving at the runway).

"The identification of the lack of thrust occurred at FL 210, which limited the choice of airports to those within gliding range and with adequate runway length available to meet the landing distance required," the report said.

During the emergency, ATC personnel discussed the possibility that the cargo aboard the incident aircraft might include dangerous goods shipped by U.S. military forces. The report did not say whether ATC personnel discussed risks of vectoring the aircraft over heavily populated areas of the city.

The U.K. *Manual of Air Traffic Services (MATS), Part 1,* addresses situations involving "diversion from the flight-planned route while carrying dangerous goods" and "maneuvering, over a densely populated area such as central London, of an aircraft in an unsafe condition."

Among provisions applicable to this incident were the following:

- Heathrow and Gatwick are not suitable for diversion of an aircraft that requires special ATC handling while carrying dangerous goods. Such an aircraft should not be deviated from its flight-planned route except in an emergency. In an emergency, the most suitable airports for ATC diversion of such an aircraft are military airfields as the first choice and Stansted or Glasgow (Scotland) Prestwick Airport as the second choice because their personnel have the required expertise in handling and parking aircraft carrying dangerous goods;

- The "desirable" practice is that the emergency aircraft should not be routed by ATC over densely populated areas. The MATS said, "If this is inconsistent with providing the most appropriate service to the aircraft, for example, when any extended routing could jeopardize the safety of the aircraft, the most expeditious route is the one which should be given. Where possible, when expeditious routing is not required, suggestions of alternative runways or aerodromes together with the rationale that the routing would avoid densely populated areas and be consistent with safety, shall be passed to the pilot and his intentions requested";

- If ATC wants to require or request diversion to a different airport than selected by the aircraft captain, the reasons first should be established and communicated to the captain with an additional request for the captain's intentions; and,

- The captain has ultimate responsibility for the safety of the aircraft, including any decision to comply with ATC advice or instructions to land at an airport other than the diversion airport selected by the captain.

The report included the following safety recommendations:

- "The [U.K.] Civil Aviation Authority (CAA) should review the guidance provided in *MATS Part 1* and *Civil Aviation Publication 475, The Directory of CAA Approved Organisations,* and consider whether ATC-unit training for unusual circumstances and emergencies … [adequately prepares] controllers to handle aircraft in emergency, and in particular, whether sufficient guidance is provided on the avoidance of built-up areas when vectoring aircraft in emergency. Where considered necessary, this guidance should be amended as soon as practicable [Safety Recommendation 2005-069];

- "The [U.S. Federal Aviation Administration (FAA)] and the European Aviation Safety Agency [EASA] should require that aircraft flight manuals contain guidance relevant to the aircraft's gliding characteristics in the optimum and approach configurations [Safety Recommendation 2005-070]; [and,]

- "Evergreen International Airlines should ensure that its flight crews have available [aboard] their aircraft all the pertinent en route [charts] and approach charts for all the diversion airports applicable to the aircraft type and routes being flown [Safety Recommendation 2005-071]."

Responses to the recommendations were expected in March 2006 from U.K. CAA, FAA and EASA.

The report said, "[Evergreen International] responded to [Safety Recommendation 2005-071] by stating that a large proportion of its work was in support of the [U.S.] military. Consequently, it was more convenient to adopt U.S. Department of Defense charts since these invariably covered their military destinations while also covering a good cross-section of civil airports worldwide. … London Heathrow is not included in this chart series, but Stansted airport is included. Had this not been a severe emergency condition, the flight crew would have diverted to an airport for which they had charts. The operator concluded by stating that it believed the company complied with all regulations."

As to controllers' uncertainty about any dangerous goods aboard the incident aircraft, the report said that in 2004, cargo information normally was maintained at the departure airport and aboard the aircraft. Asking the pilots for this information while they were handling an emergency would have been "inappropriate," the report said. A solution was devised.

"Following discussions between the AAIB and the CAA … new requirements included [one that] a copy of the notification to captain (NOTOC, detailing dangerous goods on board) or the information on [this form] must be readily available at the airfield of departure and the next scheduled arrival point. [Another requirement was that] if the size of a NOTOC is such that transmission of information to ATC would be impractical, provision is made for the pilot to pass a telephone number to ATC for the use of the airfield authorities to obtain a faxed copy."

CAA also updated its guidance for air traffic controllers about aircraft emergencies.[3]♦

Notes

1. U.K. Air Accidents Investigation Branch. "N481EV." *AAIB Bulletin 1/2006.* Publication no. EW/C2004/04/04. January 2006.

2. The turbofan engines were Pratt & Whitney JT9D-7F series.

3. Air Traffic Service Standards Department, Safety Regulation Group, U.K. Civil Aviation Authority. *Aircraft Emergencies: Considerations for Air Traffic Controllers.* Civil Aviation Publication 745. March 2005.

Further Reading From FSF Publications

FSF Editorial Staff. "Use of Standard Phraseology by Flight Crews and Air Traffic Controllers Clarifies Aircraft Emergencies." *Airport Operations* Volume 26 (March–April 2000).

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