



Controller's Misperception of Aircraft Positions Sets Stage for Collision on Runway in Paris

The investigation generated recommendations about the practice of clearing more than one aircraft onto a runway, the terminology used in takeoff clearances, coordination among controllers and the use of different languages in controller-pilot communication.

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FSF Editorial Staff

At 0252 local time May 25, 2000, a McDonnell Douglas MD-83 was near rotation speed for takeoff from Runway 27 at Paris (France) Charles de Gaulle Airport when its left wing struck the cockpit of a Short Brothers SD3-30 (Shorts 330) that had been taxied onto the runway. The Shorts crew had been cleared as “number two” for takeoff by a controller who did not know that the Shorts was holding at a runway intersection (Taxiway 16). The MD-83 crew rejected the takeoff after the collision; none of the 157 occupants of the aircraft was injured. The first officer of the Shorts was killed, and the captain was seriously injured.

The French Bureau Enquêtes-Accidents (BEA) said, in its final report, that the probable causes of the accident were the following:

- “The [local] controller’s erroneous perception of the position of the aircraft [that] led him to clear the Shorts [crew] to line up [on the runway];
- “The inadequacy of systematic verification procedures in ATC [air traffic control], which made it impossible for the error to be corrected; [and,]
- “The Shorts crew not dispelling any doubts they had as to the position of the ‘number one’ aircraft before entering the runway.”

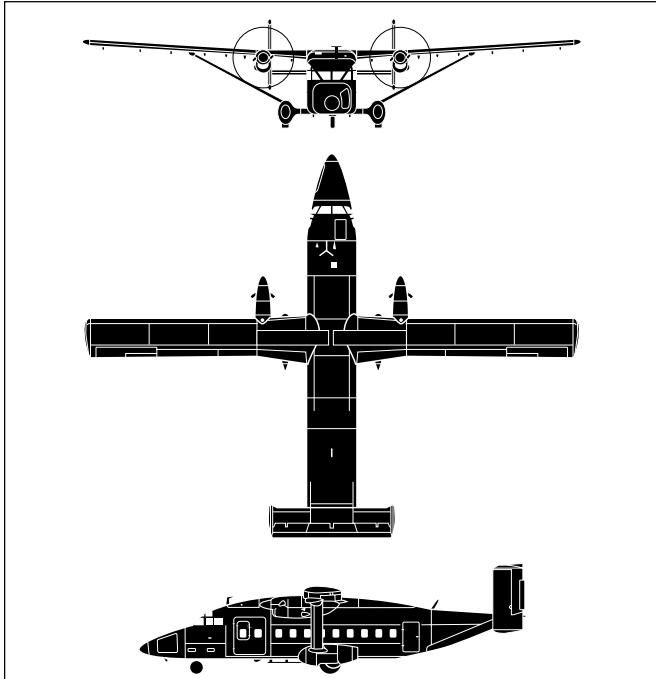


The report said that contributing factors included the following:

- “Light pollution [from construction] in the area of Runway 27, which made a direct view difficult for the [local] controller;
- “Difficulty for the [local] controller in accessing radar information: [One ground-traffic-movement-display system] was difficult to read and the [other system was] not displayed at his control position;
- “The use of two languages for radio communications, which meant that the Shorts crew were not conscious that the MD-83 was going to take off;
- “The angle between access Taxiway 16 and the runway, which made it impossible for the Shorts crew to perform a visual check before entering the runway;
- “The lack of coordination between the [ground controller] and [the local controller] when managing the Shorts, [which was] exacerbated by the presence [in the control tower] of a third party whose role was not defined; [and,]
- “A [safety-information] feedback system which was recent and still underdeveloped.”

The MD-83, operated by Air Liberté of Paris, was departing on a charter flight to Madrid, Spain. The captain, 55, had an airline transport pilot (ATP) license and 11,418 flight hours. The first officer, 47, had a commercial pilot license and 11,104 flight hours.

The Shorts, operated by Streamline Aviation of Luton, England, was departing on a cargo flight to Luton. The captain, 41, had



Short Brothers SD3-30

The Short Brothers SD3-30 (Shorts 330) is a twin-turboprop, short-range commuter/regional transport derived from the SC.7 Skyvan, a short-takeoff-and-landing (STOL) utility transport that first flew in 1963 with reciprocating engines and later was equipped with turboprop engines. The 330, which has a larger cabin than the Skyvan and retractable landing gear, first flew in 1974.

The aircraft has two Pratt & Whitney PT6A-45R engines, each producing 893 kilowatts (1,198 shaft horsepower) and driving a Hartzell five-blade propeller. Maximum usable fuel capacity is 2,182 liters (577 gallons).

The 330 accommodates two pilots and up to 30 passengers. Maximum takeoff weight is 10,387 kilograms (22,900 pounds). Maximum landing weight is 10,251 kilograms (22,600 pounds).

Takeoff distance at maximum takeoff weight and standard atmospheric conditions is 1,159 meters (3,800 feet). Maximum rate of climb at sea level is 1,180 feet per minute. Single-engine service ceiling is 11,500 feet. At 9,525 kilograms (21,000 pounds) and 10,000 feet, maximum cruising speed is 190 knots and economy cruising speed is 160 knots. Range at 10,000 feet with 30 passengers and no fuel reserves is 876 kilometers (473 nautical miles). Stall speed at maximum landing weight and in landing configuration is 73 knots.♦

Source: *Jane's All the World's Aircraft*

an ATP license and 2,240 flight hours, including 1,005 flight hours in type. The first officer, 43, had a commercial pilot license and 4,370 flight hours, including 14 flight hours in type.

The local controller, 36, conducted ATC services in Bastia, France, from 1985 to 1990, and at Paris Charles de Gaulle Airport from 1990 to 1998. He then was employed as an instructor at the École Nationale de l'Aviation Civile (ENAC; the national civil aviation college).

The local controller was completing his sixth day of a two-week qualification-maintenance course at the airport. He had begun duty in the tower at 2000.

Automatic terminal information service (ATIS) information recorded at 0210 said that Runway 27 and Runway 26L were being used for landings, and Runway 27 and 26R were being used for departures. Winds were from 230 degrees at 15 knots. Visibility was 10 kilometers (six statute miles) in light rain, and there were scattered clouds at 2,300 feet.

A championship football (soccer) match between teams from Madrid, Spain, and Valence, France, had been held in Paris the evening of May 24, 2000. To accommodate a large number of flights departing to Madrid and Valence after the match, the airport used all three runways and more controllers than typical for evening duty.

At the time of the accident, operations on the three runways were being coordinated by controllers in the north control tower, which was 1,800 meters (5,906 feet) from the approach end of Runway 27. The south control tower had been in operation earlier but was closed when the level of traffic began to decrease.

A fourth runway was being constructed north of Runway 27. On the night of the accident, several taxiways were closed for construction; a new taxiway was under construction in an area between the north control tower and the approach end of Runway 27 (see Figure 1, page 3).

"Some 10 vehicles were employed on the work site, all equipped with orange emergency flashing lights," the report said. "Halogen lamps, approximately three meters [10 feet] high, were used to light the work site. The lights were pointed towards the ground."

At 0212, the ground controller told the MD-83 to taxi from the terminal to the holding point for Runway 27; the holding point is on Taxiway 19. The report said that the French language was used for communication between controllers and the MD-83 crew.

The local controller cleared the crew for takeoff at 0222. The first officer, however, told the local controller that they had a problem and wanted to maintain their position for 30 seconds.

flight-data strip as indicating that the MD-83 was holding for takeoff on Runway 26R.

At 0247:52, the local controller told the MD-83 crew that they would conduct the Aigle [eagle] 8 Bravo departure procedure. The first officer questioned the instruction, because the Aigle 8 Bravo departure typically is conducted by aircraft departing from Runway 26R; aircraft departing from Runway 27 typically conduct the Aigle 8 Alpha departure procedure.

“We’re lined up on two seven here,” the MD-83 first officer said.

“My mistake, eight eight zero seven [the MD-83’s call sign],” the local controller said. “So, it is really two seven, and it will be a departure on Aigle 8 Alpha.”

“Eight alpha,” the MD-83 first officer said. “OK, no problem.”

The controller then told the MD-83 crew to report when they observed a Boeing 737 on short final approach to Runway 27.

“We have an aircraft on final, and it’s a thirty-seven,” the MD-83 first officer said. “We see it clearly.”

“Liberté eight eight zero seven, behind the traffic on short final on two seven, line up behind and wait,” the controller said.

The MD-83 first officer said, “After the traffic on final, and if it’s a thirty-seven, we line up and hold position runway two seven.”

The controller then issued instructions to the crews of two other aircraft.

The B-737 passed in front of the Shorts and exited Runway 27 at Taxiway 10 at 0250:45.

At 0250:49, the controller said, “Liberté eight eight zero seven, cleared for takeoff two seven.”

“Taking off on two seven, Liberté eight eight zero seven,” the MD-83 first officer said.

The Shorts captain told investigators that he heard a message transmitted in French and that he did not understand the message.

The MD-83 captain told investigators that he observed beacon lights to his left and believed that the lights were on aircraft that were behind the MD-83.

“After receiving permission to take off, [the MD-83 captain] heard messages transmitted in English, which, for him, could only be addressed to the aircraft situated behind him,” the report said. “This information, therefore, did not cause him to modify his course of action.”

Five seconds after clearing the MD-83 crew for takeoff, the controller said, “Streamline two hundred, line up runway two seven and wait, number two.”

“Line up runway two seven and wait, Streamline two hundred,” the Shorts first officer said.

The Shorts captain began to taxi the aircraft onto the runway. Taxiway 16 is a high-speed exit for aircraft landing on Runway 9 and is at a 20-degree angle to Runway 27. The report said that the MD-83 would have been at the Shorts’ five o’clock position.

The Shorts captain asked the first officer, “Where’s the number one? Is he the number one?” The report said that the captain was referring to the B-737 that had passed by. While moving forward on the taxiway, however, the crew observed that the B-737 was slowing down and exiting the runway.

“When they realized that this aircraft had just landed, they were in doubt and looked for another aircraft, but this did not prevent them from entering the runway, especially as they were carrying out pre-line-up duties at the same time,” the report said.

At 0251:45, the Shorts captain said, “Can you see anything down there?”

“No, I can’t,” the first officer said. “Unless there’s one coming out in front.”

“How about now?” the captain said.

The Shorts captain told investigators that he then leaned over to look out the right window and observed the lights of an aircraft.

“He applied the foot brakes immediately, and his aircraft stopped,” the report said. “He realized there was nothing he could do to vacate the runway.”

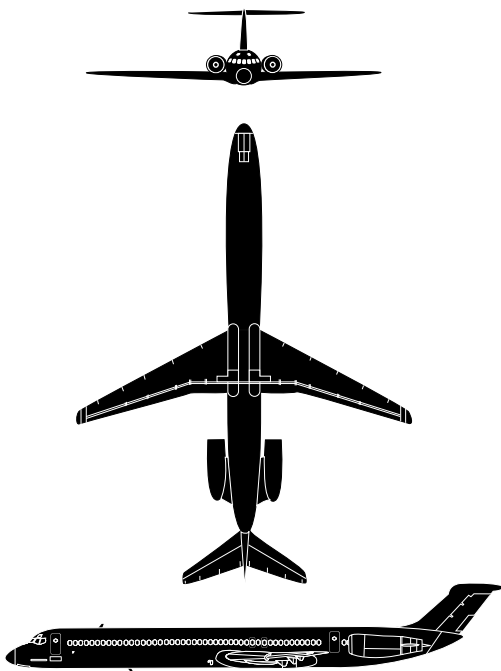
The MD-83 captain told investigators that he had observed an aircraft stopped on a taxiway about 200 meters to 300 meters (656 feet to 984 feet) ahead and believed that there was adequate clearance.

“Immediately after, since the aircraft appeared to be moving, [the MD-83 captain] prepared to abort the takeoff in case of contact,” the report said. “While approaching V_R [rotation speed], the captain saw the Shorts move forward from the left and heard the noise of its engines.”

The MD-83 first officer called “ V_R ” at 0251:59.

At 0252:01, the pilots of both aircraft voiced unintelligible exclamations. The CVRs in both aircraft then recorded the sound of impact.

The MD-83's groundspeed was between 152 knots and 155 knots when the collision occurred. The MD-83's left-wing tip separated when it struck the Shorts' right-wing strut. The MD-83's left wing then struck the Shorts' right-engine cowling, two of the five propeller blades and the cockpit.



McDonnell Douglas MD-83

The MD-80 series jet transports are derivatives of the Douglas DC-9, which first flew in 1965. Douglas Aircraft Co. and McDonnell Co. merged in 1967 to form McDonnell Douglas Corp. The MD-80, originally called the Super 80, has longer wings, a longer fuselage and more fuel capacity than the DC-9, and an integrated digital flight control system.

The MD-80 prototype flew in 1979, and the airplane entered production in 1980 as the MD-81. Production of the MD-82 began in 1981. The MD-83, which first flew in 1984, is the same size as the MD-81 and MD-82, and has the same passenger capacity (172 passengers, maximum). The MD-83 has more fuel capacity, more fuel-efficient engines and, thus, greater range than its predecessors. The increased fuel capacity was derived by the installation of two extra tanks in the cargo compartment. Total fuel capacity is 26,495 liters (7,000 gallons).

The airplane has two Pratt & Whitney JT8D-219 engines, each rated at 9,526 kilograms (21,000 pounds) thrust. The engines are two percent more fuel efficient than the MD-82's JT8D-217 engines.

Maximum takeoff weight is 72,576 kilograms (160,000 pounds). Balanced field length at maximum takeoff weight is 2,554 meters (8,380 feet). Maximum level speed is 500 knots. Maximum cruising speed is 0.76 Mach. Range with 155 passengers and domestic fuel reserve is 4,634 kilometers (2,502 nautical miles). Maximum landing weight is 63,277 kilograms (139,500 pounds). Landing distance at maximum landing weight is 1,585 meters (5,200 feet). ♦

Source: *Jane's All the World's Aircraft*

“The point of impact with the cockpit was situated above the window line, approximately 50 centimeters [20 inches] to the rear of the right-hand forward-door frame,” the report said. “This door was torn off and pushed to the inside of the fuselage. The opening created by the MD-83 wing is practically horizontal.

“Inside the cockpit, the seat backs were not damaged. The MD-83 wing cut through the central column located between the two seats. It then cut into the left-hand side approximately 50 centimeters into the back of the rear-left-side window. The [windshield] was broken and its uprights [were] cut through.”

The Shorts first officer received head injuries and brain injuries that caused his immediate death. The captain received “superficial injury of the cranial vault in the back median parietal area,” the report said.

The captain was thrown left on impact, and the first officer's body fell on him.

“He pushed away the body of the first officer ... and attempted to move the aircraft off the runway while lighting the control panel above him with his torch [flashlight],” the report said. “After this, he tried to stop the engines, for which he had to use the fuel shut-off levers. He saw the rescue services approaching and tried to warn them, with the red filter of his torch, that the propellers were rotating. He was then evacuated from the aircraft.”

The report said that no fuel leaked from the MD-83's damaged left wing. “Low-power electrical wires were cut off at the end of the left wing. These were used mainly to supply the navigation lights. No trace of electric arc or electrical fire could be found on these wires.”

At 0252:23, the MD-83 first officer told the local controller that the MD-83 had struck another aircraft.

The local controller said, “Confirm that you have hit an aircraft, Liberté eight eight zero seven.”

The first officer confirmed that the MD-83 had collided with a Shorts and told the local controller that they would taxi the MD-83 to the end of the runway and exit the runway.

“After vacating the runway and [receiving] confirmation of the damage by the senior flight attendant, the [MD-83] crew decided not to evacuate the passengers using the escape slides, so as to avoid any further trauma,” the report said. Safety vehicles escorted the MD-83 to the apron, where the passengers disembarked.

The local controller made several radio transmissions to the Shorts crew, but none was acknowledged.

The report said that the local controller had perceived erroneously that all aircraft departing on Runway 27 were

beginning their takeoffs from the approach end of the runway and that the Shorts was behind the MD-83.

The report said that the following factors might have been involved in the local controller's erroneous perception of the position of the Shorts:

- "As he stated in his testimony, the controller had formed a picture of the situation based on a false hypothesis: the fact that, because of the [construction], Taxiways 16 and 17 would not be in use, [and that all] departures were to take place from the runway threshold;
- "This erroneous perception was facilitated by the absence of a tower-team briefing, which would among other things have led to a unified picture ... in the minds of the controllers;
- "From the beginning of [his] tour of duty [in the airport control tower] right up until the accident, the controller had not had to control an aircraft using an intermediate-access taxiway, which reinforced the false picture he had made of the situation;
- "The lack of coordination during allocation of Taxiway 16 to the Shorts did not change this picture;
- "For a relatively long period of time, the controllers' attention was focused on the MD-83, that's to say on the aircraft which was experiencing problems;
- "According to the logic of his perception of the situation, the controller did not ask himself any questions about the takeoff sequence. This may explain why he didn't read the [flight-data] strips systematically at the same time as [they were transferred to him]; [and,]
- "The MD-83's strip was written over and contained some incoherence, which contributed to distracting his attention from the Shorts strip, as well as other sources of information."

The report said that the local controller's erroneous perception of the Shorts' position might have been corrected by an examination of the aircraft's flight-data strip, a visual check of the aircraft, a radar check of the aircraft or a radio call to the crew to confirm the aircraft's position.

The ground controller had written the number 16 on the Shorts flight-data strip and had circled the number to indicate that the aircraft was holding on Taxiway 16. The strip was transferred to the local controller, without comment, by the head of ATC. At the time, the local controller's attention was fixed upon the MD-83 and the MD-83's flight-data strip.

The report said that visual surveillance of the area near the runway threshold would have been difficult because of the

darkness, the lighted construction area and the reflectivity of the rain-soaked ground.

"Furthermore, bearing in mind [the local controller's] mental picture of the situation and his failure to take into account the information on the strip, he had no reason to focus his attention on Taxiway 16," the report said.

The control tower had two displays of ground traffic: One was a monochrome display of an airport map (including runways and taxiways) and of primary-radar images of targets (e.g., aircraft and vehicles) with no target-identification information; the other was a color display of the airport map and of primary-radar targets with identification information.

The local controller told investigators that the monochrome display at his workstation was garbled and that he could not observe the color display, which was at the ground controller's workstation.

Using the radio to confirm an aircraft's position is done only when a controller is uncertain about the aircraft's position, the report said. The local controller believed that the Shorts was behind the MD-83. The Shorts crew did not tell the local controller that they were on Taxiway 16. The local controller's clearance to line up on the runway did not — and was not required to — include the taxiway from which the crew was to line up the aircraft on the runway.

The report said that there was no systematic procedure for using flight-data strips, conducting visual checks or radar checks, or using the radio to confirm aircraft positions.

The report said that the control tower procedures manual contained no procedures for returning controllers to duty after a prolonged absence or for approving instructor-controllers (i.e., ENAC instructors) for duty as controllers.

"[Instructor-controllers] are basically expected to familiarize themselves with memos and instructions issued during their absence," the report said. "Self-assessment is often sufficient in practice for a controller to be considered fit to return to a position safely."

At the time of the accident, the local controller was not aware of two AIRPROX [aircraft proximity] incidents that had occurred at Paris Charles de Gaulle Airport. (The report said that the International Civil Aviation Organization defines an AIRPROX incident as a "situation in which, in the opinion of a pilot or of the air traffic control personnel, the distance between aircraft moving under their own power as well as their relative positions are such that the safety of the aircraft involved could be endangered in flight or on the ground in the aircraft maneuvering area.")

The report included the following information about the incidents:

- At 0217 local time Oct. 6, 1998, a Streamline Aviation Shorts 330 crew was cleared to taxi to the holding point for Runway 10 (later redesignated as Runway 08L). Three minutes later, an Air France Boeing 747 crew told the local controller that they were ready for takeoff from the holding point for Runway 10. The controller told the B-747 crew to line up on the runway and to hold for takeoff. The Shorts crew then told the controller that they were ready for line-up but did not specify the aircraft's position; the Shorts was on a taxiway 1,000 meters from the Runway 10 holding point. The controller believed that the Shorts was behind the B-747 and told the Shorts crew to line up the aircraft on the runway. The controller then cleared the B-747 crew for takeoff. The B-747 crew, however, observed the Shorts on the runway and did not begin the takeoff. The B-747 crew filed an AIRPROX incident report. The Commission Nationale de la Sécurité de la Circulation Aérienne (CNSCA; the French national air traffic safety committee) said that the causes of the incident were the following:

- “[The Shorts crew’s] noncompliance with a control instruction [i.e., to taxi to the Runway 10 holding point];
- “[The local controller’s] failure to detect the conflict, [and the controllers’] issuance of a conflicting clearance; [and,]
- “Phraseology: When an aircraft contacts control and asks to line up, the controller must use an adequate, strict phraseology aimed at eliminating all risks of error concerning the aircraft position.”

- At 1854 local time May 17, 1999, the crew of an Air France B-737 (call sign AF 766) was cleared for takeoff on Runway 08L. About 26 seconds later, the controller cleared the crew of another Air France B-737 (AF 2434) for takeoff on Runway 08L. The controller had mistaken AF 2434 for another B-737 that was behind AF 766 at the Runway 08L holding point. The AF 2434 crew told the controller that they were holding at a runway intersection ahead of AF 766. “The controller then realized [that] the line-up instruction had been given to the wrong aircraft,” the report said. “He apologized, explaining that he had [misread the aircraft’s flight-data strip].”

The report said that the investigations of the two incidents by CNSCA and by the National Airprox Bureau (BNA) had not been completed when the MD-83 and the Shorts collided.

“None of those present in the tower seemed to have improved their awareness as a result of these two events, or at least not sufficiently to realize that a situation of such a type was recurring,” the report said.

Twenty runway incursions occurred at the airport from January 2000 through June 2000 — “sixteen of them presenting a risk of collision in the takeoff phase and four in the landing phase.” The report said that the runway incursions involved the following recurring factors:

- “Aircraft cross the runway or go past a holding point;
- “Aircraft line up in front of an aircraft on takeoff or on final [approach] instead of lining up behind; [and,]
- “There is confusion in [aircraft] call signs, which leads to [aircraft movement not intended by the controller].”

The report said that a “feedback system” established by Aéroports de Paris (ADP) to collect and disseminate safety information was not completely operational or fully used at the time of the accident. The system includes collection of incident reports from controllers and pilots, and dissemination of information on significant incidents to controllers based at the Paris airports.

The report said that, except for the processing of AIRPROX incidents by CNSCA and BNA, no organized system exists for exchange of safety information among French airports or between French airports and airports in other countries.

“Feedback culture is still new in the world of ATC and is not yet completely integrated by everyone as one of the factors for the improvement of safety,” the report said.

The report said, “The investigation showed the importance for safety of great precision in runway usage and the grave risks created by any misunderstanding, especially when the [airport’s] procedures allow for the occasional presence of more than one aircraft on the runway. Consequently, the BEA recommends that:

- “[ADP] and the DGAC [Direction Générale de l’Aviation Civile (French civil aviation directorate)] together study all of the procedures and associated means for the simultaneous use of two different parts of a runway so as to guarantee, in all circumstances, the same level of safety as when the runway is used by only one aircraft;
- “Terminology used in practice by [ground controllers] include the systematic identification of the holding point specific to the required taxiway during the instruction to taxi towards the runway;
- “Terminology used in practice by [local controllers] include the systematic identification of the taxiway from which the aircraft must line up;
- “Terminology used in practice by [local controllers] systematically include, where a clearance is issued to line up behind a departing aircraft, the formal and unambiguous identification of said aircraft;

- “The procedure for sequential line-up be defined, as well as conditions for its application;
- “The control positions at Paris Charles de Gaulle [Airport] be equipped with the latest ground-radar equipment;
- “The use of high-speed exits for line-ups be subject to the existence of arrangements which guarantee a level of safety equivalent to visual checks performed by the crew; [and,]
- “The DGAC study the expediency and methods of implementation for the systematic use of the English language for air traffic control at Paris Charles de Gaulle [Airport], as well as the extension of this measure to other [airports] with significant international traffic.”

The report said, “The investigation brought to light the inadequacy of individual [procedures] or cross-check procedures for tasks and the importance of a more systematic and rigorous definition of ATC methods and practices. Consequently, the BEA recommends that:

- “The DGAC establish a precise definition [of ATC methods and practices], and a verification procedure for control tower operations manuals;
- “The DGAC study the implementation in ATC practices of systematic checking procedures; [and,]

- “The DGAC accelerate and systematize the implementation of an ATC resource management training course, specifically taking into account questions related to coordination.”

BEA also made the following recommendations based on the findings of the investigation:

- “The functions of an assistant (role, prerogatives and possible manning of the position) be defined;
- “It only be permissible for the tower manager to handle a control position where this remains compatible with his other responsibilities; [and,]
- “Procedures for releasing controllers to duty be defined so as to exclude this being dependent on self-assessment.”♦

[FSF editorial note: This article, except where specifically noted, is based on the French Bureau Enquêtes-Accidents (BEA) report: *Accident on 25 May 2000 at Paris Charles de Gaulle (95) to aircraft F-GHED operated by Air Liberté and G-SSWN operated by Streamline Aviation*. The report is an English translation by BEA of the official report, which was published in French. BEA said, “As accurate as the translation may be, the original text in French should be considered as the work of reference.”]

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