No Brakes, No Steering

A Northwest Airlines DC-9 struck an A319 after losing hydraulic pressure.

BY MARK LACAGNINA

The captain's decision to shut down the left engine while taxiing a McDonnell Douglas DC-9-50 with a known right hydraulic system problem was blamed for the airplane's collision with an Airbus A319-100 on the ramp at Minneapolis–St. Paul (Minnesota, U.S.) International Airport on May 10, 2005. Fluid in the DC-9's right hydraulic system had leaked from a fractured valve before the airplane landed in Minneapolis, and the subsequent shutdown of the left engine resulted in insufficient hydraulic pressure to effectively operate the brakes, steering and thrust reversers, said the report by the U.S. National Transportation Safety Board (NTSB).

Both airplanes were substantially damaged when the DC-9 rolled under the tail of the Airbus and came to a stop with the trailing edge of the A319's right wing embedded in the roof of its flight deck. The captain of the DC-9 received serious injuries, and the first officer, two flight attendants and two passengers received minor injuries. Three flight attendants and one passenger aboard the A319 received minor injuries. Three ramp workers also received minor injuries.

The DC-9, operated by Northwest Airlines, had departed about an hour earlier with 94 passengers for a return flight to Minneapolis from Columbus, Ohio. The first officer, who had more than 7,000 flight hours, including 3,985 flight hours as a DC-9 second-in-command, was the pilot flying. He said that soon after the flaps and slats were retracted on departure, the "MASTER CAUTION" light and the "RUDDER CONTROL MANUAL" light illuminated.[1] He observed that pressure in the right hydraulic system was about 1,000 psi; normal pressure is about 3,000 psi.

The captain, who had about 20,000 flight hours, including 6,709 flight hours as a DC-9 pilot-in-command, noticed that fluid quantity in the right hydraulic system was decreasing rapidly. "The captain reached over to turn off the hydraulic pumps but later noticed that he had only selected the right engine hydraulic pump switch to the 'LOW' position instead of 'OFF,'" the report said. "He then corrected the switch position to 'OFF' and finished the 'Hydraulic Pressure Low' and 'Fluid Loss' [checklist procedures]."

The DC-9's left hydraulic system and right hydraulic system have fluid reservoirs and engine-driven pumps. The right hydraulic system also has an electrically driven auxiliary pump (Figure 1, p. 34). An interconnected alternate pump can pressurize the left system or a portion of the right system if an engine-driven pump fails. However, hydraulic fluid cannot be routed from one system to the other.

Confusing Condition

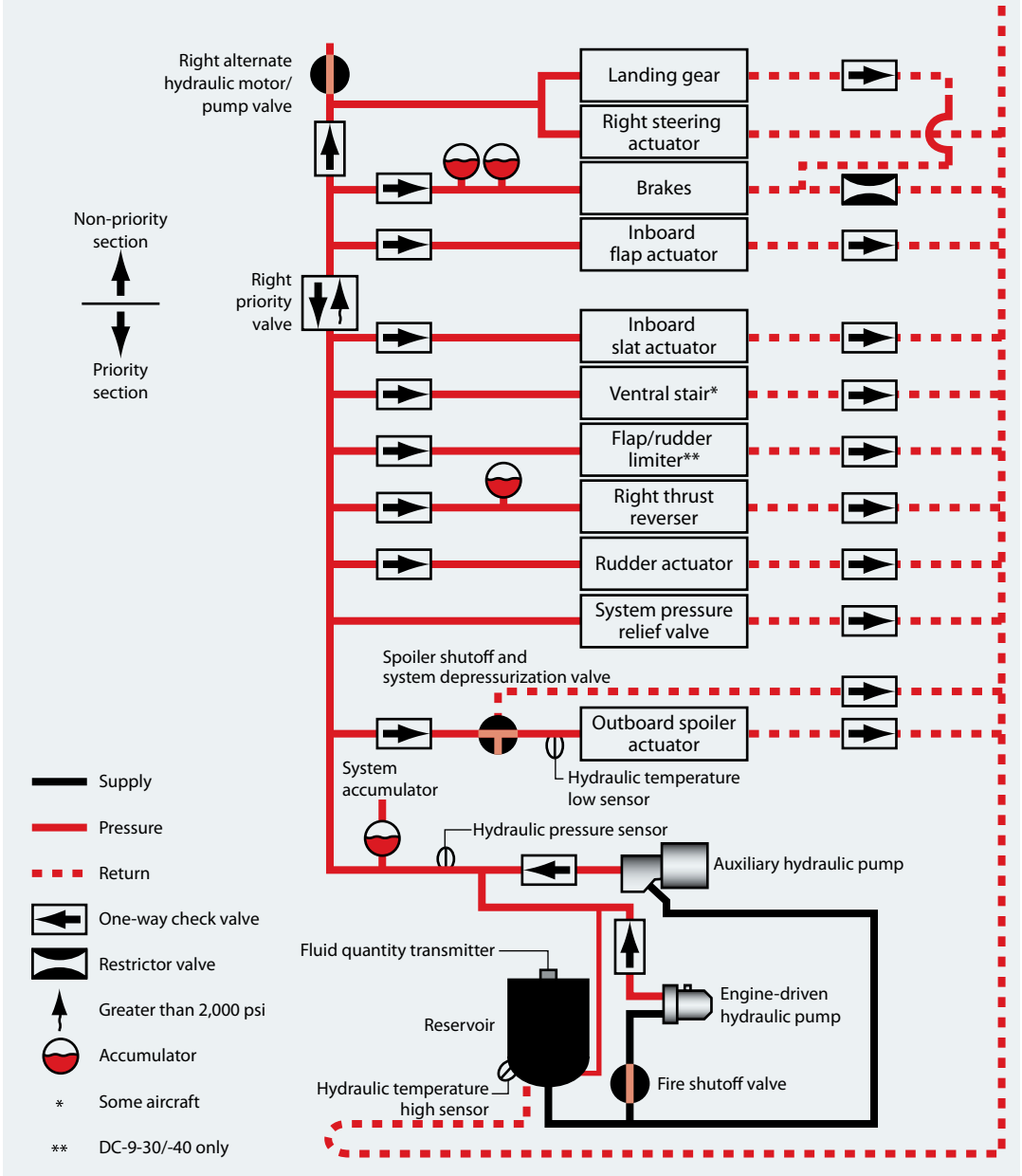
The first officer asked the captain whether they should turn back to Columbus. The captain replied, "We're going to talk to everybody before we make any decisions. I don't see an urgent need to be turning around right this second." The first officer agreed.

The report said that the pilots initially were confused about the nature of the hydraulic system problem and whether they were using the correct checklists. "The right hydraulic system pressure was indicating zero, but the hydraulic low pressure light ('R HYD PRESS LOW') on the annunciator panel was not illuminated," the report said. In addition, the pilots observed indicated fluid quantity in the right hydraulic system gradually increase from zero to 8 qt (8.9 l), a normal level.

The captain checked the annunciator panel and found that the light bulbs for the hydraulic low pressure light were inoperative. "When he attempted to change the bulbs, the entire housing came apart," the report said. "He stated that he basically slammed the door closed, and the light came on, but it was so broken up that he was not certain if the light came on because the housing was broken or … because it was actually indicating low pressure."

A company maintenance technician contacted by radio told the captain that there apparently was a problem with the hydraulic fluid reservoir. "The captain interpreted that to mean that … there was a problem with the fluid quantity transmitter on the

DC-9 Right Hydraulic System



Source: U.S. National Transportation Safety Board

Figure 1

reservoir," the report said. The flight crew decided to continue the flight to Minneapolis, to reduce fuel load, and to conduct the checklist procedures related to low pressure and normal fluid quantity in the right hydraulic system.

'Lost Our Quantity'

Weather conditions at Minneapolis included a 5,000-ft broken ceiling and 10 mi (16 km) visibility, with light rain. The captain briefed the flight attendants, and the crew planned for a visual approach to the longest runway: Runway 22, which is 11,006 ft (3,355 m) long.

The airplane was nearing the airport when indicated right system fluid quantity dropped to zero. The first officer said, "We just lost our quantity." The captain declared an emergency and told air traffic control (ATC) that they had a "hydraulic problem."

The report said, however, that the landing gear extended normally, which reinforced the captain's belief that the right hydraulic system indicators were malfunctioning and that there was no problem with the system itself. A flaps 40 setting was selected, and the crew used the localizer and visual approach slope indicator as supplemental guidance for the visual approach. After a normal touchdown, the first officer applied the wheel brakes earlier than normal to ensure that they were functioning. During rollout, the thrust reversers also functioned normally.

Control was transferred to the captain, and, as the airplane was being taxied off the runway, the first officer told ATC that "[we] no longer need any assistance for the emergency response." The flaps and spoilers retracted normally. The low-pressure light remained illuminated, but the captain believed that the light was broken. "He was thinking that everything was normal," the report said.

'Dead in the Water'

About eight minutes before the collision, the flight data recorder recorded a decrease in engine pressure ratio consistent with a shutdown of the left engine. Company procedure encourages pilots to shut down an engine during taxi to save fuel and reduce brake wear. However, the captain told investigators that he did not remember shutting down the left engine; the first officer said he was unaware of the shutdown.

The captain was turning off a taxiway into the gate area when the nosewheel steering system failed. "We just lost our left system pressure," he said. "Look at that … there's no pressure at all."

The first officer told ATC that they were experiencing steering problems and likely would have to be towed to the gate; they had been assigned Gate 7. He then asked the captain if he had brakes; the captain said no and asked the first officer to try his wheel brakes. "The brake pedals went right down to the floor," the report said.

The captain deployed the right engine thrust reverser, and the airplane came to a stop. "We're dead in the water," he said. The first officer recommended shutting down the engine, but

McDonnell Douglas DC-9-50

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The DC-9 made its first flight in 1965, two years before Douglas Aircraft Co. merged with McDonnell Aircraft Corp. The initial production version, the DC-9-10, has 12,250-lb-thrust (54.5-kilonewton [kN]) Pratt & Whitney JT8D-5 turbofan engines and can carry 90 passengers. Several versions followed before the DC-9-50 was introduced in 1975 with 16,000-lb-thrust (71.2-kN) JT8D-17 engines, a longer fuselage and a redesigned interior with accommodations for 139 passengers.

The 172-passenger Super 80 was introduced in 1979 and was the basis for the subsequent MD-80 and MD-90 versions. McDonnell Douglas merged with The Boeing Co. in 1997, and production of the series was terminated in 2000.

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

the captain said that he would keep it running to retain use of the thrust reverser.

'Lost My Reversers'

The first officer informed ATC of the situation. "Our bad day got worse," he said. "We lost all our control over the brakes and steering. … We're having to use thrust reversers to keep from rolling." He said that they would need the wheels chocked or a tug connected before they shut down the right engine. "Otherwise, we won't have any ability to keep the airplane from rolling."

The first officer then radioed the company's maintenance department and requested that they "bring a crew out here with a tug and some chocks, whatever's needed [to] bring us in the rest of the way … probably chock us first to keep us from rolling into something."

"It's going to be a few minutes," the maintenance technician said. "We need an escort out there. He's on his way, so just hang tight." The first officer said that they were in a "very precarious situation" and needed help right away.

A few seconds later, the airplane began to roll forward slowly, either because of engine thrust or a slight slope to the ramp. The captain selected reverse thrust, but the thrust reverser did not deploy. "Lost my reversers," he said. "You can't steer or anything?" the first officer asked. The captain said no.

The DC-9 was rolling at about 16 mph (26 kph) when it struck the A319, which had just been pushed back from Gate 10 and was being prepared to be taxied under its own power. The captain said that the force of the collision was greater than he had expected. His injuries included broken ribs. The first officer said that he struck his head and ribs when he ducked before the "cockpit imploded and glass came flying in." Fuel also began pouring into the DC-9's flight deck from a ruptured wing tank in the Airbus. There was no fire. Both pilots initially were trapped in their seats by debris, but they managed to extricate themselves and exit through the flight deck and cabin doors.

The captain of the A319, which also was operated by Northwest Airlines, recalled that he was conducting the "Before Taxi" checklist when he felt a tremendous jolt and the airplane began moving forward and to the left. "He 'stood' on the brakes, but he could not stop the airplane from moving," the report said. "He estimated that the airplane was pushed 20 or 30 ft [6 to 9 m]."

Fatigue Crack

After the accident, the right hydraulic system was filled and pressurized. Investigators found hydraulic fluid leaking from a 0.4-in (10-mm) crack in the threaded area of the pressure port in the rudder hydraulic shutoff valve housing, which had accumulated 62,436 service hours. The NTSB materials laboratory determined that the crack was caused by fatigue.

On May 6, 2005, four days before the accident, Boeing had issued a service letter that cited a "failure history" of the cast rudder shutoff valve housing and encouraged operators of DC-8, DC-9, MD-80 and MD-90 series airplanes to replace cast housings with machined housings. The service letter said that 29 housing failures had been reported and that most were caused by fatigue related to porosity of cast housings with 30,000 to 65,000 service hours.

Northwest's records showed that the airline received the service letter on May 19, 2005. However, the report said that the airline previously was aware of the problem, had studied it and had determined that it was a reliability issue rather than a safety of flight issue. "The benefit for enhancing the reliability of the valve did not exceed the financial consequences of the continued failures," the report said. ●

This article is based on U.S. National Transportation Safety Board accident briefs nos. CHI05MA11A and CHI05MA11B, and public docket no. 39833.

Fuel began pouring into the DC-9's flight deck from a ruptured wing tank in the Airbus.

Note

1. When pressure in the DC-9's right hydraulic system decreases below a specific level, rudder control reverts from hydraulic to manual. "During manual rudder operation, rudder/brake pedal movement operates the rudder control tab," the report said. "Aerodynamic forces move the rudder." A minimum airspeed of 135 kt is required on approach until landing is assured.