



Noncompliance With Departure Procedures Sets Course for Impact With Mountain

Investigators said that the controlled-flight-into-terrain accident resulted from the flight crew's failure to properly plan for a night departure from an unfamiliar airport. The crew of the U.S. Air Force C-130H did not follow published instrument departure procedures.

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FSF Editorial Staff

At 2250 local time Aug. 17, 1996, a U.S. Air Force (Lockheed) C-130H struck a mountain ridge during departure from Jackson Hole Airport in Jackson, Wyoming, U.S. The aircraft was destroyed, and the eight crewmembers and a passenger were killed.

The U.S. Air Force Accident Investigation Board, in its final report, said, "The crash of Havoc 58 [the call sign for the flight] was caused by crew error."

The report said, "Unfortunately, mountainous terrain in all quadrants and a short runway at high altitude presented too great a challenge to crewmembers accustomed to flying in the flatlands of Texas."

The report said, "The crew ... failed to avoid the mountainous terrain ahead. They were complacent and not situationally aware of their proximity to that terrain. Visual cues were limited by a dark, moonless night. Radar information, which would have been showing on the navigator's radar scope, was not correctly interpreted. Arrival/departure charts were not studied



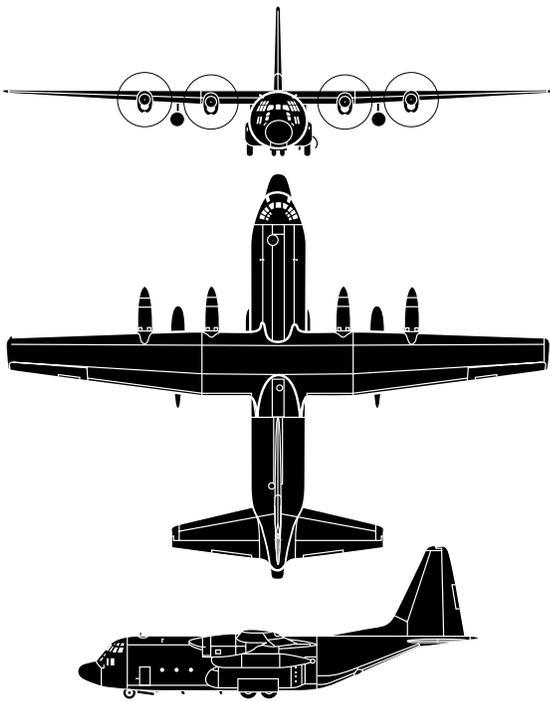
by the pilot/copilot and were incorrectly interpreted by the navigator."

The report said that the crew was current and qualified for the mission, and that crew rest was adequate.

The pilot, who held the rank of captain, was executive officer of the 39th Airlift Squadron at Dyess Air Force Base, Texas. He had 1,744 flight hours, including 904 flight hours in C-130s.

"[The pilot] was an instructor pilot respected by his peers for his excellent flying skills and had been characterized as a 'by-the-book pilot,'" the report said. "He had completed C-130 instructor school in March 1996. He had completed the advanced airlift tactical training course in April 1996, where he received instruction and actual flying experience in mountainous terrain."

The pilot had flown 37 hours in the 60 days preceding the accident and nine hours in the 30 days preceding the accident.



U.S. Air Force C-130H

C-130 is the U.S. Air Force designation for the Lockheed 382 Hercules. The medium-range to long-range combat transport aircraft was designed to an Air Force specification issued in 1951. Deliveries of the C-130 began in 1952.

Deliveries of the C-130H began in 1975. The C-130H is similar to earlier models but has more powerful engines. Each of the four Allison T56-A-15 engines produces 4,508 equivalent horsepower (3,362 kilowatts) and drives a four-blade, fully feathering and reversible Hamilton Standard propeller.

The aircraft has six internal wing tanks with a total fuel capacity of 6,960 gallons (26,344 liters). Two optional underwing pylon tanks have a total fuel capacity of 2,720 gallons (10,295 liters).

The flight deck has accommodations for five crewmembers. The aircraft has a galley and sleeping quarters for relief crewmembers. The cabin can accommodate 92 regular troops or 64 paratroops. The flight deck and main cabin are air-conditioned and pressurized. Maximum pressure differential is 7.5 pounds per square inch (0.52 bar).

The aft fuselage has a hydraulically operated cargo door and ramp. Maximum payload is 42,673 pounds (19,357 kilograms). Maximum normal takeoff weight and landing weight are 155,000 pounds (70,308 kilograms). Maximum overload takeoff weight and landing weight are 175,000 pounds (79,380 kilograms).

Maximum rate of climb at sea level is 1,900 feet per minute (580 meters per minute). Service ceiling is 33,000 feet. Maximum cruising speed at maximum takeoff weight is 325 knots. Stall speed is 100 knots.

Range with maximum payload and with fuel reserves is 2,046 nautical miles (3,789 kilometers). Range with maximum fuel and fuel reserves is 4,250 nautical miles (7,871 kilometers).

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

During the two weeks preceding the accident, he had flown one mission: an annual mission/qualification flight evaluation.

“His annual tactical qualification check ride was completed on 15 August as a ‘solid Q-1’ (Qualification Level 1, the highest qualification),” said the report.

The copilot, a captain, had 188 flight hours, including 149 flight hours in type. She had flown 52 hours in the 60 days preceding the accident and 21 hours in the 30 days preceding the accident.

“[The copilot] was a fine pilot and was highly regarded by superiors and peers,” the report said. “She was current in all flying-training events. In the two weeks prior to the mishap, [she] flew three local training missions.”

The navigator, a lieutenant, had 170 flight hours, including 79 flight hours in C-130s.

“[The navigator] was highly regarded by his superiors and peers alike,” the report said. “Their comments indicate [that] he was smart, very thorough and eager to begin his new career. He was current in all flying-training events. In the two weeks prior to the mishap, [he] received in-flight instruction on C-130E to C-130H model conversion training, local area indoctrination and an off-station mission to Pope AFB [Air Force Base], North Carolina. The mishap mission was his first flown without an instructor navigator.”

The report said, “Although the copilot and navigator were relatively inexperienced, they had completed all training requirements, were current and qualified, and were characterized by their peers as conscientious and progressing well for their level of experience,” said the report.

The crew also included a flight engineer, a senior loadmaster, two loadmasters and an assistant crew chief.

The pilot, copilot and navigator spent several hours Aug. 16 planning the mission, which included a flight from Dyess to Jackson, and a flight from Jackson to John F. Kennedy International Airport (JFK), Jamaica, New York.

“However, the major planning effort focused on the complex follow-on JA/ATT [joint airborne, air-transportability training] mission at Pope AFB, North Carolina — a mission with 13 airdrop sorties in six days,” the report said. “The second priority was the complex arrival [procedures] and departure procedures associated with [JFK].

“Finally, Jackson Hole Airport was discussed with the operations officer, but the only aspect discussed was that it was a nonradar facility. Since the airport was serviced by a precision instrument approach [procedure] and because [the navigator] had the proper arrival/departure chart, the airport did not raise a warning flag in the operations officer’s mind.”

No one witnessed the flight-crew briefings conducted before the C-130 departed from Dyess. The report said that flight-crew briefings normally are conducted at the aircraft before takeoff.

“The crew did have an abnormal engine start on [the no. 3] engine,” the report said. “They continued the start sequence of the other engines and restarted [the no. 3] engine, and departed Dyess. The crew worked the minor engine problem on their own, having no interaction with maintenance.”

The flight from Dyess to Jackson Hole Airport took about three hours and 25 minutes. The flight crew conducted a visual approach and landed on Runway 18 at 2105.

A passenger — a U.S. Secret Service agent — boarded the aircraft at Jackson. The purpose of the flight from Jackson Hole Airport to JFK was to transport a U.S. Secret Service communications vehicle.

“[U.S.] President William J. Clinton had been vacationing in Jackson ... and was planning to celebrate his birthday in New York City on 18 August 1996,” the report said. “U.S. Air Force cargo aircraft routinely provide airlift support of this type during periods of presidential travel.”

The aircraft was serviced with approximately 14,359 pounds (6,513 kilograms) of fuel, and the 10,000-pound (4,536-kilogram) communications vehicle was loaded.

The instrument flight rules [IFR] flight plan filed by the pilot included an estimated flight time of five hours, 30 minutes and a requested cruise altitude of Flight Level (FL) 190.

The report said that the cockpit voice recorder (CVR) transcript [see Appendix, page 6] showed that, while preparing for takeoff, the pilots and the navigator failed to plan for the departure.

At 2218:54, the navigator asked the pilot how he wanted the navigational aids set up for the departure.

The pilot said, “You tell me what makes sense, because I am not really sure of what the course is and all that stuff out of here. I assume it will probably be set up Jackson [very-high-frequency omnidirectional radio/distance-measuring equipment (VOR/DME) station] initially, but I don’t know what our course is defined off of.”

The navigator did not respond immediately, and the crew proceeded with the engine-start checklist and the before-taxi checklist. The crew again had difficulty starting the no. 3 engine.

The report said that the CVR transcript shows that the crew was concerned about runway length and aircraft performance.

At 2223:04, the pilot asked the flight engineer if “assault” takeoff procedures would be required. The flight engineer said

that he would calculate critical field length. [An “assault” takeoff basically is a short-field takeoff conducted with maximum power, using the least amount of runway possible and climbing as steeply as possible. Critical field length is the minimum runway length required for a specific aircraft takeoff weight.]

The captain said, “Okay, sounds good. Yeah, if we got critical field length within the runway length, we’ll be okay, but, if not, we will have to probably go with the assault data.”

The report said that runway length was 6,299 feet (1,921 meters) and that critical field length was 7,600 feet (2,318 meters) under the existing conditions, which included a field elevation of 6,445 feet and an aircraft gross weight of 145,000 pounds (65,772 kilograms).

At 2224:48, the flight engineer said, “We don’t have critical field length.”

The pilot said, “All right, so we’ll have to do assault data then.”

The pilot then briefed the crew for takeoff. He told the copilot that, “if we’ve got a little extra runway,” he would not conduct an assault takeoff. “We will just do a nice gradual rotate there,” he said.

At 2226:46, the pilot asked the navigator about the terrain off the end of the runway.

The navigator said, “It’s pretty much a mountain and valley terrain, rising to seventy-three hundred feet, about a thousand-foot rise, 10 miles [19 kilometers] south of the field.”

The report said that the navigator had misread his chart scale; five nautical miles (nine kilometers) south of the airport, the terrain rose to 7,339 feet.

The captain said, “All right, now if I need to turn, I need to turn right, correct? Or, excuse me, left.”

The navigator said, “Left turns.” He later said, “We would like a pretty sharp left turn and a pretty rapid climb rate.”

“Okay,” the captain said. “Climb rate, we’ll have to work on; the left turn, I think we can do.”

The report said, “There is no follow-up discussion about the reason for the rapid climb rate or how high the terrain is after the left turn. No one asks to see the navigator’s chart or discusses the fact that the minimum safe altitude within 25 nautical miles [46 kilometers] in the south and east quadrants is 12,800 feet.”

At 2228:45, the copilot requested an IFR clearance from the Salt Lake City Air Route Traffic Control Center (Salt Lake City Center). The controller cleared the flight as filed and asked

when the flight would depart. The copilot said that the flight would depart in about 10 minutes. The controller told the crew to hold for release and that another aircraft was expected to arrive in about 14 minutes.

At 2229:57, the copilot told the Jackson Hole Airport Unicom operator that they were beginning to taxi the aircraft.

The Unicom operator said, “Roger, please use AWOS [automated weather observation system] on [frequency] one three five one seven five for winds and altimeter. Preferred runway is one eight, and no known traffic in the area. And are you aware of the noise-abatement procedure?”

The copilot said that the crew was aware of the noise-abatement procedure.

The published noise-abatement procedure states, in part: “Preferred departure is Runway 18. Use a 45-degree left turn as soon as safely possible to reduce noise impact on residential areas southwest of the airport.”

The airport operator told Air Force investigators that Runway 18 is preferred for departure because of the prevailing winds and because southerly departures preclude low overflights of Grand Teton National Park, which is north of the airport.

“For noise-abatement procedures, an immediate left 45-degree turn avoids the houses off the end of the runway,” the airport operator said. “You cannot maintain your heading after the left turn for very long because of the terrain.”

The airport operator said that when the accident occurred, the moonless night was “inkwell black” and that there were no lights on the mountain ridge that was struck by the aircraft.

“The only ground reference you would have would be a small smattering of lights just to the north of the accident site, down in a valley, a long way below,” said the airport operator.

The CVR transcript shows that for about two minutes, the crew focused their attention on taxiing the aircraft and avoiding collision with parked aircraft.

At 2233:35, the navigator told the pilot that an immediate left turn would be required to fly directly toward the Boysen Reservoir tactical air navigation (TACAN) station.

“That’s about a hundred and seventy miles out so ... we’ll fly the SCNS [self-contained navigation system],” said the navigator.

The crew then conducted the before-takeoff checklist. The pilot asked if there were any questions. The crew chief asked about the problem encountered while starting the no. 3 engine. Both the pilot and the flight engineer said that the engine had been slow to start.

The crew chief said, “I don’t know. I, uh, guess maybe that bleed-air regulator or something.”

At 2236:22, the pilot asked the navigator what heading he should turn to on departure. The navigator told him to make a left turn to 080 degrees.

“Left to zero eight zero,” the pilot said. “That’s going to be my terrain-clearance heading, too?”

“Yeah, that’s affirmative,” the navigator said. “The sooner we can turn, the better.”

The report said that the crew did not discuss obstacle-clearance data or the required climb rate for departure.

“It appears that the crew was not aware of the climbout terrain and the obstacles on departure,” the report said.

The crew had a U.S. Department of Defense Flight Information Publication that included airport information, instrument approach procedures and instrument departure procedures.

The Jackson Hole Airport approach charts contained a symbol — a white “T” in a black triangle — that showed that special departure procedures were published for the airport.

The Runway 18 departure procedures required, in part, an initial climb to 11,000 feet via the 188-degree radial of the Jackson VOR/DME (which is located on the airport), then a climbing left turn to the Jackson VOR/DME.

The report said that Air Force regulations require that “if a departure procedure is published for the runway in use at the departure airport, the pilot should review the procedures to be familiar with the location of obstacles When a SID [standard instrument departure] or radar vectors are used for departure, follow these procedures. If neither a SID nor radar vectors are available [or] used, the published departure procedures should be used to avoid obstacles unless alternate procedures are used to ensure all obstacles can be safely avoided.”

The report said that the CVR transcript shows that the crew did not discuss the published instrument departure procedures.

“No one discusses the IFR departure procedures,” the report said. “No one discusses the fact that, in spite of a VFR (visual flight rules) weather report, there is no moon, and one cannot see the tops of the mountains to the east.”

At 2238:29, the crew checked the AWOS, which said that the surface winds were from 350 degrees at six knots [11 kilometers per hour].

The report said, “No one mentions the fact that takeoff [on] Runway 18 with winds [from] 350 degrees at six knots gives a

six-knot tail wind in a situation where the crew was already concerned about takeoff performance.”

At 2239:25, the crew of a SkyWest Embraer Brasilia reported on the Unicom frequency that they were conducting a straight-in approach to Runway 36 and that they were 17 nautical miles (32 kilometers) from the airport.

The crew of a Delta Air Lines aircraft then reported that they were taxiing to Runway 36 for departure.

“Why is everybody going to three six?” the C-130 pilot said. “I thought they said preferred runway was one eight.”

“Yeah, I thought that is what he said, too,” said the copilot.

The pilot then reported on Unicom that the C-130 was “in the approach end of runway one eight, holding for traffic.”

At 2240:36, the copilot requested release for departure. The Salt Lake City Center controller released the flight for departure and told the crew to climb to and maintain FL 190.

The navigator asked the pilots if the takeoff would be conducted on Runway 36. The copilot said, “No, they are landing three six, we’re going to take off on one eight.”

The pilot asked the SkyWest crew for a position report. The SkyWest crew said that they were on a seven-mile (13-kilometer) final approach to Runway 36.

The pilot said that the C-130 was at the approach end of Runway 18 and asked, “Are we going to be in your way coming inbound, sir?”

“Shouldn’t be,” the SkyWest crew said.

“Copy that,” the pilot said. “We’ll get airborne after you’re on the ground, sir.”

The pilot then told the copilot, “As soon as he is on the ground and clear, we’ll see if we can beat this Delta guy [out of] here.”

At 2244:56, the SkyWest crew reported that they were clearing the runway. The C-130 pilot told the copilot, “All right, go for it.”

The copilot reported on Unicom: “Jackson Hole traffic, Havoc five eight taking the runway for departure on one eight.”

During the crew briefing, the pilot had said that he would conduct the takeoff and then transfer the flight controls to the copilot.

At 2246:08, the pilot said, “And power’s coming in.” The report said that full power was used for the takeoff and climb.

At 2247:07, the copilot said “go,” then “rotate.”

At 2247:19, the pilot said, “All right, climbing away, gear up.”

“Gear up,” said the copilot.

“All right, I am going to go ahead and start a left-hand turn,” said the pilot.

The report said that the aircraft was approximately one nautical mile (1.9 kilometers) from the end of the runway when the pilot began the turn.

A charter pilot who resided near the airport observed the takeoff. He said that the aircraft appeared to be flying “very low.”

“When I first saw the aircraft from my yard, they were about 100 [feet (31 meters)] over the tops of some trees,” the charter pilot said. “At that point, they were definitely in a left-hand turn. They went wings-level. ... I told my girlfriend that I wondered what they were doing. Some people do some pretty strange procedures out of here, and most of them make it out. I mentioned to her that they were awful low and off course.”

At 2248:38, the copilot told Salt Lake City Center that the aircraft was “passing eight thousand [feet] for one nine thousand [feet].” The controller acknowledged the call. The report said that the aircraft was too low to be detected by air traffic control radar.

At 2249:25, the copilot said that she had completed her after-takeoff checks.

The pilot said, “All right, Co, are you ready to fly?”

“Hold on,” said the copilot.

“Okay, no rush,” the pilot said. “Whenever you’re ready.”

The navigator told the pilot to roll out of the turn on a heading of 078 degrees. The pilot said, “Roger that. You want me to intercept [the] SCNS course?”

The navigator said, “Yeah.”

The report said, “This means a course appears on the pilot’s instruments from present position direct to Boysen Reservoir [TACAN].”

At 2250:09, the copilot said, “And copilot is ready to fly.”

“Okay, you have the aircraft,” said the pilot.

At 2250:25, the pilot said, “My radar altimeter just died.” This was the last statement recorded by the CVR.

The aircraft struck a mountain ridge 9.2 nautical miles (17 kilometers) east of the airport. The initial impact was 500

feet (153 meters) below the ridge on terrain that sloped eight degrees.

“The aircraft impacted the ground ... at an altitude of 10,392 feet ... on the west side of Sheep Mountain, also known as Sleeping Indian Mountain, Teton National Forest,” the report said. “Approximate aircraft parameters were: heading 077 degrees magnetic, 173 knots indicated airspeed, climbing flight with approximately seven [degrees] to eight degrees nose-up attitude, near wings-level.

“The aircraft and cargo were destroyed on ground impact, with the wreckage strewn along a 094-degree true axis, approximately 370 feet [113 meters] wide by 1,480 feet [451 meters] long.”

The report said that an intense fire occurred upon impact and that there was no evidence of an in-flight fire.

Several people saw a fireball and made telephone calls to local emergency facilities. Teton County Sheriff’s Department deputies and search-and-rescue personnel, and Grand Teton National Park rangers responded to the calls. U.S. Secret Service agents accompanied the search-and-rescue personnel. They traveled by foot and on horseback six statute miles (9.7 kilometers) to the accident site, because operation of motorized vehicles was not allowed in the area.

“The first ground team to reach the crash site did so at 0430,” the report said. “No survivors were found. The area was secured.”

The report said that the aircraft occupants were killed by “multiple blunt-force injuries.”

All the maintenance documents aboard the aircraft were destroyed by the impact and fire.

“A review of the remaining aircraft forms and records did not reveal any evidence of maintenance discrepancies which may have contributed to the accident,” said the report.

The records showed that an unscheduled replacement of the no. 3 engine had been conducted the week before the accident. The report said that the flight crew’s difficulty starting the no. 3 engine before takeoff from Dyess AFB and before takeoff from Jackson Hole Airport was not a factor in the accident.

“A review of engine components by Allison Engines found that there was no inherent engine mechanical failure,” the report said. “Fuel samples ... from the servicing truck at Jackson Hole [Airport] and the servicing truck at Dyess AFB ... were normal. ... A review of engine performance, utilizing data extracted from the flight data recorder and thrust-and-torque calculations from Hamilton Standard, indicated [that] all engines were operating at or near maximum power at the time of impact.”♦

[This article, except where specifically noted, was based on the U.S. Air Force Aircraft Accident Investigation Board report AFI 51-503, 17 August 1996, C-130 Aircraft, USAF, S/N 74-1662. The 630-page report contains diagrams and photographs.]

Appendix

Cockpit Voice Recorder Transcript, U.S. Air Force C-130H, Aug. 17, 1996

[FSF editorial note: The following transcript, which begins when the crew taxis the aircraft onto the runway for takeoff, is as it appears in the U.S. Air Force Aircraft Accident Investigation Board report, except for minor column rearrangement and minor editing for consistency. Times are local.]

MP = Mission pilot
MCP = Mission copilot
MN = Mission navigator
MF = Mission flight engineer
ML = Mission loadmaster
SLC = Salt Lake City Air Route Traffic Control Center
SKY257 = SkyWest Airlines Flight 257

Time Source Content

2244:56 SKY257 And Jackson traffic, SkyWest two fifty-seven, Brasilia, clearing, uh, runway three six, Jackson.

2245:03 MP All right, go for it.
2245:06 MCP <radio> Jackson Hole traffic, Havoc five eight, taking the runway for departure on one eight.
2245:13 MP All right, you’re cleared up on the inboards, Eng. Let’s get a lineup checklist, crew. I guess, Co, once we get airborne we will make a turning outbound call on this frequency and then give, uh, Center a call, I guess.
2245:26 MCP Sounds good to me.
2245:28 MP Clear final for me, please.
2245:30 MCP Clear.
2245:31 MP And lineup checklist.
2245:34 MCP Lineup checks.
2245:35 MF Complete, Engineer.

2245:36	MN	Navigator.	2248:27	MCP	Gear's up, flaps are up.
2245:37	ML	Loadmaster.	2248:28	MCP	Hot mike ...
2245:39	MCP	And Copilot ... The lights all the way up.	2248:29	MP	Off, Pilot.
2245:43	MP	That'll work.	2248:30	MCP	Copilot. After-takeoff checks.
2246:03	MP	All right, you're cleared to close the bleeds, Eng.	2248:31	MF	Complete, Engineer.
2246:08	MP	And power's comin' in.	2248:32	MN	Navigator.
2246:21	MF	Power checked at four ... fourteen.	2248:33	ML	In progress, Loadmaster.
2246:23	MP	Okay ... All right, ready, ready ...	2248:36	MF	Clear on bleeds?
2246:31	MP	Hack ... Looking for 32 seconds, Nav.	2248:37	MP	You bet.
2246:32	MN	Timing.	2248:38	MCP	<radio> Salt Lake Center, Havoc five eight's passin' eight thousand for one nine thousand.
2246:51	MP	Pilot's controls.	2248:43	SLC	Havoc five eight, Salt Lake Center, roger.
2246:52	MCP	Roger, Pilot controls.	2248:54	MP	And we are clear to what altitude, you said?
2247:07	MCP	Go.	2248:56	MN/MCP	<simultaneously> One nine.
2247:08	MCP	Rotate.	2249:00	MP	All right, thanks.
2247:19	MP	All right, climbing away, gear up.	2249:09	MP	All righty.
2247:20	MCP	Gear up.	2249:20	MP	I'll tell you what, let's keep one seventy in the climb for now.
2247:31	MP	All right, I am going to go ahead and start a left-hand turn.	2249:22	ML	After-takeoff checks complete, Loadmaster.
2247:37	MCP	<radio> Jackson traffic, Havoc eight five, airborne to the south, turning to zero eight zero at this time.	2249:25	MCP	And complete, Copilot.
2247:41	MN	Zero eight zero, Pilot.	2249:27	MP	All right, Co, you ready to fly?
2247:47	MP	Thanks, and, Eng, can you kill those flight deck domes, I don't think I got them all the way off.	2249:30	MCP	Hold on.
2247:53	MF	Flight deck ... ?	2249:32	MP	Okay, no rush. Whenever you're ready.
2247:56	MP	The dome lights on the far left.	2249:42	MN	Pilot, roll out to a zero seven eight.
2247:59	MF	Yeah, they're all the way down.	2249:44	MP	Roger that.
2248:01	MP	Are they? Huh, it's awful bright in here. Maybe it is just me.	2249:55	MP	You want me to intercept, uh, SCNS course?
2248:07	MF	I'll turn mine down some. Overheads.	2249:57	MN	Yeah.
2248:11	MP	Okay. All right, understand landing gear is up?	2249:59	MP	All right.
2248:16	MCP	Gear's up.	2250:03	MN	SCNS is sequenced to Boysen.
2248:17	MP	Let's go ahead and get flaps twenty, please.	2250:06	MP	Okay.
2248:18	MCP	Flaps coming to twenty.	2250:09	MCP	And Copilot is ready to fly.
2248:21	MCP	Flaps are twenty.	2250:10	MP	Okay, you have the aircraft.
2248:23	MP	Thank you, and let's go ahead and get flaps up with an after-takeoff checklist, please.	2250:12	MCP	Okay, I have the aircraft.
2248:25	MCP	Flaps are coming up.	2250:15	MP	Going up to one nine oh.
2248:26	MP	Thank you.	2250:17	MCP	Roger.
			2250:21	MP	I tell you what, Co, if you want, I will set ten ten.
			2250:23	MCP	Yeah. Thanks.
			2250:25	MP	My radar altimeter just died.
			2250:27		<End of recording>

Source: U.S. Air Force Aircraft Accident Investigation Board

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