July 3, 2026

Aviation Investigation Report AIR-26-05

In-Flight Loss of Control and Impact with Pack Ice

Bering Air Flight 445

Textron Aviation 208B, N321BA

Near Nome, Alaska
February 6, 2025

Abstract: This report discusses the February 6, 2025, accident involving a Textron Aviation 208B airplane operated by Bering Air as a charter flight to Nome Airport, Nome, Alaska. While the airplane was descending to its destination, the airplane experienced an aerodynamic stall and loss of control, and impacted pack ice. The pilot and nine passengers died. Safety issues identified in this report include:

- The need for upset prevention and recovery training for all Title 14 *Code of Federal Regulations* (*CFR*) Part 135 and 91K operators, except single-pilot and single-pilot-in-command operators,
- Bering Air's inadequate flight risk assessment and operational control process and procedures,
- the Federal Aviation Administration's (FAA) inadequate oversight to identify operational complexity and rapid growth as risk factors for Bering Air,
- the lack of required load manifests and recordkeeping requirements for aircraft operated under 14 *CFR* Part 135,
- the lack of requirements for a structured flight data monitoring program and associated recording devices for all 14 *CFR* Part 135 operators, and
- the lack of requirements for certain aircraft operated under Parts 91, 121, or 135 to be equipped with crash-resistant flight recorder systems.

As a result of this investigation, the National Transportation Safety Board issues two new safety recommendations to the FAA, reiterates six safety recommendations to the FAA, and classifies one safety recommendation each to the FAA and the National Weather Service as Closed—Acceptable Action.

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Acronyms and Abbreviations

AAWU	Alaska Aviation Weather Unit
AD	airworthiness directive
ADS-B	automatic dependent surveillance–broadcast
AFIS	automatic flight information service
AIRMET	airmen's meteorological information
agl	above ground level
AOA	angle of attack
ARC	aviation rulemaking committee
ATC	air traffic control
ATP	airline transport pilot
AWC	Aviation Weather Center
CFR	*Code of Federal Regulations*
CG	center of gravity
CHAT	certificate holder assessment tool
CIP	current icing product
CWA	center weather advisory
DCT	data collection tool
FAA	Federal Aviation Administration
FDM	flight data monitoring
FIP	forecast icing product
fpm	feet per minute
FSDO	flight standard district office
FSS	flight service station

IFR	instrument flight rules
inHg	inches of mercury
IPA	Icing Product Alaska
GFA	graphical forecasts for aviation
GOM	general operations manual
HAA	helicopter air ambulance
KIAS	knots indicated airspeed
LAA	low airspeed awareness
METAR	meteorological aerodrome report
MGTOW	maximum gross takeoff weight
msl	mean sea level
NCAR	National Center for Atmospheric Research
NOTAM	notice to airmen
NWS	National Weather Service
OCM	operation control manager
PAMK	St. Michael Airport
PAOM	Nome Airport
PAUN	Unalakleet Airport
PIC	pilot-in-command
PIREP	pilot report
POH	pilot operating handbook
POI	principal operations inspector
RPAT	risk profile assessment tool
SAS	safety assurance system

SD	secure digital
SLD	supercooled large droplets
SIGMET	significant meteorological information
sm	statute miles
SMS	safety management system
STC	supplemental type certificate
TKS	Tecalemit-Kilfrost-Sheepbridge Stokes
VASI	visual approach slope indicator
VFR	visual flight rules
ZAN	Anchorage Air Route Traffic Control Center

Executive Summary

What Happened

On February 6, 2025, about 1520 Alaska standard time, a Textron Aviation 208B airplane, N321BA, operated as Bering Air flight 445, was destroyed when it was involved in an accident near Nome, Alaska. The pilot and nine passengers died. The airplane was operated under Title 14 *Code of Federal Regulations* (*CFR*) Part 135 as a scheduled charter flight.

The accident pilot was scheduled to fly a three-leg roundtrip on the day of the accident, originating at Nome Airport (PAOM). The accident occurred during the third leg of the trip on the return flight to PAOM. The pilot departed on this last leg about 1437. He used the autopilot for most of the final flight.

The Bering Air dispatcher who reviewed the day's weather with the pilot before the first flight leg stated that the pilot was aware of the weather and conditions for the time and route of the accident flight based on the information available at the time and had no concerns. However, about 38 minutes after departing on the last leg, the flight encountered severe icing conditions, including supercooled large droplets (SLD).[1] The airplane had a functioning Tecalemit-Kilfrost-Sheepbridge Stokes (TKS) ice protection system, which the pilot used during the flight's encounter with icing conditions.

About 1512, PAOM closed both of its runways for deicing, which was expected to take 10 to 15 minutes. The radar controller informed the pilot of the closure and suggested that he could "slow down a little bit" to prevent arriving before the runway was reopened. The pilot reduced engine power, and the airplane's airspeed decreased from about 160 kts to about 110 kts; the pilot then increased engine power, and the airspeed increased to about 126 kts. About 1519, the airspeed again began to decrease, down to about 99 kts, which activated the airplane's low airspeed awareness (LAA) system. As designed, activation of the LAA system resulted in the autopilot disengaging.

At 1519:46, the airplane's descent rate was about 2,000 feet per minute (fpm); data from the airplane's onboard avionics indicate that the airplane's pitch attitude reached its maximum value of about 10° to12° nose up (consistent with an elevator

[1] According to FAA Advisory Circular (AC) 00-45H, "Aviation Weather Services," SLD icing conditions comprise supercooled water droplets, such as freezing drizzle or freezing rain, that measure 0.05 mm in diameter or larger. Chapter 5.19.1.2.5 of the AC also states that SLD icing conditions are outside the envelopes used for aircraft icing certification (contained in Appendix C of 14 *CFR* Part 25) and that SLD icing conditions "can be particularly hazardous" to some aircraft (FAA 2016a).

input by the pilot) at an airspeed of 89 kts about this time. Its descent rate then decreased to 1,400 fpm over 3 seconds. Over the next 8 to 9 seconds, the airplane's airspeed decreased to about 70 kts at an altitude of about 3,100 ft mean sea level (msl).

At 1520:07, the radar controller instructed the pilot to climb and maintain 4,000 ft msl. The controller attempted to contact the pilot again 7 seconds later but received no response. The final automatic dependent surveillance–broadcast position data point was recorded at 1520:09 when the airplane was at an altitude of 1,325 ft msl. It impacted pack ice about 12 miles offshore of Norton Sound and about 32 miles east of PAOM.

What We Found

We found that the National Weather Service products that existed at the time of the accident flight did not indicate potential areas of SLD icing for Alaska. The accident flight encountered icing conditions more severe than forecast, and although the TKS ice protection system was not approved for operation in SLD icing conditions, it functioned properly during the airplane's encounter with these conditions and prevented significant ice buildup on protected surfaces. Although it did not contribute to the accident outcome, we found that the pilot's operation of the airplane beyond the glide distance to the shoreline was not in compliance with Bering Air's guidance concerning single-engine operation over water.

We found that managing the airplane's deicing process and the approach may have resulted in the pilot's degraded situation awareness, which inhibited his ability to monitor and maintain adequate airspeed, allowing it to reach the activation threshold for the LAA system and disengagement of the autopilot. The airplane's airspeed slowed to the point where it entered an aerodynamic stall, and the pilot likely did not recognize the low airspeed or the high angle of attack in enough time to prevent the stall. The safety of Part 135 and 91K operations would be enhanced by requiring upset prevention and recovery training for these operators.

In addition, we found that Bering Air's flight risk assessment and operational control process and procedures at the time of the accident were inadequate to prevent the accident flight from operating in an overweight condition, which reduced its stall margin. We found a pattern of Bering Air manifests having weights underreported by pilots, with several flights operating above weight limits. Requiring joint operational control responsibility between a certificated dispatcher and a pilot-in-command (PIC) can minimize the potential of a single-point failure to affect the safety of Part 135 operations. We found that flight data monitoring (FDM) programs using data from onboard avionics similar to the system installed on the accident airplane could provide operators like Bering Air with objective information to identify and mitigate operational risks, such as the recurring weight discrepancies identified during the investigation.

We also found that the Federal Aviation Administration's (FAA) oversight of Bering Air did not identify its increased operational complexity and rapid growth following the 2020 pandemic and the bankruptcy of its largest competitor as risk factors warranting increased surveillance. The FAA's risk profile for the operator did not change, nor did its surveillance frequency.

We determined that the probable cause of this accident was the pilot's inadequate airspeed management due to workload and degraded situation awareness and his improper inputs leading up to and during the aerodynamic stall, which increased the airplane's angle of attack. Also causal was operation of the airplane above maximum gross weight, which reduced the airplane's stall margin. Contributing to the accident were the operator's inadequate safety management, which allowed the routine operation of flights that exceeded weight limitations, and the Federal Aviation Administration's inadequate oversight of the operator, which failed to identify and address the routine operation of overweight flights.

What We Recommended

We recommended that the FAA require all Part 135 and 91K operators, except single-pilot and single PIC operators, to incorporate upset prevention and recovery training, whether in a simulator or an aircraft, and related checklists and procedures into their training programs.

We also recommended that the FAA develop explicit surveillance criteria for 14 *CFR* Part 135 and 91K operators that are experiencing rapid growth, increased complexity of operations, or other changes that warrant increased oversight.

In addition, we reiterated previously issued recommendations to the FAA to require Part 135 operators, except single-pilot and single PIC operators, to use certificated dispatchers whose responsibilities include preflight planning; flight dispatch, release, and cancellation decisions; and flight monitoring, consistent with the requirements for 14 *CFR* Part 121 domestic and flag operations, and to require all Part 135 operators to install flight data recording devices capable of supporting an FDM program and to establish a structured FDM program that reviews all available data sources to identify deviations from established norms and procedures and other potential safety issues.

We also reiterated a recommendation to the FAA to expand the applicability of the load manifest and recordkeeping requirements of Part 135.63(c) to include Part 135 single-engine aircraft operations. We also reiterated recommendations to the FAA to require certain aircraft operated under Part 91, 121, and 135 be equipped with crash-resistant flight recorder systems.

We classified two recommendations (one each to the FAA and NWS) requesting the depiction of potential areas of SLD icing on the graphical products for Alaska as Closed—Acceptable Action.

1. Factual Information

1.1 History of Flight

On February 6, 2025, about 1520 Alaska standard time, a Textron Aviation 208B airplane, N321BA, operated as Bering Air flight 445, was destroyed when it was involved in an accident near Nome, Alaska. The pilot and nine passengers died. The airplane was operated under Title 14 *Code of Federal Regulations* (*CFR*) Part 135 as a scheduled charter flight.[2]

The accident pilot was scheduled to fly a three-leg roundtrip on the day of the accident, originating at Nome Airport (PAOM) with intermediate stops at St. Michael Airport (PAMK) and Unalakleet Airport (PAUN), where he arrived about 1032 (see figure 1). The first two legs were uneventful. The accident occurred during the third leg of the trip.

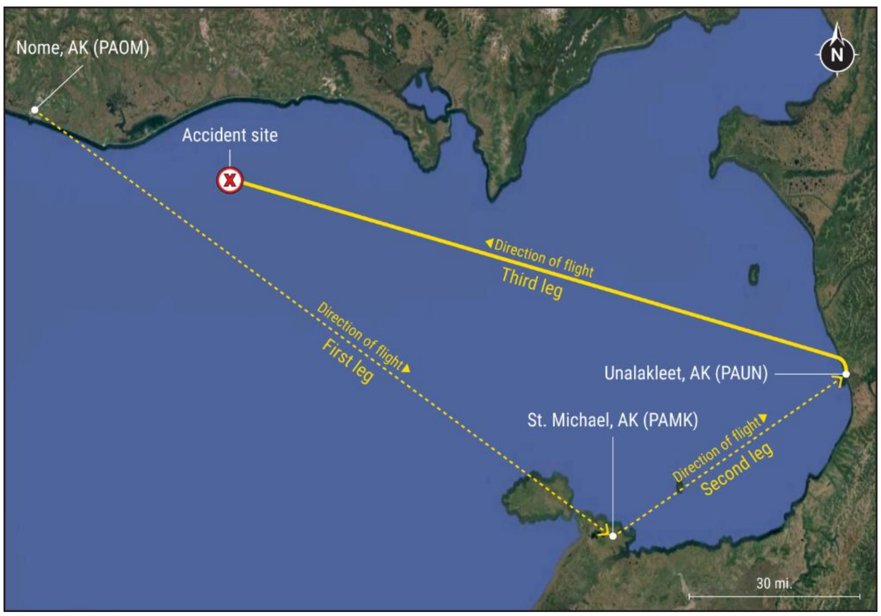

Figure 1. Ground track for flight 445 from PAUN to PAOM.

According to the dispatcher on duty at PAOM the day of the accident, he reviewed the weather with the pilot, spending about 20 minutes with him planning the day's route and discussing scenarios for the flight to PAUN as well as the return flight to PAOM. The dispatcher stated that the pilot was "aware of the weather and the conditions" and that they had specifically discussed the forecast concerning conditions over the Norton Sound area, which were expected to improve. He stated the pilot did not express any concerns about the weather and that icing was

[2] Visit ntsb.gov to find additional information in the public docket for this NTSB accident investigation (case number ANC25MA108).

discussed "first thing in the morning" but that there was nothing officially reported to confirm its presence. The dispatcher stated that the pilot was calm, well rested, and appeared to be in a good mood.

According to the operator's fueling log, the pilot requested a fuel load of 1,800 lbs before departure from PAOM. Data recovered from the airplane's onboard avionics (Garmin G1000 integrated flight deck) indicated that about 1,842 lbs of fuel were onboard at the initial departure from PAOM to PAMK.[3] When the airplane took off from PAUN (where it was not refueled) for the accident flight, about 1,464 lbs of fuel were onboard.

According to Bering Air's director of operations, when the pilot arrived at PAUN, "the weather was poor in outlying villages" so he remained at PAUN until conditions were flyable. The customer service representative on duty at PAUN the day of the accident reported that the pilot reviewed the weather online while there.[4] The PAUN weather observation, recorded about 1429, noted wind from 290° at 3 kts, visibility 2.5 miles, light snow, mist, overcast ceiling at 1,400 ft above ground level (agl), temperature of -6°C, dew point temperature of -7°C, and an altimeter setting of 30.19 inches of mercury (inHg). The observation remarks indicated trace precipitation since about 1356 and that freezing rain information was unavailable.

The airplane was not equipped, and was not required to be equipped, with a cockpit voice recorder or a flight data recorder.[5] Information for the accident flight was obtained from automatic dependent surveillance–broadcast (ADS-B) data, communications between the pilot and Anchorage Air Route Traffic Control Center (ZAN), and data downloaded from the airplane's Garmin G1000 integrated flight deck.[6]

[3] The Garmin G1000 integrated flight deck is a collection of multiple avionics units that include flight displays, air data computers, attitude/heading reference system, communications, and other systems (see section 1.6 for more information). It relies on an installed secure digital (SD) card for data storage.

[4] Although the accident pilot had an account with ForeFlight, evidence does not indicate that he used the account before the accident flight nor did he call Alaska Flight Service. See section 1.11.3.2 for more information concerning Bering Air's requirements for preflight activities.

[5] Title 14 *CFR* 135.151 requires a cockpit voice recorder on multiengine, turbine-powered airplanes having a passenger seating configuration of six or more that are required to be flown by two pilots by certification or operating rules. Title 14 *CFR* 135.152 requires a flight data recorder on airplanes with a passenger seating configuration of 10 or more seats.

[6] The Garmin G1000 integrated flight deck is not a flight data recorder, and as such, is not designed to survive accidents and is not subjected to the same certification standards as a flight data recorder.

About 1351, the pilot contacted the Nome flight service station (FSS) to file both a visual flight rules (VFR) and instrument flight rules (IFR) flight plan from PAUN to PAOM. The pilot contacted the Nome FSS again about 1435 to request activation of the VFR flight plan. About 1436, the pilot contacted the ZAN radar controller, reported that he was on the ground at PAUN, and requested an IFR clearance to PAOM.[7] The pilot then received an IFR clearance to PAOM at an altitude of 8,000 ft mean sea level (msl).

About 1437, the airplane departed from runway 33 at PAUN and proceeded west over Norton Sound toward PAOM. The autopilot was engaged at 1438:58, initially in the flight level change pitch mode and roll lateral mode.[8] At 1439, the pilot contacted the ZAN radar controller to report the flight was at 1,600 ft and climbing to 8,000 ft, and the controller advised the pilot that radar contact was established. About 1440, the ZAN data controller informed the Nome FSS that flight 445 was estimated to arrive at PAOM about 1535 and would be conducting an area navigation approach to runway 28. About 1449, the flight leveled at a cruise altitude of 8,000 ft msl; it was about 20 miles west of PAUN. The autopilot transitioned to altitude hold mode at that time.

About 1456, the radar controller cleared the flight to descend and maintain 6,000 ft msl at the pilot's discretion, and requested the pilot to advise when he had received automatic flight information service (AFIS) information Kilo.[9] About 1511, the flight was about 50 miles east of PAOM, and the pilot reported to the controller that he was beginning a descent from 8,000 ft msl. The pilot also advised receiving current weather and airport information from AFIS at PAOM; AFIS Kilo would have been based on the 1453 meteorological aerodrome report (METAR), which indicated, in part, wind from 340° at 6 kts, 9 statute miles (sm) visibility, few clouds at

[7] Title 14 *CFR* 135.105(a) provides exception to the second-in-command requirement (in section 135.101) for Part 135 passenger-carrying operations in IFR by allowing single-pilot operations if the aircraft has "an operative approved autopilot system and the use of that system is authorized by appropriate operations specifications."

[8] The airplane was equipped with a Garmin G1000 integrated autopilot and flight director system. The autopilot is a three-axis digital flight control system composed of multiple Garmin line replaceable units providing autopilot, flight director, and manual electric trim. Figure 5 in section 1.3.2.2 shows the autopilot mode control unit and buttons for mode selection.

[9] AFIS (for Alaska flight service stations [FSS] only) provides a continuous broadcast over a discrete Very high frequency radio (usually the automated surface/weather observing systems) of recorded non-control information at airports in Alaska where an FSS provides local airport advisory service. The AFIS broadcast automates the repetitive transmission of routine but essential information such as weather, wind, altimeter, favored runway, braking action, and airport notices to airmen, and other applicable information.

900 ft agl and scattered clouds at 2,600 ft agl, overcast at 6,000 ft agl, temperature -11°C, and an altimeter setting of 30.21 inHg.

During the descent, the autopilot remained engaged and transitioned from altitude hold to vertical speed select mode. The airplane airspeed increased from about 150 kts to about 160 kts. At 1512, PAOM operations advised Nome FSS that both of the airport's runways were closed temporarily for deicing; however, runway 10/28 was expected to reopen in 10 to 15 minutes.

About 1513, Nome FSS advised the ZAN data controller of the runway closures. About 1514, the ZAN radar controller informed the pilot about the runway closures at PAOM and the estimated duration. The radar controller suggested that the pilot could "slow down a little bit" to prevent arriving before the arrival runway reopened, which the pilot acknowledged. About that time, the airplane engine power was reduced from 688 hp to 290 hp, and the airplane airspeed began to decrease from about 160 kts to about 114 kts as the descent continued. Available weather data indicated that the airplane entered moderate-or-greater icing with supercooled large droplets (SLD) about 1514:55 (see section 1.4 for more information about the weather conditions).[10]

About 1515:30, the airplane leveled off at 6,000 ft msl, and the autopilot transitioned to altitude hold mode. About 15 seconds later, the airspeed had decreased to about 110 kts. About 1515:50, the engine power increased to about 340 hp, and airspeed subsequently increased to about 126 kts. About 1516, the controller instructed the pilot to descend and maintain 4,000 ft msl at the pilot's discretion, which the pilot acknowledged. Shortly afterward, the airplane began to descend to about 5,500 ft, and the autopilot transitioned again to vertical speed mode. At 1518:16, at an airspeed of about 126 kts, engine power decreased to 265–290 hp, and the airplane's airspeed began to decrease.

Between 1519:20 and 1519:24, the airplane leveled off at 4,000 ft msl, and the engine power began to gradually increase from about 290 hp to 350–400 hp. The autopilot remained engaged and transitioned into altitude hold mode. The airplane's airspeed was about 118 kts and gradually decreasing. The airplane pitch attitude slowly increased from near nose level to about 9° nose up. At 1519:35, the autopilot disengaged due to decreasing airspeed and the activation of the low airspeed

[10] According to FAA Advisory Circular (AC) 00-45H, "Aviation Weather Services," SLD icing conditions comprise supercooled water droplets, such as freezing drizzle and/or freezing rain, that measure 0.05 mm in diameter or larger. The AC also states that SLD icing conditions are outside the envelopes used for aircraft icing certification (contained in Appendix C of 14 *CFR* Part 25) and that SLD icing conditions "can be particularly hazardous" to some aircraft.

awareness (LAA) system (see section 1.3.2.3). At that time, the airplane airspeed was 99 kts, and its heading changed slightly from 270° to about 260°.

At 1519:46, the airplane's descent rate was about 2,000 feet per minute (fpm); the data indicate that the airplane's pitch attitude reached its maximum value of about 10° to12° nose up (consistent with an elevator input by the pilot) at an airspeed of 89 kts about this time. Its descent rate then decreased to 1,400 fpm over 3 seconds. Over the next 8 to 9 seconds, the airplane's heading changed from about 260° to about 200° (that is, from a westerly to a southerly course), and its airspeed decreased to about 70 kts at an altitude of about 3,100 ft msl.

The final data point recorded from the airplane's avionics was at 1520:03 and indicated its altitude at 2,100 ft msl in a 64° left-wing-down and 30° nose-down attitude and a descent rate of about 7,800 fpm. The largest recorded lateral and vertical accelerations were -0.77 g and 2.2 g, respectively, with both occurring about 3 seconds before the end of the recorded data.

At 1520:07, the ZAN radar controller instructed the pilot to climb and maintain 4,000 ft msl. The final ADS-B position data point was recorded at 1520:09 at an altitude of 1,325 ft msl about 32 miles east of PAOM and about 12 miles offshore of Norton Sound. Satellite tracking position data provided by a third-party vendor recorded two additional data points. The final satellite tracking data point corresponded to a time of 1520:17 and an airplane altitude of 200 ft msl.

At 1520:18, the radar controller transmitted to the pilot, "Low altitude alert…check your alt[itude] immediately altitude Mode C indicates 1600 descending," but received no response. The radar controller then contacted the pilot of an uninvolved aircraft operating in the PAOM area about 60 miles north and requested they attempt to reach the accident pilot. The pilot of the uninvolved aircraft was unable to establish communication. ZAN and Nome FSS made multiple attempts to contact the pilot on various frequencies, but no further communications were recorded. The airplane impacted pack ice about 12 miles offshore of Norton Sound and 32 miles east of PAOM.

Another Bering Air pilot who was flying northeast of PAOM as the pilot approached PAOM from the east-southeast reported during a postaccident interview that she "chatted briefly" with the accident pilot on the common traffic advisory frequency, and she advised him that conditions were "icy" where she was. During the interview, she reported that ice began to accrete on her airplane about 40 nautical miles northeast of the initial approach fix for PAOM.

Initially, she operated the airplane's Tecalemit-Kilfrost-Sheepbridge Stokes (TKS) ice protection system in normal mode and moved it to "high" as she got closer to PAOM; she occasionally used the "max airframe" setting and the defrost windshield heat to attempt to clear the ice (see section 1.3.2.1 for more information on the TKS ice protection system). This pilot stated that keeping the windshield clear of ice was "the big problem." When asked whether SLD comes up during preflight weather discussions, she said, when in contact with dispatch, "It's typically quantity based. If it's amongst other pilots, it will be type and accumulation rate."

A second Bering Air pilot, who was flying out of PAOM about the time of the accident, stated during postaccident interviews that he did not anticipate getting into any icing. He added:

> There was no icing forecast as far as I'm aware. No icing in the METAR at the time. There were at least three PIREPs that I checked before I launched that said negative ice, negative turbulence, one from a Caravan, two from, I think they were 737s.

He departed in VFR conditions but encountered icing "fairly quickly" though it was not severe. Icing became worse as he proceeded east, so he called base operations to report that he was returning due to the conditions. He stated that he had "never flown in [SLD conditions] before but…was starting to think that's what I was experiencing out there as it was getting worse."

1.2 Pilot Information

The pilot, age 34, held a commercial pilot certificate with ratings for airplane single- and multiengine land, and an airplane instrument rating with an English Proficient limitation. He held a type rating in the BE-1900 with a limitation for second-in-command privileges only. The pilot also held a mechanic certificate with airframe and powerplant ratings, as well as a remote pilot certificate with a rating for small unmanned aircraft systems. He was issued an FAA first-class medical certificate on December 3, 2024, with no limitations.

The pilot had been employed by the operator as a pilot since March 2022 and was based at PAUN at the time of the accident. He completed his most recent 12-month flight (line) check, as required by 14 *CFR* 135.299, on July 28, 2024. The airplane's pilot operating handbook (POH) stipulated that pilots-in-command (PIC) were required to complete "specific training" provided by the airplane manufacturer within the preceding 12 calendar months for any flight into known or forecast icing conditions. Consistent with this requirement, the accident pilot successfully completed the Cessna TKS-Equipped Caravan Cold Weather Ops Course on October 29, 2024.[11]

His most recent 12-month competency check, as required by 14 *CFR* 135.293, and 6-month instrument proficiency check, as required by 14 *CFR* 135.297, were completed on December 9, 2024, at FlightSafety International in Wichita, Kansas. The 4-day recurrent training included 14 hours 30 minutes of ground school, 6 hours of simulator training, and a 1-hour-54-minute FAA Part 135 checkride. The pilot completed Bering Air's ground recurrent training on January 17, 2025.

The pilot had accumulated about 2,500 hours total flight time, including 1,060 hours in 208B airplanes. He had flown about 58.4 hours within the preceding 30 days, and 4.4 hours within the preceding 24 hours (the pilot operated seven flights on February 5, 2025).

The pilot's typical schedule with Bering Air was to work 2 weeks then be off 2 weeks. During his off time, he resided in North Branch, Minnesota, with his domestic partner and during his on-duty time, he resided in an apartment in Nome provided by Bering Air. In the 72 hours before the accident, the pilot had just returned to work his 2-week shift on the morning of February 4, 2025, but did not fly that day (he was previously on duty from January 4, 2025, through January 20, 2025). He had been scheduled to return to work on February 3 on an early morning flight from Minnesota to Nome but was delayed due to weather and had to stay overnight in Anchorage. The pilot's roommate while in Nome was off-shift and away during the time preceding the accident; as a result, a more detailed account of the pilot's 72-hour history could not be obtained.

The pilot's partner reported during postaccident interviews that he enjoyed flying for Bering Air and particularly liked that it was "a family-owned company" and that it "wasn't very corporate." She described the pilot as "overly cautious" concerning flying duties. She stated that he had complained about his flights being overweight and that "basically his concerns were disregarded." Recounting the pilot's complaint, she added, "They would want him to take more cargo than fuel, and he would rather have more fuel than cargo because he would always say, 'you can't fly without fuel'." She reported being aware of these complaints during the "entire time" she knew him, which was about 1 year.

[11] In December 2004, the NTSB issued Safety Recommendation A-04-64 to the FAA to "require all pilots and operators of Cessna 208 series airplanes equipped for flight into known icing conditions to undergo seasonal training for ground deicing and flight into icing conditions on an annual basis." This recommendation was classified Closed—Acceptable Action on January 29, 2009. In response to this recommendation, Bering Air offered two e-learning courses: Boot-Equipped Caravan Cold Weather Ops Course and TKS-Equipped Caravan Cold Weather Ops Course.

1.3 Airplane Information

1.3.1 General

The airplane was a Textron Aviation Inc. (Cessna) 208B (S/N 208B5613). At the time of the accident, it was configured with two pilot seats and nine passenger seats. A fuselage cargo pod was installed along the bottom of the fuselage. The airplane was powered by a Pratt and Whitney PT6A-140 engine (S/N PCE-VA0701) capable of producing 867 shaft horsepower, and a McCauley 4HFR34C778 (S/N 150502) four-blade, controllable pitch propeller. The airplane was manufactured in 2020 and issued a normal category, standard airworthiness certificate on December 3, 2020. It was purchased by Bering Air, Inc. on December 29, 2020.

Because the airplane was equipped with a TKS ice protection system and was subject to associated operating limitations and training requirements (see sections 1.3.2.1 and 1.2 for more information), it was certificated for flight into known icing conditions as defined in 14 *CFR* Part 25 Appendix C.[12] According to the airplane's POH and applicable supplements, flight in freezing rain, freezing drizzle, mixed conditions, conditions defined as severe, and conditions outside of the criteria contained in 14 *CFR* Part 25 Appendix C were prohibited. This prohibition also applied to the use of the autopilot.

1.3.2 Airplane Systems

1.3.2.1 TKS Ice Protection System

The airplane was equipped with a TKS ice protection system, which included porous titanium panels along the leading edges of the wings, horizontal and vertical stabilizers, and wing struts, a slinger ring on the propeller, and a spraybar on the windshield (these locations are identified in figure 2). The TKS ice protection system is designed to both prevent and remove ice from these surfaces by pumping fluid from a tank in the cargo pod through the panels and other fluid delivery devices.

[12] Title 14 *CFR* Part 25 Appendix C defines three atmospheric icing conditions: (1) continuous maximum icing defined by the variables of the cloud liquid water content, the mean effective diameter of the cloud droplets, the ambient air temperature, and the interrelationship of these three variables, (2) intermittent maximum icing defined by the variables of the cloud liquid water content, the mean effective diameter of the cloud droplets, the ambient air temperature, and the interrelationship of these three variables, and (3) takeoff maximum icing defined by a cloud liquid water content of 0.35 g/m3, the mean effective diameter of the cloud droplets of 20 microns, and the ambient air temperature at ground level of -9 °C.

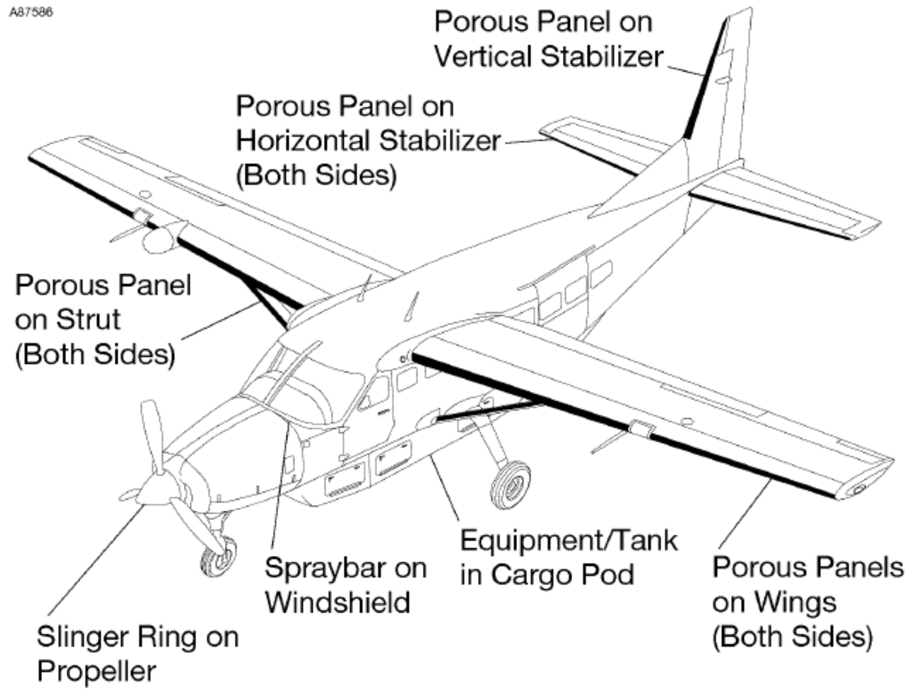

Figure 2. Exterior surfaces on a Textron Aviation 208B protected by TKS ice protection system. (Source: Model 208B POH/Airplane Flight Manual)

As shown in figure 3, the system is controlled through use of three toggle switches, located on the lower left of the pilot's instrument panel:

- PRIMARY (HIGH/toggle up, NORM[AL]/toggle center, and OFF/toggle down)
- MAX FLOW (AIRFRAME/toggle up and WINDSHIELD/toggle down)[13]
- BACKUP (ON/toggle up and OFF/toggle down)

[13] The MAX FLOW switch is spring-loaded and will automatically return to center position after an up or down selection is made.

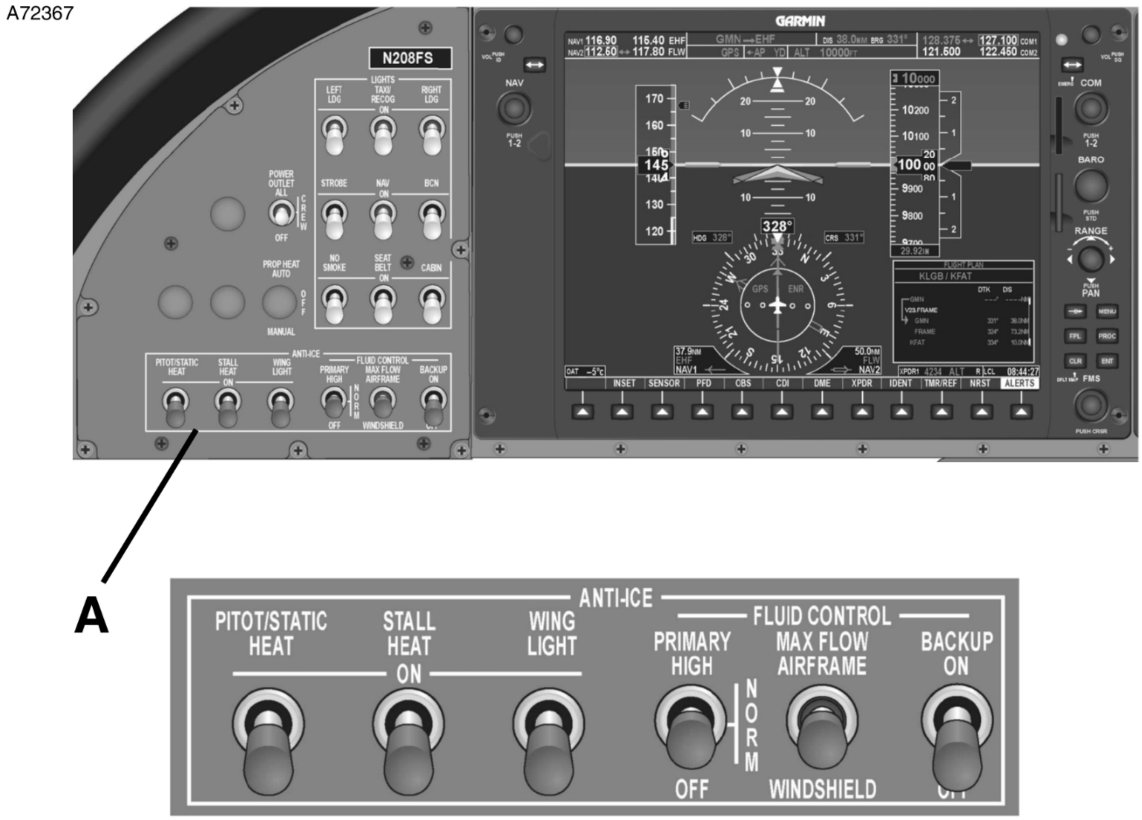

Figure 3. TKS ice protection system switches on the Model 208B pilot instrument panel. (Source: Model 208B POH)

In normal mode, two metering pumps will run for 20 seconds then deactivate. After 100 seconds of inactivity, the pumps reactivate for another 20 seconds. In primary high mode, one pump runs continuously. In max flow airframe mode, which is intended for heavy or extreme icing conditions, both metering pumps run continuously for 2 minutes after release of the spring-loaded switch. Operation of the max flow airframe mode ends after a timer turns the mode off after 2 minutes or the PRIMARY switch is moved to OFF. After 2 minutes, the system returns to operating in the mode selected by the PRIMARY switch. A supplement to the POH for the ice protection system cautioned that the pilot should exit icing conditions immediately if use of max flow airframe mode is required.

In max flow windshield mode, the windshield pump will run for about 4 seconds after release of the spring-loaded switch; it will continue to run if the MAX FLOW switch is continuously held in the WINDSHIELD position. Backup mode activates a second metering pump that operates continuously and is independent of the other modes. Backup mode is intended to be a redundancy in case the other modes are inoperable.

The TKS ice protection fluid tank has a maximum capacity of 20.8 US gallons; the POH supplement indicated a required minimum of 11.7 gallons for the system to be considered operational for dispatch into known icing conditions. Table 1 shows the maximum time ice protection fluid is available by operating mode before depletion. Each 2-minute use of max flow airframe mode consumes about 1 gallon of ice protection fluid, representing 5% of the total fluid capacity of the ice protection system.

Table 1. Ice protection fluid endurance by mode.

Mode	Maximum Fluid Endurance
Primary Norm	3 hours 25 minutes
Primary High	1 hour 20 minutes
Backup	1 hour 20 minutes
Max Flow Airframe	40 minutes

Bering Air reported that pilots are responsible for checking the quantity of TKS fluid during each preflight inspection. According to the airplane POH, the only approved means of verifying sufficient fluid quantity is a visual check of the sight gauge located on the filler end of the TKS fluid tank. A customer service representative at PAUN stated that TKS fluid was available and that the accident pilot informed her that he did not need fluid added. The investigation found no record indicating when TKS fluid was added to the airplane before the accident flight.

The TKS ice protection system supplement to the POH limited the airplane's maximum takeoff gross weight to 8,807 lbs for flight into known or forecast icing conditions. The POH supplement also specified a minimum airspeed of 95 knots indicated airspeed (KIAS) for operations in icing conditions with a fully functional TKS ice protection system and 120 KIAS with a failed or inoperative TKS ice protection system.

1.3.2.2 Autopilot

The airplane was equipped with a Garmin G1000 autopilot system, also known as the Garmin integrated autopilot and flight director system GFC 700. The autopilot was a three-axis digital flight control system providing autopilot, flight director, and manual electric trim. Once the autopilot is engaged, the pilot can disengage it by using the disconnect switches located on the control wheel (see figure 4) or on the autopilot mode controller panel (see figure 5). The autopilot will automatically disconnect upon activation of the LAA system (see section 1.3.2.3) or as the airplane's angle of attack (AOA) increases and the wing approaches an aerodynamic stall condition.

Figure 4. Model 208B control wheel with the autopilot disconnect button highlighted. (Source: Textron Aviation)

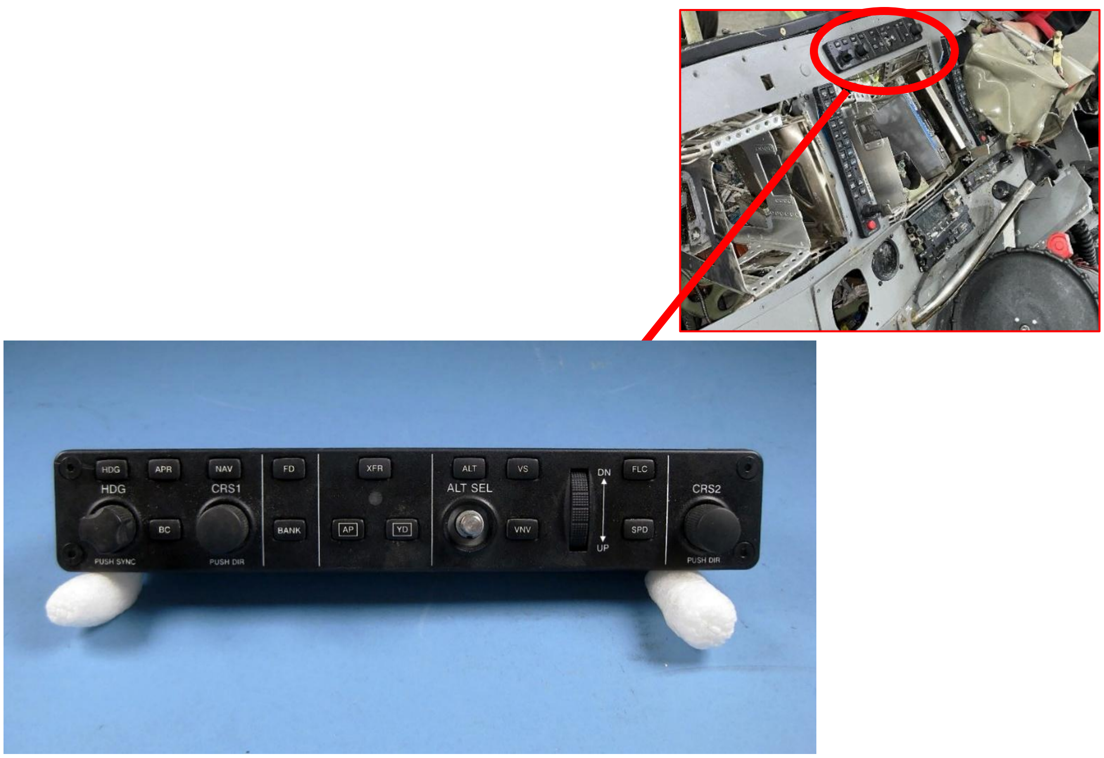

Figure 5. The autopilot mode controller panel from the accident airplane with inset showing its location on the instrument panel.

Note: The cover for the ALT SEL (altitude select) knob is missing.

When the autopilot is disconnected by the pilot, an amber flashing "AP YD" appears on the autopilot control panel for 5 seconds or until acknowledged by the pilot. When the autopilot automatically disconnects, a flashing red and white "AP" appears on the autopilot control panel, and an aural tone sounds until acknowledged by the pilot.

Regarding recorded data, if the pilot acknowledges an autopilot disconnection within the 1 Hz sampling interval of the associated parameter (AFCSon), the recorded AFCSon state will transition directly from ON to OFF without transitioning through either the AFCS automatic disconnect state or the AFCS normal disconnect state. In other words, the recorded data will indicate ON and then OFF, with no intermediate parameter recorded.

1.3.2.3 Low Airspeed Awareness System

The airplane was equipped with an LAA system. The LAA system is installed on airplanes that are equipped with the TKS ice protection system and works with the airplane's stall warning system to provide a stall warning margin in icing conditions for all combinations of weight, center of gravity (CG), and flap settings.[14] The LAA system is the certified stall warning device when operating in icing conditions.

The system is armed when the pilot activates the pitot static heat and is designed to warn the pilot if airplane airspeed decreases below 97.5 kts ± 2.2 kts.[15] When the airspeed drops below the specified value, the LAA module sends a discrete signal that causes the flight deck warning horn (in the panel above the pilot's position) to operate and the flight deck panel light (directly in front of the pilot) to alternately illuminate amber, then white (figure 6 shows the panel light with each color illumination). When the LAA activates, the autopilot automatically disengages. In contrast to the stall warning's continuous tone, the LAA aural alert is an intermittent tone. Depressing the annunciator will silence the aural alert and stop the flashing of the annunciator. However, the annunciator will remain illuminated until the airspeed increases above the designated threshold.

[14] The LAA system does not measure AOA and is independent of the aerodynamic stall warning system.

[15] Postaccident examination of the pitot-static system found that it functioned properly.

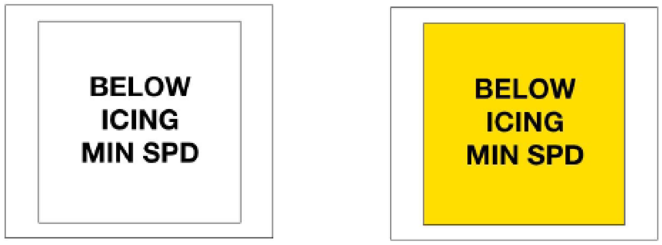

Figure 6. LAA flight deck panel light with white and amber illuminations. (Source: Textron Aviation)

1.3.2.4 Stall Warning System

The airplane is equipped with an aerodynamic stall warning system that is designed for activation about 5 to 10 kts above the airplane's stall airspeed for all airplane configurations, CG, and weights. The system is composed of a "lift detector" stall warning vane and a stall warning horn. The vane is located on a lift transducer mounting plate installed on the leading edge of the airplane's left wing, and the warning horn is located above the pilot's head in the flight deck.[16] The vane and the warning horn are connected electronically.

The lift detector (transducer) vane is a spring-loaded metallic flap that extends out into, and is moved by, the airflow over the left wing (see figure 7). When the vane is moved upward to a predetermined point, an electrical signal is sent to the stall warning horn. The vane does not measure a local AOA directly but senses the separation of the airflow as it passes over and under the wing. As the airplane's airspeed decreases (and AOA increases) the airflow around the wing changes from

[16] The mounting plate is equipped with a heating element to protect the sensor in icing conditions, which is operated by the stall heat switch on the anti-ice switch panel.

pushing the vane down to lifting the vane up. The increasing upward airflow on the vane will lift it to the calibrated set point, activating the stall warning.

Figure 7. An example of a lift detector (transducer) vane such as was installed on the accident airplane. (Source: Textron Aviation)

1.3.3 Airplane Maintenance

The airplane was maintained under a continuous airworthiness maintenance program. A review of the available maintenance records indicated that the most recent inspection activity included 12-month/100-hour airframe, engine, and propeller inspections, which were completed on January 7, 2025. At the time of those inspections, the airframe total time was 4,291.3 hours. At the time of the post-recovery examination, the recording hour (Hobbs) meter indicated 4,333.7 hours.

A review of the FAA airworthiness directive (AD) log for the accident airframe indicated compliance with the applicable ADs. Review of the airplane discrepancy log revealed two items since the inspections were completed. One noted a broken static wick on the left elevator, which was replaced. The second noted improper safety wiring on the battery, which was corrected.

The operator provided documentation related to issues regarding the cockpit power control quadrant. In January 2021, shortly after delivery of the airplane, the quadrant assembly was replaced when the friction lock became jammed. The discrepancy logs for the airplane from January 2023 to the time of the accident did not include any additional entries related to the engine control levers or the friction lock.

1.3.4 Weight and Balance Information

Bering Air weight and balance data for the accident airplane (dated January 4, 2023) indicated that in the 11-seat configuration—two flight crew seats and nine passenger seats—its empty weight was 5,388.2 lbs. The forward and aft CG limits for the airplane were 200.0 inches and 204.4 inches, respectively.

The Bering Air General Operations Manual (GOM, dated March 22, 2024) indicated that the operating empty weight to be used in preparing load manifests was the sum of the equipped empty weight plus the flight crew. Every load manifest for the accident airplane reviewed for this investigation indicated 5,500 lbs for the operating empty weight.[17] At his last aviation medical examination (in December 2024), the accident pilot reported his weight was 230 lbs.

The maximum gross takeoff weight (MGTOW) for the basic airplane was 8,807 lbs. FAA records indicated that the airplane was modified under Supplemental Type Certificate (STC) SA01213SE, which provided for an increased MGTOW of 9,062 lbs. However, for flight into known or forecast icing conditions, the POH supplement noted that the maximum allowable gross takeoff weight was the same as that of the pre-modified airplane. Postaccident interviews with Bering Air personnel and the principal operations inspector (POI) assigned to the company indicated that, before the accident, Bering Air operated flights into known icing conditions using the STC MGTOW of 9,062 lbs.

An estimated weight and balance calculation for the accident flight performed during the NTSB's investigation using the operator flight manifest, FAA data, and G1000 data indicated that the gross takeoff weight was about 9,798 lbs.[18] The pilot flight report for the accident flight noted a fuel weight of 1,000 lbs (compared to the Garmin G1000 fuel weight of 1,464 lbs), 9,062 lbs for the MGTOW, and a gross takeoff weight of 9,044 lbs.

Based on similar calculations, the investigation estimated the gross weight at takeoff for the first flight leg from PAOM to PAMK was about 9,807 lbs. The pilot flight report corresponding to the PAOM to PAMK segment noted a fuel weight of 1,200 lbs (compared to the Garmin G1000 fuel weight of 1,842 lbs), 9,062 lbs for the MGTOW, and a gross takeoff weight of 8,873 lbs.

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[17] The reviewed data included 16 multi-leg flights completed January 28, 2025, through February 6, 2025, which comprised 35 individual flight legs.

[18] The estimated CG at takeoff was about 200.6 inches aft of the datum. The estimated landing CG would have been about 202.0 inches aft of the datum.

1.4 Meteorological Information

A stationary front was located across the southern portion of Norton Sound, south of the accident site, and stretched west to east from the Bering Sea eastward into northwestern Canada. Precipitation was moving northward across the accident site and Nome at the time of the accident. The station model closest to the accident site depicted an air temperature of 13°F (about -10°C), a dew point temperature of 9°F (about -12.8°C), cloudy skies, and a north wind at 5 kts.

The PAOM weather observation, recorded at 1505, noted, in part, wind calm, visibility of 10 sm or greater, light snow, broken ceiling at 2,700 ft agl, broken clouds at 3,500 ft agl, overcast skies at 5,500 ft agl, temperature of -10°C, dew point temperature of -12°C, and an altimeter setting of 30.20 inHg. Remarks indicated that snow began about 1503 and a trace of precipitation since 1453.

The PAOM weather observation, recorded at 1545, noted, in part, wind from 350° at 6 kts, visibility of 4 sm, haze, few clouds at 900 ft agl, broken ceiling at 2,500 ft agl, overcast clouds at 3,200 ft agl, temperature of -10°C, dew point temperature of -13°C, and an altimeter setting of 30.20 inHg.

An upper air sounding at PAOM, taken at 1500, indicated a near-surface stable layer to 6,000 ft msl with a conditionally unstable atmosphere from 6,000 ft through 7,500 ft msl. The Rawinsonde Observation program indicated cloud cover between 450 ft through 8,250 ft msl.[19] It also indicated moderate or greater rime and mixed icing conditions between the surface and 8,250 ft msl.

The 1500 PAOM sounding wind profile indicated a near-surface wind from the west at 5 kts with the wind veering to the southwest by 5,000 ft.[20] The wind speed increased to 10 kts by 5,000 ft with a southwest wind increase to 20 kts by 7,000 ft.

There were no significant meteorological information (SIGMET) advisories or center weather advisories (CWA) valid for the accident site at the accident time.[21] The

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[19] The Rawinsonde Observation program is a software application that automatically decodes data from over 100 different formats and plots it on 12 interactive displays, displaying over 200 atmospheric parameters including icing, turbulence, wind shear, clouds, inversions, etc.

[20] Veering wind turns clockwise with height.

[21] A SIGMET is a weather advisory that contains meteorological information concerning the safety of all aircraft. There are two types of SIGMETs: convective and non-convective. Non-convective SIGMETs are issued for 6-hour periods for conditions associated with hurricanes and 4 hours for all other events. If conditions persist beyond the forecast period, the SIGMET is updated and reissued. Convective SIGMETs are issued hourly for thunderstorm-related aviation hazards. Primarily used by aircrews to anticipate and avoid adverse weather conditions in the en route and terminal

Alaska Aviation Weather Unit (AAWU) had text airmen's meteorological information (AIRMET) advisories Sierra and Zulu, issued at 1237, valid for the accident site at the accident time for below 15,000 ft.[22] The AIRMETs forecast IFR conditions and mountain obscuration due to light snow and mist, clouds and precipitation, and occasional moderate icing between 2,000 and 8,000 ft msl.

The AAWU area forecast for the accident site was issued at 1229 and forecast the AIRMETs noted previously. In addition, the area forecast indicated few clouds at 1,500 ft, scattered clouds at 2,000 ft, and overcast skies at 2,500 ft with clouds tops to 15,000 ft, and visibility 3 to 5 sm in light snow showers and mist.

Information included in five pilot reports (PIREPs) disseminated into the National Airspace System within 3 hours of the accident time and within 100 miles of the accident site is summarized in table 2.[23]

Table 2. Summary of PIREP information within 3 hours and 100 miles of the accident.

Time (local)	Aircraft	Location / Altitude	Clouds	Icing	Remarks
1314	C208	5 nm north of PAOM/2,000 ft	overcast 2,000 ft	None	
1317	C208	PAOM / 2,000 ft	overcast 2,000 ft	None	
1537	C208	PAOM / surface	—	Moderate rime	Freezing mist on approach to runway 28
1630	AS350	Cape Nome / 500 ft	—	Light rime	Temp -10°C
1542	B737	PAOM / surface	—	—	Visibility 2 sm; braking action medium, runway 28

environments, a CWA is an unscheduled weather advisory for conditions meeting or approaching national in-flight advisory criteria and is valid for up to 2 hours.

[22] An AIRMET advises of potentially hazardous weather phenomena that are occurring or forecast to occur along an air route that may affect flight safety.

[23] The pilot would have had access to the first two PIREPs that were disseminated before the accident time if he had accessed the AAWU forecast before departing PAUN.

1.4.1 Alaska Aviation Weather Unit Icing Forecasts

The AAWU issued an Icing Forecast product around 1300 valid at 1500.[24] The Icing Forecast indicated occasional-to-constant moderate icing at the accident site between 2,000 and 8,000 ft msl (see figure 8).

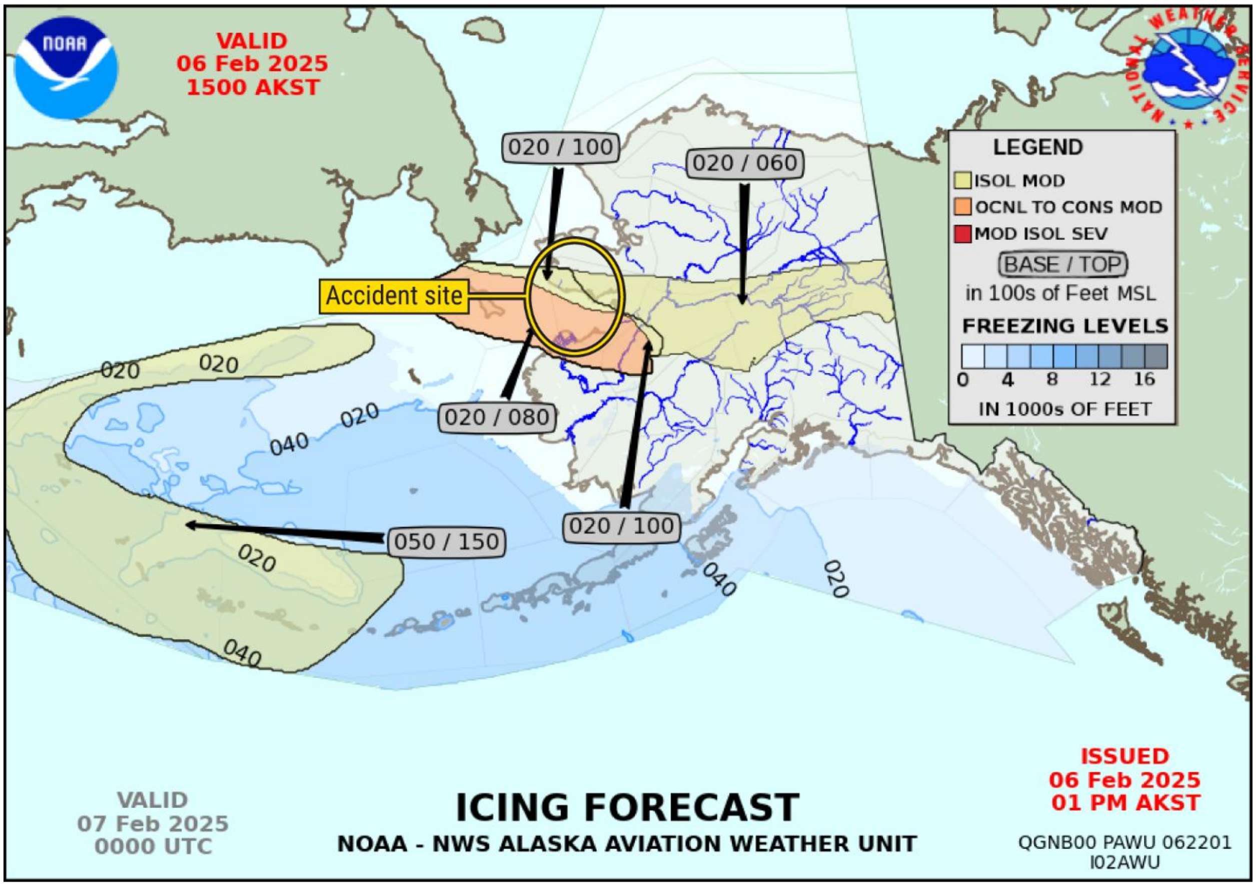

Figure 8. AAWU Icing Forecast product valid at 1500.

During a postaccident interview, the lead meteorologist and forecaster responsible for the forecasts at the accident time stated that a new hire (on his second-to-last day of training) initially assessed the icing over the Norton Sound area as "isolated moderate," referencing the facility's graphical forecast editing software.[25] The lead meteorologist noted that, although that classification is correct, it is below the threshold to trigger an AIRMET. For this reason, he revised the assessment to

[24] Located in Anchorage, Alaska, the AAWU is part of the National Weather Service and issues aviation weather products for the airspace over Alaska and the adjacent coastal waters.

[25] Both the Icing Forecast graphical product and text-based AIRMETs are produced based on the graphical forecast editing data.

"occasional moderate," which triggered AIRMET Zulu. However, he did not have time to correct the icing area indicated in the AIRMET (southwest of Unalakleet), which did not represent what the graphic showed (moving north into Norton Sound).[26] He described the conditions of the front moving into the Norton Sound area as follows:

> …it's what we kind of call more of a freezing drizzle signature where we had good saturation from the surface all the way to about 8,000 feet where most of that, that I could evaluate, was—from a temperature perspective, it was around from zero to minus 10. So it was like kind of this classic freezing drizzle, kind of a low-topped cloud, most of it was going to be supercooled water.

1.4.2 Supercooled Large Droplet Icing Forecasts for Alaska

According to FAA Advisory Circular (AC) 00-45H, "Aviation Weather Services," SLD icing conditions comprise supercooled water droplets, such as freezing drizzle and/or freezing rain, that measure 0.05 mm in diameter or larger (FAA 2016). The AC states that SLD icing conditions are outside the envelopes used for aircraft icing certification (contained in Appendix C of 14 *CFR* Part 25) and that SLD icing conditions "can be particularly hazardous" to some aircraft. Even for aircraft that are certificated for flight in icing conditions, flight into SLD icing conditions poses a structural icing hazard.

The AAWU does not issue SLD-specific forecasts or products. Its graphic products do not distinguish between rime icing or clear icing in freezing drizzle or freezing rain. According to the lead meteorologist, "the AIRMET text would kind of clarify that a little bit" if manually revised but he was not sure whether staff were trained to make this change. At the time of the accident, the National Weather Service (NWS) Aviation Weather Center (AWC) produced graphical forecasts for aviation (GFA), accessible on the GFA website, that showed areas of icing (trace to severe/heavy) in Alaska but did not depict areas with potential SLD icing.

The AWC also produces graphical forecasts—the current icing product and the forecast icing product—that depict the potential for significant icing, including SLD conditions, for the contiguous United States but, at the time of the accident, did not for Alaska. On March 23, 2026, the NWS issued Service Change Notice 25-80,

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[26] AIRMET text is autogenerated based on underlying data used to create the Icing Forecast. The lead meteorologist stated that a longstanding problem with the autogeneration process is the output of text that accurately describes information portrayed graphically, which requires manual revisions. He explained that often, time permitting, he revises the turbulence and icing sections in AIRMETs as needed to more accurately represent the graphic product and that no guidance existed instructing forecasters to do this.

updated on March 30, announcing the inclusion of information indicating the potential for SLD conditions over Alaska in the AWC graphical icing forecasts.

When asked about the tools he used to develop icing forecasts, the AAWU lead meteorologist mentioned the Icing Product Alaska (IPA), experimental guidance produced by the National Center for Atmospheric Research (NCAR). He described using the IPA more for determining coverage than icing severity. He stated that he rarely used the product's SLD probabilities because "the output that comes from that is very small, very sporadic."

1.5 Airport Information

The accident site was about 32 miles southeast of PAOM, the intended destination. PAOM had an elevation of 40.6 ft msl and two runways: 3/21 and 10/28. Runway 3/21 was 6,176 ft long and 150 ft wide. Runway 10/28 was 6,009 ft long and 150 ft wide. Both runways had a four-light visual approach slope indicator (VASI) located on their left side; however, the VASI was unusable beyond 2 nm from the threshold of runway 21 due to rapidly rising terrain.[27] Runway 28 also had a 1,400 ft medium intensity approach lighting system with runway alignment indicator lights.

PAOM did not have an air traffic control (ATC) tower. Air traffic services into and out of PAOM were provided by Anchorage Air Route Traffic Control Center, known as ZAN. The Nome FSS was located at the airport and provided airport status, current weather conditions, and traffic advisory information to landing and departing pilots. Additionally, the Nome FSS relayed instrument clearances to pilots on behalf of ZAN.

1.6 Recorded Flight Data

As stated previously, the accident airplane was not equipped nor required to be equipped with a cockpit voice recorder or a flight data recorder. However, the installed Garmin G1000 integrated flight deck included a data logging feature (such availability depends on the display unit software). A typical installation includes a primary flight display and a multifunction display. Each display includes two secure digital (SD) card slots: an upper and a lower slot. The lower SD card slot is used by the system for software updates and various databases.

The data logging feature must be enabled by the aircraft operator. If the data logging feature is available and enabled, an SD card has to be installed in the upper

[27] A VASI is a pilot-controlled lighting system that provides visual guidance during landing, indicating whether an aircraft is on, above, or below the glidepath.

slot of the multifunction display. Depending on the airframe and engine combination, as many as 64 parameters can be stored at a rate of one sample per second (1Hz). According to the manufacturer of the display unit, 1 flight hour can be stored in about 2 megabytes.

The SD card installed in the accident airplane's Garmin G1000 system was in good condition and the data were downloaded using the manufacturer's procedure. The SD card contained 208 log files dating back to December 16, 2024. The accident flight recording was about 45 minutes.

1.7 Wreckage and Impact Information

The airplane impacted an ice pack and came to rest upright. The propeller assembly separated from the engine and was located adjacent to the wreckage. The engine cowling was dislocated and fragmented. The engine remained secured to the mounts. Both the engine assembly and the mounts were damaged consistent with impact forces.

Contents of the cargo pod, including fragments of the TKS fluid tank, were found 30 to 40 ft from the tail section of the airplane, northwest of the main wreckage, along with the nose gear and one main wheel. The other main wheel was located about 150 ft to the west-southwest of the main wreckage.

The fuselage exhibited upward crushing damage along the entire length. Both wings were damaged, with the left wing partially separated from the fuselage. Both wings exhibited leading-edge crushing damage along the entire spans. The outboard portion of the right wing was rotated aft and partially separated.

The flight control surfaces remained attached to the airframe. The ailerons remained attached to each wing at the hinges; however, they displayed damage similar to the wings. The wing flaps and spoilers remained attached. The horizontal and vertical stabilizers remained attached to the aft fuselage. The elevators and rudder remained attached to the stabilizers at the hinges. The outboard right elevator was bent downward, and the upper portion of the rudder was bent to the left.

Some ice accumulation was observed on the leading-edge surfaces aft of the TKS porous membranes. Significant icing accumulation was observed on the base of the beacon/strobe light located at the top of the vertical stabilizer (see figure 9).

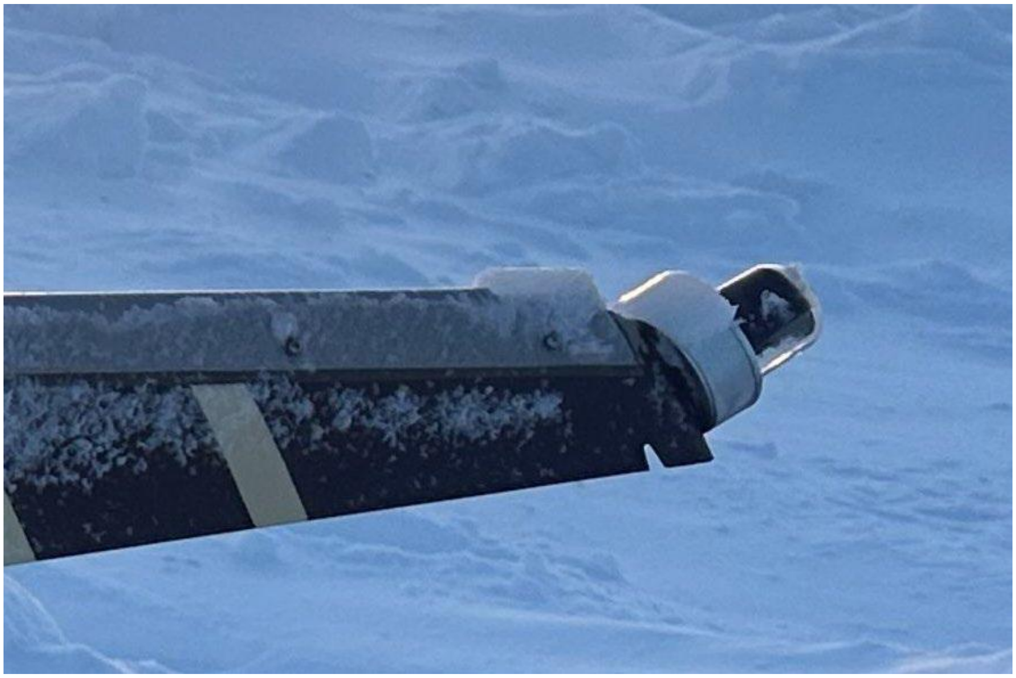

Figure 9. Photograph of the vertical stabilizer with ice accumulation.

Examination of the flight control system revealed damage and control cable separations consistent with the impact sequence. The extension of the wing flap actuator was consistent with the wing flaps being retracted (up) at the time of the accident. No anomalies or control cable separations attributable to a preimpact failure or malfunction were observed.

The airplane aerodynamic stall warning system vane assembly was removed from the left-wing leading edge. The transducer was visually examined; no faults were found. The lift vane could be moved by hand with no restrictions noted. The lift vane was operational when tested with a multimeter. The plate-heating elements were confirmed as operational when electrical power was applied.

The TKS system components were located in the cargo pod and sustained significant damage consistent with impact forces. The tank was compromised, and the quantity of TKS fluid onboard at the time of the accident could not be determined. Continuity of the porous areas of the leading-edge TKS panels was confirmed during the postaccident airframe examination. Specifically, a positive flow of TKS fluid was observed from the individual panel sections when fluid was provided at the inlet lines. Detailed examination of the TKS components—pumps, pressure switches, solenoid valve, and timer box—did not reveal any anomalies consistent with a preimpact failure or malfunction. Impact damage precluded functional testing of any of the components.

No anomalies were observed during postaccident examination of the fuel system's boost pump, float switch, and check valve.

The cockpit power quadrant was damaged and dislocated to the right consistent with impact forces. The engine control levers—power, condition, emergency power, propeller, flap—remained in place on the mating shaft. The friction knob, spring, and spacers were in place. Each engine control lever moved freely through the full range of motion. Adjustment of the friction knob between full tight and full loose revealed the control levers were retained at full and moved freely at low, consistent with normal operation. No anomalies consistent with a preimpact failure or malfunction were observed.

The on-scene examination determined that the emergency locator transmitter had become disconnected from the antenna, likely during the impact sequence. When a portable emergency locator transmitter antenna was installed, a strong signal was heard from a handheld receiver.

Examination of the engine assembly revealed rotational scoring of the power and compressor turbines and shrouds consistent with engine operation during impact. Stationary components near the bottom of the engine exhibited rotational scoring consistent with a flat impact of an operational engine. Further, the propeller hub studs were captured in the propeller shaft flange and had rotationally scored the top and bottom propeller shaft oil seal retain rings. This damage is consistent with continued rotation of the engine after impact.

Examination of the propeller assembly revealed blade bending at multiple spanwise locations and gouging consistent with hard body impact damage. One blade was separated from the hub; the remaining blades remained attached at the propeller flange. Contact marks between all four blade butts and the corresponding beta rod springs were consistent with the blades being in a high-power, forward thrust condition at the time of impact. No evidence of any preimpact failures with respect to the propeller assembly was observed. Testing of the propeller governor and fuel control unit revealed no anomalies that would have affected normal preimpact component operation.

1.8 Medical and Pathological Information

An autopsy of the pilot was performed by the State of Alaska Medical Examiner. According to the autopsy report, the cause of death was blunt impact, and the manner of death was accident. Toxicology testing performed at the FAA Forensic

Sciences Laboratory on specimens from the pilot was negative for carboxyhemoglobin, ethanol, glucose, and drugs of abuse.[28]

1.9 Air Traffic Control

The accident flight received ATC services from the ZAN and the Nome FSS. Neither PAUN nor PAOM was served by a control tower.

1.9.1 Anchorage Air Route Traffic Control Center

ZAN, located in Anchorage, was a Level 10 air route traffic control center responsible for approximately 2.5 million square miles of airspace encompassing the entire state of Alaska, including the Aleutian Islands and oceanic airspace extending northward to the North Pole.[29] Radar coverage was available in approximately 55–60% of the controlled airspace. The facility was organized into three areas of specialization—North, South, and High—comprising 15 sectors. At the time of the accident, the North Area sectors 3, 13 (where the accident occurred), and 9 were combined into a single position. The 13R (radar) position was staffed by one controller; the 13D (data) position was staffed by one controller and one controller in training. One operations supervisor was assigned to the North Area.

The ZAN center weather service unit, located within the operational area, was staffed by one NWS meteorologist at the time of the accident. The center weather service unit provided weather briefings and support to ATC personnel, including pre-duty weather briefings produced three times daily.

1.9.2 Nome Flight Service Station

Nome FSS was located on the PAOM grounds about 700 ft southeast of the intersection of runways 21 and 28. The facility operated three flight service positions: Inflight 1, Inflight 2, and preflight.[30] Nome FSS operated from 0715 to 2245; when closed, its frequencies and one briefing phone line transferred to Fairbanks FSS. In

[28] The FAA Forensic Sciences Laboratory has the capability to test for around 1,000 substances, including toxins, prescription and over-the-counter medications, and illicit drugs.

[29] ATC facilities are assigned a level from 1 to 12 based on weighted formulas that account for factors such as traffic volume, operational complexity, airspace size and type, mix of operations (including foreign traffic), terrain, and staffing requirements.

[30] The Inflight 1 controller handled traffic management, issued transponder codes, relayed IFR clearances from ZAN, and managed in-flight emergencies. The Inflight 2 controller handled pilot briefings, filed flight plans, and managed IFR and VFR arrivals, departures, and clearances for 15 outlying airports.

2007, all Alaska FSS facilities received an upgrade to the Operational and Supportability Implementation System, standardizing the equipment used to display weather, notices to airmen (NOTAM), and flight plan information across all Alaska FSS facilities.

1.9.3 Air Traffic Control Procedures

FAA Order JO 7110.65, "Air Traffic Control," required controllers to become familiar with pertinent weather information when coming on duty and to stay aware of current and forecasted weather information needed to perform ATC duties (FAA 2025). The order also required controllers to solicit PIREPs when light or greater icing existed or was forecast for their area of jurisdiction and to relay pertinent PIREP information to concerned aircraft in a timely manner.

1.10 Tests And Research

1.10.1 Airplane Performance Study

An airplane performance study was conducted using data recovered from the accident airplane's Garmin G1000 integrated flight deck system and flight-test-validated C-208B simulation models to supplement the recorded data. The simulation models did not account for ice accumulation on either the protected or unprotected surfaces of the airplane. Consequently, the build-up of any significant ice during the flight would have resulted in increasing differences between the simulation and the recorded data, but the investigation did not observe any such differences.

The airplane configuration, flight conditions, and airplane dynamics from the recorded data closely matched the simulation results from 1438:10—about 1 minute after takeoff—until 1519:33—about 2 seconds before the autopilot disconnected. Of note, beginning about 1515 and continuing until the end of the data, the wing AOA calculated from the recorded data was about 0.5° greater than that provided by the simulation. This marginal difference was consistent with minor ice accretion on the airframe's unprotected surfaces. It was not consistent with significant ice accretion on the protected surfaces.

The data indicated that the airplane reached the maximum wing lift coefficient (CLmax) for a wing of the accident airplane's type without ice at 1519:46. This was 11 seconds after the autopilot disconnected and about the same time that the lateral (directional) oscillations significantly increased.

The airplane POH noted the aerodynamic stall speed as 78 kts at MGTOW and level flight (1g).[31] The POH indicated an increased stall speed to 84 kts for the airplane in a level, 30° banked turn. However, the airplane's almost 1,000-lbs exceedance of the maximum gross weight for operation in icing conditions increased the stall speed about 6 kts for either level flight or a banked turn.

1.10.2 Review of Historical Weight and Balance Data

Using the recorded fuel quantities from the Garmin G1000 installed on the accident airplane, the NTSB's investigation calculated estimated weight data for 16 multi-leg flights completed January 28, 2025, through February 6, 2025, which comprised 35 individual flight legs.[32] Our calculations indicated that, in addition to the accident flight and the flight from PAOM to PAMK on the day of the accident, five flights were operated in an overweight condition compared to both the STC-increased MGTOW and the MGTOW for flight in known icing conditions.[33] All seven overweight flights are listed in table 3, which also shows that the fuel weights the pilots entered into the associated flight reports (used by the operator application in the preflight weight and balance calculations) were less than the fuel quantity recorded by the onboard avionics for each of the overweight flights.

Table 3. List of overweight flights involving N321BA (January 28, 2025, through February 6, 2025).

Date	Flight Number	G1000 Fuel Weight	Pilot Entered Fuel Weight	Weight Over MGTOW[a]	Weight Over MGTOW (flight in known icing)[b]
January 31, 2025	810	2,040	1,850	424	679
February 2, 2025	846	1,990	1,900	248	503
February 3, 2025	4440	1,589	850	1,160	1,415
February 3, 2025	8440	1,273	975	448	703
February 5, 2025	3820	1,487	1,200	349	604

[31] The 1g stall speed of an aircraft is the minimum steady-flight speed at which it can maintain level flight (a load factor of 1 times Earth's gravity) before the wing exceeds its critical AOA and stalls.

[32] The NTSB's calculations also used passenger and cargo information from load manifests provided by Bering Air and POH-derived weights for the airplane and equipment.

[33] All five of the overweight flights were operated by Bering Air line pilots. Two reviewed flights were overweight compared to the MGTOW for flight in known icing conditions but are not listed in table 3 because the investigation could not determine whether those flights were operated in known icing conditions.

Date	Flight Number	G1000 Fuel Weight	Pilot Entered Fuel Weight	Weight Over MGTOW[a]	Weight Over MGTOW (flight in known icing)[b]
February 6, 2025	830	1,842	1,200	781	1,036
February 6, 2025	445	1,464	1,000	736	991

[a] Airplane Payload Extender III supplement specified a MGTOW of 9,062 lbs except for flight in known icing conditions.
[b] Pilot's Operating Handbook/Airplane Flight Manual specified a MGTOW of 8,807 lbs for all flight conditions.

1.10.3 Single-Engine Overwater Operation

Based on ADS-B data, the investigation determined that the accident pilot did not maintain the required altitude and distance from the shoreline to allow a glide to the shoreline in the event of an engine failure. This placed the airplane beyond the glide distance to the shoreline required by Bering Air's GOM (see section 1.11.3.3 for more information). The NTSB's investigation examined 17 FAA ADS-B tracks of Bering Air operations in January 2025 on similar routes. Of these flights, all were in compliance for single-engine overwater operations.

1.11 Organizational And Management Information

1.11.1 General

The operator, Bering Air, Inc., was established in 1979 and based in Nome, Alaska, with hubs in Kotzebue and Unalakleet serving 32 communities along the northwest coast of Alaska, operating scheduled regional flights and passenger and cargo charter flights. At the time of the accident, Bering Air employed about 200 to 215 personnel, including 54 pilots and 2 dispatchers. Its fleet consisted of 30 airplanes (4 BE-1900s, 4 King Air B200s, 17 C208Bs, 3 C408s, and 2 CASA 212s) and 13 helicopters (2 UH-1Hs, 5 A-Stars, 3 MD500s, and 3 R44s).

During postaccident interviews, the president described the company's growth in the context of the 2020 pandemic and the bankruptcy of its primary competitor, Ravn Alaska. After Ravn went bankrupt during the beginning of the pandemic, Bering Air became the only passenger-carrying operator in the region. The president stated that, while passenger travel declined significantly during the pandemic, freight and mail volumes remained steady and eventually increased as communities that could not travel to shop became more dependent on air cargo.

Given that air service is the only means of transportation connecting most of the communities the company serves, Bering Air anticipated that an increased need for flights and seat capacity would eventually materialize as passenger demand recovered. The president stated that the company built its fleet to absorb the increased demand resulting from Ravn's closure. The company acquired some of Ravn's facilities through the bankruptcy proceedings, expanding its physical presence at PAOM, and providing additional capacity to shelter and maintain a larger fleet. He described the company's posture as accepting an obligation to serve the communities that had lost their alternative carrier.

Outlining an estimated timeline for the company's growth, the director of safety indicated in an email that acquisition of additional and new types of aircraft as well as facilities was ongoing when he was hired in October 2022. He noted that "the larger footprint and demand on staff [as a result of increasing passenger demand combined with ongoing cargo/freight demand] required adding personnel in all departments."

1.11.2 Key Personnel

1.11.2.1 Director of Operations

The director of operations was hired at Bering Air in October 1984 as a line pilot and became director of operations around 2005. He held an airline transport pilot (ATP) certificate with multiengine privileges, commercial single-engine, and type ratings in the CASA 212 and Beech 1900, with an estimated 20,000 total flight hours. At the time of the postaccident interview, he described his current flying activities as mostly limited to training and checkrides.

At the time of the accident, he held operational control during the week and was the primary authority for flight release decisions.[34] He stated that Bering Air's vice president, chief pilot, or director of training would sometimes exercise operational control if he was not available.[35] He described his involvement in load manifest issues as limited to cases involving discrepancies or questions, with day-to-day weight and balance responsibility resting with cargo personnel, customer service agents, and the pilots.

1.11.2.2 Director of Safety

The director of safety was hired at Bering Air in October 2022. He had previous experience with the company from 1998 to 2007 as a pilot and assistant chief pilot.

[34] According to 14 *CFR* 1.1, "General Definitions," "operational control" is defined as the exercise of authority over initiating, conducting, and terminating a flight. At the time of the accident, Bering Air's director of operations was primarily responsible for operational control.

[35] During postaccident interviews, the director of safety stated that he also sometimes exercised operational control.

He held an ATP certificate with multiengine land privileges, commercial single-engine and rotorcraft helicopter ratings, instrument ratings for both airplane and helicopter, and certified flight instructor certificates in single-engine, multiengine, and instrument airplane.

As director of safety, he reported directly to the company president with no one reporting to him. During postaccident interviews, he stated that he also served as a line pilot and operational control delegate on certain days. He added that he would separate himself from his safety role when performing those functions and that “we try not to intermingle a lot of the duties at the same time on the same day. It’s unavoidable though. It is not a perfect world.”

1.11.2.3 Chief Pilot

The chief pilot was hired at Bering Air in September 2001 as a line pilot and became chief pilot around 2012 or 2013. He held an ATP certificate with type ratings in the CASA 212, Cessna 408, and Beech 1900, along with commercial single-engine privileges, and had about 10,000 total flight hours, of which about 9,000 were as PIC. His flying had been reduced over the preceding 12 years due to chief pilot duties, varying from zero to 20 hours per month.

His responsibilities included pilot recruitment, training oversight, pilot scheduling, and serving as a check airman. He also served as a designated operational control delegate. He described managing the pilot group primarily through face-to-face interactions and telephone calls, with information not included in the GOM mainly being disseminated to pilots by email without a mechanism (for example, read receipts) to confirm acknowledgment.

1.11.2.4 Dispatcher

The dispatcher for the accident flight was originally hired at Bering Air in about 2001 as a customer service agent for a short period then rehired in March 2003, again as a customer service agent. He became a dispatcher around 2007 and is not a pilot. He described his training for the dispatcher position as “very basic” on-the-job training with a more senior customer service agent or dispatcher; he did not recall how long the training lasted. It included radio etiquette, protocols for certain situations, and basic weather knowledge.

Bering Air’s GOM stated that dispatchers’ duties include “arranging and dispatching flights, obtaining village agent weather observations and other weather information, flight-following, and ensuring a return to base or overnight location, and activation of the Emergency Response Plan.” The dispatcher for the accident flight described his primary duty as flight-following, which involved tracking flights from departure through all stops to return.[36] His daily routine included printing NOTAMs and weather forecasts, briefing weather and operational concerns with the director of operations, and reviewing routes, weather, and runway conditions with pilots before departure. While in flight, pilots would notify him if they needed to divert or had extended operations. He stated that ultimate operational control rested with the director of operations. The dispatcher served as a go-between and had the ability to cancel a flight.

The dispatcher explained the weight and balance control process as being between the pilot and the cargo/customer service staff, with the pilot providing a load available number that could not be exceeded. Pilots would notify him if they needed to offload cargo or baggage due to weight, and he would coordinate rescheduling of bumped freight or passengers. He stated that pilots did not routinely provide him with fuel load information, though they would notify him if fuel state became a factor, such as in a diversion scenario. He stated that TKS fluid was, to his knowledge, always topped off, and he had never heard a discussion about TKS quantities.

1.11.3 Operational Guidance and Procedures

1.11.3.1 Flight Risk Assessment and Operational Control

Bering Air's GOM stated that "operational control involves two parties: the Pilot and the DO [director of operations] or his designate." Before the accident, Bering Air did not have, nor was it required to have, a formal flight risk assessment or flight release tool.[37] According to the director of safety, flight risk assessments were conducted via face-to-face discussion. As described by the director of safety, "There was a [hand-written] weather sheet....and…our reservation system had the flights built in there," which included routings and considered the weather. He added that "a board downstairs…had the runway conditions written on it" and that Bering Air had conducted flight risk assessments this way for at least 20 years.

The director of safety also stated that "ultimate operational control" was performed at the Nome base. When asked whether flight release approval occurred

[36] The dispatcher explained that the dispatch office was equipped with a company radio, which was the primary means of communication with pilots in flight, subject to line-of-sight range limitations. When radio contact was not possible, pilots could reach dispatch by cell phone or satellite phone from the ground, and the dispatch office could relay information through village agents by telephone.

[37] According to the FAA, a flight risk assessment tool facilitates proactive hazard recognition, is user-friendly, and provides a visual representation of risk levels. It serves as an essential aid in assisting pilots with informed go/no-go decisions.

for the first leg of a multileg trip or for each flight, the director of safety answered, “Each flight.” He then added:

> Yes, it's difficult to do that. You say each leg…in a perfect world that would be great, but that's impossible because these flights go on multi-leg and stuff… And then the nuances of trying to gain access to cell phone service and stuff each way.

He then clarified that flight release occurred before the first flight leg and occurred again after aircraft returned to Nome for the next flight from base.

Bering Air’s GOM stated that it was each pilot’s responsibility to ensure preparation for flight duty, including “ensuring their aircraft is airworthy for the planned flight operation, the crew is fit to fly” and “the environmental conditions are acceptable.” Before each flight, pilots were required to review current and forecast weather conditions and plan their flight, fuel, and load accordingly (see section 1.11.3.2 for more information on the operator’s preflight weather and weight and balance requirements).

The director of operations stated that if the weather was below “500 and 2” (that is, a ceiling below 500 ft agl and visibility of 2 sm) or if icing conditions were present, he or a dispatcher would need to review and release the flight. The director of operations added that if the pilot did not want the flight, “then it’s a no go.” If a disagreement arose, the director of operations, dispatcher, and pilot would discuss it and come to an agreement.[38] The director of operations stated that “it’s all equal…unless it’s something beyond the other two. Then I probably weigh in more.”

1.11.3.2 Pilot Preflight Responsibilities

According to Bering Air’s GOM and Operations Specification A010, pilots must obtain preflight weather and NOTAMs before each flight and are responsible for obtaining and evaluating “all sources of weather reports and PIREPs prior to each flight and throughout the duty period as weather conditions change.” Pertinent data could be obtained through a combination of the following means: Foreflight on the tablet electronic flight bag, AeroWeather, FAA publications, Internet-based official sources, Bering Air dispatch, FSS, and PIREPs, among other options.

[38] Postaccident interviews with other Bering Air pilots corroborate this description. One pilot described the dispatch interaction as "really just going over the weather that either one of us have seen, kind of putting our heads together, looking at the current and what it's forecasted to do and then coming up with the decision between the two of us as to whether to go or not go." When asked if dispatch used any kind of form, she said no.

The GOM included the following information concerning adverse weather conditions and de-icing protocols:

- **Inflight Icing.** Inflight ice accumulation can occur anytime the temperature is at or below +5°C and visible moisture is present. It typically becomes less of a factor the colder and drier the air becomes.

- **Avoidance.** Check weather and PIREPs before flight. Leave a PIREP for the next pilot.

- **Policy.** Pilots must evaluate all sources of weather reports and PIREP's prior to flight and throughout the duty period as weather conditions change. Pilots shall make every reasonable effort to reduce exposure time in icing and exit those conditions if required due to aircraft performance. C208 pilots will ensure an adequate supply of TKS fluid is onboard prior to departure.

- **Procedure.** Icing PIREP's shall include Flight# / Intensity / Type / Altitude(s) / Location / Temperature. The person recording the PIREP will include the time of the report and the type of aircraft.

- **Intensity**

    - TRACE: Ice becomes perceptible. Deicing/anti-icing equipment use not required unless remaining in the trace icing for an extended period of time, over an hour.

    - LIGHT: The rate of accumulation may create a problem if the aircraft remains in light icing for over an hour. Occasional use of deicing/anti-icing equipment may be required to remove or prevent the accumulation, and the aircraft systems are capable of handling it.

    - MODERATE: The rate of accumulation is such that even short encounters become potentially hazardous. Deicing/anti-icing equipment must be used frequently or exit the icing immediately.

    - SEVERE: The rate of accumulation is such that ice protection systems fail to remove the accumulation of ice, or the ice is on surfaces where it normally does not accumulate, such as aft of the protected surfaces (ie. de-ice boots or spinner). Immediately exit the conditions.

Note: Icing intensity is aircraft dependent. Severe icing may occur at any accumulation rate.

- **Icing Types**
  - CLEAR
  - RIME: Small water drops contact the aircraft and freeze rapidly in a thick, milky white appearance.
  - MIXED: Combination of clear and rime Ice.
  - FROST: Ice crystals formed by sublimation when the temperature and dew point are below freezing.

Concerning preflight weight and balance requirements, the GOM stated that "in all cases, the weight and balance must be completed prior to takeoff." To complete the calculation on the pilot flight report, pilots were to enter the airplane's operating weight empty, fuel, takeoff weight, and CG; the GOM noted that "Flight Report will not generate and print with missing or invalid data."[39] The GOM stated that, as required by 14 *CFR* 135.63, the chief pilot is to retain a copy of the part of the flight report that contains "the actual CG Index and Limits" for 30 days.

1.11.3.3 Single-Engine Overwater Procedures

Concerning single-engine operations over water, the GOM stated the following:

> Single engine aircraft shall always be operated at an altitude and distance allowing a glide or autorotation to shore should an engine failure occur, except when necessary for takeoff and landing due to airport location.
>
> Life vests and life rafts are not required to be carried.
>
> The Glide Advisor in ForeFlight is a useful tool to visually display predicted glide distance. The C208 average glide is 12:1 but varies with weight and environmental conditions. Approximately 2 miles horizontally can be achieved for each 1000' vertically. A water crossing at 10,000' therefore must remain within 20nm of shore, or 40nm total span. Verify performance data, weight, and wind direction as part of preflight duties.

[39] The GOM noted that for CG calculations, C208 pilots were to use the SeeGee Center of Gravity Calculator, or Whiz Wheel, and indicated instruction could be found in the supplements section of the Airplane Flight Manual.

Sea ice is classified as water, but in an actual emergency, if strength of the ice can reasonably be assumed, an emergency landing on ice is often a better choice.

1.11.4 Safety Management

Bering Air did not have a voluntary safety management system (SMS) at the time of the accident.[40] The FAA's final rule requiring a regulatory SMS for Part 135 operations was effective May 28, 2024, with an implementation date of May 28, 2027 (see section 1.13 for more information). During postaccident interviews, the director of safety stated that the company previously used a safety reporting system, called OMNI, that had been replaced with a new system just 3 days before the accident. Both are intended to help support operators in meeting SMS requirements. The director of safety described SMS at Bering Air as being in its "infantile stages" and that he was "trying to get up to speed" on it.

Bering Air's new safety reporting system is accessible online, and pilots can submit reports about safety concerns by name or anonymously, or they can talk to the director of operations or safety. The director of safety stated that he reviewed submitted reports every other day if not every day. He disseminated submitted reports to the appropriate department to be addressed and sometimes discussed them at management meetings; such reports were the only source of safety-related issues discussed at management meetings. He stated that he had not yet hosted a safety meeting in the more than 2 years he had been director of safety.

Three line pilots were interviewed after the accident. When asked if they knew what Bering Air's safety management program contained, two pilots believed the program to be the company's flight release program. All three pilots stated they would report an issue or concern by either going to their management or by submitting a report through the safety reporting system.

1.11.5 Postaccident Actions

After the accident, Bering Air adopted several changes to procedures and training, including the flight release process, cargo loading, and weight and balance procedures, among other changes. The flight release process includes color coding

[40] The FAA defines an SMS as "the formal, top-down, organization-wide approach to managing safety risk and assuring the effectiveness of safety risk controls. It includes systematic procedures, practices, and policies for the management of safety risk." The FAA established a voluntary SMS Program to allow the FAA to assess applicant voluntary SMS programs in accordance with 14 *CFR* Part 5, "Safety Management Systems." See [Safety Management System | Federal Aviation Administration](#).

based on weather risk assessment and a formal escalation process for go/no-go decisions. The new system also removes the ability to release an overweight flight or manipulate aircraft load weights. If the system flags a flight as overweight compared to the increased MGTOW or basic MGTOW for flight in icing conditions (as applicable), dispatch will not approve release of the flight and excess weight has to be offloaded to get the aircraft within limits.

To communicate these updates, Bering Air issued GOM Bulletins 90-10 and -11 on March 29, 2025. In addition, Bering Air's POI stated that, since the accident, he conducts an "in-depth" review of all archived pilot records as part of his weight and balance surveillance. This includes a review and summary of pilot weights, aircraft weights, onboard equipment weights, fuel on board, load, and passenger weights.

1.12 Federal Aviation Administration Oversight

The FAA oversight for Bering Air's Part 135 operating certificate was performed by the Fairbanks Flight Standard District Office (FSDO), which is about 520 miles from Nome. The certificate management team overseeing the operator consisted of a POI, principal avionics inspector, and principal maintenance inspector. The FSDO was responsible for about 40 certificates that were managed by 12 to 14 certificate management teams led by the FSDO front-line manager. Three of the 40 certificates, including Bering Air, were Part 135 commuters, and the rest were basic or single-pilot operations.

1.12.1 Front-Line Manager

The front-line manager for the Bering Air certificate management team had been at the FSDO since the summer of 2018 and assigned to the team about 2022. During postaccident interviews, he described his assignment process for certificate management teams as mainly based on inspector qualifications and workload rather than geography. Teams managed surveillance through work programs scoped to the size of the operator. According to the front-line manager, if surveillance identified elevated risk or a change in the operation (such as a new airplane), then he worked with the team to adjust surveillance as necessary. He stated that he met with inspectors quarterly to review their surveillance plans.

When asked whether he was aware of Bering Air's growth, the front-line manager stated that management had conversations in which the company's growth was a feature but not necessarily a specific focus, describing awareness in terms of logistics. He did not recall if increased surveillance was planned following the period of growth since he was not the front-line manager for the team at the time. He also did not recall discussing increased surveillance when he assumed responsibility for Bering Air's certificate management team.

Asked to define complexity of operations as a driver of frequency and level of surveillance, the front-line manager stated that complexity was determined by an operator's fleet size and operational scope. As an example of a complex operation, he described an operator with "five different make and model series, six different maintenance programs." Using the FAA's safety assurance system (SAS), an operator is assessed and assigned a score that determines inspector grade eligibility.[41] For example, a score below 500 would get a less experienced inspector assigned who would be considered an assistant rather than a principal. As the complexity increases, so does the score and the experience level and number of inspectors assigned to an operator. An entry in the SAS system about Bering Air on May 2, 2022, indicated that no increased surveillance was necessary. Similarly, an entry on February 10, 2025, indicated that no action was required and the current surveillance level for Bering Air was still sufficient.

1.12.2 Principal Operations Inspector

The POI for Bering Air had worked for the FAA since October 2016 and was assigned as the POI in the spring of 2022. When asked how many certificates he oversees, he stated that he was the POI for about six operators and air carriers and also oversaw the designated pilot examiner group for the Northern District in Alaska.[42] Normally, the POI visited Bering Air for 1 week per month, which was a self-imposed interval in the absence of a required schedule and was based on the complexity of the operation. The POI believed a personal presence was essential to effective surveillance and that "you can't perform surveillance, collaborate with the carrier, from the cube."

Describing his oversight activities, the POI reported spending a significant amount of time on manual revisions, reviews, and approvals; training program review and approval; and training surveillance from ground school to flight training,

[41] Implemented in 2010 to support oversight for Part 121, 135, and 145 certificate holders, SAS is the FAA's standardized, risk-based, data-supported system used to perform certification, surveillance, and continued operational safety functions. Later phases of SAS implementation included oversight of Part 141, 142, and 147 certificate holders. SAS has five process modules: system configuration; planning; resource management; data collection; and analysis, assessment, and action. See section 1.12.3 for more information.

[42] He explained the lower number of certificates he oversees compared to the typical POI load as follows: "I too have had 30 to 40 [certificates] but when we see the 20 to 30 operators, they're typically less complex, small operations as opposed to Bering Air. Bering Air is one of the largest airlines in the State of Alaska. And given its complexity, my workload is limited…"

including check airmen surveillance and approval. He indicated that his general daily duties included the preceding activities as well as “route checks and inspections, the SAS, and database.”

The POI described his process for weight and balance surveillance as beginning with a review of archived pilot flight reports, and if they “pass the smell test,” there is “typically no reason to dig deeper.” If risk indicators were apparent, he would “probe deeper,” which he described as performing “an invasive practice, such as delaying the plane…putting passengers on the scale, or offloading boxes back onto the scale.” He noted that verifying weight and balance in this manner is “invasive to the operator” and “rarely happens.”

He stated that he had never seen any deviation from the GOM protocol and had “no indications of overweight operations, especially chronic overweight operations.” He described weight and balance as not having been a "special emphasis item" before the accident and that "it became a special emphasis after the accident."

When asked whether Bering Air’s “rapid growth and expansion” caused “any alarm bells,” the POI acknowledged that the operator’s growth was a topic of discussion but countered that their infrastructure (ground support and equipment) were “unparalleled” in the Part 135 industry in Alaska. He, therefore, considered it “responsible, measured” growth. The POI stated that, annually, he had 30 to 50 specific data collection tool (DCT) inspections per quarter and that it was a manageable workload, noting flexibility to perform advance inspections or reschedule an inspection for another quarter.[43] Concerning using SAS, he stated that it was “frustrating” for someone like him, “a brick-and-mortar generation guy.” He added the following:

> It's more of an office, computer-based surveillance system. I'm, once again, from the old school…in-person surveillance and observation, as opposed to computer-dictated surveillance. It's like anything…that's new. It takes a while to be comfortable with it, and to be good at.

When asked whether surprise route checks would help provide a better read than a scheduled check on an organization’s risk or health of its culture, the POI responded, “Unannounced route checks…are always going to be an increased surveillance. No doubt about it.” He added that because he is known by the operator’s personnel, he is not able to conduct unannounced checks.

[43] DCTs are questionnaires inspectors use to assess risk and regulatory compliance based on certificate holders’ operating profiles (see section 1.12.3 for more information).

The POI described a positive impression of Bering Air before the accident, calling it "hands-down the best operation [he had] ever seen in [his] life" and a "gold star airline of the state of Alaska." Regarding the company's safety culture, he stated, "…rank and file, is probably the best I've seen in any operation ever. It is a group of very smart, capable, conscientious, knowledgeable, trained employees."

1.12.3 Safety Assurance System Overview

FAA Order 8900.1, Volume 10, "Safety Assurance System (SAS) Policy and Procedures" provides an overview of the SAS process and tools (2016b). As part of planning activities, inspectors use the certificate holder assessment tool (CHAT) and comprehensive assessment plan to develop a risk-based, data-supported plan for oversight activities. As part of surveillance or certain approval activities, inspectors use DCTs to gather information for evaluation using the risk profile assessment tool (RPAT). Inspectors use the RPAT to help prioritize follow-up activities and determine whether adjustments to the comprehensive assessment plan are necessary, including increased surveillance.

Fleet size and related operational attributes are among the criteria used to generate a certificate holder's operating profile; operational complexity and rapid growth or downsizing are among the 28 CHAT risk factors explicitly identified in the guidance. Review of planning data, including risk profiles, is required at least once a year for Part 135 certificate holders.

The order states that "any time a change to certificate holder risk is identified," inspectors must update the "input risk factors in the CHAT" and select or adjust the value for ranking the level of concern.[44] The order provides a Level of Concern Decision Matrix to assist inspectors in determining the potential safety impact of an identified failure and associated risk (see figure 10). If no change to a certificate holder's risk profile is identified, inspectors make a corresponding selection in the application and add a note indicating no action required and the date of review before submitting the updated CHAT.

[44] The order states that the level of concern value selected is based on "the likelihood a failure will occur and its potential for adverse impact on the certificate holder's safety performance and/or regulatory compliance."

Likelihood	Safety Impact		
	Significant	Moderate	Minor
Frequent	(10) High (Red)	(6) Medium (Orange)	(3) Low (Yellow)
Occasional	(6) Medium (Orange)	(6) Medium (Orange)	(3) Low (Yellow)
Remote	(6) Medium (Orange)	(3) Low (Yellow)	(1) Minimal (Green)

Figure 10. Level of Concern Decision Matrix from Order 8900.1, Volume 10.

Note: Significant safety impact is defined as one or more fatalities, serious injuries, and/or substantial damage. Moderate is defined as moderate injuries and/or moderate damage, and minor is defined as minor injuries and/or light damage.

The NTSB's review of the DCT inspection data for Bering Air over the 24-month period before the accident did not identify deficiencies related to the circumstances of the accident. Review of CHAT data over the same period found that all entries indicated no action required and that neither operational complexity nor rapid growth or downsizing were among the noted risk factors for any of the assessments. No enforcement actions were taken against Bering Air in the preceding 24 months.

1.13 Safety Management Systems

FAA Order 8000.369C, "Safety Management System," establishes the SMS policy and requirements for the FAA and defines the roles and responsibilities of the FAA organizations in safety management and safety oversight activities (FAA 2020). SMS includes systematic procedures, practices, and policies for the management of safety risk, and describes the four main components of an SMS:

- **Safety Policy:** An organization's safety policy contains defined objectives and standards for the organization and its employees and management's commitment to its employees regarding the safety performance of the organization. As safety risk management and safety assurance processes are developed, the organization revisits its safety policy to ensure that its commitments are being realized and its standards are being upheld.

- **Safety Risk Management (SRM):** SRM provides a decision-making process for identifying hazards and mitigating risk based on a thorough understanding of the organization's unique systems and operating environment. SRM allows risk controls to be incorporated into the organization's processes, products, and services, and for those controls to be redesigned when existing controls do not meet the organization's safety expectations as outlined in its safety policy. Change management refers to the set of organizational processes by which intended reforms are translated into sustained changes in everyday practice (Kotter 1995). Organizational research has shown that policy or procedural changes alone are unlikely to produce durable effects unless they are accompanied by corresponding adjustments to authority, resources, workload allocation, and competing priorities that shape how work is actually performed.

- **Safety Assurance:** The goal of safety assurance is to monitor the organization's processes and operations to ensure that the defined safety objectives and existing risk controls are working. Safety assurance requires monitoring and measuring the safety performance of operational processes and continuously improving safety performance levels. Strong safety assurance processes yield information that can be used to identify weaknesses in existing policy and procedures, thereby assuring the safety performance of the organization.

- **Safety Promotion:** Training and communication ensure that employees understand the organization's safety policies and risk controls, as well as their personal responsibility to the organization's SMS, including safety reporting expectations and procedures. Organizations must ensure that their workforce has the necessary competencies to perform their duties relevant to the operation and performance of the SMS.

In its guidance to operators, AC 120-92D, "Safety Management Systems for Aviation Service Providers," the FAA states:

> Active involvement of operational leaders, maintaining open lines of communication up and down the aviation organization and among peers, staying vigilant in looking for new hazards and identifying associated risks, and ensuring that employees know that safety is an essential part of their job performance are key elements that can have a positive effect on the aviation organization's SRM decisions (FAA 2024).

2. Analysis

2.1 Introduction

The accident occurred during the pilot's third trip of the day, a scheduled commuter flight from Unalakleet (PAUN) to Nome (PAOM), Alaska. Available data indicate that about 42 minutes into the flight, shortly after leveling off at 4,000 ft msl as it approached PAOM, the airplane began descending about 2,000 fpm. The final data point from the airplane's avionics indicated its altitude at 2,100 ft msl and a descent rate about 7,800 fpm. The airplane impacted pack ice about 12 miles offshore of Norton Sound and 32 miles east of PAOM, fatally injuring the pilot and nine passengers.

The investigation's comprehensive review of the circumstances that led to this accident established that none of the following factors contributed to its cause:

- *Pilot qualifications.* The pilot was certificated, current, and qualified in accordance with federal regulations.
- *Pilot medical conditions:* The pilot held a valid and current FAA airman medical certificate. A review of the pilot's available information revealed no evidence of medical conditions that could pose a hazard to flight safety.
- *Pilot alcohol or other drug use.* Toxicology testing revealed no evidence of alcohol, medication, or other substances that may have affected the pilot's ability to safely fly the airplane.
- *Airplane mechanical condition.* Examination of the airplane's airframe, engine, propeller, and systems identified no evidence of preimpact anomalies or malfunction that would have precluded normal operation. The TKS system could not be operationally tested due to significant damage during the impact sequence. However, examination of the individual system components did not reveal any anomalies consistent with a preimpact failure or malfunction, and results from the airplane performance study indicate the TKS system functioned properly in preventing significant ice buildup on protected surfaces.
- *Air traffic control.* ATC handling of the flight conformed to required standards and procedures.

Thus, the NTSB concludes that none of the following were factors in the accident:

- pilot qualifications,
- pilot medical conditions or impairment by alcohol or other drugs,
- airplane mechanical condition, or
- air traffic control.

This analysis discusses the accident, including the pilot's attention and situational awareness, and evaluates the following:

- Bering Air's organizational deficiencies, including its flight release process and weight and balance controls
- The FAA's oversight of Bering Air
- the lack of required load manifests and recordkeeping requirements for aircraft operated under Part 135
- the lack of requirements for a structured flight data monitoring (FDM) program and associated recording devices for all Part 135 operators
- The value of certain aircraft operated under Parts 91, 121, or 135 to be equipped with crash-resistant flight recorder systems

2.2 Accident Summary

2.2.1 Preflight Planning

Before departing on the first of three flight legs planned for the day (PAOM-to-PAMK, PAMK-to-PAUN, and PAUN-to-PAOM), the pilot reportedly checked the weather conditions for the flight to PAUN as well as the return flight to PAOM, but the NTSB's investigation could not determine the sources he reviewed. The dispatcher at PAOM who reviewed weather and planned the day's route with the pilot stated that the pilot was "aware of the weather and the conditions" and that they had specifically discussed the forecast concerning conditions over the Norton Sound area, which were expected to improve. He stated the pilot did not express any concerns about the weather and that icing was discussed "first thing in the morning," but nothing was officially reported to confirm the presence of icing conditions.

While at PAUN, where the pilot waited about 4 hours for weather conditions to improve in the surrounding area before beginning the accident flight returning to PAOM, he was reportedly observed reviewing weather online by the customer service representative on duty at PAUN, but the NTSB's investigation found no evidence indicating that he called FSS or checked ForeFlight on the day of the accident. AIRMETs issued by the AAWU about 1237, while the pilot was at PAUN, forecast IFR conditions and mountain obscuration due to light snow and mist, clouds and precipitation, and occasional moderate icing between 2,000 and 8,000 ft msl for the accident location and time. The Icing Forecast graphical product issued by the AAWU about 1300 and valid for the accident time indicated occasional-to-constant moderate icing at the accident site between 2,000 and 8,000 ft.

At the time of the accident, AWC graphical forecasts in the current icing product and the forecast icing product were not capable of depicting the potential for significant icing, including SLD conditions, for Alaska. The two PIREPs that were disseminated before the pilot departed PAUN (one reported from PAOM and one from 5 nm north of PAOM) did not indicate icing conditions. The AAWU Icing Forecast issued around 1300 indicated occasional-to-constant moderate icing at the accident site between 2,000 and 8,000 ft msl. However, the investigation's analysis of available weather and performance data estimates that the airplane likely encountered SLD icing conditions. Therefore, the NTSB concludes that the accident flight encountered icing conditions more severe than forecast.

As part of preflight planning, the pilot also completed the company's required flight reports with weight and balance information for the day's flights. For both the PAOM-to-PAMK and PAUN-to-PAOM flight legs, he underreported the fuel weight and used the increased MGTOW of 9,062 lbs (associated with the airplane's STC modification) rather than 8,807 lbs, the basic MGTOW, as indicated in the POH for flight into known or forecast icing conditions. As a result, the pilot reports indicated both flights were within weight limitations when they were actually well beyond. The investigation's postaccident calculations estimated the accident flight's actual weight was about 9,798 lbs, which exceeded the increased MGTOW by 736 lbs and the basic MGTOW (for flight into known or forecast icing conditions) by 991 lbs.

2.2.2 Accident Sequence

After departing PAUN, the single-pilot, nine passenger scheduled commuter flight proceeded normally. The autopilot was engaged shortly after takeoff, and the pilot established a course toward PAOM, climbing to 8,000 ft msl. About 34 minutes into the flight, the pilot began the descent to PAOM, as instructed by the ZAN radar controller. During the descent, the controller advised the pilot that both runways at PAOM would be closed for deicing and that the arrival runway would reopen in about 10 to 15 minutes. The controller suggested that the pilot could "slow down a little bit" to avoid arriving before the runway reopened if he wanted. The pilot acknowledged and subsequently reduced engine power. The airplane's airspeed slowed from about 160 kts to about 114 kts as the descent continued.

Comparison of the G1000 recorded data from the accident flight with flight-test-validated C-208B simulation models during the NTSB's airplane performance study showed that the airplane's aerodynamic performance closely matched a clean (no ice) configuration during climb and cruise. About 4 minutes into the airplane's descent, as it descended through 6,250 ft, the calculated AOA derived from the G1000 data began to exceed the simulation value by about 0.5°. The investigation's analysis of available weather and performance data estimates that the airplane likely encountered SLD icing conditions about this time at an airspeed of about 114 kts. While the pilot likely had the TKS ice protection system on, which would have prevented ice from accreting on the protected surfaces, the small difference between the G1000 AOA and simulation AOA could be the result of ice accreting on the airplane's unprotected surfaces.

Recorded data indicate that the pilot increased engine power about a minute later and airspeed recovered to about 126 kts. About 3 minutes later, before leveling off at 4,000 ft, the pilot reduced engine power a second time, resulting in a decrease in airspeed that continued until the end of the data. The data also show that the autopilot changed modes as appropriate during climb, cruise, and descent and when the airplane leveled off at an assigned altitude. When airspeed reached 99 kts, about 30 seconds after the airplane leveled off at 4,000 ft, activation of the LAA system caused the autopilot to disengage, as designed. Therefore, the NTSB concludes that the autopilot was operating properly, including when it automatically disengaged due to activation of the LAA system.

About 11 seconds later, the airplane reached a descent rate of about 2,000 fpm. Analysis of the data indicated that an elevator input by the pilot, at an airspeed of 89 kts, resulted in the airplane's pitch attitude reaching its maximum value of about 10° to 12° and the airplane exceeding its critical AOA, consistent with the onset of an aerodynamic stall. The pilot's pitch input was not consistent with guidance in AC 120-109A change 1, which states that "reducing…AOA is the most important pilot action in recovering from an impending or full stall." Therefore, the NTSB concludes that the pilot's improper inputs leading up to and during the aerodynamic stall, which increased the airplane's AOA, were not in accordance with FAA guidance.

The airplane's descent rate decreased to 1,400 fpm over a 3-second period after the pilot's elevator input, its airspeed decreased to about 70 kts, and its altitude was about 3,100 ft msl. However, the descent rate increased again and ultimately exceeded 5,000 fpm, consistent with a loss of control. Therefore, the NTSB concludes that the airplane entered an aerodynamic stall and subsequent loss of control from which the pilot did not recover.

According to the POH, the level flight (1g) aerodynamic stall speed was 78 kts at MGTOW. However, the airplane performance study determined that, at almost

1,000 lbs over the allowed MGTOW for flight in known icing conditions (8,807 lbs), the airplane's additional weight increased the stall speed about 6 kts. Therefore, the NTSB concludes that the airplane's overweight condition reduced its stall margin.

Although the flight was likely in SLD icing conditions at the time of the aerodynamic stall and loss of control, the performance study determined that the airplane exceeded the critical AOA for an uncontaminated wing. This would not have been possible with significant icing accumulation. This finding was consistent with a properly functioning TKS ice protection system, although it is not intended for use in conditions outside of the criteria contained in 14 *CFR* Part 25 Appendix C, including SLD icing. Therefore, the NTSB concludes that although the airplane's TKS ice protection system was not approved for operation in SLD icing conditions, it functioned properly during the airplane's encounter with these conditions and prevented significant ice buildup on protected surfaces.

Based on ADS-B data, the investigation determined that the accident pilot did not maintain the required altitude and distance from the shoreline to allow a glide to the shoreline in the event of an engine failure. This placed the airplane beyond the glide distance to the shoreline required by Bering Air's GOM. The NTSB concludes that, although it did not contribute to the accident outcome, the pilot's operation of the accident flight beyond the glide distance to the shoreline was not in compliance with Bering Air's guidance concerning single-engine operation over water.

2.2.3 Pilot Attention and Situation Awareness

The investigation evaluated why the pilot did not maintain adequate airspeed before LAA system activation and ensuing autopilot disengagement. The airplane's autopilot had been engaged for almost the entire 43-minute flight. As required equipment for single-pilot passenger-carrying IFR operations under Part 135, the autopilot was likely engaged by the accident pilot to help manage workload. The Bering Air pilot who briefly chatted with the accident pilot as he approached PAOM stated during postaccident interviews that the autopilot is "there for a reason and it's there to help alleviate some of that workload so that you're not…overlooking important things."

According to the dispatcher at PAOM, the pilot was aware of the potential for some icing but nothing they reviewed confirmed it, and the conditions over the Norton Sound were expected to improve. Given this account, the pilot was likely unaware that he had entered severe icing conditions, including SLD, that explicitly prohibited continued use of the autopilot.

Workload management is a benefit of such automation, but it can also reduce the transparency of the airplane's state. The POH indicated a minimum speed of

95 kts for flight in icing conditions with a fully functional TKS ice protection system. The airplane's airspeed at the time the pilot reduced power to delay arrival for the runway closure at PAOM was about 160 kts. By the time the airplane entered the SLD environment, airspeed had already decayed to roughly 114 kts. After recovering to about 126 kts following the pilot's increase of engine power, airspeed resumed a downward trend, decreasing below the 95-kt minimum within seconds of the autopilot disengaging.

At the time the autopilot disengaged, the pilot's attention was likely focused on operating the TKS ice protection system, which would have increased his workload compared to routine flight in clear conditions. He would have had to allocate attention to scanning flight surfaces for icing, ensuring the system was working properly, and regulating fluid distribution and timing, in addition to managing the approach to the airport. Workload is a dynamic concept that depends on the demands of the operating environment and the capacity of the operator (Kantowitz 1988). Further, to maintain positive situation awareness, which is critical to decision-making and effective control of the aircraft, a pilot must have "an accurate, up-to-date picture of the state of the environment" (Endsley 1999).

Maintaining situation awareness can be challenging in single-pilot operations where the workload is already higher than a two-person system in which monitoring, flying, and decision-making tasks are divided. The division of labor provides a lower workload for each person and an element of redundancy within the system. Managing circumstances such as monitoring icing conditions and initiating deicing protocols consumes attention and increases workload beyond routine tasks required for flight. As workload increases, a person's capacity to manage the workload decreases. Undesirable states can result, such as a degraded situation awareness and monitoring capability, poor decision-making, the inability to process information effectively, and slower response times (Hofer et al 2024).

In this case, managing the airplane's deicing process and the approach may have resulted in the pilot's degraded situation awareness, which inhibited his ability to monitor and maintain adequate airspeed, allowing it to reach the activation threshold for the LAA system, which subsequently disengaged the autopilot. Therefore, the NTSB concludes that the pilot did not monitor and maintain adequate airspeed likely due to increased workload, which led to degraded situation awareness.

Further, given that the pilot provided some inputs as the accident sequence progressed, it is likely he committed an error of omission by not performing the intended action of increasing engine power at the correct time (as the autopilot leveled the airplane at 4,000 ft). This type of prospective memory error is often caused by an interruption or disruption of a normal routine or divided attention (Dismukes et al 2003). Therefore, the NTSB concludes that the pilot committed an error of omission when he did not increase engine power as the airplane leveled off that was possibly the result of his divided attention on managing the deicing process and the approach to PAOM.

When the autopilot disengaged, a quick response by the pilot would have been required to maintain airplane control due to the SLD environment and the airplane's overweight condition. The pilot's only option to prevent an impending stall, as indicated in FAA guidance, was to lower the AOA to account for the decrease in airspeed. However, the pilot's timely assessment of the hazard was likely degraded.

Studies of aviation loss of control events have shown that a sudden and unexpected situation can result in surprise and increase performance impairment (Dehais et al 2015; Landman et al 2017).[45] Automation surprises can be a threat because the automation often assumes workload and decision-making for the pilot (Parasuraman and Riley 1997). Studies have also shown that pilots often struggle with the ability to recognize aerodynamic stall at the onset, thereby losing time needed to respond and recover from the stall (Casner et al 2013; Landman et al 2017). Therefore, the NTSB concludes that the pilot likely did not recognize the airplane's low airspeed state and high AOA in enough time to provide control input to prevent the onset of an aerodynamic stall.

2.3 Upset Prevention and Recovery Training

The NTSB has long recognized the safety benefit of training that prepares pilots to recognize, avoid, and respond appropriately to developing stall and upset conditions. In 2009, following the Marlin Air Cessna Citation accident, the NTSB issued Safety Recommendation A-09-113, which asked the FAA to require all Part 91K and Part 135 operators to incorporate upset recovery training and related checklists and procedures into their training programs (NTSB 2009).[46] The recommendation was based, in part, on our finding that pilots would benefit from training and readily accessible guidance emphasizing that, when confronted with abnormal flight control forces, they should prioritize airplane control, including airspeed, attitude, and configuration, before attempting to identify and resolve the underlying problem.

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[45] Surprise is a response to an unexpected event—such as automation failure—that is difficult to comprehend and momentarily forces the recipient to change his understanding of the situation (Landman et al 2017). It is different from startle, which is an uncontrollable, physiological response (such as an automatic muscle reflex or raised heart rate or blood pressure) elicited by exposure to a sudden, intense event that violates a person's expectations (FAA 2017).

[46] Upset prevention and recovery training is specialized aviation training designed to teach pilots how to prevent, recognize, and safely recover from unexpected aircraft upsets or unusual flight attitudes.

In 2010, following the Colgan Air flight 3407 accident, the NTSB issued Safety Recommendation A-10-22, which asked the FAA to require Part 121, Part 135, and Part 91K operators, as well as Part 142 training centers, to develop and conduct training that incorporates stalls that are fully developed, unexpected, involve autopilot disengagement, and include airplane-specific features (NTSB 2010). Although that accident involved a Part 121 operation, the safety issue addressed by Safety Recommendation A-10-22 was not limited to Part 121 operations in that it reflected our concern that traditional approach-to-stall training did not fully prepare pilots to recognize and respond to unexpected stall conditions and airplane-specific cues.

Safety Recommendations A-09-113 and A-10-22 were classified Closed—Acceptable Alternate Action, in December 2022 and October 2021, respectively, based on a similar response from the FAA to both recommendations. The FAA's response indicated that it would not take the recommended action for Part 135 and 91K operators, in part, because its review of available accident data at the time "found that lack of pilot [upset prevention and recovery training] does not appear to be a significant contributing factor to Part 135 and 91K accidents." Additionally, the FAA's rationale at the time for not taking action was that simulators were not available for all aircraft operating flights under Part 135 and 91K.

The NTSB believes the safety objectives underlying these recommendations remain relevant to Part 135 and 91K operations. The accident sequence involving Bering Air flight 445 again raises concern about pilot recognition and appropriate response to stall-imminent conditions. Further, a review of NTSB accident data for Part 135 accidents for which aerodynamic stall/spin was a defining event found 11 occurring between 2008 and 2025, 9 of which were fatal.[47] Most occurred during takeoff, initial climb, approach, or landing.

In many of these accidents, the low altitude and limited time available after the stall developed reduced the opportunity for successful recovery, which reinforces the importance of recognizing prestall conditions before a stall has the chance to develop. In addition, we note that simulator technology has advanced since Safety Recommendations A-09-113 and A-10-22 were closed and that these recommendations did not state that upset prevention and recovery training had to be conducted in a simulator.

As discussed in the NTSB's 2024 special investigation report *Safety and Industry Data Improvements for Part 135 Operations*, Part 135 operations include a

[47] The NTSB case numbers for these accident are ANC24LA043, ANC22LA063, CEN22FA031, ANC18FA055, CEN16MA036, ANC16FA017, CEN15FA048, DCA13MA121, ERA12FA007, CEN12FA100, and ANC08MA038.

wide range of operators, from single-pilot and single-PIC certificate holders with limited operations to larger, more complex commuter, air ambulance, cargo, and passenger-carrying operations. In that report, we recognized that Part 135 safety data and safety initiatives should account for differences in certificate type, operating authority, and scope, including whether the operator is standard, basic, single-pilot, or single-PIC. Given this diversity, the NTSB believes that a more targeted approach is warranted.

Therefore, the NTSB concludes that the safety of Part 135 and 91K operations would be enhanced by requiring upset prevention and recovery training for these operators. As a result, the NTSB recommends that the FAA require all Part 135 and 91K operators, except single-pilot and single-PIC operators, to incorporate upset prevention and recovery training, whether in a simulator or an aircraft, and related checklists and procedures into their training programs.

2.4 Organizational Factors

2.4.1 Safety Management

Bering Air did not yet have an established regulatory SMS or a voluntary SMS at the time of the accident. The director of safety stated he was working to implement an SMS, as required, describing the process as in its "infantile stages" and stating that he was trying to "get up to speed." As Bering Air worked to stand up a formal SMS program, it had a patchwork of systems, procedures, and processes intended to support safe operations. However, what was in place at the operator did not appear to be understood among line personnel as a unified safety program. Gaps, lapses, and the inability of existing safety controls to identify latent risks eventually led to this accident. These factors are discussed in the next sections.

2.4.1.1 Flight Risk Assessment and Operational Control

At the time of the accident, Bering Air did not have a formal flight risk assessment process or flight release tool. Its GOM outlined preflight duties and responsibilities for pilots, dispatchers, and management, with pilots being primarily responsible for obtaining and evaluating "all sources of weather reports and PIREPs prior to each flight and throughout the duty period as weather conditions change."

The GOM contained moderately detailed descriptions of icing conditions that were not represented correspondingly in the operator's flight risk assessment process. Critically, this process lacked a structured way to flag whether forecast icing conditions were within or outside of the airplane's limitations for operations in icing. Further, this process was mainly conducted through face-to-face discussions between pilots and dispatchers without documented decision points based on forecast icing conditions. Generally, if the weather conditions were below company weather minimums or if icing conditions were present, the director of operations or a dispatcher would need to review and release the flight, but the operator did not have a formal escalation process based on risk assessment.

In the case of the pilot's flight on the day of the accident, the dispatcher who planned the day's flights with him reported reviewing weather conditions together before the pilot departed on the first flight leg. Icing was discussed at that time but, lacking an official forecast confirming its presence, the pilot did not express concerns about the weather. However, conditions had changed by the time the pilot was ready to return to PAOM from PAUN, where he waited for several hours for weather conditions in the surrounding area to improve before departing on the accident flight. During that time, the AAWU issued two forecasts indicating moderate icing along the route of flight to PAOM.

The pilot was reportedly observed checking weather online at PAUN, which the GOM required of pilots throughout their duty day, but no control existed in Bering Air's process to ensure pilots performed that responsibility when away from the base of operations in Nome. The investigation was unable to determine what weather sources the accident pilot checked or if he was aware of the two AAWU forecasts issued during that time period. There is no evidence that he was in communication with dispatch personnel in Nome during this time.

Lacking a formal flight risk assessment process, flight release tool, or method of operational control when away from the operator's base, there was no one other than the pilot to exercise operational control for the accident flight. He made his own go/no-go decision. The NTSB concludes that Bering Air's flight risk assessment process at the time of the accident did not provide a method for operational control oversight of flights departing locations other than its base in Nome, leaving the go/no-go decision for the accident flight solely to the pilot.

Bering Air pilots were also responsible for preparing load manifests (documenting the airplane's operating weight empty, fuel, takeoff weight, CG, and other data) before every flight. Despite this requirement, the NTSB's investigation found these manifests routinely contained inaccurate baseline data that set the stage for multiple flights being operated while exceeding weight limitations.

For the accident flight specifically, the airplane was over MGTOW for standard operations (736 lbs over) as well as for flight in known or forecast icing conditions (991 lbs over). Comparison of fuel weight recorded by the airplane's Garmin G1000 to the fuel weight the pilot entered in the load manifests for the accident flight and first flight that day from PAOM to PAMK showed that he underreported these weights by 464 and 642 lbs, respectively.

In addition, the airplane's operating empty weight, the same for all three of the day's flights, did not reflect the expected result of the formula indicated in Bering Air's GOM (the sum of the equipped empty weight and the flight crew). Specifically, using the pilot's reported weight at his last medical examination (230 lbs), the operating empty weight should have been about 5,618 lbs—118 lbs more than entered in the load manifests.

Further, the investigation's review of 35 load manifests for flights involving the accident airplane that were completed January 28, 2025, through February 6, 2025, indicated that 7 flights, including the accident flight and the flight from PAOM to PAMK on the day of the accident, were operated in an overweight condition. This review also found that pilots were consistently underreporting fuel load on the load manifests compared to the amount of fuel actually onboard (as recorded by the airplane's Garmin G1000).

The NTSB concludes that Bering Air's flight risk assessment and operational control process and procedures at the time of the accident were inadequate to prevent the accident flight, or other flights, from operating in an overweight condition.

The findings from our review of the 35 load manifests provided are consistent with an ongoing practice of underreporting certain weights. Normalization of deviance is the tendency to gradually shift from established protocols, procedures, rules, or guidance to an extent that unsafe practices become accepted as normal by a group or organization (Rosenkrans 2015; Vaughan 2016). Normalization of deviance disregards the continued existence of whatever hazard the rule or procedure was designed to mitigate and, in deviating, practitioners invite unnecessary risk back into the system. The NTSB concludes that the repeated underreporting of weights in Bering Air load manifests represented a normalization of deviance that resulted in several flights, including the accident flight, being operated in exceedance of weight limitations.

The NTSB notes that, unlike Part 121 operations, dispatchers for Part 135 operations are not required to be certificated, and the dispatcher for the accident flight was not. As the NTSB explored in our 2024 special investigation report on the safety of Part 135 operations, the standardized operational control and flight-locating methods used by dispatchers in Part 135 operations can vary widely compared to those used by dispatchers for Part 121 operations. So, too, can the training and qualifications of the personnel who perform such tasks.

Part 135 operators may commonly use terms like "dispatcher," "flight follower," "flight monitor," "flight coordinator," "operational control agent," "flight locator," or "specialist" to refer to various personnel who perform various flight support duties. However, such personnel are not required to hold a dispatcher certificate, and their duties are not defined by regulation for Part 135 operations (except for the flight-locating requirement specified in 14 *CFR* 135.79).[48]

The dispatcher for the accident flight described his training for the position as "very basic," which he received from senior personnel while on the job. He did not recall how long the training lasted but noted that it included radio etiquette, protocols for certain situations, and basic weather knowledge. Dispatcher certification for Part 121 operations requires the completion of an approved training course (or documentation of acceptable experience) and passing scores on knowledge and practical tests.[49] Certificated dispatchers required for Part 121 operations hold joint responsibility with the PIC for the safety and operational control of flights, including preflight planning, flight delays, and flight dispatch releases.[50] They are subject to initial and recurrent training requirements and competency checks and have inherent accountability for their performance, as their certificate can be suspended or revoked if they perform in an unsafe manner.[51]

The NTSB concluded in the 2024 report that the safety of Part 135 operations would be enhanced by the required use of certificated dispatchers, which would allow for improved quality control over the functions such as preflight weather, fuel, and route planning; active monitoring of in-flight aircraft position and conditions along the route of flight; and timely notification of emergency response organizations if an aircraft becomes overdue. As a result, the NTSB issued Safety Recommendation A-24-17 to the FAA to require all Part 135 operators, except single-pilot and single-PIC operators, to use certificated dispatchers who hold joint responsibility with the PIC for the safety and operational control of flights and whose responsibilities include

[48] These personnel may or may not have delegated operational control authority; if they do, such authority must be defined in the company's GOM or operations specifications.

[49] An approved dispatcher course (per 14 *CFR* 65.61 and Part 65, appendix A) involves a minimum of 200 hours of training on regulations, meteorology, navigation, aircraft, communications, ATC, emergency and abnormal procedures, and practical dispatch applications. Alternatively, acceptable experience (per 14 *CFR* 65.57[a]) includes having worked at least 2 years (in the preceding 3 years) as a military pilot, flight navigator, or meteorologist; a Part 121 pilot, flight engineer, meteorologist, or assistant dispatcher; an air traffic controller or a flight service specialist; or while performing other duties that the FAA considers equivalent. The knowledge and skill requirements covered by the computer-based knowledge test and the evaluator-administered practical test are described in 14 *CFR* 65.55 and 65.59, respectively.

[50] As specified in 14 *CFR* 121.533 and 121.535, dispatchers' responsibilities include monitoring the progress of each flight, issuing necessary information for the safety of the flight (such as meteorological information to identify potential hazards and the most desirable route of flight), and canceling or redispatching the flight if either the dispatcher or the PIC determines that the flight cannot be operated safely as planned or released.

[51] The training and competency check requirements are specified in 14 *CFR* 121.415, 121.422, 121.427, and 121.463).

preflight planning; flight dispatch, release, and cancellation decisions; and flight monitoring, consistent with the requirements for 14 *CFR* Part 121 domestic and flag operations.

On November 4, 2024, the FAA responded that it was evaluating appropriate actions to take and would keep the NTSB informed of its plans and progress. Safety Recommendation A-24-17 is currently classified Open—Acceptable Response. The NTSB believes that the circumstances of the accident involving Bering Air flight 445 demonstrate how having dispatcher personnel certificated and trained to monitor weather conditions along the route of flight or be a checkpoint in the weight and balance process could enhance flight safety. The NTSB concludes that requiring joint operational control responsibility between a certificated dispatcher and a PIC can minimize the potential of a single-point failure to affect the safety of Part 135 operations. Therefore, the NTSB reiterates Safety Recommendation A-24-17.

2.4.1.2 Flight Data Monitoring

Repeated overweight flights at Bering Air invited unnecessary risk into the operation. Effective safety risk management (as part of a fully functional SMS) would have provided the opportunity to those responsible to identify and mitigate risks, such as the operation of its 208B airplanes outside of weight limitations, particularly those associated with flight in icing conditions. Even without an established SMS, safety risk management could have been accomplished by structured monitoring of the data recorded by the Garmin G1000 integrated flight deck installed on the accident airplane, which were available to the operator to be used in this way.

The NTSB has long recognized the value of a FDM program for various Part 135 operations. In 2009, we issued Safety Recommendation A-09-90 asking the FAA to require helicopter air ambulance (HAA) operators to establish a structured FDM program and install recording devices capable of supporting it.[52] As a result of our investigation of the 2015 fatal accident in Akron, Ohio, we expanded the recommended action to apply to all Part 135 operations and asked the FAA to do the following:

> Require all 14 *Code of Federal Regulations* Part 135 operators to install flight data recording devices capable of supporting a flight data monitoring program. (A-16-34)
>
> After the action in Safety Recommendation A-16-34 is completed, require all 14 *Code of Federal Regulations* Part 135 operators to

[52] Safety Recommendation A-09-90 was classified Closed—Unacceptable Action on January 25, 2018.

> establish a structured flight data monitoring program that reviews all available data sources to identify deviations from established norms and procedures and other potential safety issues. (A-16-35) (NTSB 2016)

In response to these recommendations, the FAA informed us that, although it agreed with the benefits that additional flight data can provide, it encountered challenges in achieving a favorable cost-benefit analysis. On April 6, 2017, we replied that we disagreed with the FAA's previous determination that a mandate for FDM equipment and programs would provide no quantifiable benefits, and we cited seven accidents that occurred from 2000 through 2015 that were relevant to this safety issue.[53] These accidents, which involved Part 135 operators, resulted in fatal injuries to 53 people and serious injuries to 4 people (NTSB 2022a). Both recommendations are currently classified Open—Unacceptable Response.

In the 10 years since we issued these recommendations, we have reiterated them five and six times, respectively, based on the findings from our investigations of other fatal accidents involving Part 135 operators relevant to this issue. The FAA identified monitoring-related mitigations for 12 of the 35 accidents cited in its evaluation to support SMS rulemaking for Part 135.[54] We continue to believe that implementation of an FDM program is one method by which operators can acquire and analyze the data necessary to support the safety assurance monitoring requirements of an SMS.

For example, as part of an FDM program, comparison of the airplane avionics system's recorded data of actual fuel loads against archived load manifests would have shown the pattern of discrepancies with pilot-reported fuel loads. The operator would have been prompted to verify actual takeoff weights and would have had the opportunity to investigate the nature of the discrepancies. The patchwork of procedures and tools Bering Air had at the time of the accident, in an environment where pilots controlled the information documented in load manifests, could not detect the latent pattern.

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[53] When the FAA informed us in 2017 that it would conduct a review to determine the feasibility of requiring all Part 135 certificate holders to install FDM recording devices, it referenced the cost-benefit analysis it performed in 2014 when considering such a mandate for HAA operators. The FAA's regulatory evaluation for the proposed HAA rule showed costs of about $20.4 million and a benefit of $0 for a 10-year period. As discussed in the NTSB's 2024 special investigation report on Part 135 operations, typically, benefits estimates represent the statistical value of fatalities and injuries that may be averted by implementation of a proposed rule (NTSB 2024).

[54] The FAA's evaluation of accidents cited the safety assurance monitoring aspect of 14 *CFR* 5.71 for NTSB cases ANC18LA027, CEN18FA215, ANC18FA045, ANC17FA021, DCA17FA109, ANC16FA017, ERA16FA215, CEN16LA386, ANC17MA001, ANC15MA041, CEN16MA036, and WPR16FA037 (FAA 2022).

The NTSB notes that lightweight flight recording systems are increasingly becoming standard equipment or available as retrofit options for new production general aviation and business aircraft. According to a General Aviation Manufacturers Association representative, about 70% to 80% of new production turbine-powered business airplanes were equipped with a lightweight flight data recording system, and about 10% to 20% had at least some data recording and download capability, such as through the avionics or other systems. Standard and retrofit recorder equipment options for new production piston-powered airplanes have increased, driven, in part, by demand from customers wanting to participate in an FDM program (NTSB 2022c).[55]

Although the FAA has not yet pursued rulemaking to address Safety Recommendations A-16-34 and A-16-35, we are encouraged that, in the FAA Reauthorization Act of 2024, Congress directed the FAA to task an aviation rulemaking committee (ARC) to review and assess the need for changes to the safety requirements related to FDM for certain aircraft and operations. The Act directed the FAA to consider any applicable NTSB safety recommendations and the recommendations of previous ARC that reviewed FDM requirements for Part 135 operators.[56] We continue to believe the need for the recommended action is well justified based on the findings in this and other investigations.

Therefore, the NTSB concludes that operational FDM programs can provide Part 135 operators with objective information regarding the way their pilots conduct flights, and a periodic review of such information could assist operators in detecting and correcting unsafe deviations from standard operating procedures. Therefore, the NTSB reiterates Safety Recommendations A-16-34 and -35.

2.4.2 Federal Aviation Administration Oversight

Oversight of the Bering Air certificate was performed by a certificate management team of three inspectors out of the Fairbanks FSDO, located about 520 miles from Nome. At the time of the accident, Bering Air had 54 pilots and 40 aircraft (30 airplanes and 10 helicopters), reflecting a period of growth that began in 2020 following the bankruptcy of its primary competitor carrier, Ravn Alaska.

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[55] In October 2022, the NTSB moderated a roundtable discussion with experts from government and industry about the benefits and proven value added by FDM programs for any sized operation.

[56] Specifically, section 333 of the Act directed the FAA to task a rulemaking advisory committee to review and assess FDM requirements for certain helicopters, and section 363 addressed FDM for commercial air tour operations.

FAA Order 8900.1, Volume 10, "SAS Policy and Procedures," requires reassessment of a Part 135 certificate holder's risk profile at least once a year and specifically identifies operational complexity and rapid growth or downsizing as risk factors that could affect a risk profile. The NTSB's review of SAS data for Bering Air indicated that multiple CHAT assessments were performed between 2022 (when the front-line manager and POI assumed their respective oversight roles for the operator) and 2025, and that none identified operational complexity or rapid growth as risk factors despite both being present. Every assessment during this period indicated no action was required, and Bering Air's risk profile remained unchanged.[57]

Bering Air's president and the director of safety both described the period of growth in the context of the 2020 pandemic and bankruptcy of Ravn Alaska. Becoming the only passenger-carrying operator in the region, the company strove to meet increased demand for cargo service while also accommodating increased passenger demand as travel restrictions eased. These pressures required additional personnel in all departments, new types of aircraft, and new facilities.

All of these changes introduced operational risk. The NTSB's identification of underreported weight data across several load manifests for flights using the accident airplane (compared to recorded flight data and the company's GOM) is one example of such risk. Once introduced into the system, that risk led to the accident airplane being operated while overweight for several flights, including the accident flight, in the week before the accident. The POI stated postaccident that he did not believe flight 445 was the first on the Bering Air certificate to fly overweight.

As described by the POI, his weight and balance surveillance primarily involved manual review of Bering Air's voluntarily maintained archive of load manifests.[58] If they passed the "smell test," there was typically "no reason to dig deeper." The POI reported that because inaccurate weight recordkeeping had not been identified as a risk indicator—consistent with a SAS principle—verifying weight and balance by more "invasive" means (for example, offloading passengers and cargo) "rarely" happened as part of his surveillance activities. It is this approach that resulted in no related data being entered into SAS and no associated risk indicator being identified.

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[57] During postaccident interviews, the POI framed Bering Air's growth as "solidification of their existing route structure" rather than expansion and regarded it as "responsible, measured." The front-line manager for the certificate management team described being aware of the company's growth as a feature but not necessarily a specific focus.

[58] As discussed later in this section, single-engine aircraft are excluded from the load manifest requirements of 14 *CFR* 135.63(c).

The NTSB's investigations of the February 2009 accident involving Colgan Air flight 3407 and October 2019 accident involving PenAir flight 3296 similarly found that significant organizational change created operational risks that oversight did not detect or mitigate. Regarding Colgan Air, we found that, at the time of the accident, the FAA's surveillance standards for oversight at air carriers undergoing rapid growth and increased complexity of operations did not guarantee that any challenges encountered by the carriers as a result of these changes would be appropriately mitigated.[59] As a result, the NTSB issued Safety Recommendation A-10-26, which asked the FAA to do the following:

> Develop more stringent standards for surveillance of Part 121, 135, and 91K operators that are experiencing rapid growth, increased complexity of operations, accidents and/or incidents, or other changes that warrant increased oversight, including the following: (1) verify that inspector staffing is adequate to accomplish the enhanced surveillance that is promulgated by the new standards, (2) increase staffing for those certificates with insufficient staffing levels, and (3) augment the inspector staff with available and airplane-type-qualified inspectors from all FAA regions and Part 142 training centers to provide quality assurance over the operators' aircrew program designee workforce.

In response, the FAA issued Notice 8900.236, "ATOS Resource Management," on September 13, 2013, amending policy and procedures specified in FAA Order 8900.1, "Flight Standards Information Management System." The amendments allowed managers of certificate management teams to use personnel from other offices to assist with oversight, as necessary, and to streamline the process for requesting that assistance. In an April 17, 2014, response, the NTSB noted that, to satisfy Safety Recommendation A-10-26, the improved policies and procedures in Notice 8900.236 had to be incorporated into SAS before the notice expired in September 2014. After the FAA confirmed completion within the indicated timeframe, we classified Safety Recommendation A-10-26 Closed—Acceptable Action in November 2015.

Concerning the PenAir flight 3296 accident, we found that the FAA's oversight of PenAir during the 2 years before the accident was insufficient to identify safety risks resulting from the company's bankruptcy, reduced route structure, loss of experienced pilots, acquisition, and merger (NTSB 2021). As a result, we issued Safety Recommendation A-21-49, which asked the FAA to do the following:

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[59] Among the organizational changes at Colgan Air that the NTSB's investigation evaluated was the significant increase in its Bombardier Q400 fleet (in addition to its existing Saab 340 fleet), which required increased pilot upgrades and training.

> Notify principal operations inspectors and frontline managers about the circumstances of this accident and emphasize the importance of existing Federal Aviation Administration guidance for detecting and mitigating the safety risks that can result when certificate holders experience significant organizational change, such as high personnel turnover, a reduction to route structures or flight schedules, bankruptcy, acquisition, and merger.[60]

Following its initial response indicating intent to take responsive action, the FAA informed the NTSB in September 2023 that a Daily Broadcast published before the recommendation was issued notified POIs and front-line managers about the circumstances of the PenAir accident. Our February 2025 response noted that the broadcast did not emphasize the importance of existing guidance for detecting and mitigating the safety risks that can result when certificate holders experience significant organizational change, as recommended, and classified this recommendation Closed—Unacceptable Action.

Both Safety Recommendations A-10-26 and A-21-49 were issued as a result of Part 121 accidents; however, A-10-26 was scoped to include Part 135 operations and responsive action was anticipated to extend to those operations. However, our investigation of the Bering Air flight 445 accident has identified the same oversight gap identified in the earlier investigation. Despite the intended design of the SAS framework to leverage data to identify risk specifically associated with operational complexity and rapid growth, neither the front-line manager nor the POI for Bering Air recognized those factors during any of the reassessments as applicable to the operator's profile, which included increases in fleet size with different airplane types and additional personnel and facilities.

The NTSB concludes that the FAA's oversight was inadequate to identify operational complexity and rapid growth as risk factors for Bering Air, which resulted in its risk profile remaining unchanged as it grew to meet the demands of being the only passenger-carrying operator in the region.

Therefore, the NTSB recommends that the FAA develop explicit surveillance criteria for Part 135 and 91K operators that are experiencing rapid growth, increased complexity of operations, accidents and/or incidents, or other changes that warrant increased oversight, including verifying that inspector staffing is adequate to

[60] At the time Safety Recommendation A-21-49 was issued, the FAA's existing guidance for detecting and mitigating the safety risks that can result from organizational change was contained in Order 8900.1, volume 6, chapter 2, section 18, Safety Assurance System: Evaluation of a Certificate Holder's Management of Significant Changes Parts 121, 135, and 91 Subpart K.

accomplish the enhanced surveillance resulting from the new criteria, and increasing staffing for those certificates with insufficient staffing levels.

Single-engine aircraft are excluded from the load manifest requirements of section 135.63(c), which apply only to multiengine aircraft. Even so, Bering Air voluntarily created and maintained load manifests for its single-engine operations. Despite this voluntary practice, the NTSB's investigation found that it was repeatedly compromised and in various ways, resulting in several flights (including the accident flight) being operated over the airplane's MGTOW. The assigned POI visited the operator weekly and reported postaccident that he occasionally manually reviewed their load manifests. However, he reported observing "no indications of overweight operations, especially chronic overweight operations."

The load manifest requirements specified in section 135.63(c) are intended to prevent discrepancies like those identified during this investigation. The NTSB has long advocated for required load manifests for single-engine aircraft, beginning with the issuance of Safety Recommendation A-89-135 in December 1989. This recommendation asked the FAA to expand the recordkeeping requirements of 14 *CFR* 135.63(c) to include single-engine aircraft.

The FAA declined to take responsive action, and Safety Recommendation A-89-135 was classified Closed—Unacceptable Action in July 1990. Based on our continued investigation of fatal accidents relevant to this safety issue, the NTSB issued this recommendation two more times (A-99-61 and A-15-29), and the FAA ultimately declined to take responsive action in both instances despite agreeing with the intent of those recommendations.[61]

Notably, in its October 30, 2015, initial response to Safety Recommendation A-15-29, the FAA stated that it would review its SAS data collection tools to determine whether the tools adequately assess Part 135 operators' single-engine weight and balance procedures, training, and checking. In 2020, the FAA completed its review, identified no systemic issues with Part 135 operators' single-engine weight and balance procedures, and planned no regulatory action.

Specifically, the FAA informed us that the applicable SAS tools required FAA inspectors to conduct comprehensive assessments of operators' weight and balance calculations, policies, procedures, controls, monitoring, evaluating, and correcting of deficiencies, and that these assessments allowed inspectors to recognize areas of risk and provided operators the opportunity to mitigate those risks. The FAA stated that it believed these assessments presented an equal, more immediate, and positive

[61] We classified Safety Recommendations A-99-61 and A-15-29 Closed—Unacceptable Action on September 11, 2014, and May 18, 2021, respectively.

impact on safety than a load manifest and recordkeeping requirement for single-engine aircraft operations would.

Weight and balance was one of the four safety issues the NTSB evaluated in our special investigation of Part 135 operations, which resulted in the issuance of Safety Recommendation A-24-18 in July 2024. Again, the FAA was asked to expand the applicability of section 135.63(c) to single-engine aircraft (NTSB 2024). The FAA's initial response, in November 2024, stated that it does not believe the accident data and costs associated with implementing this recommendation would support a new rulemaking and asserted that Safety Alert for Operators 18012, published in 2018, emphasizes the criticality of using accurate data when calculating aircraft weight and balance. The FAA also noted that AC 120-27F, which was updated in 2019, includes guidance on developing a weight and balance program.

Our August 2025 response stated that we do not believe the guidance specified in the FAA's response is an acceptable alternative to the recommended action and that excluding single-engine aircraft operations from this requirement unjustifiably applies a different level of safety to these operations. Safety Recommendation A-24-18 is currently classified Open—Unacceptable Response.

The circumstances of the accident involving Bering Air flight 445 demonstrate how latent areas of risk can go unrecognized despite a formal data-based approach to safety assurance, like SAS, being in place and the availability of guidance emphasizing the criticality of using accurate weight and balance data. Our review of SAS data for Bering Air for the 24 months preceding the accident did not identify findings pertinent to the safety issues identified in this investigation, and no enforcement actions were taken against Bering Air during this period.

The NTSB notes that expanding the applicability of section 135.63(c) to single-engine aircraft would provide a required standard for inspectors to audit against during surveillance activities. Further, intentionally misrepresenting data on a required manifest would entail enforcement action. The single-engine accident airplane was equipped to carry nine passengers and operated for scheduled commuter service; passengers aboard such aircraft are entitled to the same level of safety as those on multiengine aircraft. Therefore, the NTSB concludes that manifest and recordkeeping requirements for all aircraft that are operated under Part 135 would provide inspectors with a regulatory standard during surveillance activities to identify operational risk areas that may influence improper aircraft loading and mitigate them before an accident occurs. Therefore, the NTSB reiterates Safety Recommendation A-24-18 to the FAA.

2.5 Supercooled Large Droplet Forecast Products for Alaska

The NTSB's investigation was unable to determine what weather sources or products the pilot referenced before the accident flight. However, the weather reports and forecasts that were available before the flight did not represent the severity of the icing encountered during the flight, and none contained SLD-specific information.

The AIRMET icing forecast issued about 2 hours before the pilot departed PAUN indicated occasional moderate icing between 2,000 and 8,000 ft msl, and the graphic icing product issued by the AAWU about 1.5 hours before the pilot departed PAUN indicated occasional-to-constant moderate icing within the same altitude range. Further, the AIRMET text did not accurately indicate the area of forecast icing (indicating southwest of Unalakleet rather than moving north into Norton Sound). So, if the accident pilot only saw the AIRMET text, he would have been under the impression that the worse area of forecasted icing was not along his route of flight.

The AAWU does not issue SLD-specific forecasts or products. Based on experience, the lead meteorologist responsible for forecasts at the accident time identified the combination of forecasted elements in the graphical forecast editing software (and subsequently in AIRMET Zulu) as representative of SLD conditions. However, at the time of the accident, no official product existed in which that feature could be explicitly communicated. When asked about the tools he used to develop icing forecasts, the lead meteorologist mentioned experimental guidance produced by NCAR that he used for coverage information but rarely used its SLD probabilities because "the output that comes from that is very small, very sporadic."

The NTSB previously identified the lack of SLD-specific forecast products for Alaska as a safety issue for aviation operations there. On August 16, 2021, the pilot of a Cessna 208B airplane, being operated as a Part 135 scheduled commuter flight from Fairbanks International Airport to Huslia Airport; Huslia, Alaska, experienced a loss of control while descending from 10,500 to 10,000 ft msl in SLD conditions. The pilot later reported that, during the accident, it felt as if the aileron controls were jammed. She regained control of the airplane, declared an emergency, and returned to the departure airport where she landed without further incident. None of the occupants were injured, and the airplane was substantially damaged. We determined the probable cause of the accident, in part, was "the pilot's unexpected encounter with [SLD], which resulted in a loss of control due to ice accumulation."[62]

[62] The full probable cause statement was "the pilot's unexpected encounter with [SLD], which resulted in a loss of control due to ice accumulation. Contributing to the accident were: (1) the pilot's failure to maintain the minimum airspeed for flight in icing conditions, (2) the pilot's failure to disconnect the autopilot every 10 minutes to check for ice buildup, (3) the overweight airplane, (4) the

As a result of our investigation, we issued Safety Recommendations A-22-21 and -22 in June 2022. These recommendations asked the FAA and NWS, in collaboration with each other, to develop a graphical forecast depicting potential areas of SLD icing conditions in Alaska and to make this information available to pilots (NTSB, 2022b). Both the FAA and the NWS responded positively, in October 2023 and July 2024, respectively, and the recommendations were classified Open–Acceptable Response awaiting further action. On March 23, 2026, the NWS issued Service Change Notice 25-80, updated on March 30, announcing the inclusion of information indicating the potential for SLD conditions over Alaska in AWC graphical icing forecasts.

The updating of AWC graphical icing forecasts to include potential SLD conditions in Alaska is responsive to Safety Recommendations A-22-21 and -22. Thus, the NTSB concludes that graphical forecasts depicting potential areas of SLD icing conditions in Alaska will help pilots avoid inadvertent encounters with these hazardous conditions. Therefore, the NTSB classifies Safety Recommendations A-22-21 and -22 Closed—Acceptable Action.

2.6 Crash-Resistant Flight Recorder Systems

The accident airplane was not equipped with a cockpit voice recorder or a flight data recorder and was not required to be equipped under the applicable regulations. Despite the absence of a requirement for recording equipment, the installed Garmin G1000 integrated flight deck system recorded multiple flight parameters that provided the basis for the NTSB's airplane performance study and weight and balance analysis of prior flights that were key to identifying the causes of this accident. Our investigation was only able to perform these analyses because the G1000 SD card was recovered in sufficiently good condition.

The G1000 system and the SD card required to enable the data logging function are not crash-resistant.[63] In the case of this accident, the SD card was recoverable mainly due to the wreckage location (on sea ice rather than submerged in water) and lack of a postcrash fire. Under different circumstances, the SD card

lack of an SLD forecast product for the state of Alaska, and (5) the Federal Aviation Administration's failure to require weight and balance documentation for each flight in Title 14 *Code of Federal Regulations* Part 135 single-engine operations." Use the CAROL Query to search for more information about this accident (case number ANC21LA073).

[63] The types of cockpit voice recorders and flight data recorders that are required by regulation to be installed on certain aircraft are designed to stringent crash-survivability standards. Crash-resistant flight recorders, which are designed to a less stringent survivability standard, are generally less expensive, lighter weight, and able to record much of the same information as cockpit voice recorders and flight data recorders, as well as cockpit images.

could have been destroyed or its data unrecoverable, leaving little more than ADS-B data and the physical wreckage to reconstruct the accident sequence.

Even with the successful recovery of the G1000 flight data, the absence of cockpit audio and image recordings left gaps in the investigation's understanding of the pilot's actions and awareness of the airplane's state during the critical final minutes of the flight (the pilot's actions and awareness are explored in section 2.2.3). Without cockpit image recording, investigators could not observe the pilot's instrument scan, his interaction with the flight controls or avionics, or whether the icing conditions outside the airplane were visually apparent from the cockpit. Without cockpit audio recording, investigators could not know if there were any other distractions for the pilot during the accident flight. The airplane performance study noted that the overall airplane handling qualities at the excessive gross weight and with ice on the unprotected surfaces could not be determined. A recording of the cockpit environment could have helped address this limitation by documenting the pilot's control inputs and the airplane's visible response in real time.

Since 2000, the NTSB has repeatedly identified the absence of crash-resistant flight recorder systems on Part 135 turbine-powered aircraft as a barrier to understanding accident causes and identifying safety deficiencies. Table 4 details our previous recommendations related to these recorder systems.

Table 4. Previously issued recommendations to the FAA on crash-resistant flight recorder systems.

Recommendation Number	Reiterations	Classification
A-99-60		Closed—Superseded by A-03-64 (12/22/2003)
A-03-62		Closed—Unacceptable Action/Superseded by A-09-9 (2/9/2009)
A-03-63		Closed—Unacceptable Action (10/27/2009)
A-03-64		Closed—Unacceptable Action/Superseded by A-09-10 (2/9/2009)
A-03-65	Kirksville, MO (1/24/2006)	Closed—Unacceptable Action/Superseded by A-09-11 (2/9/2009)
A-09-9		Closed—Unacceptable Action (6/11/2012)
A-09-10	Aleknagik, AK (6/9/2011)	Closed—Unacceptable Action (6/11/2012)
A-09-11	Aleknagik, AK (6/9/2011)	Closed—Unacceptable Action (6/11/2012)
A-13-12	Frisco, CO (4/13/2017) Ketchikan, AK (5/9/2017) Togiak, AK (4/26/2018) Zaleski, OH (6/8/2020)	Open—Unacceptable Response (4/20/2021)
A-13-13	Owasso, OK (10/23/2014) Frisco, CO (4/13/2017) Ketchikan, AK (5/9/2017) Togiak, AK (4/26/2018) Zaleski, OH (6/8/2020)	Open—Unacceptable Response (2/25/2021)

Recommendation Number	Reiterations	Classification
	Calabasas, CA (2/25/2021) Kekaha, HI (5/26/2022)	

Note: See Appendix C for the full text of the listed safety recommendations.

In May 2013, as a result of our investigation of the 2011 accident involving an AS350 B2 helicopter that crashed in Mosby, Missouri, we issued Safety Recommendation A-13-13, which asked the FAA to do the following:

> Require all existing turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a flight data recorder or cockpit voice recorder and are operating under 14 *Code of Federal Regulations* Parts 91, 121, or 135 to be retrofitted with a crash-resistant flight recorder system. The crash-resistant flight recorder system should record cockpit audio and images with a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all as specified in Technical Standard Order C197, "Information Collection and Monitoring Systems." (NTSB 2013)

We also issued Safety Recommendation A-13-12, which recommended such systems for newly manufactured aircraft. We have reiterated Safety Recommendation A-13-13 seven times—most recently in May 2022 as a result of our investigation of the 2019 accident involving an AS350 B2 helicopter operated by Safari Aviation Inc. as a commercial air tour flight that encountered IMC and collided with terrain near Kekaha, Hawaii. Because of the accident circumstances and the absence of recording devices, the investigation was unable to determine whether the accident occurred due to controlled flight into terrain or an in-flight loss of control (NTSB 2022a).

In May 2023, the FAA indicated that it was initiating an ARC "that will provide a forum for the U.S. aviation community to discuss, prioritize, and provide recommendations to the FAA concerning requirements for the installation of existing, new, and upgraded investigative technologies that affect applicable airworthiness standards and operating rules."[64] The NTSB responded in November 2023 expressing support for the ARC but also concern that, given the age of A-13-12 and -13, no progress has been made toward requiring Parts 91, 121, and 135 aircraft to be equipped or retrofitted with a TSO C197-compliant recorder.

[64] FAA staff provided an update to the NTSB in November 2024 indicating that the actions described in the May 2023 response continued.

We note that the ARC's final report, issued in August 2025, included the following recommendation to the FAA:

> The FAA should consider implementing a flight recorder mandate for all turbine-powered aircraft operated under § 91.147 and part 121, and aircraft originally certificated as turbine-powered operating under part 135, while focusing on reducing installation complexity and ensuring a low barrier to regulatory compliance as well as reducing the potential for over-regulation…

The NTSB believes that the accident involving Bering Air flight 445 underscores both the investigative value of recorded flight data and the risk of relying on data sources that are not designed to survive an accident. That the data from this accident existed at all was because the operator had enabled the G1000 logging function and installed an SD card, and they were recoverable because of the circumstances of the airplane impact. Neither condition can be assumed in future accidents involving similarly equipped aircraft.

The NTSB concludes that a crash-resistant flight recorder system as described in Safety Recommendations A-13-12 and -13 likely would have preserved flight data regardless of impact conditions and captured cockpit audio and imagery that would have enhanced understanding of the airplane's handling characteristics and the pilot's actions and responses as the accident sequence developed. Therefore, the NTSB reiterates Safety Recommendations A-13-12 and -13.

3. Conclusions

3.1 Findings

1. None of the following were factors in the accident:
    - pilot qualifications,
    - pilot medical conditions or impairment by alcohol or other drugs,
    - airplane mechanical condition, or
    - air traffic control.
2. The accident flight encountered icing conditions more severe than forecast.
3. The autopilot was operating properly, including when it automatically disengaged due to activation of the low airspeed awareness system.
4. The pilot's improper inputs leading up to and during the aerodynamic stall, which increased the airplane's angle of attack, were not in accordance with Federal Aviation Administration guidance.
5. The airplane entered an aerodynamic stall and subsequent loss of control from which the pilot did not recover.
6. The airplane's overweight condition reduced its stall margin.
7. Although the airplane's Tecalemit-Kilfrost-Sheepbridge Stokes ice protection system was not approved for operation in supercooled large droplets icing conditions, it functioned properly during the airplane's encounter with these conditions and prevented significant ice buildup on protected surfaces.
8. Although it did not contribute to the accident outcome, the pilot's operation of the accident flight beyond the glide distance to the shoreline was not in compliance with Bering Air's guidance concerning single-engine operation over water.
9. The pilot did not monitor and maintain adequate airspeed likely due to increased workload, which led to degraded situation awareness.
10. The pilot committed an error of omission when he did not increase engine power as the airplane leveled off that was possibly the result of his divided attention on managing the deicing process and the approach to Nome Airport.

11. The pilot likely did not recognize the airplane's low airspeed state and high angle of attack in enough time to provide control input to prevent the onset of an aerodynamic stall.

12. The safety of 14 *Code of Federal Regulations* Part 135 and 91K operations would be enhanced by requiring upset prevention and recovery training for these operators.

13. Bering Air's flight risk assessment process at the time of the accident did not provide a method for operational control oversight of flights departing locations other than its base in Nome, leaving the go/no-go decision for the accident flight solely to the pilot.

14. Bering Air's flight risk assessment and operational control process and procedures at the time of the accident were inadequate to prevent the accident flight, or other flights, from operating in an overweight condition.

15. The repeated underreporting of weights in Bering Air load manifests represented a normalization of deviance that resulted in several flights, including the accident flight, being operated in exceedance of weight limitations.

16. Requiring joint operational control responsibility between a certificated dispatcher and a pilot-in-command can minimize the potential of a single-point failure to affect the safety of 14 *Code of Federal Regulations* Part 135 operations.

17. Operational flight data monitoring programs can provide 14 *Code of Federal Regulations* Part 135 operators with objective information regarding the way their pilots conduct flights, and a periodic review of such information could assist operators in detecting and correcting unsafe deviations from standard operating procedures.

18. The Federal Aviation Administration's oversight was inadequate to identify operational complexity and rapid growth as risk factors for Bering Air, which resulted in its risk profile remaining unchanged as it grew to meet the demands of being the only passenger-carrying operator in the region.

19. Manifest and recordkeeping requirements for all aircraft that are operated under 14 *Code of Federal Regulations* Part 135 would provide inspectors with a regulatory standard during surveillance activities to identify operational risk areas that may influence improper aircraft loading and mitigate them before an accident occurs.

20. Graphical forecasts depicting potential areas of supercooled large droplet icing conditions in Alaska will help pilots avoid inadvertent encounters with these hazardous conditions.

21. A crash-resistant flight recorder system as described in Safety Recommendations A-13-12 and -13 likely would have preserved flight data regardless of impact conditions and captured cockpit audio and imagery that would have enhanced understanding of the airplane's handling characteristics and the pilot's actions and responses as the accident sequence developed.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the pilot's inadequate airspeed management due to workload and degraded situation awareness and his improper inputs leading up to and during the aerodynamic stall, which increased the airplane's angle of attack. Also causal was operation of the airplane above maximum gross weight, which reduced the airplane's stall margin. Contributing to the accident were the operator's inadequate safety management, which allowed the routine operation of flights that exceeded weight limitations, and the Federal Aviation Administration's inadequate oversight of the operator, which failed to identify and address the routine operation of overweight flights.

4. Recommendations

4.1 New Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following new safety recommendation.

To the Federal Aviation Administration:

Require all 14 *Code of Federal Regulations* Part 135 and 91K operators, except single-pilot and single-pilot-in-command operators, to incorporate upset prevention and recovery training, whether in a simulator or an aircraft, and related checklists and procedures into their training programs. (A-26-64)

Develop explicit surveillance criteria for 14 *Code of Federal Regulations* Part 135 and 91K operators that are experiencing rapid growth, increased complexity of operations, accidents and/or incidents, or other changes that warrant increased oversight, including verifying that inspector staffing is adequate to accomplish the enhanced surveillance resulting from the new criteria, and increasing staffing for those certificates with insufficient staffing levels. (A-26-65)

4.2 Previously Issued Recommendations Reiterated in This Report

The National Transportation Safety Board reiterates the following safety recommendations.

To the Federal Aviation Administration:

Require all 14 *Code of Federal Regulations* (*CFR*) Part 135 operators, except single-pilot and single-pilot-in-command (PIC) operators, to use certificated dispatchers who hold joint responsibility with the PIC for the safety and operational control of flights and whose responsibilities include preflight planning; flight dispatch, release, and cancellation decisions; and flight monitoring, consistent with the requirements for 14 *CFR* Part 121 domestic and flag operations. (A-24-17)

Require all 14 *Code of Federal Regulations* Part 135 operators to install flight data recording devices capable of supporting a flight data monitoring program. (A-16-34)

After the action in Safety Recommendation A-16-34 is completed, require all 14 *Code of Federal Regulations* Part 135 operators to establish a structured flight data monitoring program that reviews all available data sources to identify deviations from established norms and procedures and other potential safety issues. (A-16-35)

Expand the applicability of the load manifest and recordkeeping requirements of Title 14 *Code of Federal Regulations* (*CFR*) 135.63(c) to include 14 *CFR* Part 135 single-engine aircraft operations. (A-24-18)

Require the installation of a crash-resistant flight recorder system on all newly manufactured turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a flight data recorder and a cockpit voice recorder and are operating under 14 *Code of Federal Regulations* Parts 91, 121, or 135. The crash-resistant flight recorder system should record cockpit audio and images with a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all as specified in Technical Standard Order C197, "Information Collection and Monitoring Systems." (A-13-12)

Require all existing turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a flight data or cockpit voice recorder and are operating under 14 *Code of Federal Regulations* Parts 91, 121, or 135 to be retrofitted with a crash-resistant flight recorder system. The crash-resistant flight recorder system should record cockpit audio and images with a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all as specified in Technical Standard Order C197, "Information Collection and Monitoring Systems." (A-13-13)

4.3 Previously Issued Recommendations Classified in This Report

The National Transportation Safety Board classifies the following safety recommendations.

To the Federal Aviation Administration:

In collaboration with the National Weather Service, develop a graphical forecast depicting potential areas of supercooled large droplet icing conditions in Alaska and make this information available to pilots. (A-22-21)

To the National Weather Service:

> Work with the Federal Aviation Administration to develop a graphical forecast depicting potential areas of supercooled large droplet icing conditions in Alaska and make this information available to pilots. (A-22-22)

Safety Recommendations A-22-21 and -22 are classified Closed—Acceptable Action in section 2.5 of this report.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JENNIFER L. HOMENDY
Chairwoman

THOMAS CHAPMAN
Member

MICHAEL GRAHAM
Vice Chairman

JOHN DELEEUW
Member

Report Date: July 3, 2026

Appendixes

Appendix A: Investigation

The National Transportation Safety Board (NTSB) was notified of this accident about 1832 eastern standard time on February 7, 2025. An investigator from the NTSB's Alaska Regional Office responded to the community of Nome the same day to observe the ongoing search and rescue efforts. On the afternoon of February 7, aerial search and rescue personnel found the wreckage on a large floating ice pack on Norton Sound. The ice pack, which was subject to the tidal ocean currents, continuously moved about 5 to 10 miles per day, complicating search, rescue, and recovery efforts. An investigative team from the NTSB's Central Regional Office arrived in Nome about 1500 Alaska standard time on February 8, 2025. Investigative groups were formed in the areas of operations, powerplants, and air traffic control. Specialists were assigned to perform the readout of the data from the Garmin G1000 integrated flight deck system at the NTSB's laboratory in Washington, DC. Specialists in the areas of meteorology, materials, aircraft performance, human performance, and systems also supported the investigation.

Parties to the investigation were the Federal Aviation Administration; Bering Air, Inc; Textron Aviation; Garmin Aviation; Pratt & Whitney Canada (technical advisor to the Transportation Safety Board of Canada); Parker Hannifin; Woodward Inc.; and the National Air Traffic Controllers Association.

Appendix B: Consolidated Recommendation Information

Title 49 *United States Code* 1117(b) requires the following information on the recommendations in this report.

For each recommendation—

(1) a brief summary of the Board's collection and analysis of the specific accident investigation information most relevant to the recommendation;

(2) a description of the Board's use of external information, including studies, reports, and experts, other than the findings of a specific accident investigation, if any were used to inform or support the recommendation, including a brief summary of the specific safety benefits and other effects identified by each study, report, or expert; and

(3) a brief summary of any examples of actions taken by regulated entities before the publication of the safety recommendation, to the extent such actions are known to the Board, that were consistent with the recommendation.

To Recipient 1

A-26-64
Require all 14 *Code of Federal Regulations* Part 135 and 91K operators, except single-pilot and single-pilot-in-command operators, to incorporate upset prevention and recovery training, whether in a simulator or an aircraft, and related checklists and procedures into their training programs.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.3, Upset Prevention and Recovery Training. Information supporting (b)(1) can be found on pages 48–50; (b)(2) is not applicable; and (b)(3) is not applicable.

A-26-65
Develop explicit surveillance criteria for 14 *Code of Federal Regulations* Part 135 and 91K operators that are experiencing rapid growth, increased complexity of operations, accidents and/or incidents, or other changes that warrant increased oversight, including verifying that inspector staffing is adequate to accomplish the enhanced surveillance resulting from the new criteria, and increasing staffing for those certificates with insufficient staffing levels.

Information that addresses the requirements of 49 *USC* 1117(b), as applicable, can be found in section 2.4.2, Federal Aviation Administration Oversight. Information supporting (b)(1) can be found on pages 56–61; (b)(2) is not applicable; and (b)(3) is not applicable.

Appendix C: Prior Safety Recommendations Related to Crash-Resistant Flight Recorder Systems

A-99-60
Require, within 5 years of a technical standards order's issuance, the installation of a crash-protective video recording system on all turbine-powered nonexperimental, nonrestricted-category aircraft in 14 *Code of Federal Regulations* Part 135 operations that are not currently required to be equipped with a crashworthy flight recorder device. (Superseded by A-03-64)

A-03-62
Require the installation of a crash-protected image recording system on all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured after January 1, 2007, that are not equipped with a flight data recorder, and that are operating under 14 *Code of Federal Regulations* Parts 135 and 121 or that are being operated full-time or part-time for commercial or corporate purposes under Part 91. (Superseded by A-09-9)

A-03-63
Amend the current regulations for 14 *Code of Federal Regulations* Parts 91, 135, and 121 operations to require all turbine-powered, nonexperimental, nonrestricted category aircraft that have the capability of seating six or more passengers to be equipped with an approved 2-hour cockpit voice recorder that is operated continuously from the start of the use of the checklist (before starting engines for the purpose of flight), to completion of the final checklist at the termination of the flight.

A-03-64
Require all turbine-powered, nonexperimental, nonrestricted-category aircraft that are manufactured prior to January 1, 2007, that are not equipped with a cockpit voice recorder, and that are operating under 14 *Code of Federal Regulations* Parts 91, 135, and 121 to be retrofitted with a crash-protected image recording system by January 1, 2007. (Supersedes A-99-60) (Superseded by A-09-10)

A-03-65
Require all turbine-powered, nonexperimental, nonrestricted-category aircraft, that are manufactured prior to January 1, 2007, that are not equipped with a flight data recorder, and that are operating under 14 *Code of Federal Regulations* Parts 135 and 121 or that are being used full-time or part-time for commercial or corporate purposes under

Part 91 to be retrofitted with a crash-protected image recording system by January 1, 2010. (Superseded by A-09-11)

A-09-9
Require the installation of a crash-resistant flight recorder system on all newly manufactured turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a flight data recorder and are operating under 14 *Code of Federal Regulations* Parts 91, 121, or 135. The crash-resistant flight recorder system should record cockpit audio (if a cockpit voice recorder is not installed), a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all to be specified in European Organization for Civil Aviation Equipment document ED-155, Minimum Operational Performance Specification for Lightweight Flight Recorder Systems, when the document is finalized and issued. (Supersedes Safety Recommendation A-03-062)

A-09-10
Require all existing turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a cockpit voice recorder and are operating under 14 *Code of Federal Regulations* Parts 91, 121, or 135 to be retrofitted with a crash-resistant flight recorder system. The crash-resistant flight recorder system should record cockpit audio, a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all to be specified in European Organization for Civil Aviation Equipment document ED-155, Minimum Operational Performance Specification for Lightweight Flight Recorder Systems, when the document is finalized and issued. (Supersedes Safety Recommendation A-03-064)

A-09-11
Require all existing turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a flight data recorder and are operating under 14 *Code of Federal Regulations* Parts 91, 121, or 135 to be retrofitted with a crash-resistant flight recorder system. The crash-resistant flight recorder system should record cockpit audio (if a cockpit voice recorder is not installed), a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all to be specified in European Organization for Civil Aviation Equipment document ED-155, Minimum Operational Performance Specification for Lightweight Flight Recorder Systems, when the document is finalized and issued. (Supersedes Safety Recommendation A-03-065)

A-13-12
Require the installation of a crash-resistant flight recorder system on all newly manufactured turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a flight data recorder and a cockpit voice recorder and are operating under 14 *Code of Federal Regulations* Parts 91, 121, or 135. The crash-resistant flight recorder system should record cockpit audio and images with a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all as specified in Technical Standard Order C197, "Information Collection and Monitoring Systems."

A-13-13
Require all existing turbine-powered, nonexperimental, nonrestricted-category aircraft that are not equipped with a flight data recorder or cockpit voice recorder and are operating under 14 *Code of Federal Regulations* Parts 91, 121, or 135 to be retrofitted with a crash-resistant flight recorder system. The crash-resistant flight recorder system should record cockpit audio and images with a view of the cockpit environment to include as much of the outside view as possible, and parametric data per aircraft and system installation, all as specified in Technical Standard Order C197, "Information Collection and Monitoring Systems."

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For more detailed background information on this report, visit the NTSB Case Analysis and Reporting Online (CAROL) website and search for NTSB accident ID ANC25MA018. Recent publications are available in their entirety on the NTSB website. Other information about available publications also may be obtained from the website or by contacting –

National Transportation Safety Board

Records Management Division, CIO-40

490 L'Enfant Plaza, SW

Washington, DC 20594

(800) 877-6799 or (202) 314-6551