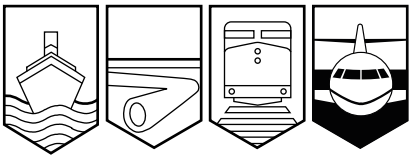
Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A01O0021



COLLISION

BETWEEN LUFTHANSA GERMAN AIRLINES BOEING 747-430 D-ABTD AND HUDSON GENERAL DE-ICING BETA TRUCK TORONTO/LBPIA CENTRAL DE-ICING FACILITY 24 JANUARY 2001

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Aviation Investigation Report

Collision

Between Lufthansa German Airlines Boeing 747-430 D-ABTD and Hudson General De-icing Beta Truck Toronto/LBPIA Central De-icing Facility, Ontario 24 January 2001

Report Number A01O0021

Summary

The Lufthansa German Airlines Boeing 747-430 aircraft, flight number DLH471, was parked at pad 5 at Toronto / Lester B. Pearson International Airport (LBPIA) central de-icing facility while de-icing procedures were being carried out on the aircraft. After completing the de-icing procedure on the right wing, the operator of vehicle 13, one of four vehicles applying de-icing/anti-icing fluid to DLH471, observed that the wing root was still contaminated. The vehicle operator asked permission from the zone de-icing controller to pass in front of the Boeing 747's engines to apply a second coating of de-icing fluid to the area. He was not able to communicate with the zone de-icing controller on the congested company UHF radio and maintained a position 15 feet inboard of the aircraft's right wing tip.

Assuming that the de-icing procedures were complete and that the equipment was clear of the path of the aircraft, Iceman issued the aircraft a taxi authorization out of the central de-icing facility. When the de-icing vehicle operator saw that DLH471 was beginning to move forward, he attempted to move the vehicle to a safe position away from the path of the oncoming aircraft. The right leading edge of the aircraft's wing struck the boom just below the extended cab of vehicle 13, tipping the vehicle over on its right side. The de-icing vehicle operator sustained non–life-threatening injuries to the head, face, and lower left leg. The de-icing vehicle's cab was destroyed, and the right leading edge wing skin of the Boeing 747 was damaged. The accident occurred at 2146 eastern standard time.

Ce rapport est également disponible en français.

Other Factual Information

The de-icing procedures at Toronto / Lester B. Pearson International Airport, Ontario, are controlled using a radio communication system. When an aircraft requires de-icing before departure, the flight crew advises apron control at the same time as they request an authorization to push back from the terminal gate. The aircraft is pushed back, the engines are started, and the flight crew calls apron control again when the aircraft is ready to taxi. Apron control authorizes the aircraft to exit the apron at a specified exit point and advises the flight crew to switch to Toronto ground control frequency before the aircraft enters the taxiway. Ground control then gives the flight crew taxi route instructions and a taxi clearance to the central de-icing facility (CDF). The aircraft is routed via taxiway Tango, Victor, Mike, or Echo, the only taxiways to enter the CDF. (See Appendix A.) Before reaching the CDF, the aircraft is instructed to hold short of the de-icing pads and to contact Iceman to request routing instructions to one of the six de-icing pads.

The authorization from Iceman includes instructions to follow the “Follow Me” truck to the specified de-icing pad. (See Appendix B.) The flight crew is told to advise Iceman when the aircraft is stopped in position with the brakes set and the aircraft configured for de-icing. Iceman confirms with the flight crew that the aircraft is ready for de-icing and advises them to monitor the lit sign board, which displays “Stop” and two red lights throughout the de-icing process. Iceman also tells the flight crew when the application of de-icing/anti-icing fluid begins.

All radio communications with apron control, ground control, and Iceman use published common VHF radios. Zone de-icing controllers (ZDCs), however, have a UHF radio to communicate with the de-icing vehicles on a discrete frequency. ZDCs communicate with as many as four de-icing vehicles per pad, normally to a maximum of three pads. These UHF communications are recorded. Along with the usual radio traffic from the de-icing vehicle operators, there is also itinerant UHF radio traffic from roaming quality assurance personnel, de-icing supervisors, and other staff vehicles. The company has no instructions or procedures limiting the number of de-icing pads that one ZDC can oversee at once. Similarly, it has no instructions or procedures limiting the number of company UHF operators on one frequency.

The de-icing vehicles (beta trucks) are operated by a single driver/operator. From the operator’s cab, on a hydraulically actuated boom, the operator can manoeuvre the truck, extend or retract the boom, and manipulate the de-icing fluid spray cannon. When de-icing heavy aircraft, standard operating procedures call for four de-icing vehicles. The six de-icing pads lie east/west and have a “safe zone” clearly marked on the south and north side of each pad. When preparing to de-ice a heavy aircraft on pad 5, two beta trucks would wait in the safe zone south of pad 5 and two beta trucks would wait in the safe zone north of pad 5. These teams, “5 south” and “5 north”, wait until the aircraft has entered the pad, confirmed brakes set, and configured for de-icing. The beta trucks do not monitor a VHF frequency; therefore, the truck teams must wait until receiving a clearance from a ZDC on the UHF radio before manoeuvring their respective trucks into position to de-ice the aircraft. The forward truck on the south side moves to a position forward of the left wing and applies fluid to the top of the aircraft, if required, and from the left wing root outward to the left wing tip. The rear truck on the south side moves into position aft of the left wing and applies fluid to the top of the aircraft, if required, and to the left tail section of the aircraft. Similarly, “5 north” de-ices/anti-ices the right side of the aircraft.

The forward truck operator on the south side, for an east-to-west traffic flow, is considered the lead of the four-truck formation. This operator is responsible to advise when de-icing starts and holdover time starts. The last operator (the last of the four) to have his/her nozzle closed will advise when de-icing is complete. In addition to the above, the forward truck on the south side is responsible for advising the ZDC that the two trucks on the south are back inside their safe zone. The aft truck on the north side is responsible for advising the ZDC that the two trucks on the north are back inside the safe zone. The south forward truck advises the ZDC with the call "5 south safe" when that two-truck team is back in the safe zone, and the north aft truck calls "5 north safe" when that two-truck team is back in the safe zone. Should the flow be in a west-to-east direction, the forward north truck is the lead of the four-truck formation and is responsible to advise that the north side is safe. The aft south truck is responsible to advise the ZDC that the south side is safe. The ZDC after the de-icing/anti-icing process is complete then passes a "de-icing strip" to Iceman. Iceman cannot see all the pads or trucks operating at the CDF. Iceman's only method of ensuring that all the de-icing vehicles are clear of the aircraft before issuing taxi instructions is the passing of the de-icing strip from the ZDC to Iceman. Once Iceman receives this strip, it is assumed that de-icing/anti-icing procedures are complete, the aircraft is free of contamination, and all equipment is clear. Iceman then changes the lit signboard from "Stop" to "Exit Now" and verbally authorizes the aircraft to taxi to one of the CDF's four exit points.

On the evening of the occurrence, only one ZDC was on duty. The operations manager had anticipated a slow evening and had sent the other ZDC home and shut down the second UHF radio. Consequently, one controller was coordinating the operations of four de-icing pads instead of the usual three pads. The de-icing of DLH471 proceeded normally until the operator of beta truck 13 noticed that the aircraft's right wing root remained contaminated. Before leaving the area ahead of the right wing and outboard of engine No. 4, the operator of beta truck 13 attempted to call the ZDC to request permission to approach the aircraft to remove the contaminant. However, he was unable to communicate with the ZDC on the congested UHF. The ZDC heard the call from the operator but was not able to determine which operator was calling and what was being requested. Each time communication was attempted, the transmission was interrupted by another beta truck attempting radio contact. Beta truck operators are not required to hold a restricted radio telephone operator's licence. The CDF has no procedure for a beta truck operator to return to an aircraft to re-apply anti-icing/de-icing fluid.

While this was occurring on 5 north, 5 south had completed de-icing operations on the left side of the aircraft and made the call "5 south safe" to the ZDC. This transmission was immediately followed by numerous calls from pad 5 and pad 4 and by an undetermined number of truck operators keying the push-to-talk feature on their radios.

The ZDC assumed that 5 north and 5 south had called "safe" and passed the de-icing strip to Iceman. Iceman called DLH471 on VHF and advised the pilots that de-icing was complete, of the type of fluid used and the holdover time, and that the aircraft was free of contamination and clear of all equipment. Iceman requested DLH471 to advise when the aircraft would be ready to taxi. DLH471 immediately called "ready to taxi". Iceman instructed DLH471 to wait until the signboard changed to "Exit Now", then to taxi straight ahead to the Tango exit and hold short of taxiway Mike. Iceman was not aware that beta truck 13 was still in position ahead of the Boeing 747's right wing and changed the signboard to indicate "Exit Now". The captain of DLH471 observed the signboard change and, after both flight crew members maintained that they had visually checked through the flight deck windows, increased engine thrust to manoeuvre the aircraft as cleared.

Window posts in the flight deck may create a blind spot along the wing leading edges for flight crew seated in either of the two pilot seats and looking outboard at the respective wing tips. The first officer maintains that he looked out the right side window and did not recall seeing anything ahead of the right wing. The CDF is a completely marshalled environment; the flight crew has no regulatory obligation to check for obstructions before moving the aircraft.

The leading edge of the right wing, outboard of engine No. 4, struck the extended boom of beta truck 13 four feet below the operator's cab, and the truck tipped over on its right side. The driver/operator of a beta truck working on pad 4 saw truck 13 tip over and radioed a "Mayday" to the ZDC over the UHF. The ZDC informed Iceman, who instructed all aircraft at the CDF to hold their positions and DLH471 to shut down all engines. The ZDC and Iceman then began advising and coordinating airport emergency services.

The occurrence took place several hours after official sunset; however, the CDF is well lit. Weather conditions were not a factor, and ground visibility was not obscured.

Analysis

Several factors created the unsafe situation that led to the occurrence. Task saturation, UHF radio congestion, and inadequate training in radio telephone procedures will be discussed in this section. The lack of a fail-safe method to confirm beta truck positions before issuing aircraft taxi authorizations will also be examined.

The ZDC usually controls the operation of three de-icing pads. Task saturation and radio frequency congestion became a serious problem when four de-icing pads were operated using one ZDC and one UHF radio. The UHF was more congested than normal because of the additional radio traffic from the activities of the extra pad. The safety and the effectiveness of CDF operations are affected by the number of aircraft to be handled, weather conditions, lighting, visibility, and the skill and the experience of individual operators. The CDF's standard operating procedures do not state the maximum number of de-icing pads that one ZDC can oversee and the maximum number of operators that can use the UHF at one time.

Operators who did not hold a restricted radio telephone operator's licence showed a general lack of radio discipline. Extraneous comments and conversations over the UHF radio increased the congestion of an already busy frequency. Just before the accident, the ZDC had to instruct the drivers/operators of the de-icing vehicles using UHF to listen before keying their radio microphones. The operator of truck 13 tried several times to request permission to approach the aircraft. The ZDC tried to identify and ascertain the position of the requesting operator numerous times. Each time, other operators on the same frequency interrupted the operator's and the ZDC's attempts to communicate. CDF standard operating procedures do not specify a procedure for operators to approach an aircraft to re-apply anti-icing/de-icing fluid. ZDCs rely on memory to determine whether the north and south sides have both called in safe. Relying on memory is less of a problem if both sides call in safe at the same time. If one team is delayed, the ZDC has no formal way to record on the de-icing strip who is in the safe zone and who is still engaged in de-icing activities. The ZDC can become task saturated trying to keep a clear picture of who is where on several de-icing pads.

Iceman is unable to visually confirm that all de-icing vehicles are in the safe zone following the de-icing/anti-icing procedure. Receipt of the de-icing strip from the ZDC is the only assurance

Iceman has that it is safe for a de-iced or anti-iced aircraft to taxi.

Findings as to Causes and Contributing Factors

1. By passing the de-icing strip, the zone de-icing controller (ZDC) indicated to Iceman that the de-icing procedure was complete. In fact, beta truck 13 was still in position ahead of the aircraft's right wing.

2. On receipt of the de-icing strip, Iceman concluded that the de-icing equipment was clear and issued movement instructions to the flight crew of the aircraft while beta truck 13 was still in position ahead of the aircraft's right wing.

3. One ZDC was monitoring four active de-icing pads instead of the usual three pads. This increased activity resulted in task saturation and frequency congestion for the ZDC.

4. Because of the increased activity and the radio congestion, the driver/operator of beta truck 13 was unable to effectively establish radio communication with the ZDC to advise that he was still in position in front of the aircraft.

Findings as to Risk

1. Standard operating procedures at the central de-icing facility (CDF) did not restrict one ZDC from overseeing more than three de-icing pads at a time.

2. Standard operating procedures at the CDF did not restrict the number of operators on one ultra-high frequency (UHF).

3. Drivers/operators of beta trucks were not required to undergo radio telephone operations training nor were they required to obtain a restricted radio telephone operator's licence. This lack of qualification adversely affected UHF radio discipline, which did not meet an acceptable standard for safe operations at the CDF.

4. The CDF did not have a procedure for fluid re-application.

Safety Action Taken

Within two days of the accident, Hudson General, the operator of the central de-icing facility (CDF), corrected some of the deficiencies that contributed to the occurrence. The de-icing strip used by Iceman and the ZDCs was redesigned to include four separate boxes that must be filled in by ZDCs when the beta trucks are reported inside the safe zone. Pad Control now controls aircraft arrivals and departures at the CDF. Pilots are therefore required to change VHF frequency before leaving the de-icing bay. Pad Control no longer controls aircraft in the staging bays at the CDF.

A fully enforced procedure has been put in place to ensure that staffing of Iceman and ZDC positions does not fall below acceptable levels. Whenever more than three de-icing bays are in use, two Iceman controllers are required. Iceman controls aircraft movement in the de-icing and staging bays, allowing aircraft in the staging bays to monitor VHF radio traffic in the de-

icing bays.

Pad Control and Iceman are now on Nav Canada's extended computer display system (EXCDS) program, allowing improved tracking and control of aircraft at the CDF and partially eliminating the manual strip for these controllers. ZDCs will continue to use the improved manual flight progress strip with Iceman until the start of the 2002/2003 winter season, at which time they are scheduled to be fully equipped with EXCDS.

An automated guidance system is now in place. The system will reduce VHF radio telephony and eliminate the need for "follow-me" vehicles, reducing traffic congestion at the CDF.

Closed circuit television cameras have been installed on all pads. The workstations of the operations manager and each Iceman controller and ZDC have individually controllable display screens. There are also six overhead display screens.

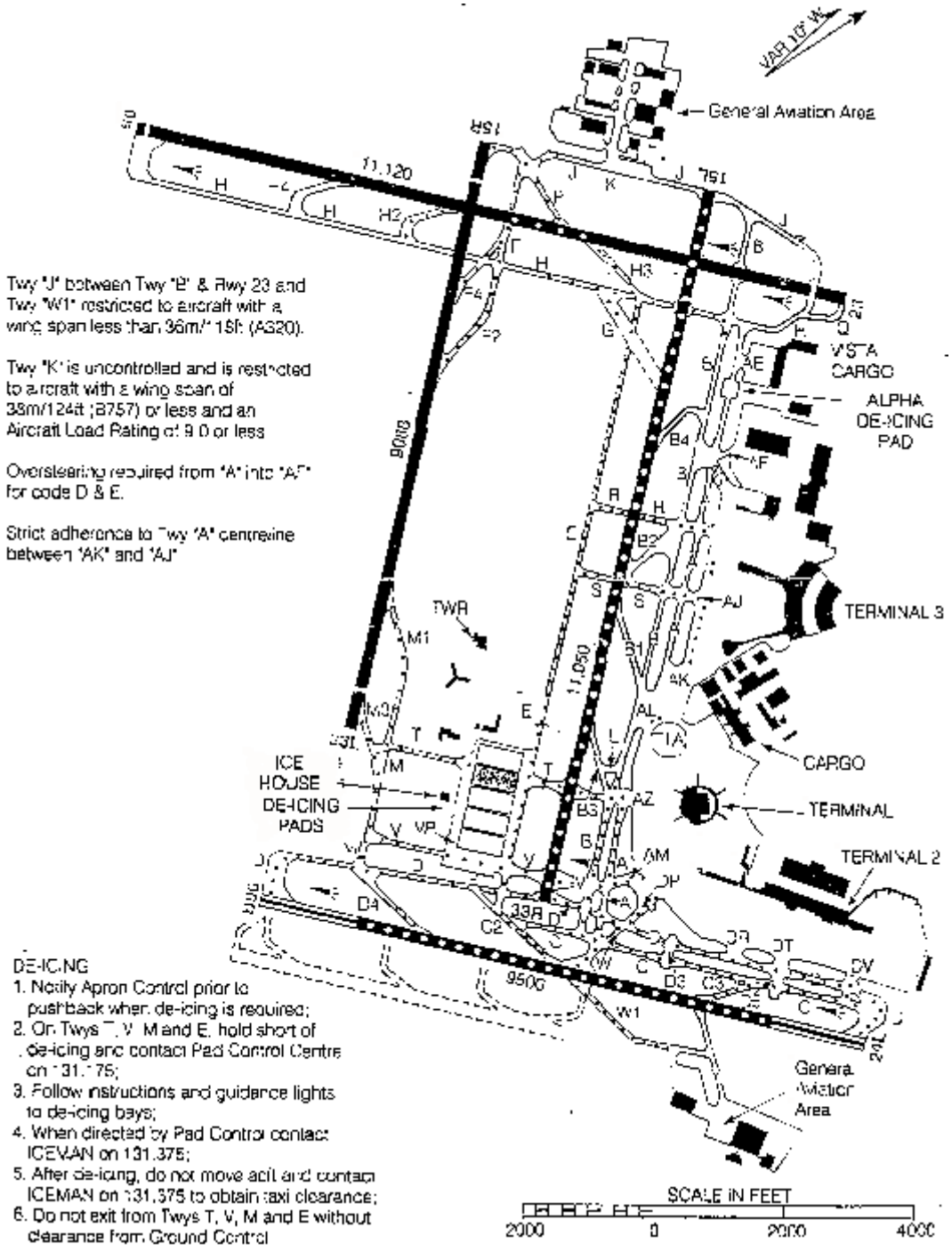
A data transfer system, planned for the 2002/2003 winter season, will display de-icing information to the flight crew, further reducing VHF radio telephony. This system will also substantially reduce UHF transmissions since de-icing information will be transmitted directly from the beta de-icing vehicles to the ZDCs' display computers.

Globe Ground has committed to ensuring that all beta truck operators of UHF/VHF radios have proper radio licences. Globe Ground North America has also enhanced and clarified the procedure for re-applying de-icing/anti-icing fluid.

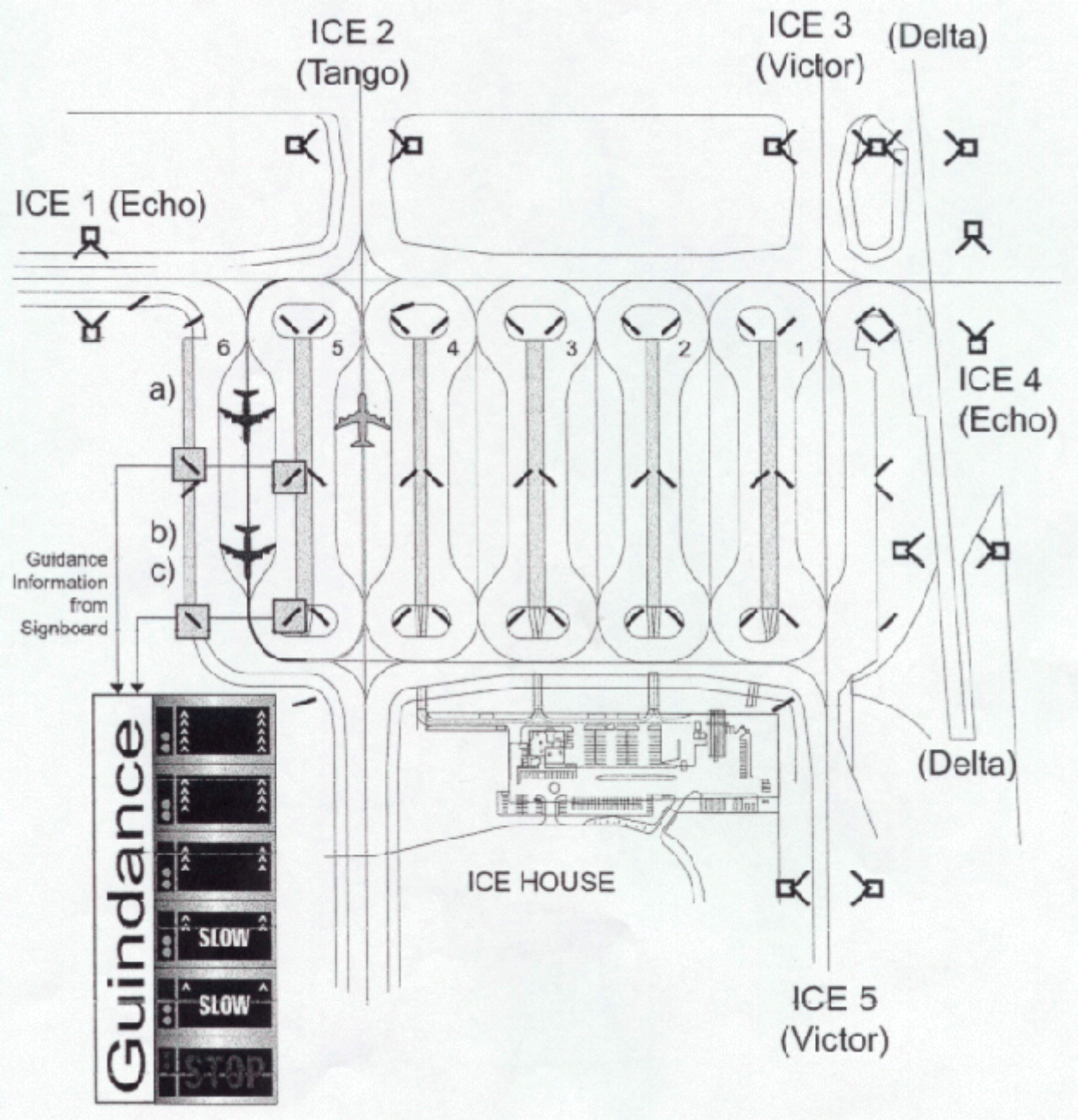
The installation of digital airport surface detection equipment (ASDE), replacing the older, outdated analogue ASDE, allows the CDF operator to zoom in and out of the CDF de-icing pads to visually identify aircraft locations.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 03 July 2002.

Appendix A—Lester B. Pearson International Airport



Appendix B—Central De-Icing Facility At Lester B. Pearson International Airport



Note: This diagram was copied from an original central de-icing facility / Hudson General operations manual. The de-icing bays and the facility layout are accurate; however, the "guidance signboard" (lower left) does not accurately depict the system that was installed and functioning on the date of occurrence.