

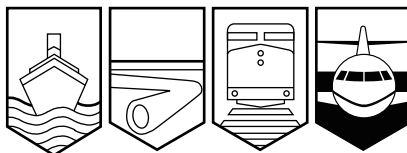
Transportation Safety Board  
of Canada



Bureau de la sécurité des transports  
du Canada

## AVIATION INVESTIGATION REPORT

A03F0114



### NAVIGATIONAL ERROR—FUEL SHORTAGE

KELOWNA FLIGHTCRAFT AIR CHARTER LTD.

CONVAIR 580 C-GKFJ

GISBORNE, NEW ZEALAND 300 nm ESE

18 JUNE 2003

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

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### *Summary*

The Kelowna Flightcraft Air Charter Ltd. Convair 580 aircraft, registration C-GKFJ, serial number 114, was on a delivery flight to its new owners in New Zealand. On board were two Canadian pilots and a ground engineer from New Zealand. On 15 June 2003, the aircraft left Kelowna, British Columbia, for Honolulu, Hawaii, where the crew rested for 29 hours. The aircraft departed Honolulu on June 16 at 0930 Coordinated Universal Time (UTC) and stopped to refuel in Pago Pago, American Samoa, on June 17 at 1820 UTC. It took off at 2040 UTC for the intended destination of Palmerston North (PN), New Zealand, via waypoints BAVAK, RUGRO, FAROA, AUTEL, IBESO, the GS (Gisborne) very high frequency omni-directional range (VOR), the WO non-directional beacon, and the NR VOR. The aircraft was at flight level 200 with an estimated flight time of 6 hours 28 minutes, an estimated fuel burn of 12 000 pounds, and 18 200 pounds of fuel on board.

After passing AUTEL, the aircraft deviated to the east of its intended track, and the crew became lost about 300 nautical miles to the east of Gisborne, New Zealand. The aircraft eventually landed at Gisborne with very little fuel remaining.

*Ce rapport est également disponible en français.*

## *Other Factual Information*

At 0210 Coordinated Universal Time (UTC),<sup>1</sup> C-GKFJ established very high frequency (VHF) radio communication with Ohakea terminal, reporting that they were estimating Gisborne, New Zealand, in 11 minutes, yet were unable to receive the GS very high frequency omni-directional range (VOR) or any other ground navigational aid. The Ohakea controller gave C-GKFJ a transponder code to squawk and asked for their distance from Gisborne, which was reported as 80 nautical miles (nm).

The controller was unable to see or identify the aircraft on radar, and requested that C-GKFJ tune in the low-frequency (LF) radio broadcast station 2YA, frequency 567 kHz, and report the bearing. C-GKFJ reported that automatic direction finding (ADF) homing was very poor because of thunderstorm activity, but the most reliable bearing appeared to be astern.

The controller then requested that C-GKFJ squawk 7700 and activate the emergency locator transmitter (ELT). The transponder was immediately tuned to 7700, but the ELT, located on the rear cabin bulkhead, was activated later, when the crew had time to do it. C-GKFJ requested and received clearance to descend to flight level (FL) 180 and to proceed directly to Palmerston North. VHF communications with Ohakea were lost at 0230.

Both of the aircraft's global positioning systems (GPSs) indicated that the aircraft was approaching Palmerston North, yet the crew members were unable to contact any air traffic control (ATC) facility on either VHF or high-frequency (HF) radio. The crew decided to descend and verify their position visually. They descended from FL180 to 3000 feet indicated and broke out over the ocean. Because of their inability to contact any ATC facility by radio, the crew began to doubt the functionality of the GPSs and radios. The aircraft had experienced a lightning strike earlier and the crew believed this might be the cause.

The crew activated the GPS nearest waypoint function. This function displays the 10 nearest airports, 5 nearest VORs, and 5 nearest waypoints. The result was a display of airports and VORs in North America and five user-defined waypoints, starting with IBESO. The crew discussed the situation and, in view of the strong westerly wind of 60 knots that they had been experiencing for some time, concluded they were most likely east of New Zealand. They decided to ignore their GPS, turn to a heading of 270° magnetic, climb to 12 000 feet (the best altitude for range) and set the long-range cruise power of 930 horsepower on each engine. At this point, fuel remaining was just less than 2000 pounds and it was decided to declare an emergency. Numerous Mayday calls were made on VHF frequency 121.5 and various HF frequencies, without a response.

The captain then pushed the present position function on the primary GPS, obtained a position of 40°10'00" S, 176°10'00" W, and plotted it on a Jeppesen chart. This plot indicated that the aircraft was approximately 300 nm east-southeast of the closest point in New Zealand, i.e. Gisborne. Fuel calculations indicated very little fuel would remain on arrival at the Gisborne airport. After some time had elapsed, the captain obtained another present position fix that confirmed the aircraft was tracking toward Gisborne.

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<sup>1</sup> All times are Coordinated Universal Time.

At this point, the ground engineer folded up the rubber ferry tank fuel bladders to extract the maximum possible amount of fuel from them, and prepared the liferaft for possible deployment. The engineer then joined the pilots in the cockpit to review the ditching drill.

At 0322, a United States Air Force (USAF) C-141 aircraft, call sign RCH5414, responded to C-GKFJ's Mayday calls and established communication with them. RCH5414 diverted toward C-GKFJ's supposed position, and located the aircraft at 0431 using traffic collision avoidance system (TCAS) equipment. RCH5414 kept station with C-GKFJ, issued periodic track corrections and distance to run to Gisborne until about 48 nm from the Gisborne VOR, and departed for Christchurch, New Zealand.

When C-GKFJ was approximately 69 nm from Gisborne, VHF navigation and communication radios started to operate normally. The aircraft landed safely at Gisborne at 0508. Calculations indicate that it landed with approximately 360 pounds of fuel remaining, sufficient for only a few more minutes of flight.

The captain held a valid airline transport pilot licence endorsed for the Convair 580 and a group I instrument rating. He had approximately 14 000 hours' total flying time, including 3000 hours as captain on the Convair 580. The first officer had been employed by Kelowna Flightcraft Air Charter Ltd. for five years. He held an airline transport pilot licence endorsed for the Convair 580 and a group I instrument rating, and had approximately 3000 hours' total flying time, including 2000 hours as first officer on the Convair 580. He had recently completed Convair 580 captain training, which included a pilot proficiency check (PPC) and 20.6 hours of line-indoctrination training.

The aircraft had been sold to Field Aviation of New Zealand. Under terms of the sale, the aircraft was to be ferried to New Zealand under its Canadian registration, with a ferry permit issued by Transport Canada (TC) to Kelowna Flightcraft Air Charter Ltd., but without a certificate of airworthiness. It was equipped and maintained in accordance with existing regulations and approved procedures. This ferry flight was conducted outside the realm of Kelowna Flightcraft Air Charter Ltd.'s air transportation operations. Upon arrival, and after change of ownership, the aircraft was to be re-registered in New Zealand.

The aircraft was prepared for the ferry flight during the week preceding departure. An HF radio, a second GPS, and two long-range fuel tanks—rubber bladders of 1000 US gallon capacity each—were installed. Several test flights were conducted to ensure proper functioning of the equipment.

The GPSs (Apollo 820 Flybuddy II tomorrow) were identical and each contained an out-of-date data card for North America only. Consequently, all waypoints to be used for the flight were manually entered as "user-defined waypoints," by a person other than the flight crew, on the day before departure.

All Kelowna Flightcraft Air Charter Ltd. Convair 580 aircraft have one GPS installed, although it is not necessarily the Apollo 820 type. Crews do not normally use GPS as the sole means of navigation, but it is used to enable them to proceed directly to a point when so cleared by ATC. The crew of C-GKFJ did not receive any special training before the flight on the use of the Apollo 820 GPS, nor did they receive a briefing on company procedures for long-range navigation.

The Apollo 820 GPS has three internal databases: airports, VORs, and user. The airports and VORs databases contain every public-use airport and every VOR in the world on the date of manufacture or update. The user database contains waypoints created by the user.

The Apollo 820 also has the capability of using a pilot-replaceable data card that contains additional information for a specific area and can include, but is not limited to, non directional beacons (NDBs) and intersections. When the data card is inserted, the airports and VORs databases are deactivated, and the user database takes over. The internal databases are reactivated when the card is removed.

The company believed that international data cards were no longer available for the Apollo 820 GPS, but it was determined that an international data card that included Hawaii was available. On 24 September 2003, an Apollo 820 GPS installed in another Kelowna Flightcraft Air Charter Ltd. Convair 580 confirmed that New Zealand airports and VORs were in the internal databases.

Skyplan Services Ltd. of Calgary was contracted to supply operational flight plans, Notices to Airmen (NOTAMs) and weather briefing information for the flight.

Standard aviation safety procedures and practices call for flight crew verification of data entered into long-range navigation systems. Kelowna Flightcraft Air Charter Ltd. has procedures to be followed when conducting operations in oceanic airspace. Section 3A.2.1, "Preflight," of the *Company Operations Manual* (COM) mandates that, during the pre-flight check of the long-range navigation system (LRNS), the flight crew shall enter and confirm the planned route of flight. The section goes on to state the following:

If not stored as a standard route, waypoints for [an] Operational Flight Plan (OFP) route must be entered into the GPS. Whether stored or not, both the pilot flying (PF) and pilot not flying (PNF) will verify the entered route during the preflight checks prior to departure confirming both waypoint designator and LAT/LONG of the waypoint.

At no time before any of the three legs of the flight between Canada and New Zealand did the crew check and compare the waypoints, bearings, and distances between waypoints as entered in the two GPSs against the computer-generated flight plan. It was determined that the last six waypoints of the last leg—IBESO, GS VOR, WO NDB, NR VOR, PN VOR, and NZPM (Palmerston North International Airport)—had been entered with west longitude coordinates instead of the correct east longitude coordinates.

Standard procedures also dictate that approaching each en-route waypoint, the crew should verify present position and confirm next waypoint, desired track, and distance. This was not done during the flight.

A Pacific trip kit of charts for instrument navigation of the route to be followed was purchased from Jeppesen for the flight, and was carried on board the aircraft. The kit included instrument approach and airport charts for selected airports only, but did not include charts for Gisborne. In general, aeronautical information on airports with a principal runway length of less than 5000 feet is omitted from these kits. The main runway at Gisborne is 4298 feet in length.

The first portion of the flight, from Pago Pago to the vicinity of AUTEL, was flown in good weather conditions. During the latter part of the flight, from the vicinity of AUTEL to about 45 nm from Gisborne, the aircraft was traversing an intertropical front. The crew had to make numerous deviations east of track en route to IBESO to avoid thunderstorms. Thunderstorm activity also affected HF radio communications and LF ADF navigation equipment.

Actual and forecast weather for Gisborne and Palmerston North was not available before the aircraft departed from Pago Pago. Weather for other places in New Zealand, including the designated alternate of Wellington, was available and acceptable, and the crew decided to complete the flight. En route, the crew was unable to obtain weather updates because radio communications were severely affected by thunderstorm activity.

## *Analysis*

While the crew did not enter the waypoints from the flight plan for each leg into their GPS, they did have a paper copy of the flight plan that included all waypoints, bearings, and distances between waypoints. They did not follow standard navigation procedures, either pre-flight or upon waypoint passage, which call for a comparison of flight plan information against GPS information.

AUTEL is east of the 180° meridian and had been entered correctly with west longitude coordinates. Since IBESO, the next waypoint and west of the 180° meridian, was the first waypoint entered incorrectly into the GPS, with west instead of east longitude coordinates, there would have been significant differences between the GPS magnetic track and distance, and those shown on the flight plan.

The GPS would have shown a track of 174° M and a distance of 425 nm, instead of the correct track of 186° M and 458 nm shown on the flight plan. Had the crew confirmed the flight plan track and distance to IBESO on passing AUTEL, it would have been apparent that there was a discrepancy between the flight plan and GPS coordinates.

Since all longitudes from IBESO on were entered as west instead of east, all GPS distances from IBESO on would have been the same as the flight plan distances, but all GPS tracks would have been significantly different as follows:

IBESO to GS VOR . . . . .	140° M instead of 185° M
GS VOR to WO NDB . . . .	105° M instead of 207° M
WO NDB to NR VOR . . . .	107° M instead of 207° M
NR VOR to PN VOR . . . .	106° M instead of 205° M

Neither company management nor the crew understood how the GPS databases were set up, although it is clearly described in the GPS manual. Had they understood the GPS better and believed that no data card to cover the route to be flown was available, they probably would not have dispatched the aircraft with the North American data card installed, because this deactivated the internal airports and VORs databases. Had the North American data card been removed before the crew used the GPS nearest waypoint listing, the GPS would have returned a display of airports and VORs in New Zealand instead of North America.

Although unable to obtain a descent clearance from any ATC facility, the crew descended from FL180 to 3000 feet when their GPS indicated they were about 50 nm from their user-defined Palmerston North waypoint. Had they been where the GPS indicated, the descent would have brought them into possible conflict with New Zealand domestic air traffic and into close proximity to terrain, as they would have been in the vicinity of the Ruahine mountain range. Maximum elevation figures (MEFs) in this area, taken from a New Zealand aeronautical chart, range from 4000 feet to 5900 feet above mean sea level. The MEF is based on the highest known feature, in each 30-minute quadrangle, including terrain and obstructions.

When it became apparent that Gisborne was the only airport within fuel range of the aircraft, the crew found that the Jeppesen trip kit purchased for the flight did not contain any Gisborne aeronautical charts. The relevant data had to be relayed to the crew by radio before landing. Under other circumstances, such as communication failure under instrument meteorological conditions, an instrument approach at Gisborne would have been impossible.

### *Findings as to Causes and Contributing Factors*

1. The last six waypoints of the flight plan from Pago Pago to Palmerston North were entered into both GPSs with west longitude instead of east longitude, resulting in the GPS directing the aircraft to positions east of the 180° meridian.
2. The crew did not check GPS data against flight plan data, either pre-flight or en route during waypoint passage, and so did not detect the significant differences between GPS and flight plan tracks and distances of the last six waypoints.
3. North American data cards were inserted in both GPSs, resulting in the internal databases of airports and VORs being deactivated, and unavailable to the crew.
4. The crew was unaware that removing the North American data card would have reactivated the GPS internal databases of airports and VORs, including all those in New Zealand. This would have resolved the crew's uncertainty about their position.
5. The crew received no special training on the Apollo 820 GPS or briefing on long-range navigation procedures. Therefore, they were unprepared to detect a navigational error caused by incorrect data input to the GPS.

## *Findings as to Risk*

1. Instrument approach and airport charts for Gisborne were not available to the crew, placing them at risk when a diversion to Gisborne became necessary.

## *Other Findings*

1. The necessity for numerous deviations east of track after AUTEL, to avoid thunderstorms in the intertropical front, may have masked the obvious direction change after IBESO.

## *Safety Action Taken*

### *Kelowna Flightcraft Air Charter Ltd.*

Kelowna Flightcraft Air Charter Ltd. has purchased up-to-date North American data cards from Garmin for all Apollo 820 GPSs installed in its Convair 580 aircraft.

### *Transport Canada*

On 02 December 2003, the Transportation Safety Board sent Aviation Safety Advisory A030024-1 to TC. The advisory outlined the manner in which the crew entered and used GPS information without confirming the accuracy of the entered waypoint information.

In response, TC acknowledged that navigational data entry errors are more common than originally thought. TC believes that the regulatory provisions relating to long-range navigation are adequate, and that safety education and promoting adherence to Standard Operating Procedures will be more effective than regulatory action in reducing the risks associated with navigational data entry.

The Aviation Safety Advisory is the subject of an article in *Aviation Safety Letter* issue 2/2004. TC will consider the need for further safety promotional activity.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 07 July 2004.*



# Appendix A—Map

