Australian Government
Australian Transport Safety Bureau

Publication Date: March 2009 ISB 978-1-921602-23-8

ATSB TRANSPORT SAFETY REPORT
Aviation Occurrence AO-2007-011
Final

Navigation event - 6 km south of Ballarat, Vic. 31 May 2007

The Australian Transport Safety Bureau (ATSB) is an operationally independent multi-modal Bureau within the Australian Government Department of Infrastructure, Transport, Regional Development and Local Government.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within Commonwealth jurisdiction.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and, where applicable, relevant international agreements.

ATSB investigations are independent of regulatory, operator or other external bodies. It is not the object of an investigation to determine blame or liability.

© Commonwealth of Australia 2009

This work is copyright. In the interests of enhancing the value of the information contained in this publication you may copy, download, display, print, reproduce and distribute this material in unaltered form (retaining this notice). However, copyright in the material obtained from non-Commonwealth agencies, private individuals or organisations, belongs to those agencies, individuals or organisations. Where you want to use their material you will need to contact them directly.

Subject to the provisions of the *Copyright Act 1968*, you must not make any other use of the material in this publication unless you have the permission of the Australian Transport Safety Bureau.

Please direct requests for further information or authorisation to:

Commonwealth Copyright Administration, Copyright Law Branch
Attorney-General's Department
Robert Garran Offices
National Circuit
BARTON ACT 2600

www.ag.gov.au/cca

Australian Transport Safety Bureau
PO Box 967, Civic Square ACT 2608
Australia
1800 621 372
www.atsb.gov.au

Released in accordance with section 25 of the *Transport Safety Investigation Act 2003*

Abstract

On 31 May 2007, the pilot of a Beech Aircraft Corp. Super King Air, registered VH-XCB, was conducting an Area Navigation (RNAV) Global Navigation Satellite System (GNSS) non-precision approach (NPA) to runway 36 at Ballarat, Vic. in instrument meteorological conditions (IMC) as part of a check flight for renewal of a command instrument rating. While conducting the approach, the check pilot on board visually determined that the aircraft was displaced outside the permitted lateral tolerances of the published final approach track. The pilot's primary flight display showed that the aircraft was within permitted tolerances and there were no associated messages or alerts.

An examination of the aircraft's navigation equipment by an avionics technician found that the installation was not approved for the procedure and a technical problem prevented the equipment from meeting approval standards.

The operator of the aircraft annotated the aircraft's maintenance release to reflect that the Global Positioning System (GPS) was not approved for use in the conduct of RNAV (GNSS) NPAs.

FACTUAL INFORMATION

On 31 May 2007, the pilot of a Beech Aircraft Corp. Super King Air, registered VH-XCB (XCB), was conducting an RNAV (GNSS)[1] non-precision approach (NPA) to runway 36 at Ballarat, Vic. in instrument meteorological conditions (IMC) as part of a check flight for renewal of a command instrument rating. On the final approach, the test officer visually identified from ground features that the aircraft was displaced outside the permitted lateral limits of the published procedure and instructed the pilot to make a missed approach.

The test officer reported that the lateral navigation guidance on the electronic horizontal situation indicator (EHSI) of the primary flight display, showed that the aircraft was within allowable tracking tolerances (a maximum of half-scale deflection). He also reported that there were no receiver autonomous integrity monitoring (RAIM) messages[2] or warning indications, as expected when GNSS navigation tolerance is not assured. He had not looked at the navigation indications on the screen of the GPS receiver display unit (RDU) during the approach.

The aircraft was fitted with a Trimble TNL2000 Approach global navigation satellite system (GNSS) RDU that provided lateral navigation guidance to a Rockwell/Collins electronic flight instrumentation system (EFIS), which was the pilot's primary flight display. An EHSI with a course deviation indicator (CDI) component, displayed a digitally generated pictorial presentation of the aircraft's position relative to the required course in the pilot's primary field of view, intended to reproduce the navigational guidance displayed on the RDU. A subsequent examination of the RDU and flight instruments systems found that the presentation of the lateral navigation on the horizontal situation display (HSD) was not

1 Area Navigation (RNAV) Global Navigation Satellite System (GNSS) approved for primary means of navigation under the instrument flight rules.

2 A process whereby the GNSS receiver makes use of the redundant satellite information as a check on the integrity of the navigation solution, before an approach is flown.

replicating the course deviation indicator (CDI) scale on the receiver display unit during NPAs.

An avionics technician was assigned by the aircraft operator to investigate the reason for the apparent incorrect indications. His examination found that in 1993, a Trimble TNL2000T RDU was installed in the aircraft before it was imported to Australia from the United Sates. In 1996, a previous Australian owner of the aircraft upgraded the RDU to a TNL2000 Approach. The approved aircraft flight manual supplement (FMS) for the RDU only approved the system for en-route and terminal navigation. The initial paragraph of the FMS stated:

> The words 'Approach GPS Navigator' are proprietary terms of the system's manufacturer and shall not be interpreted to apply approval for the navigation or approach phases of any flight operations.

The FMS advised that the aircraft's system may be used as a primary means of instrument flight rules (IFR) navigation for Global Positioning System (GPS) and Distance Measuring Equipment (DME) Arrival procedures[3]. The FMS also required the subject system to be operated in accordance with the relevant '*Trimble TNL 2000 Approach GPS Navigator Pilot Guide'*, published by the manufacturer. A copy of that guide was required to be available to pilots during flight and contained procedures for flying GPS non-precision approaches. The technician also reported that the aircraft's maintenance documentation for the upgrade contained only unapproved and undated drawings.

The technician found that incompatibility with hardware connections between the RDU and the EHSI, did not enable the CDI scale to sensitise to the 1 NM and 0.3 NM scales during the NPA sequences, as required. The CDI remained at the en-route navigation scale of 5 NM. The technician subsequently endorsed the aircraft's maintenance release with the annotation 'TNL2000 Approach not to be used for GPS non-precision approaches'.

Pilots who flew the aircraft reported that on at least one previous occasion while flying an RNAV (GNSS) NPA, they had observed a disparity between the visual position of the aircraft and the published track, when established on a final approach to the runway. They reported that they had believed RNAV (GNSS) NPAs in the aircraft were authorised.

ANALYSIS

The consequences of flying an RNAV (GNSS) non-precision approach (NPA) in this aircraft had the potential to result in a controlled flight into terrain accident during the latter part of the approach. Half-scale deflection of the course deviation indicator could result in a lateral displacement of 2.5 NM during final approach, well outside the protection afforded by the obstacle clearance parameters for RNAV (GNSS) NPAs. The incompatibility of hardware connections between the GNSS navigation receiver display unit (RDU) and the electronic horizontal situation indicator on the pilot's instrument panel, resulted in less than the required fidelity of course deviation indications.

Although some documentation of the navigation receiver's installation was incomplete and there were unanswered questions about the approval and operational status of the installed navigation equipment, the significant safety issue concerned the operation of an aircraft under the instrument flight rules (IFR), during which RNAV (GNSS) NPAs were frequently flown.

The aircraft had been flown for a number years by many professional pilots who believed that the aircraft was approved for RNAV (GNSS) NPAs and who had neither ascertained the operational status of the navigation equipment installed in the aircraft from the aircraft's flight manual supplement (FMS), nor attempted to resolve the reason for at least one previous unexplained tracking error while flying an RNAV (GNSS) NPA in visual meteorological conditions.

Although the FMS correctly specified the approved procedures, confusion may have arisen from the 'Approach' designation of the TNL2000 Approach RDU and the capability of the RDU to provide navigation for RNAV (GNSS) NPAs. Even though the RDU provided course deviation indications to the specified sensitivity, for the installation to

3 Information about the operational capability and restrictions on the use of GNSS equipment, approved for IFR navigation, was required to be included in the approved FMS. A placard was only required to be displayed on the aircraft's instrument panel for any GNSS equipment not approved for IFR or by Airworthiness Directive on some units that subsequently had approvals withdrawn.

meet approval, that information was required to be duplicated on the primary navigation display directly in the pilot's field of view. Additionally, the obligatory manufacturer's pilot guide provided instructions for RNAV (GNSS) NPA procedures.

FINDINGS

From the evidence available, the following findings are made with respect to the navigation event near Ballarat, Vic. involving Beech Aircraft Corp. Super King Air, registered VH-XCB and should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing Safety Factors

- RNAV (GNSS) non-precision approaches were flown in an aircraft for which the installed GNSS navigation equipment and associated instrumentation was not approved, and for which operational documentation correctly explained.

- Qualified pilots had not determined the operational status of the installed navigational equipment prior to conducting RNAV (GNSS) non-precision approaches and probably assumed that they were approved because of the system's capability and the 'Approach' designation of the receiver.

Other key findings

- The navigation guidance on the pilot's primary display did not provide the tracking accuracy required to fly an RNAV (GNSS) non-precision approach within specified parameters.

- As the receiver was approved for use under the instrument flight rules, no placards restricting procedures were required to be affixed to the instrument panel.

SAFETY ACTION

The operator of the aircraft annotated the aircraft's maintenance release to reflect that the Global Positioning System (GPS) was not approved for use in the conduct of RNAV (GNSS) NPAs

SOURCES AND SUBMISSIONS

Sources

The sources of information for this investigation were the operator, pilots who flew the aircraft and the avionics maintenance organisation.

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the Transport Safety Investigation Act 2003, the Executive Director may provide a draft report, on a confidential basis, to any person whom the Executive Director considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the Executive Director about the draft report.

A draft of this report was provided to the operator, the Civil Aviation Safety Authority, and the maintenance organisation.

Submissions were received from operator, the Civil Aviation Safety Authority, and the maintenance organisation. The submissions were reviewed and where considered appropriate, the text of the report was amended accordingly