



Transport Accident
Investigation
Commission

Watchlist

Technologies to track and to locate

What is the problem?

The operators of aircraft, ships and boats, and rail vehicles underuse currently available tracking and locating technologies.

Such technologies can reduce the risk of things going wrong, improve survival chances after an accident occurs, help ensure a lost vehicle and its occupants are found, and help us to learn what went wrong in order to improve safety.

What is the solution?

We call on New Zealand's transport sector regulators to encourage and, where reasonable, require the operators of air, rail, and maritime vehicles to use available tracking and location technologies.

Across the air, rail, and maritime transport modes, tracking and locating technologies offer ways to improve people's chances of avoiding or surviving an accident or incident and ensuring they can be found. Transport Accident Investigation Commission inquiries in all three modes have suggested opportunities exist for New Zealanders to get greater benefit from the life-saving technologies available to them. We encourage transport regulators to educate operators of the significant safety advantages of using the most technologically advanced tracking and locating devices that are reasonable and affordable, and to regulate for this in some circumstances.

Background

Many technologies exist to track, monitor, and locate aircraft, ships and boats, and rail vehicles. Operators of fleets of all kinds can use information from such technologies for various purposes, including the efficient management of their fleet and providing better customer service. However, the information can also play a significant role in enhancing transport safety.

Aviation

The aviation industry's use of tracking technologies gained international public attention with the disappearance of Malaysia Airlines flight MH370 in 2014. Since the incident, the International Civil Aviation Organisation (ICAO) has issued new standard recommended practices for the normal tracking of international commercial aircraft; it has also adopted further standards and recommendations relating to the transmission of location information from larger aeroplanes in distress.¹

The Civil Aviation Authority, as New Zealand's representative on ICAO, should continue to support the international effort to improve standards and requirements for tracking and location of aircraft.



In February 2014, the Commission released the report of our inquiry into a 2011 helicopter accident in which two people died.² The helicopter was fitted with a Flight Tracking Device. Generally, these devices do not alert anyone that a crash has occurred, but do provide a useful record of where an aircraft has been and its general location after an occurrence. In this instance, when the helicopter was reported overdue, search aircraft were able to be directed immediately to the general area where the helicopter had crashed.

Similarly, searches for helicopters in three other helicopter crashes the Commission has investigated were assisted by the aircraft's tracking system.³

Had there been survivors in these accidents, the information provided by the Flight Tracking Device could have proved life-saving. As a result of the inquiry into the 2011 accident, we recommended to the Civil Aviation Authority that it encourage the use of Flight Tracking Devices, especially for use in aircraft operating in remote areas around New Zealand. The Commission again referred to the recommendation in a report released in July 2017.⁴

Even where an aircraft is required to carry a satellite locator beacon, these do not always work following an accident.⁵ The helicopter in the 2011 accident was also fitted with an Emergency Locator Transmitter. These devices are manually or automatically activated in an emergency. A second recommendation to the Civil Aviation Authority resulting from the helicopter accident was to continue to support the international work underway to improve the crash survivability of Emergency Locator Transmitters and to include GPS information in the data transmitted by such devices. . The issue of crash survivability is indicated in a currently open inquiry.

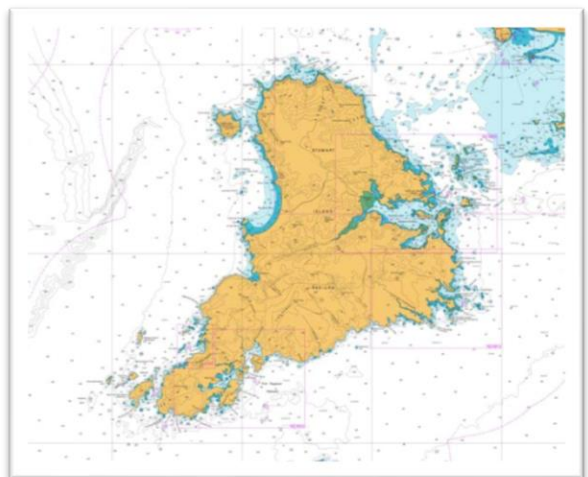
A 2018 update to the Aviation Rules regulates the installation and carriage of equipment that enables crashed aircraft to be found. As part of the New Southern Skies programme, further proposals are being considered to introduce 'Performance Based Navigation'[#] by 2023, which will aid emergency location of some aircraft. Performance Based Navigation allows a flexible framework for adopting a wider range of emergency location technologies where specified objectives can be met. This is a positive step, which is assisted by an amendment to the civil aviation rules making it possible for the Civil Aviation Authority to approve new kinds of emergency location equipment. The amendment provides for the Director of Civil Aviation to specify which equipment is required, on the basis of it achieving the performance set out in the Rules.

Also part of the New Southern Skies programme, a Rule change was made in December 2020 to require all aircraft flying in controlled airspace to be equipped with ADS-B OUT by 31 December 2022. ADS-B (Automatic Dependent Surveillance – Broadcast) is a modern satellite-based system for accurately tracking aircraft movements in real time. We believe this is a significant step forward in improving aviation safety. The Civil Aviation Authority is encouraging the adoption of ADS-B IN to enhance traffic awareness for pilots. We are pleased that a grant scheme has been established to help owners equip their aircraft.⁶

Cockpit video recorders are now available, and the Commission has recommended that these be fitted to Robinson helicopters to help explain how mast bump accidents occur.^{7†} The Commission acknowledges the efforts aviation industry participants have made in developing affordable video, audio, and data recorders; and the regulators' work to enable fitment of these technologies via Supplemental Type Certificates. Where fitted, these recorders can provide valuable information about causes of accidents and help avoid recurrences.

Maritime

Tracking and locating technologies are used in the maritime environment to assist in alerting authorities to accidents at sea, for example Emergency Position Indicating Radio Beacons (EPIRBs). In reports into two accidents involving fishing vessels in Foveaux Strait, we discussed how equipment to indicate the position of a vessel could improve the chances of people being noticed and rescued in an emergency. In one of these accidents, in which six people died⁸, we found that if the boat had been equipped with locating equipment, authorities may have been



[#] Performance Based Navigation is an internationally adopted term for procedures using satellite based systems. See the New Southern Sky website: <http://www.nss.govt.nz/>

[†] In June 2020, the US National Transportation Board called on helicopter manufacturers to equip turbine-powered helicopters with crash-resistant systems to record data, audio, and images. NTSB investigators had found the lack of recorded data hindered their understanding of several crashes. More information is here on the NTSB's website:

<https://www.nts.gov/news/press-releases/Pages/NR20200602.aspx>

able to start the search for survivors earlier. As it was, by the time search and rescue units were able to respond to the alarm, night had fallen making the search difficult and time-consuming.

In the other accident we investigated eight people died⁹. In our report, we commented on monitoring and tracking equipment and the cost of various options, to highlight what is available and its potential use.

These accidents illustrate the benefits technologies can offer at relatively small cost to operators. In 2013, the Government of Western Australia introduced laws requiring all skippers navigating more than two nautical miles from a coast to have an EPIRB.¹⁰ The law was introduced in response to new technology combined with the reduced cost of the devices. The Commission is pleased that from 1 January 2019, it became mandatory for fishing vessels between 7.5 and 24 metres in length that operate outside enclosed waters to carry float-free EPIRBs.

Automatic Identification Systems (AIS) technologies, which allow vessel movements to be tracked and monitored, are also developing. Originally intended for use in larger ships to avoid collisions, AIS is now used for other applications such as search and rescue, and accident investigation. The system is now also more affordable and used by a wider range of vessels, such as smaller commercial vessels.

Rail

Rail operators monitor and control trains in several ways to avoid collisions and enforce speed restrictions. A 'positive train control' system integrates these various methods of control, including GPS technology to monitor the location and movement of a train, and on-board equipment to access relevant information and to stop the train if necessary.

In the United States, trains providing passenger services (and freight services involving some hazardous materials) are required by law to implement positive train control. The issue had been one of the (United States) National Transportation Safety Board's advocacy priorities until US railroads met the December 2020 deadline for compliance.¹¹

Implementing full positive train control requires significant investment, and may not be justified or feasible for all areas on the New Zealand rail network. Nevertheless, opportunities exist to enhance safety by using technologies that improve the visibility of rail vehicles to train controllers, used together with technologies that can stop or slow vehicles without driver intervention.

In 2009, as the result of an inquiry into a track warrant overrun, the Commission recommended to the New Zealand Transport Agency that it ensures progress towards achieving positive train control.¹²

In 2013, we investigated an incident involving the near head-on collision between a freight train and another rail vehicle. We recommended to KiwiRail that it take all appropriate steps to ensure all rail vehicles travelling on the controlled rail network are electronically visible to train control.¹³



In response to the recommendations, in December 2014, KiwiRail introduced a system that monitors the GPS positions of many of its trains to ensure they remain inside valid track authority limits, and alerts train control when it detects a train outside these limits.

GPS tracking should ultimately cover all rail vehicles (contracted or otherwise), including ancillary and high-rail vehicles; and the New Zealand Transport Agency and KiwiRail should continue to work to integrate this improved vehicle visibility with

technologies that stop vehicles or reduce their speed where necessary to avoid collisions, derailments, and other safety occurrences. For example, although KiwiRail implemented a system that will automatically stop a train before it enters a protected worksite, an inquiry closed in 2018 found the system did not work as intended. KiwiRail has remedied the error that led to the system failure.¹⁴

We acknowledge the work the rail sector has done to reduce the incidence of track warrant irregularities, and encourage it to continue working to achieve the best possible worksite protection.

References

- ¹ Further information can be found here:
<http://www.icao.int/safety/globaltracking/Documents/Update%20on%20GADSS%20Global%20Aircraft%20Tracking%20Initiatives.pdf>
- ² Transport Accident Investigation Commission *Report AO-2011-003 In-flight break-up ZK-HMU, Robinson R22, near Mount Aspiring, 27 April 2011*
<http://www.taic.org.nz/inquiry/ao-2011-003>
Safety recommendations: 005/14 and 006/14
- ³ Transport Accident Investigation Commission reports:
AO-2013-003: Robinson R66, ZK-IHU Mast bump and in-flight break-up, Kaweka Range, 9 March 2013
<http://www.taic.org.nz/inquiry/ao-2013-003>
A news article about this accident can be found here:
<http://www.stuff.co.nz/national/10606147/Miracle-helps-find-crash-site>

AO-2015-002: Mast bump and in-flight break-up, Robinson R44, ZK-IPY Lochy River, near Queenstown, 19 February 2015
<http://www.taic.org.nz/inquiry/ao-2015-002>

AO-2014-006: Robinson R44 II, ZK-HBQ, mast-bump and in-flight break-up, Kahurangi National Park, 7 October 2014
<http://www.taic.org.nz/inquiry/ao-2014-006>
- ⁴ Transport Accident Investigation Commission *Report AO-2013-010 Aérospatiale AS350B2 'Squirrel', ZK-IMJ, collision with parked helicopter near Mount Tyndall, Otago, 28 October 2013*
<http://www.taic.org.nz/inquiry/ao-2013-010>
- ⁵ A review by the Australian Transport Safety Board (ATSB) found that "emergency locator beacons function as intended in about 40 to 60 percent of accidents in which their activation was expected". For the full review, see the ATSB's website:
<https://www.atsb.gov.au/publications/2012/ar-2012-128/>
- ⁶ More information can be found on the Civil Aviation Authority's website:
<https://www.aviation.govt.nz/about-us/media-releases/show/ADS-B-rule-signed-with-December-2022-deadline>
- ⁷ Transport Accident Investigation Commission *Report AO-2015-002: Mast bump and in-flight break-up, Robinson R44, ZK-IPY, Lochy River, near Queenstown, 19 February 2015*
<http://www.taic.org.nz/inquiry/ao-2015-002>
Safety recommendation 014/16
- ⁸ Transport Accident Investigation Commission Report MO-2006-204: Fishing vessel "Kotuku", capsized, Foveaux Strait, 13 May 2006
<http://www.taic.org.nz/inquiry/mo-2006-204>
- ⁹ Transport Accident Investigation Commission *Report MO-2012-201: Fishing vessel "Easy Rider", capsize and foundering, Foveaux Strait, 15 March 2012*
<http://www.taic.org.nz/inquiry/mo-2012-201>
- ¹⁰ Information on Western Australia's requirements relating to Emergency Position Indicating Radio Beacons is here on the Department of Transport website:
<https://www.transport.wa.gov.au/imate/distress-beacons.asp>
- ¹¹ The National Transportation Safety Board's advocacy for positive train control can be found here on its website:
<https://www.ntsb.gov/news/press-releases/Pages/NR20210114.aspx>

- ¹² Transport Accident Investigation Commission *Report RO-2007-108: Express freight Train 720, track warrant overrun at Seddon, Main North Line, 12 May 2007*
<http://www.taic.org.nz/inquiry/ro-2007-108>
Safety recommendation 005/09
- ¹³ Transport Accident Investigation Commission *Report RO-2011-102: Track occupation irregularity leading to near head-on collision, Staircase-Craigieburn, 13 April 2011*
<http://www.taic.org.nz/inquiry/ro-2011-102>
Safety recommendation 016/13
- ¹⁴ Transport Accident Investigation Commission *Report RO-2017-101: Signal Passed at Danger 'A' at compulsory stop boards, protected worksite Pongakawa, Bay of Plenty, 7 February 2017*
<http://www.taic.org.nz/inquiry/ro-2017-101>

Version history

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Consulted with: Ministry of Transport, New Zealand Civil Aviation Authority, New Zealand Transport Agency, Maritime New Zealand, KiwiRail.

Updated: October 2016

Updated content: new ICAO standards and recommendations for tracking and location of aircraft; proposed CAA rule changes referenced; date for implementation of positive train control in the US extended from 2015 to 2018; new aviation inquiries referenced; ATSB research report referenced.

Consulted with: Ministry of Transport, New Zealand Civil Aviation Authority, New Zealand Transport Agency, Maritime New Zealand.

Updated: August 2017

Updated content: release of two reports (AO-2014-006 and AO-2013-010)

Consulted with: Ministry of Transport, New Zealand Civil Aviation Authority, New Zealand Transport Agency, Maritime New Zealand.

Updated: September 2018

Updated content: aviation – recent amendment to civil aviation rules; maritime – development of AIS technologies; rail – release of report RO-2017-101, reference to worksite protection, addition of final paragraph.

Consulted with: Ministry of Transport, New Zealand Civil Aviation Authority, New Zealand Transport Agency, Maritime New Zealand.

Updated: August 2019

Updated content: KiwiRail's worksite protection systems amended from 'trailing' to 'implemented'; introduction of mandatory carriage of EPIRBs for some fishing vessels noted.

Consulted with: Ministry of Transport, New Zealand Civil Aviation Authority, New Zealand Transport Agency, Maritime New Zealand.

Updated: October 2020

Updated content: Footnote added on NTSB call for helicopter manufacturers to install recording systems.

Consulted with: Ministry of Transport, New Zealand Civil Aviation Authority, Waka Kotahi New Zealand Transport Agency, Maritime New Zealand.

Updated: October 2021

Updated content: Information added on ADS-B.

Consulted with: Ministry of Transport, New Zealand Civil Aviation Authority, Waka Kotahi New Zealand Transport Agency, Maritime New Zealand.

Te Kōmihana Tirotiro Aituā Waka

Transport Accident Investigation Commission

www.taic.org.nz

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future.