



Transport Accident
Investigation
Commission

Commission resolution to close inquiries

***Aviation inquiries AO-2017-009 and AO-2017-010
Boeing 787
near Auckland, New Zealand
5 and 6 December 2017***

October 2020



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1 Background

- 1.1. On 5 December 2017, ZK-NZE, an Air New Zealand (the operator) Boeing B787-9 aeroplane, was being operated on a scheduled passenger flight from Auckland to Narita, Japan. During the climb phase of flight, the right engine started to 'spool down' or reduce in speed. The crew completed the necessary checks, and as a result shut down the engine and returned to Auckland International Airport without further incident. The Transport Accident Investigation Commission (Commission) opened inquiry AO-2017-009 into this occurrence.
- 1.2. On 6 December 2017, ZK-NZF, another of the operator's Boeing B787-9 aeroplanes, departed Auckland on a scheduled passenger flight to Buenos Aires, Brazil. During the climb phase of flight, the flight crew received engine 'over temperature' alerts for the right engine. The crew completed the necessary checks, reduced the thrust lever for the right engine to idle and returned to Auckland International Airport without further incident.¹ The Commission opened inquiry AO-2017-010 into this occurrence.
- 1.3. Early in the investigation, the Commission was made aware of six previous Trent 1000 intermediate pressure turbine (IPT) blade separations.² Like the two New Zealand occurrences, the six failures had all involved the same type of IPT blade, and all had occurred soon after take-off or in the climb phase of flight.
- 1.4. According to the engine manufacturer, the blade separations followed cracking in the blade shanks initiated by a 'corrosion fatigue mechanism'. The manufacturer believed the mechanism involved a combination of blade design or construction, engine operational factors and environmental air contaminants.

¹ In accordance with the engine emergency checklists, the engine was not required to be shut down.

² The first IPT blade failure occurred in October 2015. The sixth failure was in February 2017.

2 Commission investigation

- 2.1. As part of its investigation, the Commission collected and analysed numerous pieces of evidence. It also conducted interviews, obtained specialist examinations of engine components, analysed flight data, and reviewed maintenance records and other documentation.
- 2.2. On 20 April 2018, the Commission approved an [interim report](#), which was published on 3 May 2018. The interim report identified two safety issues:
 - without operator-specific offsets being applied, the Control Fatigue Lifting model cannot reliably predict the point of blade failure, and thus cannot ensure that an engine with unmodified IPT blades will be removed from service well before a blade fails
 - should an engine need to be shut down in flight, the remaining engine must be operated at a higher thrust level. If the remaining engine has unmodified IPT blades, there is an increased risk of that engine failing, which could mean an aircraft on an Extended Diversion Time Operations³ flight cannot reach its designated alternative aerodrome.
- 2.3. The interim report contributed to safety actions being undertaken. The Commission continued several further lines of inquiry into these occurrences following the release of its interim report.

³ A flight by a twin-engine aeroplane operating more than 60 minutes from a suitable alternative aerodrome.

3 Events since interim report

- 3.1. To address the turbine blade 'corrosion fatigue' issue, the engine manufacturer published a service bulletin to replace all affected 114 IPT blades within a single turbine disc. The replacement blades were of a different design, using an alloy that had been used extensively before in other engine types. The new blades were also fully encapsulated by a protective coating to help prevent corrosion.
- 3.2. At the time of this resolution, 99% of the flying fleet across the world have had the affected turbine blades replaced.⁴

⁴ <https://www.rolls-royce.com/products-and-services/civil-aerospace/airlines/trent-1000-updates-hub.aspx#section-copy-of-modules3>

4 Commission resolution to close investigation

4.1. Therefore, being satisfied on the facts before it that:

- its inquiries and report published on 3 May 2018 identified the salient safety issues in these occurrences
- the manufacturer has taken safety actions through its programme of blade replacement that have addressed the safety issues
- further lines of inquiry are unlikely to identify any further circumstances that have significant implications for transport safety
- further lines of inquiry are unlikely to allow the Commission to establish any further findings or make further recommendations that may increase transport safety
- further lines of inquiry are unlikely to contribute to the Commission's purpose of avoiding similar occurrences in the future.

4.2. **The Commission resolves** to now close its inquiries into these two occurrences.

TAIC Kōwhaiwhai - Māori scroll designs

TAIC commissioned its kōwhaiwhai, Māori scroll designs, from artist Sandy Rodgers (Ngati Raukawa, Tuwharetoa, MacDougal). Sandy began from thinking of the Commission as a vehicle or vessel for seeking knowledge to understand transport accident tragedies and how to prevent them. A 'waka whai mārama (i te ara haumarū) is 'a vessel/vehicle in pursuit of understanding'. Waka is metaphor for the Commission. Mārama (from 'te ao mārama' – the world of light) is for the separation of Rangitāne (Sky Father) and Papatūānuku (Earth Mother) by their son Tāne Māhuta (god of man, forests and everything dwelling within), which brought light and thus awareness to the world. 'Te ara' is 'the path' and 'haumarū' is 'safe or risk free'.

Corporate: Te Ara Haumarū - The safe and risk free path



The eye motif looks to the future, watching the path for obstructions. The encased double koru is the mother and child, symbolising protection, safety and guidance. The triple koru represents the three kete of knowledge that Tāne Māhuta collected from the highest of the heavens to pass their wisdom to humanity. The continual wave is the perpetual line of influence. The succession of humps represent the individual inquiries.

Sandy acknowledges Tāne Māhuta in the creation of this Kōwhaiwhai.

Aviation: ngā hau e whā - the four winds



To Sandy, 'Ngā hau e whā' (the four winds), commonly used in Te Reo Māori to refer to people coming together from across Aotearoa, was also redolent of the aviation environment. The design represents the sky, cloud, and wind. There is a manu (bird) form representing the aircraft that move through Aotearoa's 'long white cloud'. The letter 'A' is present, standing for aviation.

Sandy acknowledges Ranginui (Sky father) and Tāwhirimātea (God of wind) in the creation of this Kōwhaiwhai.

Marine: ara wai - waterways



The sections of waves flowing across the design represent the many different 'ara wai' (waterways) that ships sail across. The 'V' shape is a ship's prow and its wake. The letter 'M' is present, standing for 'Marine'.

Sandy acknowledges Tangaroa (God of the sea) in the creation of this Kōwhaiwhai.

Rail: rewhenua - flowing across the land



The design represents the fluid movement of trains across Aotearoa. 'Rere' is to flow or fly. 'Whenua' is the land. The koru forms represent the earth, land and flora that trains pass over and through. The letter 'R' is present, standing for 'Rail'.

Sandy acknowledges Papatūānuku (Earth Mother) and Tāne Mahuta (God of man and forests and everything that dwells within) in the creation of this Kōwhaiwhai.



Transport Accident Investigation Commission

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Interim Report AO-2018-006	Robinson R44, ZK-HTB, Stevensons Arm, Lake Wanaka, 21 July 2018
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Interim Report AO-2017-004	Forced landing into Porirua Harbour (Pauatahanui Arm), MBB BK117A-3 Helicopter, ZK-IED, 2 May 2017
Interim AO-2017- 009 and AO-2017-010	AO-2017-009: Boeing 787-9, registration ZK-NZE, Trent 1000-J2 engine failure near Auckland, 5 December 2017; and AO-2017-010: Boeing 787-9, registration ZK-NZF, Trent 1000-J2 engine failure, near Auckland, 6 December 2017

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