



REDACTED REPORT

OF THE COURT OF INQUIRY INVESTIGATING THE ACCIDENT INVOLVING IROQUOIS NZ3806 NEAR PUKERUA BAY ON 25 APRIL 2010

Following the completion of the Court of Inquiry in to the Iroquois accident on ANZAC day 2010 the report below has been accepted by the Assembling Authority. As the Court progressed and issues were identified, work began immediately to implement improvements in our aviation systems to reduce the likelihood of another similar incident. Work continues today across the NZDF to implement the recommendations of this report in the interests of preserving our most precious resource, - our people.

This report is made available to inform members of the NZDF of the results of the investigation, and raise awareness of the lessons identified to ensure we continue to improve our operating and safety process and procedures.

IN MEMORIAM

Flight Lieutenant Hayden Peter Madsen, L1000717, Ops(Pilot),

26 January 1977 – 25 April 2010

Flying Officer Daniel Stephen Gregory, T1007785, Ops(Pilot),

29 September 1981 – 25 April 2010

Corporal Benjamin Andrew Carson, U10114341, Ops(Helicopter Crewman)

09 May 1984 – 25 April 2010



ACKNOWLEDGEMENTS

1. The following individuals, units and organisations, had vital post crash roles. Their contribution in the aftermath of the accident was exemplary and deserving of special mention by the Court of Inquiry :

- a. Westpac Helicopter.
- b. New Zealand Police.
- c. New Zealand Army 2nd Engineer Regiment.
- d. The Smith Family – the crash site land owners.
- e. Public support – offers of support from the local community.
- f. Australian Defence Force Directorate of Defence Aviation and Air Force Safety.
- g. Civil Aviation Authority – x
- h. Bell Helicopter Textron Inc – x
- i. Honeywell.
- j. Goodrich Pump and Engine Control Systems, Inc.
- k. Helipro Helicopters Ltd.
- l. Defence Technology Agency.
- m. Royal New Zealand Air Force Ohakea Photographic Flight.
- n. Royal New Zealand Air Force Flight Safety Office.
- o. Royal New Zealand Air Force Directorate of Aeronautical Engineering.
- p. Royal New Zealand Air Force Expeditionary Support Squadron.

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- q. Royal New Zealand Air Force Ohakea Base Contingency Force.
- r. Royal New Zealand Air Force No 3 Squadron Maintenance Flight.
- s. Royal New Zealand Air Force Directorate of Aeronautical Configuration.
- t. Royal New Zealand Air Force Operational Support Wing Ohakea.

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INTRODUCTION

1. On the morning of Sun 25 Apr 10, a formation of three Iroquois helicopters (NZ3805, NZ3806 and NZ3809), flying under the callsign IROQUOIS BLACK, departed Royal New Zealand Air Force (RNZAF) Base Ohakea to conduct a series of ANZAC Day flypasts in the Wellington Region. At 0549hrs IROQUOIS BLACK 2 crashed into the head of a valley, approximately half a nautical mile east of Pukerua Bay. There were four crew members on board the aircraft. The captain, Flight Lieutenant (FLTLT) H. P. MADSEN L1000717, the co-pilot, Flying Officer (FGOFF) D. S. GREGORY T1007785, and Helicopter Crewman (HCM) Corporal (CPL) B. A. CARSON U10114341 were fatally injured in the impact. The fourth crew member, HCM Sergeant (SGT) S. I. CREEGGAN P1002307 survived the accident but was seriously injured. The aircraft, NZ3806, was destroyed. The crews and aircraft allocation of IROQUOIS BLACK are detailed at annex A.

2. This is the report of the Court of Inquiry for this accident.

Process Summary

3. In accordance with the Armed Forces Discipline Act (AFDA (1971)), this Court of Inquiry was convened by the Air Component Commander (ACC) on 26 Apr 10 to investigate the following Terms of Reference (TOR):

- TOR 1 Investigate the circumstances surrounding the accident involving NZ3806.
- TOR 2 Determine the cause(s) and other relevant factors.
- TOR 3 Ascertain the extent and cause of injuries to Service personnel.
- TOR 4 Ascertain if Service personnel involved were on duty.
- TOR 5 Ascertain any damage to property, Service or civilian.
- TOR 6 Determine the compliance with and efficacy of all orders, instructions and publications.
- TOR 7 Investigate any other issues which appear to be relevant.
- TOR 8 Make recommendations if necessary.

4. The Court of Inquiry considered evidence from 34 witnesses. There were no eye witnesses to the crash.¹ Members of the public who heard or saw the formation fly past were interviewed. Specialist reports were commissioned from RNZAF Aircraft Accident, Psychology (human factors report), Aviation Medicine and Incident Response experts. External reports from Bell Helicopters (aircraft report), Honeywell (engine report), Goodrich Industries (fuel control unit report), Defence Technology Agency (DTA), New Zealand Meteorological Services, Civil Aviation Authority (CAA) and Ministry of Health pathology reports informed the specialist reports. Airways Corporation provided radar and radio voice recordings relating to the flight. There was no fire at or subsequent to the accident. The wreckage was inspected,

¹ Witness: At time of publication the surviving HCM still has only a scant recollection of the pre-flight, with no recollection of the flight, the crash or any memory until ten days after the accident.

photographed and recovered to Ohakea for detailed analysis and from where components were sent on for additional testing.

5. Gaps in recorded flight data did extend the investigation and hampered the absolute determination of the final flight path of NZ3806. The RNZAF Iroquois are not fitted with Cockpit Voice and Flight Data Recording (CVFDR) devices. These recording devices would have collected the data necessary to accurately reconstruct the final phase of the flight of BLACK 2. Terrain masked the formation from Air Traffic Control (ATC) radar coverage for 39 seconds of flight near Pukerua Bay. Formation tracking was extrapolated for this 39 second period, including the formation turn back and break up. As a formation, only BLACK 1 was squawking on mode 3/C Identification Friend or Foe (IFF) equipment and so was the only aircraft tracked on ATC radar until after the accident. Only BLACK 1 communicated on the recorded ATC radio frequencies until after the formation break up. Records of BLACK 2 inter-formation radio communications are based on the recollections of other formation members.

6. The analysis of the circumstances in this report is framed on the James Reason Model of Accident Causation, which analyses the human, environmental and organisational causes of accidents. This Court of Inquiry identified flaws corresponding to all levels of the model that started, sustained or failed to stop the accident sequence. A more detailed description of the James Reason Model is at annex B.

7. Under TOR 7, the Court of Inquiry also received reports on the conduct of the accident response and the effectiveness of survival equipment and practices. These reports identified lessons for RNZAF accident response and the effectiveness of aircraft safety and survival equipment.

8. An external review of the process of this Inquiry was conducted by the Australian Defence Force (ADF) Directorate of Defence Aviation and Air Force Safety (DDAAFS). Their report is included at annex C. New Zealand Crown Law also reviewed this report.

9. All times in this report are in New Zealand Standard Time. All headings and bearings are in degrees magnetic. All geographic locations are according to the place names as shown on the NZTopo50 map series or in latitude and longitude referenced to the World Geodetic System (1984), (WGS 84). Unless otherwise specified all heights are above surface level (ground or sea).

10. The Court of Inquiry re-assembled over 01 and 02 Dec 11 at RNZAF Base Ohakea, in accordance with the order for re-assembly, dated 21 Nov 11. The Court was opened to receive any evidence or submission that the families of FLTLT MADSEN, FGOFF GREGORY and CPL CARSON wished to present, in accordance with their natural justice rights. Over this period, the Court received an updated Impact Report, re-interviewed one witness and interviewed two additional witnesses.

BRIEF DESCRIPTION OF EVENT

11. The crews of IROQUOIS BLACK arrived at 3 Squadron at about 0400hrs on the morning of ANZAC Day 2010. Pre-flight procedures were conducted in accordance with normal Squadron procedures. BLACK 2 changed aircraft during the

pre-flight because the originally tasked aircraft did not have the requested fuel load.² The change was conducted without consequence or additional time pressure. All pre-flight procedures were completed satisfactorily.

12. Based on the weather forecast, the Formation Leader briefed that the formation would likely reroute via the coast, past Paraparaumu and via the west and south coasts to Wellington. Along the coastal route, apart from temporary reductions at Paraparaumu, the cloud base would be above the ordered 600ft minima for Night Vision Google (NVG) operations.³ To facilitate the longer bad weather route, the formation leader brought the engine start time forward by 15 minutes. This change was completed without consequence. Morning civil twilight would be at 0633hrs and the moon had set at 0247hrs.

13. The formation got airborne from Ohakea at 0513hrs and proceeded west to the coast before turning south towards Paraparaumu. At about 0540hrs the crew passed Paraparaumu enroute to Pukerua Bay. The cloud base at this point was assessed as 250-350ft.⁴ This is below the ordered minimum cloud base for the captains of IROQUOIS BLACK. As the formation continued under the cloud, witnesses reported operating at about 250ft Minimum Separation Distance (MSD) during this part of the flight.⁵ The weather improved slightly south of Paraparaumu with better visibility and a cloud base of 400-500ft, still below the ordered minimum cloud base.⁶ From near Paekakariki the highway lights and those of Pukerua Bay were clearly visible.

14. At about Paekakariki, the Formation Leader called the aircraft into Trail Formation due to the poor weather conditions and in preparation to turn back to Paraparaumu. IROQUOIS BLACK was spaced at the standard three to five rotors (between 44 and 73m).⁷ The Formation Leader eased the formation out over the sea in preparation for a possible course reversing, left turn back towards Paraparaumu. Approaching Pukerua Bay, the formation slowed to around 60 Knots Indicated Air Speed (KIAS) due to the weather conditions.⁸ ATC radar coverage of IROQUOIS BLACK was masked by high terrain near Pukerua Bay. In accordance with formation regulations, BLACK 1 was the only aircraft squawking and therefore the only aircraft of the formation actually tracked by ATC. BLACK 1 was out of radar coverage for a total of 39 seconds.⁹

15. At about 0548hrs the formation approached Brendan Beach, Pukerua Bay, from the north. They were paralleling the coast at about 500m off shore.¹⁰ The co-pilot of BLACK 1 was flying the aircraft from the left hand seat. Illumination was only from man-made lighting from townships and the highway lights along the coast to the left. There was no NVG visual reference along track to the south of the Pukerua Bay, and none to the right, over the sea. The wind was onshore at approximately 335°/17kts.

² Exhibit BT

³ Exhibit EX, Exhibit BV

⁴ Witness

⁵ Witness

⁶ Witness

⁷ Exhibit GA

⁸ Witness

⁹ Exhibit GA

¹⁰ Exhibit GA

16. When onwards visual navigation was not possible, BLACK 1 initiated the left turn.¹¹ The turn was commenced from about 300ft above the sea and 60 KIAS. From half way around the turn, the crew of BLACK 1 observed a progressive degradation of their NVG picture quality. At three quarters of the way through the turn BLACK 1 recognised that they were unintentionally in Instrument Meteorological Conditions (IMC).¹² This is a flight state known as Inadvertent Instrument Meteorological Conditions (IIMC). BLACK 1 had climbed in the turn.¹³

17. From the rear of the formation and slightly lower, BLACK 3 observed BLACK 1 disappear, shortly followed by BLACK 2. BLACK 2 was half way through its turn, on a heading of approximately 090° as they disappeared.¹⁴ Having lost formation integrity, all three aircraft conducted independent escape actions.

18. On recognising that they were IIMC, the captain of BLACK 1 took control of the aircraft from the co-pilot. He completed the turn, rolling out on what he thought was a safe heading of north. He then initiated a climb. The captain attempted to make a radio call to the rest of the formation.¹⁵ Due to incomplete switching during the hand over of control, the message was only transmitted over his aircraft's intercom and was not broadcast to the rest of the formation.

19. During the climb BLACK 1 had a great deal of trouble maintaining a stable heading.¹⁶ BLACK 1 flew an average track of 030°, unknowingly flying over high terrain along the coast. BLACK 1 avoided collision with the terrain only because, they had turned onto a heading that reduced their closure rate with the coast, then immediately climbed. If BLACK 1 had not continued the turn and not achieved a safe rate of climb, they would have impacted terrain north of Pukerua Bay within 15 – 60 seconds of flying into IMC.

20. Passing 1000ft in the climb the co-pilot of BLACK 1 contacted ATC and advised they were IIMC. He also requested a safe heading and vectors to Wellington. As BLACK 1 climbed back into radar coverage, ATC vectored the aircraft onto a safe heading of west until they were level, above cloud, at 5000ft. BLACK 1 was then vectored onwards to Wellington Airport.

21. BLACK 3 remained below the cloud but the captain was immediately and reasonably concerned that either of the first two aircraft might elect to descend out of cloud, potentially colliding with his aircraft.¹⁷ The captain of BLACK 3 tightened his turn and descended to 120ft over the water, accelerating to 120KIAS, which he maintained to Paraparaumu Airfield. The crews of both BLACK 1 and BLACK 3 expended a significant amount of time on communications during this high workload period as they tried to regain awareness of the position of the rest of the formation.¹⁸

22. BLACK 2 went IIMC at 0549hrs, apparently inadvertently following BLACK 1. Within seconds of BLACK 2 disappearing, BLACK 3 saw the searchlight from

¹¹ Witness

¹² Witness

¹³ Witness

¹⁴ Witness

¹⁵ Witness

¹⁶ Witness

¹⁷ Witness

¹⁸ Witness, Witness

BLACK 2 illuminating from inside the cloud.¹⁹ Turning on the search light is an NVG technique to confirm that the loss of visibility is due to cloud or precipitation. This is important as it suggests that BLACK 2's crew recognised almost immediately that they were in deteriorating visibility.

23. The likely flight path of BLACK 2 was reconstructed from evidence at the impact site and the topography of the valley which they flew up from the coast. BLACK 2 most likely initially flew an easterly track for up to 20 seconds, with a left turn onto between 020° and 050° within 5 to 10 seconds of impact. The crew initiated a climb between 3 and 19 seconds after going IIMC.²⁰

24. Approximately 30 seconds after flying into IMC, BLACK 2 crashed in the valley at 792ft Above Mean Sea Level (AMSL) (lat-long: S41 01.837 - E174 54.533).²¹ At impact, the aircraft was probably in a controlled climb, at between 70 and 90kts groundspeed and on a track of 036°. The rate of climb was probably between 780 and 2200ft per minute. After the initial impact, the aircraft continued on a ballistic trajectory coming to rest a further 21.4m up the valley.²² Forensic evidence and Squadron standard practice indicates that the captain, in the right-hand seat, was almost certainly the flying pilot throughout.²³ There was no indication that the crew of BLACK 2 had any warning of the impact.

25. Recollections vary between witnesses as to whether BLACK 2 made one or two radio calls after going into IMC. The important conclusions that can be drawn from the universally agreed recollection are that: 1. prior to impacting terrain FLTLT MADSEN had acknowledged that he was in IMC, 2. he had decided to climb and he had nominated a heading of north. The absence of apparent distress in his voice is inconclusive but indicates that the crew were probably not aware of the imminent danger of terrain.²⁴ Based on the minimum calculated rate of climb, when BLACK 2 reportedly called 'passing 700ft' they were probably within 5 - 10 seconds of impact.²⁵

26. The crash resulted in the death of three of the aircrew and the critical injury of the fourth crew member.²⁶ SGT CREEGGAN, the surviving HCM, had been sitting on the right hand athwartship seat. The action of the impact and the break up of the aircraft threw him clear of the aircraft. His Aircrew Life Preserver (ALP) harness and tail unit held throughout the crash sequence. He came to rest still attached to a section of the bulkhead.²⁷

Search and Rescue

27. At 0555hrs, BLACK 1 made a MAYDAY call on behalf of BLACK 2.²⁸ The call was made to both ATC and RNZAF Air Operations Communications Centre

¹⁹ Witness

²⁰ Exhibit GA

²¹ Exhibit FR

²² Exhibit FR

²³ Exhibit FV

²⁴ Exhibit GA

²⁵ Exhibit GA

²⁶ Exhibit FV

²⁷ Exhibit GA

²⁸ Witness

(AOCC).²⁹ BLACK 1 then flew on to Wellington Airport where they conducted a visual approach and shut down at the RNZAF Air Movements Terminal. At Paraparaumu, BLACK 3 refuelled and prepared to return to Pukerua Bay at dawn to search for BLACK 2.³⁰

28. Despite serious concussion, bleeding and multiple rib, femur and spinal fractures, SGT CREEGGAN was intermittently conscious and partially mobile and was influential in assisting his own rescue. At some time between the impact and 0609hrs, SGT CREEGGAN cut himself free from his harness, activated his own Personal Locator Beacon (PLB) and probably CPL CARSON's PLB as well.³¹ At some stage he removed his own helmet. At 0629hrs, SGT CREEGGAN answered a cell phone call from another squadron member. SGT CREEGGAN groaned and called for help.³² By the time he was found at approximately 0735hrs he had made his way, or fallen, 10m down the steep terrain.³³

29. At 0609hrs, Rescue Coordination Centre of New Zealand (RCC NZ) received a Search and Rescue Satellite (SARSAT) detection of CPL CARSON's PLB giving two possible positions, with a 66% probability that the beacon was at position S 41 01- E174 54. By 0705hrs the ambiguity was resolved and the position refined to within 0.5nm of the crash site. Only CPL CARSON's PLB transmission was detected by satellite that day.³⁴

30. BLACK 3 re-launched from Paraparaumu at about 0645hrs, when it was deemed light enough for a visual search. The low cloud base prevented BLACK 3 from gaining visual contact with the accident site. A Westpac Rescue Helicopter arrived on scene at about this time and the two aircraft coordinated their search in difficult flying conditions. BLACK 3 offloaded Flight Sergeant (F/S) x, T990259, OPS(HCM) on a ridge below the crash site.³⁵

31. After drop-off F/S x proceeded on foot up steep and difficult terrain to undertake a search in the cloud with coordination from the Westpac Helicopter. The Westpac Helicopter crew were able to visually acquire the wreckage and directed the HCM on the ground to it using hand signals. F/S x initially found the bodies of FGOFF GREGORY and CPL CARSON. He next found SGT CREEGGAN's helmet and called his name. SGT CREEGGAN groaned in response and was found down the steep ridge face. F/S x administered first aid to SGT CREEGGAN until the Westpac Helicopter winched a medic in. He then continued his search, finding the body of FLTLT MADSEN nearby. F/S x then assisted the medic to prepare and winch SGT CREEGGAN to the Westpac Helicopter. When needed the semi-conscious SGT CREEGGAN responded to F/S x instructions and held the winch stop, enabling SGT CREEGGAN to be lifted out.³⁶ The Court of Inquiry found that F/S x actions, as first on the scene, were instrumental in preserving the life of SGT CREEGGAN.

²⁹ Witness, Witness

³⁰ Witness

³¹ Exhibit GA

³² Witness

³³ Exhibit GA

³⁴ Exhibit FZ

³⁵ Witness

³⁶ Witness

32. Accident Response Control Procedures were activated at NZ Police Communications Centre (Wellington), RCC NZ, Headquarters Joint Force New Zealand (HQ JFNZ) and RNZAF Base Ohakea Operations Headquarters. The ACC was notified at a Dawn Parade in Upper Hutt and arrived at HQ JFNZ to direct proceedings soon after.³⁷

33. RNZAF elements that deployed to the accident site included a 3 Squadron command and engineering group, the Ohakea Air Force Flight Safety Officer, an Aviation Medical Doctor, security personnel from Expeditionary Support Squadron (ESS) and the Base Contingency Force (BCF).³⁸ The incident site was initially controlled by NZ Police who also conducted an investigation in accordance with their procedures. RNZAF personnel assisted Police with securing the site, making the wreckage safe and preserving perishable evidence. NZ Police handed the crash site over to the RNZAF that evening.³⁹

34. At Ohakea, the incident response was conducted in accordance with Base and 3 Squadron crash procedures; including securing records, notifying families and initiating family and personnel support.⁴⁰

³⁷ Exhibit FT

³⁸ Exhibit FT

³⁹ Witness

⁴⁰ Exhibit FT

ANALYSIS OF THE CIRCUMSTANCES SURROUNDING THE ACCIDENT

RNZAF IROQUOIS BACKGROUND

Aircraft Configuration: Bell UH-1H Iroquois (RNZAF)

35. The Iroquois has been in service in the RNZAF since 1966. Throughout its service, the aircraft has been employed primarily in a tactical transport role in New Zealand and abroad, in support of the NZ Army and a number of other government agencies, including Search and Rescue (SAR) and support to the NZ Police.⁴¹

36. A number of modifications have been introduced at intervals over time, including improvements to instrumentation and navigation equipment. Navigation instrument improvements since 1993 have included the introduction and upgrades of the Global Positioning System (GPS).⁴² The GPS was last upgraded in 2003.⁴³

37. The RADALT was fitted to the RNZAF Iroquois fleet from 1988.⁴⁴ The audio cancellation switch was introduced across the fleet from July 2002.⁴⁵

38. NVG were first introduced to RNZAF Iroquois operations in 1994.⁴⁶ NVG shifted the employment of the Iroquois to include more night flying. As familiarity with NVG increased, orders were progressively modified, employment was broadened and minima were made less restrictive.⁴⁷

39. Iroquois pilots interviewed all stated a clear preference to avoid Instrument Flying (IF) in the Iroquois.⁴⁸ The inherent instability of the aircraft, limited fuel capacity, lack of de-icing/ anti-icing equipment and limited navigation equipment all add up to make flight under Instrument Flight Rules (IFR) very difficult to achieve safely. Consequently, most Squadron Operating Procedures (SOP) are designed to remain under Visual Flight Rules (VFR) and to avoid flight into IMC.⁴⁹

Previous Accidents and Incidents

40. Since the introduction of the Iroquois into the RNZAF there have been three category 5 accidents (aircraft destroyed), with one fatal accident in 1972. In addition, there have been two category 4 (serious damage) accidents.⁵⁰ The causes and circumstances of these prior accidents appear to have no direct influence on this accident.

41. An analysis of all Flight Safety Event (FSE) Reports relating to the crew of BLACK 2 and the aircraft (NZ3806) found no issues relevant to this accident.⁵¹

⁴¹ NZAP 701A series

⁴² NZM/IRO/134

⁴³ NZM/IRO/153

⁴⁴ NZM/IRO/97

⁴⁵ Exhibit CD, NZM/IRO/171

⁴⁶ NZM/IRO/131

⁴⁷ Exhibit BV

⁴⁸ Witness, Witness, Witness, Witness

⁴⁹ Exhibit FK

⁵⁰ Exhibit GA, NZAP 6083.001-1

⁵¹ Exhibit GA

42. The Formation Leader had a relatively high number of FSE Reports recorded under his captaincy. Further analysis showed that the number of reports was more likely as a result of a proactive participation in reporting, rather than a particular flight safety trend. There were comments regarding the task proactive attitude of the pilot and his willingness to push on, which may be relevant. These comments are addressed openly and often volunteered by the individual in his own self-analysis. Previous FSE of the individuals involved were unlikely to have had any direct bearing on this accident.⁵²

43. Since 1982 there were a total of six reports relating to IIMC. Analysis of previous events indicates most relate to deteriorating and adverse weather conditions, including three relating to events where an IIMC escape was flown.⁵³

44. An accident involving white-out conditions in Antarctica in 1999 was of particular note because the FSE Report mentioned aspects of Radar Altimeter (RADALT) use and warnings, SOP, the 'can do' culture prevalent at 3 Squadron, and the attitude of aircrew toward IMC flight. The report also commented on the unwillingness of aircrew to undertake the option of a climb into IMC when confronted with marginal Visual Meteorological Conditions (VMC). These aspects are relevant to this Court of Inquiry because they demonstrated a historical context to the factors apparent in the current investigation.⁵⁴

45. An investigation of recent FSE reports received by the RNZAF Flight Safety Office and anecdotes recounted during the RNZAF Flying Supervisors Course provided important demonstrations of a 'can do' culture and attitudes towards flying orders and instructions.⁵⁵ The reports highlight the attitudes towards orders and instructions relating to low flying and met minima. Some of the reports demonstrated a leadership link to the attitude towards rule breaking. The way that these events were acted on demonstrated organisational tolerance of the rule breaking attitude, or at least inactivity in correcting it.⁵⁶

46. The importance of culture and the attitude to rule breaking as factors in this accident are discussed further at page 61 of this report.

TASK AND NOTIFICATION

47. The tasking signal for the ANZAC Day flypasts was emailed from HQ JFNZ to 3 Squadron Tasking Cell on 13 Apr 10 at 1050hrs.⁵⁷ As part of the RNZAF nationwide ANZAC Day flypast commitment, the signal required a 3-ship of Iroquois from 3 Squadron to fly past the Wellington Cenotaph at 0615hrs, Titahi Bay Returned Services Association (RSA) at 0635hrs, the National War Memorial at 1045hrs and the Atatürk Memorial at 1432hrs on ANZAC Day. Approval was given for the Iroquois flypasts to be conducted NI 300ft MSD, and at 'speed for best effect'.⁵⁸ Defence Force Flying Orders (DFFO) requires that a height and speed are ordered for

⁵² Exhibit GA

⁵³ Exhibit GA

⁵⁴ Exhibit GA

⁵⁵ Exhibit GA, Witness

⁵⁶ Exhibit GA

⁵⁷ Exhibit BT

⁵⁸ Exhibit BW

ceremonial flypasts.⁵⁹ 'Best effect' is not an ordered speed, as required in DFFO. The tasking also included direction to pre-position the Iroquois at Wellington on 24 Apr 10.⁶⁰

48. OFFICER A and 3 Squadron's Tasking Cell decided not to preposition the Iroquois, instead opting to conduct the task from Ohakea on the morning of 25 Apr 10. This decision was based on three factors: 1. Noise abatement regulations at Wellington Airport, which prevented aircraft movements before 0600hrs, 2. Cost of overnight accommodation at Wellington and 3. The task could be conducted from Ohakea within crew duty limits.⁶¹

49. The adjustments to task would raise the operational risk from the original task because it would require an earlier start for the crews, a NVG transit from Ohakea to Wellington and extend the duty day by an hour. The total planned duty day would be 11.5hrs with approximately 3.5hrs flying.⁶² All the adjustments could be completed within Squadron operating parameters and crew duty limits.

PREPARATION

Crew Selection

50. The crews of IROQUOIS BLACK were formed for the task so that the collective competence of the crew was sufficient for the difficulty and complexity of the task.⁶³ The New Zealand Defence Force (NZDF) manages aircrew competence through a system of graduated qualification and the maintenance of aircrew currency schedules. The training, qualification and currency requirements for 3 Squadron are published in DFFO, 3 Squadron Standing Orders, 3 Squadron SOP, Squadron Temporary Orders, NZAP 9230 and NZAP 9215.⁶⁴

51. The allocation of crews to specific tasks was undertaken by the 3 Squadron tasking officers. OFFICER A directed that the captains for the Wellington flypasts were to be Counter Terrorist (CT) qualified captains. Since this qualification no longer exists the Court of Inquiry considers that, in this context, OFFICER A meant 'NVG CT Captain.'⁶⁵ The captain of BLACK 1 was appointed as the Formation Leader at this stage.⁶⁶

52. All aircrew of IROQUOIS BLACK volunteered for the task.⁶⁷

53. On the Flight Authorising Officer's direction, FLTLT MADSEN and FGOF GREGORY were swapped from BLACK 3 to the less difficult formation position of BLACK 2 due to their experience levels. The sortie profile involved formation position changes for BLACK 3, whereas BLACK 2 would have the less difficult task of maintaining the same formation position throughout.⁶⁸

⁵⁹ Exhibit FI

⁶⁰ Exhibit BA

⁶¹ Witness

⁶² Exhibit BL

⁶³ Witness

⁶⁴ Exhibit FI, Exhibit FJ, Exhibit FK, Exhibit BV

⁶⁵ Exhibit GA

⁶⁶ Witness

⁶⁷ Witness

⁶⁸ Witness, Witness

Qualification

54. DFFO 2.90 requires that formation leaders are qualified to lead a formation.⁶⁹ When OFFICER A directed that the captains for the Wellington flypasts were to be Counter Terrorist (CT) qualified captains, both he and the Flight Authorising Officer believed that this qualification was an appropriate minimum NVG qualification to undertake the task.⁷⁰ The captain of BLACK 1 understood that he was qualified to lead this task.⁷¹

55. There is no dedicated teaching of NVG formation leading on the NVG CT captain upgrade. NVG formation training is first conducted on the Iroquois Pilots Conversion Course (IPCC). No formal NVG lead qualification is awarded on this course.⁷² A NVG CT captain is qualified for day/night Special Operations (Spec Ops) training and operations or flying as a wingman on Green role tactical missions.⁷³

56. According to the training documentation, the first occasion when NVG formation leading is taught in a specified upgrade sortie is on the Spec Ops Lead Prov upgrade, the qualification above NVG CT captain.⁷⁴ A summary of the NVG category qualifications is included at annex D.

57. Neither the Formation Leader nor the Deputy Leader were 'Spec Ops Lead Prov qualified'.⁷⁵ Therefore, according to the 3 Squadron Upgrade programme, they had not received any qualification to permit them to lead a formation on NVG.

58. Although not qualified, the Formation Leader had experience leading NVG formations. In the month before the ANZAC Day mission he conducted two flights involving 2-ship NVG formation and formation leading.⁷⁶ The Flight Authorising Officer believed that the Formation Leader was competent to undertake the task.⁷⁷

59. On 3 Squadron the ANZAC Day transit was considered an administrative move because it is flown in non-tactical conditions.⁷⁸ The commonly held view of witnesses was that it is well within the capabilities of a NVG CT captain to lead a formation administrative move at night.⁷⁹

60. The Court of Inquiry could not find a definition for an administrative move in any 3 Squadron orders, instructions or publications nor could any order be found that permitted NVG formation operations to be undertaken from an 'administrative move' qualification, or any alternative NVG formation classification.

61. There are differing interpretations of the NVG qualifications among the Qualified Helicopter Instructors (QHI) on 3 Squadron. Whereas OFFICER A and OFFICER B stated that a NVG CT Captain was qualified to lead a NVG formation, at

⁶⁹ Exhibit FI

⁷⁰ Exhibit GA, Witness, Witness

⁷¹ Witness

⁷² Witness

⁷³ Exhibit FX

⁷⁴ Exhibit FB

⁷⁵ RNZAF 5200 Witness 2, RNZAF 5200 Witness

⁷⁶ Exhibit GA

⁷⁷ Witness

⁷⁸ Witness, Witness, Exhibit GA

⁷⁹ Witness

least one senior QHI stated that a NVG CT Captain is not.⁸⁰ OFFICER A has used different interpretations of the qualification at different times. In Sep 09 OFFICER A was content for FLTLT MADSEN to be awarded his NVG CT captain qualification, since this would enable him to operate within a NVG formation, but not lead it.⁸¹ Yet, seven months later he specifically required a NVG CT qualified captain to lead the ANZAC Day flypast.⁸² No 3 Squadron did not have a unified understanding of what the formation qualification requirement was for this task.

62. Confusion over NVG qualifications stems from the misalignment of the source document for Iroquois training and qualifications, the NZAP 9230, Manual of Training for Iroquois Aircrew and the, 3 Squadron controlled, Iroquois Upgrade Sortie Cards. NZAP 9230 is considered to be out of date within the RNZAF and training is managed through the Iroquois Upgrade Sortie Cards.⁸³ This is further discussed in TOR 6, Efficacy of Orders, below.

Currency

63. No. 3 Squadron utilise the computer based RNZAF Force Elements Management System (FEMS) to record Iroquois aircrew currencies. The source document for the FEMS currency requirements is the NZAP 9215, Iroquois Aircrew Categorisation and Currency Scheme. There were a number of inconsistencies between the NZAP 9215 and FEMS currency requirements.

64. Analysis of FEMS showed that none of the Aircrew of IROQUOIS BLACK were 100% current on 25 Apr 10.⁸⁴ The pilots had achieved an average of 72.4% currency whilst the HCM were 61.4%. This situation was not unusual under the 3 Squadron currency programme at the time, because the currency programme was considered out of date and typically not followed.⁸⁵

65. The NZAP 9215 covers a wide range of currency requirements, many of which were not required for this task, for example tropical flying and monsoon bucketing.⁸⁶ It was common practice on 3 Squadron to manage currency through the authorisation process.⁸⁷ This practice was in line with the mitigation for 3 Squadron's currency gaps that was noted at the 20 Apr 10 Airworthiness Capability Management Board (ACMB).⁸⁸

66. Further FEMS Analysis was conducted on the flying currencies that the Court of Inquiry considered relevant for this task. The key points are summarised below:⁸⁹

- a. Captain of BLACK 1: Current in all relevant areas.

⁸⁰ Witness

⁸¹ Witness

⁸² Witness

⁸³ Witness, Witness

⁸⁴ Exhibit DC

⁸⁵ Witness

⁸⁶ NZAP 9215

⁸⁷ Witness

⁸⁸ IROQUOIS ACMB Minutes, dated 19 May 10

⁸⁹ FEMS

- b. Co-pilot of BLACK 1: Not current in night formation. Not current in night autorotation and night general handling. Not current in IF handling or IF approaches.
- c. FLTLT MADSEN: Not current in night autorotation and night general handling. Not current in aircraft emergency training. No evidence he was current or qualified for Low Level Over Water (LLOW) flight.
- d. FGOFF GREGORY: Not current in night formation. Not current in night autorotation and night general handling. Not current in IF handling.
- e. Captain of BLACK 3: Not current in night formation.
- f. Co-pilot of BLACK 3: Current in all relevant areas.
- g. HCM Currency: The HCM in BLACK 2 or BLACK 3 were not current in night formation spec ops mission. Both HCM in BLACK 1 were current.⁹⁰

67. The selection of aircrew for this task with these currency deficiencies demonstrates that the Currency Programme on 3 Squadron was ineffective as a means of ensuring aircrew had maintained recent flying practice in the required roles for this task.

68. It is evident that the currency monitoring system on 3 Squadron was neither being administered nor being enforced at the time of the accident.⁹¹ At the ACMB on 20 Apr 2010, there were a large number of currencies which had lapsed. Yet, there is no record of currency extensions being requested or granted as there would have been if the currencies were being managed in accordance with the orders.⁹² The NZAP 9215 allocates responsibilities to COMMANDER A and COMMANDER B for administering, implementing and supervising the currency scheme.

Recent Flying Experience

69. The type and quantity of flying accrued in the recent past has a direct relationship to pilot proficiency.⁹³ Figure 1, below, shows that all three captains had in excess of 1,000hrs flying experience on the Iroquois. However, FLTLT MADSEN and FGOFF GREGORY had relatively low recent flying experience. In the previous 12 months FLTLT MADSEN and FGOFF GREGORY had accrued the least hours of all the 3 Squadron line pilots (see figure 2).⁹⁴ The captains of BLACK 1 and 3 had the most. In the previous 3 months, FLTLT MADSEN had significantly fewer hours than the other two captains in the formation (figure 3).

70. FGOFF GREGORY had less experience in respect of total flying hours, flying hours in the last 3 months and total NVG flying hours than both the other co-pilots.⁹⁵ This is to be expected as he was a relatively recent graduate of the IPCC, even so he was behind the experience of his fellow course graduates. FGOFF GREGORY

⁹⁰ Night formation spec ops mission is the only formation currency requirement for HCM in the NZAP 9215.

⁹¹ Exhibit GA

⁹² Exhibit FL

⁹³ Exhibits GA FU

⁹⁴ FEMS

⁹⁵ FEMS

began IPCC in Mar 09 graduating in Aug 09. He had accumulated 72 Iroquois hrs by the end of IPCC and another 103.3hrs in the subsequent eight months. This is 20.7 and 40hrs less than his two fellow IPCC graduates.⁹⁶

71. In the year prior to the accident, FLTLT MADSEN had worked a total of 47 days at HQ JFNZ, spread over a 4 month temporary posting. During this period he was allowed to return to the Squadron for currency flying. He flew a total of 23.1hrs in this 4 month period.⁹⁷ Over the year, he was also released from work for 29 days for Services representational sport and 20 days annual leave.⁹⁸ This was a total of 96 working days away from 3 Squadron. This high absence from work was likely to be a factor in reducing his total flying hours for the year.

⁹⁶ FEMS

⁹⁷ FEMS

⁹⁸ Exhibit GA

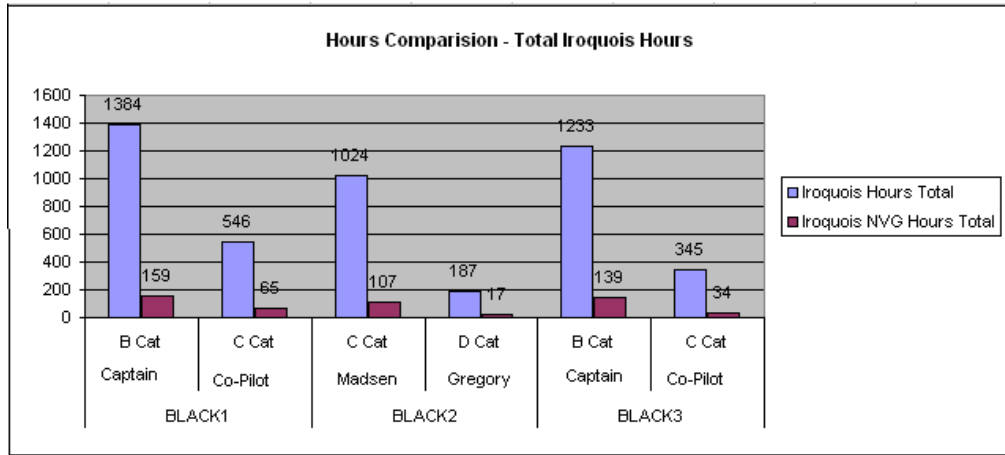


Figure 1. Hours comparison for crews of IROQUOIS BLACK.⁹⁹

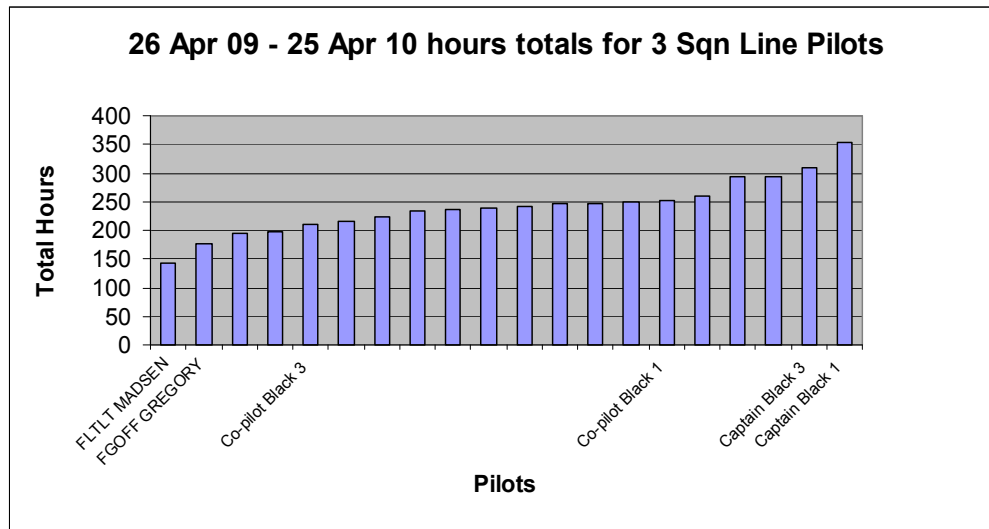


Figure 2. Pilot Hours 25 Apr 09 – 24 Apr 10.¹⁰⁰

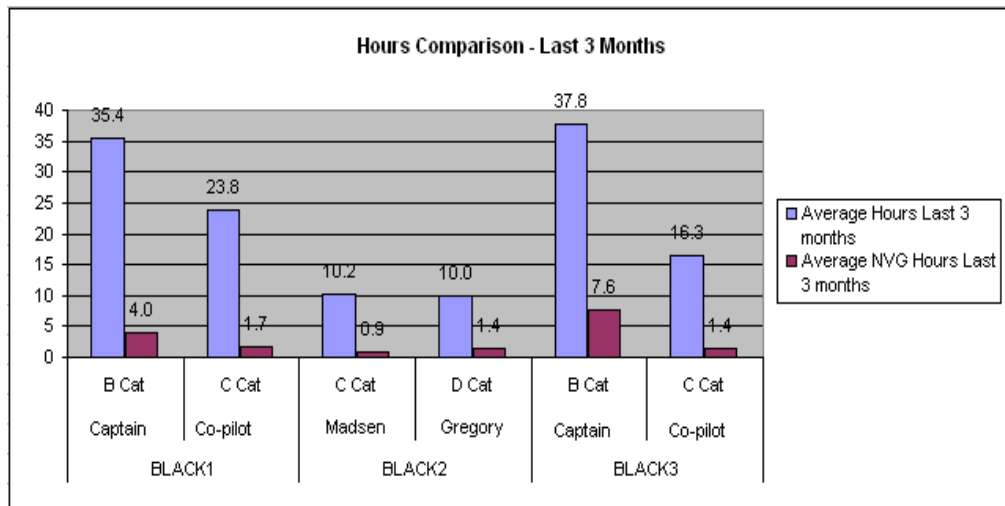


Figure 3. Pilot monthly average hours 24 Jan 10 – 24 Apr 10.¹⁰¹

⁹⁹ Exhibit GA

¹⁰⁰ FEMS

¹⁰¹ Exhibit GA

72. **NVG Flying.** FLT LT MADSEN conducted two dedicated NVG currency check flights in the week preceding the accident to meet his currency requirement. His last NVG sortie before this was on 10 Dec 09. This lack of significant recent experience could have adversely affected FLT LT MADSEN's performance on NVG.¹⁰²

73. **Instrument Flying.** As at 25 Apr 10, FLT LT MADSEN was current in IF, although he had flown only 2.4hrs of simulated and actual IF, with six instrument approaches in the previous six months. He did not fly on instruments between 12 Jan 10 and his currency check on 22 Apr 10.¹⁰³ This low recurrence of recent experience would have meant that FLT LT MADSEN was not well prepared for the IIMC event immediately preceding the accident.

74. The 3 Squadron currency programme required very little IF practice for pilots. Taken to the letter, the Iroquois currency programme requires that a C Category Iroquois pilot only fly 0.5 hrs IF as the handling pilot and two instrument approaches every three months.¹⁰⁴ It is the opinion of the Court of Inquiry that this is less than adequate currency to maintain IF competence.

Aircrew Predisposing Factors

75. A large amount of the material in this section was drawn from XXXXX-XX-CONFIDENCE files of the aircrew who were killed in this accident. This detailed material is protected under the Natural Justice Process and the Court of Inquiry Rules of Evidence.

76. In summary, this section demonstrated that FLT LT MADSEN was acknowledged by his supervisors as a good 'hands and feet' pilot. His records also reported a recurring history of a range of flying issues which generally culminated in him having recurring difficulty passing Instrument Flying Tests. At each occurrence, he was given enough remedial training to address the identified issues, however no action was taken which would have a lasting remedial effect.

77. XXXX Redacted under Natural Justice Process XXXXX.

78. XXXX Redacted under Natural Justice Process XXXXX.

¹⁰² Exhibit FU

¹⁰³ Exhibit BG

¹⁰⁴ NZAP 9215

79. XXXX Redacted under Natural Justice Process XXXXX.

80. XXXX Redacted under Natural Justice Process XXXXX.

81. Beyond written reports, 3 Squadron action to address FLTTL MADSEN's flying issues was only taken after FLTTL MADSEN's referral.¹⁰⁵ A programme was developed co-operatively by RNZAF Support, FLTTL MADSEN and 3 Squadron and was put into effect in late Mar 10 to take steps to address his flying related issues. The programme had not been in place long enough prior to the accident to be effective.¹⁰⁶

82. In the opinion of the Court of Inquiry, both 3 Squadron and FLTTL MADSEN share some responsibility for the management of FLTTL MADSEN's flying recovery.

¹⁰⁵ Witness

¹⁰⁶ Exhibit GA

No. 3 Squadron reports identified FLTLT MADSEN's issues, but no lasting corrective action had been instigated. The Squadron could have managed FLTLT MADSEN's work and sport commitments and ensured that he maintained sufficient flying to recover and build his flying skills. FLTLT MADSEN took partial remedial steps in self referring [XXXXXXXXXX] in September 2009. However he needed to give greater priority to instituting a recovery programme to address his reported flying weaknesses. He began a comprehensive recovery programme after receiving his OPR in March 2010 but these steps were probably taken too late to be effective by the time of the accident.

Formation Specific Training

83. No 3-ship formation training was conducted for this task. In the opinion of the Court of Inquiry, the currency and qualification risks highlighted above could have been mitigated with task specific training. The task was unusual, in that Vic Formation is an infrequently used pattern for Iroquois flying and the flypast involved low-level flight over a built up area, at night. The Captain of BLACK 3 was not current in night formation and had never flown Vic Formation on NVG.¹⁰⁷

84. Some 2-ship formation training was conducted on 13 Apr 10, the Formation Leader had led a two-ship formation on NVG in the Ohakea training area. On 22 Apr 10, the Formation Leader also led FLTLT MADSEN in a two-ship NVG formation training as part of the latter captain's currency check.¹⁰⁸ The practice gained in this flight was partial risk mitigation for the ANZAC Day Flight, but is not as complex, and therefore not as useful to this task as three ship formation training would have been.

Planning

85. The initial plan was prepared on the assumption that the weather would allow a direct NVG visual transit from Ohakea to the first flypast holding point at Petone.¹⁰⁹ During the transit IROQUOIS BLACK would practice changing between Staggered Trail Left and Vic Formations.¹¹⁰ The captain of BLACK 3 decided he would occupy the non-standard left seat due to his position in the formation, giving him a better visual reference on the other aircraft in the formation.¹¹¹ The crew positions and formation patterns are at annex E.

86. An IFR transit was never considered as part of the planning.¹¹²

87. A notable part of the mission planning was the 485 WG interaction. COMMANDER B required that all RNZAF ANZAC Day flypasts be scrutinised to ensure they were fully and safely planned. The plan was briefed to COMMANDER B and approved in the week prior to the flypast.¹¹³ This scrutiny for ANZAC Day flypasts was conducted because of the scale and profile of the event.¹¹⁴ The planning focussed in detail on the flypasts. 485 WG focus was only on this element.

¹⁰⁷ Witness

¹⁰⁸ Exhibit GA

¹⁰⁹ Exhibit G

¹¹⁰ Witness

¹¹¹ Witness

¹¹² Witness, Witness, Witness

¹¹³ Witness

¹¹⁴ Witness

Maps and internet satellite imagery of the flypast sites were analysed and a detailed risk mitigation process was undertaken to satisfy 485 WG requirements. There is no record that a reconnaissance of the flypast sites was conducted. Because the transit to and from Wellington was termed an administrative move it was not afforded the same amount of planning and consideration as the flypast preparation.¹¹⁵ A low level route survey was not conducted by day for the task.¹¹⁶

88. In the opinion of the Court of Inquiry, the cumulative risks of the transit were not recognised and considered. The 485 WG oversight of the fly pasts focussed on the tactical risks including the details and mitigations of the fly pasts.¹¹⁷ The oversight missed several operational level risk mitigation steps and adherence to orders, including: the omission of a low level route survey and flypast reconnaissance (as required by DFFO), that the Squadron Commander was not the Authorising Officer (as required by DFFO), the aircrew qualification and currency required and the lack of formation practice flights.

89. The Squadron has a similar responsibility to 485 WG to adhere to orders and operational considerations. In addition, the Squadron failed to consider the tactical risks fully.

90. Had a more formal Operational Risk Management (ORM) process been used, the Court of Inquiry believes the risks to the formation may have been better identified and mitigated. ORM is further discussed at TOR 7 of this report, below.

Attitude to Task

91. 485 WG communicated to the Flight Authorising Officer that the captains of IROQUOIS BLACK were to be made aware of the importance of the task.¹¹⁸ 485 WG also described the flypast as a 'big event' and that they did not want to be embarrassed.¹¹⁹ Whilst this message might have influenced the crews, it appears that the Authorising Officer did manage the potential organisational pressure to complete the task.

92. Surviving aircrew members stated to the Court of Inquiry that it was 'just a flypast' and, although important, they felt no external, additional pressure because of the occasion.¹²⁰ However, their collective decision to continue the task in poor weather conditions and statements of their personal expectation to get tasks done were indicative of pro-task motivation.

93. The Court of Inquiry considers that several decisions made to increase the likelihood of task completion also increased the risk to the formation. The attitude to this task might have shaped decision making and consequently increased acceptance of risk. This motivation is discussed further under TOR 6, 3 Squadron Culture. That section discusses the positive and negative aspects of this culture.

¹¹⁵ Witness, Witness

¹¹⁶ Witness

¹¹⁷ Witness, Witness

¹¹⁸ Witness

¹¹⁹ Witness

¹²⁰ Witness

AUTHORISATION

94. The Flight Authorising Officer was OFFICER B. He had been verbally delegated the duties of Utility Flight Commander by COMMANDER A and was therefore empowered to authorise Utility Flight tasks.¹²¹ However, DFFO 8.5 requires all ceremonial fly pasts to be authorised by the Squadron Commander. There is no record that anyone noted the requirement of DFFO 8.5.

95. Flight Authorising Officer duties are detailed in DFFO. His responsibilities included ensuring that the authorised crews were adequately briefed on the task and flight, had adequately planned the task, were competent and qualified to undertake the task, and understood the limitations that were placed on them by the Flight Authorising Officer.¹²²

96. The Flight Authorising Officer did not check FEMS to assess the currency of the crews prior to authorising the flight. The Court of Inquiry considers this reasonable as the time taken in using FEMS to determine the currencies of the 12 formation aircrew would have been considerable. In line with common squadron practice, he assumed that the Tasking Officer would ensure that the crews held the appropriate currencies.¹²³

97. The combined formation/authorisation brief was conducted at 1400hrs on Fri 23 Apr 10.¹²⁴ All formation crew members were in attendance except the captain of BLACK 3, who was unable to attend as he was conducting another flying task. He had discussed the task with the Flight Authorising Officer earlier in the day. The Flight Authorising Officer directed that the Formation Leader was to brief the captain of BLACK 3 prior to the flight.¹²⁵

98. The long term weather report was presented at the brief by BLACK 3's co-pilot.¹²⁶ Alternative routing options were discussed for each phase of the task including re-routing via the west coast to Wellington. No adjustment to flight timings was made to account for the possibility of the longer, poor weather route, until the pre-flight briefing. An IFR transit to Wellington from Ohakea was not discussed as an option.¹²⁷

99. The Flight Authorising Officer was content with the brief and signed the authorisation sheet (RNZAF1575).¹²⁸

100. The route was authorised to be flown Not Inside (NI) 250ft MSD.¹²⁹ This is contrary to DFFO 2.196(c) which requires that before authorising cross-country helicopter operations using night vision systems, the Flight Authorising Officer is to ensure that routes have been surveyed by day. An unsurveyed route must be flown above 500ft MSD.¹³⁰ A route survey was not conducted.¹³¹

¹²¹ Witness

¹²² Exhibit FI 1.39-1.49

¹²³ Witness

¹²⁴ Exhibit H

¹²⁵ Witness

¹²⁶ Exhibit BX

¹²⁷ Witness, Witness, Witness

¹²⁸ Witness

¹²⁹ Exhibit BL

¹³⁰ Exhibit FI

101. On the evening of Sat 24 Apr 10 the captain of BLACK 1 contacted the Flight Authorising Officer to discuss the likely poor weather for the flight. The discussion included an earlier start time to enable the longer, poor weather route to be flown. The Formation Leader understood that he would be supported if he assessed the weather was unfit and the sortie had to be abandoned.¹³²

Authorisation Sheet

102. Flight limitations and special instructions for the task are to be briefed and entered on the RNZAF 1575.¹³³ Several errors and omissions were evident that are further explained in TOR 6. The most significant are summarised below:

- a. DFFO 2.194 requires all night cross-country helicopter operations to be in accordance with Military Operations (MILOPS). No MILOPS authorisation was given.¹³⁴ The Court of Inquiry noted that, MILOPS is not routinely used in 3 Squadron authorisations and there is evidence to suggest that Military Minimum (MILMIN) intent is applied in Ohakea's airspace by ATC without following the correct procedure detailed in DFFO.¹³⁵
- b. No formation distances were annotated iaw DFFO 1.40(i).¹³⁶
- c. DFFO 1.40(b) requires that the aircraft registration number be entered in the RNZAF1575. The last minute aircraft change for BLACK 2 on the morning of the task was not entered in the RNZAF1575.

Summary

103. The authorisation process was conducted in good faith and in a manner believed to be professional both by the formation crews and the Flight Authorising Officer. However, ultimately it failed to properly address the numerous risks associated with this event. The Court of Inquiry identifies the following key risks:

- a. The inexperience of the pilots of BLACK 2, both individually and as a crew, was not addressed other than to change their place in the formation.
- b. The lack of key currencies and qualifications was not identified or addressed.
- c. The captain of BLACK 3 was authorised to practise formation position changes at tactical spacing during the transit to the first flypast and for the first two flypasts, yet was not current in night formation and had not flown Vic Formation at night.

104. The DFFO requirement for the Flight Authorising Officer to ensure that the crews are competent and qualified to undertake the task was not adhered to. This is primarily due to inconsistencies in the orders and publications relating to

¹³¹ Witness

¹³² Witness

¹³³ Exhibit FI

¹³⁴ Exhibit BL

¹³⁵ FSE NZ299/10

¹³⁶ Exhibit BL

categorisation and qualification of Iroquois pilots and failure of the 3 Squadron crew allocation procedure to ensure crews are fully qualified for the task.

CONDUCT OF THE FLIGHT: 25 APR 10

Preflight

105. At pre-flight the pilots checked the weather. The Terminal Aerodrome Forecast (TAF) for both Ohakea and Wellington were forecasting temporary cloud bases of 700ft and 600ft respectively. The required met minima for an NVG CT captain includes a cloud base of not below 600ft.¹³⁷ The 0400hrs Meteorological Aerodrome Reports (METAR) for Ohakea was better than the TAF with the cloud base reducing to 1400ft in drizzle. The TAF for Paraparaumu was forecasting a broken cloud base at 700ft with temporary reductions to 400ft. The auto METAR suggested that in general terms the weather was better than that forecast. The auto METAR recorded at 0330hrs for Paraparaumu was indicating a cloud base of 400ft. The auto METAR recorded at 0400hrs indicated a cloud base of 1200ft, with scattered cloud at 600ft. In summary, the weather reports indicated that the cloud base would probably be suitable for the transit to Wellington via Paraparaumu.

106. During the pre-flight, the co-pilot of BLACK 1 hand drew the coastal route on his map using distance to go marks every 5 nautical miles (NM) zeroed at the first hold point. The coastal route was not drawn on the maps of either BLACK 2 or BLACK 3. This was the extent of the formal planning for the alternate route. The additional flight time required was calculated as 10-15mins using Mental Dead Reckoning. Accordingly, the Formation Leader brought the start time forward by 15mins.¹³⁸

Ohakea to Paraparaumu

107. During the formation radio check in procedure, it appeared that BLACK 3 had an unserviceable UHF/VHF radio.¹³⁹ The apparent fault was because the captain of BLACK 3 had set an incorrect frequency. The Co-pilot recognised the wrong frequency but did not bring it to the attention of the Captain.¹⁴⁰ This is a consequence of the captain of BLACK 3 not attending the formation/authorisation brief and a breakdown in CRM. The Co-pilot should have informed the captain that the incorrect frequency was set.

108. IROQUOIS BLACK departed Ohakea at 0513hrs initially tracking North West before turning left to follow the Rangitikei River to the coast. At Ohakea the cloud base was assessed at 1000ft.¹⁴¹ The cloud base was below the civil aviation prescribed minimum for an unattended aerodrome of 1500ft.¹⁴² As they did not have a MILMIN authorisation a VFR departure was not permitted under CAR 91.¹⁴³ IROQUOIS BLACK continued to follow the river to Tangimoana before turning southbound along the coast towards Paraparaumu.

¹³⁷ Exhibit BV

¹³⁸ Exhibit GA

¹³⁹ Witness

¹⁴⁰ Witness

¹⁴¹ Witness

¹⁴² Witness, CAA AIP Vol 1 TABLE 1.2-3

¹⁴³ Exhibit GC CAR 91, AIP

109. At some point north of Paraparaumu the more senior HCM in BLACK 3 recalls the Formation Leader briefing a safe heading (in case of IIMC) of 240°. ¹⁴⁴ The captain of BLACK 1 reports that at Hokio (on the coast north of Paraparaumu and west of Levin) the formation was at 300ft with the cloud base just above but with a 'good picture' and feeling 'comfortable'. ¹⁴⁵

110. The deterioration in the weather at this point was in keeping with the TAF for Paraparaumu indicating a temporary cloud base of 400ft. The Formation Leader briefed the formation that his decision point would be the point of land closest to Kapiti Island. There were three options:

- a. If the weather was fit beyond that point the transit south would continue.
- b. If it was not fit and the airfield was visible he would take the formation there.
- c. If the airfield was not visible he would turn the formation around and head back to Ohakea. ¹⁴⁶

111. Shortly afterwards BLACK 1 was flying at 250ft when FLTLT MADSEN informed BLACK 1 that BLACK 1 was 'skimming the bottoms of the cloud'. ¹⁴⁷ At about the same time, the captain of BLACK 3 assessed the cloud base to be 250-300ft but 'still well within limits to fly'. ¹⁴⁸

112. It is clear that the formation was flying in conditions below its authorised met minima of 600ft cloud base and that the captains of BLACK 1 and BLACK 3 appear to have been comfortable to operate in these conditions. Shortly afterwards, when asked by the Formation Leader if they were comfortable to continue, both captains replied they were happy to do so. ¹⁴⁹

113. The use of 'comfort' as a criteria may be an indication of the operating culture on No. 3 Squadron at the time. Although the crews recognised that they were below the ordered NVG minimum cloud base, they considered they were permitted to continue the task, provided they felt 'comfortable' to do so. ¹⁵⁰ Tasks and transits appear to be routinely continued with the crew's own judgement of whether or not the situation is safe, a subjective feeling of 'comfort' being the widely accepted criteria. The consequence of this characteristic of culture is that the margin for error is reduced below that intended by orders.

114. The formation may have been encouraged to continue by the fact that the information passed earlier by ATC indicated that Wellington Airport's Automatic Terminal Information Service (ATIS) was reporting a broken cloud base of 1400ft. This was an improvement on the forecast received by the formation prior to departure. ¹⁵¹ The Human Factors Report identified a number of pre-disposing factors amongst aircrew which would have influenced IROQUOIS BLACK to

¹⁴⁴ Witness, Witness

¹⁴⁵ Witness

¹⁴⁶ Witness

¹⁴⁷ Witness

¹⁴⁸ Witness

¹⁴⁹ Witness

¹⁵⁰ Witness, Witness

¹⁵¹ Exhibit EX

underestimate the risk of flying into IIMC because they thought this cloud was only short term. These factors include the optimistic expectation that the weather is always better than forecast; that weather down track will be improving; and, the tendency to average out isolated risks such as localised weather.¹⁵² The 3 Squadron operating culture is discussed further at Page 61 of this report.

Paraparaumu to Pukerua Bay

115. South of Paraparaumu the cloud base lifted slightly and the lights of Pukerua Bay were visible. IROQUOIS BLACK climbed to 300ft and the Formation Leader identified Pukerua Bay as his next decision point.¹⁵³ At Paekakariki he eased the formation out over the sea on a heading diverging slightly from the coast and called them into Trail Formation in anticipation of a left turn through 180° should an escape be required.¹⁵⁴

116. The captain of BLACK 3 asked the formation whether everyone was qualified for LLOW.¹⁵⁵ FLTLT MADSEN needed to be prompted by the Formation Leader, then replied that he was and that he had set the RADALT to 50ft.¹⁵⁶ The Court of Inquiry found no evidence that FLTLT MADSEN was LLOW qualified.¹⁵⁷

117. No. 3 Squadron SOP 403.9 Table 1 states that when operating at 250ft MSD over water at night 200ft is to be set on the RADALT low set index. The fact that BLACK 2 was not corrected indicates a formation CRM breakdown in so far as the Formation Leader did not want to question the decision of another aircraft's captain.¹⁵⁸ BLACK 2's right hand RADALT was found with the bug set to 45ft, the left RADALT had been torn off in the impact, but witness marks indicate it was probably set to 50ft. The RADALT audio warning was found switched "ON."¹⁵⁹ These settings were to prove important when BLACK 2, apparently unknowingly flew across the coast line, in IMC, near Pukerua Bay, a few minutes later.

118. NVG LLOW procedures are taught during the upgrade to NVG CT Captain.¹⁶⁰ FLTLT MADSEN was a NVG CT Captain but the LLOW training was omitted from the 3 Squadron sortie upgrade process that he conducted in Sep 09. FLTLT MADSEN had experienced LLOW as a co-pilot in Aug 09 but this does not meet Squadron training requirements.¹⁶¹ Gaining a restricted qualification is not uncommon on 3 Squadron, the captain of BLACK 3 also gained his NVG CT Captaincy in Sep 09, three months before conducting his LLOW qualification.¹⁶²

119. Trail Formation in the Iroquois involves aircraft sitting directly behind and slightly higher than the aircraft in front at a minimum spacing of 2.5 rotors (in this context 'rotor' refers to rotor diameter, which is approximately 48ft). A review of other nations' SOP indicate that Trail Formation on NVG is either discouraged, or

¹⁵² Exhibit FU

¹⁵³ Witness

¹⁵⁴ Witness GA

¹⁵⁵ Witness, Witness, Witness, Witness

¹⁵⁶ Witness, Witness

¹⁵⁷ Exhibit GA

¹⁵⁸ Witness

¹⁵⁹ Exhibit GA Exhibit FQ

¹⁶⁰ Exhibit FB

¹⁶¹ Exhibit FY

¹⁶² Exhibit FX

highlighted to be a more difficult formation position to fly because it is very difficult to assess closure rates on the aircraft ahead.¹⁶³

120. There is no specific guidance in 3 Squadron SOP regarding the use of Trail Formation on NVG. No. 3 Squadron SOP 207 Formation, does state that approaching bad weather No. 2 should move to trail position at 2.5 to 4 rotor spacing.¹⁶⁴ However, this SOP is does not reference NVG operations.

121. The Court of Inquiry believes that as a result of moving into trail position, the pilots of BLACK 2 will have had to pay more attention to accurate station keeping on BLACK 1 to the detriment of their SA and this may have affected their ability to see and avoid the developing IIMC situation at Pukerua Bay. Once in the IIMC event, the lack of SA may have been detrimental to their ability to take appropriate recovery action.¹⁶⁵

122. Approaching Pukerua Bay the formation was at about 300ft and had slowed to 60 KIAS due to the weather.¹⁶⁶ BLACK 3 was sitting slightly right of the Trail position on BLACK 2 and 100ft lower. BLACK 3 had already considered a descending left turn back to parallel the road as his escape plan.¹⁶⁷

123. At this stage there was only lighting from the houses, streets and the highway on the eastern half of the Pukerua Bay headland. The western half of the headland and west out to sea remained dark with no visible horizon.¹⁶⁸ It was becoming more likely that onwards visual navigation would not be possible. IROQUOIS BLACK was presented with limited escape options. A right turn to the west or a climb straight ahead would have resulted in a loss of visual references. IROQUOIS BLACK elected to fly a visual left turn towards the land.¹⁶⁹ Approaching Pukerua Bay, BLACK 1 was positioned 500m offshore. Formation aircrew were confident that there was sufficient room to comfortably complete the turn in the space available.¹⁷⁰

124. At about 0548hrs, as the formation approached Pukerua Bay from the north, the Formation Leader initiated a left hand level turn, in order to manoeuvre the formation north back towards Paraparaumu.¹⁷¹

Inadvertent IMC

125. The co-pilot was flying BLACK 1 as they initiated the turn.¹⁷² BLACK 1 climbed in the turn.¹⁷³ The pilots of BLACK 1 stated that after approximately 90° of turn the visual picture began to deteriorate markedly. A transfer of control of the aircraft from the co-pilot to the captain took place and shortly afterwards the captain initiated the IIMC procedure. BLACK 1 flew into IMC conditions, perhaps caused by

¹⁶³ Exhibit GA

¹⁶⁴ Exhibit FK

¹⁶⁵ Exhibit GA

¹⁶⁶ Witness

¹⁶⁷ Witness

¹⁶⁸ Witness

¹⁶⁹ Witness

¹⁷⁰ Witness, Witness, Witness

¹⁷¹ Exhibit GA

¹⁷² Witness, Witness

¹⁷³ Witness

an area of unseen precipitation and/or climbing into cloud.¹⁷⁴ Either may have been exacerbated by turning away from good light reference at Pukerua Bay. On the information available, the Court of Inquiry could not determine whether one or a combination of these factors caused the IIMC.

126. BLACK 3 saw BLACK 2 disappear from view approximately 1 to 2 seconds after BLACK 1.¹⁷⁵ It is considered likely that FLTLT MADSEN was flying the aircraft at that time.¹⁷⁶ The greater separation of distance and height between BLACK 1 and 3 afforded BLACK 3 more time to assess and react to the IMC threat. Additionally, he had already decided that his course of action would be to positively descend in the turn, in order to remain in visual meteorological conditions. Immediately after losing visual contact with BLACK 1 and 2, BLACK 3 became concerned that that either aircraft might descend out of cloud onto him. To avoid collision, BLACK 3 descended to 120ft and accelerated to about 120KIAS away to the north.¹⁷⁷

127. There was probably a period when BLACK 2 was experiencing a progressive degradation of NVG picture. The Court of Inquiry notes that BLACK 1 reported a progressive degradation of NVG picture, whereas BLACK 3 observed a near instantaneous loss of contact with each of BLACK 1 and BLACK 2. This is an important demonstration of a feature of NVG performance in that NVG can see through some precipitation and cloud when inside or close to cloud. This would be in contrast to the near instant loss of visual reference that would be experienced in flight into cloud by day.

128. It is clear to the Court of Inquiry that even though the formation was flying in weather conditions that were below authorised met minima, BLACK 1, and probably BLACK 2, did not expect to lose visual references in this turn. BLACK 1 did not update the safe heading in case of IIMC before commencing the turn.¹⁷⁸

129. BLACK 1 did not adequately consider the hazard presented by the weather conditions until the visual picture quality had reduced to such an extent that IMC flight was inevitable. It is likely that the performance limitations of NVG, which make it very difficult to detect gradually deteriorating weather conditions, played a part in this. It is likely that operating in marginal weather conditions has become 'normalised' behaviour for 3 Squadron and that the formation either did not recognise the risk posed by the poor weather, or had been exposed to it so often that their perception of the risk had reduced.¹⁷⁹ There is further discussion on risk perception in relation to 3 Squadron culture, later in this report.

130. After entering IIMC, a safe heading and/or a rate of climb sufficient to clear terrain would have prevented the accident from occurring. Despite not flying a safe heading, BLACK 1 achieved a safe rate of climb. BLACK 2 achieved neither a safe heading nor a safe rate of climb to avoid terrain. This was a focus for the Court of Inquiry.

¹⁷⁴ Exhibit GA

¹⁷⁵ Witness

¹⁷⁶ Exhibit GA

¹⁷⁷ Witness

¹⁷⁸ Witness

¹⁷⁹ Exhibit FU

ANALYSIS OF THE FLIGHT PATH OF IROQUOIS BLACK IN THE VICINITY OF PUKERUA BAY

131. Full analysis and calculations for the flight path of IROQUOIS BLACK is contained in the Impact Analysis Report. The Court of Inquiry endorses the conclusions of that report, which are summarised below.¹⁸⁰

132. In the flight path figures 4-7 below, each track symbol represents the estimated position from the Impact Analysis Report at one second intervals. The time in seconds is shown next to each symbol. The lateral track limits are not intended to depict alternative tracks; rather they depict the lateral limits within which the actual aircraft track is expected to fall.¹⁸¹

Flight Path of BLACK 1

133. The points at which radar contact was lost and subsequently regained are indicated by arrows. The last recorded radar contact with BLACK 1 southbound was at 0548:52hrs. The next recorded radar contact, after entering IMC, was at 0549:31hrs, at which time BLACK 1 was at 1000ft AMSL tracking about 030°.



Figure 4. Probable Track of BLACK 1.
Google Earth Image 26 Sep 10.

134. In continuing the turn, BLACK 1 reduced their closure rate with terrain, but did not achieve a safe heading. Had BLACK 1 not commenced a climb, the aircraft is likely to have impacted terrain between 15 and 60 seconds after entering IIMC.¹⁸²

¹⁸⁰ Exhibit GA

¹⁸¹ Exhibit GA

¹⁸² Exhibit GA

Flight Path of BLACK 2

135. The track of BLACK 2 prior to entering IIMC is considered likely to conform to the track of BLACK 1, although two seconds behind that aircraft.¹⁸³

136. From the likely point of entering IIMC, BLACK 2's track is limited by the geography of the valley through which the aircraft must have flown to reach the accident site. The final portion of the track is considered to include a left hand turn to achieve a ground track of between 020° and 060°. These limits are drawn from evidence from the wreckage and the topography of the valley at that point.¹⁸⁴

137. The estimated track, together with the limits of the track as calculated, is shown at Figure 5. The topography of the valley allows a greater variation in track at higher altitude, because the valley is wider. The inner limit lines represent the lowest possible altitude that the aircraft could have flown to reach the impact site. The outer lines bound the upper possible altitude track.¹⁸⁵

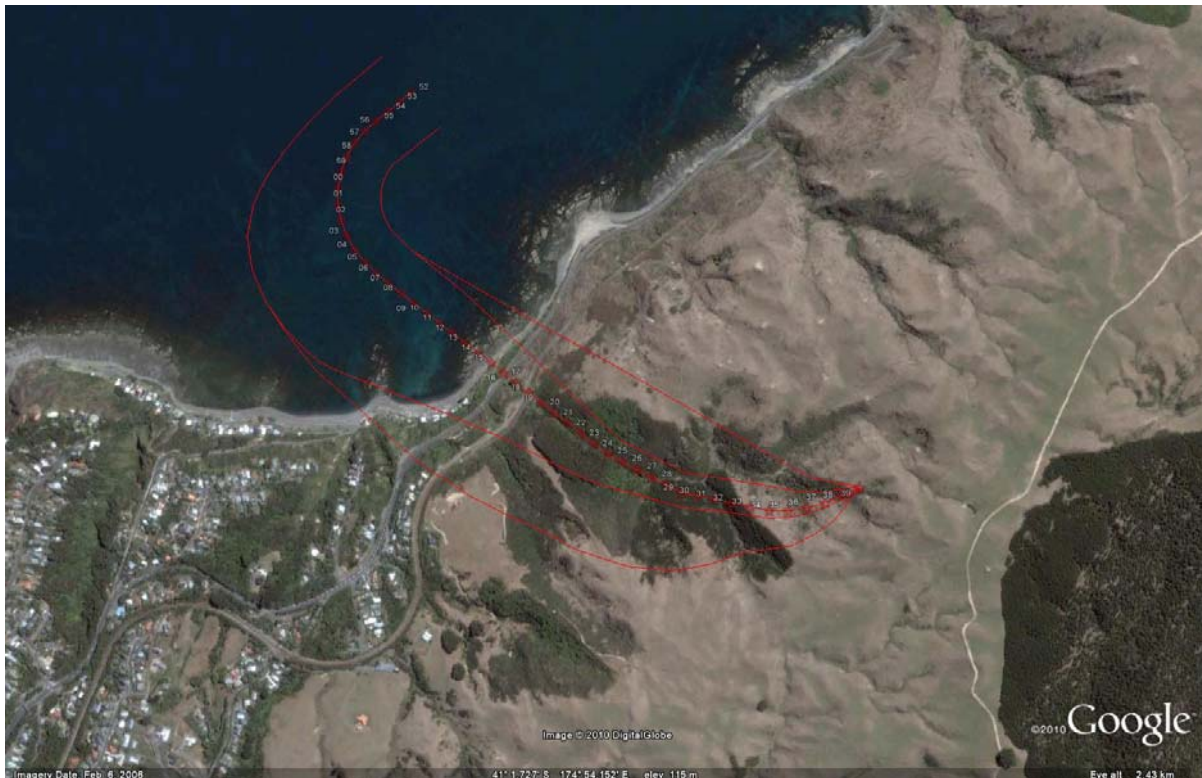


Figure 5. Probable Track of BLACK 2.
Google Earth Image 26 Sep 10.

¹⁸³ Exhibit GA

¹⁸⁴ Exhibit GA

¹⁸⁵ Exhibit GA

138. The time from entering IIMC to impact with terrain is estimated to be about 30 seconds. Depending on the actual aircraft speed and track it could have been as little as 15 seconds or as much as 60 seconds.¹⁸⁶

139. The initial impact point of BLACK 2 was at position S41 01.837- E174 54.533.¹⁸⁷

140. If the aircraft had flown the probable track, an average climb rate of 871 ft per minute would have been required following entering IIMC to have cleared the ridge that the aircraft hit.¹⁸⁸

141. Depending on the actual track at impact, the aircraft is likely to have cleared the ridgeline had the aircraft been 100 to 150ft higher.¹⁸⁹

Flight Path of BLACK 3

142. The estimated track of BLACK 3, together with the limits of the track, is at Figure 6.

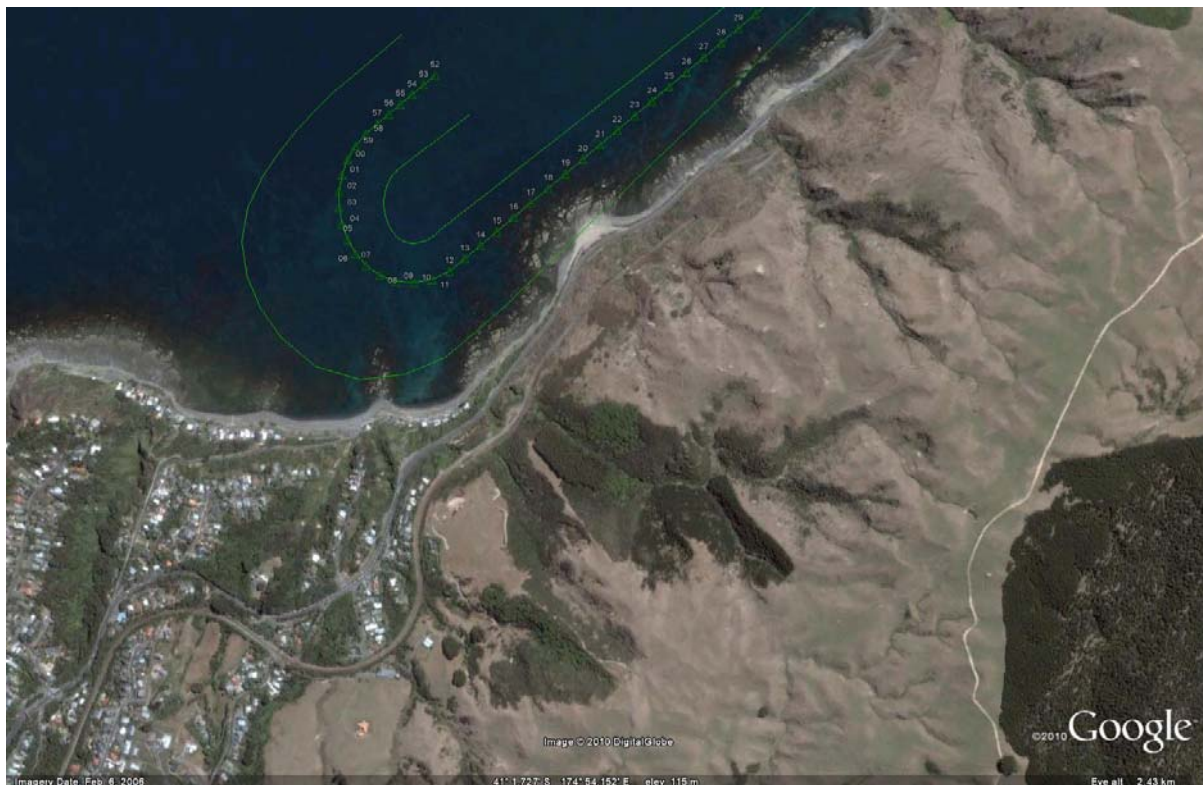


Figure 6. Probable Track of BLACK 3.
Google Earth Image 26 Sep 10.¹⁹⁰

¹⁸⁶ Exhibit GA

¹⁸⁷ Exhibit GA

¹⁸⁸ Exhibit GA

¹⁸⁹ Exhibit GA

¹⁹⁰ Exhibit GA

Flight Path of IROQUOIS BLACK

143. A three-dimensional view of the probable flight path of all three aircraft, viewed from the west, is shown at Figure 7.

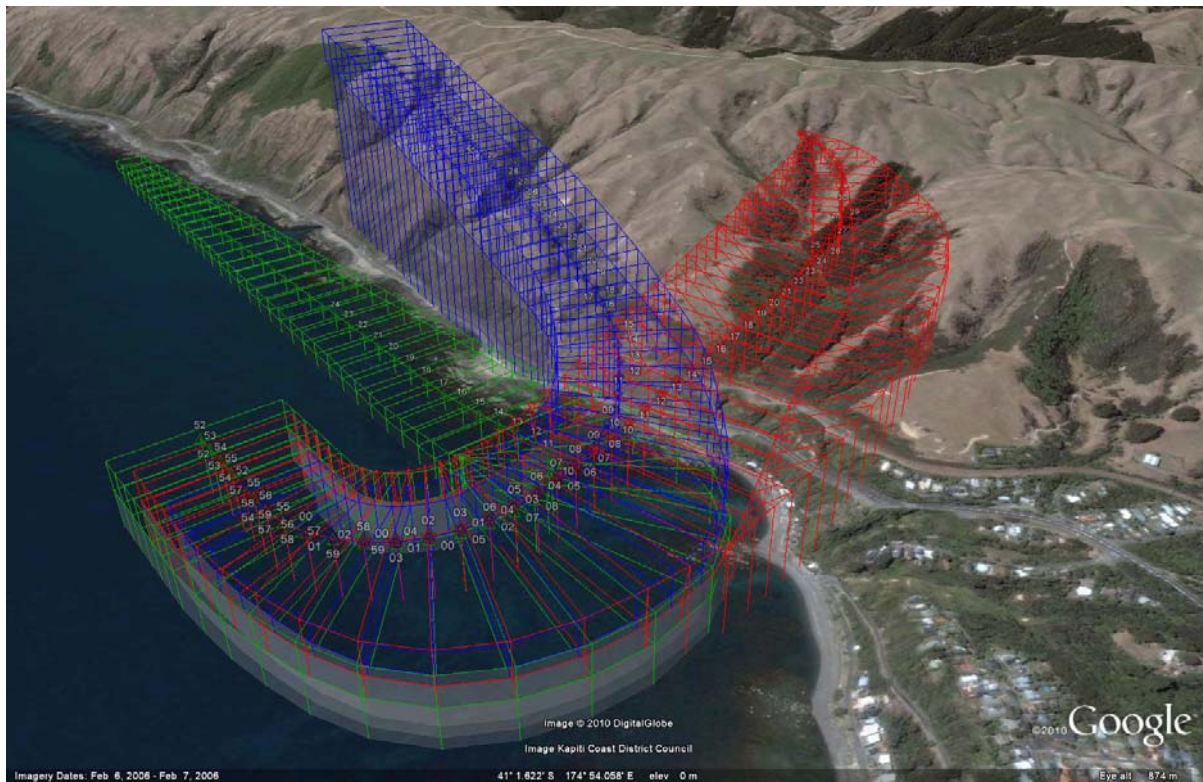


Figure 7. Probable Flight Path of IROQUOIS BLACK Viewed from the West.
Google Earth Image 28 Sep 10.¹⁹¹

¹⁹¹ Exhibit GA

IMPACT ANALYSIS



Figure 8. View from initial impact point toward wreckage.
CPE Image OH 10-0284-442

The Crash Dynamics and Pre-impact Flight Dynamics

144. NZ3806 (BLACK 2) suffered two rotor strikes on the hill, the second strike occurring almost simultaneously with the impact of the lower forward fuselage.¹⁹² During this sequence the main transmission, complete with main rotor assembly, departed upward from the aircraft. The transmission departure pulled the roof structure up from the right hand side (RHS) of the fuselage.¹⁹³

145. At the initial impact point the forward edge of the RHS skid jammed in tree roots and the aircraft pivoted clockwise around this point prior to the skid detaching from the airframe. The initial impact caused the forward lower fuselage to peel away and has released the right hand pilot's seat from the fuselage structure.¹⁹⁴

146. The initial impact launched the main fuselage on a ballistic trajectory, and the fuselage did not strike the ground again until the second and final impact point. Right roll and pivot were induced at the initial impact. NZ3806 travelled approximately 21.4m further into the gully and 2.5m higher than the initial impact point.¹⁹⁵

147. This second and final impact point caused the failure of the Left Hand Side (LHS) seating, the forward roof structure, the engine mounting points and the

¹⁹² Approximate location S41°01.850' by E174°53.741' as taken from a hand held GPS device Court of Inquiry Photo OH 10-0291-011

¹⁹³ Exhibit FZ

¹⁹⁴ Exhibit FZ

¹⁹⁵ Exhibit FZ

remainder of the forward fuselage. The tail boom also detached at this point having been structurally damaged at the initial impact point.

Likely Crew Movement During the Impact Sequence

148. FLTLT MADSEN, still in his seat, fell from the aircraft as the lower fuselage and floor structure were destroyed from below him during the initial impact sequence.¹⁹⁶

149. FGOFF GREGORY remained in place in his seat until the second impact. The second impact had sufficient force to remove the co-pilot's seat from the cockpit floor. Due to the angle of the fuselage FGOFF GREGORY was thrown downwards to his right, landing to the right of the fuselage and just in front of the detached roof structure.¹⁹⁷

150. CPL CARSON remained inside the aircraft during the accident sequence until the second impact, at which time he was thrown forward, down and right but remained attached to the aircraft wreckage through his ALP garment strop and tail unit.¹⁹⁸

151. SGT CREEGGAN's survival can be attributed to the following sequence of events:¹⁹⁹

- a. The lap belt attachments failed due to impact forces and the separation of the cabin roof during the initial impact sequence. This failure combined with the rotation of the aircraft caused SGT CREEGGAN to be thrown from the crew compartment.
- b. SGT CREEGGAN has remained attached to the fuselage by his ALP garment strop and tail unit until the final impact. He is likely to have been slightly above the main body of the fuselage at the final impact.
- c. At the final impact, SGT CREEGGAN's motion has been arrested by the ALP garment strop and tail unit and the progressive failure of their attachment point.
- d. Deceleration forces were transmitted through the tail unit and garment strop to the ALP, partially tearing the garment strop from the ALP. This is likely to have further extended the period and distance for deceleration, further reducing the deceleration load to which SGT CREEGGAN was subjected.
- e. Deceleration forces transmitted through the ALP tail unit and garment strop may have at least partially aligned SGT CREEGGAN's body with the direction of travel, resulting in the major impact being taken by his legs. This is likely to have resulted in the serious injury to his right leg, but may also have protected his head and vital organs to at least some extent.

¹⁹⁶ Exhibit FZ

¹⁹⁷ Exhibit FZ

¹⁹⁸ Exhibit FZ

¹⁹⁹ Exhibit GE

- f. SGT CREEGGAN has landed in close proximity to the engine, slightly downhill from FGOFF GREGORY and CPL CARSON. He was still attached to the aircraft wreckage by his tail unit and garment strop. The failed lap belt is likely to have been still generally in place, but separated from the aircraft. The lap belt is likely to have remained with SGT CREEGGAN as he moved away from the wreckage, perhaps partially trapped in his equipment.
- g. SGT CREEGGAN was unable to release himself from the wreckage due to damage to the plastic sheath of the release cable. He used a survival knife to cut the closing loop of the 3-ring release, allowing the tail unit to separate from the garment strop.
- h. Once free from the wreckage, SGT CREEGGAN crawled along the track to the east of the main wreckage, and removed his NVG and helmet. He has also unbuckled the failed lap belt, discarding the two ends close to the track on which he was lying.
- i. At some stage SGT CREEGGAN probably activated CPL CARSON's Personal Locator Beacon (PLB) and removed the PLB and survival knife from CPL CARSON's ALP.
- j. At some stage, SGT CREEGGAN activated his own PLB. It is not possible to determine the order beacons were activated.
- k. Subsequently, SGT CREEGGAN appears to have moved and/or slipped about 10 metres down the hillside to the position in which he was found by F/S x.

152. The Court of Inquiry is concerned that, while the ALP acted as designed to progressively decelerate SGT CREEGGAN sufficiently to permit his survival, the 3-ring release was rendered inoperative during that sequence. Had the aircraft caught fire, or rolled into water, he would have been unlikely to have been able to release himself from the wreckage quickly enough to avoid further injury.

153. HQ 485WG 3176/7/3164, dated 25 Nov 10, informed the RNZAF Directorate of Aeronautical Configuration (DAC) of this issue and referred for action.

Post Crash Activity

154. The Iroquois Emergency Locator Transmitter (ELT) aerial was sheared off in the impact, reducing the detectable range.²⁰⁰

155. The ELT is of an old standard and transmits only on 121.5 MHz and 243.0 MHz, which are not monitored by satellite.²⁰¹ The Court of Inquiry is aware that since 01 Feb 09, SRSAT have monitored only the 406.025MHz frequency.

156. After the accident PLB Serial Number (s/n) 178, carried by CPL CARSON, was activated. The 406.025 MHz signal was detected by SRSAT S07 at 0609hrs and two unresolved positions were generated. A resolved position reached RCC NZ

²⁰⁰ Exhibit FZ

²⁰¹ Exhibit GA

at 0705hrs. The resolved position was given as S41 02 E 174 55. The difference in positions equates to approximately 1 NM but it should be noted that the resolved position put the accident site on land whereas the initial position was just off the coast. The accuracy of a 406.025 MHz position is assessed by RCC NZ as 2.7 NM. The actual position of the aircraft wreckage was S41 01.841 E174 54.549.²⁰²

157. The medical report states that it is considered '*possible, although very unlikely*' that CPL CARSON was capable of activating his PLB before succumbing to his injuries.²⁰³

158. It is likely that SGT CREEGGAN removed CPL CARSON's PLB from its ALP pocket and activated the beacon.²⁰⁴

159. The PLB carried by SGT CREEGGAN (s/n 242) was also found to have been activated but its 406.025 MHz signal was never detected by a SARSAT. The aerial connection to the life vest aerial was found disconnected and the integral aerial was unlocked from its normal position but was not locked in place at the aerial connection on the top of the beacon.²⁰⁵

160. Bay testing of PLB s/n 242 after the accident showed the beacon was serviceable except for failure of the Built In Test Equipment (BITE) visual and audio 'GO' indication, and low transmitter power on 406.025 MHz. The battery timer on the PLB indicated that 135 minutes of battery life had been used. The Court of Inquiry is confident that the large use of battery life is indicative of the beacon being used after the accident.²⁰⁶

161. SGT CREEGGAN was found downhill from the accident site. It is considered likely that he fell and/or rolled downhill after activating CPL CARSON's PLB and that this fall may have disrupted the position of the integral aerial on his PLB, which may have affected the transmission. SGT CREEGGAN was lying on his PLB when he was found. The stole antenna disconnection, the incomplete deployment of the integral antenna, the low transmitter power and the rugged terrain at the accident site, may explain the lack of detection of the 406.025 MHz signal.²⁰⁷

162. Even with significant injuries, SGT CREEGGAN's post impact actions were in accordance with his training. In his initial training on 6 Squadron, RNZAF, SGT CREEGGAN had been taught to turn on the PLB of another crew member and that, on land, the PLB should be removed from the pocket and the integral antenna deployed.²⁰⁸

163. SGT CREEGGAN apparently removed the PLB from his ALP and manually activated the beacon. This action requires more manual dexterity than activating the PLB by pulling the fitted toggle. The trained procedure that the ALP should be removed from the pocket should be reconsidered. Had SGT CREEGGAN lapsed

²⁰² Exhibit FZ

²⁰³ Exhibit FV

²⁰⁴ Exhibit FZ

²⁰⁵ Exhibit FZ

²⁰⁶ Exhibit FZ

²⁰⁷ Exhibit FZ

²⁰⁸ Witness

into unconsciousness whilst completing his drills, he would not have completed the integral antenna deployment.²⁰⁹

164. The Investigation has not been able to establish the reason for the low transmitted power from PLB s/n 242 on 406.025MHz. All serviceability tests of this beacon prior to the accident indicate that it was fully serviceable at the time of testing.

165. Further testing by the Accident Investigation Team following the accident has indicated that aerial configuration can have a significant effect on the likelihood of beacon detection. This testing, whilst not definitive or conclusive, revealed different detection characteristics when the stole antenna was used, versus the integral antenna. The Court of Inquiry recommends that further work is carried out to ensure that the optimum procedure for PLB activation is developed and implemented.

SEARCH AND RESCUE

166. BLACK 3 re-launched from Paraparaumu at about 0645hrs, when conditions were deemed suitable to start a visual search.²¹⁰ Near Pukerua Bay, BLACK 3 picked up a distress beacon on 121.5MHz and proceeded to localise it using the aircraft direction finding equipment.²¹¹

167. The crew of BLACK 3 could not gain visual contact with the accident site due to the strong onshore wind and low cloud experienced in the constricted valley. After several attempts, the Captain of BLACK 3 flew the aircraft backwards up the valley, on the HCMs' calls, into the reducing visibility whilst maintaining an into wind escape down the valley to the coast.²¹²

168. A Westpac Rescue Helicopter arrived on scene at about this time and the two aircraft coordinated their search. At 0710hrs, F/S D. x, the senior HCM onboard BLACK 3 was offloaded on a ridge below the beacon position to conduct a search on foot.²¹³ F/S x ran up through steep and scrub-covered terrain not knowing exactly where the aircraft was, or what state it was in. He had the presence of mind to yell for a possible response and coordinate using hand signals with the Westpac Rescue Helicopter whilst conducting his search in poor visibility.²¹⁴

169. On finding the wreckage, F/S x noted a strong smell of fuel. He found the bodies of FGOFF GREGORY and CPL CARSON and then he found the seriously injured SGT CREEGGAN. He administered first aid until a medic was winched in by the Westpac Helicopter. He then continued his search and found the body of FLTLT MADSEN. F/S x then used his cell phone to coordinate SGT CREEGGAN's winch extraction. When needed, the semi-conscious SGT CREEGGAN responded to F/S x verbal directions making it possible to get SGT CREEGGAN into the strop and winched out. As the rescue teams arrived, F/S x phoned situation reports and assisted as he could, handing the area over to the NZ Police on their

²⁰⁹ Witness

²¹⁰ Exhibit GA

²¹¹ Witness

²¹² Witness

²¹³ Witness

²¹⁴ Witness

arrival. F/S x was picked up from up hill of the crash site by BLACK THREE and flown back to Ohakea, arriving at 0917hrs.²¹⁵

170. In the opinion of the Court of Inquiry, F/S x conspicuous actions without regard for his own safety and role in preserving the life of SGT CREEGGAN are worthy of recognition. His physical endeavour, presence of mind, sound application of training and moral support to the seriously injured SGT CREEGGAN, undoubtedly assisted in the timeliness of the rescue and, ultimately, in SGT CREEGGAN's survival. F/S x immediately recognised the fire risk he faced because of the uncontained fuel amongst the wreckage. F/S x continued without regard for his own safety, his only concern was to find the downed crew members and offer what assistance he could.

RESPONSE

171. A review of the accident response process was undertaken by an RNZAF emergency response specialist to ensure that the response had been in accordance with RNZAF expectation.²¹⁶ This report covered 3 Squadron, RNZAF Base Ohakea, HQ JFNZ and civil agency involvement. The report concluded that the response had been in accordance with expectations.²¹⁷

172. The review also provided observations on the effectiveness of current procedures and recommendations to improve current practices. This Court of Inquiry endorses the observations and recommendations of the Response Report. The Response Report should be released for broader consideration within the NZDF. The more significant findings, observations and recommendations regarding the response are summarised below.²¹⁸

- a. There are no HQ JFNZ Watch Keeper SOP for an Air Force related accident or emergency. The Watch Keeper was forced to adapt SOP written for Army and Navy incidents.
- b. Common post accident procedures in Pilot Check Lists across all platforms do not exist.
- c. Confusion over the actual casualty status arose because of different civil and military classification scales and the speed of informal communications by telephone.
- d. Post-accident response was in line with expectation and was adequate.

POST CRASH TECHNICAL ANALYSIS

173. The focus of the initial work conducted by the Engineering Investigation Team (EIT) was to determine whether any technical defect may have precipitated the accident by preventing the aircraft from sustaining flight.²¹⁹

²¹⁵ Witness

²¹⁶ Exhibit FT

²¹⁷ Exhibit FT

²¹⁸ Exhibit FT

²¹⁹ Exhibit FQ

174. The airframe, flying controls, hydraulics, electrics, engine, fuel system, transmission, main rotor, tail boom, tail rotor, navigation systems, communication equipment and the RADALT system were all examined by the EIT and found to be working correctly immediately prior to impact.²²⁰

175. External experts from Original Equipment Manufacturers (OEM) and DTA were also used to provide independent reports to the investigation. No technical defect likely to have caused the accident was found.²²¹ The following OEM submitted reports to the Court of Inquiry:

- a. Engine, Honeywell Aerospace Inc.
- b. Airframe, Bell Helicopter Company.
- c. Fuel Control Unit, Goodrich Pump & Engine Control Systems Inc.

176. Thereafter, attention was given to discover if an incident of a technical nature may have occurred which could have distracted the crew sufficiently to precipitate the accident. Central Warning Panel and annunciator bulbs, aircraft instrumentation, and some avionics were examined by DTA. No evidence of technical distraction could be found.²²²

Serviceability of NZ 3805: BLACK 1 and NZ3809: BLACK 3

177. The only potential fault brought to the attention of the Court of Inquiry was an apparent radio un-serviceability on BLACK 3 prior to departure. From witness statements this apparent fault was due to an incorrect frequency selection by the crew. There were no reported radio system faults on NZ3809 in the previous 3 months. No faults were recorded in the F700s post flight by either BLACK 1 or BLACK 3.²²³

Serviceability NZ 3806: BLACK 2

178. NZ3806 had been unavailable for flight between 26 Jan 10 and 29 Mar 10 due to scheduled maintenance requirements and subsequent rectification work. The Phase C Servicing was carried out by 3 Squadron's Phase Team between 26 Jan 10 and 10 Mar 10. A Right Hand FS166 panel replacement was carried out at Safe Air Limited (SAL) between 11 and 26 Mar 10. The documentation for these two tasks was inspected by the Iroquois Technical Support Cell for accuracy and completeness. During this inspection no adverse observations or anomalies were noted. A full inspection of NZ3806's technical administration was conducted by the EIT.²²⁴ The Court of Inquiry recommends that the Assembling Authority consider forwarding appropriate parts of the EIT report and the recommendations to the Chief Engineer of the Air Force (CEng(F)) for his consideration.

²²⁰ Exhibit FQ

²²¹ Exhibit FQ

²²² Exhibit FQ

²²³ Exhibit FQ

²²⁴ Exhibit FQ

Iroquois Certification

179. Type certification is a NZDF process by which the NZDF Airworthiness Authority (Chief of Air Force (CAF)) authorises the operation of new aircraft types or existing aircraft types that have undergone major changes.²²⁵ Because the Iroquois fleet predates the type-certification process and it has a relatively short in-service life left to run the CAF has not retrospectively type-certified the Iroquois fleet. The decision not to type-certify the Iroquois was discussed at the Iroquois ACMB on 20 Apr 10 and the item was passed to the Airworthiness Board for review.²²⁶ The Airworthiness Board held on 20 May 10 decided that consideration should be given to Iroquois Certification (pending a review of benefits versus effort); the Board also made a commitment to manage airworthiness through the ACMB process.²²⁷

180. The requirement to certify the Fleet is detailed in DFO 92. No waiver to DFO 92 has been issued for the non-certification of the Iroquois Fleet; however, as a legacy fleet the Iroquois is a low priority for retrospective certification.²²⁸

181. The Iroquois Fleet would not be compliant with CAR parts 91 and 135 with regards to CVFDR²²⁹ and 406 MHz ELT.²³⁰ Under the New Zealand Civil Aviation Act 1990, military aviation is not obligated to comply with CAR but DFFO do undertake to follow CAR where possible.²³¹ The NZDF has recorded and reviewed these decisions through the Iroquois Risk Register.²³²

182. CVFDR evidence would have greatly accelerated the investigation of flight path and removed the need to calculate the critical flight path information of the aircraft. CVFDR evidence also would have provided the information available to the crew and their actions.

Modifications

183. One approved airframe modification was yet to be embodied. NZM/IRO/179 - Dart Skids. This fit had not been a priority for embodiment, as the Dart Skids are simply an alternative fit to the Bell Skids.²³³

184. The bolts of one tail rotor blade sheared off when the other tail rotor blade struck the ground. Inspection of the sheared bolts revealed that one nut was hard up against the bolt's shank, meaning that the correct torque was not applied to the tail rotor blade grip, only to the nut on the bolt. The other attachment bolt was found to be too short and some of the threaded portion of the bolt was inside the bush. This situation occurred because the engineering modification leaflet for the dynamic balance bracket did not include the requirement for longer bolts. DAC has since taken steps to amend the leaflet and changed all affected bolts on the fleet.²³⁴

²²⁵ DFO 92

²²⁶ IROQUOIS ACMB Minutes, dated 19 May 10

²²⁷ Airworthiness Board Minutes, dated 19 Nov 10

²²⁸ Exhibit FQ

²²⁹ Exhibit FQ

²³⁰ Exhibit FQ

²³¹ DFO 92 Ch 1, 1.4

²³² IROQUOIS ACMB Minutes, dated 19 May 10

²³³ Exhibit FQ

²³⁴ Exhibit FQ

Special Maintenance Instructions (NZSMI)

185. All applicable Iroquois and T-53 engine NZSMI's had been satisfied on NZ3806 at the date of the accident.²³⁵

Limitations – Acceptable Deferred Rectification (LADR) Log

186. There was one limitation in the RNZAF F700 IRO-3 for NZ3806. This relates to the unserviceable marker beacon.²³⁶ This is not considered relevant to this accident.

187. There were 16 entries listed in the RNZAF F700 IRO-3 for NZ3806 as LADR. All 16 entries were of a minor, routine nature.²³⁷

Aircraft Weight and Balance

188. The last aircraft weigh for NZ3806 was carried out on 11 May 06.²³⁸ No anomalies were found with the SAL F E111A, Weighing Record Sheet, or the most recent RNZAF 4747A, Weight and Balance Recalculation Sheet. This data corresponds correctly with the weight and balance figures entered in the RNZAF F700 IRO-2 Block 4.²³⁹ The aircraft's basic weight of 5873.00 lbs is consistent with the remainder of the RNZAF UH-1H Iroquois fleet, being within 1.51% of the fleet average. The Centre of Gravity at 143.85 inches aft of the aircraft datum point is within the Centre of Gravity limits for the Iroquois, 143 to 144 inches aft of the datum point.²⁴⁰

Role and Safety Equipment.

189. The role equipment and safety equipment requirements for the task were not formally briefed; however, DFFO and 3 Squadron Standing Orders detail the role and safety equipment required, and these were complied with.²⁴¹ In addition, some of IROQUOIS BLACK aircrew carried an Underwater Escape Module (UEM). There are no orders prescribing when UEM are to be carried. The Aircraft Request Form details the requirement for all role equipment, fuel, flying hours per aircraft, and F700 travellerisation.²⁴² This was correctly submitted during the planning phase of the task.

Emergency Locator Transmitter

190. The Emergency Locator Transmitter (ELT) was removed and tested after the accident. The battery was found to have a low charge which is considered indicative of it having operated as a result of the crash. A weak signal on 121.5 MHz was heard by the HCM on the Iroquois used to conduct airborne photography of the crash site on 26 Apr 10. This is attributed to the ELT because all other beacons had been deactivated by the evening of 25 Apr 10. When a serviceable battery was fitted the

²³⁵ Exhibit FQ

²³⁶ Exhibit FQ

²³⁷ Exhibit FQ

²³⁸ Exhibit FQ

²³⁹ Exhibit FQ

²⁴⁰ Exhibit FQ

²⁴¹ Exhibit FJ, DFFO 14.46

²⁴² Exhibit FQ

ELT performed to standard. Although the ELT was serviceable at impact, the ELT antenna was ripped off the airframe during the accident sequence. The loss of the antenna meant that the ELT did not produce sufficient radiated energy to be detected other than at close range.²⁴³

191. The risk of a fatality from not having a 406.025MHz ELT fitted to the aircraft, in what would otherwise have been a survivable accident was assessed as 'catastrophic/possible high' at the Iroquois ACMB 20 Apr 10. The ACMB did not mitigate the risk, but directed a review of the Capability Management Group's decision not to fit CAR 91 compliant ELT.²⁴⁴ The Court of Inquiry notes that a review does not constitute mitigation.

192. RNZAF Iroquois aircraft often operate autonomously and in austere environments. Therefore, the risk of an accident going undetected should, whenever possible, be minimised and the accurate location of the aircraft should be known as quickly as possible. In the opinion of the Court of Inquiry, the fitment of a GPS capable 406.025MHz ELT would improve the chances of survival from a future accident.

Items Secured to Pilots' Seats.

193. Iroquois aircrew survival bags have historically been secured to the pilot's and co-pilot's seats. The EIT found several items clipped to the back of the pilots' seats, these included the crew day-packs and NVG bags. The heaviest of the four day-packs weighed 20kg. The combined weight of these items would have added to the weight on both pilots' seat mounts during the deceleration of the impact. The EIT found that the left hand pilot seat was buckled from the floor upwards (impact damage) and from the top downwards (overloading from behind).²⁴⁵

194. While in this accident the overloading of the seat undoubtedly contributed to the failure of both seats, the EIT consider it unlikely to have altered the question of survivability in this accident due to the massive g-forces experienced by the aircraft.²⁴⁶ In a less heavy crash, the extra weight on the back of the seats could have been a factor in the survivability. The Court of Inquiry has already advised DAC of this issue for consideration.

Makeshift Securing Strops and Clips.

195. Makeshift securing strops and clips have been riveted or bolted onto the toolkit and picketing boxes throughout 3 Squadron role equipment stores and are used to secure them to the floor of the aircraft during flight. All three of these strop sets failed in the accident, freeing the items to move during the impact sequence. These items are heavy and present a significant hazard to the occupants of the aircraft once loose. The torn strops showed evidence of rotting and contamination. These strops are not subject to typical RNZAF servicing regimes, as there are no inspection requirements or design standards for the fitting of the strops to the boxes.

²⁴³ Exhibit FQ

²⁴⁴ IROQUOIS ACMB Minutes, dated 19 May 10

²⁴⁵ Exhibit FQ

²⁴⁶ Exhibit FQ

All items routinely carried on 3 Squadron aircraft must be approved by the NZDF Airworthiness Authority for carriage and are to be secured properly for flight.²⁴⁷

196. HQ485WG 3176/7/3164, dated 25 May 10 was a minute to DAC from the Court of Inquiry raising concern with the strop quality and Iroquois stropping system.

197. **NVG.** Seven of the eight NVG Tubes were made available to Avionics Squadron for testing.²⁴⁸ Six items tested were assessed as operational, with the remaining tube being unable to be conclusively assessed due to the damage sustained. The eighth tube was only partially recovered so could not be tested. NVG failure was unlikely to be a contributing factor.²⁴⁹

198. **Alpha Helmets.** The Alpha Helmets are designed to protect the head against loads of up to 300g and spread the point loads that would otherwise penetrate head protection.²⁵⁰ The EIT found that the accident g-loads were at or beyond the limits of the capabilities of the Alpha Helmet, although all four helmets prevented any penetration of sharp objects and performed as expected.²⁵¹

199. **ALP Garment Strops and Tail Units.** CPL CARSON was still attached to NZ3806's uppermost LHS pylon forward bulkhead cargo anchor point after the accident. The garment strop and tail unit from SGT CREEGGAN's ALP were found connected to NZ3806's uppermost RHS pylon forward bulkhead cargo anchor point. As discussed earlier, damage to the three ring quick release mechanism on the tail unit prevented it from being operated by SGT CREEGGAN.²⁵²

200. **ALP.** The ALPs were found to be generally intact with the exception of SGT CREEGGAN's quick release handle for his garment strop 3-ring release, which had been ripped from his ALP sometime during the crash sequence. Furthermore, both crewmen's ALP showed extensive ripping damage between the fabric of the ALP and their garment strop. This evidence demonstrates that the strops and ALP were subjected to significant loads during the accident.²⁵³

POSSIBLE EXPLANATIONS FOR THE PROBABLE FLIGHT PATH OF BLACK 2

Factors Considered but Discounted

201. The Court of Inquiry concurred that the following factors could be discounted as causal:²⁵⁴

- a. Crew Incapacitation. The medical investigation reports that there was no evidence to indicate crew incapacitation prior to the accident.
- b. Birdstrike. There was no evidence to indicate that the aircraft had suffered a birdstrike prior to the accident.

²⁴⁷ Exhibit FQ

²⁴⁸ Exhibit FQ

²⁴⁹ Exhibit FQ

²⁵⁰ Ministry of Defence Defence Standard 05-102 Issue 1 Publication Date 20 January 2006

²⁵¹ Exhibit FQ

²⁵² Exhibit FZ

²⁵³ Exhibit FQ

²⁵⁴ Exhibit GA

- c. Lightning Strike. There was no lightning forecast for the morning of 25 Apr 10 in the area in which the formation was due to fly. There was no evidence to indicate that the aircraft had been struck by lightning prior to the accident.
- d. Turbulence. Moderate turbulence can be experienced in wind speeds of 17kts in the lee of certain terrain. Moderate turbulence is unlikely to cause the loss of an Iroquois. The crews of BLACK 1 and BLACK 3 have not reported subsequently that turbulence in the area of Pukerua Bay was an issue.
- e. Icing. There was no icing forecast at the altitudes at which the formation intended to operate. There was no icing evident on the aircraft at the accident site and no icing reported by any other member of the formation.
- f. Foreign Object Damage (FOD). There was no evidence found to suggest any damage due to FOD had occurred on or within any major aircraft system prior to the accident.
- g. Visual Illusion. There was no indication of a visual illusion which may have convinced the crew that the valley was a clear or a safe route.²⁵⁵
- h. Technical Failure or Unserviceability. The specialist investigations found no evidence of technical failure or unserviceability prior to the accident.²⁵⁶

Deliberate Deconfliction with BLACK 1 and BLACK 3

202. The captain of BLACK 3 reported that he sat at a spacing of 4-5 rotors from BLACK 2.²⁵⁷ He also stated that during the IIMC event he was concerned that BLACK 1 and/or BLACK 2 might descend onto him.²⁵⁸ The minimum spacing on NVG is 2.5 rotors with the normal considered to be 3-5 rotors.²⁵⁹ Therefore, BLACK 2 could have been sitting anywhere from 130 ft to 240 ft behind BLACK 1 and in front of BLACK 3 as IIMC was encountered.²⁶⁰ The Court of Inquiry considers it is possible that FLT LT MADSEN decided to roll to a level attitude in order to create separation between his aircraft and BLACK 1 after going IIMC. He may also have decided to maintain that heading for 30 seconds prior to turning onto the Formation Leader's declared IIMC heading as recommended in 3 Squadron's SOP.²⁶¹

203. These actions taken in sequence would account for the ground track flown by BLACK 2, but not the climb profile. However, the Court of Inquiry considers that this course of action is unlikely for two reasons. First, BLACK 1 did not declare an IIMC heading due to a switching error at the handover of control from co-pilot to captain. Second, if BLACK 2 had sufficient SA to make the decision to fly a divergent heading from BLACK 1 it is considered likely that he would have had sufficient geographical situational awareness on the high ground to recognise the danger and take avoiding action.

²⁵⁵ This factor was considered by the Court members and based on a site visit.

²⁵⁶ Exhibit GA, Exhibit FQ

²⁵⁷ Witness

²⁵⁸ Witness

²⁵⁹ Exhibit FK

²⁶⁰ Exhibit GA

²⁶¹ Exhibit FK

Attempt to Maintain or Regain Visual Contact with Terrain

204. The flight path of BLACK 2 could have been the result of one or more of the crew maintaining partial or intermittent visual contact with terrain, particularly to the right of the aircraft. This could have resulted in the crew believing they were maintaining a flight path safely clear of terrain, either because they believed the terrain in sight was associated with the coastline and they were following that terrain northbound in the direction they wished to fly, or that they believed the valley in which they were flying would provide sufficient room to manoeuvre to follow the valley back out to the coast.²⁶²

205. The range of possible flight paths of BLACK 2 would allow an initial track approximately parallel to the beach at Pukerua Bay, rather than the coastline to the north along State Highway One. This coastline also has significant artificial (cultural) lighting, and may have been visible even while the aircraft was partially IMC.²⁶³ It is possible the crew of BLACK 2 misidentified this section of coastline as the coastline to the north, and therefore believed that by paralleling the coast, they were on a safe heading. Once they entered the valley through which they flew, any partial or intermittent visual contact with terrain to their right may have confirmed in their minds they were indeed flying safely parallel to the coast to the north of Pukerua Bay. On the other hand, any partial or intermittent visual contact with terrain to their left may have resulted in them delaying a left turn as they knew they did indeed have terrain to their left. In either case, this may have resulted in a generally easterly track after the aircraft entered partial or intermittent IMC.

206. The Court of Inquiry believes that, had the crew of BLACK 2 been in partial or intermittent visual contact with terrain, the crew would have slowed the aircraft in order to better maintain visual contact and provide greater options for manoeuvre. The Impact Analysis Report estimates the airspeed at impact to be between about 70 and 100KIAS.²⁶⁴ Such a high speed is unlikely for a crew trying to regain intermittent visual contact.

207. About 20 seconds after BLACK 3 lost visual contact with BLACK 2, FLTLT MADSEN made a calm and almost jovial radio call to the effect that BLACK 2 was IMC and climbing.²⁶⁵ Some crew members believe the call included that BLACK 2 was passing 700ft, and one believes the call included information that BLACK 2 was tracking north.²⁶⁶ Such information is unlikely if the crew of BLACK 2 were in visual contact with terrain at that time.

208. The Court of Inquiry considers that even if the crew had been maintaining intermittent or partial contact with terrain early in the emergency, this contact was lost at some stage prior to the accident, and the crew would then have been required to commence IIMC procedures.

²⁶² Exhibit GA

²⁶³ Exhibit GA

²⁶⁴ Exhibit FZ

²⁶⁵ Witness

²⁶⁶ Witness, Witness, Witness

Factors Considered Relevant

Visual to Instrument Flying Transition

209. BLACK 2 would have taken time to reorient from visual to instrument flying. No. 3 Squadron experience is that, in a controlled training environment the time taken to transition from visual to IF could be as long as 20 seconds, depending on the workload.²⁶⁷ Research shows it can take civilian qualified instrument pilots as long as 35 seconds to establish full control by instruments after losing visual references.²⁶⁸ The amount of time taken to reorient would have varied depending on a number of factors.

210. The low familiarity of both pilots with IF would have reduced the speed and ease that they could interpret and orient on instruments. Flying experience and currency reduces workload because the rehearsal and training enable the pilot to conduct/control familiar tasks at an unconscious level (automatically) which frees up the pilot's working memory for other tasks requiring more conscious control, eg dealing with a novel situation or problem.²⁶⁹ Low currency would also have increased the likelihood of the pilots making errors or omissions in their assessment of the information displayed on the instrument. The low familiarity would increase the likelihood that the pilots would take longer than average to re-orient to IF.²⁷⁰

211. The captain of BLACK 1 stated that the transition from visual to IF caused a significant workload that used all his capacity.²⁷¹ As an example, although trying to maintain a track of north, he actually tracked 030°. It is likely that the IIMC event provided a similar workload and capacity issue for FLTTL MADSEN. FLTTL MADSEN's records showed he was a good 'hands and feet' pilot but struggled in areas of decision making and SA when under high workload.²⁷² These aspects could have extended the time it took FLTTL MADSEN to transition to IF.

212. FGOFF GREGORY is likely to have experienced similar capacity issues. His flying records indicate that the only IIMC practice that he conducted on the Iroquois was as a co-pilot on his first night check, on 11 Aug 09. Therefore, he was unlikely to have been well prepared to effectively reduce FLTTL MADSEN's workload.

213. Importantly, soon after flying into IMC, FLTTL MADSEN may have been susceptible to spatial disorientation. If spatial disorientation was encountered it is likely that the FLTTL MADSEN would fly the Unusual Attitude (UA) Recovery as detailed in the IPCC Student Study Guide.²⁷³ The procedure is as follows:

- a. Release g. Only a small check forward on the cyclic is required to achieve this.
- b. Roll to wings level.
- c. Pitch to the horizon.

²⁶⁷ Witness

²⁶⁸ Exhibit FU

²⁶⁹ Exhibit FU

²⁷⁰ Exhibit FU

²⁷¹ Witness

²⁷² Witness

²⁷³ Exhibit GA

- d. Check you are above Minimum Safe Altitude (MSA) and initiate a max rate climb if below MSA.
- e. Adjust your power and attitude to stabilise at 90KIAS at or returning to your assigned altitude.
- f. Establish the cause of the UA.

214. The Impact Analysis Report estimates that BLACK 2 entered IIMC on a track of approximately east.²⁷⁴ The first three actions of the UA procedure would have been the priority and could explain, at least in part, the probable flight path of BLACK 2 up the valley.²⁷⁵

215. Immediately after BLACK 2 disappeared from view BLACK 3 witnessed the illumination of BLACK 2's searchlight. The time spent trying to regain visual reference would have delayed his transition from visual to IF. Extending the period of time without visual reference increased the risk of disorientation.

Radar Altimeter Equipment and Procedures

216. When asked about over water qualification by the captain of BLACK 3 south of Paraparaumu, FLTLT MADSEN was heard to reply by several formation members that 50 ft was set.²⁷⁶ The fact that a positive radio call regarding the RADALT low set index was made by FLTLT MADSEN supports the Engineering Investigator's assessment that there was no known fault with the RADALT on NZ3806.²⁷⁷ The 50ft setting was not in accordance with 3 Squadron SOP 403, which states that 200ft is to be set when operating at 250 ft LLOW.²⁷⁸

Low Height Warning

217. The Iroquois RADALT each include a warning function for flight below a set height. Each pilot can independently set a height on their RADALT's 'low set index,' more commonly called the 'height bug'. The warnings are a small red 'Cherry' light on the RADALT display, and a series of five high pitched pulses through the Intercom System (ICS) when the aircraft descends through each warning height. The warnings are very intrusive but are only of short duration. Because the RADALT senses only the height directly under the aircraft the RADALT is unlikely to provide adequate and reliable warning of impending flight into terrain in front. However, it does give the crew SA relative to their current proximity to terrain below.²⁷⁹

218. Analysis of the topography of the terrain leading toward the initial impact site indicates the low set index, if set to 50 feet, is likely to have operated only 0.5 seconds prior to impact. If the low set index had been set at 200 ft, the low height warning almost certainly would have operated as BLACK 2 entered the valley approximately 19 seconds before impact. This earlier warning may have provided sufficient warning for the crew to take action and climb away from terrain.

²⁷⁴ Exhibit FZ

²⁷⁵ Exhibit FU

²⁷⁶ Witness, Witness

²⁷⁷ Exhibit FQ

²⁷⁸ Exhibit FK

²⁷⁹ Exhibit GA

Crew Response to Low Height Warning

219. Research indicates that processing of auditory stimuli is one of the first sensory functions to fall from conscious awareness during high workload events.²⁸⁰ It is, therefore, possible that even if the audio tone operated at some point in the IIMC event it may not have been registered by the pilots of BLACK 2.

220. The Court of Inquiry could not find any guidance within DFFO, 3 Squadron Standing Orders, or 3 Squadron SOP relating to required crew reactions to an unexpected RADALT audio or visual alert. Neither is there evidence of training for aircrew in these aspects of operations. Without an appropriate and trained response to the low height warning, an immediate and positive response such as application of power and climb away from terrain would have been less likely.²⁸¹

221. It is the view of the Court of Inquiry that 3 Squadron's procedures lack appropriate guidance to crews on the use of the RADALT as an instrument that can enhance SA and improve flight safety. The RADALT is not a collision proximity warning system, but it can be used to provide some awareness of where terrain is below the aircraft and therefore is some assistance in navigation over terrain.

222. The Court of Inquiry notes that aircraft systems such as Enhanced Ground Proximity Warning Systems (EGPWS) and moving map displays provide better situational awareness of terrain than a simple RADALT. A terrain proximity warning system should be fitted to all NZDF aircraft that operate in close proximity to terrain and that are capable of having such equipment fitted.

Crew Duties in Instrument Flying

223. Non flying pilot duties for IF are listed in 3 Squadron SOP 107. They are listed as:²⁸²

- a. Monitoring the flying pilot and advising critical headings and altitudes,
- b. Operation of radios and navigation aids,
- c. Lookout,
- d. Navigation,
- e. In-flight checks, and assisting the flying pilot to calculate drift angles.

224. Specific duties are not detailed in SOP for an IIMC event. In the opinion of the Court of Inquiry, the list above offers only generic guidance and is unlikely to unload the flying pilot in an IIMC event.

225. The Court of Inquiry found no evidence that the role of the non-flying pilot in IF is formally taught or assessed on 3 Squadron. In the opinion of the Court of Inquiry, if the role was better defined, taught, and assessed, and adequate guidance was provided in SOP the non-flying pilot would be better able to support the flying pilot.

²⁸⁰ Exhibit GA

²⁸¹ Exhibit FU

²⁸² Exhibit FK

226. As a result of the bias towards flying IF from the right hand seat co-pilots do not routinely practise IF in the left seat, from where they predominantly fly operational sorties. The offset instrument fit in the Iroquois to the right coupled with the poor attitude reference for the left seat pilot from the Artificial Horizon (AH) makes the Iroquois more difficult to fly on instruments from the left seat.²⁸³ No. 3 Squadron Standing Orders and 3 Squadron SOP direct that the flying pilot occupies the right seat for IF practice.²⁸⁴ As a result, the training regime on 3 Squadron trains pilots to fly the aircraft on instruments from the right seat. Almost all IF is undertaken from the right hand seat.²⁸⁵ This may explain why the co-pilot of BLACK 1 handed control of the aircraft to his captain as conditions deteriorated through the left turn at Pukerua Bay.²⁸⁶ Had the co-pilot of BLACK 1 continued to fly the aircraft as it went IIMC, the captain would probably have had the capacity to direct the formation IIMC procedure in a more effective manner.

IROQUOIS BLACK Communications After Entering IIMC

227. The short notice hand over of control from co-pilot to pilot of BLACK 1 caused a radio/intercom control switching omission.²⁸⁷ This resulted in the captain of BLACK 1's radio call, briefing an IMC heading of north not being transmitted to the formation. Had the call been made it may have prompted BLACK 2 to consider their aircraft heading earlier.

Formation Responsibilities as BLACK 2

228. The Court of Inquiry believes that the crew of BLACK 2 may have perceived their role as being, in a sense, passive, requiring little input to the formation. In turn, this may have created a greater reliance on the Formation Leader for the management of the sortie, including navigation and decision making.

229. As a result, the focus of BLACK 2 would likely have been in the maintenance of a good formation position in the challenging weather conditions. They probably paid less attention to the detail of navigation and SA. The possible passive mindset of the crew of BLACK 2 would have left them less well prepared for the IIMC event.

NVG IIMC Training

230. The difference in emphasis given to an IIMC event on NVG between 3 Squadron training documentation and United States Air Force (USAF) training documentation are indicated by the comparison of the extract from the respective publications below.²⁸⁸

- a. 3 Squadron: *'Although not strictly an emergency, inadvertent IMC with NVGs is worth a mention. There are only a couple of points to stress as the procedure remains the same as for unaided inadvertent IMC recoveries.'*

²⁸³ Exhibit GA

²⁸⁴ Exhibit FJ, Exhibit FK

²⁸⁵ Exhibit GA

²⁸⁶ Witness

²⁸⁷ Witness

²⁸⁸ Exhibit GA

- b. USAF: *'One of the most dangerous situations that can be experienced during NVG operations, and one with which students should be thoroughly familiar, is flight into undetected meteorological conditions. This has been and continues to be a real threat in all rotary wing communities, and has been implicated in several NVG related mishaps.'*

231. This view of IIMC is redressed in 3 Squadron SOP 406 which describes IIMC as *'a real danger'*.²⁸⁹ However, the new Iroquois pilot's first contact with NVG training suggests that IIMC is not strictly an emergency.

232. According to the IPCC Sortie Cards, the IIMC procedure is taught on a single training sortie and is not flown as part of a formation. The text suggests that the teaching involves a low level 180° turn followed by an instrument approach; a climb is not mentioned.²⁹⁰ The IPCC Sortie Cards lack sufficient detail to allow the Court of Inquiry to make a thorough assessment of IIMC instruction. The instructor guide which would normally promulgate the details of the teaching is out of date and does not contain any information on IIMC on NVG.²⁹¹ The procedure does not appear to be taught or consolidated anywhere else on the IPCC.

Formation IIMC SOP

233. No. 3 Squadron SOP relating to formation IIMC are disjointed and spread across several publications. No 3 Squadron SOP 206 gives some general advice on formation IIMC procedures. SOP 405 discusses NVG formation, including Staggered Trail NVG Formation. Further, the detailed Staggered Trail formation IIMC actions are contained in 3 Squadron Confidential SOP.²⁹² The IIMC procedure in Confidential SOP is a complex procedure which is neither easy to understand nor commit to memory and retain without frequent revision.²⁹³ The result is that IROQUOIS BLACK briefed SOP 206 opposed to the confidential IIMC SOP specifically produced for NVG Staggered Trail Formations.

234. There is no justification for the security caveat on the Confidential SOP for Staggered Trail Formation IIMC procedure. At present, the split locations make it more difficult to get a comprehensive understanding of formation IIMC actions.

235. The formation IIMC procedure as promulgated in Confidential SOP is also inherently unsafe due to the risk of mid-air collision.²⁹⁴ As the various formation SOPs stand at present, a trailing aircraft in an element has an arc of freedom 30° either side of the longitudinal axis of the element lead aircraft. In Staggered Trail Left, this allows the No. 2 aircraft to sit up to 30° to the right of the lead. However, on going IIMC while sitting in this position the No. 2 is required to fly through the centreline of the lead aircraft, which may not now be visible to No. 2, in order to take up the correct IIMC heading. Given the proximity of the lead aircraft (the minimum spacing is 2.5 rotors, or about 125 ft) this would be both an uncomfortable and unnatural manoeuvre for the pilot of the trailing aircraft and creates a real risk of

²⁸⁹ Exhibit FK

²⁹⁰ Exhibit FB

²⁹¹ Exhibit GA

²⁹² Exhibit DG

²⁹³ Exhibit GA

²⁹⁴ Exhibit GA

collision.²⁹⁵ The procedure should be amended for IIMC from staggered trail formation.

²⁹⁵ Exhibit GA

ANALYSIS OF COMPLIANCE WITH AND EFFICACY OF ALL ORDERS, INSTRUCTIONS AND PUBLICATIONS.

236. The foreword to DFFO states that ‘flying orders exist as a permanent means to govern flying operations across all RNZAF formations.’²⁹⁶ Regulations and procedures relevant to the governance of 3 Squadron and this flight begin, at the broadest level, with CAR and DFFO, then become progressively more detailed through 485 WG Standing and Temporary Orders, 3 Squadron Standing and Temporary Orders, 3 Squadron SOP (Restricted and Classified) and 3 Squadron Training and Categorisation/Currency Manuals. For this investigation, Iroquois Upgrade Sortie Cards were also considered as they provided information on aircrew training not available in the Training Manuals.

237. Orders, instructions and publications are important in this accident for two reasons. First, if orders and instructions had been adhered to, IROQUOIS BLACK would not have narrowed their margin for error with respect to cloud and terrain as much as they did. To remain compliant with existing orders that day they would have had to find another way to complete the task. Failing that, they would have had to cancel the task.

238. Second, if the orders, instructions and procedures had been effective and adhered to, the crew of BLACK 2 may have had the knowledge and skills to more quickly assess their situation and fly an escape.

239. In keeping with the role of orders in the governance of flying operations, the discussion of efficacy of orders is extended to include comment on the efficacy of the governance processes within the RNZAF, including ACMB, 485 WG Compliance Audits, RNZAF FSE Reporting and the command structure over 3 Squadron at the time of the accident.

COMPLIANCE

240. The Court of Inquiry has determined that a total of 24 relevant Civil and Defence Force orders, instructions and publications may not have been complied with in the course of the IROQUOIS BLACK task. The possible incidents of non-compliance included organisational, operational and technical aspects of the task.

241. The following discussion of compliance with orders is broken into compliance in the tasking, planning, authorisation, conduct and management of the flight. Compliance with maintenance orders, instructions and procedures are also noted. For reference DFFO as at 25 April 2010 are at exhibit FI.

Compliance in Tasking

242. The tasking for IROQUOIS BLACK stated that the speed limitation was only ‘speed for best effect.’²⁹⁷ This may have infringed DFFO in that DFFO 8.16 requires that tasking authority is to include speed limitations if the task is to over fly spectators

²⁹⁶ DFFO, Foreword, para 1

²⁹⁷ Exhibit BA

Compliance in Planning

243. The planning for the IROQUOIS BLACK, ANZAC Day task may have been non-compliant with the following orders, instructions and publications in that:

- a. IROQUOIS BLACK planned, and were authorised, to fly NI 250ft MSD for the NVG transit Ohakea to Wellington without conducting a route survey by day.²⁹⁸ DFFO 2.196 requires that a route survey is conducted by day prior to authorisation of cross country helicopter operations using night vision systems below 500ft MSD.
- b. IROQUOIS BLACK planned to fly to NI 300ft MSD for all the fly pasts in Wellington without a site reconnaissance of the fly past sites being conducted.²⁹⁹ DFFO 8.27 requires that a reconnaissance of the intended display site and adjacent areas is conducted to ensure all hazards and limitations for the display are identified and accounted for in the flypast.
- c. When the formation leader decided to change the route to Wellington, an MSA for each route segment was not recalculated.³⁰⁰ DFFO Chapt 2, annex b, para 13 requires that safety altitudes for low-level flights in VMC are to be calculated for each route segment.
- d. No. 3 Squadron temporary order T7/09, dated September 2009, was approved by COMMANDER A.³⁰¹ DFFO 12.5 requires that COMMANDER B approve temporary order books.
- e. DFFO 10.17 allocates responsibilities for individual crew members to ensure that currency programmes are instituted and maintained. None of the IROQUOIS BLACK aircrew had achieved their complete currency requirement in accordance with the NZAP9215.³⁰²

244. The Court of Inquiry notes that the apparent incidents of non-compliance above were routine practice on 3 Squadron at the time.

Compliance in the Flight Authorisation

245. The Flight Authorisation for IROQUOIS BLACK may have been non-compliant with orders, instruction and publications in that:

- a. DFFO 8.2(a) defines ceremonial flypasts of a public gathering as display flying. DFFO 8.5 directs that officers below Squadron Commander status are not to authorise formation displays. As he was not the Squadron Commander, the Acting Utility Flight Commander was not empowered to authorise the flypasts.³⁰³

²⁹⁸ Exhibit BL

²⁹⁹ Exhibit BL

³⁰⁰ Witness, Witness

³⁰¹ Exhibit BV

³⁰² FEMS

³⁰³ Witness

- b. DFFO 2.90 requires that formation leaders must be qualified to lead a formation. 3 Squadron Iroquois Upgrade Sortie Cards show that NVG Formation Lead is not taught until the qualification above that held by all IROQUOIS BLACK captains.³⁰⁴ None of the pilots of IROQUOIS BLACK were qualified to lead a formation on NVG.³⁰⁵
- c. DFFO 1.46 requires that the Flight Authorising Officer ensure that the crew is competent and qualified to undertake the task and flight. Some aircrew of IROQUOIS BLACK were not fully qualified nor fully current.³⁰⁶
- d. DFFO 2.196 and 8.27 require that Flight Authorising Officers ensure that route and display area survey reconnaissance are conducted as a prerequisite for the authorisation for low level cross country navigation flight and 300ft MSD ceremonial flypasts. Route and display areas surveys were not conducted by day.³⁰⁷
- e. DFFO 2.194 requires that night cross country operations are to be conducted in accordance with MILOPS. MILOPS was not included in the flight authorisation process.³⁰⁸
- f. The RNZAF1575 was not in accordance with DFFO 1.40(b). The aircraft registration number for BLACK 2 was not entered correctly.³⁰⁹
- g. The RNZAF1575 was not in accordance with DFFO 1.40(i). The formation distances were not annotated.³¹⁰
- h. DFFO 1.47 states that, in acknowledging a flight authorisation, Aircraft Captains (and Mission Commanders if appointed) acknowledge that the flight has been planned and briefed iaw orders and instructions. If the route survey was not conducted, as outlined above, the flight was not planned in accordance with orders.³¹¹

246. Again, the Court of Inquiry notes that all the apparent non-compliance within this particular flight authorisation were routine practice on 3 Squadron at the time of the accident.³¹²

Compliance in Flight

247. During the flight, the following acts may have been non-compliant with orders, instructions and procedures:

- a. Aeronautical Information Publication (AIP) Vol 1, Table ENR 1.2-3 requires a minimum cloud base of 1500ft for VFR operations at an unattended

³⁰⁴ Exhibit FB

³⁰⁵ RNZAF 5200 Witness, RNZAF 5200 Witness

³⁰⁶ FEMS

³⁰⁷ Exhibit BL

³⁰⁸ Exhibit BL

³⁰⁹ Exhibit BL

³¹⁰ Exhibit BL

³¹¹ Exhibit BL

³¹² Witness

airfield at night. IROQUOIS BLACK departed Ohakea under a cloud base of 1000ft, without a MILOPS authorisation.³¹³

- b. DFFO 2.9 requires operations under MILOPS to be formally authorised prior to flight. MILMIN, a category of MILOPS, was not included in the flight authorisation.³¹⁴ A MILMIN authorisation would have allowed IROQUOIS BLACK to operate at less than the prescribed civil IFR or VFR meteorological minimums by day or night.
- c. DFFO 2.113(a) requires that, while low flying, towns are to be avoided by 1.5nm lateral separation. IROQUOIS BLACK flew within 1.5nm of Paraparaumu, Paekakariki and Pukerua Bay townships.³¹⁵
- d. DFFO 2.113(d) (1) requires that while low flying, unattended airfields are to be avoided by 3nm or 3000ft vertically. IROQUOIS BLACK flew within 3nm and 3000ft of Paraparaumu airfield.³¹⁶
- e. DFFO 2.105(a) states that 'aircraft captains are not to operate inside the authorised MSD for any part of the flight. BLACK 3 flew below 250ft MSD in the course of this flight.³¹⁷
- f. No. 3 Squadron Temporary Order (T07/9) sets a minimum cloud base for NVG CT Captains of 600ft. IROQUOIS BLACK flew under a varying 250-500ft cloud base from Paraparaumu to Pukerua Bay.³¹⁸

248. The Court of Inquiry notes again that these apparent non compliance were common on 3 Squadron at the time. All aircrew interviewed (including aircrew not on 3 Squadron) could relate instances when significant breaches of orders and procedures by other 3 Squadron aircrew had apparently passed without command action being taken. This especially applied to infringements of MSD, meteorological minima and over-running crew duty.

Organisational Compliance

249. In the management of 3 Squadron, the organisation may have been non-compliant with NZDF and RNZAF orders with respect to the following:

- a. The crew currency requirements relevant to this flight had lapsed for some IROQUOIS BLACK members.³¹⁹ DFFO 10.17 requires COMMANDER B to implement aircrew categorisation and currency schemes. The NZAP 9215, Iroquois Aircrew Categorisation and Currency Scheme, adds that COMMANDER B is responsible for supervising the scheme and that COMMANDER A is responsible for administering the scheme. The respective commanders may have been non-compliant in that they did not meet their obligations to supervise and administer the scheme.

³¹³ Witness

³¹⁴ Exhibit BL

³¹⁵ Exhibit GA

³¹⁶ Exhibit GA

³¹⁷ Witness

³¹⁸ Witness, Witness, Witness

³¹⁹ FEMS

- b. In the course of this investigation, a number of earlier events were reviewed that reflected possible contravention of flying orders.³²⁰ The AFDA (1971), section 102, requires that, if it is alleged that a serviceman has committed an offence, the commanding officer of that person must see that the allegation is recorded and investigated.³²¹ That, to the Court of Inquiry's knowledge, the respective commanders did not see that these events were investigated as allegations may have been an infringement of the AFDA(1971) section 102.

Aircraft Maintenance Compliance

250. Aircraft maintenance compliance issues were addressed as they were noted. Where applicable, the actions taken are listed as 'Action' points. The following possible technical infringements were noted:

- a. The Siphon Breaker Vent Valve (known as the Roll-over Valve) was incorrectly lockwired on NZ3806.³²² This caused the ball in the valve to be held in a depressed position. This in turn increased the fire hazard after the accident because the valve allowed fuel to leak after the aircraft came to rest on its side.³²³
- b. There was a discrepancy between the dates of the last entry recorded in the RNZAF 343, Compass Log Book, dated 26 May 2006 and the deviation card fitted to the aircraft, dated 23 Jan 09.³²⁴ The Court of Inquiry has not been able to ascertain the reason for the card replacement. There was no record of a compass swing being conducted on 23 Jan 09.

251. DAC released NZSMI/IRO/319 on 28 Apr 10, requiring all Iroquois Siphon Breaker Vent Valves to be inspected prior to next flight to ensure correct lockwiring. One aircraft, NZ3801, was found with incorrect lockwiring and rectified.³²⁵

252. An amendment has been raised to NZAP 6210.002-2.2, Iroquois Maintenance Manual, reinforcing the hazard associated with an incorrectly lockwired valve.³²⁶

EFFICACY OF ORDERS, INSTRUCTIONS AND PUBLICATIONS

Introduction

253. The large number of apparently routine non-compliances found in the course of this investigation makes it evident to the Court of Inquiry that the subject Orders, Instructions and Publications have not been effective in providing a 'permanent means to govern flying operations.'³²⁷

³²⁰ Exhibit GA

³²¹ AFDA(1971), section 102

³²² Exhibit FQ

³²³ Exhibit FQ

³²⁴ Exhibit FQ

³²⁵ Exhibit FQ

³²⁶ Exhibit FQ

³²⁷ Exhibit FI

Efficacy of Defence Force Flying Orders, 3 Squadron Standing Orders and 3 Squadron Temporary Flying Orders

254. As a reflection of the state of flying orders, both the Accident Investigation Team and this Court of Inquiry spent a significant amount of time trying to interpret and assess the applicability of the various Orders and Instructions relevant to this flight. Low flying orders in particular were found to be incomplete, often written ambiguously and with clauses that made them apparently discretionary.

255. By way of example to the contradictory nature of DFFO:

- a. DFFO 2.105 states '*..MSD specified in these orders are absolute...(b) Infringement of MSD is an offence under the AFDA.*'
- b. DFFO 2.118 allows that '*Aircraft Captains may be forced to engage in low flying due to unfavourable weather....though their primary task does not specifically include such authorisation.*'

256. The second order apparently negates the first. The incongruence between these orders had caused recent discussion on 3 Squadron, with the consensus being met that the latter order allowed captains' discretion in relation to weather minima if they deemed it necessary to do so.³²⁸

257. Similarly, detail of required standards is missing from DFFO. An example of this is in the absence of a description of what is entailed in a route survey, as required for NVG low level flight under DFFO 2.196.

258. No. 3 Squadron Standing Orders, NZAP 9215 Iroquois Aircrew Categorisation and Currency Scheme, and NZAP 9230 Manual of Training for Iroquois Aircrew do not adequately describe the requirements for the pilot qualifications commonly used on 3 Squadron. For example, the Iroquois Upgrade Sortie Cards (AL20 dated Feb 10) are the only publication that indicates that a NVG Spec Ops Provisional (Prov) qualification is the first place where NVG formation lead qualification is attained. The higher level orders and instructions did not mention the NVG Formation Leader qualification requirement. This particular example contributed to squadron executives incorrectly assuming that an NVG CT Captain would be qualified to lead a NVG formation. Being Spec Ops Lead Prov qualified may have given the Formation Leader more knowledge to make better decisions, for example he may not have selected the more difficult Trail Formation on NVG.

259. The discrepancies and deficiencies of flying orders, instructions and publications in relation to 3 Squadron had been noted at least one year earlier, during the 485 WG Compliance Audit and as recently as the ACMB of 20 Apr 10.³²⁹ No. 3 Squadron had forwarded some amendments to 485 WG since the Apr 09 Audit.³³⁰ Several were outstanding at the time of the accident and had been for some time.

260. The ACMB recorded that the risk of out of date publications should be mitigated through the review of orders and managed within the flight authorisation

³²⁸ Exhibit AT

³²⁹ IROQUOIS ACMB Minutes, dated 19 May 10

³³⁰ Witness, Witness

process. In the wake of this accident, 3 Squadron have conducted their own review of orders and publications. This review has not yet been carried over to a comprehensive amendment of these publications.

261. That the deficiencies had been recognised for some time but had not yet been addressed, undermined confidence in the orders. This, coupled with the ambiguity of the orders, led to a belief that some were open to interpretation.³³¹ A clear and timely system for the review and amendment of orders is necessary to avoid this situation.

262. The primary justification given by members for the 3 Squadron interpretation of orders was that some flying rules were too restrictive for RNZAF helicopter operations. It was believed that if the orders were followed to their most restrictive interpretation, they would prevent 3 Squadron completing many of the tasks that are required of the Squadron.³³² That it was right to 'interpret' orders was reinforced through the high regard 3 Squadron is held in for its ability to complete tasks.

263. Temporary Order T7/09 – NVG Orders, dated Sep 09, also has aspects of concern to this Court of Inquiry in that it:³³³

- a. Allows less qualified wingmen to be led into weather poorer than their qualifications and categorisation allow, by a higher qualified lead captain for who, by virtue of their higher qualification was allowed lower minima.
- b. Allows a SAR Captain to use discretion to fly below their ordered NVG meteorological minima if they consider it necessary. The decision is to be based on the Captain's assessment of the experience and ability of the crew and the direction and intent of the authorising officer.
- c. Effectively allows QHI's to operate under NVG without a NVG currency check requirement. The Order does recommend that QHI do not self-authorise 'whenever possible with a lapsed NVG currency.'

264. There was a distinct gap in DFFO in respect to helicopter specific operations, such as winching, monsoon bucketing, under-slung load transfer and NVG operations. The civil aviation equivalent to helicopter specific orders is CAR 95. There is no reference between DFFO and CAR 95, as there is for CAR 91.

EFFICACY OF RNZAF PROCESSES FOR COMMAND OF FLYING

265. This Court of Inquiry extended the assessment of efficacy to those processes put in place by the NZDF to govern the standard of flying operations, including the apparent efficacy of RNZAF Airworthiness and Capability Management Groups, 485 WG Compliance Audits, the RNZAF Flight Safety System and the governance structure over 3 Squadron at the time.

³³¹ Witness, Witness

³³² Witness

³³³ Exhibit BV

Iroquois Airworthiness Capability Management Board

266. The inaugural Iroquois ACMB was conducted at Ohakea on 20 Apr 10. In addition to the risks arising from the status of publications (already noted above), also registered were:³³⁴

- a. The risk of RNZAF aircrew exceeding limits during 'critical tasks, such as SAR.' This was assessed as 'MEDIUM' risk, through 'UNLIKELY' probability and 'MODERATE' potential consequence. It was to be mitigated by targeted training, education and supervision, including the flight authorisation process.
- b. The risk of 'insufficient crash response' due to the UH-1H ELT not transmitting on 406.025 MHz. This was assessed as 'HIGH' through 'POSSIBLE' probability and 'CATASTROPHIC' consequence. There was no mitigation planned.

267. To the Court of Inquiry, the rating and mitigation of risks by the ACMB when compared against this accident, raises questions about the effectiveness of the ACMB process. The evidence demonstrates that the probability of aircrew exceeding limits was significantly higher than assessed by the ACMB. The Court of Inquiry is also concerned that a risk was identified as potentially catastrophic, but no action was intended to treat the risk. In fairness, this ACMB may have occurred too close to the accident to have time to take substantial effect on the outcome of this flight. Further analysis on the efficacy of the ACMB process, as a means to identify and control risk should be undertaken.

485 WG Audit

268. 485 WG audits of 3 Squadron were conducted in Dec 04, Jul 06, and Apr 09, in accordance with DFO 92.³³⁵ While these audits were in discovering areas of non-compliance with extant airworthiness requirements, they do not appear to be effective at ensuring timely and appropriate action is taken to rectify all non-compliant issues, nor that the action taken provides a permanent solution. For example, irregularities in the management of aircrew F5200 documentation are noted in each audit.³³⁶ Additionally, NZAP 9230 was identified in 2006 as being in need of a rewrite in order to align it with 2006 flying practises. The 2009 audit notes that this work remains outstanding. This work was still outstanding at the time of the accident.

269. The 485 WG audit process appears to address what might be described as 'housekeeping' functions within a flying unit. Currency and categorisation documentation is checked, orders and instructions on the unit are checked, command and control documentation is checked.³³⁷ This is important work, but the reports do not offer commanders any indication of the quality of the processes and personnel used to plan and execute military air operations. The audit fails to give an independent assessment of the ability of a Force Element (FE) to safely and efficiently generate the outputs expected of it. The audit does not highlight areas of

³³⁴ IROQUOIS ACMB Minutes, dated 19 May 10

³³⁵ DFO 92, Defence Force Orders for Airworthiness, Chapter 3, Section 5, Compliance Assurance

³³⁶ Exhibit GA

³³⁷ DFO 92, Defence Force Orders for Airworthiness, Chapter 3, Section 5, Compliance Assurance

weakness in operational capability and does not result in effective action being taken to address the issues raised.³³⁸

270. 485 WG staff also added confusion during the 2009 Wing Audit when a staff member told a 3 Squadron executive that Squadron Temporary Orders did not need 485 WG approval.³³⁹ This advice was contrary to the requirements of DFFO 12.5.³⁴⁰

Overload of the RNZAF Flight Safety Management System

271. The FSE Reporting system is an important part of the RNZAF flying monitoring system. Safety events may be reported by either an electronic FSE Report, or an XX Confidence Aviation Reports of Unspeakable Sins (ICARUS).³⁴¹ The intent of the RNZAF reporting system is similar to that of other Commonwealth Air Forces and is a necessary system for monitoring trends and fully investigating incidents.³⁴²

272. The RNZAF FSE system has become clogged and unwieldy. Current regulations require that FSE Reports are dispatched to the Flight Safety Office within two calendar months of the event.³⁴³ On 25 Apr 10, 3 Squadron had 148 FSE reports open. Of this number, 81 were still under action on the Squadron. In 2009, it took an average of 7.8 months for an FSE Report to leave 3 Squadron, and an average of 14.3 months for an FSE Report to be closed by the Flight Safety Office.³⁴⁴ This represents a significant delay in the ability to identify and mitigate unsafe situations. This situation is not unique to 3 Squadron.³⁴⁵

273. From late 2009, the Flight Safety System at Ohakea became progressively more overloaded as the only Safety Office at Ohakea got diverted into more pressing work, such as other Courts of Inquiry.³⁴⁶ The consequence of this overload was that reports were not being processed, and trend analysis of FSE reports was not carried out. The Safety Office became simply reactive and unable to conduct pro-active accident prevention work. The overloading of the Flight Safety System meant that opportunities to identify and act on flight safety issues may have been missed. This situation still exists.³⁴⁷

Requirement for the RNZAF Confidential Reporting System

274. In the course of this Inquiry it was noted that the RNZAF NZAP 201 para 5.8 provides:

“Disciplinary action is incompatible with the full and free investigation of FSE’s essential to any safety programme. For this reason, results of flight safety investigations are not to be used as evidence to support disciplinary action of any kind except with respect to a Court of Inquiry in support of a charge of

³³⁸ Exhibit GA

³³⁹ Witness

³⁴⁰ Exhibit EO

³⁴¹ NZAP 201

³⁴² Exhibit GA

³⁴³ NZAP 201 Paragraph 5.39.d

³⁴⁴ Exhibit GA

³⁴⁵ RNZAF FSE Database

³⁴⁶ Witness

³⁴⁷ FSE Reporting System

making a false statement, or perjury, as provided by RP 158(3). ... Care is to be taken to divorce any disciplinary proceedings from the FSE investigation:

275. It should be noted that RP158 has been repealed, but there are similar provisions in AFDA s 200S. It should also be noted that RNZAF NZAP 201 para 5.8 refers to the results of flight safety investigations not being used as evidence to support disciplinary action. On a strict interpretation, there is no restriction on information supplied as part of the FSE reporting being so used.

276. The provisions of the NZAP 201 have been interpreted by RNZAF personnel so as to allow witnesses to report openly all the information that they have, without concern that they may need to exercise their own right against self-incrimination. It may well be that this interpretation is incorrect, and there is no such protection. By contrast, the effect of AFDA s 200S is that no part of the proceedings of the Court of Inquiry may be used as the basis of disciplinary proceedings, and there is genuine protection for disclosures made to a Court of Inquiry.

277. The evidence protection provisions of NZAP 201 are an important tool in ensuring that critical (and potentially fatal) flight safety issues are discovered and remedied quickly.

278. The investigative tool of the NZAP 201 (as currently interpreted) is incompatible with the mandatory requirements of AFDA s 102. AFDA s 102 provides (emphasis added):

*“If it is alleged that a person subject to this Act has committed an offence against this Act, the commanding officer of that person must, unless he or she considers that the allegation is not well founded, either—
(a) cause the allegation to be recorded in the form of a charge and to be investigated in the prescribed manner; or
(b) cause the allegation to be referred to the appropriate civil authority for Investigation”.*

279. There is no provision for the separation of flight safety and disciplinary investigations within the AFDA.³⁴⁸ Although the Court of Inquiry process provides some protection from disciplinary action by virtue of AFDA s 200S, this is often a time consuming, expensive and inefficient process.³⁴⁹

280. This inconsistency should be addressed to ensure that the correct balance is struck between the organisational needs to:

- a. quickly and accurately identify the lessons from flight safety incidents through full and open investigation, and
- b. uphold the disciplinary requirements of the AFDA.

³⁴⁸ AFDA 1971, section 102

³⁴⁹ AFDA s 200S(1): *The record of proceedings and any evidence in respect of the proceedings, including any confession, statement, or answer to a question made or given by a person during the proceedings, must not be admitted in evidence against any person in any other proceedings, judicial or otherwise.*

281. RNZAF NZAP 201 also describes an xx-confidence reporting system (ICARUS) where an individual can report anonymously, perhaps *‘due to concerns about disciplinary action.’*³⁵⁰ The report is then processed anonymously, usually by the Flight Safety Officer to whom it is made.³⁵¹ Again, this process is inconsistent with AFDA s102.

282. As with the FSE reporting system dealt with in RNZAF NZAP 201, the AFDA does not provide protection for those who report a FSE through the ICARUS process.

Efficacy of the RNZAF Oversight of 3 Squadron

283. A number of reports brought the command effectiveness in the management of 3 Squadron’s culture into question.³⁵² The Accident Analysis Report noted several incidents and allegations relating to apparently significant breaches of safe flying practice and rule breaking. In each case, command elected to deal with the incidents by briefing the officers concerned, rather than undertaking a more transparent formal method of investigation. The influence on the 3 Squadron culture of the less formal path elected by command is discussed later in the section on 3 Squadron culture.³⁵³ The culture section finds that, in not acting in an open and transparent manner to investigate and correct the issues, command missed a number of opportunities to be effective in the management of the negative aspects of the Squadron’s culture.

284. In the opinion of the Court of Inquiry, the unclear allocation of command responsibility above 3 Squadron contributed to commanders not being certain who had responsibility to act in the above situations.³⁵⁴ The RNZAF management of flying above the Squadron level was based on a complex functionally aligned system that was introduced in 2001. Under Project REFOCUS, the functional command system replaced geographically co-located Base Commanders, who until then had managed all flying operations on their respective Bases. The current system requires that COMMANDER A reports directly to either the ACC or COMMANDER B depending on the subject. To complicate matters further, pilot training at Ohakea, was commanded by Commander Training (based in Woodbourne), who reported directly to the Deputy Chief of Air Force (DCAF) (in Defence House, Wellington). Understandably, sometimes reporting lines got crossed and responsibilities were unclear. Frustration with the system was apparent with witnesses describing the situation for 3 Squadron as ‘like working under divorced parents, Mum is in Auckland, Dad is in Upper Hutt.’³⁵⁵

285. Beyond flying operations, the engineering, logistics and personnel resources necessary to meet operational outputs are controlled by parallel organisations that answer to various directorates in RNZAF Headquarters, in Wellington – none of which are under the control of either COMMANDER B or ACC. The complexity of the current system is a constant distraction for COMMANDER A from the delivery of military helicopter operations.³⁵⁶

³⁵⁰ NZAP 201, Chapter 5, paragraph 5.48

³⁵¹ Witness

³⁵² Exhibit GA

³⁵³ Exhibit GA

³⁵⁴ Witness

³⁵⁵ Witness

³⁵⁶ Witness

286. As of 08 Dec 10, the RNZAF stood up 488 WG at Ohakea. Both 485 WG at Auckland and 488 WG at Ohakea now have responsibility to govern all flying operations on their respective Bases. Each Wing is under the command of a Group Captain. This will provide additional organisational support to the Squadrons on Ohakea. 488 WG will also have an expanded Flight Safety Office, which will aid the workload problem noted to date. These steps are designed to address many of the command issues noted in this report but will not automatically address the frustration with the command complexity observed at the Squadron Commander level.

OTHER ISSUES THAT MAY BE RELEVANT

287. The Court of Inquiry determine that four other issues might be relevant to this accident:

- a. No. 3 Squadron Culture.
- b. ORM.
- c. RNZAF Iroquois Simulator
- d. Links to issues in the wider RNZAF.

No. 3 Squadron Culture

288. In the opinion of the Court of Inquiry the culture on 3 Squadron was important to this accident because it was the Squadron's 'can do' culture and perception of flying rules which meant that all the aircrew of IROQUOIS BLACK thought they were permitted to continue the task below ordered NVG met minima. It was the 3 Squadron culture that contributed to the under-estimation of the risks associated with this flight.³⁵⁷ The 3 Squadron culture also influenced aircrew to normally avoid flying in IMC.³⁵⁸ Avoidance was part of the reason that BLACK 2 and probably BLACK 1 were not sufficiently prepared for IIMC when it did occur.³⁵⁹ This section describes the culture, then outlines how the Squadron's culture led to this situation.

289. Culture is often described as 'the way we do things around here.' A strong culture provides a compelling governance of behaviour. The Human Factors Report identified that a 'can do' culture existed on 3 Squadron at the time of the accident. The 'can do' culture had positive aspects that included increased motivation and increased effort towards achieving tasks from scarce resources.³⁶⁰ These positive aspects are actively encouraged by the RNZAF. The positive aspect was described by one expert as '3 Squadron gets the job done, that's just the way they are.'³⁶¹ Aircrew also stated that if you wanted to get another task, you'd get this one done.³⁶² This reinforcement is apparent in the Unit Citations, SAR Awards and other commendations received by the Squadron.³⁶³

³⁵⁷ Exhibit FU

³⁵⁸ Witness, Witness

³⁵⁹ Witness

³⁶⁰ Exhibit FU

³⁶¹ Witness

³⁶² Witness

³⁶³ Witness

290. The negative risks of the 'can do' culture are that it can result in an increased likelihood to misperceive risk, push limits and take risky actions.³⁶⁴ The strong motivation to get tasks done meant that some flying orders were considered overly restrictive, suitable for fixed wing aircraft but not for military helicopter operations.³⁶⁵ These factors created situations where aircrew understood they were permitted to use their own judgement in relation to the limits imposed by flying orders and that the limits could be extended at their discretion, based on their personal estimation of 'comfort.' For example, in this case, IROQUOIS BLACK aircrew were all comfortable to continue below meteorological minima to complete the ANZAC Day task.³⁶⁶

291. Risk assessed on a personal comfort criteria manner is dangerous within an aircrew culture. Aircrew inherently under-estimates risk and over-estimate their own ability to deal with the consequences.³⁶⁷

292. The 'can do' culture was central to decisions made in the run up to the task and particularly with respect to the decisions made to accept higher risk and continue below NVG met minima.³⁶⁸ Reports from similar situations involving 3 Squadron indicate that this risk accepting aspect of the 'can do' culture was wide spread in the lead up to this accident. Historic reports indicate that the culture was probably present, and had been a factor in accidents and safety events at 3 Squadron for some time.³⁶⁹

293. In Jul 09, the Flight Safety Office received an ICARUS report that alleges a number of events that had occurred on 3 Squadron.³⁷⁰ The Court of Inquiry notes that several of the events described below were not or have not yet been properly investigated. Without the rigour of proper investigations and the consideration of counterviews, these events stand as allegations only. Statements received under s 200N show that there may be alternate explanations for some of the allegations. Until proper investigation is undertaken the allegations should not be considered fact.

294. However, the allegations are important to understanding 3 Squadron's culture because they illustrate, to this Court of Inquiry, two aspects of the 3 Squadron culture: 1. the attitudes on 3 Squadron at the time and, 2. the effectiveness of the command response to these incidents in managing the Squadron culture and attitude to rules.

295. The Jul 09 ICARUS listed the following incidents:³⁷¹

- a. FSE AQ831/01: Iroquois NZ3806 on 12 Dec 01: Transmission over torque. This event was described as 'a beat-up gone wrong'. The example set by a unit pilot could be considered relevant to attitudes toward safe flying practice on 3 Squadron.
- b. During a deployment to East Timor, during an organised a flying competition, a junior pilot tried to do a wingover and lost tail rotor

³⁶⁴ Exhibit FU

³⁶⁵ Witness

³⁶⁶ All IROQUOIS BLACK Witness Statements

³⁶⁷ Exhibit FU

³⁶⁸ Exhibit FU

³⁶⁹ Exhibit GA

³⁷⁰ Exhibit GB

³⁷¹ Exhibit GB

effectiveness. The Flight Safety Office has a copy of a video recording of the incident. The detachment commander and flight commander took steps to conceal the video from the next rotation. No FSE was entered.

- c. A squadron executive attempted to fly back from Matamata on NVG with only an unqualified conversion course student in the co-pilot's seat and one crewman. During the flight, the co-pilot looked up above the level of the aircraft's flying height to see some high tension power lines, and a decision was then made to land. After a short break during which the weather improved slightly, the flight was continued down the Waikato River at approximately 100ft until reaching Hamilton Airfield. After refuelling, the aircraft was flown IFR to Ohakea. The initial airborne time and last landing time were 1350hrs and 0400hrs respectively, resulting in total crew duty period of just over 16 hours. The crew duty period for Iroquois crew in DFFO is 13 hrs. No FSE was initially entered for this event, but it was subsequently reported as FSE NZ469/08 in Sep 09, after being brought to the attention of COMMANDER A as a result of this ICARUS Report. The event is yet to be investigated, as the investigating officer is waiting for this Court of Inquiry to be completed.³⁷²
- d. During ANZAC weekend 2009, a junior C category captain with less than 90 hours captaincy and a D category co-pilot flew with a squadron executive to Whakatane to undertake ANZAC Day flypasts. The night before the flypasts, familiarisation flights were carried out by the C and D category pilots, following which the aircraft was to be repositioned to a family residence. The familiarisation flights took longer than expected and it was dark by the time they were completed. No NVGs were available, and the squadron executive got into the back of the aircraft and directed the C category captain to fly the aircraft to the farm / field to land. The C category captain felt uncomfortable about this and questioned the intent. However, the task was conducted under the 'guidance' of the squadron executive. After flying around at approximately 500ft at night the intended landing area was identified and an approach to a car within it was directed. The approach resulted in the aircraft getting low and slow, and at this point the captain motored the white light ahead of the aircraft to discover a pole and wires directly in the flight path. Avoiding action was taken with the aircraft turning downwind and descending. Flight was terminated in the intended landing area with obstacles called as being 'close' in some areas by the crewman (night unaided limits are 'well clear'). No FSE was entered for this event.
- e. The following day the C category pilot was co-pilot to a squadron executive for the ANZAC Day flypast. The authorisation was for flight NI 300ft MSD, so the aircraft was positioned over the ocean and flown so the RADALT read 300ft. The QNH was then adjusted so the pressure altimeter also read 300ft, and the squadron executive verbalised that the flypast would not be above 300ft AMSL. The co-pilot questioned this, and was told by the squadron executive that his personal opinion was that

³⁷² The delay to processing the FSE was not at the direction of this Court of Inquiry. The FSE was entered seven months before this Court of Inquiry was stood up. Similarly, this Court of Inquiry has not required any FSE investigations be held up.

300ft was not low enough for a flypast, so 300ft AMSL would be their 'not above' height. No FSE was entered for this event.

- f. On the return to Ohakea from the ANZAC Day flypast task, the C category pilot was in the back of the aircraft as the helicopter was flown so low in an attempt to return to Ohakea that he took video footage of it on his mobile telephone as a record of the conditions. The aircraft was being hover-taxied with the doors open so the crewmen could see out, and the height was estimated to be as low as 50ft. No FSE was entered for this event.
- g. NZ367/08: Iroquois NZ3812 on 2 Oct 08: Cabin windows fogged up causing complete loss of forward vision while on NVG. During this event, a squadron executive attempted to take a two aircraft formation from Waouru to Ohakea on NVG when cloud base was reported by crew as being approx 200ft. After returning to Waouru due to adverse weather, the crews achieved approximately 4 hours sleep, prior to flying out of Waouru early the following morning prior to achieving the rest requirement mandated in orders.
- h. NZ470/08: Iroquois NZ3803 on 6 Aug 08: Survivor slipped during hover on-load. During Exercise BLACKBIRD 2008 a squadron executive was coordinating photographic opportunities with media personnel as aircraft captain of a helicopter. The event resulted in a female squadron member hanging from the aircraft skid during an attempted hover on-load above mountainous terrain at 6000ft AMSL, with photographs of the incident being published in a local newspaper. An FSE was subsequently raised at the specific request of the Flight Safety Office.
- i. The return from Exercise BLACKBIRD 2008 resulted in a squadron executive leading a six aircraft formation out of Dip Flat in extremely poor weather, including poor visibility, low cloud base, and snow showers.
- j. NZ151/09: Over-torque following foot jamming rudder pedal. This event was raised as an example of a bad decision to undertake operations into an unsuitable area with insufficient power available, followed by a decision to return to Waouru camp after the resultant over-torque, rather than landing in the nearest suitable area. The FSE was raised several months after the event, but is yet to be investigated, as the investigating officer is waiting for this Court of Inquiry to be completed.
- k. NZ238/09: Iroquois NZ3801 on 2 Apr 09: Crew duty and met minima exceeded during SAR callout. During this event, a spiral descent was undertaken on NVG through a closing hole in a cloud layer, followed by flight below a 300ft cloud base and 300ft visibility to extract an injured tramper who had an ambulance and rescuers in the vicinity. In addition, despite all the crew almost certainly having been up since at least 0800hrs the previous morning, the decision was made to fly home that night at 0500hrs. The FSE was raised several months after the event. Of note, this FSE was raised on 15 Jun 09 and has yet to be investigated, as the investigating officer is waiting for this Court of Inquiry to be completed.

296. The above events were discussed with both COMMANDER B and COMMANDER A immediately after being brought to the attention of the Flight Safety Office. A number of courses of action were agreed upon, including that the Flight Safety Office at Ohakea would undertake a careful study of the attitudes of unit pilots and executives towards flying operations, and in particular attitudes towards orders and instructions relating to low flying and meteorological minima. Less than two weeks after agreeing this course of action, the Flight Safety Office was diverted to assist a Court of Inquiry, until close to the end of the year. As a result of this and two other subsequent aircraft accident investigations during 2010, the agreed Flight Safety Office action was never carried out.³⁷³

297. In another significant example, two senior pilots on their last flight before posting from 3 Squadron, apparently abused a 'Nap of the Earth' (NOE) authorisation. This included flying the aircraft at 8ft and 110kts along a beach, with one of the pilots videoing the act.³⁷⁴ When this incident became known to COMMANDER A, he reported it to COMMANDER B.³⁷⁵ Following consultation with his command, COMMANDER B undertook to brief the individuals involved, but no further investigation or disciplinary action was taken.^{376 377}

298. In each case, command spoke to the individual(s) concerned and some action to hold up upgrades and qualification was imposed. The action taken on the individuals concerned did modify their behaviour.³⁷⁸ However, the action taken was not transparent to other squadron members and so did not demonstrate any clear consequence for putting the aircraft and crew at unnecessary risk.³⁷⁹ By not taking any formal action that would have been visible to the rest of the Squadron, Command lost a valuable opportunity to publicly demonstrate its expectation that appropriate attitudes towards operating culture and adherence to orders and instructions be maintained.³⁸⁰

299. The Human Factors Report considered how the rule-violating aspect of the 'can do' culture had arisen and been sustained on 3 Squadron. The study identified a list of seven preconditions for rule violating Table 1, below. Research has shown that one or a number of these factors will produce the conditions for rule violating in an organisation. The Human Factors study found evidence of a number of these preconditions on 3 Squadron at the time of the ANZAC Day task.³⁸¹ Whilst the exact applicability of some of the preconditions could be argued, the table does provide a useful list of indicators which should be addressed to ensure that rules are adhered to.

³⁷³ Witness

³⁷⁴ Witness

³⁷⁵ Witness

³⁷⁶ Witness, Witness

³⁷⁷ Assembling Authority to note Witness Statement

³⁷⁸ Witness, Witness, Witness

³⁷⁹ Witness

³⁸⁰ Exhibit GA

³⁸¹ Exhibit FU

Table 1. Rule Violation Producing Conditions.

One or a number of the violation producing conditions need to occur at an individual and organisational level in order for rule breaking behaviour within an organisation to occur and be normalised.

Mission Expectation - the perception that the rules must be broken to get the job done;

Ego & Power - the belief that the violator has the skill and stature to do the job better outside the boundaries;

Unlikely Detection - the perception that the violation is unlikely to be detected by anyone in authority;

Poor Planning - Lack of adequate planning time or depth resulting in "free styling" during execution;

Leadership Gap - Leaders who personally practice or are known to condone procedural non-compliance;

Poor Role Models - Violations and compromise of standards can often be traced to a single individual who "gets away with it" and therefore encourages others to copy their example;

300. The role of the unit leadership was important in the 3 Squadron rules culture. The table above includes a leadership gap and role models as preconditions to rule violations. The involvement of a squadron executive in the incidents outlined above demonstrated both preconditions. The organisational response was described by an expert as giving a particular individual a 'hero-villain' reputation.³⁸² The hero-villain would be lauded for what he/she had achieved, but was known to be pushing the limits of safe operations and therefore in conflict with the safety and rules expectations of the RNZAF.³⁸³

301. Subsequent examples demonstrated that the effect of the hero-villain was that junior pilots on the Squadron were more likely to break flying orders and accept higher levels of risk in order to complete tasks. As an example, one Squadron pilot reported that he had broken minima, during flypasts on ANZAC Day the year before, and a second pilot stated that he would have done the same, because that is what they thought the squadron executive would want them to do.³⁸⁴ The executive influence is creating both a leadership gap and a poor role model precondition. These are two preconditions that would, and in the example did, lead to rule violation.

Operational Risk Management

302. The experience of the ADF shows that ORM is an effective means of reducing aviation accident and incident rates. With the exception of 6 Squadron, no RNZAF flying units use a formal ORM process.³⁸⁵ The RNZAF formal risk management processes are mandated by DFO81 but this is not adapted for flying operations. In planning for the ANZAC Day flypasts, significant effort was given to assessing the risks of the flypast elements of the sortie through an ad hoc

³⁸² Witness.

³⁸³ Witness

³⁸⁴ Witness

³⁸⁵ Exhibit GA

assessment process.³⁸⁶ The assessment process was designed just for that day and based on the personal experience of the officers involved in tasking and authorisation at each level. Much less effort was given to risk assessment of the transit to Wellington.

303. An ORM process for flying operations would identify hazards in each phase of flight using tools such as mission analysis and preliminary hazard assessment. If a formalised ORM process had been used for this event, the risks to the formation in the transit may have been better identified and treated. For repeating, but infrequent tasks such as ANZAC Day flypasts, the ORM becomes a record of past experience that is reusable at each recurrence.

304. ORM can also be used at a more operational level to identify and assess risk. Its use to assess risk in NVG operations may have better articulated the risk presented by NVG operations in poor weather. This in turn might have identified the need to train for situations where control of the hazard is lost, for example when IIMC is encountered.

RNZAF Iroquois Simulator

305. The current Iroquois simulator is at Ohakea. The simulator allows aircrew to rehearse aircraft emergencies, CRM, Line Orientated Flight Training (LOFT) and IF. Witness evidence showed that Iroquois simulator usage rates have reduced compared to when simulator training was conducted overseas.³⁸⁷ The Iroquois simulator's cockpit instrumentation and lack of motion makes it unlike the actual aircraft; however, it is very good for practising and developing CRM and basic IF.³⁸⁸

306. With the reduced use of the simulator, aircrew are conducting less intensive CRM training than when the simulator was offshore. As an example FLTTLT Madsen conducted 21.0 hrs offshore simulator training in 2006 and 11.2 hrs in 2007. Since discontinuing offshore simulator training he conducted no training in 2008, 1.4 hrs in 2009 and 2.2 hrs in the 4 months of 2010.³⁸⁹

307. After failing his 2009 IRT, some of FLTTLT Madsen's remedial training was conducted on the simulator to develop his CRM.³⁹⁰ OFFICER A identified the simulator as an important tool to create a high workload environment where FLTTLT Madsen's decision making under pressure could be developed.³⁹¹

308. The Court of Inquiry notes the low simulator hours that FLTTLT MADSEN achieved in recent years and considers that better use of the simulator could have mitigated his reported flying issues. It is the opinion of the Court of Inquiry that the Ohakea based Iroquois simulator could be better utilised for 3 Squadron aircrew CRM and basic IF training.

³⁸⁶ Witness

³⁸⁷ Witness, Witness

³⁸⁸ Witness, Witness

³⁸⁹ Exhibit BF

³⁹⁰ Exhibit BF

³⁹¹ Witness

Links to the Wider RNZAF

309. The Accident Analysis Report noted that a number of the issues raised in this report have links and parallels to other Courts of Inquiry, flight safety issues and broader organisational issues. A number of these broader issues could be relevant to preventing future accidents and should be addressed.

310. In particular the Accident Analysis Report noted that:³⁹²

- a. Deficiencies in Squadron orders, instructions and publications are wider than just 3 Squadron.
- b. The failure to sufficiently address a recognised skill deficiency and the ad hoc development of FLTTL MADSEN's remedial training is prevalent elsewhere in the RNZAF.
- c. The shortfalls of the FEMS data-base in tracking and reporting currency are in line with observations on the shortfalls of the database on other squadrons.
- d. Shortfalls in the administration of flying log books and RNZAF5200 files noted for some crew members in IROQUOIS BLACK are similar to shortfalls noted in the administration of flying records in recent Courts of Inquiry.
- e. RNZAF NVG and IIMC publications showed differences in focus, emphasis and procedures with those of Allied Service's where the RNZAF publication comparatively under-rated some risks. Previous Courts of Inquiry have noted serious deficiencies caused by such differences.
- f. The back log of 148 outstanding FSE reports and the 14 month turn around for those reports on 3 Squadron as at 25 Apr 10 was not unique to 3 Squadron. At the same date there were a total of 504 FSE reports outstanding across the RNZAF.
- g. A number of recommendations from previous Courts of Inquiry have not been actioned even though, in some cases, a number of years have elapsed since the Inquiries were completed.³⁹³

311. When considered together these issues indicate wider organisational issues that are worthy of investigation if unsafe practices are to be corrected and future accidents are to be avoided. That the issues noted here might also exist elsewhere in the RNZAF is also worthy of investigation and rectification.

312. Some of the conclusions drawn in this section of the Accident Analysis Report were outside the scope of this Inquiry and so were not investigated further here. However, these conclusions are of sufficient gravity to also warrant further investigation.

³⁹² Exhibit GA

³⁹³ Exhibit GA

SUMMARY OF FINDINGS

Summary of Flight

- Finding 1. The formation got airborne from Ohakea at 0513hrs and proceeded to fly their bad weather coastal plan.
- Finding 2. At Paekakariki the Formation Leader eased the formation out to sea and called them into trail in anticipation of a left turn through 180° as an escape towards Paraparaumu, if necessary.
- Finding 3. At 0548.52hrs, ATC secondary radar contact with BLACK 1 was lost for 39 seconds from just prior to the initiation of the left turn near Pukerua Bay until BLACK 1 passed through 1000ft on a north- north easterly bound track.
- Finding 4. At about 0549hrs, as the formation approached Brendan Beach, (Pukerua Bay) from the north, BLACK 1 initiated a left turn, in order to manoeuvre the formation back towards Paraparaumu.
- Finding 5. About half-way through the turn, BLACK 1 inadvertently climbed and entered IMC.
- Finding 6. BLACK 2 followed BLACK 1 into IMC at about 0549hrs.
- Finding 7. The captain of BLACK 1 took control of the aircraft, continued the turn and climbed out on a track of approximately 030°.
- Finding 8. BLACK 3 completed a descending left turn, levelling at 120ft and accelerating to 120KIAS to ensure separation from BLACK 1 and BLACK 2.
- Finding 9. Approximately 30 seconds after flying into IMC, BLACK 2 impacted terrain at 792ft AMSL, 0.5nm northeast of Pukerua Bay, position S41 01.837-E174 54.533.
- Finding 10. The crash resulted in the death of the captain, FLTLT MADSEN, the co-pilot, FGOFF GREGORY and helicopter crewman, CPL CARSON.
- Finding 11. Helicopter crewman, SGT CREEGGAN, was seriously injured.
- Finding 12. SGT CREEGGAN activated his own, and probably CPL CARSON's PLB.
- Finding 13. Only CPL CARSON's PLB was detected by SARSAT.
- Finding 14. The crew of BLACK 3 and the Westpac Helicopter coordinated the SAR in difficult flying conditions.
- Finding 15. F/S Smith's conspicuous actions without regard for his own safety, and his role in preserving the life of SGT CREEGGAN are worthy of recognition.

- Finding 16. Civil Agencies, NZDF and RNZAF Base Ohakea teams were involved in the response.

Background

- Finding 17. The Iroquois has been in service with the RNZAF since 1966. Its configuration and role equipment have been without significant change for at least seven years.
- Finding 18. The Iroquois is a difficult aircraft to fly on instruments, with limited IFR capability. Because of this, 3 Squadron SOP tend to avoid flying in IMC where possible.
- Finding 19. Previous FSE of the individuals involved were unlikely to have had any direct bearing on this accident.
- Finding 20. There were six FSE reports relating to deteriorating weather conditions and adverse weather, including three where an IIMC escape was flown.
- Finding 21. The investigation into a 1999 incident mentions issues relevant to this accident, in particular: RADALT use and warnings, SOP, the 'can do' culture at 3 Squadron and the attitude of aircrew towards IMC flight.
- Finding 22. Some recent reports highlight attitudes towards orders and instructions and a 'can do' culture on the Squadron.

Preparation, Qualification and Currency

- Finding 23. The ANZAC Day task was received at 3 Squadron on 13 Apr 10.
- Finding 24. The tasking statement 'speed for best effect' was not a speed limitation in accordance with DFFO.
- Finding 25. The Squadron adjusted the tasking from an overnight at Wellington, to a predawn transit from Ohakea.
- Finding 26. This adjusted task was within Squadron operating parameters and was more efficient. The risk for the task was increased as it now required a NVG transit and a longer duty day.
- Finding 27. No. 3 Squadron Tasking Officers allocated the crews to IROQUOIS BLACK in consultation with OFFICER A.
- Finding 28. FLTLT MADSEN and FGOFF GREGORY were originally allocated to IROQUOIS BLACK 3, but were moved to the less complex role of BLACK 2 due to their relative experience levels.
- Finding 29. According to the 3 Squadron Iroquois Upgrade Sortie Cards and their respective training records, neither the Formation Leader nor the Deputy Lead were qualified to lead this sortie.

- Finding 30. The commonly held view of witnesses was that it is well within the capabilities of a NVG CT captain to lead a formation administrative move at night.
- Finding 31. No definition of an administrative move was found in 3 Squadron orders, instructions or publications.
- Finding 32. There is confusion over the NVG qualifications among the Qualified Helicopter Instructors on 3 Squadron.
- Finding 33. There is no evidence that FLT LT MADSEN was qualified to fly low level over water at night.
- Finding 34. With the exception of the captain of BLACK 1, the co-pilot of BLACK 3 and the HCM of BLACK 1, the crews of IROQUOIS BLACK were not current in relevant flying competencies for this task.
- Finding 35. There are discrepancies between the currencies detailed in the NZAP 9215 Iroquois Aircrew Categorisation and Currency Scheme, and those recorded by FEMS.
- Finding 36. The currency programme and the currency monitoring system on 3 Squadron were not being enforced or administered.
- Finding 37. FLT LT MADSEN and FG OFF GREGORY had lower flying qualifications and fewer recent flying hours than their peers in the formation.
- Finding 38. FLT LT MADSEN was released from 3 Squadron for 96 working days in the year prior to the accident. This included 29 days Services representational sport, 20 days annual leave and 47 days while on attachment to HQ JFNZ.
- Finding 39. FLT LT MADSEN had regained his currency in IF; however, he had not flown any IF between 12 Jan and 22 Apr 10. The low recent recurrence of practice would have meant that FLT LT MADSEN was not well prepared for the IIMC event.
- Finding 40. FLT LT MADSEN initially failed three of the five IRT's he undertook on the Iroquois. He subsequently passed the retests, after remedial training.
- Finding 41. The recovery of deficiencies in FLT LT MADSEN's IF performance was only managed to get him through the retests.
- Finding 42. One month before the accident, FLT LT MADSEN had self-started a programme to improve his identified flying deficiencies.

Task Preparation and Planning

- Finding 43. No task specific formation training was conducted for this task.
- Finding 44. Task-specific practice, involving all formation aircrew, would have helped bridge the gaps in the formation flying experience for the crews.

- Finding 45. The intended profile for the transit was a 3-ship Staggered Trail Formation under NVG. Formation position changes to Vic Formation were to be practised enroute to the first flypast.
- Finding 46. The captain of BLACK 3 had never conducted Vic Formation on NVG and was not current in Night Formation.
- Finding 47. An IFR route to Wellington from Ohakea was never given consideration during planning.
- Finding 48. The main area of concern and focus for 485 WG oversight was the planning and risk mitigation of the flypasts.
- Finding 49. The scrutiny afforded to this task overlooked several risks, including: aircrew qualification, currency, the lack of formation training and the lack of route and site reconnaissance.
- Finding 50. 485 WG communicated to the Flight Authorising Officer that the captains of IROQUOIS BLACK were to be made aware of the importance of the task.
- Finding 51. Formation aircrew were motivated towards the mission, stating that it was important, although they did not feel any additional pressure.
- Finding 52. The attitude to this task might have shaped decision making in relation to this task and increased the acceptance of risk.

Flight Authorisation

- Finding 53. The combined authorisation and formation brief was conducted at 1400hrs on Fri 23 Apr 10.
- Finding 54. The captain of BLACK 3 was not present at the formation/authorisation brief. He was briefed prior to the sortie by the Formation Leader, as directed by the Flight Authorising Officer.
- Finding 55. The task was authorised by OFFICER B, who had been verbally delegated the duties of Utility Flight Commander.
- Finding 56. The Flight Authorising Officer did not check FEMS to assess the currency of the crews prior to authorising the flight. He assumed that the Tasking Officer would ensure that the crews held the appropriate currencies.
- Finding 57. The route was authorised to be flown NI 250ft MSD, without the route survey for an NVG low level route, contrary to DFFO 2.196(c).
- Finding 58. The authorisation process failed to properly address the numerous risks associated with this task.

Critical Stages of the Flight

- Finding 59. On VFR departure from Ohakea, without a MILMIN authorisation, the formation may have operated below the civil aviation prescribed minimum for an unattended aerodrome.
- Finding 60. At Paraparaumu the cloud base was assessed as 250 to 300ft.
- Finding 61. IROQUOIS BLACK were operating below the ordered NVG cloud base minima of 600ft as they passed Paraparaumu.
- Finding 62. In keeping with the operating culture on 3 Squadron at the time, the crews felt permitted to fly below ordered minima as long as they felt comfortable to do so.
- Finding 63. Human Factors research shows that aircrew are likely to under-estimate risk in situations where they use their personal comfort as a measure to judge risk.
- Finding 64. Operating below NVG cloud base minima reduced the formation's margin for error.
- Finding 65. Other nations' SOP discourage Trail Formation on NVG because it is very difficult to assess closure rates on the aircraft ahead.
- Finding 66. No specific guidance was found in 3 Squadron SOP regarding the use of Trail Formation on NVG.
- Finding 67. Approaching Pukerua Bay BLACK 1 and BLACK 2 were in Trail Formation at about 300ft and had slowed to 60KIAS. BLACK 3 was 100ft lower and positioned slightly right of the trail position.
- Finding 68. There was no visual reference to the west.
- Finding 69. The Formation Leader prepared for a left turn, towards visual references, if VFR flight beyond Pukerua Bay was not possible.
- Finding 70. IROQUOIS BLACK was approximately 500m offshore as they approached Pukerua Bay.

Inadvertent IMC

- Finding 71. At about 0548hrs, the Formation Leader initiated a left hand level turn in order to manoeuvre the formation north, back towards Paraparaumu.
- Finding 72. The co-pilot was flying BLACK 1 as they initiated the turn.
- Finding 73. BLACK 1 climbed in the turn.
- Finding 74. After approximately 90° of turn BLACK 1's visual picture began to deteriorate markedly and shortly afterwards the captain took control and initiated the IIMC procedure.

- Finding 75. BLACK 3 saw BLACK 2 disappear from view 1 to 2 seconds after BLACK 1 disappeared.
- Finding 76. BLACK 2 probably experienced a similar progressive degradation of visual picture to BLACK 1.
- Finding 77. BLACK 1, and probably BLACK 2, did not expect to lose visual references in the turn. As a result they were not fully prepared for IIMC.
- Finding 78. It is likely that the characteristics of NVG detection of precipitation and the proximity of BLACK 1 and 2 to cloud contributed to their entering IIMC.
- Finding 79. After entering IIMC, both BLACK 1 and BLACK 2 had to achieve either a safe heading and/or a safe rate of climb to avoid terrain.
- Finding 80. In continuing the turn BLACK 1 reduced closure rate with terrain but did not achieve a safe heading. BLACK 1 achieved a safe rate of climb.
- Finding 81. If BLACK 1 had not achieved a safe rate of climb, they would have impacted terrain north of Pukerua Bay within 15 – 60 seconds of flying into IMC.
- Finding 82. BLACK 2 impacted terrain an estimated 30 seconds after being lost from view by BLACK 3. The time could be as little as 15 seconds or as much as 60 seconds, depending on the actual track they flew, within the possible envelope, defined by terrain and aircraft performance.
- Finding 83. The actual climb profile of BLACK 2 is not known. If the climb was initiated straight away, it could have been as low as 708 feet per minute (fpm). If the climb was delayed to the last possible moment it could have been as high as 2200fpm.
- Finding 84. The final portion of the track is considered to include a left hand turn to achieve a ground track of between 020° and 060°.

Impact

- Finding 85. The initial impact point of BLACK 2 was at position S41 01.837-E174 54.533.
- Finding 86. If BLACK 2 had flown the probable track after entering IIMC, an average climb rate of 871ft per minute would have been required to clear terrain.
- Finding 87. BLACK 2 would have cleared terrain if they had climbed an additional 100 – 150 ft, depending on the actual track at impact.
- Finding 88. NZ3806 travelled approximately 21.4m further into the gully and 2.5m higher than the initial impact point.

- Finding 89. FLTLT MADSEN, still in his seat, fell from the aircraft as the lower fuselage and floor structure were destroyed from below him during the initial impact sequence.
- Finding 90. FGOFF GREGORY remained in place in his seat until the second impact. The second impact had sufficient force to remove the co-pilot's seat from the cockpit floor. Due to the angle of the fuselage FGOFF GREGORY was ejected downwards to his right.
- Finding 91. CPL CARSON remained inside the aircraft until the second impact, at which time he was thrown forward, down and to his right, but remained attached to the aircraft through his ALP garment strop and tail unit.
- Finding 92. SGT CREEGGAN's seat belt failed in overload at the first impact. This failure combined with the rotation of the aircraft caused SGT CREEGGAN to be thrown from the crew compartment, but he remained attached to the fuselage by his ALP garment strop and tail unit.
- Finding 93. SGT CREEGGAN was decelerated by his ALP garment strop and tail unit and he landed clear of the fuselage in the vicinity of the engine.
- Finding 94. The plastic sheath of the tail unit release cable was damaged and distorted during the impact sequence, preventing SGT CREEGGAN from operating the 3-ring release.
- Finding 95. SGT CREEGGAN has cut the closing loop of the 3-ring release mechanism in order to release himself from the wreckage.

Search and Rescue

- Finding 96. The Iroquois ELT aerial was sheared off in impact, reducing the detectable range.
- Finding 97. The ELT is of an old standard that is no longer monitored by SARSAT.
- Finding 98. The 406.025 MHz signal from CPL CARSON's PLB was detected by SARSAT S07 at 0609hrs and two unresolved positions were generated. The position with 66% probability was S41 01 E174 54.
- Finding 99. The initial position was resolved based on SARSAT S08 alert at 0658hrs which arrived at RCC NZ at 0705hrs. The resolved position was S41 02 E174 55. This position matches the actual position of the beacon to within 0.5nm.
- Finding 100. It is likely that SGT CREEGGAN removed CPL CARSON's PLB from its ALP pocket and activated the beacon.
- Finding 101. SGT CREEGGAN removed his own PLB from his ALP pocket and activated it at the crash site. This 406.025 MHz signal was never detected by a SARSAT.
- Finding 102. Removing the PLB requires more manual dexterity than activating the PLB by pulling the fitted toggle.

- Finding 103. SGT CREEGGAN was lying on his PLB when he was found. The stole antenna disconnection, the incomplete deployment of the integral antenna, the low transmitter power and the rugged terrain at the accident site, may explain the lack of detection of the 406.025 MHz signal.
- Finding 104. Even with serious injuries, the actions of SGT CREEGGAN post impact were in keeping with his training.
- Finding 105. There are no HQ JFNZ Watch Keeper SOP for a RNZAF related accident or emergency. The Watch Keeper was forced to adapt SOP written for Army and Navy incidents.
- Finding 106. Common post accident procedures in Pilot Check Lists across all platforms do not exist.
- Finding 107. Confusion over the actual casualty status arose because of different civil and military classification scales and the speed of informal communications by telephone.
- Finding 108. Post-accident response was in line with expectation and was adequate.
- Finding 109. There are a number of SOP that need alignment and update including civil/military casualty status, HQ JFNZ Watch Keeper SOP and aircrew post accident checklists.

Technical

- Finding 110. The Court of Inquiry considers that the accident was not precipitated by, or related to any aircraft technical failure or unserviceability.
- Finding 111. The embodiment of CVFDR equipment would have greatly assisted the investigation in reconstructing the flight paths and crew actions.
- Finding 112. IROQUOIS BLACK complied with DFFO and 3 Squadron Standing Orders requirements with regard to role and safety equipment.
- Finding 113. Some of the crew carried additional safety equipment in the form of UEM.
- Finding 114. The excess loading of the pilots' seats with personal equipment could reduce the chances of crew survivability in an otherwise survivable accident.
- Finding 115. The cabin equipment stropping system failed during the crash sequence allowing equipment to come loose.
- Finding 116. The Court of Inquiry found that the flying clothing provided the expected level of protection for the crew.

Explanation of the Flight Path of BLACK 2 after IIMC

- Finding 117. It is unlikely FLTTL MADSEN considered he needed to manoeuvre to maintain separation between his aircraft and BLACK 1 after going IIMC.
- Finding 118. The accident is unlikely to be related to the crew maintaining partial or intermittent visual contact with terrain for any extended period.
- Finding 119. Spatial disorientation, followed by an UA recovery procedure soon after entering IMC could at least in part explain BLACK 2 flight path to the east.
- Finding 120. The crew of BLACK 2 would have taken time to reorient from visual to IF.
- Finding 121. The low IF familiarity of BLACK 2's pilots would increase the likelihood that the pilots would take longer-than-average to re-orient to IF.
- Finding 122. The IIMC event created a high crew workload. The captain of BLACK 1 reported he was at maximum capacity. It is likely that FLTTL MADSEN had a similar workload and capacity issue.
- Finding 123. Due to high workload and inexperience, FGOFF GREGORY would have been ill prepared to effectively reduced FLTTL MADSEN's workload.
- Finding 124. The time taken to illuminate the search light once in IIMC would have further increased the risk of disorientation.

Relevant Factors

- Finding 125. There is insufficient detail in 3 Squadron's SOP regarding the duties expected of the non-flying pilot during IIMC.
- Finding 126. There is no evidence the role of non-flying pilot in IF is formally taught or assessed on 3 Squadron.
- Finding 127. No. 3 Squadron Standing Orders and 3 Squadron SOP direct that the flying pilot occupy the right seat for IF practice. Almost all IF is undertaken from the right hand seat.
- Finding 128. Co-pilots do not get opportunity to routinely to practise IF in the left hand seat, where they predominantly fly operational sorties.
- Finding 129. Had the co-pilot of BLACK 1 continued to fly the aircraft as it went IIMC, the captain may have had the capacity to direct the formation IIMC procedure in a more effective manner.
- Finding 130. There is no evidence from the technical investigation to suggest that there was a RADALT failure in BLACK 2 prior to the accident.
- Finding 131. A height of 50 ft was probably set by both the pilot and co-pilot of BLACK 2.

- Finding 132. The low height warning, if set to 50 ft, is likely to have operated only 0.5 seconds prior to impact with terrain.
- Finding 133. If the low set index had been set at 200 ft in accordance with SOP, the low height warning almost certainly would have operated as BLACK 2 entered the valley approximately 19 seconds before impact.
- Finding 134. No. 3 Squadron procedures lack guidance to crews on the response to RADALT low height index warnings.
- Finding 135. RADALT equipment in use on the RNZAF Iroquois is not forward looking and therefore does not warn of impending impact with terrain.
- Finding 136. A terrain proximity warning system should be fitted to all NZDF aircraft that operate in close proximity to terrain and that are capable of having such equipment fitted.
- Finding 137. BLACK 1's IIMC radio call was not transmitted to the formation due to a radio/intercom control switching omission.
- Finding 138. Immediately prior to IIMC, BLACK 2 was likely to have been focused on maintaining a good formation position to the detriment of maintaining good SA.
- Finding 139. Few of the aircrew on 3 Squadron have ever experienced an actual NVG IIMC event and it is rarely practised either as a single aircraft or as part of a formation.
- Finding 140. According to the IPCC Sortie Cards, the IIMC procedure is taught during a single aircraft sortie and is not flown as part of a formation. The formation IIMC procedure does not appear to be taught on the IPCC and does not feature on Iroquois NVG Captain Upgrade Training.
- Finding 141. There appears to be little experience or training on the Squadron post IPCC with respect to IIMC either as a single aircraft or in a formation.
- Finding 142. No. 3 Squadron operate in marginal weather using NVG but do not regularly rehearse IIMC recovery.
- Finding 143. The 3 Squadron SOP relating to formation IIMC are disjointed.
- Finding 144. There appears to be no justification for the formation IIMC procedure to be resident in Confidential SOP.
- Finding 145. The 3 Squadron formation IIMC procedure as promulgated in Confidential SOP is inherently unsafe due to the risk of mid-air collision in a turn. It is a complex procedure which is neither easy to understand nor commit to memory and retain without frequent revision.
- Finding 146. No. 3 Squadron training and procedures did not adequately prepare the crews of IROQUOIS BLACK for the IIMC event.

Adherence to Orders, Instructions and Publications

- Finding 147. The Court of Inquiry has determined that a total of 24 relevant Civil and Defence Force orders, instructions and publications may not have been complied with in the course of the IROQUOIS BLACK task. The possible incidents of non-compliance included organisational, operational and technical aspects of the task.
- Finding 148. Adherence to flight authorisation and NVG meteorological minima restrictions could have prevented the accident.
- Finding 149. The apparent non-compliance with certain orders and minima were common on 3 Squadron at the time of the accident. It is likely that contemporary Squadron aircrew, if substituted into the same task, would also have flown below NVG met minima on the flight in question.
- Finding 150. There were several misunderstandings and mis-interpretations of orders, instructions and procedures applicable to flying operations noted in the course of this Inquiry.
- Finding 151. NZDF Orders, instructions and procedures were not adequate to ensure the crews of IROQUOIS BLACK were qualified, competent, and current to undertake the task.
- Finding 152. DFFO, 3 Squadron Standing Orders and 3 Squadron SOP are all in need of review and re-write to simplify, clarify, de-conflict, and give an unambiguous hierarchical structure to the rules and procedures governing NZDF aircraft operations on 3 Squadron.
- Finding 153. No. 3 Squadron Temporary Order T7/09 raises several concerns for the safe conduct of NVG operations.³⁹⁴
- Finding 154. Audits undertaken by 485 WG do not appear to be effective at ensuring timely and appropriate action is taken to permanently rectify non-compliant issues.
- Finding 155. The RNZAF Flight Safety Office became overloaded from late 2009 such that the progress of reports was delayed and the flight safety system became reactive, rather than proactive.
- Finding 156. The evidence protection provisions of NZAP 201 are an important tool in ensuring that potentially fatal faults are discovered and remedied quickly.
- Finding 157. The incompatibility between the expectations of confidentiality relating to FSE reporting in the NZAP 201 and the mandatory disciplinary process in the AFDA(1971) need to be addressed.
- Finding 158. By not taking any formal action in relation to apparent breaches of flying orders, Command lost a valuable opportunity to publicly demonstrate its

³⁹⁴ Finding 150 was advised to CO 3 at HQ 485WG 3176/7/3164, dated 13 Jan 11, for his consideration and action.

expectation that appropriate attitudes, operating culture and adherence to orders and instructions be maintained.

Finding 159. The complexity of the governance structure over 3 Squadron at the time of the accident was a distraction for the Squadron Commander from the delivery of military helicopter operations.

Culture

Finding 160. The positive and negative aspects of a 'can do' culture existed on 3 Squadron.

Finding 161. Some preconditions for a culture of rule-breaking existed on 3 Squadron.

Finding 162. In 3 Squadron's culture the breaking of certain rules is conducted out of a belief of permission to do so.

Finding 163. In 3 Squadron's culture there is a belief that some DFFO rules are designed for fixed wing aircraft and are not suitable for Iroquois operations.

Finding 164. Risk assessed on a personal comfort criteria manner is dangerous within an aircrew culture, which inherently under-estimates risk and over-estimates individual ability to deal with the consequences.

ORM

Finding 165. With the exception of 6 Squadron, no RNZAF flying units use a formal ORM process.

Finding 166. ORM to identify flight safety risks to aircraft operations may have better identified and treated the risks associated with this task.

RNZAF Iroquois Simulator

Finding 167. The Ohakea based Iroquois simulator could be better utilised for 3 Squadron aircrew CRM and basic IF training.

Links to Other Reports

Finding 168. The Accident Analysis Report notes a number of apparent parallels between this and other RNZAF investigations that may reflect organisational level issues worthy of further investigation.

Finding 169. Some of the conclusions drawn in the Accident Analysis Report were beyond the terms of reference for this Court of Inquiry but are of sufficient gravity to also warrant further investigation.

TOR 1. THE CIRCUMSTANCES SURROUNDING THE ACCIDENT INVOLVING NZ3806

313. On the morning of Sun 25 Apr 10, a formation of three Iroquois helicopters (NZ3805, NZ3806 and NZ3809), flying under callsign IROQUOIS BLACK, departed RNZAF Base Ohakea to conduct a series of ANZAC Day flypasts in the Wellington Region. At 0549hrs IROQUOIS BLACK 2 crashed into the head of a valley, approximately half a nautical mile east of Pukerua Bay. There were four crew members on board the aircraft. The captain, FLTLT H. P. MADSEN, the co-pilot, FGOFF D. S. GREGORY, and HCM CPL B. A. CARSON were fatally injured in the impact. The fourth crew member, HCM SGT S.I. CREEGGAN survived the accident but was seriously injured. The aircraft, NZ3806, was destroyed.

314. The Court of Inquiry found that a number of predisposing factors had created an environment where the supervisors and crews of IROQUOIS BLACK underestimated operating risks and, consequently, undertook inadequate preparation and mitigation for the task and, in particular the risk of IIMC. A number of decisions that were made in the preparation, planning and conduct of the flight progressively narrowed the margin for error for IROQUOIS BLACK or raised the risk profile for the flight. As IROQUOIS BLACK approached Pukerua Bay, the formation was flying on NVG, over water at 300ft under a 350ft cloud base. There was no visual reference beyond Pukerua Bay, or to the right of track. The formation were not adequately prepared for IIMC, including an under-assessment of the likelihood, and inadequate procedures and training. During the turn back two of the three aircraft inadvertently flew into IMC. Formation integrity was immediately lost and all three aircraft were then forced to fly independent and unrehearsed escape profiles.

315. From BLACK 2's last known position and heading, the necessary escape action after entering IMC was to turn the aircraft onto a safe heading within 5 seconds, before crossing the coast, or execute a safe rate of climb. Critically, BLACK 2 delayed executing an effective escape and then did not compensate for the delay. This was probably due to a loss of SA brought on by the high workload of the surprise IIMC event, resulting in the overload of crew capacity. The workload was probably exacerbated by the unaddressed flying issues of the captain, the low recent flying experience of both pilots and a lack of suitable IF SOP, which they could immediately employ. The accumulation of factors overwhelmed the crew's capacity to determine and fly the necessary escape, resulting in loss of SA followed by Controlled Flight Into Terrain (CFIT) without warning to the crew.

316. BLACK 1 did not maintain a safe escape track and unknowingly flew over high terrain to the east of their intended track. BLACK 1 avoided CFIT because the aircraft captain executed a climb sufficient to fly above terrain.

317. BLACK 3 maintained VMC throughout the incident and escaped to the north descending to 120ft. When the other aircraft flew into IMC, BLACK 3 was immediately at risk of mid-air collision should either of the other two aircraft elect to descend to get out of IMC.

JAMES REASON MODEL ANALYSIS OF CIRCUMSTANCES

318. Using the Reason Model of Accident Causation to analyse the human and organisational causes of this accident, the Court of Inquiry concludes that the relevant circumstances surrounding this accident were:

Active Failures

319. During the left turn in the vicinity of Pukerua Bay, BLACK 1 and BLACK 2 inadvertently entered IMC.

320. After inadvertently entering IMC, the crew of BLACK 2 most likely suffered a loss of SA.

321. After inadvertently entering IMC, the crew of BLACK 2 did not immediately commence a turn onto a safe heading.

322. After inadvertently entering IMC, the crew of BLACK 2 did not commence an effective rate of climb to avoid terrain.

323. In taking control of the aircraft the captain of BLACK 1 did not select his interplane radio. As a consequence, his IIMC radio call was not transmitted to the rest of the formation.

Task and Environment

324. The Court of Inquiry notes the particular pressures associated with high profile public tasks in general, and ANZAC Day flypasts in particular. While the crews of IROQUOIS BLACK are confident these pressures did not influence decisions made, the crews did recognise the profile of the task which was still likely to influence their acceptance of higher risk in order to continue with the task.

325. The 'can do' culture on 3 Squadron was such that the crews of IROQUOIS BLACK considered they were permitted to continue the task below NVG meteorological minima required by orders, provided they themselves were 'comfortable' to do so, and if the act would increase the probability of completing the task. As a result, IROQUOIS BLACK continued south past Paraparaumu, despite having encountered a cloud base below ordered NVG meteorological minima.

326. While the crews of IROQUOIS BLACK had been trained with respect to the difficulties of recognising deteriorating meteorological conditions while using NVG, the characteristics of NVG are likely to have contributed to the aircraft entering IIMC.

327. The change to Trail Formation from Paekakariki would have increased the workload for the crew of BLACK 2, thereby decreasing their capacity to fully comprehend peripheral issues, such as proximity to cloud and terrain.

Management and Supervision

328. Neither FLTLT MADSEN nor FGOFF GREGORY had fully achieved the necessary currency requirements for the task.

329. FLTLT MADSEN and FGOFF GREGORY had achieved very low recent flying experience in the lead up to this flight.

330. The risks associated with IIMC, particularly in formation, were not adequately identified and therefore not mitigated through appropriate and effective procedures and training.

331. The recovery of identified weaknesses in FLTLT MADSEN's flying skills was not managed adequately or effectively.

332. 485 WG and 3 Squadron flying supervision and the flight authorisation process were not adequate to ensure the crews of IROQUOIS BLACK were fully qualified, competent, and had sufficient currency to conduct the task.

Organisational Issues

333. Audits undertaken by 485 WG were not effective at ensuring timely and appropriate action was taken to rectify issues identified and prevent issues recurring.

334. Earlier opportunities for RNZAF commanders to intervene and address the culture and attitudes to orders and instructions prevalent on 3 Squadron were not undertaken in a manner adequate to clearly demonstrate that command would not tolerate non-compliance.

335. RNZAF ORM processes, at both the operational and tactical level, were not effective in identifying and mitigating the risks associated with NVG operations undertaken by 3 Squadron and the potential consequences of IIMC.

336. No. 3 Squadron SOP relating to formation IIMC are disjointed, unnecessarily complex and spread across Restricted and Confidential SOP. There appears to be no justification for the formation IIMC procedure to be resident in Confidential SOP.

337. No. 3 Squadron training and procedures for the non-flying pilot during IF and IIMC do not adequately prepare the non-flying pilot to assist the flying pilot in these situations.

338. RNZAF training did not adequately prepare the crew of IROQUOIS BLACK for the situation in which they found themselves. This resulted in the crew of BLACK 2 not being able to take effective action to establish a safe climb and/or turn onto a safe heading after inadvertently entering IMC.

339. NZDF Orders, instructions and procedures were too complex, contradictory, convoluted and, (in some cases), out-of-date to be useful. As such, they were not adequate to ensure the crews of IROQUOIS BLACK were fully qualified, competent, and had sufficient currency to undertake the task.

Failed Defences

340. IROQUOIS BLACK continued beyond ordered NVG meteorological minima from Paraparaumu to Pukerua Bay, narrowing the margin for error in flight path control and thereby increasing the likelihood of inadvertently flying into IMC. An aspect of the 3 Squadron 'can do' culture led aircrew to believe they were permitted to fly into such situations if they felt comfortable to do so.

341. IROQUOIS BLACK did not consider an IFR transit from Ohakea to Wellington nor at any stage as the weather deteriorated. The weather conditions, both forecast and actual, were suitable for this option. The flight characteristics and equipment of the Iroquois and 3 Squadron's culture of the time, led to the IFR option not being considered.

342. In setting the RADALT Warning system to only 50ft the crew of BLACK 2 made the system ineffective in providing timely proximity warning to terrain. A lack of procedures, training, experience and the ad hoc use of the RADALT warning system in normal operations would have contributed to this decision and meant that the system was not naturally used by the crew to provide warning of proximity to terrain.

343. That the incorrect RADALT setting was briefed by FLTLT MADSEN over the radio and not picked up by other formation members was a breakdown of formation CRM.

TOR 3. THE EXTENT AND CAUSE OF INJURIES TO SERVICE PERSONNEL

344. FLTLT H.P. MADSEN, L1000717, OP(Pilot) died as a result of his injuries sustained in the accident. His injuries indicate he probably experienced g forces of between 50 and 100g.³⁹⁵

345. FGOFF D.S. GREGORY, T1007785, OP(Pilot) died as a result of his injuries sustained in the accident. His injuries indicate he probably experienced g forces of between 50 and 100g.³⁹⁶

346. CPL B.A. CARSON, U10114341, OP(HCM) died as a result of his injuries sustained in the accident. His injuries indicate he probably experienced g forces of between 50 and 100g.³⁹⁷

347. SGT S.I. CREEGGAN, P1002307, OP(HCM) suffered multiple injuries and was seriously injured. His injuries indicate he probably experienced g forces of between 50 and 100g.³⁹⁸

TOR 4. CONFIRMATION OF DUTY STATUS OF PERSONNEL INVOLVED

348. All personnel of IROQUOIS BLACK formation were on duty at the time of the accident.³⁹⁹ The crew details are listed at annex A.

³⁹⁵ Witness, Exhibit FV

³⁹⁶ Witness, Exhibit FV

³⁹⁷ Witness, Exhibit FV

³⁹⁸ Witness, Exhibit FV

³⁹⁹ Witness

TOR 5. DAMAGE TO PROPERTY, SERVICE AND CIVILIAN

349. The aircraft damage has been categorised as category 5, not repairable/destroyed.⁴⁰⁰

350. The crash caused contamination to the crash site due to fuel and oil spillage and from fine debris, particularly from the rotor blades and the cabin glazing system. The land was considered by the landowner to be of low value for livestock or recreational purposes.⁴⁰¹

351. All possible measures were taken to remove as much debris as possible, which included using a platoon of the NZ Army's 2nd Engineer Regiment with metal detectors who swept the entire crash site for all visible and metallic debris.

352. Remediation of crash site contamination has been completed by exclusion, using professionally installed livestock fencing.

353. No farm improvements (fences, buildings etc) were damaged in the course of the accident.

354. Access to the crash site during the response and investigation caused some damage to farm roads. The NZ Army 2nd Engineer Regiment has carried out some capital works to repair damage and compensate the farmer for the inconvenience.

355. The Ohakea BCF Trailer broke a trailer axle during its use on 25 April 10.

TOR 6. DETERMINE COMPLIANCE WITH AND EFFICACY OF ALL ORDERS, INSTRUCTIONS AND PUBLICATIONS.

356. The Court of Inquiry has determined that a total of 24 relevant Civil and Defence Force orders, instructions and publications may not have been complied with in the course of the IROQUOIS BLACK task. The possible incidents of non-compliance included organisational, operational and technical aspects of the task.

357. The apparent non-compliance with certain orders, instructions and publications was routine on 3 Squadron at the time of the accident. The Court of Inquiry believes that if other Squadron aircrew of the time had been substituted into this flight, they would likely have made similar decisions in relation to the applicability of certain orders. This indicates that non-compliance is more likely an organisational problem, than an isolated case of an individual or group conducting non-compliant acts. The routine non-compliance meant that the RNZAF could not be certain that orders were effective in providing 'a permanent means to govern flying operations,' which is their stated aim in DFFO.

358. The use of the orders, instructions and procedures was not adequate to ensure that the crews of IROQUOIS BLACK were fully qualified, competent and had

⁴⁰⁰ Exhibit GD

⁴⁰¹ Exhibit FQ

sufficient currency to undertake the task. Orders, instructions and publications were identified that were either too complex, contradictory, convoluted and, in some cases, out-of-date to be useful.

359. The RNZAF Governance systems were inadequate in modifying practices on 3 Squadron. The 20 Apr 10 Iroquois ACMB inaccurately classified some risks that became apparent in this accident and the mitigation proposed was not effective.⁴⁰² Preceding 485 WG audits identified shortfalls with orders and instructions. Some, orders and publications had not been rectified by the time of the accident. Neither the ACMB nor Audits identified or rectified the risk posed by the significant gaps in aircrew currency on 3 Squadron.

360. The RNZAF Flight Safety system was overloaded and had been inadequate in rectifying recognised risks in 3 Squadron operating practice. The over-loaded flight safety management system of recent time and the apparent inaction of command to address significant safety breaches have meant that proactive accident prevention has not been conducted.

361. The investigation evidence protection provisions of the NZAP 201 are an important tool in ensuring that potentially fatal and/or damaging safety faults are discovered and remedied quickly. However, except for the Court of Inquiry, these protection provisions are mismatched with the mandatory disciplinary rules of the AFDA(1971). Some form of evidence protection is necessary for the continuance of a healthy flight safety reporting culture.⁴⁰³

362. The RNZAF command of flying operations over 3 Squadron was a constant distraction for the Squadron Commander from the delivery of military helicopter operations. The functional command structure led to crossed lines of communication and unclear responsibilities. The stand up of 488 WG at Ohakea is a step towards resolving this issue. Effort is now required to ensure the processes put in place are effective.

TOR 7: OTHER ISSUES THAT MAY BE RELEVANT

No. 3 Squadron Culture

363. A 'can do' culture was prevalent on 3 Squadron at the time of the accident. Positive aspects of this culture included increased motivation and increased effort towards achieving tasks from scarce resources. A significant negative aspect of the culture had manifested in the understanding amongst aircrew that they were permitted to break certain flying rules.

364. Rules are developed from experience and are designed to ensure an adequate safety margin to enable recovery from emergencies and contingencies.

⁴⁰² IROQUOIS ACMB Minutes, dated 19 May 10

⁴⁰³ The Court of Inquiry does not support amnesty from disciplinary investigation through this protection. However, if the evidence from free and frank disclosure that is necessary to aid a speedy and accurate flight safety investigation is to be used to support disciplinary proceedings there is a risk that individuals will be reluctant to admit blame themselves, or to provide information that may lead to others (who may be senior to them in rank) facing charges.

Aircrew will inherently under-estimate risk and over-estimate their ability to deal with the risk.

365. Reports from similar situations involving 3 Squadron indicate that the risk accepting aspect of the 'can do' culture was wide spread in the lead up to this accident. Historic reports indicate that the 'can do' culture was probably present, and had been a factor in accidents and safety events at 3 Squadron for some time.⁴⁰⁴

Operational Risk Management

366. If a formalised ORM process had been used for the ANZAC DAY task, the risks to the formation in the transit may have been better identified and treated. Its process to assess risk in NVG operations may have better articulated the risk presented by the poor weather. This in turn might have identified the need to train for situations where control of the hazard is lost, for example when IIMC is encountered.

RNZAF Iroquois Simulator

367. The Court of Inquiry notes the low simulator hours that FLTLT MADSEN achieved in recent years and considers that better use of the simulator could have mitigated his reported flying issues. It is the opinion of the Court of Inquiry that the Ohakea based Iroquois simulator could be better utilised for 3 Squadron aircrew CRM and basic IF training.

Links to the Wider RNZAF

368. The Accident Analysis Report noted that factors in this accident may be prevalent across the RNZAF. Although the parallels are beyond the scope of this report, the issues raised in the Accident Analysis Report are of sufficient gravity to warrant further investigation and rectification.

TOR 2: CAUSES AND RELEVANT FACTORS

369. After inadvertently entering IMC the crew of BLACK 2 did not turn onto a safe heading and/or establish a safe climb in time to avoid CFIT. Iroquois NZ 3806 impacted the ground about 0.5nm east of Pukerua Bay. The Court of Inquiry has determined that the accident was caused by:

- a. The failure to comply with NZDF orders, instructions, and flying supervision procedures, and the deficiencies of those orders, instructions and flying procedures, led to failure to ensure the crews of IROQUOIS BLACK were fully qualified, competent and current to undertake the task.
- b. RNZAF ORM processes, at both the operational and tactical level were not effective in identifying and mitigating the risks associated with NVG operations undertaken by 3 Squadron.
- c. The operating culture on 3 Squadron was such that the crews of IROQUOIS BLACK considered they were permitted to continue the task

⁴⁰⁴ Exhibit GA

below ordered minima, provided they themselves were 'comfortable' to do so. Continuing below minima increased the risk to the formation.

- d. RNZAF flying management, supervision and practices did not adequately prepare the crews of IROQUOIS BLACK for the IIMC situation. This resulted in the crew of BLACK 2 not achieving a safe heading and/or safe rate of climb after entering IMC.
- e. The crew of BLACK 2 lost situational awareness after entering IIMC and did not recover in time to take effective escape action.
- f. RADALT procedures and training in use on the RNZAF Iroquois did not optimise the equipment to give effective awareness of proximity to terrain.

TOR 8. RECOMMENDATIONS

370. The Court of Inquiry makes the following recommendations to address the causes of this accident:

- a. The RNZAF revise and reissue orders and instructions, including DFFO, Base, Wing, and Unit Orders to establish a logical and consistent set of regulations for RNZAF flying operations. In particular, revise and reissue orders and instructions relating to aircrew currency and qualification, low level and NVG operations.
- b. The RNZAF establish and implement an appropriate flying supervision system to ensure RNZAF aircrew are qualified and competent to undertake assigned tasks.
- c. The RNZAF establish and implement appropriate management systems to support RNZAF flying supervision. FEMS has not proved effective for 3 Squadron in this regard.
- d. The RNZAF establish and publish an appropriate and effective ORM System for flying operations, at both the Operational and Tactical levels.
- e. The RNZAF take action to address the negative aspects of the 'can do' culture of 3 Squadron.⁴⁰⁵
- f. The RNZAF establish procedures and training to ensure crews are adequately prepared to take effective action after inadvertently entering IMC, either as single aircraft or in formation.
- g. No. 3 Squadron revise and implement Iroquois crew duties for IF in order to better share the workload of IF amongst the crew.

⁴⁰⁵ This factor was determined to be of sufficient importance that it was notified to the Assembling Authority for urgent attention corrective action in the letter dated HQ485WG 3176/7/3164, dated 26 May 10.

- h. No. 3 Squadron develop and publish effective procedures to make best use of the functions and warnings available using currently fitted RADALT equipment.
- i. The NZDF fit effective ground proximity warning equipment to all aircraft that do not already have such equipment fitted and which operate in close proximity to terrain.
- j. RNZAF CRM training should be reviewed and updated to current industry best practice.

371. The following recommendations are made to address findings, not directly relevant to the causes of the accident:

- a. NZDF crash response procedures, including HQ JFNZ Watch Keeper SOP, casualty status reports, post crash aircrew checklists and family reconciliation should be updated and aligned.
- b. Fit all NZDF aircraft with a crash-worthy, automatically activated, 406.025 MHz emergency location transmitter with integral GPS.
- c. The current 406.025 MHz Personal Locator Beacon be upgraded to include an integral GPS.
- d. An investigation be undertaken to determine the reason for low transmitter power on 406.025 MHz for Personal Locator Beacon serial number 242.
- e. Ensure that the best method of PLB activation and operating procedures are identified and incorporated.
- f. Ensure that the Ohakea based Iroquois simulator is better utilised for CRM and basic IF training.
- g. Develop a safer method of securing miscellaneous cabin items in the RNZAF Iroquois.
- h. Fit crash-worthy Cockpit Voice Recorders and/or Flight Data Recorders to all NZDF aircraft.
- i. That protection of evidence from judicial proceedings is provided for all safety reports and investigations, in order to foster open and honest reporting.
- j. The RNZAF investigate possible parallels between this accident and the reports of other Courts of Inquiry, flight safety issues and broader organisational issues that could be relevant to preventing future accidents.

372. The following non-causal recommendations have already been passed to the RNZAF by the Court of Inquiry because they were deemed in need of urgent attention:

- a. The siphon breaker vent valve lock wiring should be checked on the whole Iroquois fleet. This was done and one other aircraft was found incorrectly

lock-wired and corrected. A warning has been inserted into the Iroquois maintenance manual.

- b. The Iroquois Pilot seating weight limits should be investigated, noting that both pilots had stowed equipment on their respective seats. This is with RNZAF Structures Support Unit for investigation.
- c. SAP missing parts alerts be reviewed. This is with RNZAF Maintenance Wing for review.
- d. Iroquois tail rotor blade grip bolt torque loading and length be checked across the fleet. This was done. Rectification was done and the maintenance manuals were amended.
- e. Engine monitoring policy anomalies should be standardised. This is with OC Technical Support Cell Medium Utility Helicopter (MUH) / Light Utility Helicopter (LUH) for rectification.
- f. Initiate modification action to the ALP to ensure the spiral steel release cable will operate under, or after, high loads. This is with the RNZAF Director of Aeronautical Configuration for investigation.
- g. All seat belts and restraints in service in RNZAF aircraft are inspected to ensure they are serviceable and in an appropriate condition, and are replaced if necessary. This is with the Director of Aeronautical Configuration for investigation.

373. The 23 recommendations of the EIT Report are endorsed to the Assembling Authority and the Court of Inquiry recommends these are forwarded to CEng(F) for consideration.

374. Recommendations 1-13 of the 14 recommendations of the Human Factors Report are endorsed to the Assembling Authority for consideration.

375. The 10 recommendations and 11 observations of the Accident Investigators' Report have been considered. Those endorsed have been included in this report.

376. The 10 recommendations of the Emergency Response Investigator's Report are endorsed to the Assembling Authority for consideration. Further, the Court of Inquiry requests that the Assembling Authority consider forwarding this report to NZDF emergency response authorities for consideration and action.

377. The 5 recommendations of the Medical Officer's Report are endorsed to the Assembling Authority for consideration.

Dated at _____ on 02 Dec 2011

President

Wing Commander L.C. Cudby, J92445, OP(AWO)

Members

Squadron Leader M. J. Scott, P1001732, OP(Pilot)

Squadron Leader I. M. Cokayne, H1020310, ENG

REDACTED REPORT

ANNEX A TO
REPORT OF THE COURT OF INQUIRY
IROQUOIS NZ3806
DATED 02 DEC 11

IROQUOIS BLACK CREW LIST

Aircraft	Rank & Name	Service Number	Trade	Crew Position	
BLACK 1 NZ3805	XXXXXXXXXX	XXXXXXXXXX	OPS (Pilot)	Captain	
	XXXXXXXXXX	XXXXXXXXXX	OPS (Pilot)	Co- Pilot	
	XXXXXXXXXX	XXXXXXXXXX	OPS (HCM)	HCM 1	
	XXXXXXXXXX	XXXXXXXXXX	OPS (HCM)	HCM 2	
BLACK 2 NZ3806	FLT LT H.P. MADSEN	L1000717	OPS (Pilot)	Captain	KILLED
	FGOFF D.S. GREGORY	T1007785	OPS (Pilot)	Co- Pilot	KILLED
	SGT S.I. CREEGGAN	P1002307	OPS (HCM)	HCM 1	SERIOUSLY INJURED
	CPL B.A. CARSON	U10114341	OPS (HCM)	HCM 2	KILLED
BLACK 3 NZ3809	XXXXXXXXXX	XXXXXXXXXX	OPS (Pilot)	Captain	
	XXXXXXXXXX	XXXXXXXXXX	OPS (Pilot)	Co- Pilot	
	XXXXXXXXXX	XXXXXXXXXX	OPS (HCM)	HCM 1	
	XXXXXXXXXX	XXXXXXXXXX	OPS (HCM)	HCM 2	

THE JAMES REASON MODEL OF ACCIDENT CAUSATION

1. The RNZAF uses the Reason Model of Accident Causation to analyse the human and organisational causes of FSE's. The Reason Model has a number of versions and variations. The model used by the RNZAF is outlined at figure B1 and includes the following aspects:
 - a. Active Failures. The Reason Model classifies 'Active Failures' as errors or violations that result in immediate adverse consequences. Each active failure is categorised as a 'Slip', a 'Lapse', a 'Mistake', or a 'Violation' depending on the intent and awareness of the individual concerned.
 - b. Task and Environment. The Reason Model recognises that the task being undertaken and the environment within which the individual is operating will have an effect on the individual concerned, and may include conditions likely to produce errors and/or violations. These and other aspects below are termed 'Latent Conditions', as they often exist in the organisation for a significant period prior to an accident or incident.
 - c. Management and Supervision. The Reason Model also recognises that management decisions and the level and effectiveness of the supervision the individual is operating under will affect or influence the environment within which the individual operates, and so affect or influence the individual concerned.
 - d. Organisational Issues. The Reason Model also recognises that organisational issues such as published orders and procedures, allocation of priorities and resources, and organisational culture will also affect or influence the management and supervision of the operation, and so affect or influence the individual concerned.
 - e. Failed Defences. Defences are those aspects that do not prevent a hazardous situation from developing, but prevent it from progressing into an accident. Defences may be technical (such as ground proximity or system failure warning systems) or procedural (such as flight reference card procedures). Accidents will often include a failure of such defences to detect and/or cope with the emergency situation.
2. The Court of Inquiry has used this model to discover and analyse the latent conditions, active failures and failed defences that allowed the chain of events to proceed unchecked to the accident.

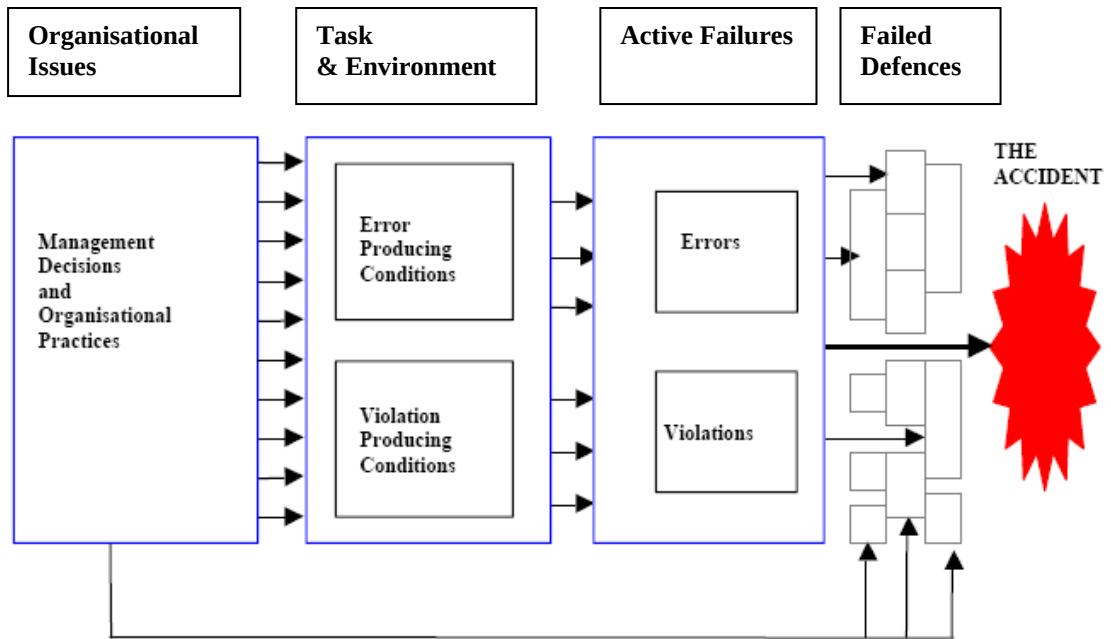


Figure B1. The Reason Model of Accident Causation

ANNEX C TO
REPORT OF THE COURT OF INQUIRY
IROQUOIS NZ3806
DATED 02 DEC 11

DDAAFS PEER REVIEW



AIR FORCE HEADQUARTERS

Russell Offices (R1-6-C036) Department of Defence, CANBERRA ACT 2600

DDAAFS/OUT/2010/AB4373032

Air Commodore S.J. Moore
Air Component Commander
Headquarters Joint Forces New Zealand
2 Seddul Bahr Road
Trentham
Upper Hutt
NEW ZEALAND

Dear Air Commodore Moore

Please find enclosed the report of the Peer Review of the Inquiry into the accident involving Iroquois NZ3806 on 25 April 2010. Despite the tragic circumstances surrounding the accident, the team found working with the Court of Inquiry a professionally rewarding experience.

We wish you well in your efforts to prevent a recurrence of this accident, and look forward to continuing to work together to improve aviation safety.

Yours sincerely



T.B. SLOANE
Wing Commander
Director Defence Aviation and Air Force Safety

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15 September 2010

Enclosures:

1. Peer Review Report

Directorate of Defence Aviation and Air Force Safety

Peer Review into the Investigation of the Accident Involving UH1H NZ3806

Background

1. Following the accident involving RNZAF Iroquois NZ3806 on 25 April 2010 at Pukerua Bay, the Directorate of Defence Aviation and Air Force Safety (DDAAFS) from the Royal Australian Air Force was requested by RNZAF Flight Safety to conduct a peer review of the Court of Inquiry (COI). This review was conducted over the period 16 to 20 August 2010 at RNZAF Base Ohakea.
2. The purpose of this report is to provide a summary of the assessment of the efficacy of the inquiry from a military aviation peer perspective. Although this report will not make specific recommendations, it does make a number of observations based on the Australian Defence Force (ADF) experience.
3. As the COI report was not complete at the time of the review, it was not reviewed by the DDAAFS team. The observations made by the DDAAFS team are based on the evidence and analysis to date that was made available, as well as discussions with the COI and investigation team members.

Peer Review Team Composition

4. DDAAFS is an agency within Air Force Headquarters, which is responsible to the Australian Defence Force Airworthiness Authority for the provision of independent and direct advice on the safety health of the Australian Defence Force aviation capability. DDAAFS is also tasked with providing advice and expertise to commanders in successfully implementing their aviation safety management systems. DDAAFS capabilities include both proactive safety measures such as safety education and training and risk management policy development; as well as having the charter of conducting independent (of the military chain of command) investigation into all accidents involving Australian State operated aircraft.
5. DDAAFS liaises closely with Australian government departments and agencies in relation to aviation safety, as well as internationally through memberships of safety institutions, various Memorandums of Understanding, and the Air and Space Interoperability Council (ASIC). Both Australia and New Zealand are signatories to ASIC Air Standard 85/2A – *Safety Investigation and Reporting of Accidents/Incidents Involving Military Aircraft and/or Missiles*.
6. The DDAAFS team comprised the following personnel:
 - a. **Wing Commander Chris Dunstan.** WGCDR Dunstan is the Deputy Director Safety Education and Training and Fixed Wing Team Leader at DDAAFS. He is a graduate of the United States Navy Aviation Safety Officer Course (2003) and has served in aviation safety roles as the Air Command Aviation Safety Officer and for the United Nations Mission in Sudan. WGCDR Dunstan was responsible for the review of accident reports as the Air Command Aviation Safety Officer and has conducted a

serious incident investigation. He currently leads a team that trains Australian and international military aviation safety officers.

- b. **Squadron Leader Ian Goold.** SQNLDR Goold is the Fast Jet Desk Officer at DDAAFS, which covers Hawk, F/A-18 Hornet and F-111. He is a graduate of the United States Navy Aviation Safety Officer Course (2010) and has experience of operating within the Royal Air Force, the Royal Saudi Arabian Air Force and the Royal Australian Air Force.
- c. **Captain Jason Otter.** CAPT Jason Otter is the Australian Army Aviation representative within the DDAAFS Safety and Education and Training instructional team. He is a graduate of the United States Air Force Accident investigators Course (2009) and has over 16 years experience as an Army Helicopter pilot including 10 years as a CFS (RAF) trained Helicopter Instructor. With 5100hrs total military flight time, he has flown Bell206B-1 Kiowa, AS350B Squirrel and CH47D Chinook. He has over 250 hours utilising night vision goggles (NVG) within Australia and on operations flying the CH47D in Afghanistan.

Peer Review Methodology

- 7. Upon arrival in New Zealand, the DDAAFS team were shown the accident site, which enabled a clearer understanding of the environmental considerations relevant to the investigation.
- 8. Upon arrival at RNZAF Ohakea, the DDAAFS team received extensive and detailed briefs on the following aspects of the inquiry:
 - a. The overall military and legal framework around which the COI operates.
 - b. The actions, methodology and findings of the accident investigation team, including those of the aviation medicine and human factors specialists.
 - c. The organisational, command and control and regulatory framework within which the accident crew operated.
 - d. Access to the aircraft wreckage, the accident scene photography and wreckage mapping and supporting written evidence.
- 9. The DDAAFS team was given excellent access and cooperation to any requested areas of interest. It is notable that throughout the peer review, the COI members and accident investigation team were open and cooperative, providing the DDAAFS team with all requested information or opinions.
- 10. As the COI Report had not been finalised at the time of the peer review, the DDAAFS team was not able to comment on its efficacy. However, the team were able to examine a number of the supporting documents, such as all the supporting evidence exhibits, the Human Factors Report and the investigation mind-map.

RNZAF Investigation

11. The team found the methodology used in the investigation to be both thorough and systematic. The COI and investigation team used the Reason model of Organisational Accident investigation. The model requires the investigation team to ascertain the details of the unsafe act or acts, and then to identify preconditions for those unsafe acts, organisational influences and the presence or omission of defences. Contributing factors to the accident can then be awarded relevance and placed in order of importance. The application of the Reason model is particularly effective in ascertaining organisational aspects of an accident or incident and is consistent international investigation standards¹.

12. The team believes the Court of Inquiry was adequately resourced in terms of both the number and competency of its members and investigation support. The COI process appears to be robust and effective. The DDAAFS team was confident that the COI has or will identify the primary contributing factors leading to the accident.

13. The team did observe that the COI and the Accident Investigation team worked very closely in most elements of the accident investigation. The potential for 'group-think' was noted; although there was no evidence that this had occurred. The danger therein is that consensus thinking could replace critical testing, analysing, and evaluation of ideas. It was also noted that with a number of aviation Courts of Inquiry in progress, there was little manpower available to manage the RNZAF flight safety system.

14. In considering the COI's assessment of the organisational factors affecting the accident, the DDAAFS team commented that the ADF has found that the implementation of an integrated Aviation Safety Management System (ASMS) could be an effective way to monitor and improve the safety of the aviation system. Similarly, in addressing the failed or absent defences identified in the accident, the ADF experience of implementing a comprehensive Risk Management process was discussed. A systems approach to safety management, which includes the core process of risk management, is now mandated within civil aviation through the International Civil Aviation Organisation (ICAO). DDAAFS has offered to further share information on the ADF ASMS with the RNZAF.

Conclusion

15. A team of Aviation Safety Investigators from the Royal Australian Air Force's Aviation Safety Directorate conducted a peer review into the investigation of the accident involving Iroquois NZ3806 on 25 April 2010. The team found the methodology used in the investigation to be both thorough and systematic. The use of the Reason Model is consistent with DDAAFS and international investigation standards and encourages the investigation to investigate deeper than just the actions of the operating crew. The team believes the Court of Inquiry is adequately resourced in terms of both the numbers and competency of its members, as well as investigation support, and that the Court of Inquiry process is advantageous to identifying the contributing factors that led to the accident.

¹ The international Standard and Recommended Practice for accident investigation is Annex 13 to the Convention on International Civil Aviation, Signed at Chicago, 7 December 1944.

16. As at the time of production of this report the final COI report had not been seen by the DDAAFS team; consequently the team is unable to comment specifically on its contents. However, based upon the observations of the COI process at the time of the review, the team believes the COI is likely to produce a report that is both comprehensive and useful in order to prevent a recurrence.



C.R. DUNSTAN
WGCDR
DDAAFS Peer Review Team Leader

15 Sep 10

ANNEX D TO
REPORT OF THE COURT OF INQUIRY
IROQUOIS NZ3806
DATED 02 DEC 11

CURRENCY, QUALIFICATIONS AND HOURS

Pilots' FEMS Currency

Note: 1. Grey box indicates uncurrent
2. Date currency last completed.

	Capt BLACK1	Co-pilot BLACK1	Madsen	Gregory	Capt BLACK3	Co-pilot BLACK3
NVG						
Night-Formation					OCT09	
Night-Form SOMsn						
Night-Autos&GH		APR10		FEB10		
Night-LL TOT Nav						
Night-SPECOP Msn						
Night-C/Area				FEB10		
Night-LL/CLF			DEC09			
Night-Loads				FEB10		
Night-LLOW						
Night-Unaided App						
Day-Formation						
Day-LL TOT Nav						
Day-LL/CLF		DEC09				
Day-Autos&GH				MAR10		
Day-C/Area				APR10		
Day-Loads						
Monsoon Bucket'g						
Emergency			FEB10			
Green Role Form						
Live-Gunnery						

REDACTED REPORT

D-2

Live-Roping/Rapell						
IF-Handling (CT2)		MAR10		FEB10		
IF-Instr Apphs		FEB10				
Nav-IFR Enroute						
Winching						
Wet Winching						
Deck Winching						
Winchperson						NOV09
Captaincy				FEB10		
Mountain Flying				NOV09		
Tropical Flying						
% of Currency	87.5	62.5	65.6	59.4	71.9	75.0

Table D1. Pilots' FEMS Currency

REDACTED REPORT

D-3

HCM FEMS Currency

	HCM1 BLACK1	HCM2 BLACK1	Creeggan	Carson	HCM1 BLACK3	HCM2 BLACK3
NVG						
Night-Form SO Msn			MAR10	FEB10		
Night-Specop Msn			MAR10			NOV09
Night-Unaid Apph						
Night-Confined Area						APR10
Night-Loads						APR10
Night-Winch Op						APR10
Emergency						
Day-Confined Area		APR10				
Day-Loads		APR10				
Day-Winch Op		APR10				
Live-Roping/Rapel			MAR10			
Live-Gun Night						
Live-Gun Day						
High Line Transfer						
Deck Winching						JUN09
Wet Winching				JUN09		
Winchperson						
Monsoon Bucketing			APR10			
% of Currency	84.2	52.6	52.6	63.2	68.4	47.4

Table D2. HCM FEMS Currency

REDACTED REPORT

REDACTED REPORT

D-4

Aircrew Hours

	Aircrew Cat	NVG Cat	Iroquois Hours Last 3 Mths	Iroquois NVG Hours Last 3 months	Iroquois NVG Hours Total	Iroquois Hours Total
BLACK1						
Captain	B	CT Capt	106.3	12.0	159.0	1384.2
Co-pilot	C	Co Pilot	71.4	5.1	64.8	546.1
HCM1	B	Q	21.6	11.1	297.3	1553.5
HCM2	D	Q	42.8	11.8	19.1	126.7
BLACK2						
Madsen	C	CT Capt	30.7	2.8	107.1	1023.7
Gregory	D	Co Pilot	29.9	4.3	17.3	187.1
Creeggan	C	Q	65.8	18.5	163.3	911.0
Carsons	C	Q	48.6	11.5	40.7	240.2
BLACK3						
Captain	B	CT Capt	113.4	22.7	139.3	1232.7
Co-pilot	C	Co Pilot	49.0	4.3	33.5	344.5
HCM1	B	Q	84.1	12.6	239.5	1747.6
HCM2	C	Q	31.4	7.2	38.7	228.6

Table D3. Aircrew Hours

NVG Category Qualifications

1. RNZAF uses the following NVG qualifications:⁴⁰⁶
 - a. **NVG Co-Pilot** – Completed on IPCC.
 - b. **NVG Captain** - Qualified for night role flying, cross country nav, day/night spec op training profiles as single aircraft or wingman (e.g Ex Pekapeka - no troops.) Actual profile should be commensurate with A/C Category and NVG experience.
 - c. **NVG CT Captain** - Qualified for day/night live SpecOp training/operations or flying as wingman on Green role Tac mission.
 - d. **Special Operations Lead (Prov)** - Qualified to lead a formation commensurate with their Tac qualification outside of a high threat environment. (e.g. Trooping at YCTA, AR Range, Ex Pekapeka etc).
 - e. **Special Operations Lead** – Qualified to lead a formation commensurate with their Tac qualification in a high threat environment. (e.g. Real SpecOps assault, Green Role with ground threat etc).
 - f. **NVG HCM** – Completed on HCM basic course.

⁴⁰⁶ Iroquois Upgrade Sortie List AL21

ANNEX E TO
REPORT OF THE COURT OF INQUIRY
IROQUOIS NZ3806
DATED 02 DEC 11

IROQUOIS BLACK FORMATIONS⁴⁰⁷

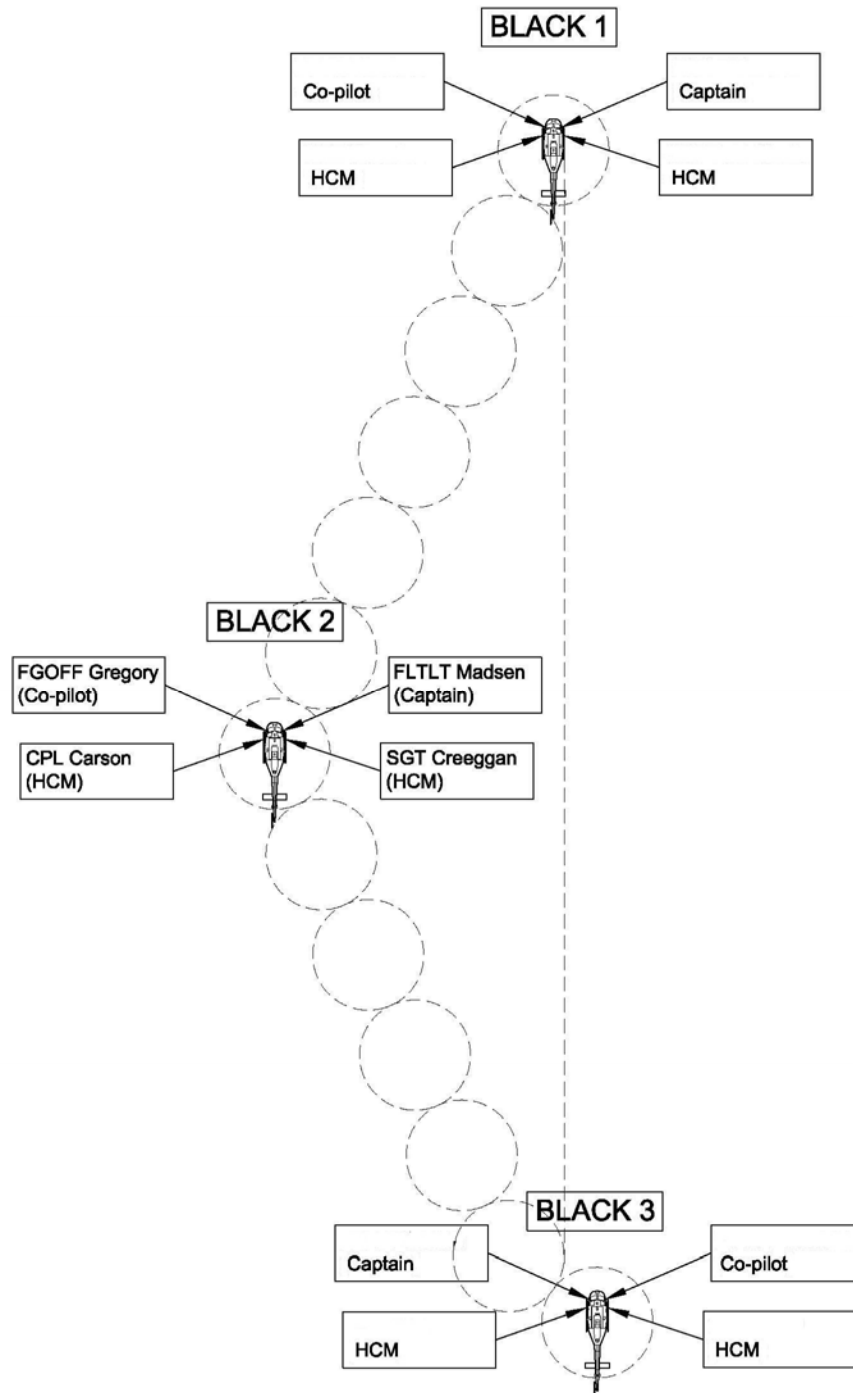


Figure E1. Staggered Trail Left Formation

⁴⁰⁷ Exhibit GA

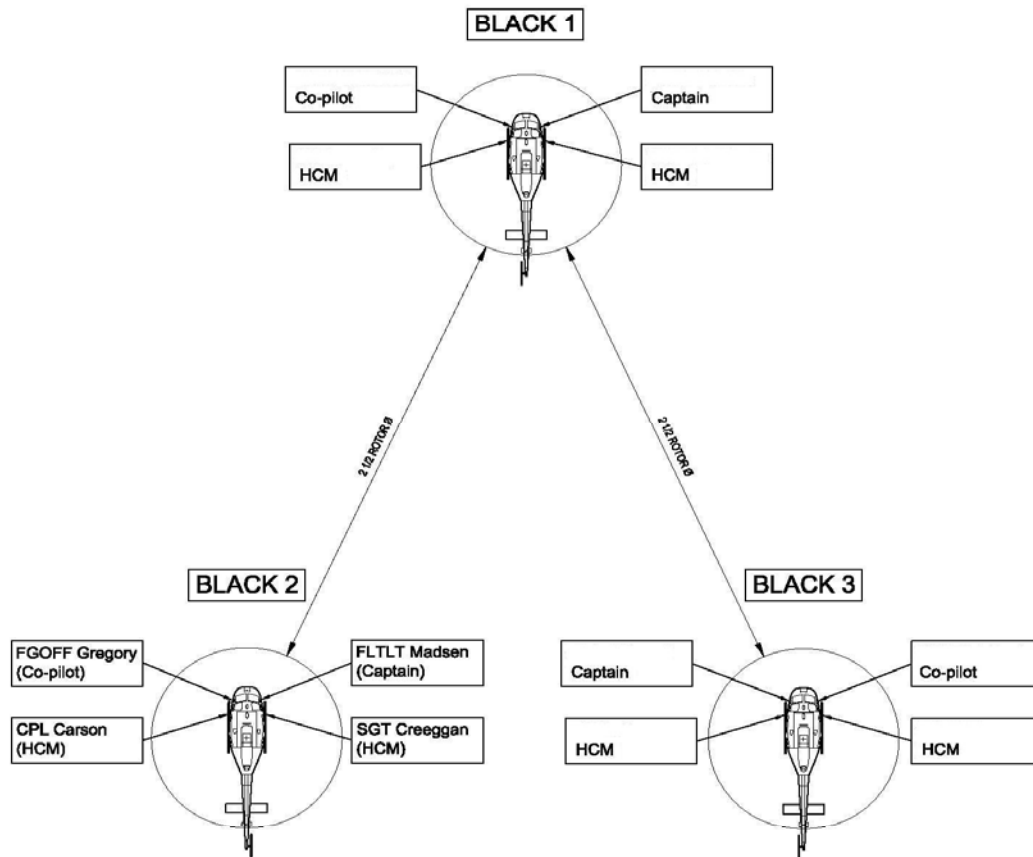


Figure E2. VIC Formation