BEFORE THE BOARD OF INQUIRY

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of applications for resource consent and notices of requirement by Transpower New Zealand Limited for the North Island Grid Upgrade Project

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STATEMENT OF EVIDENCE OF RODNEY ERNEST SULLIVAN IN REBUTTAL FOR TRANSPOWER NEW ZEALAND LIMITED (Aviation risks relative to Ardmore Airport)

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INTRODUCTION

1. **MY** name is Rodney Ernest Sullivan. I wish to present rebuttal evidence to the statements of evidence of:

(a) Mr Allan McCreadie on behalf of Ardmore Airfield Tenants and Users Committee (**AATUC**);

(b) Mrs Nicky and Mr Mark Auld; and

(c) Mr Christopher Freke on behalf of Manukau City Council (**MCC**);

2. **I** address the evidence of each submitter below.

DEFINITIONS AND ABBREVIATIONS

3. **WITH** the following additions, I have used the abbreviations and acronyms listed in my earlier statement of evidence.

Aeroplane	A fixed wing aircraft
Aircraft	A generic term which includes both aeroplanes and helicopters
AS/NZS	Australian/New Zealand Standard
AWIB	Aerodrome Weather Information Broadcast
MCC	Manakau City Council
OEI	One-engine-inoperative
OSH	Occupational safety and health
SMM	Safety Management Manual
SMS	Safety Management System

Alan McCreadie (AATUC) (Submission number 0549)

4. **IN** his statement of evidence, Mr McCreadie has focused on four main concerns:

(a) the Airbiz risk assessment methodology does not follow the AS/NZS 4360: 2004 Risk Management standard;

(b) the Airbiz Report is severely deficient in scope and understanding;

(c) the AATUC was not given the opportunity to sign-off on the Airbiz Report; and

(d) the proposed line presents a "significant and unavoidable" risk to an inexperienced pilot in command who may suffer an engine failure or serious partial power loss on either take-off or final approach to land.

5. **HE** has also sought to discredit my suggested mitigation measure to assist pilots with "real time" information on visibility and cloud ceiling in the Clevedon Valley by implying the technology is not available.

6. **I** note that Mr Warren Sattler, Chief Flying Instructor of Ardmore Flying School, has reviewed and verified paragraphs 17(b) to (f) of Mr McCreadie's statement of evidence and has countersigned to that effect. These paragraphs relate directly to the fourth of Mr McCreadie's main concerns.

7. **I** wish to address Mr McCreadie's statement of evidence in the order in which I have listed his main concerns, and then provide a summary which outlines additional considerations which arise from his statement of evidence.

ICAO and AS/NZS risk management methodologies

8. **I** am familiar with the joint Australian/New Zealand Standard (**AS/NZS**) 4360: 2004 *Risk Management*) dealing with risk assessment and note that this is a generic document rather than one designed specifically for application within the aviation industry. I note that the latest edition of this standard is dated August 2004.

9. **I** am also familiar with the ICAO risk assessment methodology which is described in the ICAO Safety Management Manual (**SMM**). I note that the first edition of this manual was published in November 2006. For some reason, Mr McCreadie considers this specialist aviation document to be "archaic" (his paragraph 16(l)) and dismisses its use.

10. **I** note that this manual has been specifically developed to assist the consistent worldwide implementation of safety management systems (**SMS**) by aviation industry operators and service providers. Chapter 1 acknowledges that in developing the SMM, ICAO drew heavily on the "*work, writing and best practices of many organisations and individuals*" and while not able to identify the source of all such material, gave special acknowledgement to both Australia and New Zealand.

11. **I** note that although New Zealand has committed through the Civil Aviation Act 1990 to implement international (ICAO) aviation standards and recommended practices, the CAA has yet to adopt the ICAO requirements for aviation organisations to implement an SMS and develop an SMM. This puts New Zealand temporarily out of step with the rest of the world and may explain why Mr McCreadie is unfamiliar with the ICAO SMM document referenced by Airbiz.

12. **IN** his paragraph 17(a)(ii)), Mr McCreadie agrees that AS/NZS 4360:2004 is generic. In my view, this provides justification for the use of industry specific processes provided these are not inconsistent with that standard.

13. **IN** fact, the ICAO "safety assessment" process and the main elements of the risk management process described in AS/NZS 4360: 2004 are remarkably similar. I have included a diagram at **Appendix "1"** which is adapted from Figure 2.1 in AS/NZS 4360: 2004 and is annotated to show how, by following the ICAO SMM methodology, the Airbiz Team complied with the requirements of the joint risk management standard.

14. **IN** his statement of evidence, Mr McCreadie makes much of the "Avoid-Mitigate-Compensate" hierarchy for risk management adopted for hazard treatment in New Zealand occupational safety and health (**OSH**) legislation (his paragraphs 16(a),(k),(t), and 17(a),(t)). He then seeks to imply (particularly in his paragraph 17(a)), that this hierarchy is endorsed or embraced by the joint risk management standard.

15. **AS/NZS** 4360:2004 states that risk analysis is about developing an understanding of the risk and that it provides an input to decisions on whether risks need to be treated and the most appropriate and cost-effective risk

treatment strategies. (My emphasis). In this context, the joint standard acknowledges "risk avoidance" but cautions that it "can occur inappropriately if individuals or organisations are unnecessarily risk-averse" and that "inappropriate risk avoidance may…lead to the loss of opportunities for gain."

16. **THE** joint standard does emphasise that "the maximum benefit is usually obtained by applying the risk management process from the beginning". While this may well involve consideration of differing design options, the objective is a design solution which presents an acceptable risk, rather than avoidance of the risk at any cost.

17. **MITIGATON** or risk treatment options are dealt with in some detail in the joint standard as is the requirement to record the risk management process, but I can find no reference in the joint standard to compensation, the third element emphasised by Mr McCreadie. I do not consider that therefore that there is any support in the standard for his approach.

Scope and understanding of the Airbiz report

18. **I** am one of three aviation specialists who took responsibility for the Airbiz risk assessment and prepared the subsequent Report. Mr McCreadie has contested the relevance of the Airbiz Report on the basis that its authors have no pilot qualifications (his paragraph 16(v)). He is also concerned about my representations as an expert witness and my inability to derive meaningful evidence from the Airbiz Report (his paragraphs 16(h),(p),(r),(s),(w) and (z)).

19. **AS** he acknowledges in his paragraph 5, Mr McCreadie attended the PHA workshop held at Ardmore on the morning of 8 May 2007. This workshop commenced with an introduction of the Airbiz Team members who presented their individual qualifications to participants.

20. **MY** experience has been fully detailed in my statement of evidence. In paragraphs 24-29 of this rebuttal, I have also summarised key elements of that experience to reinforce my standing as an expert witness.

21. **ONE** of the Airbiz Team members, Mr Geoff Dickie, has an Australian Private Pilots Licence with around 2,000 hours flying time, primarily in civil aviation, although with some military (RAAF and Australian Army) flying experience.

Mr Dickie has also held a Malaysian Private Pilots Licence, a Commercial Pilots Licence and twin endorsement and has flown throughout Australia and Asia. His extensive career in Aviation includes 33 years in Air Traffic Services. He held Air Traffic Controller endorsements in Brisbane and Sydney Centres and Approach Control and Tower ratings at seven locations.

22. **ON** retirement from Airservices Australia, Mr Dickie held the position of Safety Manager, a role which required him to prepare aeronautical studies, safety cases and risk assessments in support of systems/equipment changes being considered and/or implemented by Airservices Australia. In this role, Mr Dickie also conducted numerous safety/incident investigations and conducted internal Investigations Training for Airservices staff. He is a member of the International Society of Air Safety Investigators.

23. **I** note that Mr Dickie was team leader for a number of Airservices assistance and consultancy projects, primarily in the development and implementation of SMS. He has also developed and presented safety management training to the Airports Authority of India and the Hong Kong Civil Aviation Department. His work experience extends to Indonesia, Malaysia, Singapore, Papua New Guinea, India, Nepal and Hong Kong.

24. **WHILE** I hold no pilot qualifications, my role on the Airbiz Team was to provide expertise relating to airport/airspace planning and the applicable aviation standards, and to assist with the conduct and documentation of the risk assessment.

25. **I** was a long time employee of the Australian Civil Aviation Authority and its predecessors (24 years), my position on retirement being Manager Facilities, a role in which I supervised:

(a) instrument procedure design and the validation/publication of instrument approach and departure procedures;

(b) navigation aid calibration;

(c) national oversight of the regulatory program to ensure consistent implementation of aerodrome standards; and

(d) liaison with Air Traffic Services on the implementation of airspace design standards.

26. **I** then established an airport/aviation consultancy which in 12 years became recognised as one of the foremost specialist airport/aviation consultancies in Australia. A key field of work involved the assessment of proposals which might impact on the safety of aircraft operations in airspace associated with aerodromes including Brisbane, Sydney, Melbourne, Canberra, Darwin and, perhaps most importantly, Ardmore equivalents such as Bankstown, Moorabbin, and Archerfield.

27. **A** significant number of these assessments were commissioned by the re-named Australian Civil Aviation Safety Authority. I am the author of the Civil Aviation Safety Authority's Advisory Circular which deals with the impacts of plume rise on aircraft safety. The preparation of this document required extensive liaison with airworthiness and aircraft performance specialists.

28. **I** have developed and implemented SMS for airports, a task which involves formal risk assessment of aerodrome based/related hazards and identification of appropriate mitigation strategies. I have prepared aeronautical studies, safety cases, and risk assessment, for a wide range of potential aerodrome/airspace related hazards utilising recognised world's best practice methodology.

29. **MY** consultancy employed or sub-contracted a number of aviation industry professionals including pilots, flying operations, and aircraft performance specialists, air traffic controllers, airspace and aircraft instrument procedure designers, airport planners and the like.

30. **IN** preparing my statement of evidence and this rebuttal, I have consulted with and have been assisted by Mr Dickie, Mr Max Stevens (a former Deputy Director of the New Zealand CAA), and Mr Alan Nichol (an agricultural aviation pilot with 16,300 flying hours who has also provided evidence to this Board of Inquiry), all of whom have detailed knowledge of the Upgrade Project.

31. **I** have also consulted with Mr Greg Barrow an experienced pilot with many hours flying from Ardmore. Mr Barrow has 10,500 flying hours including around 7,400 in helicopters and 3,100 in aeroplanes. He holds an Air Transport

Pilots Licence for both helicopters and aeroplanes. He is a Performance Category B Helicopter Instructor and a Helicopter Flight Examiner.

32. **ADDITIONALLY** I have also been assisted by employees and associates of my former consulting business one of whom, Mr Graeme McKeown, has 7,600 flying hours in aircraft ranging from B737 to the Cessna 172, and in flying activities ranging from civil and military transport, freight operations, instrument procedure and navigation aid calibration, flight instruction and private flying. His flying experience includes 1,100 hours flight instruction in both military and civil training aircraft. He is the current holder of an Australian Air Transport Pilot Licence (First Class).

33. **IN** his statement of evidence, Mr McCreadie claims that the Airbiz Report and my evidence are nevertheless deficient in scope and understanding, that they simplify and focus on a limited range of pilot concerns, that they misrepresent the risks and that they ignore the fundamental option of undergrounding the proposed line.

34. **IN** terms of scope, it is important to recognise that Airbiz was engaged to provide professional/expert opinion on potential additional hazards to aviation activity at Ardmore that may be posed by the proposed line, i.e. the change in risk from the current situation to one where the proposed line is in place.

35. **RISKS** to the line, and electricity supply to Auckland, posed by Ardmore flying activity was not included in the Airbiz scope. As Airbiz was tasked with assessing the change in risk posed by the proposed line, the option not to construct or to underground the line was also beyond the defined scope. Airbiz nevertheless considered undergrounding as a potential mitigation measure and raised the possibility in this context. Since Airbiz was tasked with the examination of aviation risks, OSH issues were also beyond the scope of their work.

36. **I** emphasise that the Airbiz Report acknowledges the ever present risks to aviation in any aerodrome/airspace environment and seeks to discover objectively whether the additional risks - if any - related to the proposed line can be deemed acceptable by reference to international standards. In contrast, Mr McCreadie, and Mr Sattler who countersigned the evidence, simply take the

position that the risk is unacceptable and are unable or unwilling to consider or acknowledge an alternative view.

37. **THERE** is an undeniable background risk – with or without the proposed line – as aviation statistics will show that a number of aeroplane accidents do occur near airports, most recently at Whenuapai. It seems clear that Mr McCreadie is seeking to lay the blame for any such future occurrences at Ardmore on the proposed line.

38. **IN** preparing this rebuttal I have also examined radar data information provided by Airways Corporation for aircraft operations in Auckland and Ardmore airspace and environs for the period 30 November 2007 to 7 February 2008. The analysis of this radar data is summarised in **Appendix "2".**

Stakeholder consultation

39. **IN** his statement of evidence, Mr McCreadie seeks to discredit the Airbiz Report in a number of ways including the fact that it has no “stakeholder/expert review sign-off by the Ardmore pilots and operations manager consultees” (his paragraph 16(v)).

40. **TRANSPOWER** acknowledged that AATUC is a significant stakeholder in the risk management process by engaging Airbiz to address their specific perceptions of risk. The Airbiz Team participated in and conducted two workshops specifically intended to identify and record AATUC perceptions of risk so that these could be integrated into the decision-making process, as required by AS/NZS 4360: 2004.

41. **WHILE** the joint standard emphasises that each stage of the risk management process – including consultation – should be fully documented, it does not require stakeholder sign-off to be obtained. For many projects, it would clearly be impossible to reach this degree of consensus, particularly where strongly held differing views may be difficult to resolve.

42. **IN** this instance, the AATUC perceptions and concerns, the assumptions and methodology used in analysing these concerns, other data sources and final conclusions regarding the acceptability of risks to aviation at Ardmore are fully and objectively documented in the Airbiz Report.

43. **THIS** report allows Transpower, as proponent of the Upgrade Project to satisfy the main thrust of AS/NZS 4360: 2004 by establishing the nature and acceptability of potential aviation risks created by the proposed line.

Risks to low hours student pilots

Identifying the scenarios of concern

44. **I** note that while Mr McCreadie urges rejection of the Airbiz Report, he does not contest the majority of its findings. While seeking its rejection, he does not present arguments to refute/dispute the conclusions reached in relation to 25 of the 28 hazard/outcome scenarios considered, other than to rely on the fact that I am not a pilot.

45. **I** note that Mr McCreadie is primarily concerned with the issue of an inexperienced low flight hours student pilot, who may have to deal with an engine failure after take-off (his paragraphs 16(e),(f) and 17(d)). I acknowledge his point that the simulated engine failure is an instructor controlled exercise, and by no means as risky as the engine failure being dealt with by a low hours, solo student pilot. Even so, I must emphasise that by treating simulated and real events as equally high risk, the estimates of risk/exposure derived in the Airbiz Report must be regarded as highly conservative.

46. **THE** situation which particularly concerns Mr McCreadie is one where the engine failure or serious power loss occurs between 400 and 900 feet altitude on climb to or through the crosswind leg of the traffic circuit (paragraphs 3, 12 and 14 of his ERRATA). I propose to show that:

(a) in the early stages of this climb – through 400 to 600 feet - the pilot of a singe engine aeroplane is more likely to collide with the OTA-WKM C and OTA-WKM A/B lines which are closest to the aerodrome at around 1.4 and 2.2 kilometres from the end of the runway;

(b) for the balance of the climb - from 600 to 900 feet – the pilot of a single engine aeroplane adopting the best angle of glide will make a forced landing before reaching the proposed line, which is a further 3 kilometres distant; and

(c) due to the faster rate of climb before engine failure, the pilot of a twin engine aeroplane will have an early height advantage and increased distance to the proposed line, sufficient to regain control of the aeroplane and avoid collision either with the ground or the proposed line.

47. **I** note that Mr Stevens also reaches similar conclusions in his rebuttal in dealing with these practical scenarios which are of concern to Mr McCreadie.

48. **IN** his statement of evidence, Mr McCreadie also criticises, and asks the Board to reject the Airbiz Report, on the basis that Airbiz considered but then found these scenarios to be "not applicable" i.e. a combination of circumstances that is not possible. Mr Stevens and I both agree with that finding in the Airbiz Report.

49. **I** now turn to my analysis of these scenarios.

The OTA-WKM A/B and OTA-WKM C lines

50. **SHOULD** an aeroplane suffer an engine failure on or just after take-off, the inner OTA-WKM C and OTA-WKM A/B transmission lines present an immediate consideration. The pilot of a single engine aeroplane will have no choice other than to glide towards the line(s) or to manoeuvre to avoid them. Even then, depending on how early the engine failure occurs, it may be possible to land straight ahead before the line. The pilot of a twin engine aeroplane has more choice provided he/she can overcome the handling and control difficulties described by Mr McCreadie.

51. **I** note that engine failure in relation to these lines is not mentioned in Mr McCreadie's statement of evidence, which may simply be an omission or may indicate acceptance of the hazard posed by them. If the latter, I intend to demonstrate that the proposed line presents a far less significant consideration for the student pilot.

52. **AT** this stage, I reiterate that the OTA-WKM C and OTA-WKM A/B lines are located approximately 1.4 and 2.2 kilometres from the end of runway 03. From a piloting perspective, it may be more relevant to note that they are located

around 2.9 and 3.7 kilometres from the start of take-off for a pilot using runway 03. By comparison, the proposed line is almost 3 kilometres further distant, or 6.6 kilometres from the start of take-off on runway 03.

The proposed line

53. **WHILE** Mr McCreadie makes much of the height comparison between the ARI-PAK A line and the proposed line which replaces it (his paragraph 16(p)) he is silent on what I deem a more critical height comparison. The highest OTA-WKM C tower under the take-off fan of the OLS is recorded as 67.2 metres (or 220 feet) AMSL. By comparison, the highest tower of the proposed line under the take-off fan is 78.5 metres (or 258 feet) AMSL. Although the tower height above ground is greater, the ground level at the location of the proposed line is somewhat lower than the airport.

54. **ALTERNATIVELY** – given that Mr McCreadie states categorically that "a decision to underground at least 500m of line either side of the Runway 03/21 extended centreline would meet our hazard avoidance requirements without further ado" - if we consider only the towers 500m either side of the extended centreline the highest tower of the proposed line is 72.4 metres (or 238 feet AMSL).

55. **THIS** means that the new towers of specific interest to Mr McCreadie and the AATUC are only 5.2 metres (or 18 feet) AMSL higher than the OTA-WKM B towers, yet 3 kilometres further away along the take-off flight path. Intuitively this suggests the proposed line will be a far lesser risk to Ardmore based aviation than one which is clearly accepted by Mr McCreadie.

Aeroplane performance considerations

56. **I** have prepared diagrams which are included at **Appendices "3", "4" and "6"** which represent the consensus view of the pilots I consulted in conducting the initial risk assessment, and/or in preparing my statement of evidence and this rebuttal. I note that this expert consensus is supported by radar data information provided by Airways Corporation for the period 30 November 2007 to 7 February 2008. The analysis of that data is summarised in **Appendix "2".**

57. **WE** considered a range of aeroplanes typically used in flying training at Ardmore – the single engine Cessna 150 and 172, the Piper Cherokee and Piper Tomahawk, as well as the twin engine Beech Duchess. It should be noted that the Beech 76 Duchess was specifically chosen as it was noted by Mr Sattler at the HazID Workshop for its poor single-engine climb performance. I then chose the Cessna 172R as the representative single engine aeroplane as it is operated by the Ardmore Flying School where Mr Sattler is the Chief Flying Instructor.

58. **WE** used normal and, for the twin engine Beech 76, one-engine-inoperative (**OEI**) climb rates from an aeroplane performance data base which I sourced during my tenure with the Australian Civil Aviation Authority. These performance figures are calculated values derived from flight tests conducted by the aeroplane manufacturer and will vary with individual aeroplanes and other factors such as take-off weight, ambient temperature, the airport elevation and runway slope, and pilot capabilities.

59. **IN** our analysis, we considered aeroplanes at their maximum take-off weight. Climb performance will be better at lighter weights typical of flying training with its solo student pilot or instructor/student pilot configurations. We also considered take-off with nil wind. The normal take-off into wind will further improve the climb performance. We have ignored both of these factors to ensure that our underlying assumptions are conservative.

60. **WE** noted that airworthiness/regulatory authorities anticipate a reduction of around 0.8% in climb performance during the service life of an aeroplane and also, in part, to allow for variations in pilot skills/capabilities, the latter being particularly relevant for student pilots at Ardmore. We allowed for this in our analysis, again to ensure our assumptions were conservative.

Engine failure in a single engine aeroplane

61. **THE** aeroplane performance data base suggested a normal rate of climb for the Cessna 172R of 720 feet/minute at 80 knots, which equates to a climb gradient in zero wind conditions of 8.9%. In keeping with the airworthiness/regulatory expectations, we reduced this to 8.1% (8.9% – 0.8%) for the purpose of our assessment. Mr Stevens who owns a Cessna 172 confirmed this to be a realistic expectation.

62. **THE** pilot of a single engine aeroplane which suffers an engine failure has no alternative, but to make a forced landing. Conventional wisdom, reiterated by Mr McCreadie (in his paragraph 17(c)(x)), suggests that if this happens below 500 feet AGL - which in this case equates to 600 feet altitude – the pilot is generally advised to continue "straight ahead" on runway heading and, where possible, avoiding "power lines, hilly terrain or shelterbelt trees…buildings, individual trees, rock outcrops etc". This has to be accomplished while attempting to achieve the best angle of glide for the aeroplane.

63. **ACCORDING** to pilot consensus, the best angle of glide in a single engine aeroplane with a dead engine is likely to be between 1:8 and 1:10. My research has suggested that for a Cessna 172R the best angle of glide is in fact 5.4 degrees - 9.5% or 1 in 10.5. As this provides the most conservative estimate of glide distance required, I have adopted this value in the diagram at **Appendix "3**" which depicts a typical Cessna 172R take-off.

64. **IN** practice, the pilot will need time to react and this will mean a steeper descent initially before the attitude of the aeroplane is adjusted for best glide. The glide distance is therefore likely to be somewhat less than depicted in **Appendix "3".**

65. **ON** normal climb, the Cessna 172R will reach an altitude of around 800 feet AMSL overhead the OTA-WKM C line and around 1,000 feet AMSL overhead the OTA-WKM-A/B line.

66. **THIS** means a pilot of a single engine aeroplane who is intending to fly circuits and turns onto the crosswind leg at 600 feet AMSL, will do so inside the OTA-WKM C line. This is the lowest turn altitude permitted by the Ardmore Noise Abatement Procedures and also the height (500 feet AGL) at which the CAA New Zealand Flight Instructor's Guide recommends pilots should normally start the turn.

67. **ON** the other hand, a pilot initiating the turn at around 900 feet AMSL as suggested by Mr McCreadie, or even delaying the turn until reaching the circuit altitude of 1,100 feet AMSL, should be doing so in the vicinity of the OTA-WKM A/B line. It must be noted that these calculations are referenced to

zero wind conditions. Angles of climb and track distances to the initial turn onto the crosswind leg of the circuit will be reduced if there is a headwind component. These deductions are supported by analysis of radar data supplied by Airways Corporation for the period 30 November 2007 to 7 February 2008, which is summarised in **Appendix "2"**.

68. **SHOULD** the engine failure occur before and including 600 feet AMSL, the pilot has little option other than to glide straight ahead towards the OTA-WKM C or OTA-WKM A/B lines.

69. **SHOULD** the engine failure occur between 600 and 900 feet AMSL, the pilot should be able to make a forced landing before reaching the proposed line. In this instance, a wider range of landing sites can be considered because the increased height gives the pilot more time for decision-making. The CAA New Zealand Flight Instructor's Guide suggests that "anything in the windscreen" is a realistic choice and that this "could result in a turn of between 60 and 90 degrees at the most and a crosswind landing."

70. **AT** this juncture, I note also that Mr McCreadie advocates turning directly into wind even if an engine failure occurs on the crosswind leg of the circuit. This means that he accepts that a 90 degree turn is within the capabilities of a low hours student pilot. I note that a lesser turn of perhaps 60 degrees will provide some headwind component while increasing the choice of landing sites. The available forced landing options are depicted in the diagram at **Appendix "4".**

71. **APPENDIX "5"** provides a pilot's perspective (courtesy of Google Earth) of the available options. This also indicates there is advantage in turning away from the rising ground to the left of the take-off flight path.

72. **MY** conclusion is that the pilot of a single engine aeroplane typified by the Cessna 172R would, if properly trained and prepared for an engine failure after take-off, complete a forced landing without conflict with the proposed line.

Engine failure in a twin engine aeroplane

73. **I** turn now to the case of a twin engine aeroplane as typified by the Beech 76. I have prepared a diagram, included as **Appendix "6"**, which depicts the likely

sequence of events in this situation – engine failure, a recognition and reaction phase in which a pilot deals with the “dead engine” and feathers the propeller, recovery and subsequent OEI climb.

74. **THE** aeroplane performance data base suggests a normal two engine climb gradient for the B76 of 1,248 feet/minute at 85 knots, equivalent to a zero wind climb gradient of 14.5%.

75. **THE** data base indicated an OEI rate of climb for the Beech 76 of 235 feet/minute, also at 85 knots, equivalent to a worst case climb gradient of 2.7%. Mr Sattler’s comments at the HazID workshop conducted by Airbiz, confirmed this to be a realistic expectation.

76. **FOR** the purpose of our assessment we (again conservatively) reduced both the normal and OEI rates of climb by 0.8% - to 13.7% and 1.9% respectively.

77. **THE** most significant differences from the single engine aeroplane, are the rate of climb available to the pilot prior to an engine failure and the fact that the aeroplane retains an OEI climb capability. Once again it can be seen that engine failures at very low altitudes create the potential for conflict with the inner OTA-WKM B/C and OTA-WKM A lines. I note that these potential risks are not debated by Mr McCreadie and that their consideration was also outside the scope of the Airbiz Report.

78. **AT** its normal rate of climb, the Beech 76 would normally achieve 1,100 feet altitude directly above the OTA-WKM C line. This is supported by analysis of radar data for the period 30 November 2007 to 7 February 2008, which is summarised at **Appendix "2".**

79. **AS** noted earlier, Mr McCreadie has stated that that the low hours student pilot is particularly vulnerable if an engine failure or significant power loss should occur between 400 and 900 feet altitude.

80. **REFERRING** to the diagram shown in **Appendix "6"**, the worst case scenario as described by Mr McCreadie must be an aeroplane which suffers an engine failure at around 400 feet AMSL. I have depicted a subsequent timeframe in which the aeroplane maintains airspeed while the pilot recognises and deals with the emergency. I have allowed 45 seconds – 30 seconds as suggested by

Mr McCreadie (in his para 16(xi)) as the extreme recognition time for a low hours student pilot, and 15 seconds for the pilot to secure the dead engine and feather the propeller.

81. **EXPERIENCED** instructors have assured me that they would expect student pilots to deal with this situation without losing altitude. Even if this was not the case here, the loss must be limited to 200 feet otherwise the aeroplane will collide with the OTA-WKM C line.

82. **AS** the student pilot can be expected to comfortably replicate this recovery manoeuvre at increased altitudes, the subsequent OEI climb will place the aeroplane well above the proposed line. Examples of engine failure at 600 and 900 feet are also depicted in the diagram at **Appendix "6".**

83. **A** pilot suffering an engine failure in a location closer to the proposed line will be well established at the circuit altitude and at higher airspeed, both factors which give a wider range of options to deal with an engine failure, but one would expect a continuation/rejoin of the traffic circuit for a landing back at Ardmore.

Summation

84. **IN** this context, the risk of collision with the proposed line – whether the pilot is at the controls of a single or twin engine aeroplane - is primarily one of perception. As with other lines, this can be addressed in classroom and simulated engine failure training.

85. **I** conclude that the Airbiz Report was justified in finding these scenarios "not applicable" in the context of its risk assessment.

Cloud and visibility information for the Clevedon Valley via AWIB

86. **IN** his statement of evidence (at paragraph 16(s)), Mr McCreadie asserts that that I have offered "*as a mitigation sweetener automatic cloud ceiling sensing information on ATIS…[which]…if actually available would be very new technology*."

87. **METSERVICE** has advised that they have the capability to deliver the system envisaged in my statement of evidence where remote cloud and visibility sensors would be placed in the Clevedon Valley and their readings would be relayed at one minute intervals to the automatic weather station (a personal computer) located on Ardmore Airport.

88. **THE** Aerodrome Weather Information Broadcast (**AWIB**) would need to be programmed to include and clearly note the source of the additional information as in: "*Ardmore: Weather MIKE: Ardmore: 250 14 knots, gusts 25 knots, 19 degrees, QNH 1016: Clevedon: visibility 30 kilometres, cloud scattered 1500 feet, broken 2200 feet…"*

89. **I** understand that Wellington Airport currently has a cloud sensor located at Shelly Bay, remote from the other sensors which are located on the western side of the runway. While the distances proposed here are greater, the available technology can still be utilised to deliver the mitigation measure which I have proposed.

90. **I** considered that this initiative may prove useful in addressing pilot concerns expressed at the PHA and HazID workshops – but not raised by Mr McCreadie in his statement of evidence – that weather can close in quickly in the Clevedon Valley and have the potential to "trap" pilots who rely on Ardmore-specific weather information. Real time cloud and visibility information would allow pilots to make more informed decisions on whether or not they should be departing or returning to Ardmore.

91. **SOME** details of the technology currently available to deliver visibility and cloud ceiling information via AWIB or the internet are included in **Appendix "7".**

Other issues arising from consideration of the McCreadie evidence

Exposure to the proposed line

92. **IN** his original statement of evidence, Mr McCreadie asserted that circuit traffic is at risk from the proposed line and that the need to cross and re-cross the line implies the risk is cumulative. I note that the Airbiz Team studied the NZ AIP, the Ardmore Airport Operations Manual and radar data sourced from Airways Corporation, and also drew on its collective experience to determine that circuit

activity, except in very exceptional circumstances, will be confined within the Ardmore MBZ. This is confirmed by analysis of the radar data supplied by Airways Corporation for the period 30 November 2007 to 7 February 2008, which is summarised in **"Appendix 2".**

93. **IT** is difficult to accept that a pilot with extensive personal experience of the Ardmore circuit such as that claimed by Mr McCreadie (his paragraph 16(r)(iii)), could have made this mistake in the first place. I am not surprised that he withdrew the statement (at paragraph 2 of his errata) given time to reflect on its implications.

94. **IN** paragraph 3 of his errata, Mr McCreadie then goes on to say that all "…03 take-off traffic is potentially EXPOSED to the existing AND new lines…" While I agree with this statement, I strongly disagree with the emphasis used. Both the Airbiz Report, my statement of evidence, and an earlier part of this rebuttal statement, have shown the correct emphasis to be "POTENTIALLY exposed". This appears to be the single most important point of difference between the views in my evidence and Mr McCreadie's evidence.

95. **IN** the same paragraph, Mr McCreadie goes further than I would have deemed prudent by using the term "insidious" to describe this potential exposure. An accepted, everyday meaning of insidious, is "intended to trap", an inference I cannot support in the light of my statement of evidence and this rebuttal.

Tower heights

96. **I** note that Mr McCreadie has amended his original statement of evidence to say that the proposed line towers are between 2 and 3 times as high as the ARI-PAK A towers they will replace. I have re-checked the design data provided by Transpower (and also made available to the AATUC) and I am able to confirm that:

(a) considering only the width of the take-off fan, the proposed towers will on average be 2.33 times as high as the ARI-PAK A towers; and

(b) within the full width of the Clevedon Valley, the proposed towers will on average be 2.12 times as high as the ARI-PAK A towers.

97. **WHILE** it is true that these values do lie "between 2 and 3", it is nevertheless somewhat misleading of Mr McCreadie to present the comparison in this way. As I have indicated elsewhere, the most meaningful comparison is that the proposed line tower on the extended runway centreline will be only 5.5 metres (or 18 feet) higher AMSL, than the OTA-WKM C tower located 3.7 kilometres closer to the airport and only 2.9 kilometres from the start of take-off on runway 03.

Vulnerability of student pilots

98. **IN** his paragraph 16(g), Mr McCreadie makes much of the fact that the Airbiz Report did not address the vulnerability of low hours student pilots. I have reconsidered the Airbiz Report and acknowledge that this interpretation may be possible.

99. **HOWEVER** a careful reading would show that the reverse is actually true. In fact, the Airbiz study team dealt with this vulnerability factor in the simplest possible way by accepting a 100% failure rate - equivalent to "extreme stress" in a "rarely performed task" – in both event trees dealing with the risks associated with an engine failure.

100. **FOR** similar reasons, Mr McCreadie may have perceived that I have overlooked or casually dismissed the low hours student pilot reaction to the "real thing", compared with the simulation engine failures practiced under supervision of a flying instructor. I acknowledge the contribution of human error (human factors) and note that this is more likely where a low hours student pilot is concerned, but in this case too, I simply assumed the worst outcome where warranted – whether the pilot is inexperienced or experienced.

101. **AS** I have noted the Airbiz study team determined that the engine failure scenarios I examined earlier did not warrant detailed risk assessment. Later in this rebuttal, I will consider the probability of those scenarios requiring a pilot to take evasive action relative to the proposed line which leads to a collision with the ground.

102. **IN** relation to vulnerability, I note that flight instructors have a common law duty of care to ensure student pilots have attained appropriate skill levels before being permitted to fly solo. They also have a statutory obligation to do so which

stems from CAR 61.105 as detailed by Mr Stevens. While errors of judgement will always be made, the system is designed to ensure that student pilots are well prepared and well practiced before being permitted to fly solo.

Pilot preparation

103. **IN** his paragraph 17(xii), Mr McCreadie makes much of the decisions facing pilots when they suffer an engine failure or sudden power loss. My understanding from my long industry involvement with pilots/flying instructors, is that these decisions should in fact be made *prior* to take-off. Preparation and planning are recognised pilot by-words.

104. **I** quote briefly from a widely published aviator and academic, Professor Emeritus David F Rogers PhD:

> "*Before you pull onto the runway and apply takeoff power you should have planned what you are going to do if the engine quits. For example, say to yourself, "If the engine quits at 50 feet, then ..... If the engine quits at 200 feet, then ..... If the engine quits at 500 feet, then ..... If the engine quits at 1000 feet, then .....*"[1]

105. **INSTEAD** of this basic form of preparation, Mr McCreadie appears to be advocating that the pilot should wait for an engine failure to occur and then ask "What do I do now??" I find it surprising that an experienced pilot would take this view.

Airspace protection

106. **IN** his paragraphs 16(p), Mr McCreadie has recently added the argument that the proposed line towers will affect the whole width of the Clevedon Valley, not just the approach and take-off fan. He claims this area is used by both Ardmore and transit operations. This appears at odds with the arguments he advances in the same set of paragraphs, where he points out that "*aircraft track out on runway centreline*" and criticises me for having allowed for possible tracking down the extreme edge of the arrival/departure fan.

107. **THE** inconsistency is clear and, as Mr McCreadie himself points out, the radar track data shows that aircraft will cross the proposed line in a clearly defined

[1] Rogers, David F *The Possible 'Impossible' Turn.* AIAA Journal of Aircraft, Vol 32, pp 329-397, 1995.

and relatively narrow corridor. This is confirmed by analysis of radar data for the period 30 November 2007 to 7 February 2008, which is summarised in **Appendix "2".**

108. **AT** this point, I believe it important to emphasise that normal operations through the Clevedon Valley are in fact protected by the Ardmore OLS – the approach and take-off fan, the horizontal surface and the conical surface. The lower limits of these surfaces are designed to provide adequate vertical clearance above potential obstacles for pilots complying with the VFR and aerodrome traffic rules. I have discussed this in some detail in my statement of evidence in chief.

109. **THERE** is no basis for Mr McCreadie to assert (as he does in paragraph 16(bb)), that the AATUC does not consider the OLS relevant to the assessment of the power line. I have concerns that he is discounting an accepted international and national standard because it does not suit his purposes.

110. **CAR** Part 139 and the supporting Advisory Circular 139-10: *Control of Obstacles* clearly define the OLS parameters. The requirements make no distinction between types of obstacles, but simply require that structures should not extend above the individual or collective surfaces. Fence type structures are permitted without special restraint, as are solid walls and clusters of high rise buildings, as long as they do not penetrate the OLS.

111. **BOTH** the Airbiz Report and my statement of evidence in chief demonstrate that none of the proposed line towers or conductors penetrate the "navigable airspace" defied by the Ardmore OLS.

Aperture reduction in the Clevedon Valley

112. **IN** relation to airspace issues, I note that Mr McCreadie has now introduced the concept of "aperture reduction" as pilots must maintain 500 feet vertical clearance over the proposed line and at the same time are restricted to 1500 feet AMSL by Auckland controlled airspace above them.

113. **THEORETICALLY** Mr McCreadie is correct. Applying the minimum VFR height rule suggests pilots must now cross the proposed line at 740 feet

(238 + 500) compared with 620 feet (116 + 500) for the ARI-PAK A line. In practical terms however, there is no noticeable impact as Ardmore rules require pilots to depart the MBZ – and this happens as they cross the proposed line – at 1100 feet.

114. **MR** McCreadie appears to be suggesting that when the cloud base falls below 1100 feet pilots will be forced to disregard the rule and depart the Ardmore MBZ in the reduced aperture, and may well conflict directly with transit (north-south) traffic as a result. The 1100 feet rule means that pilots of transiting traffic would not be expecting to encounter Ardmore departures at these lower altitudes.

115. **THIS** is primarily why I suggested that "real time" visibility and cloud ceiling information be provided for this location so that Ardmore-based pilots could make informed judgments about whether they could legally take-off and depart from Ardmore.

Sunstrike

116. **THE** combination of sunstrike and engine failure is now cited by Mr McCreadie as a high risk situation (his paragraph 17(d)), and he includes this as one of the hazards given the "simplistic AirBiz/Sullivan treatment" and "not adequately developed. Mr McCreadie appears not to have noticed that the Airbiz Report acknowledges that combinations of hazards may occur, but if so, the combined risks will have a lower probability than those related to the individual hazards of sunstrike and engine failure. Provided the individual risks are deemed acceptable – as was the case – the combined hazard does not require further assessment.

The Reason Model

117. **IN** his paragraph 17(h), Mr McCreadie makes much of the Reason Model and its application in explaining the combination of events which lead to an undesirable outcome, and its role in conducting the risk assessment.

118. **THE** Reason Model considers the normal defences which are in place to prevent a hazard precipitating outcomes which risk severe injuries and/or death. The defences are described as slices of Swiss cheese which, as one

might expect, have a number of holes in them. In normal operation, some holes may be aligned from time to time, but one or more defences remain in place to guard against the undesirable outcome. An accident or incident occurs when a hole in each of the defences (slices of cheese) line up. The holes are therefore the events which may contribute to an accident chain.

119. **ENGINE** failure is a "hole"; the location of the aeroplane in the take-off manoeuvre or circuit pattern is another; sunstrike might be another; the student pilot doing his first or an early solo is another; inappropriate planning is another; and so on.

120. **IN** other words, the "holes" in the Reason Model's layers of Swiss cheese are the identifiable slips, lapses, or errors, which have a probability of occurrence. The probability of all the holes lining up is the product or multiple of these individual probabilities. The event trees used by Airbiz were a direct application of the Reason Model.

Applying the Reason Model to the McCreadie scenarios.

121. **MR** McCreadie paints a particularly black picture of engine failure scenarios confronting the low hours student pilot. As expressed by Mr McCreadie they appear to be anticipated as an everyday occurrence. This is incorrect.

122. **WHILE** Mr McCreadie can be commended for identifying the "holes" required for the application of the Reason Model, he has made no attempt to evaluate the probabilities of their individual or combined occurrences. To put Mr McCreadie's concerns into perspective, I now undertake that assessment.

123. **LET** us consider the first "hole" – the one minute noted by Mr McCreadie during each circuit in which the aeroplane/pilot combination is potentially exposed to the proposed line.

124. **MR** McCreadie has stated that annual aircraft movements at Ardmore are around 240,000. The radar data analysis suggests that 70% of this total – around 168,000 movements - is circuit traffic. A movement is defined as either a take-off or landing. This suggests a total of 84,000 completed circuits. Mr McCreadie has suggested that roughly half this activity would be runway 03

circuits. This means the exposure which particularly concerns him occurs during the take-off and crosswind legs of around 42,000 circuits per year.

125. **ACCORDING** to Mr McCreadie the aeroplane/pilot combination is exposed to the proposed line for one minute in each circuit. The total exposure each year is therefore 42,000 minutes or 700 hours.

126. **THE** second "hole" is the occurrence of an engine failure. The Airbiz Report assumed one engine failure every 2000 hours, but Mr Stevens has shown in his evidence that the probability is more realistically once in 6000 hours.

127. **THE** probability of an engine failure occurring during the critical one minute of exposure for each circuit is therefore 6000 divided by 700 or one every 8.5 years.

128. **SINCE** Mr McCreadie's main concern is for low hours student pilots flying their first or early solos, we must now consider the probability of that occurrence – the third "hole".

129. **MANY** in the circuit will be under instruction, so the instructor will deal with the failure as required. Mr McCreadie himself has taken pains to point out that this is a routine, low risk scenario.

130. **IF** we assume that half the pilots in the circuit are low hours student pilots flying their first or early solos, the combined probability of all three "holes" aligning is now one in 17 years.

131. **WE** must now consider the probability that the low hours student pilot will be one who completely mishandles an engine failure situation. Bearing in mind that the instructor has a responsibility to ensure that student pilots are equipped to deal with an engine failure *before* they are permitted to fly solo, it would be reasonable to expect the proportion who completely mishandle the situation to be relatively small. It could reasonably be only one in ten, but to be conservative, I will assume one in four.

132. **THE** combined probability of an engine failure during the critical phase of the circuit involving a student pilot who will completely mishandle the emergency is now one in 68 years.

133. **IN** this timeframe, Mr McCreadie is suggesting that Ardmore traffic will grow from its current level to around 350,000 annual movements, but for the purposes of this risk assessment, I will assume operations remain at the current level of 240,000 annual movements.

134. **SINCE** the worst case scenario is a single fatality (solo pilot), the probability of a fatality can then be expressed as one in 16,320,000 (68 years x 240,000) aircraft movements or 6.1×10^{-8}. In aviation terms, this is considered a very low probability and would normally be accepted without further comment.

135. **THIS** probability estimate has been derived without questioning Mr McCreadie's proposition that when all "holes" align a crash into either the proposed line or the ground is inevitable. I have dealt with that proposition earlier in my rebuttal evidence, and concluded the Airbiz Report to be justified in finding the scenario to be "not applicable". The probability that I have derived here using Mr McCreadie's assumptions clearly leads to the same conclusion.

136. **THEREFORE** in my opinion, Mr McCreadie has grossly exaggerated the risk to Ardmore pilots associated with the proposed line, whether they be experienced or inexperienced. The principles of airport and airspace design, and the regime the CAA expects be in place for pilot training, should ensure that potential risks associated with the proposed line are judged acceptable by international aviation standards.

Nicky and Mark Auld (Submission number 0826)

137. **AT** their paragraph 12, Mr & Mrs Auld note where they live relative to both Ardmore and Auckland Airport flight paths. I note that aviation rules have been developed with due regard to the safety and amenity of people on the ground and to safeguard their property. There is always risk in aviation – as there is in all forms of human endeavour - but the proposed line will have no influence on the pilot's ability to abide by the rules.

138. **AT** their paragraph 13, Mr & Mrs Auld raise questions concerning hazards to aircraft, all of which have been addressed in the Airbiz Report. As noted in my statement of evidence, and in this rebuttal, the risk assessment documented by Airbiz took account of the increased height of the proposed line above ground,

the numbers of aircraft movements and the vulnerability of student pilots. We have shown that there is no justification for the expressed concern that "aircraft crashes into the new pylons or each other will possibly become a common occurrence."

139. **IN** this and their following paragraph, Mr & Mrs Auld also raise questions concerning the added risk of fog which has "the effect of hiding the pylons." Flying rules impose significant limitations on operations to and from Ardmore in fog conditions. Minimum visibility and cloud base requirements are prescribed by the CAA, pilots must be suitably qualified, the aircraft must be equipped for IFR flight, and specific IFR procedures must be flown on departure and arrival. These additional precautions are determined by the CAA and will not be affected by the proposed line.

140. **AT** their paragraph 14, Mr & Mrs Auld, raise the issues of sunstrike and potential conflict between the lines and aircraft in the circuit. Both have been dealt with in the Airbiz Report and the latter more extensively in the evidence of Mr McCreadie and in this rebuttal.

Christopher Freke (MCC) (Submission number 0861)

141. **MR** Freke is primarily concerned that the potential for urbanization be recognized by undergrouding the proposed line from the point where it enters the Brookby Valley in the vicinity of tower site 14. He summarises this position in his paragraph 82 and then adds "or, if justified based on air safety issues (or the impacts of lighting or marking of lines), a point just south of the flight path to the Ardmore Aerodrome."

142. **IN** his paragraphs 150, 151 and 153 Mr Freke notes:

(a) AATUC concerns that the Airbiz Report has "*underrepresented the risks posed by the significant number of trainee and learner pilots*";

(b) his view that the "Transpower material does not appear to focus on risks to planes" and

(c) his concerns that “Transpower has not provided enough certainty around the impact and nature of mitigation measures that might be proposed to address air safety concerns."

143. **I** have dealt at length with the question of inexperienced pilots and their perceived vulnerability to the proposed line in paragraphs 92-96 of this rebuttal.

144. **I** am uncertain how Mr Freke formed the view that the Airbiz Report or my statement of evidence does not focus on the aviation risks or “risks to planes” as this has been the primary reason for conducting the Airbiz risk assessment.

145. **WHILE** the Airbiz Report considered a range of mitigation measures, it did so in the context of the AS/NZS 4360: 2004 requirement to consider if risks were not simply acceptable but as “low as reasonably practicable”.

146. **IN** this context, practicability involves considerations of social and economic cost and the increment in risk reduction likely to be achieved. Since opinion is clearly divided on the impacts of suggested mitigators such as marking and lighting of towers and sections of the proposed line (for example in the evidence of Mr Stevens), these suggested measures can be set aside. The Airbiz analysis has shown that the potential risk posed to Ardmore operations is in any case acceptable when judged by international standards.

Rodney Ernest Sullivan

14 May 2008