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 MAXWELL BROOKE STEVENS IN REBUTTAL FOR TRANSPOWER NEW ZEALAND LIMITED (Aviation risks relative to Ardmore Airport)

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INTRODUCTION

1. **MY** name is Maxwell Brooke Stevens. I am an independent aeronautical consultant, having retired as Deputy Director of Civil Aviation after a long career in the Civil Aviation Authority of New Zealand (**CAA**).

2. **MY** professional qualifications are Bachelor of Engineering – Mechanical (University of Canterbury, 1965).

3. **I** am a Fellow of the Royal Aeronautical Society (UK) and a Freeman of the Guild of Air Pilots & Air Navigators (UK).

4. **I** am an active Private Pilot Licence holder and glider pilot, with a total of more than 7,000 hours as pilot in command, accumulated over 42 years. In that time, I have flown about 20 different types of aeroplane and many gliders. As pilot in command, I have operated from time to time in and out of about 50 of the aerodromes throughout New Zealand (including Ardmore) that are listed in the NZ Aeronautical Information Publication, and also some aerodromes overseas.

5. **MY** early CAA experience was as an aeronautical engineer directly responsible for design substantiation of New Zealand manufactured aircraft. This work included the control and observation of test flying for the assessment of aircraft flight handling characteristics, and the measurement and prediction of various aspects of aircraft performance, such as take-off and climb and landing performance.

6. **MY** CAA experience includes five years as the senior manager to whom the line manager of the Aerodrome Standards Unit directly reported. Amongst other things, this Unit's work entailed continuous monitoring of new developments that could be obstacles to air navigation, their lighting and marking requirements, and the associated aeronautical charting.

7. **MY** CAA experience also includes seven years as the senior manager to whom the line managers of the Safety Investigation Unit and the Safety Analysis Unit directly reported. The Safety Investigation Unit records all reported aircraft accidents, incidents and defects, investigating them to a greater or lesser extent depending on their seriousness. The Safety Analysis Unit gathers aircraft utilisation statistics and looks at the overall occurrence data accumulated over

time, in order to analyse and report on the safety performance of various segments of the aviation industry in New Zealand.

8. **MY** recent consulting experience includes a study for the CAA into solutions for reducing aircraft wire strike accidents. This assessed the methodology that had been used in determining wire marking criteria proposed in a draft amendment to Civil Aviation Rules[1] and identified potential options for reducing the number of aircraft wire strike accidents.

9. **MY** role in the North Island Grid Upgrade Project (**Upgrade Project**) is to provide rebuttal evidence in relation to evidence on air safety from the perspective of an aviation safety regulator and pilot.

10. **I** confirm that I have read the Code of Conduct for expert witnesses in the Environment Court's Consolidated Practice Note (2006). I have approached the preparation of this evidence in the same manner that I would for the Environment Court.

11. **IN** preparing for my review of the evidence of other parties, I have fully reviewed the "Ardmore Aviation Risk Assessment" report prepared by Airbiz Aviation Strategies Ltd, which formed part of the documentation for the Notices of Requirement by Transpower NZ Ltd. Similarly, I have fully reviewed the statement of evidence in chief provided by Mr Rodney Ernest Sullivan regarding his assessment of aviation risk in relation to the proposed line in the vicinity of Ardmore Airport. I wish to offer the following introductory comments that are relevant to my comments on the evidence of submitters, which follows.

12. **I** consider the semi-quantitative assessment of hazards detailed in the Airbiz report to be appropriate and reasonable. A generally conservative approach to assumptions is taken in estimating the likelihood of each of the postulated hazardous events.

13. **FOR** example, in determining the average exposure time to the subject transmission line as a proportion of total flying hours for a given aircraft, an average sortie time of 30 minutes is assumed for flights transiting the Clevedon Valley or Brookby Ridge. Taking into account the fact that many flights in and out

[1] Civil Aviation Rule Part 77, Objects and Activities Affecting Navigable Airspace

of Ardmore are by aircraft based elsewhere, it is likely that the times for such transit flights would on average be somewhat greater than 30 minutes, leading to a reduction in exposure time per hour, in other words lower risk.

14. **A** second example of conservatism is the rate of engine failure assumed by Airbiz, of one in 2,000 hours. My analysis of reported power failures in New Zealand piston-engined light aircraft over an 11-year period from 1996 to 2006 inclusive indicates that the rate is about one in 12,000 hours, or one sixth of the rate assumed by Airbiz. Some caution needs to be applied to this figure however, because of a culture of under-reporting of safety failures within "General Aviation", which is a world-wide phenomenon not peculiar to New Zealand.

15. **EVEN** if one was to assume that only half of the power failures are reported, the failure rate used by the Airbiz analysis would still be conservative by a factor of three. I also note that the New Zealand data referred to above includes cases of carburettor icing and fuel exhaustion, as well as actual mechanical failure of the engine. Such occurrences can be reduced by better pilot training and/or discipline.

16. **THE** only area where I consider the Airbiz report is not conservative in its assumptions is in relation to conditions where the pilot may be temporarily blinded by "sunstrike". Airbiz assumed the probability of a pilot failing to see and avoid the transmission line to be 30%. In my opinion, the probability would be much higher than that. However, such an event is estimated by Airbiz to be one or two orders of magnitude less likely than some other scenarios. Thus the assumption is not fatal to the overall conclusion of the study at paragraph 1.4; ie that the likelihood of aviation hazards arising from the subject line "is in the generally acceptable region for international aviation practice."

17. **EVEN** though they considered mitigation measures were not actually necessary, in keeping with the notion that risks should be as low as reasonably practical, the Airbiz study team listed six possible risk mitigation strategies. These are discussed in section 9 of the report. I wish to comment on the efficacy of the first two of the proposed mitigation strategies, "marking of the proposed transmission line in selected areas near Ardmore aerodrome with appropriate devices" and "lighting of selected supporting towers … with … lights/strobes."

18. **PHYSICAL** marking such as coloured balls or flags strung on the wires, combined with lighting, reflects the "conventional wisdom" of the past. More recently, it has been shown that the effectiveness of physical marking is highly dependent on sun position and general weather conditions, and is of very limited and inconsistent value in alerting a pilot to danger in time to take avoiding action. I cannot therefore agree with the suggestion in the Airbiz report at paragraph 10.1 that physical marking reduces the probability of human error by one order of magnitude. In my opinion, it would be much less effective than that.

19. **RESEARCH** has shown that warning systems addressing both vision and hearing are necessary in order to overcome a human tendency to ignore or underestimate mere visual warning signals that represent interference to a planned activity. Fortunately, a technical solution is now available that provides both visual and audio warning, day or night, using radar-triggered strobe lights on the towers and broadcast over the aviation VHF radio in the encroaching aircraft. This modern Obstacle Collision Avoidance System (**OCAS**) has been shown to be highly effective in giving the pilot immediate and understandable information about a hazard ahead.

20. **THE** system lies dormant until an aircraft flies close enough to be in danger. OCAS is being enthusiastically embraced in Norway, Canada and the US. Rule-making action to mandate the use of such systems in certain situations is progressing in those countries. The CAA is fully aware of this overseas progress and it is conceivable that similar rule-making action may be considered here in New Zealand some time in the future. I note that the Airbiz report at paragraph 9.2 recommends that OCAS should be considered. I agree with that recommendation.

21. **TURNING** now to the evidence in chief of Mr Sullivan, I am in general agreement with his conclusions at paragraph 27. However, I would like to make some further points in relation to his evidence.

22. **AT** paragraph 60 of his evidence, Mr Sullivan draws attention to the fact that the CAA booklet, *"In, Out, and Around Auckland"* does not make reference to hazards posed by existing transmission lines, and they are not subject to any special alerts or avoidance procedures. I would like to add that the *"Ardmore Airport Operations Manual",* which is produced by Ardmore Airport Ltd and details local operating

procedures, also does not make any reference to any potential hazards posed by existing transmission lines.

23. **AT** paragraphs 69 to 71 of his evidence in chief, Mr Sullivan refers to the Civil Aviation Rules (**CAR**) regarding minimum heights for flights under visual flight rules (**VFR**). In particular, at paragraph 70, he mentions an exception to the general 500 feet minimum height rule, where an emergency landing is required in the event of an engine failure. In fact the relevant rule, CAR 91.311(a)(3), is more restrictive than he suggests, in that it states that a pilot-in-command of an aircraft must not operate the aircraft under VFR for any operation, at a height less than that required to execute an emergency landing in the event of engine failure without hazard to persons or property on the surface. (My emphasis.)

24. **I** agree with the conclusion in Mr Sullivan's paragraph 140 that the risk of an engine failure causing conflict with the proposed line is acceptable.

25. **I** wish to present specific rebuttal evidence in relation to the statements of evidence of:

(a) Allan Robert McCreadie for Ardmore Airfield Tenants and Users Committee (**AATUC**), and

(b) Catherine Tuck for the Whitford Residents and Ratepayers Association Incorporated and Underground in Manukau.

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

Allan McCreadie (AATUC) (Submission number 0549)

27. **AT** paragraphs 16(g), 16(i), and 16(r)(v) of his evidence, McCreadie dwells on the "vulnerability" of trainee pilots to making inappropriate actions in an emergency such as engine failure. While this vulnerability is not disputed in principle, it should be considered in the context of the instructor's responsibility to be satisfied that the trainee (student) has received instruction and demonstrated competence in a range of skills before authorising solo flight. In particular, CAR 61.105(a)(5)(xi) requires the instructor to be satisfied that the student has demonstrated competence in emergency procedures in the event of engine

failure, during and after take-off. CAR 61.105(b) requires the instructor to monitor the actions of the student during the flight to ensure that he or she has an adequate overview of the student's actions. This would generally involve a pre-flight briefing, giving guidance on the areas through which the flight is to be conducted, weather, and other relevant operational factors.

28. **AT** paragraph 16(l) of his evidence, Mr McCreadie is highly critical of Mr Sullivan's use of an ICAO template. New Zealand is a signatory to the Chicago Convention, which provides the foundation for governing international aviation in both the safety sense and the economic sense. The International Civil Aviation Organisation (**ICAO**) administers the Convention through agreed technical standards and recommended practices for States to adopt in their safety regulation of civil aviation, and to pave the way for a common air navigation system throughout the world.

29. **MOST** States, including New Zealand, apply the ICAO standards and recommended practices for domestic aviation where possible. New Zealand does this through Section 33 of the Civil Aviation Act 1990, where there is a requirement that rules made under the Act shall not be inconsistent with the *standards* of ICAO relating to safety, to the extent adopted by New Zealand. The rule-makers shall also have regard to, and give such weight, as is considered appropriate in each case, to the *recommended practices* of ICAO relating to aviation safety, to the extent adopted by New Zealand.

30. **NEW ZEALAND** has in fact adopted ICAO standards and recommended practices to a very large extent and the CAA is committed to an ongoing programme of correcting any deficiencies in that regard (ref CAA Statement of Intent 2007-2010). Therefore, I think it is inappropriate of Mr McCreadie to object to Mr Sullivan's use of an ICAO process. The ICAO process referred to by Mr Sullivan was first published in November 2006.

31. **AT** paragraph 16(m) of his evidence, in relation to avoiding collision with Transpower property, Mr McCreadie asserts that aircraft operators have a "duty of care to themselves only" and not to Transpower or its customers. In my paragraph 23 above, I have already made reference to the fact that the Civil Aviation Rules require that a pilot-in-command of an aircraft in any VFR operation must not operate the aircraft at a height less than that required to execute an emergency landing in the event of engine failure <u>without hazard to persons or</u>

property on the surface (my emphasis). Sections 43 and 44 of the Civil Aviation Act 1990 provide offences and penalties in relation to causing unnecessary danger to any other persons or to any property. Clearly, Mr McCreadie is inadequately informed on this matter.

32. **AT** paragraph 16(dd) of his evidence, Mr McCreadie describes what he refers to as an "aperture reduction" effect caused by the new lines. He says in effect that on those days when the cloud base restricts all traffic in the area to 1100 feet AMSL, maintaining separation between Ardmore aircraft in the Clevedon valley and non-Ardmore aircraft transiting north/south will be more difficult because of the increased height of the proposed line as compared to the existing line.

33. **CONSIDERING** the topography and the likely low-cloud base route for north-west/south-east traffic in relation to the position of the proposed line, I consider Mr McCreadie's scenario to be very unlikely. In weather conditions creating a cloud base down to 1100 feet AMSL, it is in my opinion most unlikely that transiting traffic would elect to cross the Clevedon Valley on a north-west /south-east track in proximity to the proposed line.

34. **THIS** is because the high ground on the northern and southern sides of the valley (the hills that create the valley) will prevent aerial traffic because of the cloud sitting just above them, effectively making them impassable if the minimum safe height rules are to be observed. In such conditions, the transiting traffic will route over lower ground several kilometres further east, probably via the coastline. Thus any cross-traffic conflict is unlikely to be caused by the proposed line.

35. **THROUGHOUT** his evidence, Mr McCreadie attempts to create a strong impression that the new line poses a seriously increased risk to aircraft suffering an engine failure, particularly in the circuit. In my opinion, this is incorrect, and I explain why in the following paragraphs.

36. **I** have considered the feasible engine-failure scenarios in relation to the new line and calculated the outcome in each case for a typical single-engine training aircraft such as a Cessna 172R, and for a typical twin-engine training aircraft such as the Beech 76. In no case does the new line pose a credible threat to the aircraft in distress. These scenarios and associated outcomes are presented in **Appendix "A"** to this evidence.

37. **AT** paragraph 17(b)(xi) of his evidence, Mr McCreadie considers a student pilot having to deal with an engine failure below an altitude of 500 feet. For operation at such a low altitude to be legal, the aircraft would have to be either taking-off or landing and thus very close to the aerodrome, in which case the presence of the new line is not relevant.

38. **AT** paragraphs 17(c)(x) and (xi) of his evidence, Mr McCreadie makes reference to "25m and 60m high electric fences" reducing the safe forced landing options in the event of engine failure below 500 feet. If his reference to 60m is intended to relate to the new line, then I reiterate my previous paragraph. The new line is not relevant in this case.

39. **AT** paragraph 17(c)(xiv) of his evidence, Mr McCreadie paints a bleak picture of a low-time trainee possibly struggling to deal with three sets of power lines in an engine-failure situation. As detailed in **Appendix A**, I do not believe this to be realistic.

40. **AT** paragraph 17(d) of his evidence, Mr McCreadie considers a take-off in a tail wind. As any pilot knows, a down-wind take off is potentially hazardous to attempt, because it can very significantly increase the take-off distance and flatten the climb gradient, thus reducing the height margins over any potential obstacles. Down-wind take-offs must be avoided if at all possible. Mr McCreadie cites the scenario of a delay in changing a busy circuit direction due to wind shift. I contend that the appropriate response to this situation is to delay the take-off until the circuit direction has changed.

41. **AT** paragraph 17(d) of his evidence, Mr McCreadie considers a simulation exercise involving engine failure in a twin-engine aeroplane struggling to clear the new line after a trainee inappropriately "secured" the live engine. I believe it would be questionable practice for an instructor to conduct such simulation exercises in proximity to potential obstacles, unless he or she were highly confident of the trainee's response and ability. In any event, I would expect the instructor to assume control in time to avoid significant loss of altitude.

42. **FURTHER** on at paragraph 17(d), Mr McCreadie describes the difficulties of controlling a twin-engine aeroplane after one engine has failed, claiming that it "is in no way capable of power-line evasion manoeuvres, as it can only turn safely towards the running engine – and this is painfully slow." I consider this to be an

exaggeration, because if the aircraft is flown at close to the optimum speed for climbing on one engine, there will be some ability to manoeuvre as well as climb. This is because the best climbing speed is comfortably above the certified minimum control speed.

43. **IN** this context, I should mention that CAR 61.53(5) and the associated CAA Advisory Circular for aircraft type ratings require the candidate to intentionally shut down one engine and then demonstrate an ability to turn towards and away from that engine. This is not a problem if the correct speed is maintained and there is a level of piloting skill that a candidate could be expected to demonstrate.

44. **A** modest 10 degrees of bank angle will not significantly degrade climb performance, but will produce a turn radius of about 1100m at the best climbing speed for the Beech 76 aircraft with one engine inoperative (85 knots). A very gentle bank like this will take 40 seconds to change the direction of the aircraft through 90 degrees. At 15 degrees of bank, the turn radius tightens to 730m and a 90 degree change of direction is achieved in about 25 seconds.

45. **AT** the "errata" to his evidence, Mr McCreadie withdraws his earlier incorrect contention that the new line was within the Ardmore circuit, but he seeks to embellish his claim that the new line poses an unacceptable risk to Ardmore take-off traffic. As I said earlier in my evidence at paragraph 36 and Appendix 1, I do not consider that the new line poses a threat to aircraft suffering an engine failure in any credible scenario. It is relevant to observe that none of the existing lines has been struck by an aircraft since they were erected.

Catherine Tuck (Submission number 1244)

46. **Ms** Tuck claims that the line through Manukau and across the South Auckland isthmus should be underground, instead of overhead. At paragraph 26, she says that one of the main reasons for this would be "an improvement (rather than impairment) of aviation safety for aircraft using Ardmore airport". At paragraphs 56 and 57 of her evidence, Ms Tuck amplifies this contention and claims that the Ardmore Aviation Risk Assessment report (the Airbiz report) confirms this. While placing the line underground may improve aviation safety in the strictest sense, the Airbiz study (at paragraph 1.4) concluded that the likelihood of aviation hazards arising from the subject line "is in the generally acceptable region for international aviation practice."

47. **AT** paragraph 58 of her evidence, Ms Tuck claims that the Airbiz study appears "to have grossly underestimated the impact" of the proposed line, with particular reference to its dismissal of undergrounding as a mitigating measure. I am not sure of the basis for her comment. Although Airbiz recommended certain mitigation measures be further investigated with the intention of ensuring any risk should be as low as reasonably practical, the conclusion mentioned at my previous paragraph is not dependent on the existence of such mitigation measures.

48. **I** agree with Mr Sullivan's opinion that a mitigation measure of greater practicable value than those considered by the Airbiz report in offsetting the perceived risk would be "real time" information on visibility and cloud ceiling in the Clevedon Valley and over the Brookby Ridge.

Maxwell Brooke Stevens
14 May 2008

APPENDIX "A"

Engine failure after take-off on Runway 03: Practical Scenarios Relating to Typical Aircraft Types

Position at failure	Single-engine light aircraft (eg C172R)	Twin-engine light aircraft (eg Beech 76)
< 600 ft in circuit.	New line not within reach – force land.	New line only a factor once clear of first two. Performance sufficient to fly over new line unless "cleaning up" the aircraft to least drag for best climb is grossly mishandled. Sufficient room exists to safely turn away from the new line in any case.
600 – 1100 ft in normal circuit inside 2nd line.	New line not within reach – force land. *See Note 1.*	New line only a potential factor if still flying close to runway direction or high enough to turn towards it. Performance sufficient to fly over new line in any case.
1100 ft in circuit	Land back at Ardmore airfield	Land back at Ardmore airfield.
On reaching 1100 ft on straight climb out.	Over 2km of paddocks ahead before reaching new line. May glide over new line in no headwind – but no need to press on that way if there is no headwind – can land in any direction appropriate to available paddock. Any Easterly headwind makes landing before new line much the safest option and should remove temptation to glide over.	Easily fly over new line.
1100 ft approaching new line.	Easily glide over new line if appropriate in prevailing wind. *See Note 2.*	Easily fly over new line.

Note 1: Assumes that the circuit does not go further West than the 2nd line (the radar data supports this) and the pilot starts the turn crosswind as soon as he/she reaches 600ft (the noise-abatement minimum). Calculations indicate that in zero wind a C172 would reach 600 ft before the 1st line. So, by the time it reaches 1100ft it is well down the crosswind leg inside the 1st line and would have to turn left towards the new line when the engine failed if there is to be a potential conflict. There would be a height loss associated with such a turn and the aircraft would not be able to reach the base of the new towers even in zero wind. The only rational reason for a pilot turning left like this would be if there was a reasonable easterly component to the wind and he/she thought the aircraft was too low to cut the corner back onto Ardmore. From that position, a headwind would ensure that the aircraft reached the ground well before the new line (if the zero-wind glide angle is 10:1 at 70kt, it drops to less than 8:1 in a 15 kt headwind).

Note 2: If the aircraft does not turn crosswind on reaching 600 ft and continues straight ahead to 1100ft, it will be well past the 2nd line (in zero wind) and should be able to glide over the new line provided the pilot does not waste too much time setting up airspeed for best glide. If there is an appreciable headwind it may be better to steepen the glide by use of flap and/or by side-slipping or S-turning as appropriate to land before the new line.