

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

**STATEMENT OF EVIDENCE OF HUGH ROBERT KELSEY WILDASH IN
REBUTTAL ON BEHALF OF TRANSPOWER NEW ZEALAND LIMITED
(Underground cables)**

SIMPSON GRIERSON
D J S LAING / J G A WINCHESTER
TELEPHONE: +64-4-499 4599
FACSIMILE: +64-4-472 6986
DX SX11174: PO BOX 2402
SOLICITORS
WELLINGTON

J S KÓŠ QC
STOUT STREET CHAMBERS
TELEPHONE: +64-4-472 9026
FACSIMILE: +64-4-472 9027
PO BOX 117
WELLINGTON

Introduction

1. **MY** name is Hugh Robert Kelsey Wildash. I wish to present rebuttal evidence to the statements of evidence of:
 - (a) Mr Tim Chatterton, on behalf of Vector Limited (**Vector**);
 - (b) Mr Christopher Freke, on behalf of Manukau City Council (**MCC**);
 - (c) Mr Doug Parker on behalf of Hunua and Paparimu Valley Residents' Association Incorporated; and
 - (d) Mrs Catherine Tuck on behalf of Underground in Manukau.
2. I address the evidence of each submitter below.

Mr Chatterton (Vector) (Submission number 0863)

3. **AT** paragraph 20, Mr Chatterton raises concerns that the designation "*could effectively prohibit Vector from accessing its infrastructure and limit its ability to add new infrastructure as and when needed in the future.*"
4. **TRANSPower** has sought to designate a greater area than will eventually be required for the Upgrade Project underground cables to provide for the installation of the cable and to ensure that the cable circuits are located in the most appropriate alignment. This wider area will give Transpower some flexibility to avoid third party assets, including those of Vector. However, once the cable has been installed, Transpower intends to reduce the width of the designation to cover only the physical works associated with the underground cable system and to provide a 1 m clearance on either side of the circuit, joint bays and link pits. This clearance should be sufficient to protect the cable from accidental damage during road excavations.

5. **EFFECTS** on Vector's assets will also be minimised by the depth of installation. Transpower's proposed cables will be installed at a depth of 1500 mm to the top cable below ground. I consider this to be a sufficient depth to allow other services, including those of Vector to cross over the Transpower cables.
6. **AS** explained in my first statement of evidence, cables create heat which is dissipated into the surrounding ground. The ability of the ground to dissipate this heat affects the cable electrical rating. When cables are installed close to other cables, the rating of both cables can be reduced by the inability of the ground to dissipate the heat generated from both cables. Accordingly, this reduction in cable rating has the potential to impact on both Transpower and Vector's assets (as well as those of any other third parties).
7. **TRANSPOWER** will design and construct the underground cables with a view to preserving the ratings and physical security of Vector's existing assets in the vicinity of Transpower cables. This approach will apply to assets currently in place, and those in respect of which plans have been lodged with territorial authorities. Transpower is having discussions with Vector regarding the existing and future assets of both parties. If the parties agree that it would be more appropriate to make changes to Vector's existing assets to preserve ratings, Transpower would expect to meet the direct costs of that work.
8. **IN** relation to future works for which detailed plans have not yet been made (or indeed no plans), I have been party to discussions between Transpower and Vector that seek to agree a process to ensure provision for, and protection of, both parties' future infrastructure. Transpower intends that the process for dealing with the circumstances of a particular installation project in close proximity to electricity, gas or fibre optic infrastructure to be formalised in an agreement between the two parties.
9. **AT** paragraph 22, Mr Chatterton raises issues about Vector's future plans and activities. In particular, he states that:

"should Transpower be granted its designation, Vector's current and future activities necessary for the development and operation of its electricity and gas networks will be subject to Transpower's approval. Should Transpower not be amenable to Vector's assets crossing or running parallel to its transmission cables, Vector's infrastructure will be cut off and separated east and west in Auckland, making efficient further development in the area impossible."

10. **AS** Vector's assets need to connect to Transpower's substations, it is usual for discussion to occur between Transpower and Vector regarding optimal design across both sets of assets. I would expect that these discussions will extend to the underground cables, and I consider it important that both parties give each other early advice of their future plans and work together to resolve any road occupancy issues in a fair manner. These discussions should address Mr Chatterton's concern that efficient further development of Vector's infrastructure could be unnecessarily obstructed by Transpower's cables.
11. **AT** paragraph 23, Mr Chatterton raises concerns that the placement of transmission assets underground in the road by Transpower, together with Vector's current network place (in the road berm), will create *"mutual heating of each others electricity assets due to their close proximity, with consequent adverse impact on the ratings of those assets."*
12. I have addressed the potential for mutual heating of Vector and Transpower assets above, and I state in paragraph 7 that Transpower will design and construct cables with a view to preserving Vector's existing cable ratings.
13. **WHERE** reasonably practicable, both Transpower and Vector should to try and avoid sharing a route with the existing transmission or sub-transmission cables (110 kV, 33 kV and 22 kV) due to space and mutual heating considerations. I am anticipating that there should be few or no restrictions in the future on the installation of distribution cables (11 kV and low voltage) laid in the berm or pavement alongside the carriage way containing Transpower's cables. However, as mutual heating effects will extend outside the proposed reduced designation

after installation of Transpower's cables, Transpower would need to know the details of future distribution cables to be installed in the same streets at the planning stage, so that any measures required to mitigate mutual heating effects can be investigated, discussed and agreed by the parties.

14. **AT** paragraph 24, Mr Chatterton summarises the relief sought by Vector. This is by and large what I consider that Transpower already intends to provide to Vector in the normal course of implementation of the works. However, I do not consider that it is reasonable for Transpower to provide an allowance for the effect of mutual heating for future Vector power cables on sections of the cable route that have the most thermally onerous environment. This is because these sections of the route determine the current rating of the cable circuit and a reduction in rating to provide an allowance for future possible Vector cables could be very costly to Transpower.

Underground cable costs

15. **BEFORE** addressing other submitter evidence individually, I would like to discuss the costs of undergrounding sections of the proposed 400 kV line south of Brownhill Road using 400 kV or 220 kV cables in more detail than given in my first statement of evidence, and to correct an error. This in turn is relevant to my following evidence relating to specific witnesses.
16. **IN** paragraph 93 of my first statement of evidence, I state that the capital cost ratio for undergrounding a section of double circuit 400 kV 2700 MVA overhead line (**OHL**) is around 15:1 and for a double circuit 220 kV 670 MVA line is around 10:1. In paragraphs 113, 170 and 200 of my first statement of evidence, I give cost estimates for undergrounding sections of the 400 kV 2700 MVA overhead line based on an underground cable cost of \$13.5 M/km.
17. **UNFORTUNATELY** an error has occurred in the calculation of this cost which was derived from the estimated cost of the proposed 190 km long 400 kV line and the 15:1 cost ratio. The overhead line cost was taken as the estimated design

build cost when it should have been the full capital cost¹. The cost which I should have used is the capital cost of the overhead line that includes investigation, property, project management, consenting and contingency costs. The correct cost of undergrounding a double circuit 400 kV 2700 MVA line based on a 15:1 cost ratio is \$25.6 M/km.

18. IT is worth noting, however, that simple ratios do not accurately convey the various issues that affect the cost differences between lines and cables. This is well summarised in a 2007 CIGRE Brochure² that concludes as follows:

- *"Cost ratios are often thought of as simple way of comparing costs, for example saying an underground cable is 10 times as expensive as overhead line. In reality there can be a wide range of values quoted for apparently similar circuits and this leads to confusion and mistrust between the various stakeholders."*
- *"Small changes in the design of the circuit can produce large changes in cost ratios and, in financial terms, the ratios have little meaning. It is the added cost of undergrounding that is important and must be weighed against the benefits (largely visual) that it brings."*
- *"The only reliable method of comparing overhead and underground costs is on a case by case basis. Generic values of cost ratio are of very limited use and should be avoided. Estimates for the costs of underground and overhead options for a specific project must be calculated and then weighed against the advantages and disadvantages of each option."*

19. I concur with the Cigre conclusions, but support the use of cost ratios as a simple means of communicating for the Upgrade Project the approximate costs of a number of undergrounding options. Based on these ratios and budgetary

¹ R Benato et al, "A new procedure to compare the social costs of EHV-HV overhead lines and underground XLPE cables", Proc. Of Cigre 2006, Paper B1-301, September 2006.

² "Statistics of AC Underground Cables in Power Networks", Cigre Working Group B1.07 Technical Brochure 338 December 2007. Cigre stands for International Council on Large Electronic Systems..

information on underground cables and transmission lines, in this statement of evidence, I have used the following costs:

- 2 x 400 kV 2700 MVA cable circuits \$26.5 M/km

- 2 x 220 kV 670 MVA cable circuits \$11.5 M/km

20. CORRECTED estimated costs for undergrounding sections of the 400 kV line given in paragraphs 113, 170 and 200 of my first statement of evidence are given in the following table:

First statement of evidence para no.	Undergrounding section	Original cost	Corrected cost
113	Extend proposed underground section by 20 to 25 km	\$270 - \$340 M	\$530 - \$663 M
170	1 km underground section at Ardmore airport	\$18.5 M	\$31.5 M
200	2 to 3 km underground section	\$32 - \$46 M	\$58 - \$85 M

Mr Christopher Freke (Manukau City Council) (Submission number 0861)

21. AT paragraphs 83 and 84 of his revised statement of evidence, Mr Freke states that MCC's initial position on where the undergrounding should commence has been refined to where the line enters the Brookby Valley in the vicinity of tower 14.

22. IT appears that Mr Freke is referring to Transpower's transition site 14 adjoining Twilight Road and not the site of tower 14 of the proposed 400 kV line that is situated approximately 650 m to the South East of transition site 14. Terminating the 400 kV line at the transition site 14 and continuing with 220 kV cable circuits to Pakuranga and Otahuhu Substations was investigated and compared with a range of other possible sites in the South Auckland area. The results of this

investigation are provided in a MWH report³ and show that transition site 14 was one of the least favoured sites, mainly due to the costs and engineering difficulties of the extended 220 kV cable routes. A comparative analysis excluding costs still favoured the Brownhill Road site over Twilight Road.

- 23.** **AT** paragraph 133 of his revised evidence, Mr Freke proposes that the 400/220 kV substation should remain at Brownhill Road and 400 kV cables be run from there to Transpower's transition site 14 off Twilight Road. He states, in paragraph 134 of his revised evidence, that the reasoning for this option is that two 220 kV cable circuits are significantly more costly than one 400 kV cable circuit.
- 24.** **HOWEVER**, it is not possible in this case for the 400 kV overhead line rating of 2700 MVA to be carried by one cable per phase. On this basis, two 400 kV cables per phase would be required and overall cable costs would in fact be higher than for the option of using 220 kV cables and moving the proposed 400/220 kV substation from Brownhill Road to Twilight Road.
- 25.** **MY** rough order costs for undergrounding the 400 kV line between Brownhill Road and Twilight Road with Mr Freke's assumed route length between 4 and 8 km are as follows:

Using 400kV cables	\$108 M to \$215 M (includes \$2.5 M for cost of transition station at Twilight Road)
Using 220 kV cables	\$92 M to \$184 M (400/220 kV substation moved from Brownhill Road to Twilight Road)

- 26.** **AT** paragraph 143 of his revised statement, Mr Freke states that he "*would seek clarification whether or not the presence of a substation separating the 400 kV and 220 kV cables reduces the operational risks alluded to within Mr Wildash's evidence*". It appears that Mr Freke is referring to the reliability issues discussed in paragraphs 97 to 115 of my first statement of evidence. As discussed in

³ North Island Grid Upgrade Project, Amended Proposal, Environmental Investigations: Interim Report on Northern End Modifications MWH October 2006.

paragraph 108 of my first statement of evidence, the inclusion of a cable section in the 400 kV overhead line increases operational risks due to the long repair times for cable faults. Transpower's proposal for a 400/220 kV substation between the 400 kV overhead line and the 220 kV cable circuits mitigates this risk, as the substation switchgear allows the faulty cable to be easily isolated and the power to be spread evenly across the remaining cable circuits.

27. **AT** paragraphs 163 to 166 of his revised evidence, Mr Freke derives estimated costs for undergrounding the 400 kV line from Brownhill Road to a point 500 m south of the Ardmore flight path of \$80 to \$150 M. He estimates that the cable route distance between any Twilight Road transition site and a point 500 m north of the Ardmore flight path would be around 1.5 to 2 km.
28. **MY** estimate for the distance between tower 13A (Twilight Road) and tower 21 (including 1 km for undergrounding across the Ardmore flight path) is 3.1 km along the overhead line route. However, I note that this route over the Brookby hills is unlikely to be suitable for cables. A route via existing roads from the junction of Twilight and Brookby Road via West Road to tower 21 is 6.3 km long. Using the road route, I estimate the total distance from Brownhill Road to tower 21 is between 10 and 14 km giving a rough order cost of \$268 to \$374 M using the corrected 400 kV cable cost of \$26.5 M/km.

Mr Doug Parker on behalf of Hunua and Paparimu Valley Residents' Association Incorporated (Submission number 0748)

29. **AT** paragraph 46 of his revised statement of evidence, Mr Parker states that 400 kV cable is "*technically far more complex and expensive*" than 220 kV cable. I would disagree with this statement to some extent so far as 400 and 220 kV XLPE cables are concerned. In this case, the cable construction is identical except for the thickness of XLPE insulation. Designs of 400 kV cable offered in response to budget price enquiries for the Upgrade Project have insulation thicknesses of 25 mm, while 220 kV cables of the same conductor size recently tendered to Transpower have an insulation thickness of 21 mm. Joints and terminations offered by cable manufacturers for these voltages are also of similar

design and construction. Budget price enquiries to cable manufacturers indicate that the purchase cost of 400 kV cable and accessories is 26% more for the same size of cable.

30. **ALSO** at paragraph 46, Mr Parker states "*there are no up-to-date analysis of the potential use of extended undergrounding at 220 kV, merely reference to assumed costs*". The rationale for limiting the extent of undergrounding, whether at 400 kV or 220 kV, is outlined in my first statement of evidence (at paragraphs 112 and 113). The information about 220kV cable costs is summarised below.
31. **AS** voltage increases, for the same size conductor and hence same current carrying capacity, 400 kV cables can convey approximately 82% more power than a 220 kV cable. However, because of higher cable manufacturing and installation costs 400 kV cables for the same transmission capacity are 66% the cost of 220 kV cables.
32. I refer to my response to Mr Freke's evidence above for further information on the advantages and disadvantages of moving the proposed 400/220 kV substation at Brownhill Road further south and extending the 220 kV cables, or leaving it where it is and undergrounding further south with 400 kV cables.
33. **ALSO** at paragraph 46, Mr Parker states "*Transpower.....decided that some 37 km of 220 kV cable is practical within the Auckland Isthmus*". This is a reference to the NAaN project which is described in the first statement of evidence of Mr Boyle. The 37 km of 220 kV cable is made up of four separate circuits, Pakuranga to Penrose, Penrose to Hobson Street, Hobson Street to Wairau Road and Wairau Road to Albany. The circuit lengths range from 9 to 10 km. The relatively short cable lengths and availability of other 220 kV overhead lines at Pakuranga, Penrose and Albany mean that the consequences of a cable fault will be restricted to one 9 - 10 km circuit.
34. **IN** Appendix 7 paragraph 3, Mr Parker refers to a typographical error in paragraph 87 of my first statement of evidence. The capital cost ratio is given as "4:5" instead of "4.5:1" for undergrounding a single circuit 220 kV 340 MVA line. This

then gives a ratio of 6.9:1 for a double circuit 220 kV 340 MVA line. In paragraph 93 of my first statement of evidence, I give a cost ratio of 10:1 for undergrounding a double circuit 220 kV 670 MVA line. The higher ratio is because the cost increase for the large cable size required is greater than that for increasing the rating of the overhead line.

Mrs Catherine Tuck on behalf of Underground in Manukau (Submission number 1244)

35. **IN** paragraph 9 of her evidence, Mrs Tuck states that "*underground transmission lines are technically feasible, more reliable, have substantially less impact on the environment, improve local aviation safety and are eminently affordable to the electricity consumer*". I would like to discuss this statement in the context of extending the underground cable section from the proposed Brownhill Substation to tower 21 on the proposed 400 kV line, a point south of Ardmore Airport.
36. I consider that it is technically feasible to underground this section of the proposed 400 kV line. However, a cable route for four cable circuits, or preferably two cable routes with two circuits each, would be required because it is difficult to accommodate four cable circuit in most roads. This undergrounding could be accomplished using 400 kV cables between a transition station site near the tower 21 site and Brownhill Road or alternatively using 220 kV cables from a substation site (of similar size to that proposed for Brownhill Road) near the tower 21 site with two cable circuits to Pakuranga and two cable circuits to Otahuhu. The longer cable lengths would probably require reactive compensation by shunt reactors at the new transition station/substation, as explained in my first statement of evidence.
37. **CONTARY** to Mrs Tuck's assertion, both the options would be significantly less reliable than continuing the 400 kV overhead line to Brownhill Road. The reasons for this are given in my first statement of evidence at paragraphs 97 to 115.
38. I consider that the impact of either underground option on the environment would be significant during the construction phase because of the disruption to road

traffic for cables laid in the roadway and the need to cut a swathe 30 m or so wide and construct a haul road across open land. Although after construction, the effect on visual amenity of the underground cables compared to an overhead line is minimal, adverse environmental effects can remain for route sections outside roadways. I discussed these issues at paragraph 168 of my first statement of evidence.

39. I consider the cost of undergrounding this section of the overhead line to be very significant, whether 400 kV or 220 kV cables are used. My estimate for the 400 kV cable option is \$268 to \$374 M (see paragraph 28 above for details). In this case, four 220 kV cable circuits will be sufficient to match the 400 kV line until 2032 (see paragraphs 23 and 24 above for details). This gives an estimated cost for the 220 kV option of \$230 M to \$322 M based on a cost of \$11.5 M/km for 2 x 220 kV 670 MVA cable circuits. I note that after 2032 forced water cooling would be required on the 220 kV cables or additional 220 kV cable circuits installed.

40. IN paragraph 10, Mrs Tuck states "*Transpower's decision to underground only 220 kV cables instead of the 400 kV cables it originally proposed removes practically all of its previous objections to extended undergrounding, apart from the additional cost*". I consider the objections to extended undergrounding are largely unchanged by use of 220 kV instead of 400 kV cables for the following reasons:

- (a) Reliability of 400 kV and 220 kV cables circuits is expected to be the same. The design, construction, installation and testing of 400 kV and 220 kV cables and accessories are very similar and so would be expected to have a similar performance so far as reliability is concerned.
- (b) Reactive compensation is also required for long 220 cables, although the amount required is only 60% of that required for 400 kV cables.
- (c) Generally, for large transmission capacity circuits, 400 kV cable costs would be only 66% of the 220 kV cable cost for the same transmission capacity.

41. **IN** paragraph 16 of her evidence, Mrs Tuck states that "*the Commission of the European Communities paper Undergrounding of Electricity Lines in Europe (U'ground in EEC) shows cost estimates ranging from 2.3-3 times in France to 7.7 times in Ireland*". This information is taken from Appendix I of the report that contains several examples of cost ratios taken from various sources. Mrs Tuck has selected ratios from an ICF Consultants Report⁴ Other examples in the same Appendix give cost ratios that vary from 2 to 22.1 for 220 kV cables.
42. I have discussed above the shortcomings of the cost ratio approach and this is confirmed by the wide spread of the historical ratios given in the European Communities paper. Clearly cost ratios can vary wildly and so, in my view, reference to this information cannot support Underground in Manukau's view that Transpower has consistently overstated the cost of undergrounding.
43. **IN** paragraph 18 of her evidence, Mrs Tuck refers to Transpower's 2007 Grid Upgrade Plan for the "*Net Present Value (NPV) mean capital cost of \$293 million for the 27 km long Penrose to Albany underground cable proposal*". This is the Plan's Cross Harbour Cable Option and Table 3.5 in the Plan shows this crossing covers not only the Penrose to Albany cables, but also the Pakuranga to Penrose cables and a number of other developments over the period 2013 to 2030. Consequently, the \$293 M figure bears no meaningful relationship to the cost of a 27 km long cable circuit.
44. **IN** paragraph 20 of her evidence, Mrs Tuck states "*The fact that it (Transpower) now plans only 220 kV cables presents an opportunity to carry the line underground for a considerably greater distance than planned, if not for its entire length*". I do not understand how the decision to terminate the 400 kV line at Brownhill Road and use of 220 kV cables from there to Pakuranga and Otahuhu, provides any greater opportunities for undergrounding than the original proposal to use 400 kV cables from there to Otahuhu. Although, as shown above, extending the undergrounding section from Brownhill Road to say Twilight Road

⁴ Overview of the Potential for Undergrounding Networks on Europe, Report by ICF Consultants to the European Commission, February 2003.

appears cheaper than using 220 kV cables than 400 kV cables, the costs are still excessive compared to an overhead line.

45. **IN** her paragraph 21, Mrs Tuck states "*the benefits of underground cables: reduced transmission losses, lower maintenance costs and reduced storm damage.*"
46. **WITH** respect to transmission losses, on existing transmission systems, utilities choose to accept higher losses rather than higher initial capital cost. This is an engineering and cost balance. If the same size and type of conductor used in a cable were air insulated, ie an overhead line, it would have lower losses than a cable. There are two reasons for this, the conductor would run at a lower temperature (due to improved heat dissipation in the air), and overhead line conductors would have lower voltage-dependant losses.
47. **IN** summary, with identical conductors and ratings, there are fewer losses with an overhead line than a cable. Transmission companies have however calculated an overhead line's conductor size based on its maximum operating temperature at the required rating. This gives a smaller conductor size (than a cable), but higher losses as more heat is required to bring an air cooled overhead line up to its maximum temperature. The engineer therefore uses the higher heat loss capabilities of the overhead line to reduce the conductor size and cost.
48. **CABLE** engineers go through a similar design process. An in-air rating for a cable is higher than the equivalent rating for the same cable when buried. The cable engineer uses this increased in-air heat loss capability to reduce the conductor size of the cable (for the same rating). An overhead line is just an extension of an air cooled cable which uses the benefits of air cooling to reduce the conductor size. At very low loads, the voltage dependant losses of a cable are higher than an overhead line and thus when a system is energised but with no, or very low, load current flowing, a cable system generates more losses on a like for like basis.

49. **ROUTINE** maintenance costs for cables are significantly lower than for an overhead line, but in the event of a fault repair, costs and time are very significantly greater. Underground cables are largely unaffected by storms although they could be subject to fault currents and switching surges due to faults on adjacent overhead lines. However, underground cables are susceptible to damage by third parties excavating in the vicinity of the cables who may be unaware of the presence of the cables.

50. **IN** her paragraph 52, Mrs Tuck states "*The response of the French authorities (to storm damage in 1999) was to order that 25 % of all new lines of high voltage (225 kV) be constructed underground*". The latest statistics on the lengths of AC underground and overhead lines installed at various voltages in different countries are given in a 2007 Cigre Brochure⁵. The table below is based on data taken from Table 2.3 and Figure 2.1 and shows the length of underground cable installed as a percentage of the total circuit length installed.

Country	50- 90 kV	110 – 219 kV	220 – 314 kV	315 – 500 kV
Australia	4.2	1.5	0.2	0.9
France	4.5	0.1	3.4	0.0
Ireland	na	3.6	5.8	Na
New Zealand	0.7	2.0	0.0	Na
United Kingdom	32.2	11.3	7.3	1.5
Average for 28 Countries	6.6	2.9	1.7	0.5

The above table shows that the current level of line undergrounding in France is unremarkable compared to other countries and a lot less than the United Kingdom.

51. **IN** paragraph 75 of her evidence, Mrs Tuck states that "*there is little dispute that underground high voltage transmission cables are superior to overhead lines in*

⁵ "Statistics of AC Underground Cables in Power networks", Cigre Working Group B1.07 Technical Brochure 338 December 2007.

almost every respect other than initial construction cost." I have mentioned earlier in this statement of evidence, the lower reliability of 220 and 400 kV cables, because of the long outage times to locate faults and repair cables. A consequence of this lower reliability is that electricity systems that are completely underground such as in Singapore have heavily interconnected systems with more circuit redundancy than is normally provided in an overhead line system.

- 52. EVEN** so, the risk of extended power outages remains if additional cable faults occur before the first cable fault can be repaired. An example of this was the Auckland CBD blackout in 1998 after four 110 kV cables failed in quick succession (22 January, 9, 19 and 20 February) and left the CBD with little electricity for three weeks. Supplies were restored not by repair of faulted cables but by construction of a temporary 9 km overhead line in 18 days.

Hugh Robert Kelsey Wildash

7 April 2008