BUNNYTHORPE–HAYWARDS CONDUCTOR REPLACEMENT

Major Capex Proposal

November 2013

Keeping the energy flowing




TRANSPOWER

Transpower New Zealand Limited The National Grid

1| Executive Summary

This proposal seeks to replace the conductors on the Bunnythorpe–Haywards A and B lines.

Our condition monitoring programme has identified the need to replace the conductors. Both lines are susceptible to accelerated deterioration due to harsh coastal climatic conditions present along most of the route. In 2005, a conductor on one line failed due to corrosion. Following this failure, we carried out targeted repair work on the worst affected sections in conjunction with a tactical upgrade to optimise the capacity of the existing conductor. This work was intended to defer the need for total conductor replacement by approximately ten years.

Recent surveys confirm the conductor must be replaced with all work complete by 2020. To go beyond this date would be an unacceptable public safety exposure.

Both lines are an important part of the backbone grid transferring power generated from renewable sources in the South Island to meet the need for electricity in the North Island. On occasions, they also supply power into Wellington and the South Island. From 2015, the two lines will serve a new connection at Paraparaumu to supply the Kapiti district. They will be required well into the future and the work we do now, which includes tower and foundation work as well as conductor replacement, will ensure they can meet New Zealand's needs for the expected life of the new conductor.

Our investigation into replacement options led to the submission of a Grid Upgrade Plan to the Commerce Commission (Commission) in December 2011. The proposal was to replace the existing conductor, known as Goat ACSR, with Zebra ACSR. Zebra is slightly larger (29 mm versus 26 mm diameter) and, importantly, will lower the electrical losses that occur in transmitting electricity. We sought approval to recover our actual costs up to a maximum of $130 million. This figure included a large (26%) uncertainty due to the unknown extent and cost of the tower and foundation work.

We agreed with the Commission to carry out a more detailed engineering assessment of the options to reduce the cost uncertainty. We have now completed that work, which required engineering site assessments of each tower. During that time we have also built new lines between Auckland and Whakamaru, and Whakamaru and Wairakei, and have applied lessons learned from their design and construction in this updated proposal.

Our conclusion is that replacing the existing conductor with Zebra ACSR remains our preferred option and hence our proposal to provide a further 50-60 years life from this key part of the backbone grid.

While there is far more certainty in our cost estimate, the maximum cost we are now seeking approval for has increased by $31 million. This is directly attributable to a better understanding of tower and foundation strengthening requirements, quantity of tower raises and conductor stringing costs.

We have also agreed with the Commission to submit the revised proposal as a Major Capex Proposal (MCP) and formally withdraw the Grid Upgrade Plan submitted in 2011. At the time of our earlier submission, the regulatory approval for major capital projects had recently been transferred to the Commission from the former Electricity Commission and the Commission's Capex Input Methodology (IM) regime was not yet in effect.

Under the Commission's regime for major projects, when the net benefit of two or more options are close, we can include unquantified benefits when selecting our preferred option. This is useful here as there are still uncertainties in costs and relatively small differences in the benefits between the options.

We are conscious of the added costs of the updated proposal. Consumers have benefitted from the low cost work[1] to extend the life and enhance the capability of the existing conductor in 2006, including during the winter of 2008 when South Island hydro storage was low. Total conductor replacement now requires the towers and foundations to be brought up to current standards.

This project will be one of a number of major conductor replacement projects expected over the next 10-15 years – although it will be much larger than most. We will seek efficiencies through all this work including a review of engineering design criteria, conducted during the detailed design phase, to reflect our emerging work on asset criticality.

Proposal at a Glance	
What:	Replace the existing conductors on the Bunnythorpe - Haywards A and B lines with Zebra ACSR rated to operate at 75°C.
When:	Commence work in 2013 and complete by 2020.
How much:	Transpower is seeking approval for up to $161 million.

We also need to prove other new conductor technologies in harsh New Zealand coastal climatic conditions and this proposal includes $3 million to use alternative conductors over a short section of one line.

To complete this project we will not only replace the conductor and strengthen towers and foundations, but also increase the height of around 18% of the towers along both lines to provide the required clearances with the new conductor. As far as practicable we have avoided making changes to towers within the few urban areas crossed by these two lines.

Much of this work is permitted under the National Environmental Standards (NES) developed for electricity transmission as well under the Electricity Act. We will seek the necessary consents and work with affected landowners.

[1] The Electricity Commission approved $3.5 million for a thermal upgrade of the Bunnythorpe-Haywards A&B lines in 2006. Our proposal for this work was submitted as Grid Upgrade Plan 2009 Instalment 6.

Contents

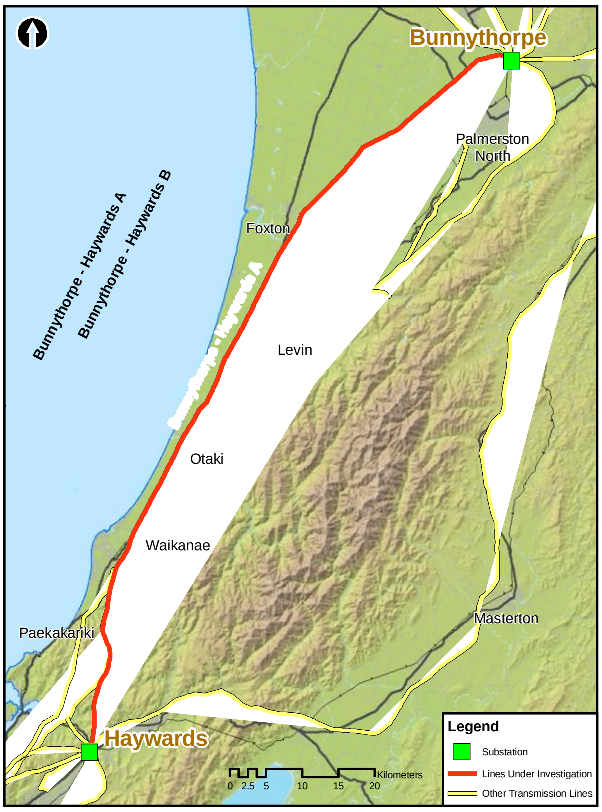
2| The Proposal

This proposal concerns two transmission lines in the lower North Island from Bunnythorpe to Haywards, known as the Bunnythorpe–Haywards A and B lines. Recent condition assessment confirms the lines are now at the stage where the conductors must be replaced[2].

The Bunnythorpe–Haywards A and B lines are a critical part of the core grid and predominately transport electricity northwards from the HVDC[3] through to the central North Island. In hydrologically dry years, they also transport electricity southwards into Wellington and then onto the HVDC to the South Island. From 2015 they will also supply a new 220 kV connection to the grid at Paraparaumu.

The A and B lines were commissioned in 1957 and 1954 respectively and consist of "Flat Top" steel lattice towers (pictured on the next page) each supporting a simplex[4] 220 kV single transmission circuit. Both lines are 120 km long with the A line having 330 towers and the B line 310 – effectively 240 km of transmission line. The conductor was previously replaced in 1980. The lines run through coastal areas on the west coast of the lower North Island. Both the towers and conductors are exposed to effects of severe coastal climatic conditions – corrosion damage from salt laden air, damage from high winds and vibration damage from low winds - over most of the line route.

Figure 1 - Bunnythorpe–Haywards A and B line route



[2] A transmission solution. "The Commission agrees non-transmission solutions are not viable options for this investment and therefore we do not need to consider non-transmission solutions, in accordance with clause 8.1.3(2)(b) of Capex IM." Letter from Commerce Commission to Transpower, 6 September 2013

[3] The HVDC is the electrical link between the North and South Islands

[4] Consists of a single conductor per phase

Figure 2 - Bunnythorpe–Haywards A and B 220 kV single circuit 'flat top' towers, typical of most of the line route

The components in the yellow box below are the grid outputs to be delivered by the project.

Components of the Proposal

- Procuring, installing and commissioning Zebra ACSR conductor on the Bunnythorpe–Haywards A and B lines and decommissioning the existing conductor
- Works on the towers to enable the Zebra conductor to be operated at 75°C
- Procuring, constructing and commissioning substation facilities to facilitate the above connections and equipment
- Obtaining property rights and environmental approvals required for these works
- Installing alternative conductor technologies on a short section to evaluate their performance in coastal climatic conditions

We propose starting this work in 2013 and completing it in 2020.

We expect the project to cost $151 million once commissioned. We are seeking Commerce Commission approval to recover the full costs associated with the Proposal, upon commissioning, up to a total amount of $161 million. This amount includes a contingency to allow for uncertainties in the project costs and is the estimated Major Capex Allowance (MCA) to implement the Proposal.

3| The Need

3.1 Asset condition

The condition of the Bunnythorpe–Haywards lines is driving both the need for and the timing of conductor replacement and tower refurbishment. Our condition assessment programme has recently confirmed the conductors must now be progressively replaced with the work completed by 2020.

The two lines are situated in both a very high corrosion environment and high wind zone over most of the line route. The expected life span of a transmission line conductor in a coastal environment is 45 years. However, in 2005, after only 25 years of service[5], we found significant manufacturing defects in the conductors on the Bunnythorpe–Haywards lines. While we have developed techniques to manage these defects as they arise, and have extended the life of the conductor longer than would have previously been possible, we now need to replace the conductor.

Figure 1 - Corrosion bulging

The towers on the line also require refurbishment. The condition of the conductors and towers is described in more detail below.

The Conductors

In 2005, a conductor on one of the Bunnythorpe–Haywards lines snapped due to corrosion. The corrosion occurred as a result of a manufacturing defect spread randomly throughout the conductor – inconsistent quantities of grease on the inner steel core. Locations where there is no grease on the inner core are known as “grease holidays” and have substantially reduced corrosion resistance. Because the corrosion initiates in the centre of the conductor it is not possible to positively identify them until the outer aluminium layers of the conductor bulges from the internal corrosion.

Figure 2 - Conductor break in 2005

We have developed mechanisms for identifying risk points through visual inspection using slow-flying helicopters. Remedial work has then been undertaken where required. This process is a first in New Zealand and has extended the life of the conductor, closer to the expected 45 year life. However, this remedial work is only a short-term measure and over time, the occurrence of these corroded sections is expected to increase, spreading throughout the line and requiring larger sections to be replaced. Despite the ongoing remedial work, the risk of conductor failure as it reaches end of life increases.

5 The conductors were replaced in 1980

Vibration damage is now also emerging as an issue. Vibration damage first appears internal to the conductor core, like corrosion damage, and is only evident on the external surface once the core is compromised. Vibration dampers were fitted to the line in the 1990s to reduce vibration damage. These have a limited life span and are also due for replacement.

To minimise the risk of further conductor failures, the conductor must be replaced soon. This proposal reflects a minimal disruption (to operation of the grid) approach to the work with the conductor progressively replaced by 2020. Condition assessment is not an exact science and we believe this approach reflects a reasonable and prudent operation of our assets.

The Towers

The Bunnythorpe–Haywards A & B lines are 120 km each and consist of 640 individual towers in total and 1,926 individual wire spans (3 per circuit). These towers were constructed over 55 years ago to the standards used at that time.

As part of the life extension repairs in 2006, thermal uprating to optimise the capacity of the conductor was also undertaken on the Bunnythorpe–Haywards lines. Thermal uprating allows short-term benefits of increased capacity at a relatively low cost by tightening the existing conductor, or undertaking low cost tower or ground modifications, so that additional capacity can be provided while still maintaining the required clearances from the conductor to ground.

Since we submitted a Grid Upgrade Plan to the Commerce Commission (Commission) in December 2011, we have completed more detailed work on the conductor replacement options. From this work, we estimate that 512 towers out of the 640 will need some form of strengthening to meet modern design standards regardless of the option chosen.

In addition, approximately 171 tower foundations will require strengthening based on the additional loadings. A further 22 foundations, some of which use old timber driven piles, will need upgrading/replacing due to both the inadequate strength and condition of the foundations.

Our proposal to use Zebra[6] ACSR conductor will result in an estimated 114 out of a total of 640 towers requiring increases in height to bring the clearances up to current standards. These height increases would occur even if we just replaced the conductor with one exactly the same as the existing conductor.

The cost of the conductor itself differs between the different sizes (ie Goat and Zebra); however, the size of the conductor makes little difference to work and cost involved in stringing the new conductor (ie: the stringing costs varies little between options).

Table 3-1 shows a summary of the work required on the towers for four short listed options. It shows the estimated number of tower height increases required for each option.

[6] Zebra and Goat are names for two sizes of Aluminium Conductor Steel Reinforced (ACSR) transmission line conductor.

Table 3-1: Number of towers requiring height increases

Option	1.5m	3m	4.0m (+)	Total
Goat 80°C	82	32	0	**114**
Zebra 65°C	50	7	0	**57**
Zebra 75°C	82	32	0	**114**
Zebra 85°C	65	64	1	**130**

For our selected option, Zebra at 75°C, only one tower needs a height increase within the urban area of Waikanae.

3.2 Network service

The service provided by an asset is dependent on how it is connected to the rest of the grid, its efficiency in transporting electricity and its overall capacity to not constrain electricity flows.

A benefit is gained by replacing an old conductor with a new, lower-loss conductor. This reduces the electrical losses incurred when transporting electricity. We have calculated the expected reduction in losses using Zebra conductor instead of the existing Goat conductor to be worth approximately $10 million in Present Value (PV) terms.

We have also looked at the required capacity of the Bunnythorpe–Haywards lines into the future. In dry year periods when South Island hydro generation is limited, there is benefit in providing some additional capacity to enable more electricity generated in the North Island to supply the lower part of the North Island and South Island. Our calculations show the benefit of this additional capacity is approximately $17 million (PV) for our proposed option.

A connection to Paraparaumu will be added to the Bunnythorpe–Haywards lines by 2015. This work arose as a result of the New Zealand Transport Agency's Transmission Gully project. A direct connection into the Bunnythorpe–Haywards lines provided a greater benefit to consumers than relocating an existing 110 kV line in the region[7].

Our analysis shows that Zebra conductor at 75°C best optimises the cost of our work with the benefits of reduction in losses, providing added capacity, and the other unquantified benefits.

If new wind generation - additional to that currently envisaged in our analysis - is connected directly into the transmission grid in the lower Wellington region, then the Bunnythorpe–Haywards lines could become a restriction. If this occurred, there are several ways to meet the capacity needs of additional future generation: for example, by balancing electricity flows across other higher capacity regional lines and by using variable and dynamic transmission line ratings.

A full technical report which discusses these issues more is included as Attachment D – Power system analysis report.

[7] https://www.transpower.co.nz/projects/paraparaumu-220-kv-supply-connection

4| Options, costs and benefits

4.1 The options

A range of options were initially considered and consulted upon in October 2010[8], in preparing the 2011 GUP. This long list of options included:

- dismantling
- "like for like" conductor replacement
- different capacity conductors
- a new line and/or duplexing
- underground cable instead of overhead lines
- HVDC runback option
- non transmission options such as generation and demand side alternatives

We have included our assessment of the long-list to short-list process, in preparing the MCP, as Attachment C and have summarised the key points below.

Under the regulated Investment Test, the proposal to replace the conductor on the Bunnythorpe–Haywards A and B lines needs to have a positive expected net market benefit. We need a base case to compare our options against. The appropriate base case here is dismantling the lines and is included as Option 1 in our economic analysis. Our analysis has found that if the Bunnythorpe–Haywards A and B lines were not there, the resulting cost to New Zealand electricity consumers would be $5.2 billion. This arises from using higher cost thermal generation to provide electricity in the North Island and incurring unserved energy in the South Island during dry hydrological years.

We short-listed two conductors: the modern equivalent of the existing conductor and a slightly larger, lower loss conductor, Zebra ACSR.

Other conductor types considered included larger conductors and AAAC conductors. All required significantly more modifications to the towers to accommodate the extra weight and/or ground clearance requirements.

Some transmission lines elsewhere in our network were originally built to accommodate a significantly larger (or an additional) conductor. This is not the case with the Bunnythorpe–Haywards A and B lines, which were designed and constructed at a time when the loading standard had the lowest windspeed requirement.

From our investigation work, replacing with a significantly larger, or adding a second, conductor would be very expensive with significant local impacts and these options were not considered further.

Similarly, the cost of a new line or undergrounding was significantly higher than other options, so these were taken no further.

The final two long-list options: HVDC run back and non-transmission options were not considered further as they did not meet the need to replace the conductor.

[8] https://www.transpower.co.nz/sites/default/files/plain-page/attachments/REQUES%201_0.pdf

The six short-listed conductor options in the 2010 GUP were:

- Goat rated to operate at 80°C[9]
- Zebra rated to operate at 65°C
- Zebra rated to operate at 70°C
- Zebra rated to operate at 75°C
- Zebra rated to operate at 80°C
- Zebra rated to operate at 90°C

The temperature rating describes the maximum operating temperature of the conductor. The operating temperature and size of conductor together determine the capacity of the conductor. They also determine the tower heights required to ensure minimum stipulated clearances from ground are achieved.

Based on the economic results from the 2010 GUP and given the expense to further refine the cost of each option, we shortened this list to five options for the MCP (including the dismantling option which is required to calculate the base case cost of not having the lines in service), as follows:

- Dismantle lines
- Goat rated to operate at 80°C
- Zebra rated to operate at 65°C
- Zebra rated to operate at 75°C
- Zebra rated to operate at 85°C

4.2 The Costs

The expected capital costs of the short-listed options are shown below in the first cost column of Table 4-1. We have shown the expected capital cost of each option in current (2013) dollars in this table. Using current year dollars is the convention for our economic analysis.

Since we are comparing these conductor replacement options to an option of dismantling the lines, we also need to consider the ongoing maintenance cost of the lines. The costs differ very slightly between the options, as shown in the second cost column below. These numbers are estimated cumulative maintenance costs out to 2050.

The third cost column shows the expected cost of each option expressed as a Present Value (PV) to account for phasing of the work over 7 years from 2013 to 2020 and maintenance out to 2050.

The final cost column shows the difference in costs between the options, relative to the cost for Goat rated to operate at 80°C. It is difficult to assess the difference between options when the magnitude of costs and benefits is high (as shown in column five), which is why we are also including the cost differences relative to a reference – in this case Goat at 80°C.

[9] The Goat conductor available in 2013 has a slightly higher capacity rating than that used when the conductor was replaced in 1980.

Table 4-1: Project costs

Option	Description	Capital costs ($m) A	Maintenance costs ($m) B	PV total costs (2013 $m) A+B	PV relative total costs (2013 $m)
1	Dismantle lines	30.0	0.0	25.3	-121.9
2	Goat@80°C	130.5	144.6	147.2	0.0
3	Zebra@65°C	124.1	145.5	142.7	-4.5
4	Zebra@75°C	134.6	144.6	150.3	3.1
5	Zebra@85°C	143.9	143.7	156.9	9.7

Although replacing the conductor with Zebra at 65°C provides the same line capacity as Goat at 80°C, it is a lower cost option. Even if an increase in line capacity was not economic, we would still be replacing the existing conductor with Zebra ACSR.

4.3 The Benefits

Our analysis has considered two key benefits:

- **Replacement benefit**

  This is the benefit from replacing the conductor on the Bunnythorpe–Haywards lines versus not replacing and instead dismantling the line. As already discussed, the benefit is large – without the lines, (expensive) thermal generation in the North Island would be run more and shortage costs would be incurred in the South Island during dry hydrological years. The replacement benefit has been calculated comparing dismantling the lines with replacing the existing conductor with Goat@80°C.

- **System benefits**

  System benefits arise from a reduction in transmission losses and a reduction in south flow constraints during dry hydrological years. To calculate these, we have used a mathematical model (SDDP) which simulates the operation of the electricity system over the next 30 years using five future generation and demand scenarios. These scenarios are based on the Electricity Commission's Statement of Opportunities 2010 publication (the SoO).

Table 4-2 – Project benefits

Option	Description	PV replacement benefit (2013 $m) A	PV system benefit (2013 $m) B	PV total benefits (2013 $m) A+B	PV relative total benefits (2013 $m)
1	Dismantle lines	0.0	0.0	0.0	-977.4
2	Goat at 80°C	977.4	0.0	977.4	0.0
3	Zebra at 65°C	977.4	15.9	993.3	15.9
4	Zebra at 75°C	977.4	27.3	1004.7	27.3
5	Zebra at 85°C	977.4	30.0	1007.4	30.0

5| Selecting the investment proposal

This section covers:

- selection of the proposal
- the timing of the investment
- the robustness of the investment proposal against changes in assumptions

5.1 Economic Assessment

The option that returns the highest positive expected net electricity market benefit satisfies the Investment Test. Details of the economic assessment can be found in Attachment E and the key results are summarised below.

The expected net electricity market benefit is the difference between benefits and costs for each option on the short list. This is shown in column five in Table 5-1. As above, we have also compared expected net electricity market benefit using a reference case of replacing the conductor with Goat ACSR to operate at 80°C. These results are shown in column six of Table 5-1.

Table 5-1 – Expected net electricity market benefits

Option	Description	PV total costs (2013 $m) A	PV total benefits (2013 $m) B	Expected net market benefit (2013 $m) B-A	Relative expected net market benefit (2013 $m)
1	Dismantle lines	25.3	0.0	-25.3	-855.6
2	Goat@80°C	147.2	977.4	830.2	0.0
3	Zebra@65°C	142.7	993.3	850.6	20.4
4	Zebra@75°C	150.3	1004.7	854.4	24.2
5	Zebra@85°C	156.9	1007.4	850.5	20.2

Option 4, Zebra rated to operate at 75°C, has the highest expected net electricity market benefit ($24.3m) of all the options and the net benefit is positive. This is our proposed option.

The net market benefit of options 3, 4 and 5 are within $4 million of each other. Given the uncertainty in inputs to the Investment Test analysis, these three options are considered equivalent, for all intents and purposes.

The Investment Test recognises this situation and allows the choice of proposal to be made on the basis of other, unquantified benefits. We have considered a range of unquantified benefits to see if they help differentiate between options 3, 4 and 5. Our assessment shows the relativity between the options and in general, considers the short to medium term. Our qualitative assessment is described in Table 5-2 below. The benefit for each option has been qualitatively ranked between ✓ and ✓✓✓, where ✓✓✓ means more benefit than ✓. The following benefits have been considered:

Optionality to further upgrade – how easy will it be to further increase capacity if required? This benefit recognises the inherent optionality in some options from being able to increase capacity if our demand and/or generation assumptions prove to be inaccurate.

Consumer benefits through enhanced competition – to what extent will the option enhance competition in the New Zealand electricity market and create competition benefits? The more competitive a market is, the closer nodal prices will be to SRMC. Higher transfer capacities, both northward and southward will enhance market competition. This benefit is not captured in our SDDP modelling.

Minimises disruption – to what extent will the local community be disrupted by the implementation of an alternative? Replacing conductor and working on towers creates disruption an often inconvenience to the local community. Over time, lower capacity or incremental upgrades are more disruptive to communities because we will have to undertake our upgrading activities more often.

Visual impact – to what extent will the conductor replacement have a visual impact. We assume that the lower the towers, the lower the visual impact. Although landowners which have towers on their land may sometimes receive limited compensation for visual impact, other parties do not.

Operational benefits – to what extent are there operational benefits not reflected in the economic analysis? If sections of the Bunnythorpe–Wilton line are out of service, higher capacity on the Bunnythorpe–Haywards lines provides more options to supply Wellington load.

Aligns long term grid development – to what extent is the option consistent with our longer term vision for the grid. Our longer term vision requires us to make the best utilisation possible of existing transmission corridors. Higher capacity conductor utilises the corridor better. Also, our long term grid development envisages higher Cook Strait HVDC capacity and higher transfer capacity between Bunnythorpe and Haywards will be required to utilise it.

Asset life – to what extent will the options differ in expected life? Zebra ACSR conductor will be expected to last longer than Goat ACSR in this relatively harsh environment. In addition, operation at a higher temperature marginally lowers expected life. These effects are not recognised in our analysis.

Table 5-2: Qualitative assessment – unquantified benefits (UQB) and overall preferred option

Item	Goat 80°C	Zebra 65°C	Zebra 75°C	Zebra 85°C
Relative Expected Net Electricity Market Benefit (ENMB)	0	20.4	24.2	20.2
Unquantified differences (UQB):				
• Optionality to further upgrade	✓	✓✓✓	✓✓	✓
• Consumer benefits through enhanced competition	✓	✓	✓✓	✓✓✓
• Minimises disruption	✓	✓	✓✓	✓✓✓
• Visual impact	✓✓	✓✓✓	✓✓	✓
• Operational benefits	✓	✓	✓✓	✓✓✓
• Aligns long term grid development	✓	✓	✓✓	✓✓
• Asset life	✓	✓✓✓	✓✓	✓
Overall ranking ENMB + UQB	4	3	1	2

The unquantified benefits for Zebra at 85°C and Zebra at 75°C are the same and both are higher than Zebra at 65°C, hence the former options are preferred. We have not been able to differentiate between Zebra at 85°C and Zebra at 75°C using unquantified benefits. However, taking the higher expected net electricity market benefit of Zebra at 75°C into account, we consider that Zebra at 75°C is preferred. Zebra at 75°C strikes a good balance between the level of works required on the lines, electrical efficiency of the solution and future options.

5.2 Robustness of the proposal

The investment proposal has been tested against a range of sensitivities. The future is uncertain and so it's important that we "stress test" the proposal. By adjusting key variables we see how robust the proposal is to changes in assumptions.

For this project we have considered the results of our analysis with:

- high and low demand
- changes in capital costs
- changes in maintenance costs
- changes in discount rates
- change in scenario weightings.

The results of the sensitivity analysis are shown in Table 5-3. All numbers are expected net electricity market benefit, PV in $2013.

Table 5-3: Sensitivity Analysis

Results					
	Dismantle Lines	**Goat 80C**	**Zebra 65°C**	**Zebra 75°C**	**Zebra 85°C**
Relative Expected Net Electricity Market Benefit (ENMB)	-855.6	0.0	20.4	24.2	20.2

Sensitivities

Demand					
High	-1066.8	0	25.3	34.4	30.4
Low	-501.5	0	17.1	14.0	7.8
Capital Costs					
120%	-841.4	0	21.4	23.6	18.2
80%	-869.8	0	19.4	24.8	22.3
Maintenance Costs					
120%	-845.4	0	20.3	24.2	20.3
80%	-865.7	0	20.5	24.2	20.1
Discount Rate					
4%	-1764.9	0	35.1	50.3	48.3
10%	-432.6	0	13.1	12.1	7.5
Scenario weighting	**MDS1**	**MDS2**	**MDS3**	**MDS4**	**MDS5**
	23.1%	23.1%	23.1%	23.1%	7.5%

The results show that in six out of the nine sensitivity cases, Zebra at 75° C has the highest expected net electricity market benefit.

Zebra at 65° C has the highest expected net electricity market benefit if demand growth is much lower than forecast and when the discount rate is 10%. We also found that Zebra at 75° is only preferred in one MDS, compared to Zebra at 65° which is preferred in three MDS. Overall, Zebra at 75° C is preferred because of a high differential in the expected net electricity market benefit in MDS5. It is only when the weighting for MDS5 is reduced below 7.5% that Zebra at 65° C becomes preferred.

In section 5.1, we concluded that, taking unquantified benefits into account, Zebra@75°C was the option which maximised the expected net electricity market benefit and was the preferred option.

In section 5.2, we have considered the sensitivity of the expected net electricity market benefit to several factors. We have found that Zebra at 75°C has the highest expected net electricity market benefit in five of the eight sensitivities. We also found that it was not until the weighting of MDS5 was reduced to 7.5% that it did not produce the highest expected net electricity market benefit.

In our view these sensitivities demonstrate that Zebra at 75°C is sufficiently robust under sensitivity analysis to satisfy the requirements of the Investment Test and it therefore becomes our proposal.

5.3 Timing

Due to the length of the lines (together about 240 km), we are planning a seven year delivery programme to replace the conductor, starting with planning in 2013 and aiming for completion in 2020. This programme utilises available outage windows, minimises disruption to the electricity market, and allows us to replace the most corroded conductor first.

Normally, for investments which are not required in order to meet the reliability limb of the grid reliability standards we would consider the implication of commissioning the proposal at different dates. However, as this project is determined by the condition of the existing conductors, our ability to resource the work over successive construction seasons and secure the outages, we have not considered different dates.

5.4 Good electricity industry practice

The proposed replacement of the conductor on the Bunnythorpe-Haywards A and B lines removes safety risk and better utilises existing assets. Overall the proposal reflects good electricity industry practice by being consistent with good international practice, demonstrating economic management, and improving safety.

6| Stakeholder engagement

We have engaged with both community and industry stakeholders.

Community Communications

As a project driven by the need to replace conductor that is near the end of life, our engagement has been with those people most affected by the work – landowners and key communities near the line, as set out in Table 6-1.

We advised key community stakeholders (such as councils and local MPs) and landowners with land under the existing lines of our investigation in August 2010.

Most interest in the project has been in the Kapiti Coast District Council region where approximately 2 km of the lines cross through the Waikanae urban area. We have held an open day in Paraparaumu and Waikanae and attended meetings with the Council and its representatives. We have also responded to questions on the nature and scope of the work.

Naturally, those communities closest to the line routes have expressed concerns over the impact of works on their properties and on their communities. Transpower has dedicated community programmes to assist with project delivery, and its presence in the community generally. A CommunityCare fund component will be included in this proposal, and will be needed to offset the likely disruption caused by the tower work and conductor replacement.

In advance of this work, Transpower has also used the Bunnythorpe–Haywards A and B lines as a focus for its first Greenline Partnerships in Kapiti and Horowhenua. Greenline partnerships establish long-term partnerships with regions where larger transmission projects are being undertaken. Local community-led environmental projects are selected, based on set criteria, and working with local councils and community groups, are delivered over a three-year period. We are in the second year of such work with the local councils along the length of the transmission lines, with work involving not only targeted funding of worthwhile community projects but Transpower volunteer time for such activities. This has positioned us well with local communities for this project to proceed.

Industry engagement

In August 2010 we published a draft "needs" report. We then released a Request for Information (RFI) and Long List of Options for this project in November 2010. From this consultation, five submissions were received.:

- Major Electricity Users Group
- Contact Energy
- Energy Managers Association of New Zealand
- Genesis Energy
- Powerco

Most submitters supported the need for the investigation, and the approach and assumptions being used. One submitter considered that a higher weighting should be given to generation that has not yet been committed. Another submitter questioned the demand forecast being used and the sufficiency of that for the investment envisaged. This submitter and one other also suggested more work was required on non-transmission alternatives – particularly given the deferral value of the required investment.

Following receipt of that feedback we:

- considered and incorporated the feedback where appropriate
- further developed the short list options
- developed the economic approach
- analysed the results
- published a draft investment proposal for consultation
- received feedback on the draft proposal; and
- prepared and submitted a Grid Upgrade Plan.

In October 2013 we published a draft investment proposal.

Three submissions were received.

- Contact Energy
- Meridian Energy
- MEUG (Major Energy Users' Association)

There was support for the draft proposal from all submissions, but a common theme of the generators' submissions was whether the proposed option provided a sufficient increase in capacity to future proof for growth.

Our studies showed that, using the 2010 SoO scenarios, our proposal provides adequate capacity for the future by providing an additional 47 MVA capacity over and above the existing conductor and find there are negligible constraints in the future with the proposed Zebra at 75°C conductor. Full details on all comments can be found in Attachment F.

Table 6-1: Stakeholder engagement to date

Date	Activity
August/September 2010	Letter and introductory factsheet detailing the need for the investigation, the types of options being considered, and next steps. Sent to landowners, MPs, local council representatives. Project set up on Grid New Zealand.
November 2010	Issued RFI to industry participants
March 2011	Meetings with Mayor/CEO of Kapiti Coast District Council (KCDC) and offer to brief others through letter. Follow up letter to KCDC. Briefing of Federated Farmers.
April 2011	Second factsheet to landowners and community stakeholders reinforcing the need for the project and also setting out three options being considered, the process by which an option is chosen and next steps. Workshop with council officers of relevant councils (5 April).
5 May 2011	Information day at Paraparaumu and Waikanae libraries setting out the process to date, the process ahead and the options on the table. Kapiti area chosen due to the potential impact of construction work on traffic and land use.
May-September	Continued briefings of key stakeholders – affected councils, MPs, community boards, NZTA.
October 2011	Issued consultation paper on our analysis and draft proposal.
November 2011	Submissions closed and summary published.
December 2011	Grid Upgrade Plan submitted to Commerce Commission, including an Attachment showing how we have had regard to submissions.
March 2012	Agreed with the Commission to undertake further work to reduce uncertainty in the cost estimates.
April 2012/ August 2013	Detailed work undertaken to reduce uncertainty in costs of reconductoring options.
September 2013	Publish revised investment proposal for consultation, using the Commerce Commission's Capex IM framework rather than the former Electricity Commission regime.
October 2013	Submissions closed
November 2013	Submit MCP
November 2013	Publish Summary of Submissions with MCP

7| Major Capex Allowance

If a project is approved by the Commerce Commission, we can recover the costs of the project through the regulated charges for the transmission grid. The Commerce Commission also approves a maximum amount, the Major Capex Allowance (MCA) that we can spend. If we spend under this amount, we only recover actual costs.

We determine a MCA by accounting for the uncertainties in the project cost. The expected cost of this investment proposal is estimated to be $134.6 million in $2013, or $151 million in $2020, once financing costs and inflation are added. The MCA we seek approval for is $161 million.

The MCA is higher than the expected cost because it includes an allowance for price uncertainties and project unknowns.

7.1 New Technologies

We are recommending ACSR conductor for this proposal. There are several emerging conductor technologies which could offer future performance benefits. These conductors need to be proven in the corrosive and windy environment to which the Bunnythorpe–Haywards lines are exposed before they can be used elsewhere.

We are proposing to string a short section of one of the lines with different conductor types, such as ACCR, ACCC and ACSS. This will not impact on the overall performance of the line but will provide valuable performance and cost information for future conductor replacement projects. The evaluation will include high temperature conductors that also have potential application elsewhere on the grid as well as conductors that could have a longer life. The incremental cost of this portion of the work is $3 million.

Our submission to the Commerce Commission for Regulatory Control Period 2, due later this year, will fully describe our future plans for innovation, including the investigation of new conductor types. We are seeking approval for the capital implementation of this work now to ensure the work can be properly integrated into the project.

Prior to constructing the test site which will be on a rural section of line, we will reach agreement with the land owners involved for the trial.

7.2 Community Care Fund

Also included in the expected cost is an amount for our Community Care funding. Transpower acknowledges that while there are clear benefits from electricity transmission, our work will impact on local communities.

7.3 Major Capex Allowance

The relationship between the expected cost of the project and our Major Capex Allowance is shown in Table 7-1.

Table 7-1: Derivation of Major Capex Allowance

Expected Cost (2013 $m)	Inflation	Financing costs	Expected Cost (2020 $m)	Major Capex Allowance (2020 $m)
134.6	12.0	4.4	151.0	161.0

7.4 Effect on transmission charges

If the Commerce Commission approves this investment proposal and we complete the conductor replacement as outlined, transmission charges will increase. Table 7-2 shows indicative increases, for information purposes.

Table 7-2 – Derivation of Major Capex Allowance

Year	Interconnection rate increase $/kW	Interconnection rate increase %	Consumers bill c/kWh
2014/15	0.20	0.2	0.003
2015/16	0.70	0.8	0.011
2016/17	1.30	1.3	0.019
2017/18	1.90	1.9	0.028
2018/19	2.40	2.5	0.036
2019/20	2.80	2.8	0.041
2020/21	2.80	2.8	0.041

These transmission charge increases would be expected to reduce from 2022 on, as the asset is depreciated.

Consumers have already benefitted significantly from the life extension and capacity optimisation (thermal uprating) of the existing conductor in 2006, in effect a 10 year deferral benefit. Total conductor replacement also requires towers and foundations be brought up to current standards.

8| Attachments

Further information supporting this proposal is included in the following appendices:

Attachment A – Meeting the requirements of the Rules

This document describes in more detail why we believe this proposal meets the requirements to be approved by the Commerce Commission under the Capex IM

Attachment B – Condition assessment of the Bunnythorpe – Haywards A and B lines

This document provides some background as to why the conductors on the Bunnythorpe – Haywards A and B lines need to be replaced.

Attachment C –Options and Costing report

This document describes how the long list of options was reduced to a short list of options. It provides detail of how the short list options were costed and how the Major Capex Allowance was derived

Attachment D – Power Systems Analysis report

This document provides detail of the power system analysis which considered future capacity requirements on the Bunnythorpe – Haywards lines.

Attachment E – Investment Test analysis

This document provides detail of the Investment Test analysis used to identify the option which satisfied the requirements of the Investment Test.

Attachment F – Summary of submissions and reply to submissions

This document summarises the submissions received in our previous consultations and includes our response to the points raised in those submissions.

The spreadsheets and modelling data are also available on request. However, please be aware that there is a substantial volume of data involved and specialist modelling software is required to process the information.