3M’s Comments on the Electricity Commission’s Draft Decision on Transpower’s Auckland 400 kV Grid Investment Proposal

3M™ Aluminum Conductor Composite Reinforced (ACCR)

A Technology Solution to Quickly Enhance Transmission Capacity Using Existing Infrastructure

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I. Executive Summary

3M respectfully asks the Electricity Commission to include 3M's approach detailed below, which features 3M™ Aluminum Conductor Composite Reinforced (ACCR), as part of its short list of options for further consideration by Transpower. Potential benefits include:

- Substantial economic savings by avoiding significant easement and structure costs because 3M ACCR's light weight allows for installation on existing structures, and its higher ampacity would provide equivalent power flow of a 400kV double circuit line deferring the need for the 400 kV double circuit line;
- Less disruption to both the community and the environment than other alternatives because 3M ACCR can be installed on the existing structures;
- Ultimately, a more robust and reliable system as part of Transpower's long-term vision of a 400kV core grid;
- A quick solution to the more immediate capacity problems, with up to 760 additional MVA at the N-1 contingency level as early as 2007;
- Resolution of the thermal issues, as well as improved voltage and dynamic stability performance;
- A solution that has successfully undergone stringent and extensive testing and has already been installed in commercial applications in conditions similar to those affecting Auckland's transmission system;
- A solution backed by a local presence that can offer the Commission and the electricity sector the benefits of 3M's global technological resources, which have been proven in the world's most demanding marketplaces;
- 3M's well-established reputation and credibility as one of the most innovative corporations in the world across its numerous businesses.

Auckland and North Isthmus represent about half of the North Island peak demand over the planning horizon, expected to grow by approximately 2.9% per year. However, the transmission system feeding this area is ageing and in need of augmentation if it is going to continue to reliably serve this growing area. Six circuits of 220 kV lines and four circuits of 110 kV lines currently serve Auckland.

3M has developed a high-performance conductor that can provide transmission capacities up to two to three times greater than those of existing transmission lines. The high-performance 3M ACCR relies on a core of aluminum matrix composite wires surrounded by temperature-resistant aluminum-zirconium wires. This conductor operates at elevated temperatures with reduced sag and with significantly higher ampacity than comparably sized traditional conductors. It can be installed quickly and easily as a replacement conductor on transmission lines, with little or no modifications to towers or foundations and minimal environmental impact.

In this submission, 3M describes two scenarios for achieving the increased transmission capacity required. New easements are clearly required for new transmission lines, but there are questions over whether easements are required for duplexing existing lines. In Scenario 1**,** 3M assumes new easements would be required immediately for duplexing the existing lines. The proposal is to upgrade in two stages. In Stage 1 the existing A and B lines would be upgraded with duplexed ACCR in 2007. The reduced weight and improved performance of 3M ACCR conductors, compared to standard ACSR, would enable a duplexing option without major structure modifications. Because 3M's ACCR features superior ampacity, the lines could be uprated to from 200 MVA to 1,000 MVA each in one step, more than quadrupling the capacity. The resulting summer path rating, including the HLY circuits, would be 2,000 MVA, considering single contingency conditions (N-1). In addition the sections of C below HLY could be retensioned, producing an additional 500 MVA, for a total of 2,500 MVA at N-1.

In the second stage, both circuits of OTA-WKM C could be upgraded to 1,000 MVA each in 2010 with duplexed ACCR Goat. The resulting N-1 summer path rating, including both Stage 1 and Stage 2, would be 3,500 MVA.

At the end of 3M's Scenario 1, capacity could equal the path rating of Stage 2 of the Incremental Upgrade Package. However, by avoiding a new 400 kV line, 3M's scenario costs are approximately $400 million less.

For Scenario 2, 3M assumes easements, if required, could be deferred until the simplex lines need to be replaced by duplex lines. 3M ACCR could provide sufficient capacity in the short-term using simplex lines, rather than duplex, deferring the costs of easements. However the voltage stability and dynamic stability benefits of duplexed conductors would not be present, so additional reactive compensation would be required, similar to the Incremental Upgrade Package scenario.

In Stage 1, the existing conductor on lines A and B would be replaced with 3M ACCR, and the capacity could then increase from 200 MVA to 500 MVA per line, resulting in a path rating of 1,760 MVA, including the HLY circuits. In addition, the C lines can be retensioned to further increase the N-1 summer path rating to 2,705 MVA.

In Stage 2, the OTA-WKM C double circuit lines would be upgraded from 400 and 615 MVA, respectively, to 1,000 MVA each using 3M's ACCR conductor. This increases the path rating to 3,050 MVA. Again, the conductor can be dropped in place, no new easements would be required, and both cost and time are reduced.

Finally, in Stage 3, the simplex lines A and B would be upgraded to duplex at 1,000 MVA each, for a total path rating of 3,500 MVA at N-1. At this point, easements costs might be incurred, but the double circuit 400 kV line would not need to be built. Approximately $400 million dollars in project costs and environmental costs could be avoided, as could the disruption to the community caused by building a major transmission line. This has been demonstrated in several successful utility installations.

3M acknowledges that a 400 kV double circuit line, backed by a strong underlying 220 kV system, is one solution to provide security and meet additional demand. However, using 3M ACCR according to the plan detailed in this submission warrants serious consideration by the Commission in its own right, distinct from a "miscellaneous augmentation option," because it is a commercially-proven technology uniquely suited to Auckland's needs and meets all of the criteria adopted by the Commission and detailed in section 6.13.25 of the draft decision (p. 51).

3M's plan using ACCR could enhance the 220 kV upgrade options by reducing overall cost, deferring the need for building new lines and the need for new easements, identified as a major uncertainty in section 7.3.45 of the Commission's draft decision (p. 70). This approach could also reduce the environmental and aesthetic impacts and, when all project stages are complete, result in a more robust and reliable transmission system

II. Introduction

3M New Zealand Ltd (3M) commends the participants in the draft decision for the thoroughness with which the requirements of Auckland's transmission system and the options for resolving its issues have been evaluated. In general, 3M recognizes the need for the upgrades identified.

3M fully supports improving the reliability of power supply to Auckland, however, 3M believes that the draft decision does not sufficiently recognize or allow for advances in transmission technology that are currently available. These advances may provide an effective alternative to some of the generation or transmission line/ power pylon solutions that are under consideration by the Electricity Commission (the Commission) as outlined in the draft decision.

3M acknowledges that a 400 kV double circuit line, backed by a strong underlying 220 kV system is one solution to provide security and meet additional demand.. However, using 3M Aluminum Conductor Composite Reinforced (ACCR) according to the plan detailed in this submission warrants serious consideration by the Commission in its own right, distinct from a "miscellaneous augmentation option," because it is a commercially-proven technology uniquely suited to Auckland's needs and meets all of the criteria adopted by the Commission and detailed in section 6.13.25 of the draft decision (p. 51). Specifically:

a. *The type and nature of the technology involved*—3M ACCR has an extensive history of testing and commercial installations that demonstrates its effectiveness in transmission applications similar to the Auckland transmission system. It is a transmission option that uses existing transmission infrastructure and clearly resolves the thermal loading, voltage stability, and dynamic stability issues.

b. *The geographic location of the alternative in relation to possible transmission constraints into the Auckland region from the south*—Because 3M ACCR could be dropped in to the existing infrastructure and corridor, the geographic location criterion is met.

c. *The scale of the alternative, and its potential contribution to meeting forecast electricity demand in the Auckland and Northland regions (or in reducing the level of that demand)*—3M ACCR could supply the projected needs through 2021, deferring the need to build the 400 kV double circuit line beyond that point, while providing an equally robust level of reliability as determined using conventional N-1 criteria.

d. *The availability of the alternative over the assessment horizon*—3M ACCR is available now, and the first stage could be operational as early as 2007, well ahead of other alternatives.

e. *The likelihood that the alternative would proceed*—3M and its partners will provide support and assistance throughout all phases of the project. The technology has been successfully installed and is in continuous operation..

3M's plan using ACCR could enhance the 220 kV upgrade options by reducing overall cost, deferring the need for building new lines and the need for new easements, identified as a major uncertainty in section 7.3.45 of the Commission's draft decision (p. 70). This approach could also reduce the environmental and aesthetic impacts and, when all project stages are complete, result in a more robust and reliable transmission system.

3M's ACCR conductor has successfully undergone stringent and extensive testing, detailed in and Applications. In addition, ACCR has been installed in commercial applications similar to those that are the subject of this draft decision and under a number of environmental and loading conditions, including northern hemisphere regions experiencing severe ice storms, corrosive coastal environments and desert conditions with high ambient and operating temperatures. It has been installed as the primary path to serve major growing and constrained urban areas, including downtowns and airports, and, due to its superior strength and low weight, it is installed in long span and environmentally sensitive applications, such as river crossings. Appendix C: 3M Aluminum Conductor Composite Reinforced Testing and Applications includes more detailed information on these installations

In June 2005, 3M made a submission to the Electricity Commission on its first draft Initial Statement of Opportunities (SOO) for industry consultation that it had published on 10 May 2005. Following the preparation of its initial submission to the Commission 3M met on several occasions with Transpower officials to bring the ACCR conductor to their attention and to seek to arrange for joint studies or trials of its potential use in New Zealand. This effort included 3M bringing some key experts from the USA to meet Transpower officials in Wellington. 3M did not however have any further involvement in the formal Electricity Commission consultation process after its initial submission; i.e. no further submissions were prepared by 3M. We do respectfully consider however that the use of the ACCR conductor will provide alternative options to the Commission, as we outline in the scenarios below, that are fully viable as well as economically, environmentally and technically attractive.

3M presents this proposal and respectfully asks the Commission to include 3M’s approach, detailed below, as part of its short list of options for further consideration by Transpower.

III. Electrical Considerations

Presently, the contingency involving loss of either circuit of the double-circuit 220 kV line between Otahuhu and Whakamaru (OTA-WKM C) or the double circuit line between Huntly and Otahuhu (OTA-HLY) determines the power transfer limit into the Auckland load center. The power transfer limit is primarily due to the thermal ratings of the remaining 220 and 110 kV lines, although some significant reactive power supply additions are also necessary to provide the voltage support required to achieve line loadings at the full thermal limit.

The 110 kV line loadings can be managed by reconductoring the line, reconfiguring the network, adding phase shifting transformers, or converting to a higher voltage, such as 220 kV. However, due to the number of taps for distribution substations, extensive conversions to higher voltages are unlikely to be economically attractive. Yet, regardless of which bulk supply option is chosen, some 110 kV capacity improvements (or load cut-overs to 220 kV sources) will be needed due to local load growth.

The 220 kV overloads can be addressed by reconductoring the line or by adding one or more parallel circuits at 220 kV or higher. In 3M's opinion, the addition of a new line, such as the proposed double-circuit 400 kV line, may be a good long-term strategy; the question is whether it may be advantageous to first do some upgrades to the existing lines. If sufficiently effective, reconductoring could both delay the large investment needed to build a new 400 kV line and provide a higher-capacity underlying system to support a future 400 kV addition.

Analysis

After installing a 400 kV line (whether single or double circuit), the transmission system South-North path rating will be limited by the capability of the 220 and 110 kV networks. This is because loss of the new 400 kV line will be the most severe single contingency; it causes the greatest drop in thermal capacity of the transmission system into the Auckland area.

The methods available for addressing the 110 kV loading concerns have already been described above.

The loadability of the 220 kV system is limited by three issues:

- the thermal ratings of the individual circuits,
- voltage stability performance, and
- dynamic stability performance.

These limitations are relevant whether or not a 400 kV line is added to the transmission system; they simply arise in varying combinations, at different times.

Reconductoring the OTA-WKM A and B 220 kV lines with higher-capacity <u>single</u> conductors would address only the thermal limits. In contrast, reconductoring the A and B lines with <u>duplexed</u> conductor would address all three of these limiting considerations:

> *Voltage Stability* would be enhanced because duplexed conductors would reduce the series inductive reactance of the circuit by approximately 25 to 30%. This is of great consequence during heavy loading conditions, as experienced during N-1 episodes, since it is the series reactance (X) that determines both the reactive power consumption (I^2X) and the reactive voltage drop (IX).
>
> *Dynamic Stability* would also be enhanced if the series inductive reactance were reduced by installing duplexed conductors. Reducing the series reactance reduces the voltage phase angle displacement required across the circuit (and related network) to transfer a given amount of power. As a result, the dynamic power transfer limit is increased.

An important advantage of duplexed conductors on the A and B lines is that after installation of a parallel 400 kV line, the A and B circuits' lower series reactance will improve the load sharing amongst the four 220 kV OTA-WKM circuits

Conclusions

Today, the potential loss of one of the circuits of the double-circuit 220 kV WKM-OTA C line causes the A and B circuits to be the transfer-limiting facilities. After installation of a 400 kV line, the A and B circuits will still be the limiting facilities (though at a higher path rating) because failure of the new 400 kV line will cause heavy loadings on all four 220 kV circuits. The optimal long-range transmission expansion plan would address both pre- and post-400 kV line addition conditions.

Installation of duplexed conductor on the OTA-WKM 220 kV lines would significantly increase system loadability in the short term, thereby deferring the need for the proposed 400 kV overlay. This deferral would be possible because reconductoring with duplexed conductors addresses all three limiting considerations: thermal capacity, voltage stability, and dynamic stability. Precise determination of the amount of deferral achieved would require detailed steady-state (powerflow) and dynamic stability studies.

Following the installation of a 400 kV line, the reconductored A and B circuits provide a higher-capacity underlying network for the 400 kV line, enhancing its long-term value by increasing the N-1 load-serving capability of the network for the most severe contingency, loss of the 400 kV line.

Another relevant transmission system planning consideration is loss of *both* circuits of a double-circuit line, such as the C line. Although beyond the basic N-1 criterion used by Transpower, physical considerations reveal many common-mode failure possibilities, such as structure collapse, wind-blown debris, and lightning-induced flashovers. Accordingly, many transmission owners and reliability councils consider loss of a double-circuit line to be a single contingency. Of course, it is also possible to have two circuits outaged due to independent, overlapping contingencies; these scenarios are referred to as “N-2” conditions. Figure 3 on page 19 shows that the 3M ACCR options consistently provide significant increases in both N-1 and N-2 system capability.

For these reasons, 3M's proposal includes reconductoring OTA-WKM A and B lines with duplex ACCR Goat as a preliminary step, prior to adding new 400 kV lines. Using 3M ACCR, with its superior thermal performance, makes it possible to delay building the 400 kV line past the planning horizon while still significantly increasing the system path rating.

However, if the Commission should decide to build the 400 kV line, as proposed, reconductoring the OTA-WKM lines with 3M ACCR (duplex) provides protection and reliability for Auckland's transmission system that is far superior to building the new line alone.

IV. 3M's Proposal: Upgrade OTA-WKM A, B and C with ACCR

To address the uncertainties around easements, identified in section 7.3.45 of the Commission's draft decision (p. 70), 3M's proposal includes two scenarios. The first assumes Transpower would need to obtain easements to upgrade the lines, whether with simplex or duplex. The second assumes that Transpower would not need to obtain easements until it upgrades existing simplex lines with duplex conductor.

Scenario 1: Complete upgrade of A and B followed by complete upgrade of C

In scenario 1, 3M proposes to upgrade in two stages. Using 3M ACCR, the result could be comparable capacity upgrades at less total cost and without the economic and environmental impacts of adding a new 400 kV line.

Stage 1—Replace OTA-WKM A and B with 3M ACCR Duplex

In Stage 1 the existing A and B lines would be upgrade with duplexed ACCR in 2007. The lower weight and improved performance of 3M ACCR compared to standard conductors could enable a duplexing option without major structure modifications. Because 3M's ACCR features superior ampacity, the lines could be uprated to from 200 MVA to 1,000 MVA each in one step, more than quadrupling the capacity. The resulting summer path rating (N-1), including the HLY circuits, could be increased from 1,240 to 2,000 MVA, assuming an N-1 contingency. In addition the sections of C below HLY could be retensioned, producing an additional 500 MVA of path rating, for a total of 2,500 MVA at N-1. The capacity of this option is equal to that of the Incremental Upgrade Package (IUP). Whilst it is unclear if easements are required when converting from simplex to duplex, we have assumed in this scenario that easements would be required

Stage 2—Replace OTA-WKM C with 3M ACCR Duplex

In the second stage, both circuits of OTA-WKM C would be upgraded to 1,000 MVA each. Both circuits of OTA-WKM C have duplexed ACSR conductors, which could be replaced by duplexed ACCR. The resulting summer N-1 path rating, including both Stage 1 and Stage 2, could be 3,500 MVA.

At the end of 3M's Scenario 1, capacity could equal the path rating of Stage 2 of the IUP. However, by avoiding a new 400 kV line, cost savings could be $400 million or more. (See tables 1 and 2).

One argument for a new 220 or 400 kV line is improved security. One relevant measure of security is the path rating at various contingency levels. The Commission's standard is the N-1 condition. 3M also considered the N-2 path rating. For the IUP, the N-2 thermal rating at the end of Stage 1 could be 2,000 MVA and 3,000 MVA at the end of Stage 2. 3M's Scenario 1 could provide an N-2 contingency thermal rating of 1,600 MVA at Stage 1and up to 2,700 MVA at the end of Stage 2. Due to the greater thermal capacity of 3M ACCR, the transmission system is capable of achieving high levels of path thermal rating, without addition of any new circuit.

Figure 1 summarizes the stages of Scenario 1.

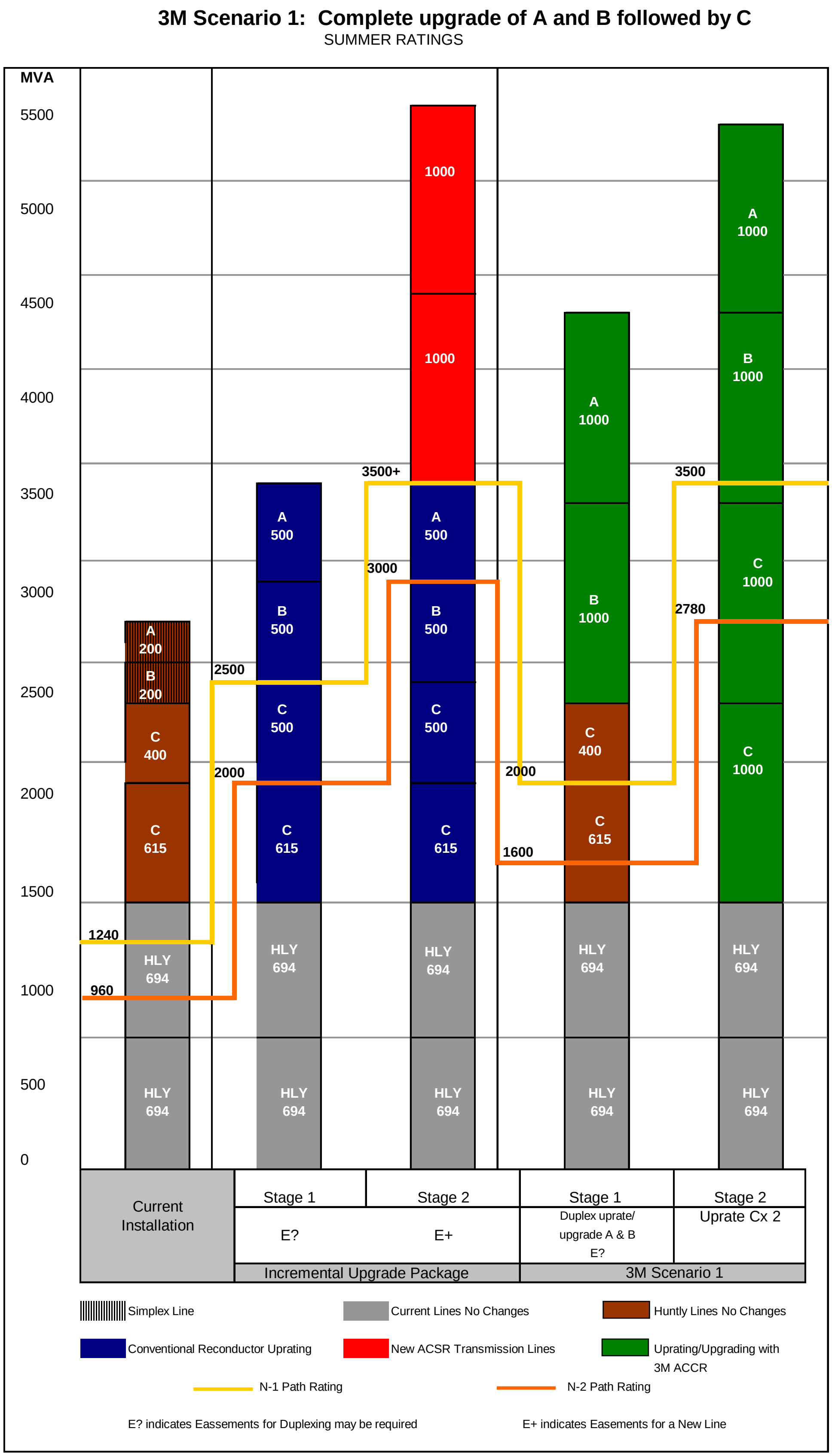

Figure 1: Chart comparing the Current Installation, the IUP, and 3M Scenario 1

Scenario 1 Economics

Tables 1 and 2 summarize the capacity and economic impacts of both 3M Scenario 1 and the IUP.

Table 1: 3M Scenario 1 Complete upgrade of A and B followed by Complete upgrade of C

Year	Augmentation	Change to line	Added Path Capacity MW	Path Capacity (N-1) MW	Installed Cost in 2006 Millions of Dollars
2007	Retension OTA-WKM C	None	500	1,740	$ 35
2007	Uprate OTA-WKM A and B 220 kV with Duplex ACCR to 1,000 MVA per circuit	Duplex	760	2,500	378
2010	Uprate OTA-WKM C 220 kV with Duplex ACCR to 1,000 MVA per circuit	None	1,000	3,500	155
2021	**Totals**		**2,240**	**3,500**	**$568***

Table 2: Electricity Commission Draft Decision Incremental Upgrade Package -- 400 kV Line in 2010

Year	Augmentation	Change to line	Added Path Capacity MW	Path Capacity (N-1) MW	Installed Cost in 2006 Millions of Dollars
2008	Uprate OTA-WKM A and B 220 kV with Duplex ACSR to 500 MVA	Duplex	740	2,000	$233
2010	Add double circuit OTA -WKM 400 kV	New Line	1,000	3,000	709
2021	**Totals**		**1,740**	**3,000**	**$942***

* *Total costs are estimates that include costs for easements, losses, installation , etc.*

Scenario 2: ACCR solution defers Easements

Deferment of costs has been recognized by the Electricity Commission as an important aspect in evaluating various alternatives. Since easements can be a significant economic factor, consideration of alternatives that might defer such easements is of great interest. For Scenario 2, 3M proposes a 3-stage approach to upgrading the capacity of the transmission system into Auckland that defers potential easements associated with duplexing. This approach is possible because 3M ACCR could provide sufficient capacity in the short-term using simplex lines, rather than duplex, thereby deferring the potential costs associated with easements. In addition, by the end of Stage 3, 3M's approach—using only the existing lines— could achieve N-1 and N-2 path ratings similar to those obtained with the IUP and the addition of two new 400 kV circuits. This result is possible because, under the IUP scenario, the new 400 kV lines' potential contribution to path rating is limited, following outage of one or both of the new high-capacity circuits, by the ratings of the existing circuits.

Stage 1—Replace Conductor on OTA-WKM A and B in 2007 with 3M ACCR Goat

By replacing the existing conductor on lines A and B with 3M ACCR, the capacity increases from 200 MVA to 500 MVA per line, resulting in an N-1 path rating of 1,760 MVA, including the HLY circuits. 3M could achieve this using a simplex design with Goat conductor. The ACCR could be dropped into place on the existing structures, significantly shortening the project time, realizing significant capacity gains sooner, and reducing costs because existing easements and towers could be used and new investments deferred.

Optional Stage 1 -- In addition, the C lines can be retensioned to increase the N-1 summer path rating to 2,700 MVA. The corresponding N-2 rating could become 2,090 MVA. Because A and B are uprated using only simplex lines, reactive support will still be required.

Stage 2—Upgrade Line C Double Circuit Lines in 2015

In Stage 2, the OTA-WKM C double circuit lines could be upgraded from 400 and 615 MVA, respectively to 1,000 MVA each using 3M’s ACCR Goat. This increases the path’s N-1 rating to 3,052 MVA, and the N-2 rating to 2,360. Again, the conductor could be dropped in place, no new easements would be required, and both cost and time are reduced.

Stage 3—Upgrade OTA-WKM A and B to Duplex in 2021

Finally, the simplex lines A and B would be upgraded to duplex at 1,000 MVA each, for a total path rating of 3,500 MVA at N-1 and 2,780 at N-2. At this point, easements costs may be incurred, but the costs here will be well below that of the double circuit 400 kV line.. The economic and environmental costs could be avoided, as could the disruption to the community caused by building a major transmission line.

3M Scenario 2: ACCR solution defers Easements
SUMMER RATINGS

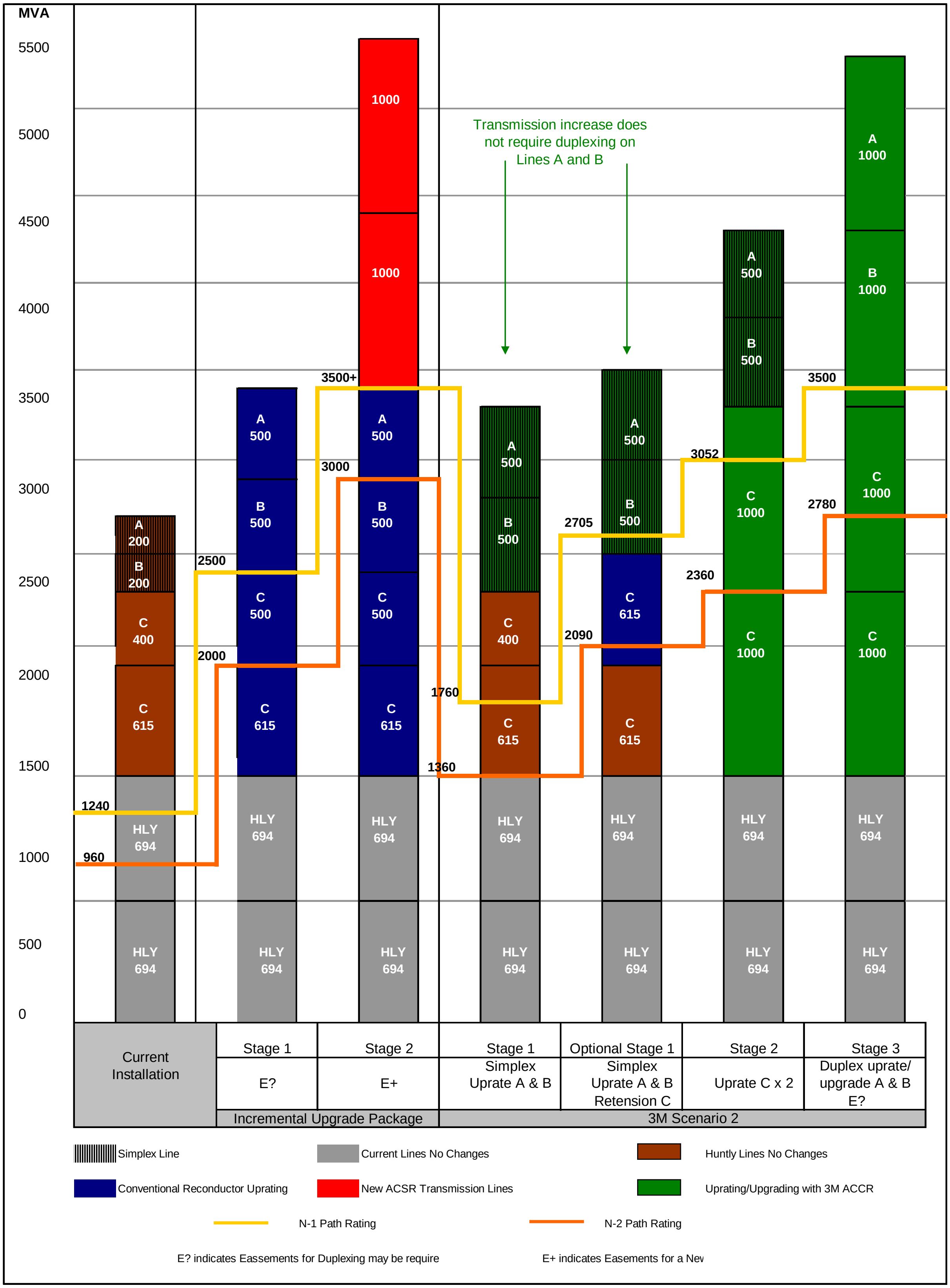

Figure 2: Chart Comparing the Current Installation, the IUP, and 3M Scenario 2

Tables 3 and 4 provide some of the capacities and estimated costs of 3M's Scenario 2 proposal and the IUP.

Table 3: 3M Scenario 2: New Easements with Duplex

Year	Augmentation	Change to line	Added Path Capacity MW	Path Capacity (N-1) MW	Installed Cost in 2006 Millions of Dollars
2007	Uprate OTA-WKM A and B 220 kV with Simplex ACCR to 500 MVA and retension C	None	1,455	2,705	$165
2015	Uprate OTA-WKM C 220 kV Duplex ACCR to 1,000 MVA	None	740	3,052	155
2021	Uprate OTA-WKM A and B 220 kV to Duplex ACCR to 1,000 MVA	Duplex	348	3,500	215
2021	**Totals**		**2,240**	**3,500**	**$535***

Table 4: Electricity Commission's Draft Decision Incremental Upgrade Package -- 400 kV Line in 2010

Year	Augmentation	Change to line	Added Path Capacity MW	Path Capacity (N-1) MW	Installed Cost in 2006 Millions of Dollars
2008	Uprate OTA-WKM A and B 220 kV with Duplex ACSR to 500 MVA	Duplex	740	2,000	$232
2010	Add double circuit OTA - WKM 400 Kv	New Line	1,000	3,000	709
2021	**Totals***		**1,740**	**3,000**	**$941***

** Total costs are estimates that include costs for easements, losses, installation , etc.*

Figure 1 compares both 3M Scenarios with various incremental upgrade alternatives, including N-1 and N-2 path ratings.

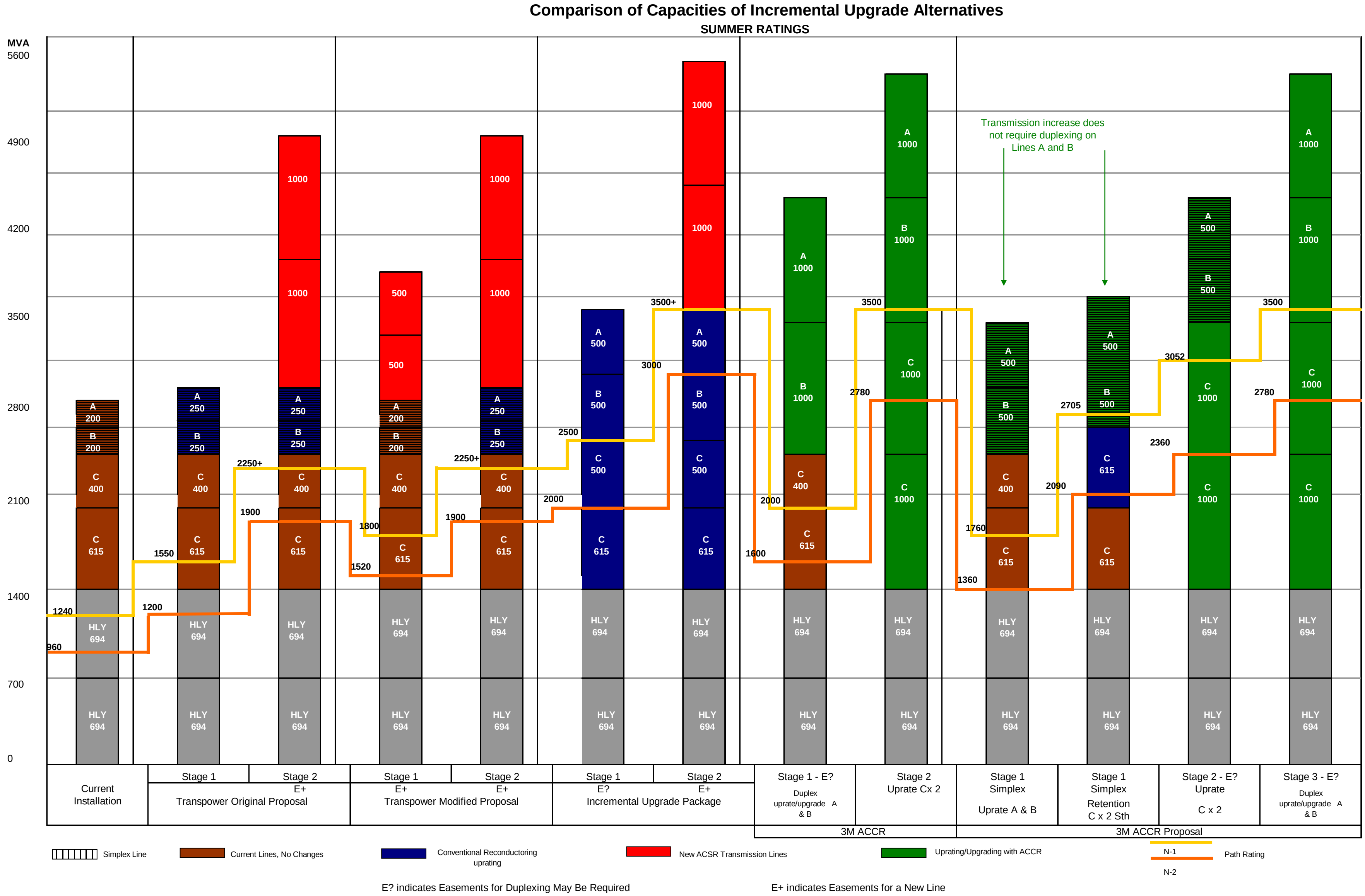

Figure 1: Summary Comparison of 3M Scenarios and Various Upgrade Alternatives

V. Environmental Benefits

Replacing existing conductors with 3M ACCR results in less environmental impact compared to building a new transmission line on a new or expanded right of way. Reconductoring with 3M ACCR does not change the visual impact of the line, unlike adding additional circuits or new, larger towers. Installation is expedient, community disruption for tower construction is eliminated, and the increased capacity of the ACCR could be available almost immediately with less cost per megawatt of capacity.

A major uncertainty when building new transmission lines is obtaining the easements. In fact, the Commission identified easements as a major uncertainty in section 7.3.45 of the draft decision (p. 70). An advantage of 3M ACCR is that it can often be installed on existing structures, eliminating the need to expand existing easements. In the scenarios developed for this submission, using 3M ACCR could potentially defer the need for a new 400 kV line beyond the planning horizon, eliminating the need to obtain easements for a new corridor.

This approach could also reduce the environmental and aesthetic impacts and, when all project stages are complete, result in a more robust and reliable system.

VI. Operational Considerations

The unique combination of an aluminum matrix composite core and heat resistant Al-Zr outer strands provides many advantages over other conductors.

- First: The use of aluminum matrix composite reinforcement, with it's light weight and low thermal elongation, reduces conductor sag allowing higher operating temperatures, and greater power transfer than traditional conductors, without additional structural loads.
- Second. The use of full strength aluminum results in a partition of load between the core and the outer aluminum, which offers redundancy in design; generally the aluminum and the core can each carry the full design load of the conductor.
- Third: The rated design temperature of 3M ACCR is 210ºC continuous, 240ºC emergency. The composite core of the conductor is a metal-based composite, an inorganic material. The core is thermo chemically stable at temperatures that are significantly higher than the operating temperature of the conductor.
- Fourth: The aluminum in the outer strands is heat resistant, also retaining its strength while operating at high temperatures
- Fifth: The composition of the core, which consists of aluminum oxide fibers that are embedded in a matrix of pure aluminum, is corrosion resistant. No protective coatings are required for the core, unlike steel cores, which require galvanized coatings. Further, there is no galvanic coupling between the core and the stranded aluminum wires, which would also be subject to corrosion.
- Fifth, the composition is unaffected by UV or humidity and retains strength after long-term exposure to both.

As with conventional conductors, a variety of accessories is needed for the successful operation of ACCR. However, the equipment and installation process is similar to those required for conventional ACSR conductor. Also, 3M provides experienced personnel to train installers and to oversee the installation process.

3M, in partnership with industry-recognized accessory suppliers, has undertaken a thorough series of tests on a variety of accessories. Terminations (also called dead-ends) and joints (also called mid-span splices or full-tension splices/joints) are commercially available from Preformed Line Products (PLP) and from ACA Conductor Accessories. Both companies furnish splices and terminations; the former provides helical rod type, and the latter compression type hardware. All hardware is rated for high-temperature operation.

3M ACCR is a proven technology, used successfully in a variety of sites, representing a broad range of environmental and operating challenges.

VII. About 3M and 3M New Zealand, Ltd.

3M is one of the largest manufacturing corporations in the United States of America and, indeed, in the world, with 61% of its annual turnover generated internationally. 3M has offered high-quality products to the electric utility market since the end of World War II when it introduced black vinyl electrical tape. Since that time, the company has continually expanded its product line and now offers power cable splices and terminations, electrical insulating products, and specialty tapes. 3MACCR continues the company's tradition of offering innovative and practical solutions to this industry.

The following chart highlights the dimensions of 3M's worldwide business, which encompass six main business sectors: Industrial and Transportation; Health; Safety, Security and Protection; Consumer and Office; Display and Graphics; and Electro and Communications.

Sales ($US)	
Worldwide	$21.2 billion
International (61% of total)	$12.9 billion

R&D Expenditures ($US)	
For 2005	$ 1.3 billion
Total last 5 years	$ 6.0 billion

Earnings ($US)	
Net income-reported	$ 3.1 billion

Employees	
Worldwide	69,315
United States	33,033
New Zealand	200

Figure 2: 3M's Worldwide Business Presence

The metal matrix composite used in 3M's ACCR and other specialty materials are just two of the company's wide range of technology platforms, as listed in the chart below.

3M Technology Platforms		
Acoustics	Fluoromaterials	Particle & Dispersion Processing
Adhesives	Health Information	Pharmaceuticals
Batteries	Imaging	Polymer Melt Processing
Ceramics	Infection Prevention	Porous Materials & Membranes
Coated Abrasives	Inks & Pigments	Precision Coating
Dental & Orthodontics	Medical Devices	Radiation Processing
Display Materials	Metal Matrix Composite	Reclosable Fasteners
Drug Delivery	Microbiology	Skin Health
Electromechanical Systems	Microreplication	Software
Electronics	Moulding	Specialty Materials
Fiber Optics	Nonwoven Materials	Surface Modification
Films	Optical Fibers and Connectors	
Filtration	Optics & Light Management	

Figure 3: 3M's Wide Variety of Technology Platforms

3M New Zealand established operations in 1956 and is headquartered in Auckland. The company employs 200 staff. Our local presence can offer the Commission and the electricity sector the benefits of the corporation's global technological resources, which have been proven in the world's most demanding marketplaces. The Commission can also rely upon 3M's well-established reputation and credibility as one of the most innovative corporations in the world across its numerous businesses. This submission is backed by the knowledge and support of our headquarter staff in St Paul, Minnesota.

VIII. Conclusions

3M acknowledges that a 400 kV double circuit line, backed by a strong underlying 220 kV system, addresses security and supply needs. However, incorporating 3M ACCR could provide substantial economic savings and be less intrusive to both the community and the environment than other alternatives, including the Incremental Upgrade Package. Particularly, it could avoid significant easement costs, delays, and uncertainty well into the future.

3M's approach could result in an equivalent N-1 path rating using only OTA-WKM A, B, and C lines than the comparison approaches provide even with the addition of two new 400 kV circuits. . Adding a high-capacity 400 kV line is not as effective as may first appear, because following failure of the new 400 kV circuit(s) the post-contingency loadability of the south-north transmission path is limited by the ratings of the existing 220 kV lines.

Again, if the Commission decides to proceed with the 400 kV line in the future, either of 3M's scenarios could provide robust support for this expansion. In addition, the conversion to a duplex conductor design could address all three of the system's issues: thermal limits, voltage stability, and dynamic stability.

3M's approach could achieve all this while costing approximately $400 million less than building a new double circuit 400 kV line. It could also save significant indirect costs, including installation time, disruption to Auckland's businesses and residents, land and, through the resulting robustness of the system, the risk of expensive outages.

3M's ACCR is an extensively tested, commercially available, proven technology well suited for the demands of a growing transmission system serving a major urban hub such as the Auckland area. The product is backed by the full range of design assistance, accessories, and installation expertise of 3M and its partners. Our local presence can offer the Commission and the electricity sector the benefits of the corporation's global technological resources, which have been proven in the world's most demanding marketplaces. The Commission can also rely upon 3M's well-established reputation and credibility as one of the most innovative corporations in the world across its numerous business lines.

For these reasons, 3M presents the scenarios in this submission as fully viable, economically, environmentally, and technically attractive alternatives, and respectfully requests that the Commission include them as part of its short list of options for further consideration by Transpower.

For more information contact Michael E Thomas, Technical and Manufacturing Director, 3M New Zealand Ltd, PO Box 33-246 North Shore 0740 New Zealand.

Appendix A: Technical Information

3M has developed a high-performance conductor that can provide transmission capacities up to two to three times greater than those of existing transmission lines. The high-performance 3M ACCR represents the first major breakthrough in overhead conductor technology since the conventional aluminum-steel reinforced conductor (ACSR) was introduced in the early 20th century. Relying on a core of aluminum matrix composite wires surrounded by temperature-resistant aluminum-zirconium wires, 3M ACCR can operate at elevated temperatures with reduced sag to increase transmission capacity. It can be installed quickly and easily as a replacement conductor on existing transmission lines, with little or no modifications to towers or foundations and minimal environmental impact.

Material Properties

The tremendous advantages of 3M ACCR are due to new innovations in the materials used. Compared to steel, the new composite core has:

- 100% metal
- less weight,
- equivalent strength,
- lower thermal expansion, and
- higher electrical conductivity.

This permits the use of higher operating temperatures, which in turn leads to higher ampacities. Both the composite core and the outer aluminum-zirconium (Al-Zr) strands contribute to the overall conductor strength and conductivity.

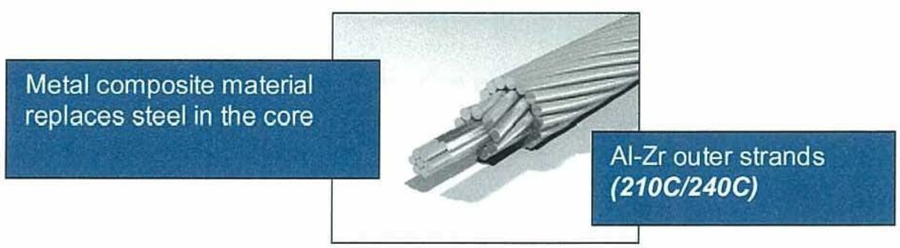

Figure 4: 3M™ Aluminum Conductor Composite Reinforced

Composite Core

The composite core contains 3M metal matrix composite wires. Depending on the conductor size, the wire diameters range from 0.073” (1.9 mm) to 0.114” (2.9 mm). The core wires have the strength and stiffness of steel, but with much lower weight and higher conductivity. Each core wire contains many thousands of small diameter, ultra-high-strength aluminum oxide fibers. The ceramic fibers are continuous, oriented in the direction of the wire, and fully embedded within high-purity aluminum. The composite wires look like traditional aluminum wires, but exhibit mechanical and physical properties far superior to those of aluminum and steel. For example, the composite wire provides nearly 8 times the strength of aluminum and 3 times the stiffness. It weighs less than half of an equivalent segment of steel, with greater conductivity and less than half the thermal expansion of steel.

Outer Strands

The outer strands are composed of a temperature-resistant aluminum-zirconium alloy that permits operation at high temperatures (210ºC continuous, 240ºC emergency). The Al-Zr alloy has properties and hardness similar to standard 1350-H19 aluminum. However, its microstructure is designed to maintain strength after operating at high temperatures - that is, it resists annealing. In contrast, 1350-H19 wire rapidly anneals and loses strength with temperature excursions above 100ºC. The temperature-resistant Al-Zr alloy wire has tensile strengths and stress-strain behaviors equivalent to standard 1350-H19 aluminum wire.

Benefits

The unique combination of an aluminum matrix composite core and heat resistant Al-Zr outer strands provides many advantages over other conductors.

- First, the use of full strength aluminum results in a partition of load between the core and the outer aluminum, which offers redundancy in design; generally both the outer strands and the core can each carry the full design load of the conductor.
- Second, the rated design temperature of 3M ACCR is 210ºC continuous, 240ºC emergency. The composite core of the conductor is a metal-based composite, an inorganic material. The core is thermo chemically stable at temperatures that are significantly higher than the operating temperature of the conductor.
- Third, the composition of the core, which consists of aluminum oxide fibers that are embedded in a matrix of pure aluminum, is corrosion resistant. No protective coatings are required for the core, unlike steel cores that require galvanized coatings. Further, there is no galvanic coupling between the core and the stranded aluminum wires, which would result in corrosion.
- Fourth, the composition is unaffected by UV or humidity and retains strength after long-term exposure to both.
- Fifth, the aluminum in the outer strands is heat resistant, retaining its strength while operating at high temperatures.

Appendix B: Accessories

As with conventional conductors, a variety of accessories is needed for the successful operation of ACCR. However, the equipment and installation process is similar to those required for conventional ACSR conductor. Also, 3M provides experienced personnel to train installers and to oversee the installation process.

3M, in partnership with industry-recognized accessory suppliers, undertook a thorough series of tests on a variety of accessories. Terminations (also called dead-ends) and joints (also called mid-span splices or full-tension splices/joints) are commercially available from Preformed Line Products (PLP) and from ACA Conductor Accessories. Both companies furnish splices and terminations; the former provides helical rod type and the latter compression type hardware. All hardware is rated for high-temperature operation.

Compression Type Hardware

The compression-type hardware from ACA uses a modified two-part approach for separate gripping of the core and then an outer sleeve to grip the aluminum strands, as shown in Figure 5. This approach is similar to the approach used in ACSS, although modified to prevent crushing, notching, or bending of the core wires. The gripping method ensures the core remains straight, to evenly load the wires, and also ensures that the outer aluminum strands suffer no lag in loading relative to the core.

Figure 5: ACA Compression – Type Hardware

Helical Rod-Type Hardware

Helical rod-type hardware has been developed by PLP for use with the 3M ACCR at high operating temperatures. It uses the helical rod design, which places minimal compression loading on the conductor. A multi-layer design maximizes both the holding strength and heat dissipation, and has the advantage of easy installation.

PLP also provides suspension assemblies for 3M ACCR. These accessories are based on field-proven ARMOR-GRIP® Suspensions. The multi-layer design maximizes the mechanical protection and heat dissipation, while minimizing heat transfer to mating hardware and insulators. A cushioned insert provides protection against wind and ice loads. The helical rods also provide local stiffening to the conductor, which reduces the bending strains on the conductor.

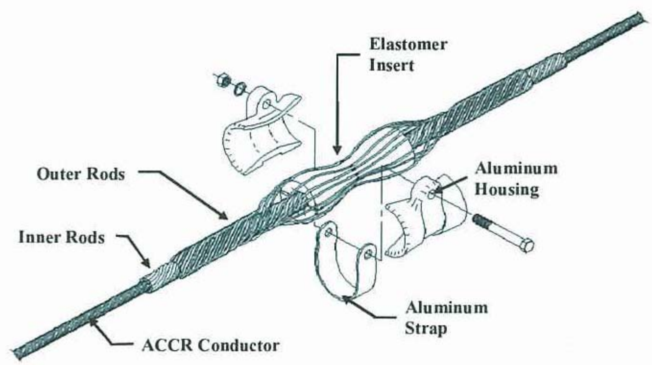

Figure 6: PLP Helical Rod-Type Hardware

Appendix C: 3M Aluminum Conductor Composite Reinforced Testing and Applications

Laboratory Testing

3M, in partnership with various industry leaders, has tested 3M ACCR in both laboratory and field conditions to verify theoretical properties and behavior. Testing to date has been performed on a variety of conductor constructions using a wide variety of tests. Testing includes:

- tensile strength;
- stress strain behavior;
- creep;
- axial impact;
- strength;
- crush strength;
- torsion behavior;
- DC resistance;
- lightning strike behavior; and
- fault current behavior.

Testing of the core includes:

- high temperature creep;
- strength retention after exposure to high temperatures;
- resistance to moisture;
- resistance to combined stress and moisture;
- corrosion resistance;
- stability of composition after high-temperature exposure; and
- visual signs of cracking or discoloration after high-temperature exposure.

Suspension tests include:

- turning angle;
- unbalanced load;
- elevated temperature profiles;
- galloping behavior;
- Aeolian vibration behavior; and
- corona RIV testing.

Deadend and splice tests include:

- tensile strength (e.g. accessory's ability to support tensile strength of the conductor);
- sustained load tests at room temperature,
- load tests at elevated temperature of 240^{o}C; and
- current cycle testing.

Jumper tests include current cycle testing, and damper tests include damper efficiency tests.

Field Testing

3M and other independent test laboratories have performed a variety of field and laboratory testing and have extensive data on the conductor and accessories. 3M ACCR has been installed in a variety of different places including field trials for:

- heavy ice and wind loading areas;

- a range of span lengths (600’ – 1100’);
- high corrosion areas;
- vibration loading;
- high-temperature, high-current operation, including post operation testing of the conductor and accessories;
- sag tension temperature testing;
- current/temperature cycling; and
- creep monitoring.

Xcel Energy

In 2001 Xcel Energy installed a 477 kcmil ACCR in its 115kV system in Minneapolis to feed power from a generation plant to the network. It replaced a conventional ACSR conductor to increase the ampacity while keeping the same clearance and tower loads.

Hawaiian Electric Company

Hawaiian Electric Company (HECO) installed a similar 477 kcmil 3M ACCR on a 46 kV line located on the North Shore of Oahu for the evaluation of ACCR corrosion resistance. In particular, the installation tests the corrosion resistance of the conductor on their 46 kV network while also increasing the ampacity along the existing right-of-way by approximately 72%.

Western Area Power Administration

In 2002 a 795-kcmil 3M ACCR was installed by WAPA on the Fargo-Jamestown 230 kV line near Fargo North Dakota. The climatic conditions there exposed the cable to high winds, extreme cold, ice loading and conditions conducive to Aeolian vibration. ACCR was installed on a 1-mile stretch of the circuit. The first two winters after the line was energized were mild. However, in the winter of 2005/2006, ice built up on the conductor, doubling the span’s mechanical loads. Despite the ice loading, there have been no problems over the last 3.5 years. The line data follows the predictions made by models for sag, tension and rating.

In January 2004 WAPA installed 1272 kcmil 3M ACCR at its Liberty- Parker location in Phoenix, AZ. The conductor was installed as an evaluation/validation cable for the installation of cable constructions with three layers of aluminum. The measured conductor tension and sag agree with predictive models. The line has been loaded to around 25% of its electrical rating since June 2004.

Salt River Project (SRP)

3M ACCR has been installed in several locations in proximity to generating stations in order to test the conductor under high current loads where it will see high ambient temperatures. Conductors for these tests are sized so that they will operate at their maximum electrical design loads. SRP installed a 795 ACCR on a 69 kV line at the expansion of their Santan generation plant in Gilbert, AZ in March of 2004. The ACCR 795 line delivers output of the Santan Expansion Project Unit 5b (combined cycle natural gas fired generator) to the 69 kV switchyard. The location is ideal to test 3M ACCR because it undergoes significant temperature swings and high summer peak demand (high conductor temperature) in desert conditions where ambient temperatures are very high.

Bonneville Power Administration (BPA)

In June of 2004 BPA successfully installed ACCR 675T13-TW on a 115 kV line in Pascal, Washington. This installation was established to test the operation of the compact trap-wire ACCR at elevated temperatures. 3M provided its 675T13-TW conductor to BPA for installation at their Pasco site as a replacement for an existing Chuker 1780 kcmil (976 mmm^2)ACSR bottom phase. The conductor was installed in June 2004, energized in August 2004run continuously since then. It was exposed to currents as high as 1100A and conductor temperatures up to 80^0C (computed). The mechanical load versus NRS temperature data at low current level matches the predicted values and has essentially been unchanged over the past two years.

San Diego Gas & Electric

San Diego Gas & Electric, in Southern California, installed 3M ACCR on short line segments near substation in Oceanside (just north of San Diego),. The Oceanside installation was funded in part by the California Energy Commission. The Electric Power Research Institute (EPRI) will monitor the line's performance.

Commercial Applications

Xcel Energy

3M ACCR received its first commercial application, when Minneapolis-based Xcel Energy installed it on a 10-mile (16-kilometer) transmission line in the Minneapolis-St. Paul region. Xcel Energy is using the conductor to increase the capacity of a transmission line that extends from Shakopee to Burnsville. The upgrade is part of a US$100 million expansion project at the utility's Blue Lake peaking plant in Shakopee, which is needed to ensure a reliable supply of power to Xcel Energy's customers in the Upper Midwest during periods of peak electricity demand. The ten-circuit mile line crosses an interstate and two major highways at multiple points, as well as traversing several residential and industrial areas.

Don Jones, Director of Transmission Asset Management at Xcel Energy, said about 3M ACCR, "We found 3M's new composite conductor to be the right solution for boosting capacity and reliability on a line that is an integral part of the grid in the Upper Midwest, where Xcel Energy serves 1.5 million electricity customers. We are always looking for new ways to improve service to our customers. We evaluated various conductors for the project,- and determined that the 3M conductor is the only option that will get the job done on time, because it will allow us to increase the line's capacity without installing new towers."

The conductor was installed during an eight-week period on Xcel Energy's Black Dog-Blue Lake line in Minnesota, which extends from Shakopee to Burnsville. "The ACCR provided a fast and cost-effective option for delivering additional energy from Blue Lake to our 1.5 million electricity customers in the Upper Midwest," said Doug Jaeger, transmission vice president for Xcel Energy. "Without it, we would have had to replace existing towers to accommodate larger sized conventional conductors. Use of the new conductor allowed us to boost capacity on the line while avoiding major construction in an area with sensitive wetlands."

Southwest Regional Utility Application

A major U.S. utility (requesting anonymity) installed 3M ACCR to increase capacity on a key overhead transmission line serving a growing metropolitan area. The new conductor eliminated the need for the utility to site, acquire right-of-way and construct a new power line route in a congested downtown business area.

3M ACCR was installed on a six-mile, 230-kV power line extending from a local area power plant to the company's downtown substation. The installation, which was recently energized, provides increased capacity to service the fast-growing metropolitan area. In this application, 3M's ACCR 1272 kcmil conductor was used to upgrade a line that already had been upgraded once with ACSS.

The utility selected ACCR as a result of a twelve-month evaluation of various high temperature, low sag conductors. 3M's ability to supply a complete package, including conductor hardware and installation support, was instrumental in the utility's selection of ACCR.

Pacific Gas & Electric (PG&E)

PG&E in Southern California installed 3M ACCR on short line segments near a substation in Santa Clara. PG&E funded its own installation and is performing its own monitoring.

The Western Area Power Administration (Western)

Western, which delivers about 40 billion kilowatt-hours of hydroelectric power annually in fifteen western and central states, chose 3M ACCR to replace a key conventional power line in western Arizona.

Western is one of four power marketing administrations within the U.S. Department of Energy, and serves nearly 700 wholesale power customers in a 1.3 million-square-mile area, including some 300 municipalities, as well as public utilities and utility districts, energy cooperatives, power marketers, irrigation districts, Native American tribal communities and government agencies.

A 230-kV ACCR will be installed initially on a twenty-mile stretch of the Topock-Davis line, which parallels the Colorado River along Arizona's western border with California. Eventually, the new conductor will be extended northward an additional sixty miles to Lake Mead at Boulder Dam, in Nevada. The area of service includes fast-growing communities such as Lake Havasu City, Kingman and Bullhead City in Arizona; Laughlin, Nevada.; and Needles, California. Installation is expected to begin in September 2006.

Alabama Power

Alabama Power Company, which supplies electricity to 1.3 million homes, businesses and industrial facilities, will install 3M ACCR to replace a key ten-mile (16-kilometer) line in northeastern Alabama. The change is being made because the existing conductor would be at capacity for certain contingencies resulting from the addition of new generation during summer peak loads, beginning in 2008. Installation of the ACCR is expected to begin in September 2006.

Appendix D: Response to the Commission's Consultation Questions

Only those questions for which 3M has a response are included below.

Q1: Do you consider there may be value in progressing at this stage a transmission corridor that would accommodate a range of overhead line technologies? Do you consider that such a corridor could be implemented under current legislation? If not, what changes do you consider would need to be made?

3M has no response to this question, except to note that Transpower's long-range plan includes a 400 kV core grid that would require new or expanded corridor. However, 3M's proposal can defer the need to procure new easements for the OTA-WKM A, B, and C lines for a significant amount of time, avoiding the disruption to the landowners and the community.

Q2: Do you agree that the Commission has adequately identified alternatives to Transpower's proposal?

3M believes that the draft decision does not sufficiently recognize or allow for advances in transmission technology that are currently proven and commercially available, and which may provide an effective alternative to some of the generation or transmission line/power pylon solutions that are under consideration by the Commission as outlined in the draft decision and may also complement the proposed 400 kV line additions.

3M acknowledges that a 400 kV double circuit line, backed by a strong underlying 220 kV system, addresses security and supply needs.. However, incorporating 3M ™ Aluminum Composite Conductor Reinforced (ACCR) could provide substantial economic savings and be less intrusive to both the community and the environment than other alternatives. Particularly it could avoid significant easement costs, delays and uncertainty well into the future.

In addition, 3M ACCR could provide a more robust and reliable system as part of Transpower's long-term vision of a 400 kV core grid.

Q3: Are you aware of any other information that the Commission should rely on to make its final decision?

3M has provided extensive information in these comments regarding options not previously considered and hopes the Commission will recommend a complete and detailed analysis of 3M ACCR as a fully viable alternative.

Q4: Do you agree with the Commission's application of the GRS?

GRS is considered to be met if:
4.1 the power system is reasonably expected to achieve a level of reliability at or above the level that would be achieved if all economic reliability investments were to be implemented [(**Economic Reliability Standard**)]; and

4.2 with all assets that are reasonably expected to be in service, the power system would remain in a satisfactory state during and following any single credible contingency event occurring on the core grid.[(**N-1 Safety Net**)]

While 3M agrees the Commission has applied this rule, the company also submits that its two scenarios, described in this proposal, will improve the reliability of the system assuming the N-1 safety net. The higher ratings of the A, B, and C lines achieved through reconductoring with

3M's ACCR allow for significant increase in the south-north path's N-1 and N-2 ratings, without resort to new line construction. Furthermore, if the Commission decides to proceed with the 400 kV line in the future, this approach could provide robust support for the expanding system under the worst case N-1 contingency, loss of one of the 400 kV circuits.

One argument for a new 220 or 400 kV line is improved security. One measure of security is the path rating at various contingencies. The Commission's standard is the N-1 contingency. 3M also considered the N-2 path rating.   For the IUP, the N-2 rating at the end of Stage 1 could be 2,000 MVA and 3,000 MVA at the end of Stage 2. 3M's Scenario 1 could provide 1,600 MVA at Stage 1, but up to 2,700 MVA at the end of Stage 2. In the IUP, the worst-case scenario is loss of the 400 kV line, but in 3M's scenario, the loss of a 220 kV line would be the worst case.

Q8: Do you agree with the Commission's treatment of forecast demand?

3M has no issue with the Commission's treatment of forecast demand and relied on that forecast for its own analysis.

Q12: Do you agree with the Commission's identification of option values?

3M has no issue with the Commission identification of option values and used its results when evaluating its own proposals.

Q13: Is the real option value of flexible investment timing justified? Should it be included in the reference case or as a sensitivity?

3M agrees that deferring investment has a real economic impact on both the utility making the investment and the consumers paying the electricity rates. In fact, a major benefit of 3M's proposal is the ability to defer investments by maximizing the use of existing transmission assets and by deferring the need to obtain easements and additional land.

Q18: Has the Commission adequately considered alternatives to the proposal in the application of the GIT?

Rule 13.3 states that:
(b) the Commission can ask Transpower to evaluate:
(i) alternative reliability investments;
(ii) transmission alternatives, where Transpower possesses relevant experience.

The standards for alternatives that could be considered include:
19.1 technically feasible;
19.2 reasonably practicable having regard to the matters set out in clauses 8.1 to 8.4;
*19.3 reasonably likely to proceed if neither the **proposed investment** nor any other **alternative project** proceeds and unlikely to proceed if the **proposed investment** does proceed;*
*19.4 reasonably expected to provide similar benefits, in type but not necessarily in magnitude, to relevant nodes, as the **proposed investment**; and*
*19.5 reasonably expected to enable the deferment of investment of the type contemplated by the **proposed investment** for a period of 12 months or more."*

3M believes the scenarios described in these comments meet those standards and requests the Commission to ask Transpower to evaluate it as a fully viable alternative.

Q19: Do you agree with the Commission's evaluation framework?

In general, 3M has no issue with the evaluation framework. However, 3M believes it possible that the Commission was not fully aware that 3M ACCR technology meets all the screening criteria and should, therefore, have been included on the Short-Short List of alternatives. Specifically:

a. *The type and nature of the technology involved*—3M ACCR has an extensive history of testing and commercial installations that demonstrate its effectiveness in transmission applications similar to the Auckland transmission system. It is a transmission option that uses existing transmission infrastructure and clearly resolves the thermal loading, voltage stability, and dynamic stability issues.

b. *The geographic location of the alternative in relation to possible transmission constraints into the Auckland region from the south*—Because 3M ACCR can be dropped in to the existing infrastructure and corridor, the geographic location criterion is met.

c. *The scale of the alternative, and its potential contribution to meeting forecast electricity demand in the Auckland and Northland regions (or in reducing the level of that demand)*—3M ACCR not only resolves the needs through 2021, but provides a more robust level of reliability during that time period and, ultimately, beyond the point where the system needs to be expanded by building the 400 kV double circuit line.

d. *The availability of the alternative over the assessment horizon*—The alternative is available now, and the first stage could be operational as early as 2007, well ahead of other alternatives.

e. *The likelihood that the alternative would proceed*—3M and its partners provide support and assistance throughout all phases of the project. The technology has been successfully installed and operated numerous times.

Q20: Do you agree that if either the Proposal or one of the Alternative Projects were build, there would be a reliable supply of electricity to Auckland for the foreseeable future? If not, why not?

3M does not dispute these alternatives as effective; however, 3M's scenarios could significantly improve the robust nature of the system, providing equivalent or superior path ratings at lower costs than the Incremental Upgrade Package or the other alternative projects.

Q23: Do you agree with the Commission's calculation of costs to be included in the application of the GIT?

3M has no issues with these costs and used this analysis as the basis for its own comparisons.

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