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30 August 2019

Dane Gunnell, Manager - Price-quality regulation
Commerce Commission 44 The Terrace
Wellington

Dear Dane

Application for Amendment of Outputs for the approved Bunnythorpe - Haywards A and B lines major capex project

In May 2014 the Commerce Commission approved our major capex project (MCP) proposal to reconductor and upgrade the capacity of transmission lines A and B between our Bunnythorpe substation near Palmerston North and Haywards substation in Wellington. As part of its decision, the Commerce Commission specified certain MCP outputs the project needed to deliver, including replacing the existing conductor with a Zebra AC SR conductor.

We are applying to amend the MCP output relating to the Zebra ACSR conductor. We intend to mitigate anticipated noise levels from the Zebra ACSR conductor during wet conditions by using a trapezoidal Curlew ACSR conductor instead on selected segments of the Waikanae and Horowhenua sections of the BPE-HAY A and B lines.

As well as improved noise perfonnance, the Curlew ACSR conductor has similar properties to the currently-specified Zebra ACSR conductor and would deliver similar or superior electricity market benefits.

We expect the incremental project costs of using the Curlew conductor to be approximately $800k, increasing the total expected costs to complete the BPE-HAY A and B lines project from $82.7 million to $83.5 million. Our intention is to undertake the remaining work in October and November this year.

Enclosed with this letter are:

- an application summary;
- the supporting information required in accordance with the Transpower Capex IM; and
- the Transpower Chief Executive's certificate required under the Transpower Capex IM.

Please let me know if you have any questions.

Yours sincerely

Stephen J nes Jor Strategic Asset Manager

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Attachment: Application summary

Our proposal

We propose to amend the MCP outputs the Commerce Commission specified in its 2014 BPE-HAY Lines A and B MCP decision by adding the following MCP outputs to those already specified:

- Procuring, installing and commissioning Curlew ACSR conductor on selected segments of the Waikanae and Horowhenua sections of the BPE - HAY A and B lines remaining to be reconductored as at August 2019, and decommissioning the existing conductor.
- Works on the foundations and towers for the spans on which the Curlew ACSR conductor is installed.

Bunnythorpe - Haywards A and B lines MCP

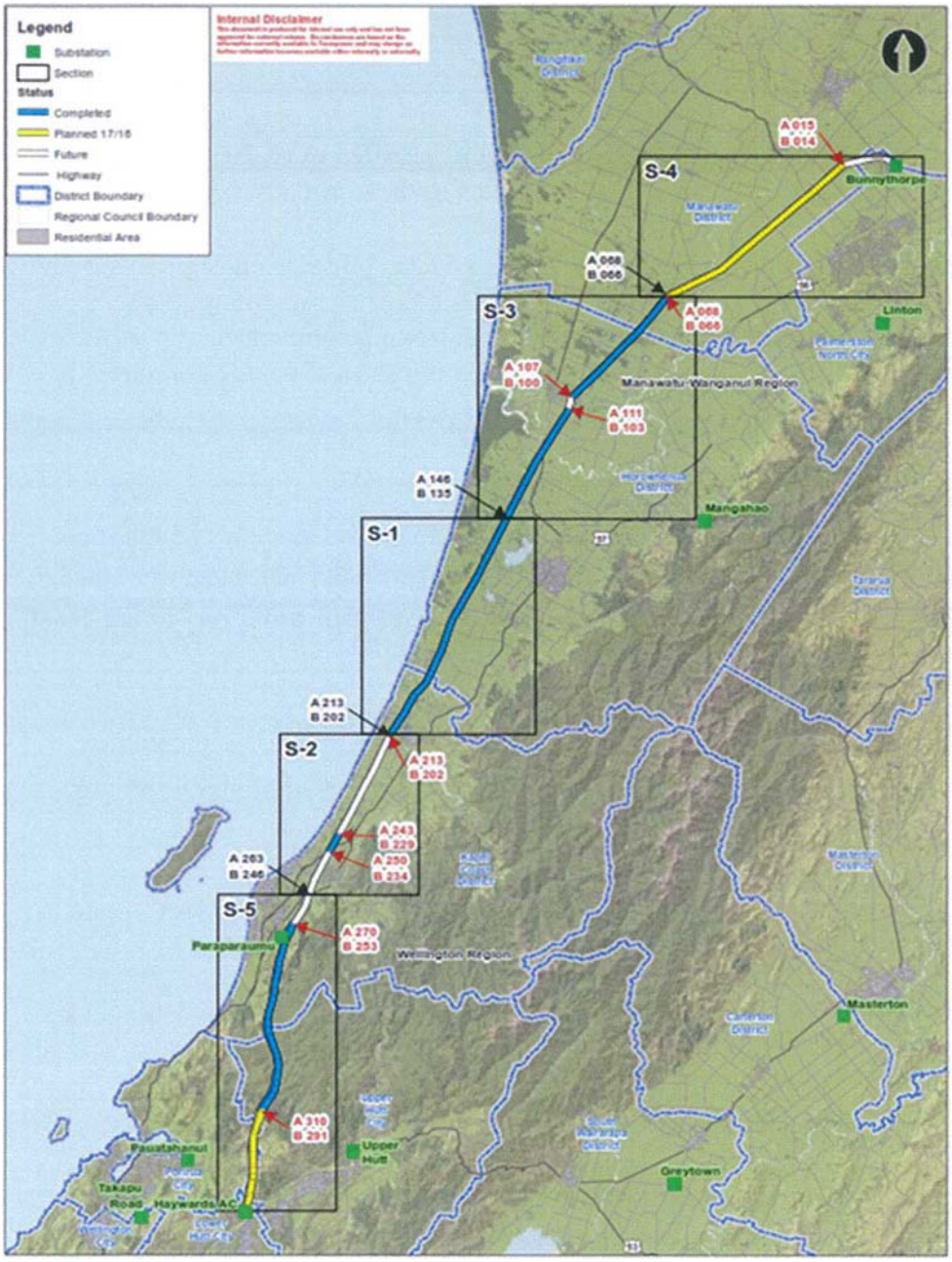
The BPE - HAY A and B 220kV lines are two "flat top" lattice steel tower lines, each 118 km long. These lines were commissioned in the 1950s, reconductored in the early 1980s, and underwent major conductor repairs in 2007. Both lines have high levels of corrosion due to their proximity to the coast, and high wear from wind induced vibration.

The Commerce Commission approved the project as an MCP, approving up to $161m to complete reconductoring of the Bunnythorpe - Haywards A and B lines by 2020 and specified the following MCP outputs:[1]

- Procuring, installing and commissioning Zebra ACSR conductor on the BPE - HAY A and B lines and decommissioning the existing conductor.
- Works on the foundations and 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 perfonnance in coastal climatic conditions.

We have completed about 97% of the project to date, covering Sections 1 and 5, and most of Sections 3 and 4 (see below map). We expect the remaining section (Section 2) over the Waikanae and Horowhenua areas to be reconductored this year.

[1] Commerce Commission "Decision on Transpower's Bumiythorpe-Haywards Lines A and B major capex proposal", 9 May 2014, page 19.



Our current total expected costs of $83.5 million are below the approved allowance, mainly due to scope reduction through design refinements, delivery efficiencies due to design efforts, and productivity efficiencies. We have not drawn down any of the contingency to date and incurred lower interest costs during construction than anticipated.

Selection of Zebra ACSR conductor based on information at the time

At the time we made our BPE-HAY A and B lines MCP application to the Commerce Commission, we had predicted noise levels for all conductor types we had identified as potentially suitable (from an operational perspective) for the project, including the existing Goat conductor. Due to a larger conductor size, we concluded all alternative conductor options would be less noisy than a Goat

conductor, which has the smallest diameter of the options we considered. Taking that into account, we identified Zebra ACSR as our preferred conductor.

However, we have discovered during installation that a new Zebra conductor on a simplex circuit, such as installed on the BPE-HAY A and B lines project, can produce audible noise levels during wet conditions higher than an existing aged conductor, with a tonal element (hum).[2]

The tonal element is relevant as it is more likely to be discernible to people living under or near a transmission line.

As a responsible operator, and to comply with the requirements of the Resource Management Act 1991, we wish to ensure any adverse noise effects of the BPE-HAY A and B lines project are mitigated, particularly in residential areas.

We investigated options to reduce noise

We have undertaken considerable research to understand and seek to mitigate potential noise issues associated with the proposed Zebra ACSR conductor.

The high-level options we considered were overhead reconductoring with either simplex or duplex conductors, or undergrounding the lines. Our analysis focused on identifying feasible overhead reconductoring options using simplex conductors because:

- while reconductoring with a duplex conductor may produce less noise, completing the project within the remaining expected life of the current conductor would be unlikely to be achieved because we would have to go through a lengthy process of acquiring further property rights; and
- undergrounding the lines in the affected areas would add significant cost to the project and would also require the acquisition of relevant property rights, particularly if the route selection altered to accommodate the undergrounding of lines.[3]

As both options, duplexing and undergrounding, would likely require approval through a separate MCP process or at least a significant amendment to the current approved MCP, we would not expect to be finished in time for the lines to be replaced before the existing conductors reach their anticipated end of life.

Our investigations of reconductoring options using simplex conductors included a literature review of available research, discussions with international industry experts and other utilities, discussions with manufacturers and research institutes, laboratory testing, field testing, and noise monitoring.
We undertook multiple rounds of laboratory tests between May 2016 and April 2019 to understand the cause of the noise of the untreated Zebra ACSR, and decide what treatments to apply to the conductor to reduce noise prior to field testing.

[2] We use the term "audible noise" to distinguish these noise levels from the tonal noise levels.
[3] In its MCP decision, the Commerce Commission came to the same conclusion when it ruled out undergrounding the lines on the basis of significantly higher costs. Commerce Commission "Decision on Transpower's Bunnythorpe-Haywards Lines A and B major capex proposal", 9 May 2014, page 57.

Initially, our testing focussed on changing the specifications for the Zebra ACSR conductor. By reducing the outer grease layer, using a more emulsifying die oil, washing the conductor after manufacture, and then light-blasting the conductor, it was possible to emulate an aged surface. We refer to the Zebra ACSR after these treatments as treated and blasted, or treated and unblasted, Zebra ACSR.

During our investigations we discovered the Curlew ACSR conductor. Its trapezoidal construction could exhibit improved audible noise characteristics and we carried out laboratory tests and field tests to better understand these.

Our investigation results

While the Curlew ACSR conductor has not been strung in the field long enough to fully understand long-term trends, our investigations show the following results:

- The untreated Zebra ACSR conductor performs poorly compared to the other options, but improves over time. However, after 3.5 years of stringing, it remains above the preferred night time noise limits in the Kapiti Coast Proposed District Plan.
- Treated Zebra ACSR conductor performs better than untreated Zebra ACSR conductor, although the results are variable. Treated and blasted Zebra ACSR conductor showed a low variability over time, and stayed above the night time noise limits in the District Plan after one year. Treated and unblasted Zebra conductor results have been variable. Most samples stay just above the night time noise limits in the District Plan after one year.
- Curlew ACSR conductor shows a marginally higher noise level when initially strung than treated and unblasted Zebra ACSR conductor, but noise levels have dropped off more quickly and consistently with design expectations. At the time of writing this application, noise levels were slightly above the nominal limits in the District Plan, but trending downwards. Tonality levels had also decreased.

Cost and electricity market benefit implications

The differences in cost and electricity market benefits between using a Zebra ACSR or a Curlew ACSR conductor on selected segments of the remaining sections of the BPE - HAY project are insignificant.

Generally, the trapezoidal ACSR Curlew conductor has superior properties due to its greater aluminium cross-sectional area. As the below photo shows, for the same overall diameter there are less voids in the conductor makeup as the stranding is much tighter than round wire. As a result, there is less resistance and better capacity.

Stranded ACSR Zebra conductor (left) and trapezoidal ACSR Curlew conductor (right)

However, as roughly 90% of the BPE - HAY A and B lines have already been reconductored with Zebra ACSR, any capacity benefits associated with Curlew could not be realised until the entire lines are upgraded to provide the same capacity at least.

We have not calculated lower electricity losses taking into account Curlew's lower resistance yet. We expect any potential loss benefits would be small, however, and would be at least partially offset by some of the incremental costs (estimated to be approximately $800k).

Our conclusions

It is our intention to reconductor selected segments of the remaining Waikanae and Horowhenua sections of the BPE - HAY A and B lines with Curlew ACSR conductor. Reconductoring of these sections is expected to commence in October this year. We consider reconductoring with Curlew ACSR preferable to using treated Zebra ACSR conductor because:

- noise levels for the Curlew ACSR conductor dropped quickly after stringing compared to the treated Zebra ACSR, and with less volatility;
- the Curlew ACSR conductor does not require any further treatment before being strung, whereas treating the Zebra ACSR conductor requires manual intervention (e.g. washing and blasting). The variability in the performance of treated Zebra ACSR conductor we have seen could be due to these interventions which leave room for human error; and
- there would be no reduction in capacity. The electricity market benefits we used for Zebra in the investment test we included in our MCP application would be unaffected or may slightly improve due to lower electrical losses.

Attachment: Supporting information for application for amendment of Major Capex Project outputs for the BPE-HAY A and B lines reconductoring project

This is an application for amendment of the approved major capex project outputs for the investment proposal. The amendment is sought pursuant to the Commission's powers under clause 3.3.6(l)(c) of the Capex IM. No other amendments pursuant to clause 3.3.6(1) of the Capex IM are sought under this application.

All clause references in the remainder of this attachment are to clauses of the Capex IM.

This application is made in respect of the major capex project outputs of the 2014 approved Bunnythorpe - Haywards Lines A and B major capex proposal, paragraph 2.8.

We are proposing to add the following major capex project outputs:

i. Procuring, installing and commissioning Curlew ACSR conductor on selected segments of the Waikanae and Horowhenua sections of the BPE - HAY A and B lines remaining to be reconductored as at August 2019, and decommissioning the existing conductor; and
ii. Works on the foundations and towers for the spans on which the Curlew ACSR conductor is installed.

Compliance with clause 7.4.2

As required by clause 3.3.6(2)(a), this application complies with the requirements of clause 7.4.2:

(1) An application under clause 3.3.6(1)(a) to 3.3.6(l)(c) must be received by the Commission by the date on which Transpower provides its annual compliance statement to the Commission for the disclosure year in which the commissioning date or completion date of the approved major capex project in question occurs.

This major capex project is expected to be completed and commissioned in 2020. We consider this application has therefore been made within the required timeframe.

(3) (b) An Application under clause 3.3.6(1)(c) must contain the information specified in Schedule H Division 2;

The required infonnation is set out in this attachment. A comprehensive summary is included with this application. We have restricted the information to the major capex project outputs we are seeking to add. Other infonnation about the wider major capex project is not considered relevant.

(4) An application under clause 3.3.6 must contain the certificates specified in clause 9.3.1.

The required certificate is attached to this application.

Schedule H Division 2 information

H7 Information to be provided

For the purpose of clause 7.4.2(3)(b), the amendment application must include the information listed or described in this division.

In this attachment we provide the required infonnation.

H8 Project identification and specifications

identification of relevant approved major capex project and its approved major capex project outputs;

The relevant approved major capex project is the Bunnythorpe - Haywards Lines A and B major capex proposal. The approved major capex outputs are:

- Procuring, installing and commissioning Zebra ACSR conductor on the BPE - HAY A and B lines and decommissioning the existing conductor.
- Works on the foundations and 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.

H9 Amendment sought

(1) proposed amendments to the approved major capex project outputs;

We are proposing to add the following major capex outputs:

i. Procuring, installing and commissioning Curlew ACSR conductor on selected segments of the Waikanae and Horowhenua sections of the BPE - HAY A and B lines remaining to be reconductored as at August 2019, and decommissioning the existing conductor; and

ii. Works on the foundations and towers for the spans on which the Curlew ACSR conductor is installed.

(2) explanation as to how each proposed amendment was arrived at,

We intend to mitigate noise levels produced by the Zebra ACSR conductor on selected segments of the Waikanae and Horowhenua sections of the BPE-HAY A and B lines by changing the conductor type from a stranded Zebra ACSR conductor to a trapezoidal Curlew ACSR conductor.

The foundations and towers affected by the change to the Curlew ACSR conductor will require some works for the Curlew ACSR conductor to be strung.

More information about how we arrived at the proposal to use the Curlew ACSR conductor is provided in the application summary.

(3) description of the extent to which each proposed amendment reflects a change to the-
(a) assets to be commissioned',

Selected segments of the remaining sections of the BPE-HAY A and B lines will be

reconductored using a Curlew ACSR conductor instead of the Zebra ACSR conductor. The foundations and towers affected will be modified, where required, for the Curlew ACSR conductor to be strung.

(b) functional capability of the grid;

The change in conductor for selected segments of the remaining sections of the BPE - HAY A and B lines project will not have an adverse impact on the functional capability of the grid (see our comments to H9(3)(c))

(c) quantum of electricity market benefit or cost elements directly related to the supply of electricity transmission services that are likely to be achieved as a result of undertaking the project',

The differences in cost and electricity market benefits between using Zebra ACSR and Curlew ACSR conductor on selected segments of the remaining sections of the BPE - HAY A and B lines project are insignificant.

The Curlew ACSR conductor is a trapezoidal conductor with a greater aluminium cross-sectional area. As a result, there is less resistance and better capacity.

However, because roughly 90% of the BPE - HAY A and B lines have already been reconductored with Zebra, there will not be any capacity benefits associated with using the Curlew ACRS conductor unless the entire lines are upgraded to provide at least the same capacity. This is very unlikely to happen until the next reconductoring of the lines.

We have not calculated reduced electricity losses due to the Curlew ACSR conductor's lower resistance yet, although we expect any potential loss benefits to be small. We expect any such benefits to be at least partially offset by the incremental cost of the Curlew ACSR conductor (estimated to be approximately $800k).

(d) in the case of a non-transmission solution, description of the extent to which each proposed amendment reflects a change to any relevant service provided by a third party,

Not applicable

H10 Progress of project

description of progress made on the approved major capex project, including as applicable details of-

(a) planning processes undertaken',

The project is being implemented using our standard project delivery procedures and processes and project specific management plans for all phases of the works.

lb) resource management consents, other regulatory consents, and property rights and access rights obtained;

The project has been designed and implemented compliant with all current environmental and property legislation.

(c) construction and labour contracts and arrangements made;

All contracts are being executed in accordance with our standard project delivery procedures and processes.

(d) construction completed;

We have completed approximately 97% of the project overall, delivering the grid outputs specified in the Commerce Commission's MCP decision and including 90% of the reconductoring works. We expect the remaining sections over the Waikanae and Horowhenua areas to be reconductored in 2019.

(e) testing undertaken;

Testing has been carried out under our standard asset commissioning procedures and processes for the works completed, full commissioning of the final upgraded lines will be carried out once the remainder of the conductor is installed.

Hll Current and forecast expenditure

(1) in the case of a transmission investment:

(a) major capex incurred',

$73 million.

(b) forecast remaining major capex;

$10.5 million.

(2) in the case of a non-transmission solution:

(a) total costs incurred proposed to be classified as recoverable costs;

Not applicable

(b) total costs incurred in relation to assets to be commissioned in relation to the non-transmission solution;

Not applicable

(c) forecast remaining costs proposed to be classified as recoverable costs;

Not applicable

(d) forecast remaining costs incurred in relation to assets to be commissioned in relation to the non-transmission solution.

Not applicable

H12 Reasons for making the application

(1) reason for applying, including

(a) description of key factors leading to the application;

The key factor leading to this application is a desire to mitigate conductor noise on the Waikanae and Horowhenua sections of the BPE-HAY A and B lines.

More information is provided in the application summary.

(b) commentary on the extent to which each key factor is within Transpower's control and actions taken to mitigate it;

We have carried out considerable research and investigation into various options to reduce conductor noise. We have identified reconductoring selected segments of the remaining sections with Curlew ACSR conductor as our preferred option to complete the project within the timeframe provided in the Commission's MCP decision.[4]

More information is provided in the application summary.

(c) commentary on the extent to which each key factor was reasonably foreseeable by Transpower before approval of the relevant approved major capex project;

At the time we made our BPE-HAY A and B lines MCP application to the Commerce Commission, we had predicted noise levels for all conductor types we had identified as potentially suitable (from an operational perspective) for the project, including the existing Goat conductor. Due to a larger conductor size, we concluded all alternative conductor options would be less noisy than a Goat conductor, which has the smallest diameter of the options we considered. Taking that into account, we identified Zebra ACSR as our preferred conductor.

(2) description and, where relevant, quantum of any current key assumptions different to those relied upon in applying the investment test in the major capex proposal;

Refer to our response to H9(3)(c). The differences in cost and electricity market benefits between using Zebra ACSR and Curlew ACSR conductor on selected segments of the remaining sections of the BPE - HAY A and B lines project are insignificant.

(3) description of the outcome of applying the investment test as it was applied in the major capex proposal modified by the proposed amendments and key assumptions described in subclause (2), including all relevant calculations and justifications for any exercises ofjudgment;

We did not consider it necessary to apply the investment test again. Consistent with our assessment of unchanged or very similar input assumptions to those relied upon in applying the investment test in the

[4] Commerce Commission "Decision on Transpower's Bunnythorpe-Haywards Lines A and B major capex proposal", 9 May 2014, page 20.

major capex proposal, the outcome of applying the investment test again would be unchanged or very similar.

(4) explanation as to why making the proposed amendment would promote the long-term benefit of consumers taking account of-

(a) the outcome referred to in subclause (3);

Refer to our response to subclause (3). The proposed output amendment continues to support the solution specified in the Commerce Commission's MCP decision because the solution continues to maximise net benefits for electricity market participants amongst the solutions we considered. The proposal to use Curlew ACSR on selected segments of the remaining sections of the BPE - HAY A and B lines continues to maximise benefits because neither the costs nor the electricity market benefits change significantly as a result of the proposal. Refer to our response to H9(3)(c).

(b) any costs that are sunk;

The proposed output amendment is independent from the project costs we have incurred so far.

(c) the context in which the major capex proposal was made;

One main driver of our November 2013 major capex proposal to the Commerce Commission was to reconductor the lines by 2020. Going beyond this date would be an unacceptable safety exposure to the public given the lines' accelerated deterioration due to the harsh coastal climatic conditions.

We made this output amendment application recognising the ongoing need for replacement.

Whilst our ongoing monitoring of the lines indicates the remaining sections we have not reconductored yet could be safely operated for a few more years beyond 2020, a key consideration for us in identifying a preferred solution was the need to meet the 2020 commissioning date in the Commission's decision on the project.[7]

(d) the context in which any subsequent amendments to the approval were made by the Commission;

There have not been any subsequent amendments.

(5) where no application for amendment to the maximum recoverable costs, is being made concurrently, an explanation as to why those costs will remain appropriate were the proposed amendment to approved major capex project outputs made;

No amendment to the maximum recoverable costs is required.

(6) an explanation as to the appropriate major capex allowance if the proposed amendment to the approved major capex project outputs were made.

Not applicable.

[5] Commerce Commission "Decision on Transpower's Bunnythorpe-Haywards Lines A and B major capex proposal", 9 May 2014, page 20.

T R A N S P O W E R

Attachment: Chief Executive Certification

Chief Executive Officer's Certification under Clause 9.3.1 of the Transpower Capital Expenditure Input Methodology Determination 2012 (Capex IM)

I, David Michael Knight, acting Chief Executive Officer of Transpower New Zealand Limited **(Transpower)** hereby certify, in relation to all information provided in accordance with Schedule H of the Capex IM **(Information)** with respect to Transpower's *Application for Amendment of Outputs for the approved Bunnythorpe - Haywards A and B lines major capex project* **(Application),** that having made all reasonable enquires, it is my belief that:

(a) the Information was derived from and accurately represents, in all material respects, the operations of Transpower; and

(b) all parts of the major capex project to which the Information relates have been approved in accordance with the applicable requirements of Transpower's director and management approval policies; and

(c) the Application complies, in all material respects, with the requirements of clause 7.4.2 of the Capex IM.

DATED: ;

ivid Michael Knight