

GEOFF BROWN & ASSOCIATES LTD

**REVIEW OF FORECAST CAPITAL EXPENDITURE:
SECOND REGULATORY PERIOD**

**Tarlac Electric Incorporated
(TEI)**

ADDENDUM

Prepared for

ENERGY REGULATORY COMMISSION

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EXECUTIVE SUMMARY

We recommend the following adjustments to the forecast capital expenditure (CAPEX) allowed in the Draft Determination.

Recommended CAPEX Adjustments (PhP million, real 2009)

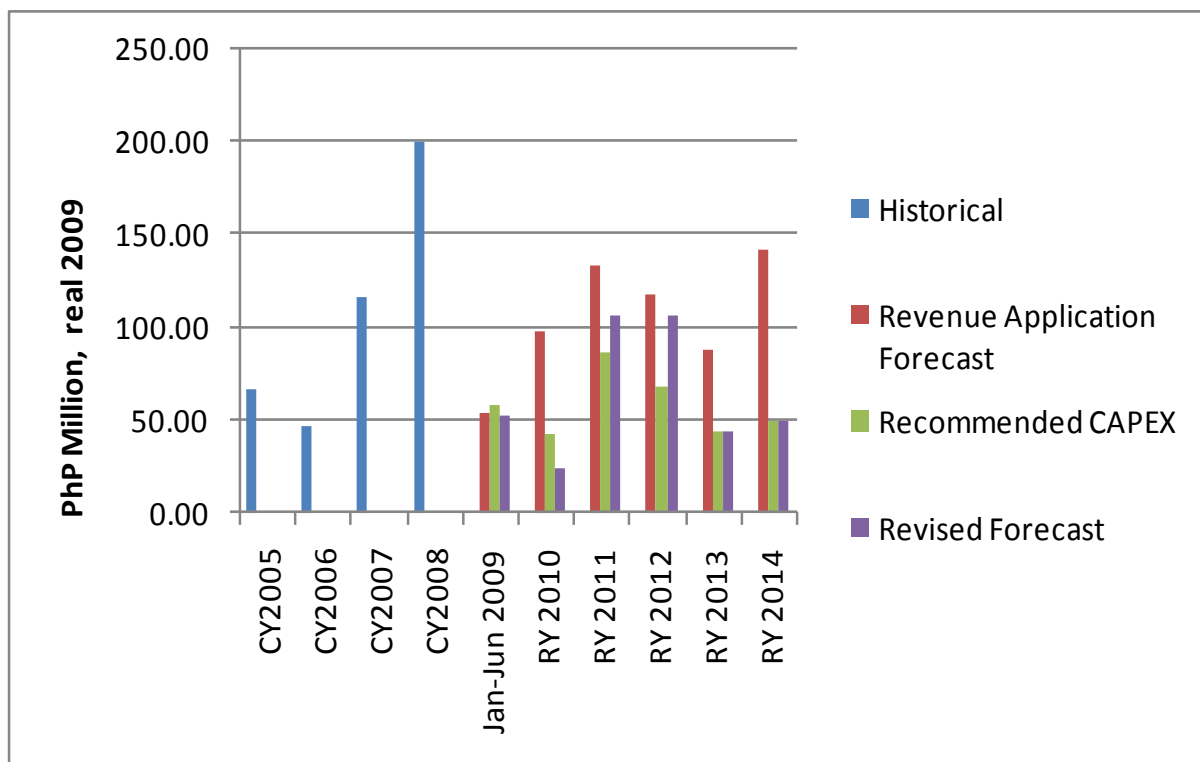
	Jan-Jun 2009	RY 2010	RY 2011	RY 2012	RY 2013	RY 2014	Total (RY 2011-14)
TEI Revenue Application	54.28	97.59	133.17	117.80	88.19	141.72	480.88
Draft Determination	57.60	43.02	86.69	67.50	44.01	49.87	248.07
Adjustments – Major Projects							
Adjustment for the use of larger conductor on San Rafael-Luisita 69 kV line	2.00						
Deferred reinstatement of TCP and San Rafael substation projects	(7.00)	(18.73)	20.00	38.73			
Revised Recommendation	52.60	24.29	106.69	106.23	44.01	49.87	306.80

Note 1: CAPEX Report, Table 6.1; Draft Determination Table 4.2.

The recommended adjustments allow for the use of larger conductor on the san Rafael-Luisita 69 kV line, and the reinstatement of the TPC and San Rafael projects, with some minor adjustments to the projects' scope and timing.

The impact of this adjustment on the allowed capex is shown in the figure below.

Impact of Recommended CAPEX Adjustments (PhP million, real 2009)



1. INTRODUCTION

The Energy Regulatory Commission (ERC) has promulgated a performance-based form of regulation (PBR) for regulated investor owned electricity distribution utilities in the Philippines. Under the PBR framework, a regulated entity will be subject to a price cap for the delivery of distribution wheeling services. The reset process for the setting of the price cap for the six (6) regulated entities entering PBR at the third entry point is currently underway. This process will result in the setting of a maximum price path that will determine the maximum average price a regulated entity can charge for each year of the Second Regulatory Period (which commences on 1 July 2010 and ends on 30 June 2014).

The mechanism for the calculation of the price cap and the procedure and timelines for the introduction of this cap, are described in the Rules for Setting the Distribution Wheeling Rate (RDWR), which was released by the ERC on December 8 2008¹. The ERC has also formulated its position on the reset process – as set out in a Position Paper, also dated December 8 2008².

An important requirement of the reset process going forward is the review of the CAPEX forecasts submitted by the regulated entities as part of the rate-setting process under PBR. The required CAPEX is critical to the determination of the revenue to which regulated entities are entitled and on which the price caps will be based.

The RDWR require that the CAPEX forecast provided by a regulated entity be reviewed by a Regulatory Reset Expert as part of the PBR regulatory reset process. Geoff Brown & Associates Ltd (GBA) has been engaged by the ERC to review the capital expenditure (CAPEX) forecasts of the six (6) regulated entities (including TEI) that will be entering PBR at the third entry point.

TEI submitted a PBR revenue application to ERC on June 15 2009³ (Revenue Application). GBA submitted its final report on its review of the CAPEX forecast included in TEI's Revenue Application on November 26 2009⁴ (CAPEX Report). ERC publicly released its draft determination on the Revenue Application on November 25 2009⁵ (Draft Determination). Following the release of the Draft Determination, ERC held a Public Consultation in San Juan, La Union on January 27 2010. At the public consultation TEI raised a number of issues in respect of the Draft Determination and was required by the ERC to subsequently provide additional information to support its position. GBA was present at the public consultation and has now reviewed the additional information supplied by TEI insofar as this information relates to the CAPEX forecast. In this Addendum to the CAPEX Report we document our review of the issues raised and, where appropriate, modify the recommendations in the CAPEX Report on TEI's reasonable CAPEX requirements for the second regulatory period.

In undertaking this review we have relied on the accuracy of the information provided to the ERC by CELCOR. We cannot be held responsible for any conclusions based on misleading or inaccurate information provided to us.

¹ *Rules for Setting Distribution Wheeling Rates (RDWR) for Privately Owned Distribution Utilities Entering Performance Based Regulation (Third Entry Point)*, Energy Regulatory Commission, December 8 2008.

² *Regulatory Reset for the July 2010 to June 2014 Regulatory Period Privately Owned Distribution Utilities subject to Performance Based Regulation, Position Paper*, Energy Regulatory Commission, December 8 2008.

³ ERC Case No 2009-042RC

⁴ *Review of Forecast Capital Expenditure for the Second Regulatory Period, Tarlac Electric Incorporated (TEI)*, Geoff Brown & Associates Ltd, November 26 2009.

⁵ *Regulatory Reset for Tarlac Electric Incorporated (TEI) July 2010 to June 2014 (Second Regulatory Period) Draft Determination*, Energy Regulatory Commission, November 9 2009.

The issues that were discussed at the public consultation are summarized in Appendix A. Only those issues that could have a material impact on the forecast CAPEX approved in the Draft Determination are discussed in detail in the body of this Addendum.

2. ANALYSIS

2.1 LINE CONDUCTOR SIZE

2.1.1 Background

In the CAPEX report we recommended that the forecast cost of the San Rafael-Luisita 69 kV line be reduced by PhP 2.00 million as we considered that the forecast load could be met with the use of 336.4 MCM conductor rather than the 795 MCM conductor proposed by TEI. The project was commissioned in Jan-Jun 2009

In response TEI submitted that the larger conductor size could be justified by the savings in the cost of losses and submitted a loss analysis in support of this argument.

2.1.2 Analysis

We have reviewed the loss analysis provided by TEI and comment as follows.

- TEI has used its SynerGEE load flow analysis package to calculate the difference in total peak losses, assuming all 69 kV lines are in service, if 795 MCM conductor was used in place of 336.4 MCM conductor. The analysis assumes a 2011 peak demand of 50.5 MVA, which is generally consistent with the peak demand assumed in the CAPEX report if the 69 kV load of the CAT sugar mill is added back and indicates that the larger conductor will reduce the peak losses on the 69 kV sutransmission network in 2011 by 196 kW.
- TEI has then annualized these losses, based on the assumption that the ratio of average losses to peak losses is equal to the load factor, which it assumes to be 0.6. The assumed load factor is consistent with the load forecast used in the CAPEX report and we accept this as reasonable. However, we do not agree that the load factor is the appropriate measure of the ratio of average to peak losses as the ratio of losses to load is not linear⁶.

The correct ratio is the loss factor, which can be approximated by the following function⁷:

$$F_{\text{loss}} = 0.15F_{\text{load}} + 0.85F_{\text{load}}^2$$

Where:

$$F_{\text{loss}} = \text{Loss Factor}$$

$$F_{\text{load}} = \text{Load Factor}$$

On this basis, if a load factor of 0.6 is assumed, the loss factor would be approximately 0.4. Hence whereas TEI calculates the annualized the savings in losses in 2011 to be 860 MWh, we estimate the savings to be about 581 MWh.

2.1.3 Conclusion and Recommendation

Using our assumed annual losses, if the cost of losses is taken to be PhP4.00 per kWh, which is a reasonable assumption given current the cost of electrical energy in Luzon, then the savings in the cost of losses over a single year would be PhP 2.32 million, which is more than our recommended PhP 2.00 million reduction. This would indicate that the

⁶ Losses increase in proportion of the square of the load.

⁷ T A Short, *Electric Power Distribution Handbook*; CRC Press LLC, 2004; Section 5.6.

use of the larger conductor is economically justified and we therefore recommend that the reduction of PhP 2.0 million in the cost of this project be reinstated.

2.2 SAN RAFAEL SUBSTATION – TPC TRANSFORMER REPLACEMENT

2.2.1 Background

In this report we consider these two projects together since they are interrelated from a network planning perspective.

In its CAPEX forecast TEI proposed to replace the existing star-delta 15/20 MVA transformer at the TPC power station with a new star-star unit so that the power station could inject power into its 69 kV subtransmission network when the transformer at the NGCP supply point is not available. It then proposed to use the existing TPC substation transformer to supply a proposed new substation at San Rafael.

In our CAPEX report, we concluded, on the basis of a high level analysis of installed power transformer capacity, that the San Rafael substation was not required by the end of the second regulatory period. Therefore we proposed that TEI install a 5 MVA zigzag transformer on the 69 kV side of the TPC substation in order to provide the earth reference that is needed before the TCP power station can inject power into the 69 kV subtransmission system when there is no supply from NGCP. This would allow the existing transformer at TPC to be retained in its current location. As a result of this lower cost approach, we recommended CAPEX reductions totalling PhP 40.32 million for the two projects.

In its submissions on the Draft Determination, TEI provided a number of reasons why the two projects should proceed as currently designed and programmed. These are summarized in Appendix A. In particular, while TEI acknowledged that there appears to be sufficient power transformer capacity without the San Rafael substation, based on a top down analysis of power transformer requirements, it argued that not all substation spare capacity could be transferred to other substations due to line constraints, and it provided some analysis that purported to demonstrate this. It also stated that construction of the San Rafael substation would result in an improvement in the voltage regulation in the area since primary lines would be shortened and there would be savings on the line loss in the area.

2.2.2 Analysis

We think the first issue to be addressed in reviewing the need for these projects is whether the San Rafael substation is required during the second regulatory period or whether it can be deferred.

We have reviewed the additional information and analysis provided by TEI and concluded that:

- While TEI currently has four 69/13.8 kV substations, just two of these (Luisita Industrial Park (LIP) and Panganiban supply the bulk of the load. The Panganiban substation is located close to the city proper while the LIP substation is located in Luisita industrial area. There appears to have been significant strip commercial development along the main road between these two substations, which now supply this load from either end.
- The number of 13.8 kV feeders that can supply this load is limited, since all development is close to the main road.
- Given the existing distribution network arrangement, the feeders that supply this load are will be loaded at between about five (5) and seven (7) MVA under normal operating conditions in 2014. While we would consider this reasonable if

the feeder backbones were constructed with heavy duty 336.4 MCM conductor (rated at 12.3 MVA) throughout their length, much of the network is still constructed of 4/0 (8.1 MVA rating) or 2/0 (6.5 MVA rating). Hence the amount of load that can be transferred between the two substations is limited.

It would seem that, in order to maintain a reasonable level of network security, TEI will need to augment this part of the network before the end of the second regulatory period. This augmentation could either be the construction of an additional substation in a strategic location or the upgrading of parts of its 13.8 kV distribution network to use heavy duty 336.4 MCM conductor. TEI has chosen the first of these solutions partly we suspect because it sees that the installation of a new transformer at TPC substation and the relocation of the existing transformer to the new San Rafael substation to be a cost effective solution to two problems.

Of the two options, we think the 13.8 kV conductor upgrades is likely to have the lower capital cost. However it has disadvantages. It will not increase the number of feeders so will have a lower impact on the inherent system reliability⁸. We also think that the construction of an additional substation will have a longer term impact.

We also note that while the installation of a zigzag transformer at the TPC substation is cost effective and technically feasible, it will also require the installation of new electronic protection relays. The protection design is more complex and the arrangement will be more difficult to TEI to design, install and maintain.

We also suggested that TEI investigate the modification of the existing TPC transformer to a star-star configuration and TEI has consulted with a transformer manufacturer about this. The local transformer manufacturer (Philelec) has advised that, while it could be done, the modification would not be straightforward and would involve derating the existing unit. While we have some reservations about this advice, we have not pursued the matter further.

2.2.3 Conclusion and Recommendation

On the basis of the above analysis, we recommend that both the replacement of the existing TPC transformer and the construction of the San Rafael substation be allowed to proceed. However we recommend the following adjustments to the forecast cost of these projects submitted in the TEI revenue application.

- The advice we received from Asian Appraisal was that TEI's forecast cost replacing the existing TPC transformer with a new one was excessive and a cost of PhP 23.4 million was more reasonable. We also note that the TPC power station comprises three (3) generators, each rated at 6 MW. However the TPC power station 13.8 kV bus also supplied two (2) distribution feeders with a total peak demand of around 5.5 MVA in 2009. We think a new 15 MVA transformer at the TPC substation will suffice, given that, if the power station is generating then the load on the locally connected feeders will not pass through the transformers⁹. On this basis we think an estimated project cost of PhP 20.00 million is reasonable.

⁸ We would expect some improvement in reliability in that the upgrades would require a rehabilitation of the existing assets, which would reduce the number of faults. However our experience is that one of the more effective ways of increasing reliability is to reduce the number of customers affected by each incident. This generally requires an increase in the number of feeders.

⁹ It could be argued that when an NGCP supply is not available, the load through the transformer could marginally exceed 15 MVA, if the local load was considered low priority and was shed as part of the load rationing exercise. However, such a situation is unlikely, particularly if the analysis factors in the low probability that all three generators will be able to simultaneously deliver their full rated power output.

- TEI's CAPEX forecast programmed the TPC transformer replacement for the period Jan-June 2009 and the San Rafael substation for RY 2010. As these dates are unachievable, we have reprogrammed the TPC project to RY 2011 and the San Rafael substation to RY 2012.

The adjustments to reflect our revised recommendations are shown in Table 2 below.

Table 2: Adjustments to San Rafael Substation – TPC Transformer Project Costs (PhP million, real)

	Jan-Jun 2009	RY 2010	RY 2011	RY 2012	RY 2013	RY 2014
CAPEX report recommendation for TPC project	7.00					
CAPEX report recommendation for San Rafael project		18.73				
Adjustments to CAPEX report recommendation for revised timing	(7.00)	(18.73)	7.00	18.73		
Recommended adjustments to project scope			13.00	20.00		
Total adjustment to reflect revised recommendation	(7.00)	(18.73)	20.00	38.73		

2.3 MAIN OFFICE BUILDING

2.3.1 Background

In its revenue application TEI included a provision of PhP 25.20 million for the construction of a new main office building on its existing site. In the CAPEX report we agreed that its existing facilities were inadequate and that the new building proposed by TEI was not extravagant. However we recommended that the building not proceed during the second regulatory period due to financial constraints, but that PhP 3.00 million be left in the project to allow TEI to refurbish the facilities vacated by linesmen so they could be used by office staff. The CAPEX report indicated that this was seen only as an interim solution.

In response, TEI reiterated that office should still be constructed within the regulatory period. It noted that ERC had already approved the construction of a new building and the reasons for which this approval was given were still valid.

2.3.2 Conclusion and Recommendation

We draw TEI's attention to Figure 9.5 of the Draft Determination, which indicates that TEI's overall distribution rate at the end of the second regulatory period will be high compared to most other utilities that have entered PBR. If the recommendations in this report are accepted by the ERC, the result will be even further uplift in this rate. Because of this, while we acknowledge TEI's need for the new office building, we are unable to recommend it at this time.

3. SUMMARY OF RECOMMENDED ADJUSTMENTS

A summary of the recommended adjustments to the CAPEX forecast approved in the Draft Determination is presented in Table 3.

Table 3: Recommended Adjustments to the CAPEX Forecast (PhP million, real)

	Jan-Jun 2009	RY 2010	RY 2011	RY 2012	RY 2013	RY 2014
Major Projects						
Adjustment for the use of larger conductor on SanRafael-Luisita 69 kV line	2.00					
Deferred reinstatement of TCP and San Rafael substation projects	(7.00)	(18.73)	20.00	38.73		

APPENDIX A
SUMMARY OF COMMENTS

Page/ Number	Section	Discussion of Comment/s and/or Questions for Clarification	Suggestions / Proposed Change(s) to the Draft Determination	GBA Comment
TEI DD - Page 23/ Section 4.5.3	<p>1. San Rafael – Luisita – CAT 69 KV</p> <p>GB Associates recommended a reduction of P2M if TEI will use 336.4 MCM ACSR instead of its proposed 795 MCM ACSR. It is projected that the 336.4 MCM conductor will not likely be loaded (61 MVA) within the 15 years planning horizon.</p>	<ul style="list-style-type: none"> - TEI conducted an impact study between 336.4 and 795 MCM conductor size, it shows that TEI proposed 795 MCM conductor still be the appropriate conductor. (See Analysis 1-1_San Rafael-Luisita-CAT 69KV and Diagram 1-1_TEI 69KV Line Diagram). - From the impact study, result reveals that it is more economical to use 795 MCM conductor due to a big difference in the line loss. Thus, the total operation cost (project cost and line loss) will yield a great savings. From the 2nd Regulatory Period (RY2011 TO RY2014) alone, using 795 MCM conductor will give TEI a savings around P4.3M. Stretching the operation to Year 2017, savings will be around P8M. - Another issue is the Voltage Regulation Criteria, during the line N-1 scenario, the 336.4 MCM conductor will more likely to breach the 5% grid code standard for voltage regulation for the Sub-transmission Line threshold of the Philippine Grid Code. - The economic life of the wires is estimated at between 25 to 30 years, as per our forecast, if we opt to use line conductor of 336.4 MCM size, the line will be fully loaded by year 2017 or eight years after its installation. The line will require upgrading to a higher capacity value or upgrade the line conductor from 336.4 MCM to 795 MCM conductor size just after only eight years of operations. If we opt for 795 MCM conductor size, the line will not be overloaded within the planning horizon period. There will be savings from the cost of upgrading the 336.4 MCM to 795 MCM when the line will be fully loaded. On the other hand, there will be voltage regulation problem during the 	<p>While we have some concerns about the validity of TEI's analysis, our alternative analysis supports TEI's conclusion that the use of larger conductor is justified by the savings in the cost of losses. We therefore recommend that the reduction in the Draft Determination be reinstated. See Section 2.1.</p>	

		<p>construction of the line upgrading since we have to shut down the said line and the demand load of the utility will be carried by the other line with same 336.4 MCM conductor in size. (See Table 1-1 TEI System Forecast)</p>	
<p>TEI DD - Page 24/ Section 4.5.3</p>	<p>2. Sto Nino (TPC) Substation Transformer Replacement</p> <p>GB Associates suggested the purchase of 'zigzag' transformer to couple with the existing star-delta 15/20 MVA power transformer in order to create an earth reference for the distribution system.</p>	<ul style="list-style-type: none"> - TEI believed that it is still more economical to purchase the new star-star power transformer instead of the 'zigzag' transformer because TEI will be able to save the old power transformer since the cost of the zigzag is almost the same with the new one. The existing transformer is intended to install at San Rafael SS. (See Document 2-1a_Zigzag Transformer Canvass, Document 2-1b_Zigzag Transformer Canvass). - In our existing contract with our embedded IPP, billing meters are located at 13.8 KV side. TEI owns the breakers at 13.8 KV side including the 15/20 MVA 69/13.8 KV transformer which is being used to supply power to TPC loads when power plant is not operational and transmit power to other TEI substation via 69 KV line generated by from IPP when plant is operating at full capacity. The transformer is more than 50% loaded when IPP generation is at full capacity. (See Table 2-1 TPC SS Forecast and Diagram 2-1_TPC SS). - There are different types of star-star transformer configuration. The star-star or auto-wye connection will allow the passage of harmonics in the system since the winding is continuous, while the star- star configuration with isolated winding and separated grounding will not allow passage of harmonics. NGCP Power Transformers at Concepcion substation where our system is connected has a star-star or auto wye configuration at the 230KV and 69KV side. This transformer allows harmonics to the 	<p>We have reviewed the additional information provided by TEI and recommend that sufficient CAPEX be reinstated to allow the project to proceed, albeit with a 15 MVA transformer rather than the 20 MVA unit proposed by TEI. See Section 2.2.</p>

		system. Our requirement is the star-star configuration with isolated winding connection.	
TEI DD - Page 24/ Section 4.5.3	<p>3. San Rafael Substation</p> <p>GB Associates suggested to defer the installation of additional capacity at San Rafael SS and to construct a switching station instead until the end of the 2nd Regulatory Year. GB Associates sought that there is enough capacity even in the N-1 setup for substation outages.</p>	<ul style="list-style-type: none"> - TEI still believes that putting San Rafael SS in the proposed year would yield an efficient system operation. - There is enough capacity, this is true when summarizing all substations' capacities. Unfortunately, our existing substations are not strategically situated especially for N-1 scenarios. Meaning, not all of each substation spare capacity can be shared to other substations due to line constraints. TEI conducted a simple simulation between two different scenarios (With and Without San Rafael SS). In the event of one substation outage during the "Without San Rafael SS" scenario, like for instance, when LIP SS outage, this setup will not satisfy the N-1 criteria because LIP SS will not get a 100% support from the spare capacity of the remaining substations (Panganiban and Maliwalo SS). While "With San Rafael SS" scenario, N-1 reliability criteria is satisfied. (See Table 3-1 Panganiban SS Forecast _No SS addition, Table 3-2 LIP SS Forecast _No SS addition; Analysis 3-1_San Rafael SS; and Diagram 3-1_Primary Line Topo_With San Rafael SS, and Diagram 3-2_Primary Line Topo_No San Rafael SS). - With regards to system power quality, there will be an improvement in the voltage regulation in the area since primary lines will be shortened and with line load reduction due to the operation of the substation. There will be savings on the line loss in the area. 	We have reviewed the additional information provided by TEI and recommend that sufficient CAPEX be reinstated to allow the project to proceed. See Section 2.2.
TEI DD - Page 24/ Section 4.5.3	<p>4. Main Office Building</p> <p>GB Associates accepts TEI submission that our existing office facilities are inadequate for our staff and customers. There is a need for a new office building and facilities to house its employees and</p>	<ul style="list-style-type: none"> - TEI reiterates that office be still constructed within the regulatory period for the same reason it was approved. 	There is a need to prioritize CAPEX expenditure in order to manage the impact of rate increases on customers. Given the additional CAPEX recommended in this review, we are unable to recommend this project proceed during the

	improve customers receiving area. However, GB suggested to delay the office building construction after 2014.		second regulatory period. See Section 2.3.
TEI DD - Page 24/ Section 4.5.3	<p>5. Service Vehicle Replacement Program (RY 2012 & RY 2014)</p> <p>GB has approved the vehicle replacement program for 2012 and differ the program for 2014 until the third regulatory period.</p>	- If we delay the replacement service vehicles which will be due for retirement by 2014, we will extend the services of the vehicles until the third regulatory period, this will require higher cost for the refurbishment and maintenance of service vehicles.	We acknowledge this. However the timing of vehicle purchases is discretionary and we consider the additional operating costs resulting from a one year delay not to be material.
TEI DD - Page 24/ Section 4.5.3	<p>6. San Isidro Substation</p> <p>GB Associates recommends to disapprove the construction of the proposed San Isidro Substation for reasons that the system has sufficient substation transformer capacity for an N-1 event.</p>	- Without the proposed substation the existing Panganiban substation will be highly loaded. This will affect the voltage regulation of loads connected to Panganiban substation. (See Table 3-1 Panganiban SS Forecast _No SS addition).	The construction of the San Rafael substation, as recommended in this Addendum report, will allow the Panganiban substation to be offloaded.
TEI DD - Page 24/ Section 4.5.3	<p>Balete Substation</p> <p>GB Associates cites that Balete Substation project will not be required before the end of the second regulatory period.</p>	- The proposed substation is projected to be commercially operational in the first year of the third regulatory period. Construction time of the proposed substation will be needed before the end of the second regulatory period in order to meet the schedule commercial operation of the proposed substation.	ERC policy is for CAPEX to be added to the RAB when a project is commissioned. Hence projects that are not due for commissioning until after the end of the second regulatory period are not considered as part of this review.