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The Regulatory Authority of Bermuda,
Craig Appin House, 1st Floor BY E-mail
8 Wesley Street
Hamilton HM 11

26th September 2018

Attn. Mr. Nigel Burgess, Senior Manager Electricity Analysis & Planning

Re: Response to Feed-in Tariff Methodology - Preliminary Report, Preliminary Decision & Order, Matter: 20180427

Dear Sirs,

We are pleased to submit the following response to your consultation document referenced above.

Firstly, we note that you have not published the six responses that you received to the previous round of this consultation, although your summary of them is perhaps more detailed than in past consultations on the electricity sector. Secondly, on page 14 of your General Determination in paragraph (b), you appear to have repeated all the wording contained in paragraph (a). Does this mean that the intended paragraph was omitted or is this an accidental repeat?

We are dismayed that despite our previous responses on this and other matters, you continue to allude that additional distributed generation may increase the cost for electricity paid by other non-solar customers. We have continuously stated previously that the wider adoption of distributed generation, particularly solar PV, will reduce BELCO's use of their inefficient gas turbines which have a much higher cost of fuel burned per MWH generated than their other generation assets. We have also previously stated that it will take at least approximately 30 MW of distributed solar to eliminate most of the use of these gas turbines, but you continue to allude that any additional solar PV may increase the cost of electricity to other users without offering any data to support your view. We therefore will now offer conclusive data to show how much additional distributed solar will be needed to substantially reduce the use of these expensive, carbon intensive gas turbines. However, having now further read some of the details in BELCO's IRP proposal and appendices, we will show that it will take well in excess of 45 MW of distributed and utility scale solar to substantially reduce the use of these gas turbines.

We also put it to the RAB that you appear to be too narrowly focused on the EA and NESP requirements in relation to the FIT and in doing so you are failing to also address items 23 (a), (b), (c), (d), (e), and (f) plus 24 (a), (b), (c) and (d) as shown on pages 7 and 8 of your preliminary report.

THE USE OF DISTRIBUTED SOLAR TO SUBSTANTIALLY REDUCE THE USE OF INEFFICIENT AND FUEL COSTLY GAS TURBINES BY BELCO's BULK GENERATION LICENSEE

We refer you to Figure's 1, 2 and 4 of the Ricardo Report prepared for the RAB in June 2017. Based on Figure 4, we have prepared our **Figure 1** showing the BELCO peak summer demand

BERMUDA ALTERNATE ENERGY LIMITED

Street Address: Airkool House, 9 Mill Creek Road, Pembroke HM 05, Bermuda
Mailing Address: P.O. Box HM 1095, Hamilton HM EX, Bermuda

Telephone: 441-297-3639 Facsimilie: 441-292-6887 E-mail: info@bae.bm www.bae.bm

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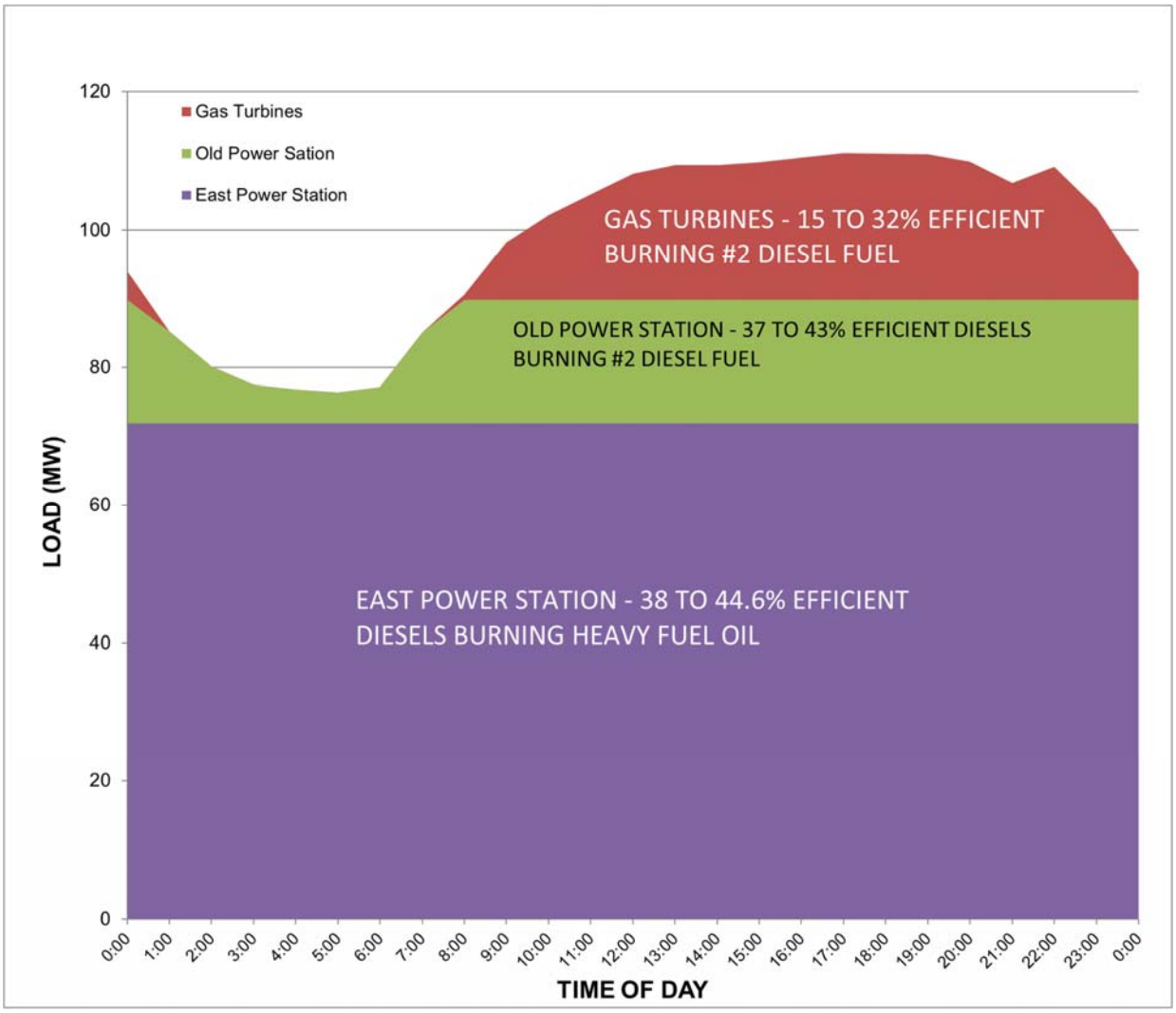
curve and our assumption of the generation assets needed to meet this demand in 2016. The East Power Station Recips have the lowest fuel cost per MWH and are thus shown as the base load assets in purple. Then the slightly most costly fuel per MWH Old Power Station Recips are shown in green. The gas turbines are shown in red at the top of the asset list because they are the most expensive to run and thus the last to be utilized. Thus they have been referred to in the Ricardo report as peaking engine generators



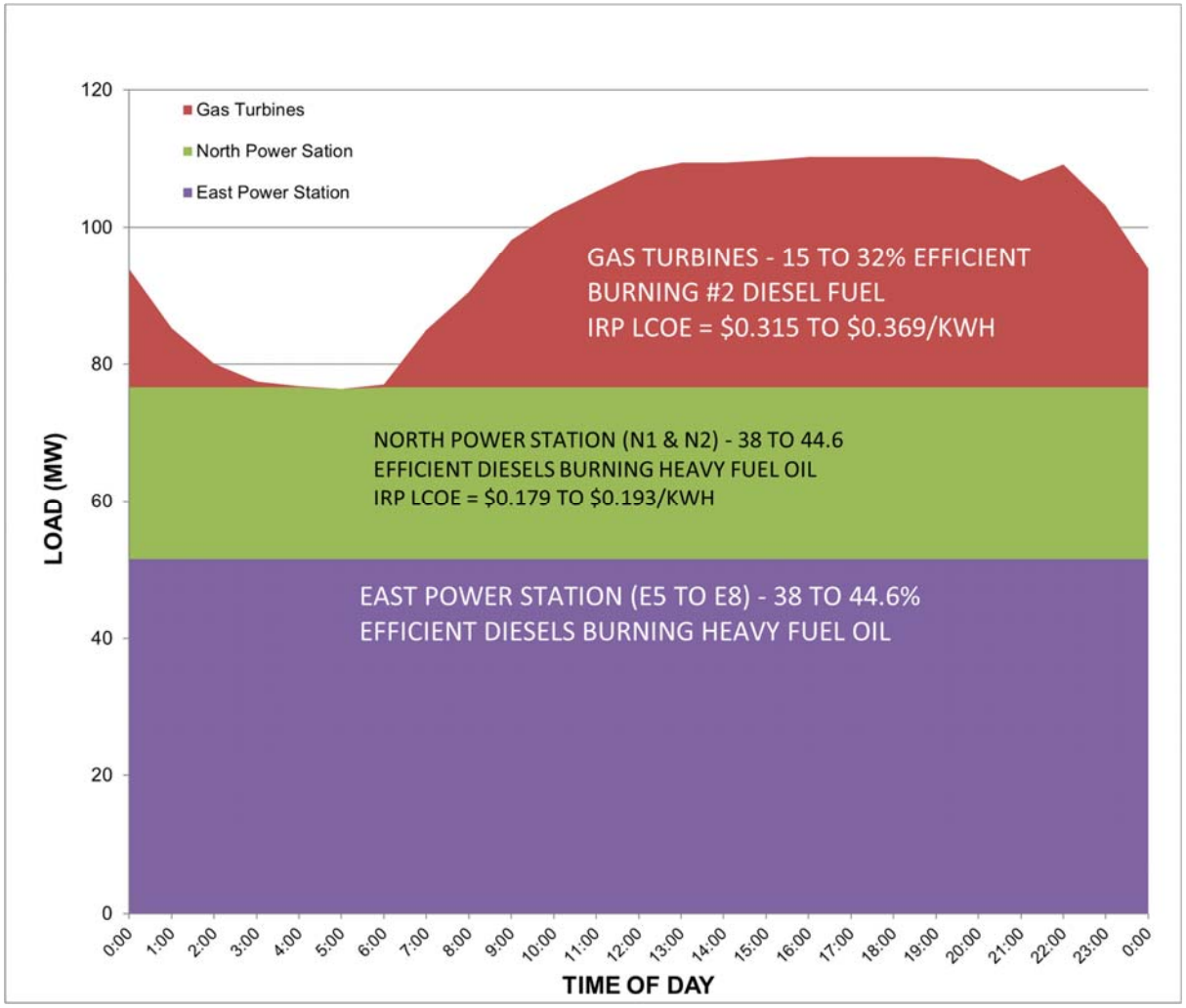
BELCO'S SUMMER LOAD PROFILE & GENERATOR OUTPUTS FOR 2016 AT 85% LOADING

NOTE: SUMMER LOAD PROFILE IS BASED ON 2016 DATA

Figure 1

We then look at the same maximum demand curve but with 2020 generation assets as listed in Appendix II.B page 4, where only two North Power Station Generators are shown in service between 2020 and 2022, when a third unit is brought on line. Please note that in the same

appendix, a total of eight generation assets are shown being retired in 2018 and 2019. The addition of just two reciprocating North Power station in 2020 seems to be confirmed in the IRP Proposal Figure 1.5, which shows four generation assets being added in 2020, but according to our interpretation of Appendix II.B, two of these new assets are gas turbines. Based on this, we produced **Figure 2** below which shows the same demand curve, but with the revised generation assets scheduled for 2020.

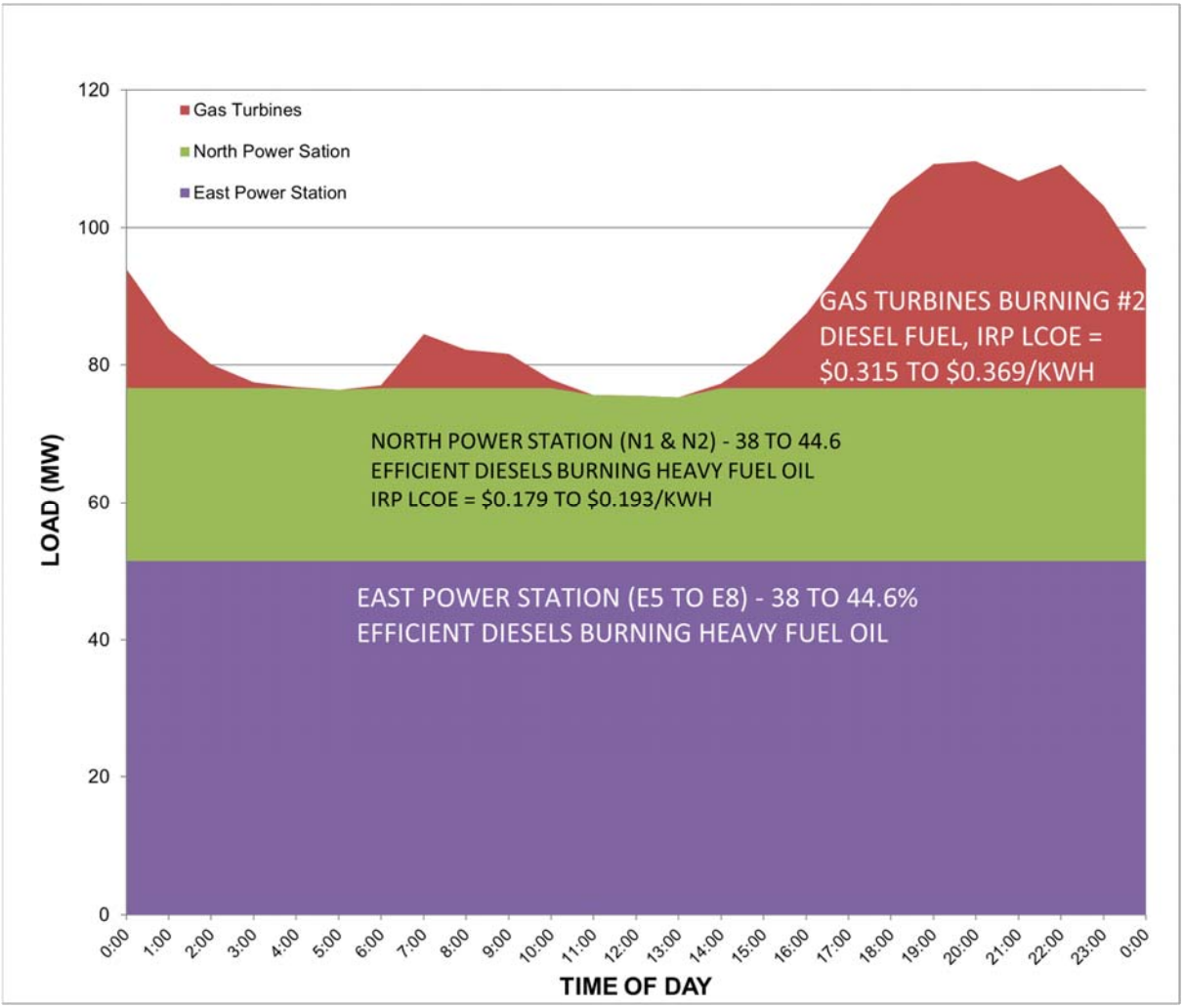


BELCO'S SUMMER LOAD PROFILE & GENERATOR OUTPUTS FOR 2020 AT 90% LOADING

NOTE: SUMMER LOAD PROFILE IS BASED ON 2016 DATA

Figure 2

Please note the dramatic shift in this figure to less use of the more cost efficient reciprocating engines and more use of the fuel guzzling gas turbines. We also noted a pronounced decline in reserve capacity, but we assume that perhaps one or two of generators E1 through E4 could be used for emergency backup as suggested by the Ricardo report. In our opinion, this dramatic shift to increased use of gas turbines between 2020 and 2022 will result in substantially higher fuel adjustment rates, (or successor rate) for all BELCO customers. Please also note that we have added the LCOE for scenario 2 of the IRP (HFO and LFO) for the new recips and gas turbines taken from the IRP appendices. This is appropriate for 2020 through 2022 because neither LNG or LPG would be introduced in this time period according to the IRP. You will note the huge extra cost per kWh for the gas turbines compared to the recips.



BELCO'S SUMMER LOAD PROFILE & GENERATOR OUTPUTS FOR 2020 AT 90% LOADING WITH 45 MW DC OF ADDITIONAL SOLAR PV

NOTE: SUMMER LOAD PROFILE IS BASED ON 2016 DATA

Figure 3

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Figure 3 is the same maximum demand curve, but this time with the addition of 45 MW DC of new solar capacity, which could include the airport utility scale systems if they eventually are built by 2020, plus distributed solar PV. Under this preliminary analysis, another 45 MW of solar PV just manages to offset the summer midday use of the gas turbines, but there would still be heavy use in the summer evenings until long after midnight and some use in the few hours after dawn. Perhaps the best wat of reducing these latter uses of the turbines will take further solar PV capacity, plus a substantial amount of energy storage.

Please note that solar PV is the best renewable resource currently available to reduce this daytime peak energy demand for almost every month of the year. Peak seasonal output from wind and wave energy are not coincident with peak demand and are thus less suited to reduce the use of these costly gas turbines.

When you compare the maximum future output of the east and north power stations in the period 2020 to 2022 to the monthly maximum demand for 2016 shown in Figure 1 of the Ricardo report and the yearly average demand in their Figure 4, you will note that with the present levels of solar and waste to energy outputs, the gas turbines will be needed every month of the year except April, whereas at present the EPS and OPS recips are the avoided generation assets for several months of the year according to BELCO's letter of September 15th, 2016 regarding their calculations of avoided fuel costs. The above appears to mean that the avoided fuel cost component of the future FIT should be for the use of gas turbines 11 months per year, starting in 2020.

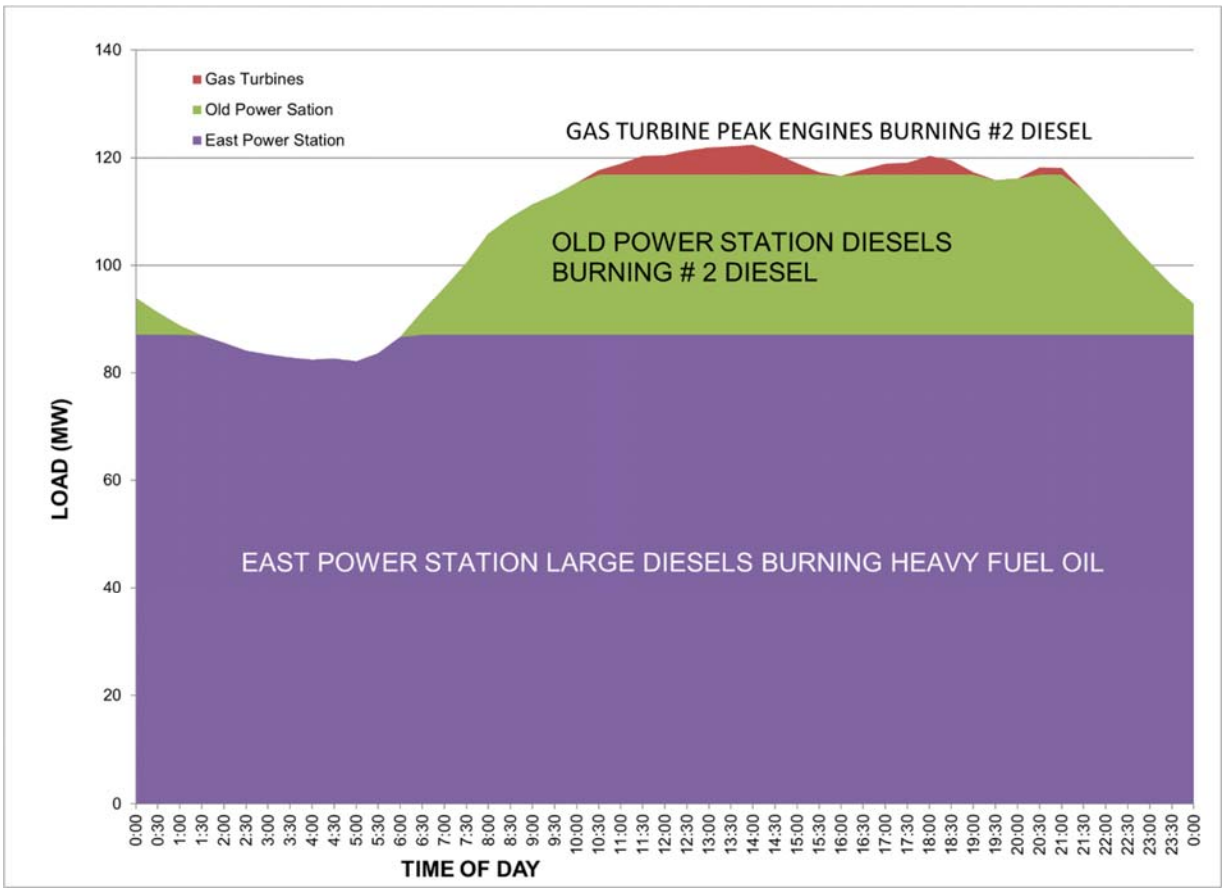
In term of your methodology, this begs the question, do you come up with a one year FIT for 2019 based on the present generation assets or do you go for a three year FIT, with the much higher avoided fuel costs that will occur beginning in 2020? Based on the need for stable, long term FITs outlined in the NESP and EA, we put it to you that a one year FIT for 2019 will only damage the solar industry further because of the further uncertainty it will introduce. The above also begs the question of how can the RAB approve the proposed IRP that will inevitably result in much higher fuel costs being passed onto all BELCO customers starting in 2020?

We wish to point out to the RAB that this increase in the use of gas turbines is a relatively recent trend by BELCO. Our **Figure 4** on the following page shows the much lower use of gas turbines to meet summer peak demand back in 2010.

We trust that the forgoing will uses pertinent local generation data to prove beyond reasonable doubt that the increased use of distributed and utility scale solar PV will reduce the use of these gas turbines and thus lower the cost of electricity for all customers, perhaps up to the point where Bermuda has 60 MW of solar PV capacity and substantial energy storage. For distributed solar to do this it means that the systems should be sized for a reasonable amount of monthly energy export to the TD&R licensee, which will require a FIT substantially higher than the present interim FIT. Sizing these systems to minimize export to the grid could be a greater benefit to the solar system owner while providing a reduced benefit to other users in the form of lower fuels adjustment rates and will take longer to get to 60 MW or above.

THE COST OF STRANDED ASSETS

The RAB continues to harp on about the potential cost of the BGL's generation assets becoming stranded with the increased use of solar PV. Firstly, Figure 3 above shows that the



SUMMER LOAD PROFILE AND GENERATION STATION OUTPUTS FOR 2010

NOTE: SUMMER LOAD PROFILE IS BASED ON 2010 DATA

Figure 4.

gas turbine assets will continue to be used well after to adoption of 60 MW of solar PV, so they will not be stranded for many years to come. Secondly, Appendix II.B implies to us that the fuel cost component of the LCOE for these gas turbines is by far the single largest component. Thirdly, this appendix shows two gas turbines scheduled for purchase in 2022, so if solar and storage capacity grow fast enough, one or more of these may no longer need to be purchased, or the RAB may reject these asset purchases, based on their high fuel costs. Fourthly, unlike the heavy reciprocating assets in the EPS and NPS, some of these GT assets are relatively portable and could conceivable be sold abroad if they are no longer required, which we believe is not the case for the recips. Fifthly, further generator retirements are scheduled for 2025 that may not need to be replaced with the much wider adoption of solar plus storage.

We trust that the data and logic above will finally disprove your assertion about the cost of stranded assets needing to be deducted from the FIT and challenge the RAB to provide the

data that proves otherwise. Furthermore, we suggest that the above are grounds for including more fixed and other costs of the gas turbines in the FIT.

THE COST OF GENERATOR EFFICIENCY LOSSES DUE TO WIDER SOLAR ADOPTION

The RAB also continues to harp on about the potential cost of the loss of efficiency of generation assets due to the wider adoption of solar PV and we again put it to you that the cost savings from the reduced use of the gas turbines far outweighs any efficiency losses that will occur until there is perhaps 60 MW of solar PV and some additional storage installed here. As further proof of our position, we note that GT's 6, 7 and 8 are only 4.5 MW each, so it would appear to us that they can be staged on and off to follow any variation in the output of distributed solar. The new BESS will also help in this regard, but we suspect that this is more geared to the variation in output from the planned solar farms. Furthermore, there will be efficiency changes in these smaller GTs as they follow varying distributed solar outputs, but as we are talking about changes of less than 3% of the total load, these efficiency losses are miniscule compared to the efficiency gains of the overall system with the wider adoption of distributed solar and resulting decreased use of the gas turbine assets.

However, variation in the output of the planned utility scale solar farms will have a bigger impact, but these solar developments are not part of this consultation and their effects on system efficiency should not be factored into the FIT for distributed solar.

At few times after 2020 when the gas turbines are not required and the recips are the only BGL assets in service, variation in distributed solar output that would require one of these recips to start or stop will require the other recips to change their output by 14 to 20%. Based on the efficiency curves that we have on file for these recips, that is not likely to change their efficiency by more than 1%. An example would be a change from 44.5% to 43.5% or vice versa depending on whether the system is loading or unloading. Given the low annual running hours when this will occur after 2020 compared to the high annual running hours when the gas turbines will be the avoided generation assets due to distributed solar, the true effect of this efficiency change in the recips is only likely to be worth approximately $0.00018/kWh to the FIT calculation. This is almost negligible compared to the fuels cost component for the gas turbines

CONCLUSION

We trust the above will help you improve your FIT methodology and subsequent FIT calculations to better reflect the true avoided cost of distributed solar exports to the TD&R licensee, which should be far higher than the present interim FIT. We also trust that the data and facts contained above will help you to better merge the purposes of the EA and RAA into the FIT methodology and subsequent FIT calculations, particularly in respect to the economic benefits of distributed solar, least cost electricity, sustainability and promoting the use of renewable energy. We further trust that the above will also help you in evaluating the IRP proposal and drafting the retail tariff in respect of the above purposes. Finally we believe that the above should be shared with the Minister in respect to policy directives about the proposed increase in the use of gas turbines with their very high fuel costs and CO_2 emissions and the wider adoption of distributed solar to help offset these increased costs to all BELCO customers.

Please contact myself should you require any further information on our data, comments and recommendations.

Yours Sincerely,

C. E. Nash, P. Eng.
Engineering Manager

CEN/nec

Cc Jeane Nicolai

Nick Duffy

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