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John Rampton
GM Market Design
Electricity Authority
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Dear John

Transpower NZ Ltd.'s responses to the Authority's questions: GRS assessment for Lower North Island (LNI)

On 16 April 2018, the Electricity Authority (EA) asked us to clarify some aspects of the analytical approach described in our LNI report on distributed generation (DG) to meet the grid reliability standards.

The responses below, from the report's team, should be read in conjunction with the report to understand references to e.g. 'DG ON' and 'DG OFF', or to 'grid backbone'.

Questions asked by the EA

"We can see some differences between this report and your earlier lower South Island report. We want to understand:

1. Why you introduced the effectiveness hurdle and what is its impact
    a. Why 0.1% per MW – what's your rationale for setting it at that level.
2. The effectiveness hurdle appears to introduce counter-intuitive results, e.g. smaller DG appears to have a bigger impact, does this affect the results.
3. Your conclusions for the grid backbone analysis – you appear to have reached a different conclusion to the one you reached in the Lower South Island (LSI) report, although Mitton's conclusion was the same in both cases, why is this.
4. You mention use of slack generation in this report, but not in the LSI report."

Responses

1. The Effectiveness Hurdle: why used, what value

For the Lower North Island (LNI) report, we introduced an effectiveness hurdle of 0.1%/MW. In our report for LNI we wrote:

> *For DG at a GXP to be considered required the DG must improve any transmission issue by at least 0.1%/MW injected.*
>
> *The size and scope of the LNI region and analysis necessitated this change because interactions between regional and grid backbone power flows can show DG improving transmission issues by percentages within the margin of modelling accuracy. The hurdle ensures that only DG directly linked to a regional transmission issue is assessed as required to manage that issue. [page 12]*

The effectiveness hurdle was introduced to ensure that reliability benefits from distributed generators were genuine and not the result of variations inherent in powerflow analysis of a meshed grid (noise). An example of noise is a large DG that is not necessarily located close to a grid issue changing the voltage plane, resulting in small changes in circuit loadings. The noise could be interpreted as a positive DG impact if an effectiveness hurdle is not used.

For the LSI an effectiveness hurdle was not necessary because grid backbone analysis did not show any instances where percentage loading was reduced by the DG ON case (compared to the DG OFF case). As there were no DGs identified as being needed, applying the effectiveness hurdle retrospectively to the LSI wouldn't change any results.

The value of 0.1%/ MW was chosen as it strikes a good balance of being large enough to filter out the noise but not too large so that it removed DGs with a genuine benefit to the issue.

The effectiveness hurdle will be used for all regions where DG ON reduces circuit loadings and modelling noise impacts the understanding of which DG influence circuit loadings.

2. The Effectiveness Hurdle: results

The effectiveness hurdle at 0.1 %/MW identifies the locations where DG has the most impact on transmission issues. In our approach, DG is the aggregated DG behind a GXP and does not distinguish size or type of individual DG. Our approach using aggregate DG means that the location of DG matters, not its size.

3. Transpower's conclusion for the LNI grid backbone differs from Mitton

Our approach provides for DG to be beneficial for reliability if it positively impacts any scenario. Our conclusion for the LNI builds from Mitton's analysis as we have applied the effectiveness hurdle. The effect of applying the effectiveness hurdle changed our conclusion.

For the Lower South Island report, our knowledge of grid backbone issues enabled us to conclude that the limiting issues on the grid backbone were not improved by DG in the LSI. Our conclusion for the LSI aligned with Mitton's conclusion.

4. Role of slack generation

A slack generator is used to balance *generation* with *load + losses. T*he slack generator replaces the DG in the DG OFF case. However, the slack generator in the model should not be on the same side of the overloaded circuit as the DG being tested for effectiveness. If the slack generation does locate on the same side of the issue, the results will be affected by the slack generator and will not be a true representation of the impact of the DGs being considered. In the LSI region, slack generation could be located in the model so that the slack generation was not on the same side of the overloaded circuit as the DGs being assessed.

In contrast, the LNI grid covers a large area of the North Island and is very meshed, with power flows in multiple directions, not just north or south flows as in the LSI region. Slack generation placement had to be carefully considered to ensure the slack generator did not affect the impact of the DGs. As we could not locate it outside the LNI region we had to test the impact of its location, within the region, on the results.

Yours sincerely

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