ONTARIO POWER GENERATION

July 10, 2020

IESO Stakeholder Engagement (Delivered via email)

Re: Market Rules:

- **Appendix 4.2 – Requirements for Generation Facilities Connected to the IESO-Controlled Grid**
- **Appendix 4.3 – Requirements of Connected Wholesale Customers and Distributors Connected to the IESO-Controlled Grid**

OPG appreciates the opportunity to provide comments on the changes proposed to Market Rules Appendices 4.2 – Requirements for Generation Facilities Connected to the IESO-Controlled Grid and 4.3 – Requirements of Connected Wholesale Customers and Distributors Connected to the IESO-Controlled Grid. OPG is pleased to see that the IESO has incorporated many of the suggestions from OPG's previous comments. OPG has reviewed the newest redline documentation and still has some concerns with the market rules as they are currently presented. A couple statements require additional clarity, and explicitly defined terms will be needed to specify performance requirements, as will be highlighted below. It is important to note that OPG is one of the largest generators with the most assets in the Province and if the performance requirements are subject to being interpreted in different ways, this will have the ability to seriously impact our Operations, Engineering, Projects, etc.

Appendix 4.2 – Requirements for Generation Facilities Connected to the IESO-Controlled Grid

1) Category #5 Reactive Power

As a result of the on-going revisions to Appendix 4.2, and some recent discussions surrounding testing results, OPG has recognized that in the following language (from the latest redline), it is not specified at what voltage the requirements apply, and that this has material implications for whether particular equipment will be found to achieve the requirements during testing or not:

> *"Continuously (i.e., dynamically) inject or withdraw reactive power at the high-voltage terminal of the main output transformer[1] up to 33% of its rated active power at all levels of active power output, except where a lesser continually available capability is permitted with the IESO's approval. A conventional synchronous unit with a power factor range of 0.90 lagging and 0.95 leading at rated active power connected via a main output transformer impedance not greater than 13% based on generation unit rated apparent power is acceptable."*

OPG believes these reactive power requirements need to be explicitly defined at particular voltage conditions. If this is not done, the requirements are open to multiple interpretations. Not specifying the voltage could have unintended consequences, such as:

- Imposing more stringent requirements on generators (e.g., if the requirements have to be achievable at all voltages within some range, including at the least favorable conditions), OR
- Accepting less reactive support for the grid than is actually intended (e.g., if test results were found acceptable just because they happened to be collected in the most favorable voltage conditions).

OPG understands that the IESO's intent, and actual practice, is to evaluate reactive power capability at one particular transmission system voltage, and believes the apparent lack of clarity in this requirement is unintentional.

OPG is seeking for the IESO to update this section to state explicitly at what voltage conditions the reactive power requirements are to be achieved. The most-recent redlined version of Appendix 4.2 now specifies the reactive power requirements at the high-voltage terminal of the main output transformer (rather than at the 'connection point' or at the 'generator terminals'). Given this, OPG's recommendation is for the IESO to specify the voltage at the high-voltage terminal of the main output transformer at which the performance requirement is to be achievable.

Additional background is as follows:

Prior to 2010, the Market Rules stated the reactive power obligation for generators within the same power factor range as is included in the current Market Rules and in these redline requirements (i.e., 0.9 lagging to 0.95 leading at RAP), but also stated that this was to be achievable based on nominal terminal voltage. The rules at that time explicitly relieved generators of having to operate outside a range of +/-5% around nominal terminal voltage, when attempting to provide reactive power to these stated levels.

Following 2010, these explicit statements were removed from the Market Rules. OPG understands this was done by the IESO in recognition of increasing penetration of distributed generating resources and the potential for more-diverse generation technologies in the future, i.e., to make the rules more technology agnostic. Also at this time, the new language specified requirements at the 'connection point', rather than at the generator terminals. Presumably to help owners of conventional generation understand the new requirement in familiar terms, acceptability criteria nearly equivalent to the previous requirements were retained, though with certain caveats (e.g., main output transformer impedance could not be >13%). For conventional generation, reactive capability testing continued to observe the practices that pre-dated the 2010 rules change, and an equivalency between the old and new rules has generally been assumed at the generator terminals (including limitations on reactive power obligation outside the +/-5% voltage range).

Recently, OPG has had reactive capability test results not accepted when initially submitted, because the amount of reactive power produced at the machine terminals during testing, which was done at an off-nominal (unfavorable) terminal voltage, did not fall within the power factor range stated to be acceptable in the current version of Appendix 4.2. Subsequent engineering analysis showed that:

- the obligated amount should have been achievable at the generator terminals, had the generator terminal voltage been at nominal voltage during testing, AND
- the amount of reactive power actually achieved at the high-voltage side of the MOT in this particular test did reach the required amount (i.e., met the 'connection point' acceptability criterion), and is thus deemed acceptable.

While OPG is happy that this test result was deemed acceptable, we would still point out that different voltage conditions on the day of this particular test could have resulted in a different conclusion – either more or less favorable for OPG. It may have been the case that less favorable voltage conditions could have still resulted in 'unacceptable' results (with the same under-lying equipment capability), OR if voltage conditions had been very favorable, the test results may have been deemed acceptable with even less under-lying equipment capability that actually exists.

OPG wishes to be clear that we are not suggesting the Market Rules requirements should be relaxed. Rather, we are pointing out that the requirement is not fully specified as it is written in either the existing Appendix 4.2 or the latest redlined version. As such, it does not provide enough criteria to make clear pass/fail determinations when comparing test results against the reactive power capability requirements. OPG believes that voltage conditions must be specified to achieve the required clarity for all cases.

2) Category #7 Excitation System

Due to changes related to excitation system forcing requirements in the most recent redlined version of Market Rules Appendix 4.2, the specification of 'rated field current' has been removed. The term 'rated field current' included in Category #7 of the existing Appendix 4.2 is as follows:

> *"Rated field current is defined at rated voltage, rated active power and required maximum continuous reactive power."*

In the IESO's comments associated with the removal of this definition, it was noted that the definition would no longer be required, since the field forcing requirements (ceiling voltages) are no longer to be evaluated at 'rated field current' or at 160% of 'rated field current'. While OPG appreciates the implications of the changes in this section and believes they will both simplify the requirements and make it easier to demonstrate compliance through testing, OPG contends that the IESO *does* need to retain this definition, or at least a similar definition, *somewhere* in the Market Rules or Manuals. The specification of 'rated field current' still determines the value of the 'rated field voltage', and thereby forms the basis of the ceiling voltage requirements, even if the ceiling requirements are no longer to be specified at a multiple of the 'rated field current' in the updated language in Category #7. Specifically, the 'rated field voltage' is presently understood to be that which must be applied to the generator's temperature-corrected field resistance to establish the 'rated field current'. Note: the temperature corrected field resistance value is registered as one attribute of a Synchronous Machine in Online IESO, and is called in the Help File the "Field Resistance (*Rfg*)".

OPG notes that it would not be necessary to have a definition of the 'rated field current' if the 'rated field voltage' were described in a way that specifies all relevant parameters, such as:

> ***Rated field voltage*** *is that required when the generator is operating at rated terminal voltage, rated active power and the required maximum continuous reactive power, with the field resistance at nominal operating temperature.*
> Note: the nominal operating temperatures are specified, by convention, in the Register Facility Help File – 75 °C for hydro units, and 100 °C for turbo-generators.

OPG understands the Market Rules generally do not contain all required technical details. However, in this case, the statements relating to forcing requirements (i.e., the ceiling voltage requirements) are themselves rather technical. To be comprehensible and complete, these requirements rely on there being a meaningful definition of 'rated field voltage' and so, at least presently, depend on the definition of 'rated field current'.

OPG believes the most user-friendly way of retaining this information would be to define the relevant term(s) right in Category #7 of Appendix 4.2, similar to how 'rated active power' is still defined within Category *4. Active Power* of Appendix 4.2, and how 'rated field current' has been defined until the present redlined version. That said, OPG recognizes that other solutions would be reasonable, as long as the terms are clearly articulated somewhere in the Market Rules or Manuals.

For additional discussion, please do not hesitate to contact Mr. Mike Cooke.

Regards,

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