DRAFT Application Guideline
Generator Interconnection Requirements – Reactive Power

Purpose

This guideline describes how the reactive power requirements may be applied for PPA generating units and what reactive requirements will apply for upgrades to existing generators.

Background

The reactive power capability and reactive margins provided by synchronous generators are critical to maintaining reliable and efficient operation of the Alberta Interconnected Electric System (AIES) and must be adequate for normal operation as well as fault and post-contingency operating conditions[1]. The reactive power capability of generating units forms the basis for all operating studies, limits and procedures and therefore must be known, verified and available under all operating conditions.

AESO Interconnection Requirements

The reactive power requirements are defined in the AESO Interconnection Requirements and apply to all generators that are interconnected to the AIES (not including distributed connected generators), as per Article 4.1 of the ISO Tariff. In accordance with Sections 20(3) and 31(b) of the Electric Utilities Act (EUA), all market participants are required to comply with ISO Rules and the terms and conditions of the ISO Tariff.

The AESO Interconnection Requirements specify that all generators must be capable of supplying continuous reactive power within the limits of 0.9 power factor over-excited (lagging)[2] and 0.95 power factor under-excited (leading)[3] as measured at the generator unit terminals. The full range of the reactive power capability must also be available over the entire MW operating range of the generator at rated generator terminal voltage. The AESO Interconnection Requirements are consistent with the WECC requirements and the requirements established in all North American jurisdictions.

In 2006, the AESO consulted with stakeholders and revised the Interconnection Requirements. Section 3.1 Generator Voltage Regulation was revised to add clarity respecting reactive power requirements. In addition, the generator reactive power factor requirement was reduced from .90 to .95 leading power factor to remain consistent with WECC/NERC policy.

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[1] The FERC staff report Reactive Power Supply and Consumption includes a description of dynamic reactive power and its importance for system reliability. It can be accessed at http://www.ferc.gov/EventCalendar/Files/20050310144430-02-04-05-reactive-power.pdf

[2] VArs flowing to the AIES from the generating facility

[3] VArs flowing from the AIES to the generating facility

Compliance with these standards is the foundation for reliable system operation and fair and non-discriminatory access to Alberta's competitive electricity markets. The AESO therefore developed a program to review, verify and test generating unit MW and MVAR capabilities.

In its review of reactive power requirements and generating unit capabilities, the AESO determined that there are some differences between the reactive power requirements described in the commercial agreements for the Power Purchase Agreement (PPA) generating units and those contained in the AESO Interconnection Requirements. The relationship between the *Power Purchase Arrangements Designation Regulation* and the EUA and its other regulations is clarified in Section 96(1) of the EUA. That section provides that the PPAs continue to have effect in accordance with their terms and conditions, but that they are subject to the EUA and the regulations. Therefore, both the EUA and the other regulations prevail over the PPAs in the *Power Purchase Arrangements Designation Regulation* (AR 175/2000).

Notwithstanding this interpretation, the AESO considers that enforcing the reactive power provisions strictly in accordance with the AESO Interconnection Requirements may potentially result in unfair costs given the provisions in the PPAs. Accordingly, as permitted by Articles 3.4 and 4.5 of the Terms and Conditions of the ISO Tariff, the AESO will apply some discretion with respect to reactive power requirements for new generating units, PPA generating units, and upgrades to existing generators, as outlined in the following guidelines.

Reactive Power Requirements for PPA Generating Units

The dispatch reactive power levels for PPA units are specified in Schedule B, Table B3.9 of each PPA and the reactive power capabilities for PPA units are specified in Schedule B, Section B3.10 of each PPA[4] as set out in AR 175/2000. Together, Table B3.9 and Section B3.10 comprise the PPA reactive power requirements. The PPA commercial agreements outline a committed capacity MW amount and any energy in excess of the committed capacity MW level is deemed to be "excess energy".

The AESO determined that some PPA generators cannot meet the AESO reactive power requirements at the PPA committed capacity or when they are producing excess energy. While the reactive power requirements vary by PPA agreement, it is generally understood that the PPA committed capacity plus some amount of excess energy was the capability envisioned in the PPA. The inherent reactive power capability at these levels was deemed to be reasonable as opposed to the requirements stated in AESO standards applicable to generators.

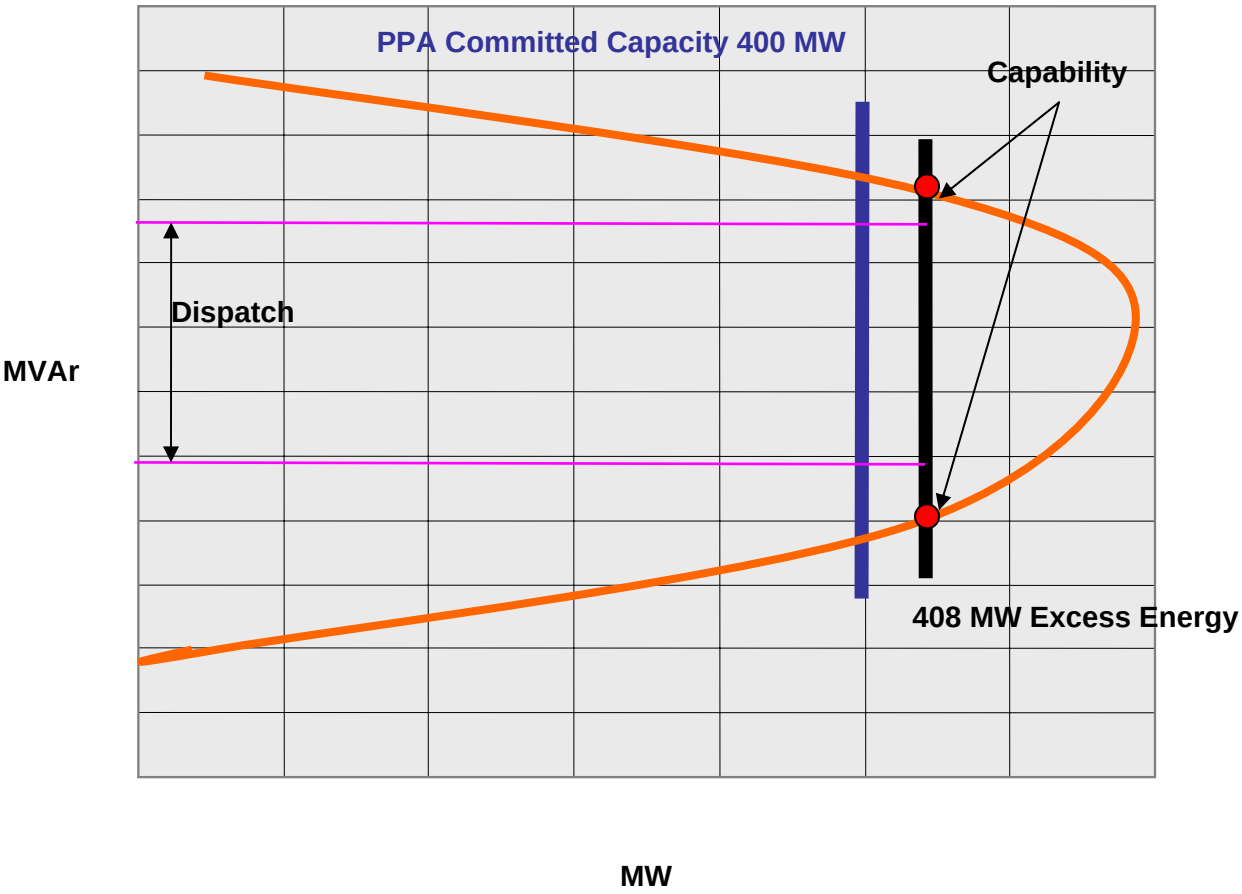
Since the committed capacity levels and inherent reactive power capability were tested and approved through the PPA regulatory process, the AESO is of the view this establishes a reasonable benchmark. However, since the PPA does not specify an excess energy MW level, the reactive power requirements for a generating unit when it is producing excess energy are also undefined. Operation in a mode where a generator is producing excess energy and maximum MW with minimal reactive capability can be unreliable for the AIES and unstable for a generator. It is therefore necessary to determine a reasonable excess energy MW limit and the associated MVAR requirements at this MW level.

[4] The PPAs were approved by the AEUB in Decisions U99073 and U99113.

From a review of historical data, it is evident that few generators actually have operated above about 2 % of the PPA committed capacity. An excess energy limit equal to 2%[5] of the PPA committed capacity is therefore deemed to be a reasonable accommodation.

Therefore, PPA generators will be required to provide reactive power capability at the existing power factor where MW output equals PPA committed capacity plus excess energy. The existing power factor information will be derived from the D-curves in the PPA. This is illustrated in the following diagram.

Reactive Capability Curve



Detailed operating procedures are provided in relevant AESO Operating Policies and Procedures, however, in principle the AESO will dispatch the PPA units within the levels of Table B 3.9 under normal conditions. Under abnormal or emergency conditions, the generator voltage regulator or the AESO System Controller may take the generator beyond the bounds of table B 3.9 up to the reactive power capability at the PPA committed capacity plus excess energy. The plant operator shall not apply any limiter within the bounds of the reactive power capability unless approved by the AESO, nor shall any plant operator manually return the generator

[5] If the PPA committed capacity was 400 MW, the excess energy capacity would be 8 MW bringing the total capacity to 408 MW.

reactive output to the bounds of Table B 3.9 without approval from the system controller with due respect to safety and risk of equipment damage.

Reactive Power Requirements for Upgrades to Generating Units

As a standard practice[6], facility enhancements that bring additional MW capacity on the AIES must be brought forward for AESO consideration through the project process to ensure reliable system operation. Through this process, unit capabilities will be verified and all system integration issues will be analysed and managed.

Upgrades are planned projects that may be justified on capital investment based on expected return on investment and known obligations. For the purpose of determining reactive power requirements for increased generator MW output, an upgrade will be deemed to be an output beyond the PPA committed capacity plus 2 %.

In the case of upgrades, all generating capacity must comply with the AESO Interconnection Requirements and the prescribed reactive power requirements will be required at any output of the generator that is in excess of the previous Maximum Authorized MW to ensure system reliability. This will include upgrades to PPA generating units in order to provide a level playing field between brown-field and green-field generation developments.

Reactive Power Requirements for New Generating Units

All new generators must meet the reactive power requirements in the AESO generator interconnection standard at all operating levels. This standard is consistent within the industry and stakeholders were consulted during the development of the standard.

Monitoring and Testing Programs

The AESO will monitor reactive power operation, enforce requirements and conduct reactive power testing in accordance with reliability standards and ISO Rules

[6] Refer to AESO interconnection process on www.aeso.ca