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The complexities and potential challenges posed by the integration of Distributed Energy Resources (DERs) into the grid entail the need for detailed studies in some circumstances. Such is the case for Battery Energy Storage Systems assets providing Fast Frequency Response (FFR). In the [FFR Pilot Lessons Learned](#) report published on June 26, 2023, the AESO indicated ongoing studies of DERs were in progress and expected to conclude in Q3 2023. Now that these studies have been successfully completed, we are pleased to share the following update with stakeholders.

In general, a DER must quickly ramp its output when providing FFR, and the incremental power injection has transient and steady-state effects on distribution feeder voltage. The ramp-down of a DER after its FFR response also affects the voltage. Distribution Facility Operators (DFOs) may have ramp rate limits to mitigate the voltage effects of fast ramping (or for other reasons). Such limits could conflict with the technical requirements for providing FFR, particularly while the DER is ramping up. Furthermore, protections implemented or required by the DFO could trip the DER to mitigate the voltage effects, thereby negating the FFR response and adversely affecting other customers. Distribution network voltages are generally regulated by upstream transformer tap changers located in a transmission substation, which may not move fast enough to correct distribution voltages when sudden changes occur.

Power Factor Determination

DFOs have raised concerns about managing the voltage effects of fast-ramping DERs. Distribution network voltages must be maintained within range to ensure power quality and voltage stability in the distribution network. The addition of DERs on load-only feeders can complicate distribution voltage management by causing feeders sharing a common transformer to have significantly different voltage profiles. Maintaining acceptable voltage profiles in the distribution network hinges on maintaining a balance of real and reactive power within the network, which in turn affects the voltage profile. Coordinated real and reactive power injection is one method for limiting the voltage deviation caused by a fast ramp. Voltage regulation by DERs could be the ultimate solution to mitigate voltage deviations. However, DFOs in Alberta do not currently allow DERs to actively manage distribution voltage using voltage regulation mode, and only fixed power factor control mode is allowed. Therefore, DFOs must determine suitable fixed power factor settings for each facility based on detailed studies to reduce the risk of unexpected DER tripping by voltage protection relays.

Ramp Rate Limits and Voltage Transients

Managing both ramp-up and ramp-down rates to limit voltage disturbances is an important aspect of distribution network voltage management, considering that the transient voltage effects of ramps depend on ramp rates. Therefore, DFOs ask that when FFR providers connect to the distribution network, transient studies are performed to simulate the full cycle of FFR response, including both the ramp-up in response to a frequency excursion and the ramp-down when the response has completed, with the goal of establishing or verifying acceptable ramp rate limits.

FortisAlberta has published its Bulk System FFR and Contingency Reserve Requirements for DER Interconnections on its website (link [here](#)). The publication outlines FortisAlberta's requirements for DERs that may be used to provide FFR services to the AESO. Other DFOs in Alberta may introduce similar technical requirements in the near future.