PRC-024-4 – Frequency and Voltage Protection Settings for Synchronous Generators, Type 1 and 2 Wind Plants, and Synchronous Condensers

General Rationale
The drafting team proposes to modify PRC-024-3 to retain the Reliability Standard as a protection-based standard with applicability to only synchronous generators, synchronous condensers, and type 1 and 2 wind plants. This proposal is a consequence of both the different natures of synchronous and inverter-based generation resources and several recent events exhibiting significant IBR ride-through deficiencies. The behavior of rotating synchronous generators during faults and other disturbances on the transmission system is well established and understood in comparison to IBR generation. The disturbance ride-through vulnerabilities of synchronous generators are pole slipping instability and undervoltage dropout of critical plant auxiliary equipment, leading to tripping of a generator. Pole slipping (or loss of synchronism) can be managed by active power dispatch constraints or stability System Operating Limits, and is outside the scope of Project 2020-02. Undervoltage dropout of critical auxiliary equipment is also outside the scope of Project 2020-02 because of complexities associated with auxiliary systems and how such equipment behaves under low voltage conditions. The Project 2020-02 Standard Authorization Request (SAR) notes that auxiliary equipment has not posed a ride-through risk and the SAR specifically excludes modifications in PRC-024-3 for auxiliary equipment.

Over-frequency protection, under-frequency protection, over-voltage protection, and under-voltage protection may or may not be applied to synchronous generating units. If applied, settings should be coordinated between the needs of generating unit protection and the no-trip zones within PRC-024-4 attachments. Coordination of generating unit capabilities, voltage regulating controls, and protection is addressed within PRC-019-2. Excitation and governing controls affect synchronous generator ride-through behavior to some degree but because of progressive improvement, standardization, and level of maturity of these controls, they are rarely a cause of unnecessary tripping during disturbances. In addition, there are other existing NERC standards to prevent unnecessary tripping of the generators during a system disturbance such as PRC-025-2 "Generator Relay Loadability" and PRC-026-2 "Relay Performance During Stable Power Swings". For these reasons, there is no need to impose actual disturbance ride-through requirements on synchronous units but only to include restrictions for frequency and voltage protection setting ranges as maintained in PRC-024-4.

Rationale for Applicability Section (4.0)
Functional Entities (4.1)
The functional entity responsible for setting frequency, voltage, and volts per hertz protection for synchronous generators, type 1 and 2 wind plants, and synchronous condensers is either the Generator Owner (GO) or Transmission Owner (TO). Planning Coordinators (PC) are retained as applicable entities only in the Quebec Interconnection. Modifications are proposed in PRC-024-4 to expand functional entity

applicability to include "Transmission Owners that apply protection" because of the inclusion of synchronous condenser applicability in section 4.2.2.

Facilities (4.2)
Applicability Facilities subparts in Section 4.1.1 were modified to restrict PRC-024-4 to synchronous generators and type 1 and 2 wind plants. Section 4.2.2 was added to cover synchronous condensers and associated equipment.

Rationale for Requirements R1 through R4
Modifications were made to Requirements R1, R2, R3, and R4 to include the Transmission Owner as a functional entity applicable to each requirement because of the addition of synchronous condensers.

Modifications were made to Requirements R1, R2, R3, and R4 to include language for type 1 and 2 wind plants and synchronous condensers and to remove language that relates to inverter-based resource (IBR) functionality since IBRs will be addressed in a new standard PRC-029-1.