

## Overview

The bulk power grid must maintain resilience despite inherent physical, operational, and reliability constraints. These constraints experience additional stress when subjected to new interconnection projects and unexpected system contingencies. Preserving grid reliability necessitates comprehensive transmission planning studies to evaluate system characteristics and develop robust contingency mitigation plans.

## Study Scope

### Feasibility Studies

Assessment that utilizes a preliminary network model to verify the basic thermal and voltage interconnection requirements.

### Site Assessment

Evaluation to compare the transmission impacts of several potential interconnection points to select the optimal geographical location.

### Voltage Control and Reactive Power Studies

These studies aim to (but not limited to) avoiding voltage collapse, specifying static var devices and sizing and allocation of capacitors.

### Interconnection or Impact Studies

Comprehensive system analysis to determine the necessary grid upgrades required to support new generation or transmission interconnection.

### Network Studies

Large-scale network analysis and application of power flows, short circuit, contingency analysis, stability simulations and other power engineering calculations.

### Fatal Flaw Studies

Assess the transmission requirements for a new power project using a quick but accurate analysis. Identify potential transmission fatal flaws before get too far along on project development.

### Transient Studies

Modelling and simulation of new or proposed equipment for switching events, over voltage, inrush/outrush currents, lightning, transient recovery voltage, fast transients, insulation coordination, breaker and capacitor applications, arrester sizing, using electromagnetic transients' software.

### NERC Compliance Studies

Performs the analytical portion of verifying, and derivation of power plant (conventional and renewables) control functions and protection embodied in the following standards:

#### Standard PRC-019-2

Coordination of Generating Unit or Plant Capabilities, Voltage Regulating Controls, and Protection

#### Standard MOD-026-1

Verification of Models and Data for Generator Excitation Control System or Volt/Var Control Functions

#### Standard MOD-027-1

Verification of Models and Data for Turbine/Governor and Load Control or Active Power/Frequency Control Functions

#### MOD-032-1

Data for Power System Modeling and Analysis

## Analytical Studies

As part of its overall project engagement or as standalone tasks, Pterra conducts the following types of analysis:

- **Power Flow Analysis** to determine thermal and voltage capabilities on an electrical circuit or grid. This may also include contingency analysis to determine impacts of outages, power factor tests to determine adequacy of voltage support, and transfer limit analysis to measure power injection capacity.
- **Short-Circuit Analysis** to determine fault levels. This may include breaker-by-breaker analysis for substations, and protection relay setting and coordination.
- **Positive Sequence Dynamic Simulations** to determine transient and dynamic stability of synchronous systems. The analysis may also be applied to voltage stability and collapse assessment.
- **Three-Phase Electromagnetic Transient Simulations**, also known as **EMTP studies**, applied to simulate transient and temporary overvoltages (TOV), capacitor switching, recovery of voltage, sub-synchronous resonance (SSR), among others.

## Software

Pterra will apply the appropriate in-house or commercial software to various engagements. In-house software<sup>1</sup> are developed for specific purposes and can be configured for particular applications. Our expertise in commercial software include GE Energy's Positive Sequence Power Flow (**PSLF™**), Siemens PTI's Power System Simulator for Engineering (**PSS®E**), PowerGEM's Transmission Adequacy and Reliability Assessment (**TARA**), Aspen Inc.'s **OneLiner™** for short circuit and relay coordination, and Manitoba HVDC Research Centre's **PSCAD™/EMTDC** for transient analysis.

<sup>1</sup>Pterra also develops in-house tools such as dqBot (see description in main brochure)