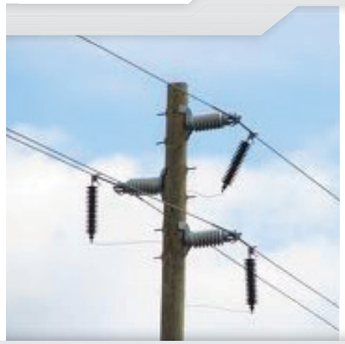
Utility Power System Studies

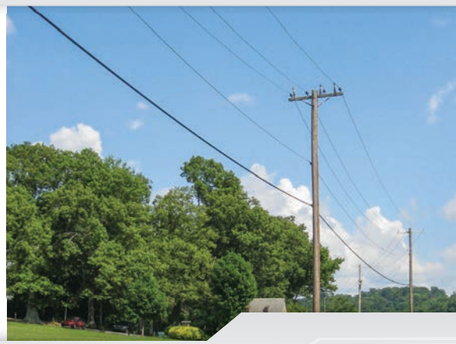
SOFTWARE TOOLS

ArcPro // ASPEN // DIgSilent // DranView // Paladin DesignBase
EMTP-RV // GridLab-D // Matlab // NexHarm // NexFlash // OpenDSS
PQView // PSCAD // PSLF // PSS®E // Simulink // TOP

OUR CLIENTS

American Transmission Company // Arizona Public Service // AWS TrueWind // Calpine // Dominion
DONG Energy (Denmark) // Duke Energy // DSTAR // Electric Reliability Council of Texas (ERCOT)
Energinet.dk (Denmark) // Georgia Power (Southern Company) // Hawaiian Electric Company
Idaho Power Company // MidAmerican Energy // Midwest Independent System Operator (MISO)
Minnesota Public Utilities Commission // National Grid // National Renewable Energy Laboratory (NREL)
Nebraska Public Power District // Northeast Utilities // Northern States Power // NSTAR
Pike Electrical Engineering // Portland Generation Electric // Progress Energy // Public Service Colorado
Public Service New Mexico // Sacramento Municipal Utility District (SMUD) // Southwestern Public Service
TenneT (Denmark) // TVA // United Illuminating // Vestas American Wind Technology // Xcel Energy





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Steady-state Studies

These studies identify system operating conditions under normal operation.

Impedance Plots Calculation

The impedance of a large power system is a function of the frequency and of the system operating conditions (generation levels, load levels, and outages). Determining the system impedance requires to build a large model and to study numerous system operating conditions and contingencies. The results of the study can be used to determine the impact of harmonics on the power system or to help SVC (static var compensator) filter designers. Impedance plots calculation is performed by using NexHarm.

REFERENCE: IEEE Std 1031-2000

Harmonic Filter Design

The combination of resonance conditions and harmonic sources at the resonance frequencies in some cases results in excessive harmonic distortion and potential harm to the power system. An harmonic filter allows limiting the impact of the offending harmonics by detuning the system. EnerNex experience in filter design allows identifying the most appropriate filter topology and size for different customers, from industrial facilities to wind plants. Harmonic filter design is performed by using NexHarm or EMTP-RV.

REFERENCE: IEEE Std. 519-1992

Inductive Coordination

The use of shared right of ways results in a tight coupling of parallel power lines or of power lines with other systems such as telephone systems or railroad tracks signaling. Coupling between the two systems may take form of ground coupling (through ground currents) or inductive coupling (through magnetic field). Inductive coordination consists in the analysis of the interference levels between two or more systems and designing mitigating solutions when required. Inductive coordination is performed by using EMTP-RV.

REFERENCE: IEEE Std. 776-1992; IEEE Std. 367-1996

Live Line Clearance

During maintenance of transmission lines, there is a concern related to safety of workers for disturbances on a nearby line. To ensure workers safety, the minimum operating and safety clearances needs to be established. Live line clearance is performed by using EMTP-RV.

REFERENCE: IEEE Std. 1427-2006

Transient Studies

These studies identify system response to major events, such as switching operation, faults or lightning.

Switching Studies

Switching of equipment on a system is a common operation, which may result in excessive overvoltage and overcurrent when compared to normal system operation. Switching studies allows determining the severity of the conditions caused by switching operation. The most common types of switching studies include the following:

- >> energization of overhead transmission lines and distribution feeders,
- >> energization of capacitor banks or reactors,
- >> transients associated with various switching actions such as fault application and clearance.

EnerNex provides a broad portfolio of switching studies, including transient recovery voltage (TRV) and temporary overvoltage (TOV) analysis. Switching studies are performed by using EMTP-RV.

REFERENCE: IEEE Std. C37 series; IEEE Std. C57 series

Insulation Coordination

Insulation coordination consists in determining insulation levels in an electrical power system or to verify that the existing insulation is adequate. Arrester sizing against switching and lightning surges is performed as part of insulation coordination. The probability of insulation failure under transient conditions is also determined. Insulation coordination studies are performed by using EMTP-RV.

REFERENCE: IEEE Std. C62 series

Short Circuit and Arc Flash Study

An arc flash is a consequence of a short circuit and current flowing in the air and may result in equipment damage and injuries to workers. EnerNex provides full service in aiding to reduce arc flash concerns, by building computer model that allows assessing the short circuit levels, calculating the safety distances and personal protective equipment (PPE) for workers, and printing arc flash labels. Short circuit and arc flash studies are performed by using CAPE, ArcPro and NexHarm.

REFERENCE: IEEE Std. 1584-2002; NFPA 70

Failure Analysis and Troubleshooting

Failure in power systems may involve substation transformers, switchgear, circuit breakers, reactors and capacitors or fuses. Causes of equipment failure include: excessive surges caused by lightning or switching events, harmonics, resonance conditions, insulation degradation, chopping phenomenon, voltage sags, over-voltages or poor grounding practices, and inrush currents.

EnerNex experience in understanding power systems operation combined with modeling capabilities has resulted in a successful solution of numerous root-cause analyses.

Recent completed root-cause-analysis included failure of equipment at different substations (including reactors, capacitors and transformers), excessive harmonics caused by control interactions, and power supply failure investigation.