INNOVATION THROUGH COLLABORATION

CEATI INTERNATIONAL

Report No. T083700 3116

Dynamic Loading of Power Lines to Increase Transmission Network Capacity

Contractor: Kinectrics

William A. Chisholm (principal investigator) and Zsolt Peter (project manager)

Toronto, ON, Canada

Dynamic Loading of Power Lines – 3116 Project

Sponsor

- CEATI Power System Planning & Operations Interest Group
- Builds on previous CEATI work in WISMIG and other groups

Background

- Transmission network capacity is limited by line voltage and by the ability of the conductors to carry current, known as ampacity.
- While system voltage tends to be fixed, the line currents are inherently dynamic with fluctuations in response to customer loads and internal system configuration.
- Additional transmission network capacity can be obtained in some cases by increasing the ampacity of lines through the use of improved survey and monitoring methods.

Dynamic Loading of Power Lines – 3116 Project

Present State of Utility Practice

- Some utilities have more than twenty years of experience with ampacity that is adjusted for ambient temperature, wind speed and solar radiation.

- Others continue to use fixed ratings, for example at 30°C and 2.2 km/h (2 ft/sec) wind speed, to match values used in the original line design.

- A third group of utilities rely on a mechanical measurement of the state of a line - such as tension, sag from an attachment point, or clearance to ground - as input to reduce the uncertainty in predictions of nearby ground clearances.

Dynamic Loading of Power Lines – 3116 Project

Contribution of This Technology Review

- Organizes the various methods for establishing and verifying transmission line ampacity, using the Smart Grid Matching Funding Qualifications such as security and interoperability.
  - Includes assessment of input data (such as using LIDAR to verify the span-by-span tensions)
  - Includes several systems for spot and distributed measurements of conductor temperature
  - Includes several approaches for mechanical state (tension, clearance, sag, vibration frequency)
- Evaluates results from utility case studies.
- Identifies issues such as interoperability that could be resolved to improve the effectiveness of future dynamic rating projects.

Dynamic Loading of Power Lines – 3116 Project

Conclusions of this Technology Review

- Some thermal rating projects met the Smart Grid matching-fund qualifications much better than others.

- Two complementary technologies solve an operational difficulty different ways:
  - Magnetic field approach gives independent measurement of current
  - End-to-End resistance (synchronized phasor) increases accuracy of existing, “secure” monitoring by two orders of magnitude (four significant figures for current).

- Intercomparisons among technologies are of limited duration and the industry probably needs to support a more sustained effort, similar to that proposed for collecting weather data.

- CEATI reports are available for purchase at www.ceati.com, +1 (514) 866-5377 .