



**KINECTRICS**

# Plant and Distribution Cable Life Management

Complete Field & Laboratory Assessment Services



# FIELD TESTING SERVICES

Kinectrics provides comprehensive in-situ condition assessment to enhance reliability, safety, and investment efficiency. Kinectrics' experience and results driven approach supports the development of test programs that are tailored to the needs of customers. Our graded methodology aims at reducing risks of "False Positive" and "False Negative" results, within the financial and operational constraints of the application.

## CORE ELEMENTS OF KINETRICS CABLE FIELD CONDITION ASSESSMENT



### Scientific

Integrates proven fundamentals, extensive research and field experience



### Systematic

Process driven protocols with transparent decision making



### Advanced

Combination of advanced, diverse diagnostic technologies to maximize defect sensitivity



### Technology Independent

Technology choices driven by specific application needs



### Risk Optimized

Tailored for low risk tolerance, high reliability applications



### Economically Intelligent

Localizes and grades problems to support investment targeting and deferral decisions

## CORE TECHNIQUES DEPLOYED

Kinectrics applies a suite of core techniques which are selectively combined to meet client requirements. The combination of various techniques allow the technical merits of both AC (50/60Hz) and low frequency methods to be realized. It also maximizes sensitivity to a variety of defects, including localized dry electrical defects, moisture ingress, shield irregularities, thermal aging, and radiation aging. Technique application is based on nearly 40 years of extensive experience by Kinectrics (including predecessor Ontario Hydro Research) in LV / MV cable commissioning and aging management, continuous technology benchmarking, applied research, and immersion within international standards committees and working groups.

Technique	Low Voltage Cables	Medium Voltage Cables
<b>Withstand Testing</b>		
Primary Insulation		
Power Frequency 50 / 60Hz, VLF 0.1Hz		✓
Jacket (DC)		✓
<b>Locally Sensitive Diagnostics – Electrical</b>		
Broadband, Multi-Sensor 50 / 60Hz Partial Discharge		✓
Time Domain Reflectometry	✓	✓
Frequency Domain Reflectometry (including LIRA™)	✓	✓
<b>Globally Sensitive Diagnostics - Electrical</b>		
Dielectric Spectroscopy	✓	✓
VLF (0.1Hz) Tangent Delta		✓
Polarization / Depolarization Current	✓	✓
Metallic Resistance	✓	✓
Insulation Resistance	✓	✓
<b>Physical / Material In-Situ Diagnostics</b>		
Indenter	✓	
Portable FTIR, NIR	✓	
Infrared Thermography	✓	✓
Micro-sampling of Jacket / Insulation Materials	✓	

## LIFE CYCLE STAGES SUPPORTED

Kinectrics owns a large suite of mobile test equipment complemented by specialist technical services that can be deployed to support:

- Commissioning, acceptance, and post-repair
- Maintenance and condition assessment
- Anomaly investigation and troubleshooting
- Prioritization of cables and cable segments for replacement
- Localization of defects to minimize replacement impact



# IN-LAB CABLE TESTING SERVICES

## INDEPENDENT LABORATORY QUALIFICATION & TYPE TESTING – MV CABLES

- ISO17025 accredited laboratory for Qualification and Type Testing according to relevant industry standards, including IEC and IEEE.



## CONTRACT R&D

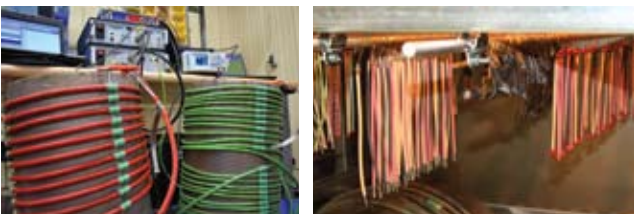
Kinectrics offers custom cable research test program development, execution and consulting, with an extensive history in this field tracing to roots as Ontario Hydro's Research Division.



## LABORATORY CONDITION ASSESSMENT

Kinectrics provides comprehensive services for the condition assessment of service-aged LV and MV cable insulation and outer jackets. In the laboratory, our core field testing techniques are supplemented by additional electrical and material testing capability and can also rely on our ISO17025 certified analytical chemistry lab. Additional capability includes:

- Timed AC Breakdown Testing
- Thermogravimetric Analysis
- Differential Scanning Calorimetry (DSC)
- Elongation-at-break insulation testing
- Neutron Activation Analysis (NAA) of insulation
- Chemical testing and analysis (by extraction and chromatography)



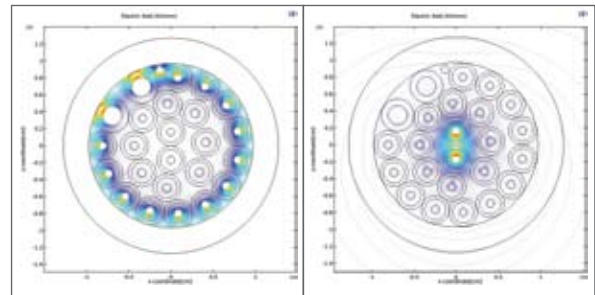
## FAILURE ANALYSIS

- Data collection and visual inspection (including capabilities for radioactive and hazardous materials)
- Comprehensive non-destructive electrical cable and accessories testing
- Macroscopic and microscopic examination, dissection, and metallographic analysis of components
- Chemical and physical characterization of insulation material (FTIR, DSC, TGA, GC-MS)



## SIMULATION AND FORENSIC STUDIES

- Electrical system level studies (steady-state or transient, insulation coordination, grounding) to identify system based root causes in forensic studies
- Component level studies (i.e. multi-physics simulations based on Finite Element Analysis)



## ENVIRONMENTAL QUALIFICATION (EQ) - MV/LV CABLES

Kinectrics has the specialized capabilities (mechanical/electrical/chemical) and accredited laboratory facilities to provide complete environmental and equipment qualification services.

Examples include:

- Determination of activation energy for insulation/jacket compounds
- Controlled thermal and radiation aging according to industry standards (IEEE 383 and IEEE 323).
- Functional electrical testing of unaged and aged samples
- Seismic testing
- Design Basis Event testing (LOCA/HELB)





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