



# Cable Life Cycle Management Services





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**Our holistic cable offering helping you achieve the lowest cost of ownership for your cable assets.**

Electricity networks have been leaders in asset management for decades. For most asset classes, there are detailed asset management plans in place which are continuously improved and refined.

Underground cables are a vital and significant part of the electricity network, but these assets have largely been forgotten from detailed asset management plans. Historically, networks have benefitted from a high degree of redundancy and surplus capacity in their circuits. Cable failures did not necessarily lead to network failures and outages, and buried cables have been out of sight, and out of mind.

As we transition to a net-zero carbon economy, electricity networks will carry increasing demands, including higher loads, changing load profiles and a need for greater flexibility. At the same time, regulatory scrutiny is increasing to try and control costs while ensuring networks are ready to meet these challenges.

In this context, proactive planning, measurement and management of cable assets is becoming more important.

Our strength is offering services across the cable life cycle. By combining materials and cable design expertise with lab and field testing, we have insights into cable performance and ageing that nobody else has. This lets us do the planning and asset strategies better than anybody else.

**Our strength is offering services across the cable life cycle** by combining materials and cable design expertise with lab and field testing.

# Your trusted partner for cable expertise

Kinectrics' cable life cycle management services support all stages of the cable life cycle to help ensure safe and reliable operation of your network with data-driven, pragmatic investment decisions.

## Cable Life Cycle Management Services

### Stage 1

#### Engineering Design & Consultancy

- › Requirements/Front End Engineering Studies (FEED)
- › New Product Development Support
- › Research and Development for Industry Organizations
- › Cable and Insulator Design Consultancy
- › Subsea Cable Technology
- › Maximizing Asset Value

### Stage 2

#### Manufacturing

- › Next generation cable technology materials design and testing
- › Factory Type Testing of HV Cables
  - › Qualification Tests
  - › Independent Expert Witness
  - › Independent Testing Consistent with Standards
  - › Non-Standard Testing

### Stage 3

#### Installation

- › Third Party Commissioning
- › Advanced Diagnostic Testing During Installation
- › Integration into Your Existing Systems

### Stage 4

#### Operation & Maintenance

- › Maintenance Testing and Ageing Management
- › Asset Condition Assessments
- › Advanced Diagnostic Testing - Partial Discharge
- › Anomaly Investigation and Troubleshooting
- › Achieve Maximum Value of Your Assets

### Stage 5

#### End of Life/Life Extension

- › Cable Asset Management/End of Life Studies
- › ISO55000 Asset Management
- › Failure Analysis and Forensic Studies
- › Ageing Fluid-Filled Cable Solutions

**We provide you with the best data on your cable system** that enables you to make risk-based decisions based on an understanding of your assets and the options available to you.





Stage 1

# Engineering Design & Consultancy

## Requirements/Front End Engineering Studies (FEED)

### New Product Development Support

- › T&D products have been tested and verified in our laboratories for many years
- › Our ongoing involvement in the application and testing of new products helps us remain up to date with new technologies and applications

### Research and Development for Industry Organizations

- › Industry collaboratives with UK Distribution System Operators, Transmission Owners, ENA, EIC and Academia
- › Collaboratives with Electric Power Research Institute (EPRI) and Centre for Energy Advancement through Technical Innovation (CEATI) for research into systems performance and cable ageing
  - Including studies on the feasibility of using alternative materials, materials ageing and condition assessment techniques

### Cable and Insulator Design Consultancy

- › Experienced materials scientists
  - A track record of designing and testing new materials for electrical application
  - Networks and systems sustainability combined with advanced technology knowledge
  - Technically unbiased – Our subject matter expertise spans across a wide range of technologies for the most technically challenging applications

### Technology Offering

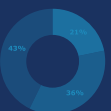
- › Water blocking technology
- › Fluid-filled cables
- › Cable insulation materials capabilities
- › Anagen™ technology



A track record of designing and testing new materials for electrical application



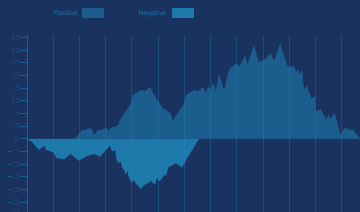
Technically unbiased – Our subject matter expertise spans across a wide range of technologies for the most technically challenging applications



Including studies on the feasibility of using alternative materials, materials ageing and condition assessment techniques



Networks and systems sustainability combined with advanced technology knowledge



60%



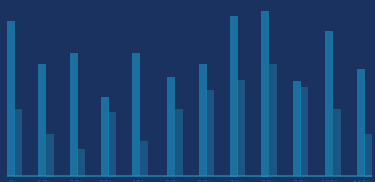


Stage 2

## Manufacturing

### Factory Type Testing of HV Cables

- › Test to ANSI, UL, IEEE, AEIC, NEMA, CEA, IEC and other national and international standards including:
  - Visual Corona Test
  - Radio Interference Voltage (RIV) Test
  - Contamination – solid layer, clean fog method
  - Partial Discharge Testing
  - Wet and Dry Power Frequency Withstand and Flashover Test
  - Dry Lightning Impulse Critical Flashover and Withstand Test
  - Steep Front Impulse Voltage Test
  - Materials Testing
- › Qualification tests
- › Independent expert witness
- › Independent testing consistent with industry practice
- › A flexible approach to customer-specific standard testing



87%



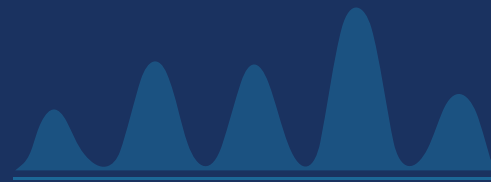
36%



24%



74%



21.5

33.1

31.8

59.4

22.6





Stage 3

## Installation

### Third-Party Commissioning

- › High Voltage in-field commissioning testing
- › One-stop, independent experts for HVAC testing, testing in compliance with industry standards
- › Post repair testing
- › Maintenance testing
- › SCT36 testing

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### Advanced Diagnostic Testing

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### Integration into Your Existing Systems



## High Voltage Testing

- › Insulation DC Voltage Withstand Test
  - AC oil-filled cable systems only
- › Insulation DC Withstand Test
  - mass-impregnated HVDC cables only
- › Insulation AC Voltage Withstand Test
  - AC XLPE insulated cable systems only
- › Partial Discharge Testing
- › Cable Conductor Resistances
- › Circuit Positive and Zero Sequence Impedances
  - AC cables only
- › Oversheath Voltage Withstand Testing
- › Verification of Single Point Bonded Sheath System
- › Verification of Cross-Bonded Sheath System
- › Sheath System Contact Resistances
- › SVL (Sheath Voltage Limiter) Operating Voltage Testing
  - zinc oxide SVLs only
- › SVL Visual Inspection and Insulation Resistance Testing



Kinectrics-owned fleet of Resonant Test Systems (RTS) globally for longer and higher voltage cable testing and rapid deployment in Europe



Partial discharge diagnostics expertise





Stage 4

## Operation & Maintenance



### Maintenance Testing and Ageing Management

- › Localization of defects to minimize replacement impact
- › Accurate, technology agnostic and adaptable testing
  - Test programs within the technical, practical and economic constraints of our customers
- › Large suite of mobile test equipment
- › Highly trained specialists and engineers

### Asset Condition Assessments

#### Power Plant Ageing Management Programs, Cable Condition Assessment Testing

- › Shielded and unshielded cable testing

#### Dynamic and Thermal Cable Modelling

- › Seek technical solutions to significantly improve the power density of such bottlenecks
- › Understand the best approach to technical solutions targeted at the bottleneck
- › Understand the best approach to targeted investment and possible investment deferral
- › Enhance network performance
- › Increase capacity without increasing the risk
- › Less reliance on inaccurate ratings that promote over specification and unnecessary reinforcement
- › Increase the current knowledge base and cable data libraries

### Advanced Diagnostic Testing

- › Terminal Partial Discharge Testing
- › Distributed Partial Discharge Testing
- › Dielectric Spectroscopy – dielectric loss over broad frequency range
- › Time and Frequency Domain Reflectometry (TDR and FDR)
- › Optical Time Domain Reflectometry (OTDR)
- › Withstand Testing
- › VLF Tangent Delta
- › Polarization/Depolarization Current
- › Metallic Resistance
- › Insulation Resistance

### Anomaly investigation and troubleshooting

### Achieve maximum value of your assets

**Comprehensive test analysis results produced by our in-house TAASK (Test Acquisition, Analysis, Storage) software to support the digitization of asset management data**





Stage 5

## End of Life/Life Extension

### Cable Asset Management/End-of-Life Studies

- › Develop Strategic Asset Management Plan (SAMP) and Asset Management Plan (AMP) in accordance with ISO55000 requirements
- › Provide or assist with selecting appropriate Asset Performance Management (APM) software solutions
- › Rate filing application support
- › Optimize total life cycle costs and facilitate end-of-life decisions, i.e. replace, refurbish, rehabilitate
- › Review and recommend improvements to your existing Asset Management decision-making process
- › Advise on how to support deferral of investment while maintaining a resilient network
- › Assist with demonstrating your compliance with legal, statutory and regulatory requirements

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### ISO 55000 Asset Management

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### Failure Analysis and Forensic Studies

- › Kinectrics personnel are trained in failure analysis and root cause determination. Kinectrics facilities contain extensive lab equipment to support virtually all aspects of failure analysis.
  - Data collection and visual inspections
  - 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, SEM-EDS)
  - Electrical system level studies (steady-state or transient, insulation coordination, grounding) to identify system-based root causes
  - Component level studies (i.e. multi-physics simulations based on Finite Element Analysis)

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### Ageing Fluid-Filled Cable Solutions

- › Anagen™, Kinectrics' self-healing fluid, is a 'no-dig' repair solution developed to reduce and eliminate fluid leaks from low-pressure fluid-filled cables.
  - Eliminates leaks up to 70 litres per month
  - Contains environmental contamination
  - Maintains electrical performance of cable systems
  - Integrates easily into existing operations and equipment





## About Kinectrics' T&D Life Cycle Services

**Our tailored life cycle services are achieved through use of our state-of-the-art labs, field services and consultancy:**

- › High Current & High Voltage Laboratories
- › Dynamic Conductors Lab & Seismic Tables
- › Connector & Hardware Laboratories
- › Real Time Digital Simulator & Our New GRIDSIM Laboratory
- › Thermal & Voltage Endurance Laboratories
- › Safety Equipment Testing Laboratories
- › LineVue® Robot for Conductor Inspection & Condition Assessment
- › Tower & Conductor Vibration Monitoring
- › Advanced Mobile Field Service Testing
  - Cables
  - Gas Insulated Substations
  - Protection & Control
  - Substation Testing on Transformers, Switchgear, Ground & Lightning
- › Renowned Technical Experts - Multidisciplinary Engineering Consultancy
  - Power System Studies
  - Asset Management, Asset Condition Assessments, Software Solutions
  - Failure Analysis
  - Customized Training Services

Kinectrics' Transmission and Distribution (T&D) Technologies group provides **testing, inspection and certification on all the T&D assets.**



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