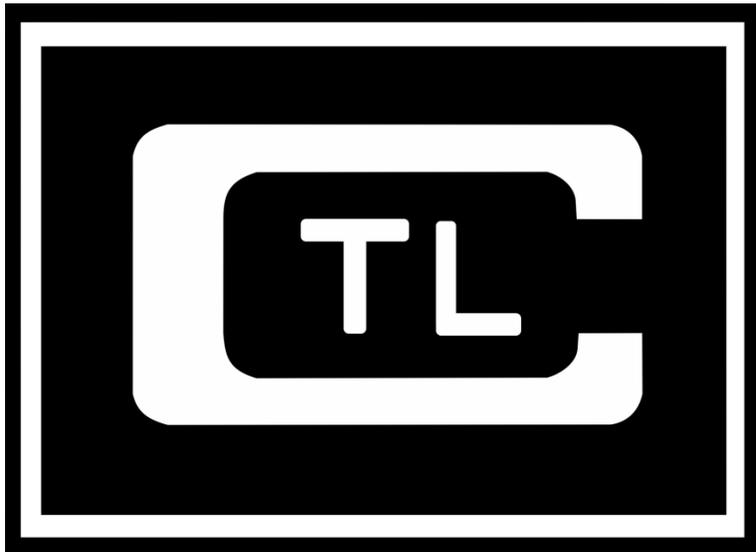


**OVER 40 YEARS OF PROFESSIONAL,  
INDUSTRY EXPERIENCED SERVICE!!**

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**CABLE TECHNOLOGY  
LABORATORIES**

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**INTEGRITY • ACCOUNTABILITY • TRUST • COMMITMENT**

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**GUIDE TO OUR PRINCIPAL  
SERVICES**

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**ISO/IEC 17025:2017 ACCREDITED**

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## HIGH VOLTAGE TESTING OF CABLES AND ACCESSORIES

CTL is equipped to conduct high voltage tests on electrical apparatus and specializes in testing extruded and laminar power cables and accessories. Test equipment includes high voltage a.c., impulse and d.c. sets, high and low frequency high voltage sets. Partial discharge, ionization factor, dissipation factor, impulse, a.c. and d.c. voltage breakdown and high-voltage time tests can be conducted on cables, joints and terminations for all types of distribution and transmission cables rated through 138 kV. Experienced engineers are available to interpret test data of all types of oil-paper insulated and extruded cables, as well as joints and terminations.



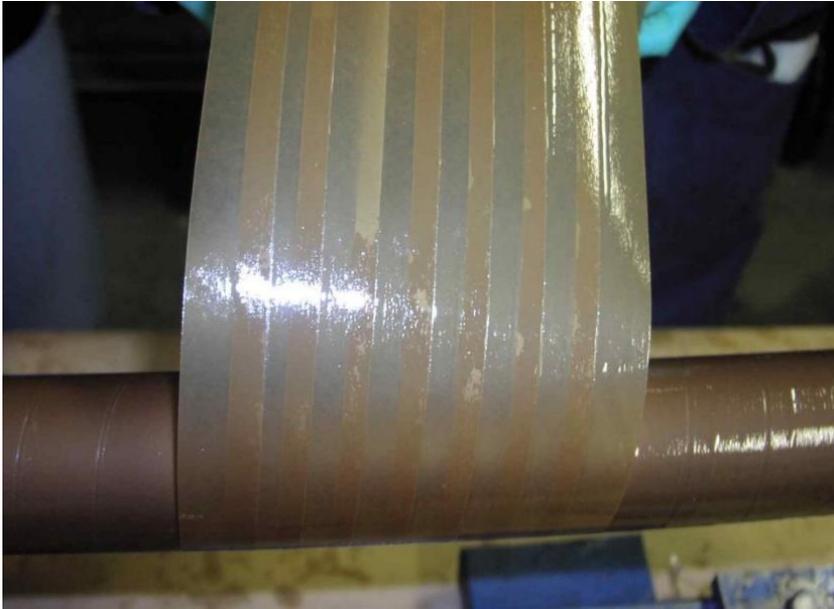
## ACCEPTANCE TESTING AND IN-PLANT CABLE INSPECTION



Cable Technology Laboratories conducts key dimensional, electrical and physical tests on cable samples to ensure compliance with applicable specifications. This service is low cost and provides a rapid response to ensure cable quality. Staff members have cable manufacturing experience in all types of extruded dielectric and paper-oil cables and the capability of detecting the defects which shorten cable service life. This service can include a CTL inspector at the plant to witness key manufacturing processes and final testing of completed cables and to select samples at random for further testing.

## **LAMINAR DIELECTRIC CABLES**

Staff members have direct experience in the design, manufacture and testing of all types of paper or paper-polypropylene oil impregnated cables, components and accessories. They have similar expertise in varnished cambric and paper-insulated flexible transformer lead cables. Facilities are available for testing components of high voltage paper-oil insulated cables and for evaluating new and service-aged cable components. CTL can furnish test data on in-service cable degradation, estimating remaining cable service life and the analysis of cable quality and in-service failures. Research programs related to performance of all types of laminar dielectrics can be conducted.



## **ASSISTANCE TO THE LEGAL PROFESSION**

Forensic investigations and cable testing services are provided to determine the cause of power cable failures. CTL engineers are available to give depositions pertaining to cable design, suitability, application and performance of all types of cable and to serve as expert witnesses. When required, engineers conduct field and laboratory tests and determine the adequacy and quality of cable installations. Staff members possess over 50 USA and foreign patents pertaining to the design, manufacture and installation of underground and submarine power cables, joints and terminations; and have authored over 100 technical publications on these subjects.

## **DETERMINATION OF CABLE LIFE EXPECTANCY**

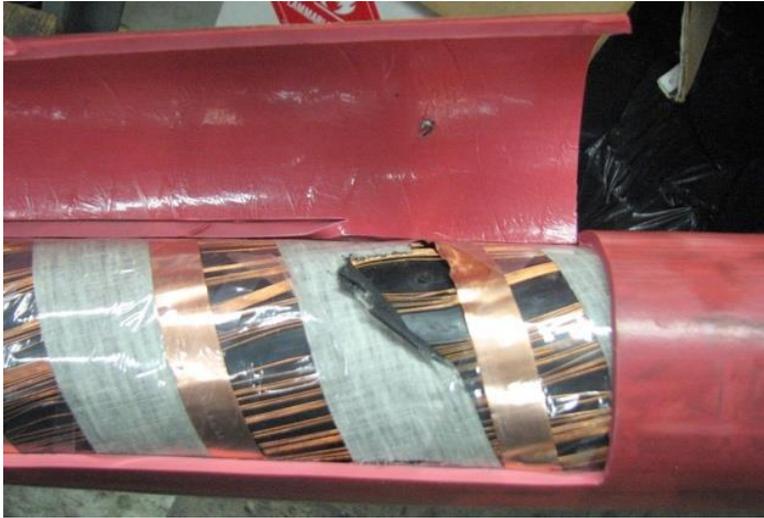
CTL can evaluate cables which have been exposed to severe or unusual service conditions and where doubt exists concerning the remaining useful life. Such cables are characterized by degradation in the insulation, but not to an extent that excessive service failures have occurred. Extruded dielectric cables have their service life shortened principally by moisture ingress, voids and contaminants in the insulation and by an excessive increase in shield resistivity. Solid type paper-oil insulated cables and low pressure (gas-filled) cables have service life shortened principally by partial discharge in the insulation. An assessment of remaining service life is provided.

## CTL 40 YEARS

### MILESTONES AND ACHIEVEMENTS

- Participation in establishing the nature, and developing adequate testing approaches for water treeing in polymeric insulations
- Invention of methodology to rehabilitate (rejuvenate) aged cables having XLPE or EPR insulation
- Basic study of transient breakdown voltage in solid dielectric cables
- Development of cross linked polyethylene insulated cable for cryogenic operation
- Establishing thermal overload characteristics of extruded dielectric cables
- Development of a cable manufacturing process using dry-cure with internal pressurization
- Aging study of distribution cables at ambient temperature with surges
- Thermal issues and rating of separable insulated connectors
- Development of criteria for VLF testing of extruded cables
- Failure mechanism assessment of MV EPR cables
- Development of methods to assess condition of aged paper insulated cables both medium and high voltage (PILC, LPGF, MPGF, and HPGF, HPFF, and Self-Contained)
- Numerous R&D projects resulting in the development of novel designs, manufacturing regimens, procedures, and test methods for cables and accessories:
  - Heat shrinkable accessories
  - Cable moisture barriers
  - Connectors for stranded conductors with impaired contact between strands (for instance, due to water blocking materials in interstices)
  - The need for prompt testing of aged extruded cables after de-energizing due to a rapid regeneration of dielectric strength

- Development and performance of customer-oriented test programs for supporting their quality assurance systems, including:
  - Design, type and qualification tests on all type of cables and accessories
  - Acceptance, compliance, and claim testing
  - Factory audits
  - Witnessed manufacturing tests
  - Failure analysis
  - Comparative testing of alternative design and brand products
  - Accelerated aging tests
- Development of new test methods, procedures and equipment for evaluation of different type cables and accessories:
  - Torsion test for cables used in drip loops of wind turbine generators
  - Evaluation of splice structure by measurement of contact resistance between individual strands and connector barrel
  - Instrumental evaluation of soft spots in paper insulated cables
  - Methods of finding and visualizing water trees in dark polymeric insulations
- Evaluation of newly developed test methods and equipment:
  - Very Low Frequency (VLF) method for diagnostic and maintenance testing of aged cable systems
  - Several versions of partial discharge testing and monitoring systems
  - Line resonant test system (LIRA).
- Failure analysis and research projects resulted in findings of significance to the industry:
  - The need for additional steps in pressurization schedule for high pressure fluid filled cables lacking oil
  - The effect of inter-granular corrosion cracking in flat strap neutrals of heavily loaded cables
  - Overheating of accessory connectors in heavily loaded cable systems



### **FAILURE ANALYSIS OF CABLE AND ACCESSORIES**

Special techniques for dissection of cables and their components have been developed at CTL for conducting post-mortem analysis. These techniques are useful for all URD, feeder and transmission cables, and for all types of paper-oil insulated cables. Microscopes, special dyeing techniques and voltage breakdown equipment are available to establish the extent of water tree damage; the most usual cause of extruded type cable degradation. Special magenta dyeing techniques to study wax formation, caused by disarray in the insulation structure, are available to establish the extent of ionization damage in paper-oil insulated cables.

### **CABLE APPLICATION ENGINEERING**

CTL was founded in 1978 by engineers with research, engineering, manufacturing and installation experience covering all types of underground power cables. Such experience is useful to cable users when designing new systems, changing old ones and adapting new types of cables to old systems. The technical decisions of our engineers are backed by in-house testing of both laminar and extruded cables and transition between both types. Staff members have published numerous technical papers pertaining to cable engineering and have been active members of the IEEE Insulated Conductors Committee since 1950.

### **CABLE LIFE EXTENSION TESTING**

CTL has developed means to extend the life of extruded dielectric cables that have been damaged by water trees in the insulation. Testing support is provided to power utilities and industrial users of high voltage cables to establish the condition of their cable circuits and if cable upgrading is suitable to achieve longer life. The testing of samples of in-service cables can be useful to the user engineer when making the decision to replace, upgrade or continue the cable in service. When these tests are performed before and after application of one of the available techniques, it allows one to establish the potential improvement to be achieved. An assessment of remaining service life can be provided.



### **A FEW WORDS ABOUT CTL**

Cable Technology Laboratories is an independent laboratory specializing in the study and testing of power and control cables, accessories and other related electrical equipment of cable systems.

The facilities include modern test equipment for evaluation of extruded and laminar cables. Electrical, physical and mechanical testing is patterned to meet customer needs. The work is supervised by specialists having more than 30 years of experience in the manufacturing and testing of extruded and laminar cables and accessories. Laboratory technicians provide responsive direct support to staff members, assisting them to expedite problem solving. Our specialists have conducted R&D programs which have resulted in numerous technical papers and USA/Foreign patents pertaining to the design, manufacture and testing of power cables and components. A list of pertinent technical articles is available upon request.

### **OTHER SERVICES**

AEIC Qualification Approval Testing  
of XLPE and EPR Cables

AEIC Specification testing of HPPF and  
LPPF cables

New cable material investigations

Cable joint and termination evaluations

NRECA Quality Assurance Program

Cable reliability audit

Lecture on cable technology

Troubleshooting cable installation

Secondary network cable overload/damage testing

Paper insulated transformer and lead cables

Evaluation of cable components

Generating plant cable testing

Cable joint mechanical testing

Purchase specification writing

Varnished cambric cable testing

New product investigations

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