



GeothermUSA

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INSTRUMENTATION, TESTING AND CONSULTING SERVICES **T & D, UNDERGROUND AND SUBMARINE POWER CABLE APPLICATIONS**

May we take a few minutes of your time to introduce our company and services that we offer to electric utilities, cable manufacturers/installers and consulting engineers in the field of high voltage transmission & distribution.

Geotherm was founded in Canada; offering consulting and testing services for the measurement and analysis of thermal parameters using state-of-the-art technology. These find applications in numerous fields where the knowledge of heat and mass transfer through natural as well as man-made materials is essential. The soil is of particular importance in view of the modern trend in utilizing the sub-surface for many purposes. **Underground and submarine power cables**, storage and containment of radioactive spent fuel, and the utilization of earth energy for space heating and cooling via ground-coupled heat pumps are prime examples where this knowledge of soil thermal properties is a must.

As a result of pioneering work performed for the electrical industry in North America, **Geotherm** has developed test and measurement instruments, and the technology whereby results of a high degree of accuracy are obtained rapidly and economically. The practical applications are limitless because the test equipment is portable and ideally suited for field as well as laboratory use.

In addition to route thermal surveys, laboratory testing and design of corrective thermal backfills for power cable projects. We have over 500 route thermal survey projects to our credit; ***including underground and submarine crossings of record lengths***. The South China Sea (Bakun - 640 km), Baltic Sea (Sweden-Poland, 230 km), Australia - TransEnergie US (180 km HVDC cable), Persian Gulf - U/G and submarine (60 km), NYPA - U/G and submarine (50 km), NEES- submarine (80 km), KeySpan Construction (35km) are prime examples.

We were part of the team of experts retained to investigate the cable failures in Auckland, New Zealand.

Please call us if you have any questions or require further information.

Geotherm Inc.

Deepak Parmar, President

COOL SOLUTIONS FOR UNDERGROUND POWER CABLES
THERMAL SURVEYS, CORRECTIVE BACKFILLS & INSTRUMENTATION
25 years in the service of the Electric Power Industry



KEY PERSONNEL, EXPERIENCE AND EXPERTISE

Deepak Parmar, President (Canada Office)

B.Sc. Civil Engineering, Woolwich Polytechnic, UK, 1966
Diploma in Management Studies (DMS), Slough, UK, 1972

Member: Engineering Institute of Canada
 Canadian Society for Civil Engineers
 Canadian Geotechnical Society
 Canadian Society for Electrical and Computer Engineers
 Tunneling Association of Canada
 IEEE/PES/ICC
 Canadian Electrical Association
 CEGRE

1960-1978: Worked on various civil engineering (soil and rock mechanics) projects in UK and Canada. Formed Geotherm Inc., in 1978 and since then worked solely on underground and submarine power cable projects in Canada, USA and overseas.

J. E. (Jan) Steinmanis, P. Eng., V.P.

B.A. Sc., Civil Engineering, University of Toronto, Canada, 1975

1976-1982, Research Engineer with Ontario Hydro. Worked on several civil engineering projects and on the electric Power Research Institute (EPRI) funded projects for the Development of Thermal Property Analyzer. Conducted numerous research projects including the soil geotechnical-thermal properties database for Canada. (Project sponsored and funded by the Canadian government).

H. S. Radhakrishna, Ph.D., P. Eng. V.P.

B.E., Civil Engineering, University of Mysore, India, 1960
M. Eng., Soil Mechanics and Foundation Engineering, Ind.Int.of Sc., India, 1961
Ph. D., Geotechnical Engineering, University of Waterloo, Canada, 1967

Member: Canadian Nuclear Society
 Canadian Society for Civil Engineers
 Canadian Geotechnical Institute
 Canadian Electrical Association
 IEEE/PES/ICC

Senior engineer with Ontario Hydro Research 1967-1994. As a specialist in soil mechanics, has conducted numerous studies on thermal analysis of soils. These include research in heat and mass transfer in soils and backfills. Co-leader of the EPRI sponsored research project on the development of the Thermal Property Analyzer, and co-leader of the Canadian Electrical Association sponsored project of software development for power cable ampacity calculations and the development of fluidized Thermal Backfills. Presented numerous papers and publications in the area of geotechnical and thermal soil mechanics research. Joined Geotherm Inc., in 1994.



Geeta Parmar, Vice President (US Office)

B.A. Hon., York University, Toronto, Canada

Diploma – Civil Engineering Technician, Seneca College, Toronto, Canada

Member: IEEE/ICC

Conducted route thermal surveys for underground transmission line projects, collected test samples, conducted laboratory related testing and writing reports. Performed Quality Assurance (Q/A) testing of backfills and project supervision. Office management and project scheduling duties were also undertaken. Additional duties include assembly of test instrumentation and accessories.

Nimesh Patel, President (US Office)

University of Alabama, B.S.

Member: IEEE/ICC

Conducted route thermal surveys for underground transmission line projects, collected test samples, conducted laboratory related testing and writing reports. Performed Quality Assurance (Q/A) testing of backfills and project supervision. Office management and project scheduling duties were also undertaken. Additional duties include assembly of test instrumentation and accessories.



SERVICES FOR THE ELECTRIC POWER INDUSTRY

Geotherm is diversified engineering company offering a range of services and test equipment to meet particular needs of the T&D departments of electric power industry. Applications arise wherever power facilities are in contact with the earth and depend upon one or another of its properties. Such instances may range from foundations supporting buildings, transmission lines and equipment, to the burial of transmission and distribution power cables.

The economical design and satisfactory performance of these earth-related elements of a power system depend upon the proper evaluation of the mechanical and thermal properties of the ground strata. This is what **Geotherm** is equipped to do by way of engineering and testing services and the design and manufacturing of measuring and monitoring equipment.

The technical services offered by **Geotherm** have the unique capability of being able to address both the geotechnical and geothermal engineering aspects of problems with equal facility. Proven expertise and capability from long term consulting and instrumentation experience in this field are backed-up by comprehensive support facilities to perform all of the required testing in the field and the laboratory. We are pleased to place our resources at your services for:

- 1. Site investigation and cable route thermal surveys**
- 2. Laboratory testing**
- 3. Field testing and monitoring**
- 4. Instrumentation design, manufacturing & implementation**
- 5. Design and testing of corrective thermal backfills**
- 6. Engineering consultation**
- 7. Contract research and development**



LIST OF CLIENTS AND PROJECTS

CANADA & USA

Ontario Hydro	Hydro Quebec
B.C. Hydro	PowerTech Labs
Edmonton Power	New Brunswick Power
Norsk Hydro	ASL Environmental Sciences
Water Works Dept. City of Calgary	Atomic Energy Canada Ltd.
National Research Council Canada	Energy, Mines & Resources
Geological Survey of Canada	CANMET
Dept. of Supply & Services Canada	University of Calgary
Dept. of National Defense	MIG Engineering Ltd.
Chinook Phi-Beta	Cominco Engineering Ltd.
Carleton University	University of Waterloo
McGill University	Husky Oil
Nixon Vicarb	Trow Consulting Engineers
Warnock Hersey Consultants	SIAL International
Thompson Research Ltd.	Georoch Ltd.
N.R.G. Consultants Ltd.	Ground Loop Systems
Group Eight Engineers	M.V. Mark, Inc.
Comstock Canada Constructors	Alcatel Canada Wire & Cables
Hitachi Cables, Ltd.	Pirelli Cable Corp.
Burnside Development Services	Great Lakes Power
Atlantic Electric	South Maryland Electric Coop.
New York Power Authority	Long Island Lighting Co.
Indeck Energy Service	ConEdison of New York
Florida Power & Light	Orlando Utilities Commission
Westinghouse Electric Coop.	Public Service Co. of Colorado
Iowa Power	Tampa Electric
Green Mountain Power	Wasa Electric
Hawaiian Electric	United Illuminating
City Public Service, Texas	Southern Cal-Edison
San Diego Gas & Electric	Louisville Gas & Electric
Pacific Gas & Electric	Los Angeles Water & Power
City of Roseville, California	Public Service Electric & Gas
Philadelphia Electric (PECO)	Sierra Pacific Power Co.
Boston Edison	Wisconsin Electric
Potomac Electric Power Co.	Wisconsin Power & Light
Omaha Public Power Dist.	Desquesne Light Co.
New England Electric	Virginia Power
Northern States Power	P.S.I. Energy
U.S. Dept. of Energy	Kansas City Power & Light
Rochester Gas & Electric	Puget Power
Vermont Electric Power Co.	BICC/CABLEC
Nevada Power Co.	Fujikura America
American Electric Power Corp.	Baltimore Gas & Electric
ONCOR, TX	Boyer



CANADA & USA (cont.)

Infrasource Inc.	Barrie Hydro
Commonwealth Edison	Colorado Springs Utilities
City of Austin	DISNEY Corp.
Central Power & Light	Texas Utilities
Indeck Energy Services, Inc.	Bechtel International Inc.
Ohio Power Co.	Pirelli Cables
Lake Mead Constructors	U.S. Navy, Anaheim, Cal.
ACME Electric	CSW (Texas)
WYO-BEN, Inc.	Electric Power Research Institute
National Bureau of Standards	Power Delivery Consultants, Inc.
WW Engineering & Science	Sargent & Lundy Engineers
Woodward Clyde Consultants	Sandia National Laboratories
Georgia Power (Research Cntr.)	South Dakota State University
Oklahoma State University	University of Wisconsin
University of Nebraska at Lincoln	University of Alaska at Fairbanks
Black & Veatch Corporation	Electrical Constructors
R.W. Beck	Power Technologies, Inc
Power Engineers, Inc.	Underground Systems, Inc.
Gilbert Commonwealth	P.S.I., Inc.
S.T.S. Consultants, Inc.	NEETRAC
Ocean Surveys, Inc.	W.A. Chester
COM-Electric	Liquid Earth Support, Inc.
Caldwell's Diving Co.	U-TEC Constructors Inc.
Royal Contracting Co.	American Contracting, Inc.
Century Contractors West, Inc.	New River Electrical Corp.
Holloway Houston, Inc.	SWEPCO, Louisiana
Hooper Corporation	ABEL Construction Co.
Union Power Const. Co.	Commonwealth Associates, Inc.
TELCON, Inc.	Wisconsin Public Service Co.
Doyen & Associates, Inc.	Black Eagle Consulting, NV.
David Evans Associates	KeySpan Construction, Inc.
Florida Power Corp.	TransEnergie US Ltd.
KeySpan Energy	R&W Engineering, Inc.
ABB PowerT&D Co., Inc	Raytheon Eng. & Const., Inc
Foster Wheeler USA Corp.	LMEC/DEC Constructors
Bonneville Power Administration	LawGibb Group
Wisconsin Public Service Corp.	Ref-Chem Constructors
LMEC/DEC, California	URS Corporation
American Electric Power	Power Cable Consultants, Inc.
South Wire	Raymond Profession Group
Alliant Energy	M.A. Mortenson Co.
Andesron & Associates	Inberg-Miller Engineers
Christenson Electric	GeoPro Inc.
D.H. Blattner	Wind Energy Constructors
Dixie Electric	Energy Erectors
Mueller Pipeliners	EHV Power
LaFarge	Jacobs Civil Inc.



EUROPE & OTHER COUNTRIES

**ABB, Sweden
Siemens AG, Germany
ITAS, Norway
Norwegian Geotechnical Institute
Swedish Geotechnical Institute
University of Oulu, Finland
University of Luxembourg
Royal Vet. & Agri Uni., Denmark
Queen's University, Ireland
University College Cardiff, U.K.
Pirelli General, U.K.
Pirelli Cables, France
BICC, U.K.
Pirelli Cables, Brazil
ARAMCO, Saudi Arabia
Alexandria University, Egypt
EletroPaulo, Brazil
National University of Singapore
EletroLima, Peru
Central B.A., Argentina
ESSA, Santiago, Chile
MEW & DEWA, U.A.E.
Freeport, Indonesia
LIGHT Servicos, Brazil
TransEnergie, Australia
CEPCO, Saudi Arabia
Bermudes & Longo, PR
Compliance Eng., Ireland
TechTrend Eng., Hong Kong
Western Power, Australia
NEXANS Norway AS
Suelos, PR
Longo de Puerto Rico**

**Fugro B.V., Netherlands
Terratema A.B., Sweden
MMT, Sweden
Danish Geotechnical Institute
Chalmers University, Sweden
Delft Geotechnics, Netherlands
University of Brussels
University of Barcelona, Spain
Pirelli Cables, Italy
Imperial College, London, U.K.
National Grid, U.K.
KENDAT Cabling U.K
Universal Cables, India
KFUPM, Saudi Arabia
Egyptian Electrical Authority
TATA Electric, India
Olex Cables, Australia
Israel Electric Corp., Israel
CADAFE, Venezuela
Escuintla Enrg. Cntr. Guatemala
BAKUN, Malaysia
ENERGEX, Australia
Mercury Energy, New Zealand
Meritec (Worley), New Zealand
PREPA, Puerto Rico
MEA/PEA, Thailand
Energy Australia
CSA Group, PR
Garde, Australia
PB Power, UK/Qatar
TecnoCrete, PR
WGI, Iraq
Lord Electric, PR**



Soil Thermal Property Analyzer - TPA2000 and Thermal Probes

Description & Technical Specifications

All our test equipment and accessories are custom-built. The Thermal Property Analyzer Model TPA2000 is an upgraded version of the Electric Power Research Institute (EPRI) product, and it surpasses IEEE Standard, ASTM as well as ICC guidelines for thermal testing.

TPA2000 is a computer-controlled system that provides programmable power to the thermal probes; reads temperature sensors (high resolution thermistor type); probe current and voltage, and computes in real time the thermal resistivity, coefficient of determination, etc., for each active temperature sensor.

It offers simplified operation, automatic data storage, detailed analysis routines and off-line data plotting and

All operations are controlled by “Windows” based software in a totally interactive manner. Programming experience is not required of the operator.

The main program residing on the hard drive (program supplied on a floppy disk) is loaded and executed automatically. A menu of possible operations is presented for the operator to choose from.

Desired activity is selected using available options.

Probe specifications and test directions (test information, number of sensors, power level, test duration, time interval, etc.) are entered into a setup file that is stored on the hard drive.

All set up and test parameters are checked automatically before a test can be started (in laboratory or in the field). If all parameters are accepted, simply clicking on the OK button to start the test.

Once a test is initiated, set-up data and data file names are recorded; parameters and hardware checked, and all active temperature sensors are tested for thermal equilibrium.

When probe temperatures are stable, power is applied to the probe(s) and data acquisition and analysis begins.

Data Display, Storage and Analysis:

Running calculations are displayed on the computer screen; time temperature and current values are stored on the HD.

All test data can be accessed for graph plot, analysis, etc.



Hardware Description (Power Supply and Data Acquisition System):

The instrument can be operated on 115-230 VAC, 50-60 Hz, or with a power inverter (12 VDC–115 VAC) that can be plugged into a car cigarette lighter socket.

TPA2000 contains a 9-channel data acquisition/controller and 2 power supplies that operate in series (when required) to deliver the specified power to the probe(s).

High quality thermistors are used as temperature sensors in all our thermal probes. The interchangeability between thermistors is within 0.2°C and the operating range is from -20 °C to +120 °C. The resolution is about 0.005 °C over a wide range.

Computer:

The TPA2000 can be used with any notebook type PC (Pentium)

Calibration:

The instrument is factory calibrated and does not require any further calibration. It has no moving parts except a cooling fan. Each unit has 2 scale factors that are part of the software, and are installed on the computer dedicated for use with the unit.

Thermal Probes:

All thermal probes are custom made to client specifications or to meet specific field conditions. Stainless steel (316L) tubing of a wide range of wall thickness (for rigidity and strength) is used for the probe body. Probe heater is made of an alloy with the lowest coefficient of resistance change with temperature. This assures a constant power under the constant current mode of the power supply (the best possible configuration). Probe core is filled with a metal enriched thermal epoxy of very high heat conductivity. This epoxy provides electrical insulation between probe heater element, thermistor(s) and all internal connections from each other and also from the probe body. Electrical insulation is hi-pot tested to 500 Volts. Laboratory probes are designed to withstand temperatures in excess of 120 °C for extended periods (for thermal dryout tests).

We also manufacture custom thermal probes with integral cable for submarine and deep on-land applications.



Training Program:

We offer a 3-5 days training program in the use of the TPA7000 for laboratory as well as field applications.

Field (in-situ) Testing and Sampling:

Perform in-situ measurement of temperature and thermal resistivity and obtain soil samples for laboratory testing. This includes supplying of Thermal Property Analyzer, thermal probes, accessories and the services of a field engineer to perform in-situ testing and supervision of soil boring and sampling.

Laboratory Testing:

Conduct laboratory tests that include: moisture content, sieve analysis, organic content, compaction, and **thermal dryout** characterization (thermal resistivity as a function of moisture content at a constant dry density).

Sourcing, Formulation and Testing of Corrective Thermal Backfills:

Visit local quarries and aggregate suppliers to source materials suitable as corrective thermal backfills (totally dry thermal resistivity of less than 100 C-cm/watt). Formulate Fluidized Thermal Backfill (FTB) of specific thermal, strength and flow characteristic to meet specific requirements with respect to Ampacity, trench optimization and cable protection, etc.

Quality Control during Construction and Installation of Cable:

We provide quality control and testing services for corrective thermal backfill during construction and installation.

We will be pleased to quote prices on any of the above items upon request.