

METATECH CORPORATION BROCHURE

Content

Services

Products

Facilities

People

This brochure has been prepared to familiarize current and potential customers with our services, products, and resources.

SERVICES

Electromagnetic Interference (EMI)

Definition: "Degradation of the performance of a piece of equipment, transmission channel, or system caused by an electromagnetic disturbance." (ANSI C63.14, 1992; IEC 60050(161), 1990)

What We Do: Metatech provides analysis services for the various EM disturbances and their effects, including combined effects on systems, subsystems and equipment.

Example: The Forbes Magnetic Storm Data Project

Metatech has been working since 1991 in an ongoing program to study magnetic storm effects on power and communications lines. The objective of the Forbes magnetic storm project was to understand the relationship between geomagnetic field fluctuations and the resulting electric fields which couple to long lines. Metatech supplied the measurement equipment and data analysis, and Minnesota Power provided access to the Forbes facility (a high voltage power substation located in northern Minnesota).

The Forbes facility is unique in that it has two insulated communications lines available that are oriented in approximately N/S and E/W directions and are about 60 km in length. Given the line resistances and the load parameters, we can compute the average electric field over the length of the line from the measured current. The experiment also provided a measurement of the geomagnetically induced current (GIC) on the neutral of a 500-kV power line originating 500 km north of Forbes near Winnipeg, Canada. A 3-axis fluxgate magnetometer was used to measure the geomagnetic field variations at the Forbes facility at a sample rate of 1 sample every 2 seconds.

Since measurements of the geomagnetic field, the average electric fields, and the current flowing on a power line neutral were all available on a time-tied basis, it was possible to examine the relationship between calculated and measured

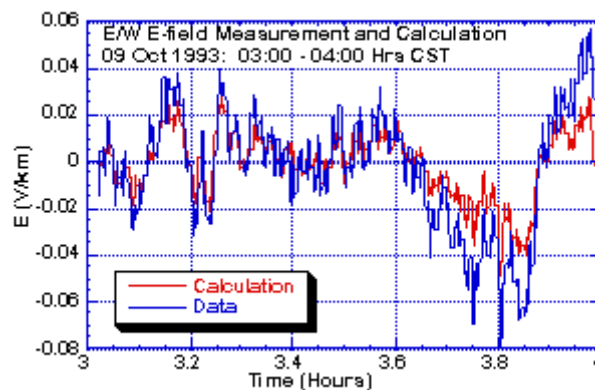
358 South Fairview Avenue ➤ Goleta, CA 93117 ➤ Phone (805) 683-5681 ➤ Fax (805) 683-3023

© Metatech Corporation, All Rights Reserved

METATECH CORPORATION BROCHURE

electric fields and power line currents. Measurements were made on a continuous basis, and data was collected each month. Immediate examination of data after a severe magnetic storm or electrical power anomaly was available by download.

Metatech developed the data acquisition system, its controlling software, and analysis tools for studying the data. Results were displayed in a number of ways. The accompanying figure shows a comparison of a measured average electric field with a calculated electric field derived from the measured geomagnetic field and a model of the earth conductivity in the region.



Electromagnetic Compatibility (EMC)

Definition: "The capability of electrical and electronic systems, equipments, and devices to operate in their intended electromagnetic environment within a defined margin of safety, and at design levels of performance, without suffering or causing unacceptable degradation as a result of electromagnetic interference." (ANSI C63.14, 1992)

What We Do: Metatech provides EMC services to customers seeking reliable analyses of electromagnetic emissions or immunity in support of EMC protection and/or testing.

Example: Analysis of GTEM Fields

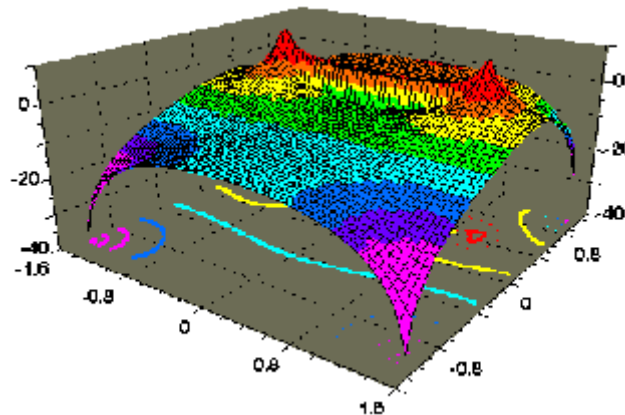
In early 1994 Metatech began an analysis program to study the response of small electronic systems exposed to EM fields in GTEM test cells. The purpose of this effort was to provide a better understanding of the interaction of test objects with the GTEM fields through a series of 3D calculations performed with

METATECH CORPORATION BROCHURE

advanced computer codes developed by Metatech. Results from this study will be used to evaluate the fidelity of box tests in the GTEM cell.

GTEM (Gigahertz Transverse Electromagnetic Mode) is a relatively new development in the field of EMC testing. The cell was developed by Diethard Hansen and Dietrich Koenigste in 1984 at the EMI Control Center of Asea Brown Boveri Ltd. in Baden, Switzerland. GTEM is manufactured under license by the Electro-Mechanics Company (EMCO) of Austin, Texas. As of 2002 more than 200 GTEMs had been installed worldwide.

Metatech has performed 3D calculations over a range of parameters, and plots were generated showing contours of peak fields at a number of ranges from the source and at specific frequencies between 50 to 500 MHz. The example shown below is a three-dimensional contour of the maximum peak predicted total electric field strength in dBV/m in a plane perpendicular to the GTEM longitudinal axis.



Nuclear and Lightning Electromagnetic Pulse (EMP)

Definition: "The electromagnetic radiation caused by Compton-recoil electrons and photoelectrons from photons scattered in the materials of the nuclear device or in a surrounding medium as the result of a nuclear explosion or lightning. The resulting electric and magnetic fields may couple with electrical and/or other electronic systems to produce damaging current and voltage surges." (ANSI C63.14, 1992)

What We Do: Metatech is a key contributor to EMP research in the areas of High-altitude and Source Region environments and

358 South Fairview Avenue ➤ Goleta, CA 93117 ➤ Phone (805) 683-5681 ➤ Fax (805) 683-3023

© Metatech Corporation, All Rights Reserved

METATECH CORPORATION BROCHURE

coupling and in the development of hardening and testing technologies including military standards, specifications, and handbooks. Major programs include SREMP testing and analyses at flash x-ray simulators, SREMP and HEMP standards development and HEMP environment and long-line coupling calculations.

Example: Metatech personnel have participated with other international researchers to develop long-line coupled stresses resulting from the new IEC HEMP environment waveform for civil systems. In particular, Dr. Radasky has been the project leader for the development of the IEC conducted environment standard for commercial systems (IEC 61000-2-10)

Electrostatic Discharge (ESD)

Definition: "A transfer of electric charge between bodies of different electrostatic potential in proximity or through direct contact." (ANSI C63.14, 1992)

What We Do: Metatech performs analyses and test planning to support ESD research aimed at obtaining a better understanding of the phenomena and designing protection for equipment exposed to ESD environments.

Example: Metatech has collected and analyzed various military, commercial and international standards and specifications for ESD and is in the process of developing "first principles" analysis models which calculate the fields produced from ESD arcs.

Computer Code and Analysis Tool Development

Metatech has extensive expertise in the development of computer codes and analysis tools to support a constantly expanding range of problems. Much of this work involves special purpose applications. Computer codes and analysis tools have been developed to perform calculations in all areas of electromagnetic environmental effects including EMC and nuclear EMP.

Examples include time and frequency domain transmission line codes, special purpose codes tailored to geomagnetic storm studies, and calculational techniques which provide 3D outputs for GTEM studies.

METATECH CORPORATION BROCHURE

PRODUCTS

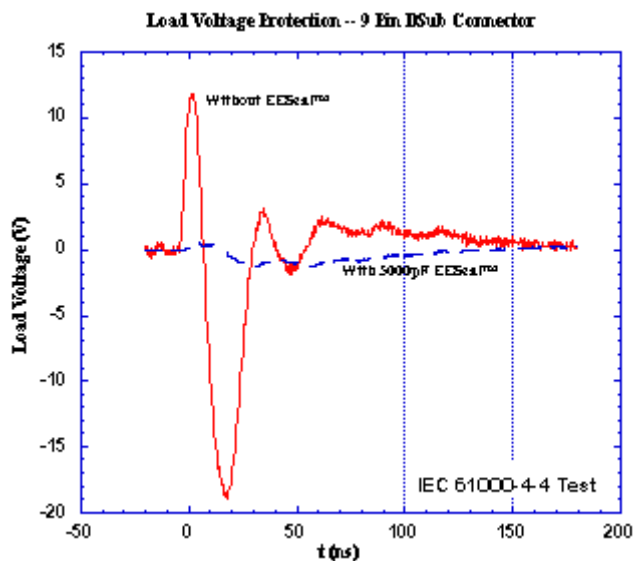
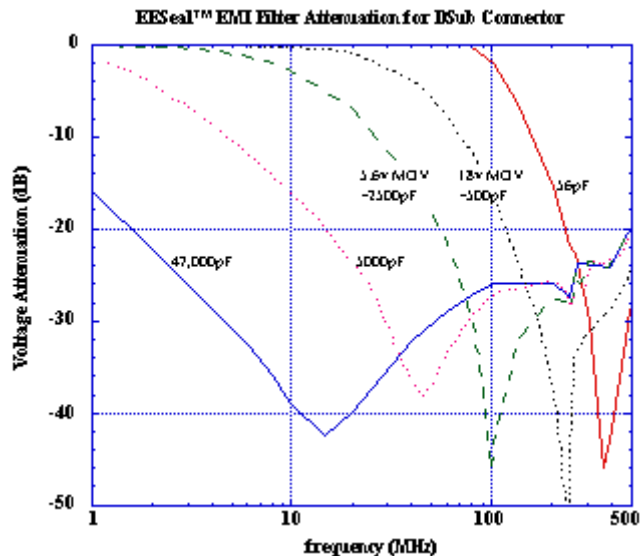


Installs Easily

The **Metatech** Commercial Products Division (CPD) has recently been spun off from Metatech as a new corporation, Quell. **Metatech** CPD developed a unique line of EESeal(tm) EMI filters and transient suppressors. The EESeal(tm) provides EMI protection and an environmental seal. It is designed to easily slip between any pair of mating connectors and can also be readily removed and reinserted. Once installed the EESeal(tm) shunts high-frequency electrical signals to the shell or to any preselected pin of the connector. Custom configurations, connector types, colors, sizes and electric specifications are available. Rapid prototyping is offered (within days) to support compliance testing.

METATECH CORPORATION BROCHURE

Measured frequency attenuation characteristics of several EESeal(tm) filters are shown below for different capacitor values; the performance of a 5000 pF 9 Pin DSub filter is also shown for an IEC 61000-4-4 electrical fast transient waveform.



SUMMARY OF SERVICES AND PRODUCTS AVAILABLE FROM METATECH

- Development of EM environment and protection standards and specifications
- Development of susceptibility assessment and hardness verification test procedures

358 South Fairview Avenue ➤ Goleta, CA 93117 ➤ Phone (805) 683-5681 ➤ Fax (805) 683-3023

© Metatech Corporation, All Rights Reserved

METATECH CORPORATION BROCHURE

- Test and evaluation program planning, coordination and documentation
- Development of simple PC-based codes to display complex calculations and/or data
- EESeal(tm) filters and transient suppressors (Quell Corp.)
- Geomagnetic Storm Forecasting Services

FACILITIES

Metatech Facilities

Metatech has offices in Goleta, CA, Albuquerque NM, and Duluth MN. All **Metatech** facilities contain state-of-the-art equipment required to perform research for government, commercial and international clients.

Test Laboratory

Metatech has a test research laboratory at its Goleta, California facility. The laboratory is currently capable of performing high speed transient measurements and immunity tests using the IEC 61000-4-4 Electrical Fast Transient generator, among other test sources.

Computers

Metatech uses the latest state-of-the-art 64-bit microcomputers for scientific computing, desktop publishing and remote access to customer computers. These microcomputers include both the latest Pentium-Class IBM compatibles with large memory capacity and Apple Power Macintosh computers with enhanced color graphics and video editing capability. **Metatech** facilities have color laser printers and utilize high speed communications between offices and with customers, other researchers, and remote computing facilities.

METATECH CORPORATION BROCHURE

Publication Production

Metatech offices have modern color laser printers, copy machines, binding equipment, and scanners which enable us to produce high-quality publications. All **Metatech** offices have complete color capabilities for producing high-quality briefings. The Goleta office has the capability to create computer-generated video tapes and DVDs. The publications staff provides editing, layout, and planning support to ensure the quality of our documents. **Metatech** primarily employs Macintosh computers for word processing, report layout, and graphics.

Libraries and Databases

Metatech maintains extensive libraries on electromagnetics and related subjects at each of its offices. These libraries are cataloged on an in-house database system. Through subscription services and the close proximity of government and university libraries, **Metatech** has fast access to technical publications it may need for its research efforts.

PEOPLE

Excellent performance depends on excellent people. **Metatech** prides itself on attracting and maintaining a technical and support staff of the most qualified personnel available. **Metatech** is nearly unique in that the 100% employee-owned company is successfully managed by experienced scientists and engineers. The following brief résumés highlight some of our key personnel.

Dr. William A. Radasky

Metatech Corporation was formed by William A. Radasky in Goleta (Santa Barbara County), California in April of 1984. He has served as President since the founding of the company. Dr. Radasky has played a central role in the development of electromagnetic pulse (EMP) and related electromagnetic environment specifications applicable to defense electronic systems. A major current interest is the development of EM standards that are compatible with EMC requirements. Dr. Radasky is particularly well known to the EMP community in the United States and abroad for his continuing contributions to EMP/SREMP research, a field in which he has been active since

METATECH CORPORATION BROCHURE

1968. Dr. Radasky is Chairman of the IEC Advisory Committee on EMC (ACEC) and is currently the Chairman of SC77C which deals with HEMP/HPEM standards for commercial systems. He has authored over 250 publications on EM subjects and holds the following academic degrees: B.S., Air Force Academy; M.S., University of New Mexico; and Ph.D. in Electrical Engineering, University of California at Santa Barbara. He was elected an EMP Fellow in 1988, and is a Senior Member of the IEEE.

Christopher W. Jones

Mr. Jones is Chairman of the Board of **Metatech** and Manager of Albuquerque Operations. He manages and actively participates in technical work on a wide range of EM and radiation related topics. Mr. Jones has more than 30 years experience as a leader and major contributor to electromagnetic research efforts. His current work is primarily directed toward the development of hardening and test standards for systems. In addition, he performs analyses of the effects of high power microwave, HEMP and SREMP stresses on military and commercial systems. He is also a contributor to the development of an IEC standard for the testing of commercial equipment to withstand HEMP effects, developing requirements and methods that are compatible with other EM effects. Mr. Jones has published extensively in the EMP literature and has served as Guest Editor for the IEEE Transactions on Nuclear Science. His academic degrees include: B.S., University of Missouri and M.S. in Physics, Iowa State University. Mr. Jones was elected to the position of EMP Fellow in 1990.

Dr. James L. Gilbert

Dr. Gilbert is the Chief Scientist of **Metatech Corporation** and is active in the development and use of analytic and numerical techniques to model electromagnetic and plasma effects produced by nuclear and natural radiation. Much of his work over the last 30 years has dealt with the protection of military systems from the EMP effects produced by nuclear explosions. He is the principal developer of the HEMPTAPS and SREMPTAPS codes, used by numerous U. S. government agencies to evaluate EMP environments and coupling to military systems. He is presently active in the development of the **Metatech** PowerCast code which uses ground magnetometer data and satellite predictions of the auroral currents to predict the effects of solar storms on large power distribution

METATECH CORPORATION BROCHURE

networks. At Mission Research Corporation, he was manager of the Electromagnetics Division and, as an Air Force officer, was a research physicist with the Satellite and Communications Branch at the Air Force Weapons Laboratory (now the Air Force Research Laboratory) and a guest scientist at Los Alamos National Laboratory. Dr. Gilbert attended the Massachusetts Institute of Technology where he received his B.S. and Ph.D. degrees in Physics. He was elected an EMP Fellow in 1992 and has received two Best EMP Paper Awards from the Summa Foundation.

John G. Kappenman

John G. Kappenman is a 1976 graduate in Electrical Engineering from South Dakota State University. After graduation, he joined Minnesota Power (1977-1998). In 1998 he joined **Metatech** as the Manager of the Applied Power Solutions Division. He directs the development of products, services, and consulting that are provided to clientele worldwide, primarily focusing on lightning and Space Weather impacts on electric utilities. He has been an active researcher in power delivery technologies and his primary engineering contribution has been his research work on lightning and magnetic storms and their disruptive effects on electric power systems. He led a utility industry effort to deploy a monitoring satellite that now provides advanced warnings of geomagnetic storms (launched by NASA in August 1997). He has also been a collaborator with EPRI and Global Atmospherics on the development and application of the Fault Analysis and Lightning Location System that will allow economic Location-Centered mitigation of lightning to transmission networks. He is a Senior Member of the IEEE and the Power Engineering Society, and is the Past Chairman of the Transmission and Distribution Committee (1994-1996). He currently serves as an Instructor at the University of Minnesota-Duluth Department of Electrical and Computer Engineering. He has also served a number of times as a faculty member on a University of Minnesota Short Course on EMTP. He has published over 30 papers in a variety of subject areas. He is a recipient of the IEEE Walter Fee Outstanding Young Engineer Award, the IEEE Prize Paper Award, the Westinghouse Nikola Tesla Award and two EPRI Innovator Awards. In February 1997, Mr. Kappenman provided presentations to the US Presidents' Commission on Critical Infrastructure Protection on the potential impact of geomagnetic storms on electric power system reliability and also served as an Invited Lecturer at the International Space University on Space

METATECH CORPORATION BROCHURE

Weather and Impacts on Electric Power Systems. Mr. Kappenman has been appointed to the Organizing Committee and was one of the Lecturers at the NATO Advanced Science Institute on Space Storms and Space Weather Hazards that was held in June 2000.

GOALS AND APPROACH

The goals set for *Metatech* are to:

- provide government and industry with technically sound and responsive research services, and products,
- provide *Metatech* employees with a technically satisfying and financially rewarding career experience, and
- provide *Metatech* stockholders with an attractive return on investment.

While job satisfaction and profitability are important goals at *Metatech*, these goals are viewed as natural consequences of providing value to our customers and of exercising prudent management of corporate resources.

METATECH OFFICES

Metatech's Corporate Office is located in Goleta, California (Santa Barbara County). This office, managed by Dr. William A. Radasky and is located at 358 S. Fairview Avenue, Suite E, Goleta, California 93117. The Goleta office can be reached by telephone at (805) 683-5681 or by FAX at (805) 683-3023.

Metatech's Southwestern Facility is located in Albuquerque, New Mexico (Bernalillo County). This office, managed by Mr. Christopher W. Jones, is located at 2340 Alamo Avenue S.E., Suite 300, Albuquerque, New Mexico 87106. The Albuquerque office can be reached by telephone at (505) 243-0681 or by automatic FAX at (505) 243-0683.

Metatech's Applied Power Solutions Office (APS) is located in Duluth, Minnesota. This Division, managed by Mr. John Kappenman, is located at 5 West 1st Street, Suite 301, Duluth,

METATECH CORPORATION BROCHURE

MN 55802. APS can be reached by telephone at (218) 727-2666
or by FAX at (218) 727-2728.