

# PowerPAC™: Acoustic Emission Testing Technology Package

## *Instrument and Procedure for Detecting, Locating and Assessing Electrical & Thermal Faults in Power Transformers During On-Line Monitoring*

### **Introduction & Overview**

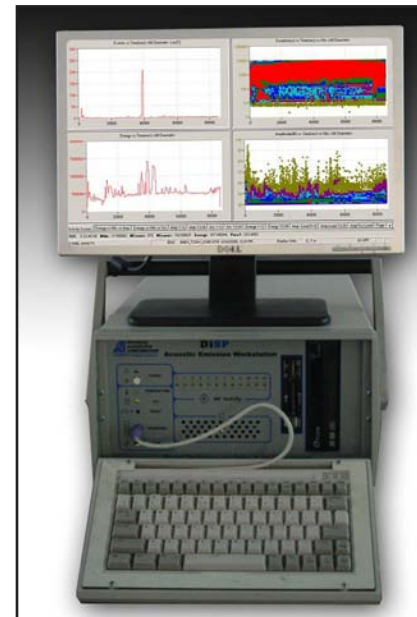
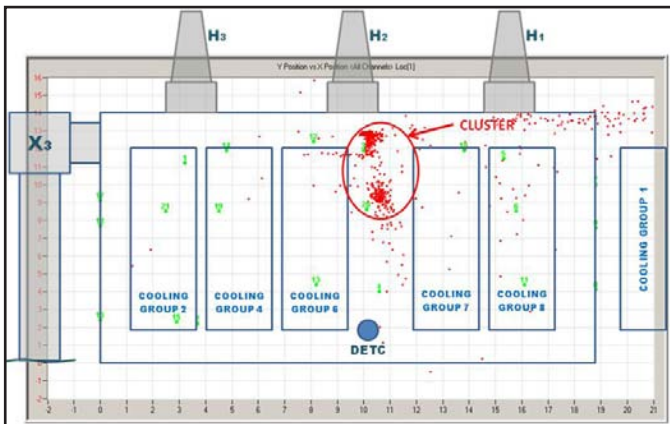
PowerPAC™ is an Acoustic Emission (AE) technology package for testing power transformers. An on-line monitoring procedure was developed under an EPRI (Electric Power Research Institute) sponsored and tailored collaboration with Physical Acoustics Corp. (Project I.D. No. 051481). This collaboration refined the package with three phases of program development resulting in on-line monitoring of power transformers to detect, locate and assess electrical and thermal faults.

AE sensors are installed on the transformer covering both the tank and the LTC compartment (if one is present) along with sensors to monitor pump current, fan current, load current, tank wall temperature and LTC compartment wall temperature collecting data for comparison with the AE data during post test data analysis.

In order to observe the effects of a complete load cycle, data is collected over a period of 24 hours. Results are presented showing the location (in 3-D) and types of faults. A grading system is used for each fault and provides an overall evaluation of the transformer for maintenance or operation planning.



This technology packages uses the MISTRAS Products & Systems/Physical Acoustic Model DiSP Digital AE Workstation. It operates using application specific software designed for data acquisition during field testing and has several utilities for post test analysis. Some of the key features of this software is its ability to perform three dimensional source location and to classify different types of AE signals (faults) using neural networks.



*DiSP-24 is a portable, hardened and compact AE system, equipped with a handle for carrying*

## Technology Package Details

Included with this technology package are:

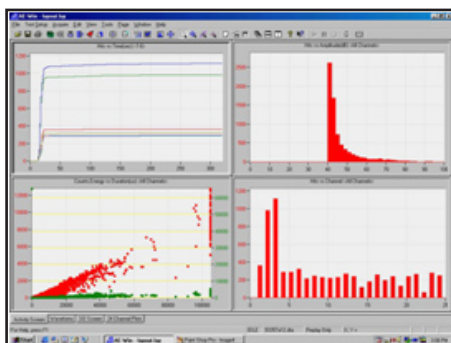
- DiSP-24 Hardened, Portable Computer
- PCI/DSP-4 Data Acquisition Boards with up to 8 parametric inputs
- R15I-AST sSensors with integral 40dB preamp
- Parametric Breakout Box and Parametric Sensors
- PowerPAC™ Software Package
  - PowerPAC Data Acquisition and Analysis Software with 2-D & 3-D Location Software Modules
  - AEwin Post Processing Analysis Software
  - Database Software with EPRI Cases
  - PDDMATE Post-processing software
- Documentation
  - EPRI Reports Phases I, II & III
  - Technical papers
  - Case Studies
- Three Day Classroom Training (theory) and Start-up Assistance
- 10 Days on the Job Training (Field Test)
- Consulting Time (Remote and On-site)

## Hardware

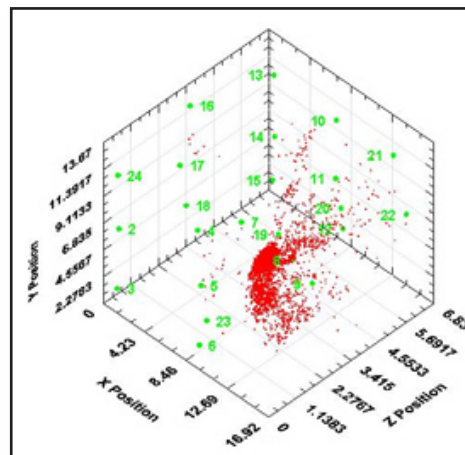
DiSP-24: 24 Channel, Digital AE instrument which includes PAC R15I integral preamp sensors with built-in self diagnostics capability (Auto Sensor Testing) and 30 meter cables. The system comes with a built-in high performance PC controller, RW-CD, keyboard, mouse and video monitor and is shipped in a rugged transport case. This system can be used from the smallest of transformers (typically around 13.8 kV) to the largest GSU transformers (typically around 500 kV). Three current transducers (CT) and 2 resistance theorem devices (RTD) needed for recording parametric signals are also included.

## Software

PowerPAC™: This is real time AE data acquisition and feature extraction software. It is used in real time test as well as post analysis to remove unwanted data due to such extraneous noise sources as pump operation, fan operation, wind and rain. Accomplished with this is the AE-WIN- POST utility that is included with this package. Other utilities include the TBFH software that is used to identify whether the AE source is due to either an electrical or thermal fault.



This software also includes the 3-dimensional location software to provide real time test as well as post analysis for three dimensional source location of faults detected in



Three dimensional fault showing a fault (red dots)

either the main tank or the LTC compartment  
 PowerPAC™ Database: A system created to facilitate the management of data generated by testing power transformers with Acoustic Emission. The main components are: transformer nameplate and test data.

A design number can be assigned to a transformer of some characteristics. This allows comparing acoustic activity obtained in identical transformers.

This software also allows the user to “Grade” each source obtained during the test and provides a “combined grade (AE & DGA)” for the unit [A, B, C or D]. This allows the utility to prioritize maintenance activities. Combined Grades are obtained using the information from the acoustic test and dissolved gas analysis data.

The Database is pre-loaded with all EPRI tests performed under this program.

Acoustic Emission Partial Discharge Detection Mate (PDDMate): This post-processing software allows the user to determine if the acoustic activity detected during the test is in synchrony with the nominal frequency of the system. When synchronicity exists, it is likely for the source to have an electrical origin such as Partial Discharge. It provides a graphic visualization of the results per channel.

The PDDMate reads the data file created by PowerPAC software and performs signal processing, statistics, filtering and spectrum analysis etc. with effective proprietary algorithms.

One feature is presented by the PDDMate software. This feature is named "TAFI Index" which exhibits scattered dots along the testing time to reveal a possibility of the partial discharge. Evenly distributed and properly aligned TAFI number along the testing time show a pattern that could be correlated with partial discharge. However, on the other hand, extraneous noises, show random distribution pattern.

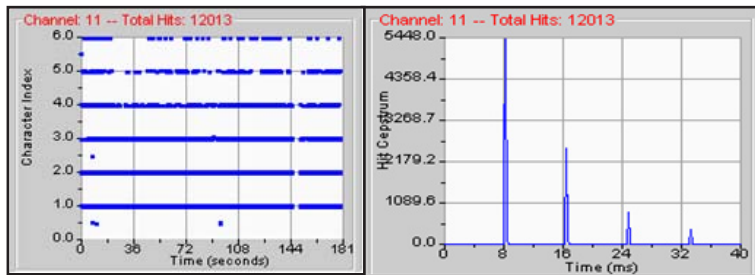
**Technology & Support:**

The purchase of this technology package includes all of the pertinent documents produced during the Phase I, II and III such as: papers, case studies, test procedure, sample report, EPRI reports, etc.

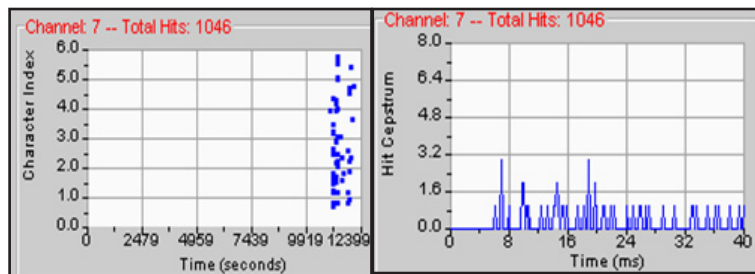
Consulting via telephone and email will also be provided over the course of the first year in support of the customer's need to analyze and interpret data.

Commissioning, equipment training and On-The-Job Training (OJT) are included in the PowerPAC package, but a more detailed quotation will be provided based on the geographic location of the customer site.

This technology package comes with a standard one year warranty for the equipment and for unlimited software updates during the first year.



Patterns of TAFI Index vs time and vs Hits for data with apparent partial



Patterns of TAFI Index vs time and vs Hits for data with no partial discharge (extraneous noise)

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