Digital Partial Discharge (PD) Measuring and Briefcase Diagnostic System (FDD-EPT)

Major Characteristics
The system / device should be suitable for measuring the severity of PD inside Electrical Power Transformer in field / site/plant and capable of detecting the location of PD accurately and should have following functionalities:

- Detecting, locating, measuring and storing the amplitude, frequency and phase resolved PD data.
- Post processing of stored PD data [for evaluation of the characteristic PD quantity in mili volts ("apparent charge" associated with pico coulombs from an electrically triggered system if possible)] and display in 2D & 3D graphs.
- Provide information for magnitude (apparent charge) phase-position and event time of each PD signal to be recorded and stored.
- Supplied with diagnostic tool (software) for data evaluation and automatic PD failure recognition using a PD data base tool (foot print analysis).
- Software capable of creating a 3 dimensional picture of transformer tank and diagrammatic representation of location of sensors on surface of transformer tank with colour code.
- Visualizing & analyzing the PD events in reply mode (based on stored data), without loss of any information.
- Hardware provided should be suitable for wide-band PD signal processing in frequency range 50 KHz to 350 KHz (with maximum SNR of 100 dB) using Wavelet Transforms methodology.
- For high-resolution digitization of PD signals, resolution of digital signal acquisition should be '12 bits' i.e. data acquisition system should have minimum accuracy of 12 bits (with SNR of 76 dB.
- Digital signal processing should be done using HW or SW filters for specified BW to filter unwanted interference due to RIV and external sources. The system should have efficient noise suppression via hardware and software filters
- Estimation of location of PD with an accuracy of 10 cm or better.
- PD measurement display in graphical form on each screen with amplitude vs. time represented for each sensor data. The next screen displays data acquired about the SNR vs. frequency for all the sensors used in the acquisition of data.
- Specifications of Data Acquisition System (DAS): DAS should have six (06) channels at present and expandable to twelve (12) channels in future. The channel switching should be automatic (software controlled).

  DAS should have following specifications:
  i) Input impedance: 50 ohms
  ii) Input Capacitance: 20 pF (approx.)
  iii) Maximum safe input voltage at 50 ohms: 5.0 volts rms (continuous) signal and 250 volts transient (for less than 100 micro secs.) for power to the system.

- **Specification of Pacer clock**

  a) Internal   i) Frequency: up to 16 MHz or better
                                 ii) Stability: 100 ppm over temperature and aging (1 year)

  b) External

  i) Type TTL-level, up to or less than 64 MHz
  ii) Max input voltage: +/- 4 V, (with 50 ohms termination)

- **Specification of A.D.C. (analog to digital converter) :**

i) Type: 12-bit or better, flash
ii) Linearity (Integral and differential): +/- 0.60 L.S.B. (least significant bit)
iii) Non-linearity (---do---): +/- 0.94 L.S.B. with no- missing codes
iv) Aperture jitter: 15 ps
v) Input slow rate: 440 V/micro sec.
vi) SNR (signal to noise ratio): 48 dB or better.
vii) USB 2.0 interface with laptop

- **Accuracy of DAS:**

i) Gain: +/- 5% of FS
ii) DC offset: +/- 5% of offset
iii) Real-time Sampling period: Time base accuracy (+/- 1 ps) + ADC apperture jitter
   (+/- 17 ps) = +/- 18 ps total (+/- 0.18% @ < or = 64 MHz).

Other general features in specifications of DAS:

i) Input ranges: +/- 100 mV up to +/- 4 V
ii) Onboard memory buffer: 1M bytes
iii) Operating Temperature: -10^0 to + 50^0 C

- **Sensors**

Acoustic sensors suitable to meet the desired functionalities of P.D. detection system, having specifications in line with the parameters mentioned below:

i) Gain: 40 dB +/- 1 dB (with integral amplifier)
ii) Peak sensitivity: 30 dB re 1V/microBar
iii) Noise (rms): < 1.0 micro V
iv) Dynamic range: > 80 dB
viii)   Output Voltage: < or = 5 V pp (into 50 ohms)
ix) BNC type connectors
x)   Automatic self-test capability with integral amplifier with a gain of 40 dB minimum.

- <u>**Specifications of Briefcase Computer System, Hardware & Software**</u>

i)   Processor: Pentium III / IV or higher, lap-top (tough-book) or similar field suitable
ii) Monitor: LCD screen with Color integrated with lap-top
iii) CD-Rom drive
iv) 512 MB RAM
v)   16-bit graphics adapter and display (for 256 simultaneous colors)
vi) Microsoft Windows supported graphics accelerator card and sound card
vii) Suitable color printer.
viii) Adobe Acrobat Reader to view and print the output of software (SW in PDF format)
ix) Microsoft Word 7.0 or Office 2000 to run the S.W.
x)   Microsoft Windows 95/98 (ME)/2000/XP

- **Specifications of Diagnostic Software**

Suitable PD detection and analyzing software with graphic user interface (GUI) suitable for PC (laptop or similar) based platform for data acquisition, analysis and evaluation of partial discharge sites within the confines of the transformer tank (like HMSGAHT2000DDI OR WTPDDDI2000 and DDILOC) in its latest version, to meet desired functionalities as mentioned earlier and also summarized as below:

a) Provide GUI using digital signal processing and wide band correlation technique or Wavelet Transform technique for PD location.
b) Provide 3-D diagram of transformer tank with provision to show locations of sixteen sensors on transformer tank surface.
c) Software compatible with MATLAB 7.1.
d) Provide facility to enter various test parameters (date, year, site I.D. Transformer tank size etc.)
e) Integrated detection and data acquisition software with location algorithm
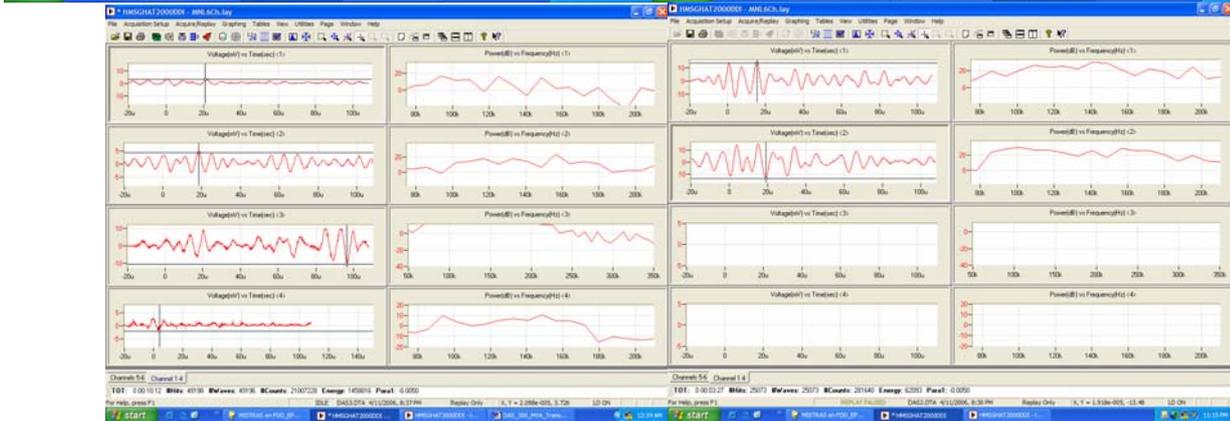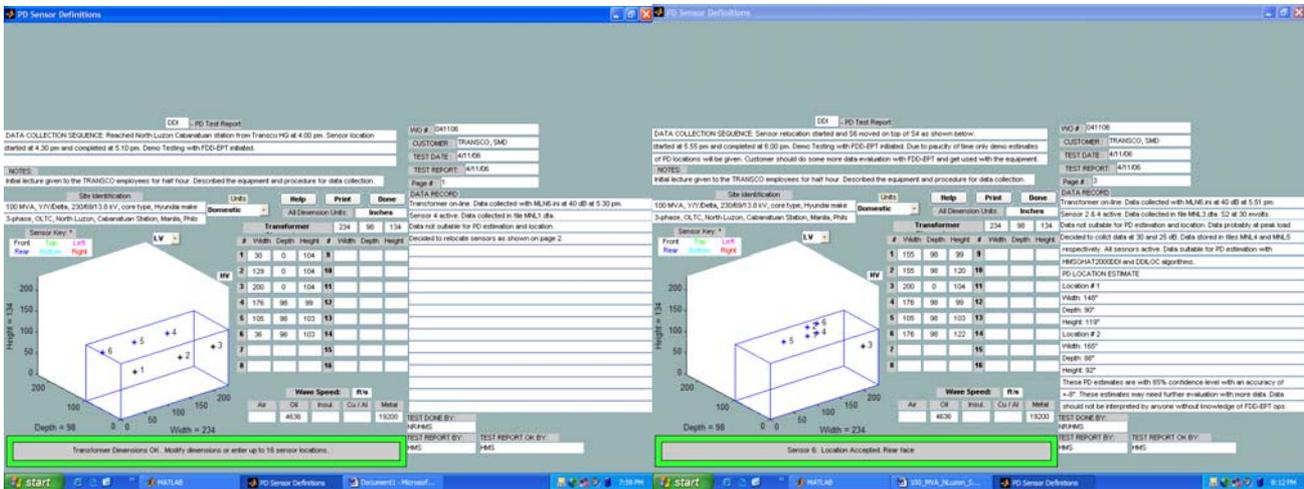
Other Requirements:

1. Automatic calibrator of measuring circuit or device supplied with suitable external calibrator (covering complete range of device).
2. Facility to down load the results to a suitable laptop tough filed suitable– computer.

Power Supply (to device): 115/230 volts +/- 15% 50/60 Hz +/- 2.5%.

Operating temperature range: -10^0 to 50^0 C

3. Minimum detectable charge in mili volts suitable on the acoustic sensors comparable to a known electrical charge in pC

4. Device to be supplied with suitable filter (external or internal) for radio interference suppression.

5. Training by experts to operating Engineers (at site) or at supplier

6. Device should be upgrade able to latest version, at least, for a period upto 1 year.

7. Technical support by expert Engineers for analysis & recognition of PD fault for a period of one year.

8. User' Manual with all documentation of specification, end user's license for software and guarantee.