India Corner

Activities at High Voltage Laboratory, National Institute of Technology, Durgapur-India

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The High Voltage Laboratory at National Institute of Technology (NIT), Durgapur was established in the year 2008 with the prime objective of promoting research in the field of high voltage engineering and to familiarize the students, utilities and industries with high voltage power apparatus in traditional laboratory as well as through distance learning with the aid of information and communication technology(ICT). At present more than three thousand institutes provide engineering education in India and among them approximately half of them offer undergraduate programs in Electrical and Electronics engineering that includes High Voltage (HV) Engineering. Also it is mandatory as per the guidelines of All India Council for Technical Education (AICTE) that the laboratory facilities are to be provided for all the programs which are offered by the institutes. However, very few institutes have High Voltage Laboratory facilities due to involvement of huge costs and availability of specialized faculty members and skilled staffs in the field of High Voltage Engineering. It leads to develop a ICT enabled High Voltage Laboratory in eastern region to facilitate the remote facilities to the institute as well as utilities.

Availability of High speed internet facility in most of the institutes/colleges are the prime advantage to formulate a network for digital e-learning environment for recently developed remotely operated High Voltage Laboratory at NIT, Durgapur. It is an unique facility for remote operation and first in world which can be augmented to provide the remote facilities of digital e learning with the inclusion of ICT enabled technology in India and abroad.

Important features of the ICT enabled High Voltage Laboratory (ICTRHVL), at NIT ,Durgapur are the followings:-

1. ICT enabled High Voltage Laboratory, NIT Durgapur, first of its kind in world can be accessed with proper authentication from anywhere in the world by 24×7.
2. Provides an economical means of learning high voltage engineering for institutes offering Electrical and Electronic programs at undergraduate and postgraduate level.
3. Enhance hands on experience of conducting real time laboratory experiment for the HV courses among the students all over the world at anywhere and anytime.
4. The ICTRHVL at NIT Durgapur also provides facilities to the industries as well as the utilities for online testing of HV power apparatus and on line test report generation.
5. ICT enabled HV laboratory culminates the “access to all” opportunity to every incumbent to build the trust between industries, government agencies and individual which is a powerful tool for the development of underdeveloped and developing countries.

Laboratory Infrastructure

High Voltage Laboratory at NIT, Durgapur is equipped with the following traditional laboratory equipments.

- Impulse Voltage Generator
- 500mm sphere gap for HV measurement
- Impulse voltage divider (damped capacitive type)-800kV
- Digital Impulse oscilloscope with software.
- AC Power frequency HV testing transformer 300 kV , 0.5 A
- AC Divider (300 kV)
- Partial Discharge measuring system upto 300 kV
- Coupling capacitor
- Capacitance and Tan delta measurement (LV & HV)

Figure 1: HV Laboratory at NIT, Durgapur

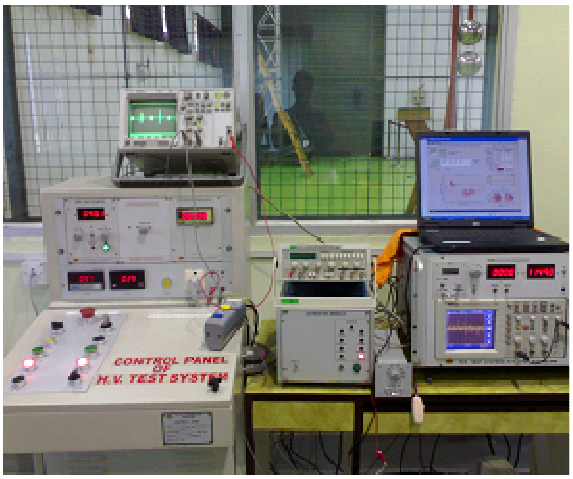

Figure 2 ICT enabled operation of HV Laboratory experiments

- Resistivity meter
- Leakage current tester
- Limited remote facility of impulse and AC high voltage systems

The traditional laboratories have some limitations associated with them in achieving their objectives efficiently and economically as to develop and maintain, it needs costly infrastructure, skill technicians and efficient faculty members. The AC High Voltage and impulse High voltage test system are capable to operate remotely through ICT enabled operation. The laboratory is also equipped with high resolution video camera for better realization of the experimental setup, arcing phenomenon and activities during the testing and experiments in high voltage power apparatus.

Ongoing research projects at HV laboratory, NIT Durgapur

On-line monitoring of partial discharges in high voltage power apparatus using optoelectronic method

Recent development in the field of high voltage engineering, automation technology and information communication technology are showing a significant

Figure. 4 A photograph of the schematic experimental setup of partial discharge measurement

boost in up gradation of power system. As insulation of any electrical equipment is a sensitive zone of failure in the power system, utmost care should be taken by power engineers. The insulation of high voltage (HV) equipment gradually degrades due to the cumulative effects of electrical, chemical and mechanical stresses caused by the partial discharges (PD). Partial discharges are small local electrical discharges that occur within electric insulation of HV equipment such as switchgear, cables, transformers, windings in large motors and generators. In addition, Partial discharges occur at voids, contamination, poor conductor profiles and floating metal-work in the high voltage equipment. Therefore it is very essential to detect, measure and also localization of partial discharge within the HV equipment for prediction of insulation life, replacement time and early indication of outages during their period of service. The optical technique that has been introduced in this work is sensitive for PD measurements inside the HV equipment compared to other technique such as electric detection, chemical detection and acoustic detection methods. In this work, the optical PD detection technique is used to measure the PD in the model transformer by two alternative procedures, firstly the detector collected the signal of PD, when the

Figure 3: ICT enabled operation of AC & Impulse High volatge test system

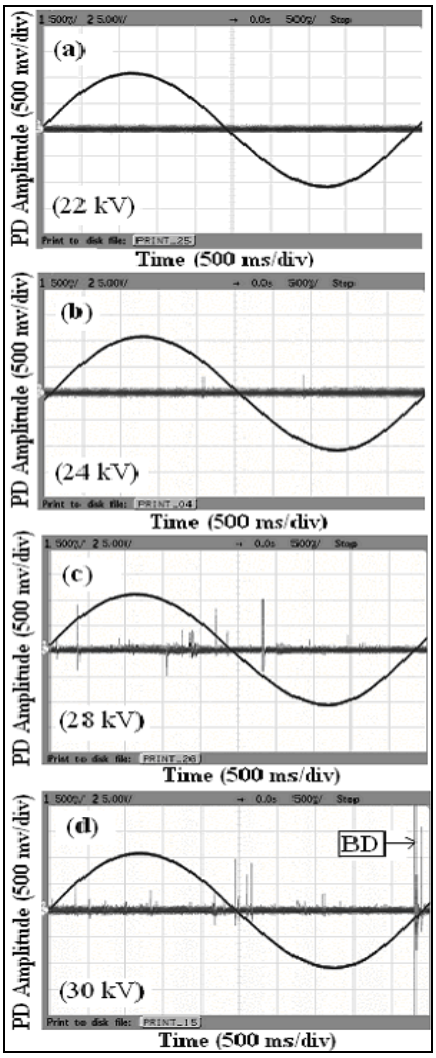

Figure. 5. PD signal observed when the optical sensor is placed at the centre axis of the two electrodes,

(a) applied high voltage of 22kV,
(b) applied high voltage of 24 kV,
(c) applied high voltage of 28 kV,
(d) applied high voltage of 30 kV till the break-down occurs

direct laser beam passes through the centre axis of the electrode arrangement of the transformer model, and secondly the laser beam passes through the fiber optic cable, attached with an optical sensor for acquiring the acoustic signal is placed in the centre axis of the electrode arrangement of the transformer model as well as in different location of the transformer model. Finally, the measured values of PDs are compared for both the ways. The proposed method has several advantages over the conventional PD detection method such as electrical detection, chemical detection, and acoustic detection .

Study on the application of wavelet analysis method for denoising the partial discharge signal

Partial Discharges being a major source of insulation failure in power system ,detecting it accurately is a critical need for power companies to improve personnel safety and decrease the potential for loss of service. To achieve this, the suppression of noise is crucial priority to any partial discharge (PD) data analysis in on-line PD measurement. Therefore the study on the application of wavelet analysis method for denoising the partial discharge signal is being performed to achieve good effect in noise rejection in on-line PD detection by the method of Wavelet Transform (WT).

Development of a model for On-line Fault Diagnosis in the Transformer oil by Dissolve Gas Analysis (DGA)

In any electrical power system, transformers constitute one of the largest investments in a utility's system. For this reason, transformer condition assessment and management is a high priority. If a transformer fails, it would have a significant negative impact on revenue and service reliability. Hence monitoring the state of health of power transformers, a key component in the path of reliable power, is very essential. The model will help to increase the self life of the transformers by predicting the need for filtration and thus making the overall power system more efficient and reliable.

Remote operation of High Voltage 100kV AC test set with Labview

Using NI Labview, the automation of 100kV AC test system is being studied for enhancing the ICT facilities of the laboratory. With proper authentication, anybody from anywhere can access this facility all 24x7 hours through the web. The software implementation is done through proper coding in NI Labview.

In addition to the above projects , High Voltage Laboratory NIT Durgapur obtained several sponsored projects from the following government funding agencies :-

1. Ministry of Human Resources and Development (MHRD), Govt of India
2. Department of Science & Technology, Govt of India
3. National project Implementation Unit(NPIU), Technical Education Quality Improvement Programme (TEQIP), World Bank
4. National ICT Mission , Govt of India

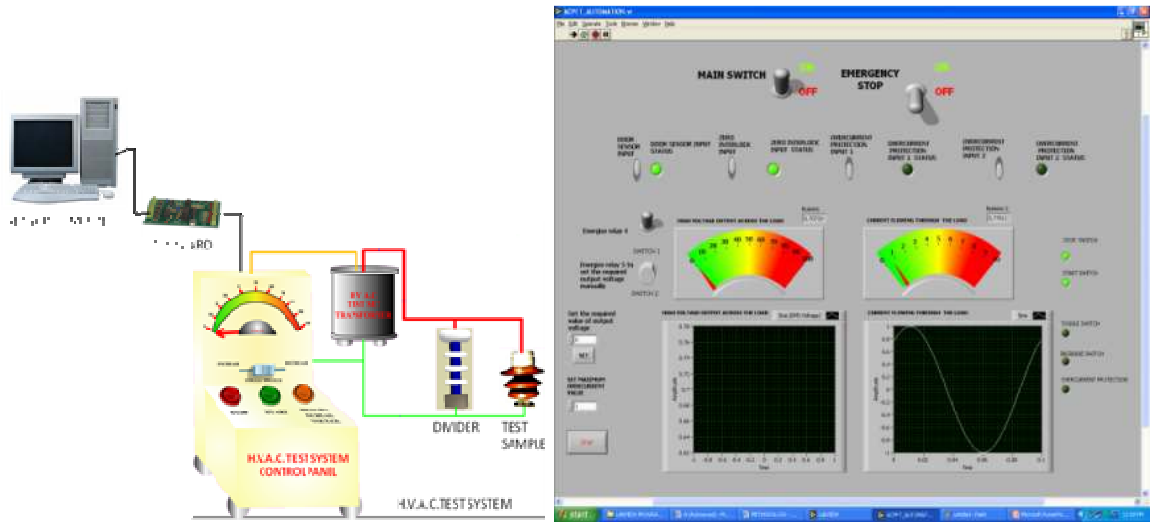

Figure 6: Schematic diagram for automation of H.V.A.C. Test set and Front Panel view for online access of H.V.A.C. Test set.

Conclusion

High Voltage Laboratory at NIT, Durgapur maintains a close association with professors at various institute in India and abroad. As the coordinator and developer of the HV laboratory, NIT, Durgapur, I am happy to disseminate the innovative ideas for continuous development of the laboratory and research in the field of High voltage engineering. To work in the new research areas of high voltage engineering, we are eagerly looking forward to enhance the scientific collaboration between NIT Durgapur and various research institutes in India and abroad. It has the opportunity to support all the learning objectives of the traditional high voltage laboratory in a remote setup. To the authors' knowledge, the laboratory is the first remote educational high voltage laboratory in the world. It is foreseen that it will be part of an e-learning network nationally and internationally, similar to that being developed in LabShare – a project that has been funded by the Australian Government's Department of Education, Employment and Workplace Relations, through the Diversity and Structural Adjustment Fund. I personally invite the researchers to pay a visit to our high voltage laboratory, NIT, Durgapur so as to strengthen our scientific collaboration and ICT enabled activities in the field of High Voltage engineering.

Acknowledgement

The author wishes to thank Ramanujam Satrathi, Department of Electrical Engineering, Indian Institute of Technology, Madras, India for giving an opportunity to write about the High Voltage Laboratory activities at NIT, Durgapur India.

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