

PES COLLEGE OF ENGINEERING

Mandya – 571 401

(Autonomous Institution Affiliated to V.T.U Belagavi)

(Accredited by NAAC, New Delhi.)

(161th Rank in NIRF, MHRD GOI)



REPORT ON

“ESTABLISHING HIGH VOLTAGE INSULATION LABORATORY”

Funded by Karnataka Council for Technological Upgradation (KCTU)

(Sanction order No. KCTU/R&D Centre/2014-15 dated 30-06-2014)

**Department of Electrical & Electronics Engineering
PES College Of Engineering, Mandya**

INDEX

1. Preamble
2. Need for Establishing High Voltage Insulation Laboratory
3. Research and Development Works Identified
4. Approved list of Equipments & Procurements
5. Equipments Procured With Specifications
6. Project Outcome Achieved
7. Research Paper Publications
8. Third Party Inspection Report from TECSOK
9. Report on Awareness Program

1. PREAMBLE

Research and Development work in Engineering is essential in the present scenario across the globe for technological Innovations and Development for the society. In this context, Industry Institute interaction is being encouraged both by Govt. of India and Govt. of Karnataka. Also UGC, AICTE and Universities encourage to promote R&D interaction between Engineering Colleges and Industries. This will benefit the society for developmental activities. The knowledge and expertise in technical competence of faculty members from our Engineering college need to be utilized by Students, Society and Industries. The existing Research laboratories in Engineering colleges need to be upgraded constantly considering the state of the art of the technology. This will benefit industries where it is difficult to have technical expertise and research lab for new innovation. Industries need to commercialize new products to meet the challenging market which require considerable support from R&D units.

2. Need for Establishing high voltage insulation laboratory:

India has ambitious mission "POWER FOR ALL". To be able to transmit this power to the entire country, expansion of the regional transmission network and inter regional capacity to transmit power would be essential. The later is required because resources are unevenly distributed in the country and power needs to be carried over longer distances to areas where load center exists. In our country, 400kV ac power systems have already come into operation, and in another ten years time every state is expected to be linked by a national power grid operating at 400kV or 800 kV.

Electric Power Systems comprises a large number of power equipment's like generators, HV motors, transformers, cables which are quite expensive and form the significant portion of plant assets. More importantly they are vital components for reliable delivery of electric power. However, the reliability of these equipment depends to a large extent on the healthy condition of their insulation. Failure of the insulation directly or indirectly will result in failure of power equipment which in turn results in forced outages, reduced reliability and increased maintenance and repair costs.

3. Research and Development Works Identified

- High voltages are used for wide variety of applications covering the power systems industry and research laboratories. The principle media of insulation used are gases, vacuum solid, liquid or a combination of these. For achieving reliability, the knowledge of the causes of insulation deterioration is essential. The tendency is to increase the voltage stress for optimum design which needs judicious selection of insulation in relation to the dielectric strength, discharges and other relevant factors.
- Insulation Engineering is one of the thrust areas identified worldwide in high voltage engineering. Lot of work is going on at various organizations and education institutes for futuristic materials which include fiber, sand, composites, plastics, conducting plastics, glass, ceramics, gases, super conductors. Multinational companies are looking forward for new dielectric material like solids, liquids, gases and their composite forms.
- Liquid dielectrics are used mainly for impregnation in high voltage cables and capacitors and for filling up of transformers, circuit breakers etc. Liquid dielectrics also acts as heat transfer agents in transformers and as arc quenching media in circuit breakers. Petroleum oils (transformer oil) are the most commonly used liquid dielectrics. Synthetic hydro carbons and halogenated hydro carbons are also used for certain applications. For very high temperature application silicon oils and fluorinated hydro carbons are employed.
- Partial discharge studies on Mineral oil and Synthetic Ester liquid with Solid dielectrics.
- Partial discharge studies on Vegetable oils with Solid dielectrics.
- Characterization of Partial Discharge pulses in voids in different Solid dielectrics under different ambient conditions.
- Ageing analysis on PD experimental data in Solid and Liquid dielectrics.

4. Approved list of Equipments & Procurement

Sl. No.	Equipments
1	PD Free High Voltage Generation unit
2	High frequency High voltage generator
3	Vacuum system with high pressure chamber
4	Electric oven with Temperature and Humidity control with HV bushing
5	Dielectric Analyzer
6	Vacuum impregnation unit
7	Digital storage oscilloscope
Total	

5. EQUIPMENTS PROCURED WITH SPECIFICATIONS

1. PD Free High Voltage Generation unit



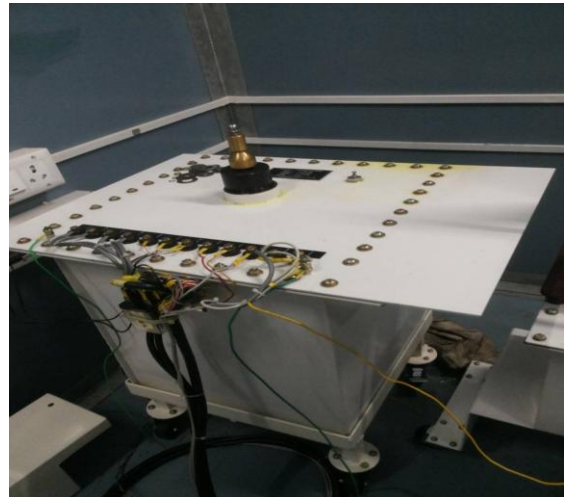
- Rated Secondary Voltage : 0-100 kV Continuously variable
- Rated Primary Voltage : 220V, 50 Hz
- Rated output power : 7.5 KVA continuous 10 KVA
- Impedance voltage : approximately 8% as referred to continuous duty KVA.
- Partial Discharge Level : <5pC at full rated voltage of 100Kv

CAPACITOR COUPLING

Oil insulated and hermetically sealed capacitor in FRP housing mounted on mobile platform and with Corona-free HV Electrodes

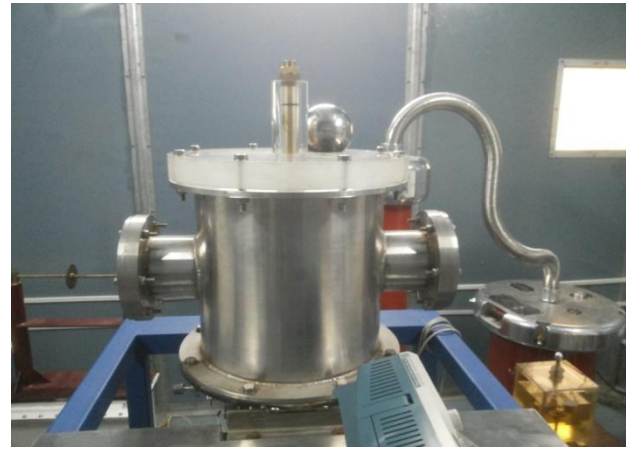
- RATED VOLTAGE = 120kV, 50Hz
- RATED TEST VOLTAGE = 144kV, 50Hz
- RATED CAPACITANCE = 1000pF +/-10%
- RATED PD LEVEL - < 5pC

2. HIGH FREQUENCY HIGH VOLTAGE GENERATOR UNIT



- The equipment has output Frequency range from 500 Hz to 30 kHz . Both coarse and fine adjustments are made available with two 10 round potentiometer.
- The output voltage is variable from 0 volts to 30 kilo volts peak value. 1000:1 bleeder is built in inside the transformer.
- Both the Control Unit and High voltage transformer are mounted on a trolley for easy movement.
- AC to DC high voltage conversion unit with built in 1000:1 bleeder.

3. Vacuum system with high pressure chamber



Vacuum system:

- Vacuum pump with low pressure – 01 torr
- Vacuum Measurement - Twin head Pirani guage
- Mounted on a MS frame work on mobile platform

High Pressure Chamber

- Test cell - 10mm SS plate with flanges on both ends. Acrylic/Perspex end flange of 25mm thick with O rings for sealing
- HV bushing – 50kV
- Electrode - Stainless Steel – HV & LV Electrodes
- Inspection window - One No. transparent glass/Perspex
- Gap measurement - Wilson Seal arrangement with Micrometer to adjust gap distance
- Set up - mounted on a suitable MS frame work on mobile plat form

4) Electric oven with Temperature and Humidity control with HV bushing



The oven is designed to attain maximum temperature upto 200 degrees C

5) DIELECTRIC ANALYZER



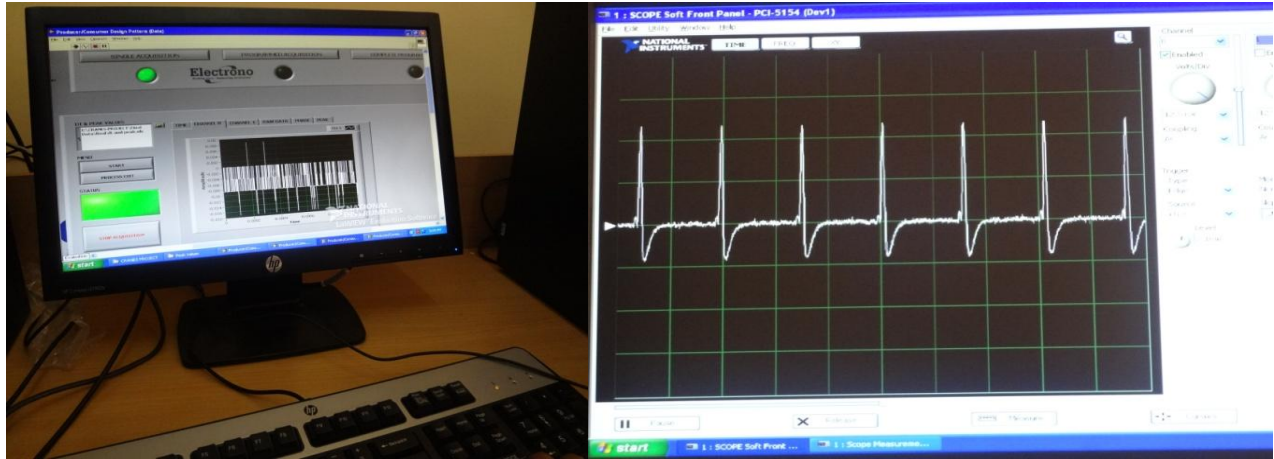
- Fully automatic Dielectric constant tan delta and resistivity measurement
- Automatic heater control and temperature display
- RS232 PC Interface & USB printer Interface
- Windows Interface software
- Oil test cell: 2Kv, 50-70Pf
- Automatic oil test cell heater
- Solid test cell: 3-Terminal guarded 2.5kV, 70pF

6) VACUUM IMPREGNATION UNIT



- 25 liters Capacity filtering
- De-gassing and processing unit under vacuum
- Distilling set up under vacuum
- Digital temperature controller and digital timer
- Vacuum pump with gauge

7) Digital storage oscilloscope



- This unit is PC based Digital Storage Oscilloscope
- This equipment is procured to serve the following purposes
 - a) To capture the real time oscillograms for analysis as DSO
 - b) This equipment can also be used as PD Instrument to capture real time Partial Discharge Pulses for PD analysis.
- Programmable environment for Statistical analysis of the captured PD Pulses

Awareness Program:

One-Day Awareness Program on “High Voltage Insulation Laboratory” was organized by Department of Electrical and Electronics Engineering to give exposure about High-Tech infrastructure in the Laboratory and training on the usage and applications of equipments. Representatives from companies/organizations situated in and around Mandya district have participated in the program.

6. RESEARCH PAPER PUBLICATIONS

1. L.Sanjeev Kumar, B.Ramachandra, and S. Senthil Kumar “Performance of PCCC in Presence of Mercaptans in Transformer Oil using Φ -t-N Technique” 2015 International Conference on Power and Advanced Control Engineering (ICPACE), 978-1-4799-8371-1/15 ©2015 IEEE, BNMIT, Bengaluru.
2. L.Sanjeev Kumar, B.Ramachandra, and S. Senthil Kumar “Online tan- δ Measurement and Investigation of Insulation Behavior during PD Activity of PCCC in Mercaptans Contaminated Transformer Oil” International Conference on Emerging Research in Electronics, Computer Science and Technology – 2015, 978-1-4673- 9563-2/15 ©2015 IEEE, PESCE, Mandya
3. L.Sanjeev Kumar, B.Ramachandra, and S. Senthil Kumar “PD Pulse Sequence Studies with model transformer insulation in Mercaptans contaminated transformer oil” 2016 IEEE Power Modulator and High Voltage Conference - 05-09 July 2016, San Francisco.
4. L.Sanjeev Kumar, B.Ramachandra, and S. Senthil Kumar “Investigation of model transformer insulation behavior during PD activity in Di-Benzo-Di-Sulfide Sulphur contaminated transformer oil using online tan δ measurement” 2016 IEEE Power Modulator and High Voltage Conference - 05-09 July 2016, San Francisco.
5. Mahesh Kumar K M, B.Ramachandra, “Calibration of Partial Discharge Measuring System by a Reference Square Wave” Test Engineering & Management, January-February 2020 ISSN: 0193-4120 Page No. 16276 – 16281
6. Mahesh Kumar K M, B.Ramachandra, “Design Of Matching Impedance And Amplifier Circuit for Partial Discharge Measurement” International Journal of Advanced Science and Technology, Vol. 29, No. 7s, (2020), pp. 2020-2026
7. Mahesh Kumar K M, B.Ramachandra, L.Sanjeev Kumar “Analysis of Phase Resolved Partial Discharge Patterns of Kraft Paper Insulation Impregnated in Transformer Mineral oil” IEEE 2020 International Conference on Smart Electronics and Communication (ICOSEC), Trichy, India, 2020, pp. 1157-1161, doi: 10.1109/ICOSEC49089.2020.9215344,
8. Mahesh Kumar K M, B.Ramachandra, L.Sanjeev Kumar, “Analysis Of Partial Discharge Patterns Of Natural Ester Oil And Mineral Oil Used In Power Transformer” Article accepted for publication on 20th Dec 2020, Materials Today: Proceedings an Elsevier Journal ISSN: 2214-7853

REPORT ON AWARENESS PROGRAM

One-Day Awareness Program on “High Voltage Insulation Laboratory” was Organized by Department of Electrical and Electronics Engineering on 17th August, 2019, PES College of Engineering, Mandya

The chief guest for the function was Sri M N Murulesh, Joint Director, District Industries Center, Mandya and the guests of honour was Dr P S Puttaswamy, Former Proferssor & Head, Dept. Of E&E Engineering, PESCE and Dr. B Ramachandra, Professor and Project Co-ordinator for the established Laboratory.

The workshop was formally inaugurated with the invocation and lighting of lamp by the Dignitaries. Welcome speech was delivered by Dr P S Puttaswamy and highlighted about Department and program. The key note address was delivered by Chief Guest Sri M N Murulesh, who gave useful information about Government facilities and various schemes available for Small & Medium scale industries. He also enlightened about KCTU fundings to industries. Dr B Ramachandra, Professor and project Co-ordinator for Establishment of High Voltage Insulation Laboratory gave presentation on the various equipments installed, its applications and also advised the Industries to make best use of the High-tech infrastructure of the established new Laboratory. The inaugural function was concluded with the vote of thanks.

The participants visited the High voltage Insulation laboratory and got exposure to the latest equipments for better understanding of the latest technology in power sector for testing and R&D activities.

PARTICIPATED ORGANISATIONS

- **District Industries centre & District Skill Development Office**
- KPTCL, Mandya division,
- CHESCOM, Mandya Division
- Welpson Corporation Limited,
- Mysugar company Limited
- Atria Power Corporation Limited
- MVSS, Garudana ukkada
- Sri Annapoorneshwari Electicals, Mandya
- S. M Enterprises, Mandya
- S S Panel
- Prasura Enterprises
- Vajra Technologies
- Raj Electricals
- M-Tech Electronics
- MVSS, VC Farm
- MVSS, Dooda Byadrahalli
- MVSS, Kadhakothanahalli

Awareness Program Photos



Registration



Invocation

Lighting of Lamp



Welcome address by Dr. P S Puttaswamy



Speech by Dr. B Ramachandra about Laboratory and Awareness Program



Speech by Chief Guest Mr. M N Murulesh, Joint Direct, District Industries Center, Mandya



Participants

Lab Visit

