

## High Voltage Engineering Lab

<http://www.power.uwaterloo.ca/HVEL/index.htm>

(HVEL) is a leading research and teaching lab in the field of insulation, applied electrostatics, nanodielectrics, pulse power applications, and power electronics. Our extensive experimental and test facilities - available to industry - allow the design, prototyping, and testing of high-voltage components and advanced dielectric materials, while our research experts are recognized around the world.

### Location

CPH 1332/1333

### Management

- Director: Shesha Jayaram, jayaram@uwaterloo.ca, (519) 888-4567 x35337
- Lab Technologist and Industrial Liason Officer: Michael-jianfeng Zhang, jfzhang@uwaterloo.ca, (519) 888-4567 x32772

### Users

- Graduate students (Engineering)
- Undergraduates
- Visiting Scholars
- Industrial Collaborators:
  - General Electric
  - Waterloo North Hydro
  - University of Guelph
- Frequent users: G&W, GE Peterborough, Teaching for undergraduate course ECE-464
- Research Groups: HVEL includes Dr. Shesha Jayaram, Dr. Edward Cherney, Dr. Magdy Salama and Dr. Ehab-El-Sadany
- HVEL group members and visiting scholars

### Research

#### HV and Insulation Engineering

- Rotating Machines
- Outdoor Insulation
- Nanodielectrics
- Cables
- Diagnostics
- Smart Grid
- Electric Field Computations
- Partial Discharges (PD)
- Grounding
- EMI
- Liquid Dielectrics
- MV and HB Circuit Breakers

## HV Applications

- Biotechnology
  - Pulsed Electric Field (PEF) Treatments
  - Air Pollution and Water Treatments
  - Electroporation
- Nanotechnology
  - Electrospinning and Nanofabrication
  - Nanodielectrics and Composite Materials
- Specialized Power Supplies
  - Thyatron based Pulse Power Supplies
  - MOSFET/IGBT based Pulse Power Supplies
  - Low Power High Voltage Inverters
  - Compact DC Power Supplies

## Lab Capability

- We have all the equipment in the lab needed to carry out all the high voltage industry specific di-electric tests while meeting all the latest standard requirements such as standard lightning impulse test, partial discharge test, tan delta and capacitance measurements, Dry band arcing tests, DC and AC breakdown tests etc.
- We are the only lab in the world with a high voltage PWM generator that can simulate output of high frequency induction machine drives at multiple frequencies and variable high voltage outputs.
- Standard AC withstand and breakdown tests (Dry and Wet Type)
- Standard Impulse tests (Lightning and Switching)
- Special HV DC Tests
- Special Impulse Tests using Steep Front Impulses (Surge Tests)
- Standard ASTM Tracking and Erosion Tests
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- Non-destructive tests
- Partial discharge
- Capacitance and Tan-delta
- Thermal Imaging
- Impedance Spectra analysis
- Electric Field Measurements using Electrostatic voltmeter
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- Development of new insulating materials
- Electric Field and Potential Computations using Numerical Methods
- Turn-key problem solving of insulation systems
- Development of Specialized High Voltage Power Supplies for Process Industries
- Development of Specialized High Voltage Power Supplies for Insulation Testing
- Consulting on field and on-site HV and MV problems
- Presenting HV related courses

## Selected Projects

- Nanodielectrics
  - Erosion Resistance of Silicone Nanodielectrics
  - Magnetic Wire Nanodielectric Enamel Insulation

- Silicone Nanodielectrics Prepared with Surfactant
- Smart Grid
  - Effects of Power System Harmonics on Distribution Transformer Insulation Performance
  - Cable Terminations Analysis Under Fast Rise Time Pulses

## Equipment

The University of Waterloo is the only university with a high voltage lab, therefore, each piece of equipment is rare.

### Major Equipment

- 400 kV/200 kVA AC Test Transformer
- 800 kV/60 kJ Impulse Generator
- 600 kV/30 kJ Impulse Generator
- 300 kV/20 mA DC Test Unit
- Capacitance and Tan-delta Bridge
- Partial Discharge (Noise level: < 1 pC at 150kV, < 3 pC at 300kV)
- Salt-Fog and Clean-Fog Chamber
- Inclined Plane, Laser and Dry Arc Tests

### Other Equipment

- Thermal Imaging Camera
- Impedance Spectrum Analyzer
- Non-contact Electrostatic Voltmeter
- Temperature Controlled Climate Chamber
- 30kV DC Power Supply - Del Electronics Corp. 30-10-3
- 30kV DC Power Supply - Glassman High Voltage Inc. PS/ER30P10.0-11
- 5kV DC Power Supply - Glassman High Voltage Inc. PS/WX05R200-202
- Vacuum Oven VWR 1370-FM
- Regulated DC Supplies (5 kV to 30 kV)
- Power Modulators (5 to 50 kV, 1  $\mu$ s to DC)
- Pulse Power Supplies (Exponential and Square Wave)
- Nicolet Oscilloscope
- Tektronics Oscilloscopes (200 MHz to 1 GHz)
- [Other Miscellaneous Equipment](#)

## Supporting Partners

- NSERC Canada
- University of Waterloo

## Access Rights

- **Open to University Students/ Faculty**
- **Open to Public/Industry for a Fee**
  - The fee depends on the type of test(s) being conducted