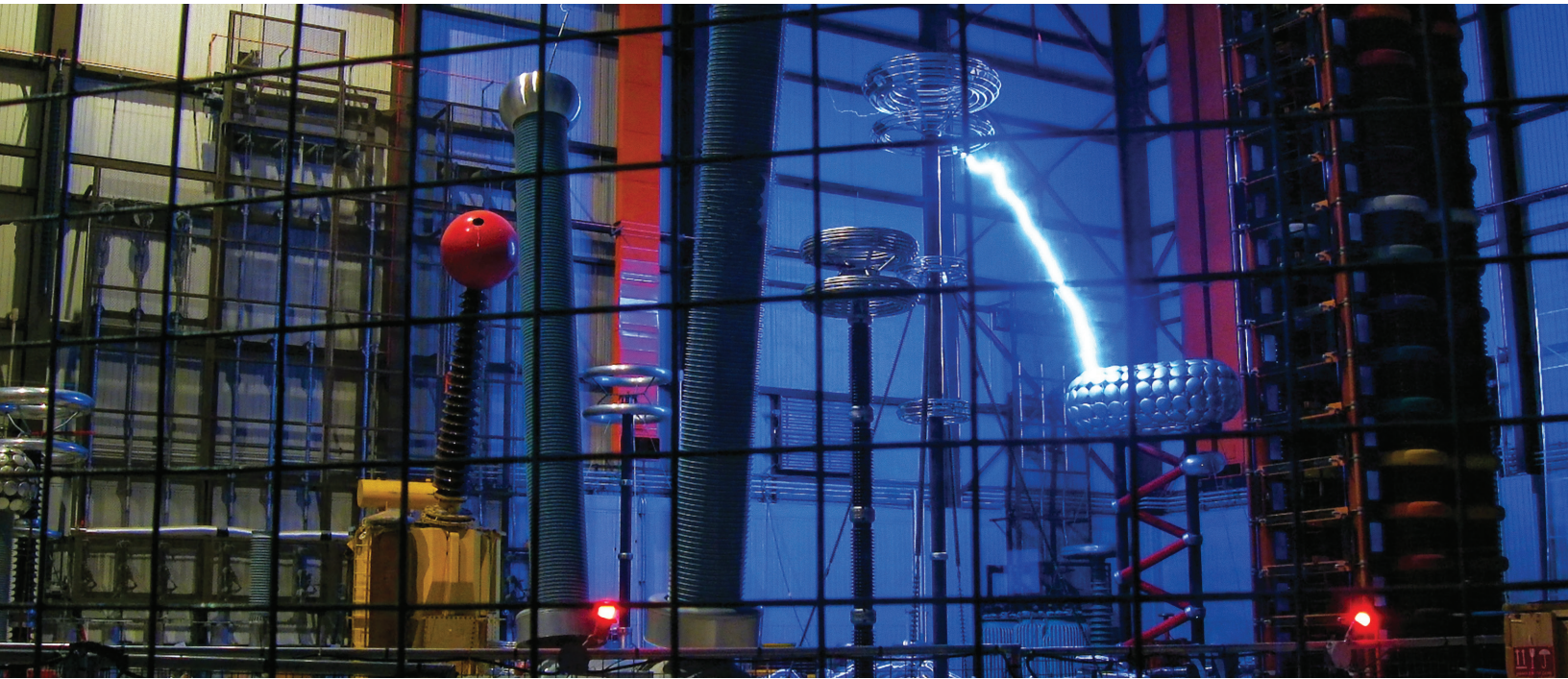


HIGH VOLTAGE TECHNOLOGY & TESTING

Powertech
The Power of Trust. The Future of Energy.

HIGH VOLTAGE TESTING



Qualification testing, condition assessment, and forensic analysis

Manufacturers and utility users of high-voltage electrical equipment face a number of challenges. New products must be tested to ensure their conformance with design specifications and national and international standards. In-service equipment must be periodically assessed to determine its condition, prevent unscheduled outages, and enhance safety.

Adding to these challenges, high-voltage technologies are continually evolving, the tools necessary for testing are specialized, and the testing, failure analysis, and research require high-level experience and expertise.

Powertech's High Voltage Laboratory helps manufacturers and utilities address these requirements. As the largest test lab on the west coast of North America, the lab is capable of conducting distribution- to transmission-level high-voltage tests on all types of equipment, including transformers, insulators, switchgear, bushings, cables and accessories, instrument transformers, and transmission line hardware.

Powertech is a trusted name with a worldwide reputation in high-voltage testing. The lab's independent, third-party status and experienced and knowledgeable technical staff of more than 30 years enhance the credibility of manufacturers' test reports.

The High Voltage Laboratory offers a full range of qualification and certification tests, as well as custom testing solutions. Condition assessment tests may be performed in the field or in the lab to evaluate the equipment condition.

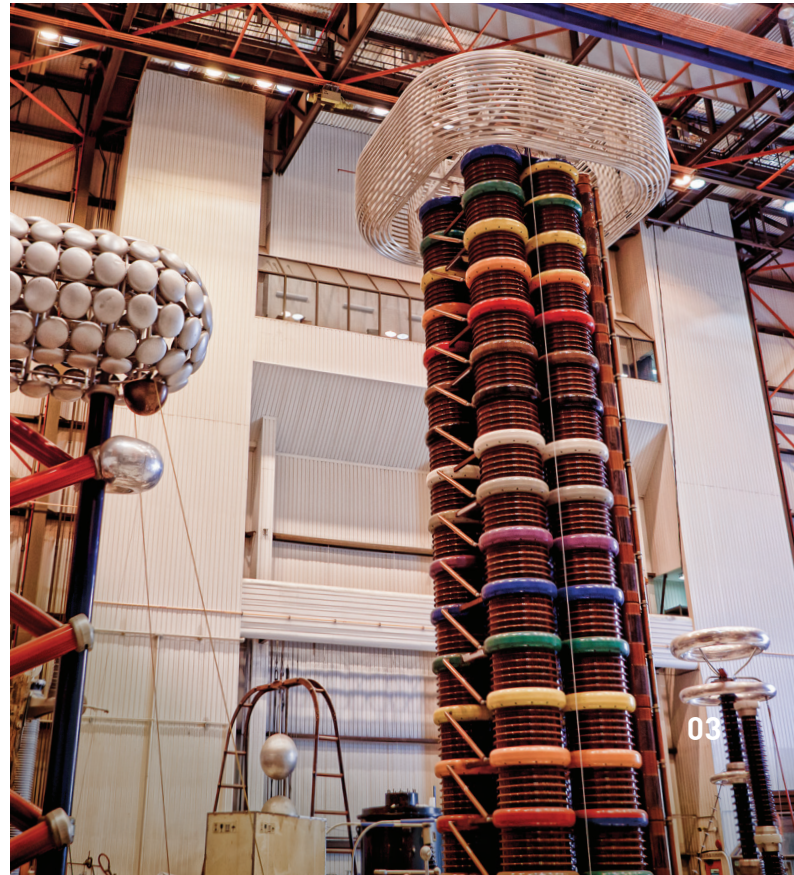
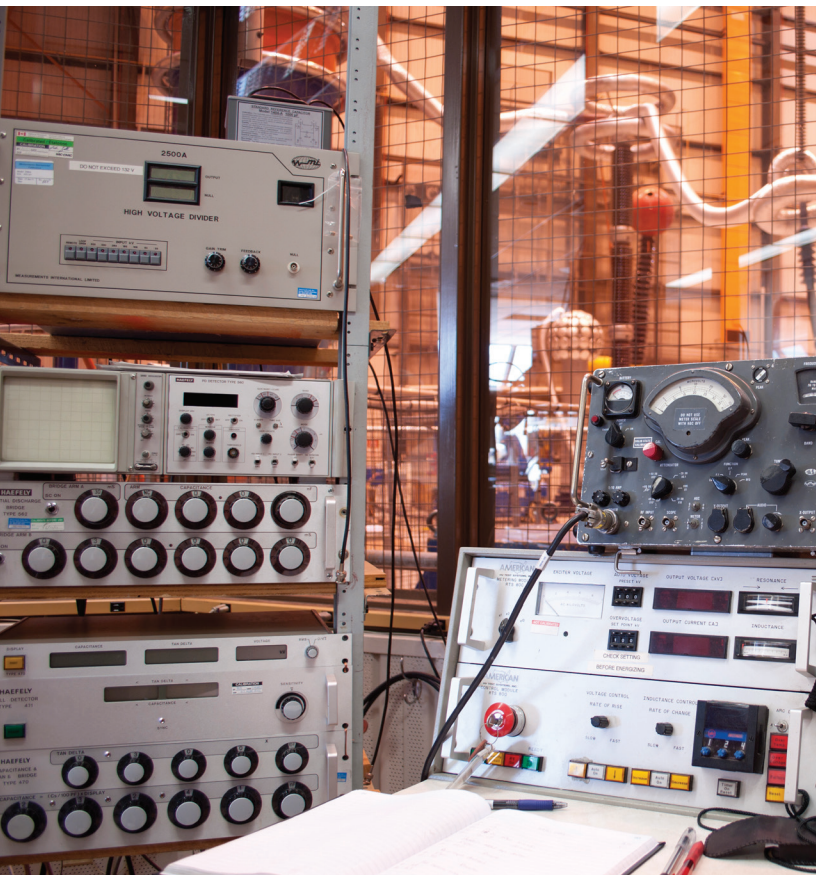
The lab also has a long history of conducting forensic analysis investigations to identify the cause of failures and providing expert witness services.

In addition, Powertech has the experience and capabilities to conduct research involving advanced test techniques, new high-voltage equipment, and novel diagnostic tools and methods.

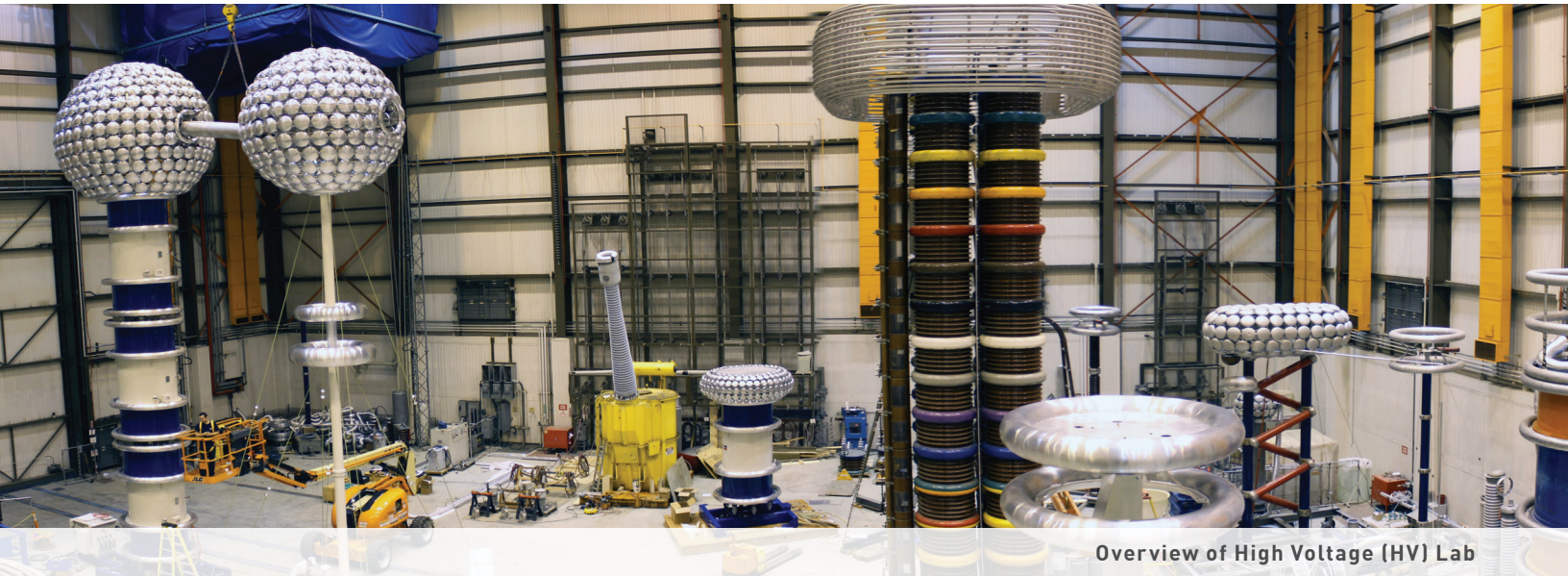


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TESTING CAPABILITIES



Overview of High Voltage (HV) Lab

MAIN TEST EQUIPMENT

Powertech's High Voltage Laboratory is the largest test lab on the west coast of North America. The lab is capable of providing high-voltage tests at voltages up to 1600 kV AC, 3 MV impulse, and 1 MV DC.

Facilities comprise an indoor lab, clean fog pollution test chamber, salt fog pollution test chamber, two-acre outdoor test area, and a 500-kV 180 m Inverted Delta transmission line.

The indoor labs include a high-voltage lab and a medium-voltage lab, which are furnished with state-of-the-art equipment for measurements such as partial discharge, RIV, tan delta, and electrical properties of materials.

- **AC test equipment** – 1600 kV resonant test set, 5.0 A, for testing in the lab or in the field.
- **High-voltage VFRTS (Variable Frequency Resonance Test Set)** – 90 kV, 34 A-portable.
- **Impulse voltage test equipment** – **3.2 MV, 225 kJ impulse generator.**
- **3 Phase Generator** – 60 Hz, 5 MVA and 300 Hz, 1 MVA.
- **DC voltage test equipment** – DC test set rated 1000 kV, 10 mA for testing in the lab or in the field.
- **Insulation tracking wheels (dip and spray wheels) and fog chambers** – 1,000 hours.
- **Partial discharge test equipment** – for field testing of cables and high-voltage equipment.

HIGH VOLTAGE TESTING CAPABILITIES

TEST TYPE	NOMINAL RATING	
High Voltage AC	1600 kV	
High Voltage DC	1000 kV	
Impulse Testing	3200 kV	
3 Phase AC feeder	12 kV	
3 Phase Generator	60 Hz, 5 MVA	300 Hz, 1 MVA

HIGH VOLTAGE SERVICES



Field testing



High Voltage Lab testing

Powertech's High Voltage Laboratory provides qualification testing, condition assessment, forensic analysis, expert witness, and research on all types of high-voltage equipment.

Test equipment includes transformers, instrument transformers, insulators (porcelain, glass, and composite), bushings, capacitors, switchgear, surge arrestors, cables and accessories, SF₆ insulated equipment, generators, transmission line hardware, insulated aerial lift devices, and transformer rectifier units (TRUs).

SERVICES INCLUDE:

Qualification Testing

Qualification and certification tests are conducted in accordance with all relevant industry standards such as AEIC, ANSI, ASTM, CSA, IEC, ICEA, IEEE, UL, and utility-specific standards. Custom tests can also be tailored to the client's requirements.

Forensic Analysis

The High Voltage Laboratory has the technical expertise to carry out detailed failure investigations on power equipment.

Condition Assessment

Condition assessments can be performed in the field and lab.

Expert Witness

The technical staff have conducted failure analysis investigations for legal proceedings and provided expert witness services.

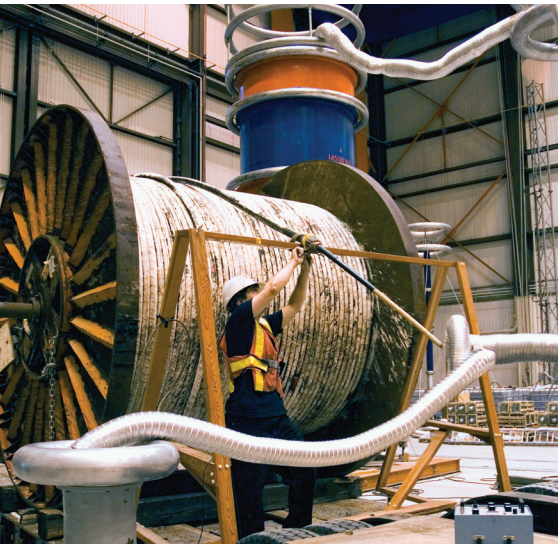
Research

Powertech is a principal investigator for large research organizations such as EPRI, CEATI, and the research sections of large utilities.

TEST CATEGORIES

- Dry and wet AC and DC voltage withstand and flashover
- Lightning impulse voltage withstand and flashover
- Switching impulse dry and wet voltage withstand and flashover
- Radio influence voltage (RIV)
- Partial discharge and visual corona
- Tracking and erosion wheel and fog chamber
- Salt fog and clean fog pollution
- Dielectric testing - capacitance and tan delta
- Induced testing

CABLE SERVICES



High voltage cable testing in the HV lab



High voltage cable testing in the MV (medium voltage) Lab

The Cable Technology section focuses on standard testing and specialized evaluation of all types of transmission, distribution, and submarine cables and accessories.

Transmission-class cables include oil/paper insulated (pipe type or self-contained fluid-filled [SCFF]), cross-linked polyethylene (XLPE), and ethylene propylene rubber (EPR). Distribution-class cables are XLPE, EPR, and paper-insulated, lead-covered (PILC). Accessories consist of separable insulated connectors, terminations, and splices.

SERVICES INCLUDE:

Condition Assessment

Powertech conducts condition assessment tests in the field on in-service cables and accessories and in the lab on cables and accessories removed from service to prevent unscheduled outages and determine replacement priority. On-line tests include visual inspections, partial discharge tests, infrared imaging, and metallurgical tests. Among off-line tests are AC withstand tests, tan delta, and partial discharge measurements. Laboratory tests include partial discharge tests, tan

delta measurements, AC withstand/breakdown, hot and cold impulse/switching tests, and a variety of material and chemical tests.

Qualification Analysis

Qualification tests can be performed on new designs of cables, splices, and terminations in accordance with all relevant industry standards.

Failure Analysis

Cable Technology has extensive expertise in failure analysis investigations to determine the root cause of equipment failure.

TEST CATEGORIES

- AC withstand and breakdown
- Partial discharge measurements (conventional and non-conventional)
- Capacitance and tan delta/dissipation factor
- Termination and splice
- Separable insulated connector
- Accelerated aging
- Cable and accessory aging
- Impulse (cold and hot)

MULTIDISCIPLINARY TESTING

Advantages of cross-disciplinary analysis

Powertech’s electrical testing labs have facilities for high-voltage, high-power, and high-current testing, as well as in-house access to labs to assist with **mechanical**, **chemical**, and **materials** testing. These labs offer unique capabilities and expertise for cross-disciplinary analysis and provide advantages for customers.

One advantage arises in projects that require across-the-board testing. Insulation condition assessment, for example, may require expertise in electrical, mechanical, chemical, and materials engineering. Powertech can conduct investigations into all aspects of equipment.

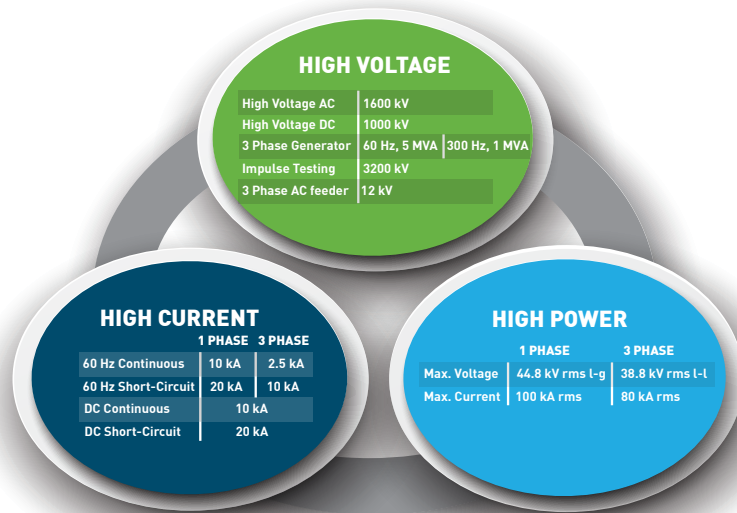
Customers may also realize time and cost efficiencies by having equipment undergo several different electrical tests at Powertech labs.

The collocation of Powertech laboratories also means that different tests can be performed efficiently in sequence while mitigating the risks

of transportation and setup between tests. This is a typical scenario when testing large, expensive equipment such as switchgear cabinets.

The electrical labs also specialize in integrated test programs in areas such as transmission and distribution cables, stator winding insulation, and metering and protection devices. For example, insulators may undergo dielectric

testing in the High Voltage Laboratory and power arc tests in the High Power Laboratory. A combined voltage-current instrument transformer may undergo voltage accuracy, lightning impulse withstand, temperature rise, and partial-discharge-AC withstand testing in the High Voltage Laboratory, current accuracy testing in the High Current Laboratory, and fault current testing in the High Power Laboratory.



SELECTED CLIENTS



High
Voltage

THE POWERTECH ADVANTAGE

Powertech Labs Inc. is one of the largest testing and research laboratories in North America, situated in beautiful British Columbia, Canada. Our 11-acre facility offers 15 different testing labs for a one-stop-shop approach to managing utility generation, transmission and distribution power systems.

Powertech is home to a broad range of scientists, engineers, and technical specialists, with capabilities in electrical testing, cable condition assessment, mechanical and materials engineering, software technologies, power system studies, chemical analysis, gas systems engineering, and smart utility services. These skilled researchers have decades of collective and real-world experience and often work in cross-departmental teams to investigate, diagnose and solve complex problems.

As an independent, third-party testing facility, we adhere to the **highest** laboratory (**ISO 17025**), quality (**ISO 9001**) and environmental

(**ISO 14001**) management standards. Many of our scientists and engineers chair or participate in various standards committees within their fields of expertise. Additionally we have the capabilities to derive and develop **non-standard testing** methods and setups required to test product prototypes and perform forensic analysis.

Outside of the utilities industry, Powertech provides routine **testing** capabilities, product **development**, research and **consulting** services to support an array of industrial-type operations, electrical equipment manufacturers and automotive original equipment manufacturers.



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