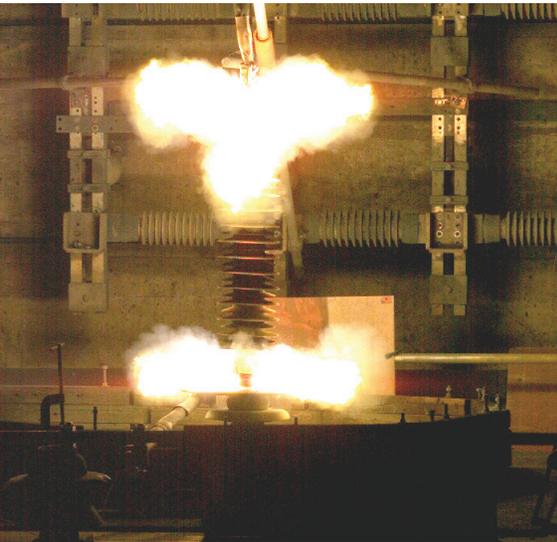


HIGH POWER TECHNOLOGY & TESTING

Powertech

The Power of Trust. The Future of Energy.

HIGH POWER TESTING



Internal fault pressure relief test



High Power Laboratory

Largest grid-connected short-circuit testing facility in North America

Manufacturers of transmission and distribution products designed to carry, sense, and/or route electrical current are required to test and verify those capabilities through the life of their products.

Such testing ranges from exploratory proof-of-concept testing at the R&D stage of product development to traceable standards-based certification tests on existing products.

Powertech's High Power Laboratory offers evaluation, verification, and certification testing of medium- and high-voltage products to support manufacturers, power utilities, and other users of electrical equipment.

The lab specializes in testing for proper switching, withstand, and sensing of protection equipment during power flow transients.

The lab is the largest grid-connected short-circuit testing facility in North America and operates independently of utilities and manufacturers. It has controlled power level capabilities for short-duration single-phase tests up to 400 MVA and three-phase tests up to 1,000 MVA.

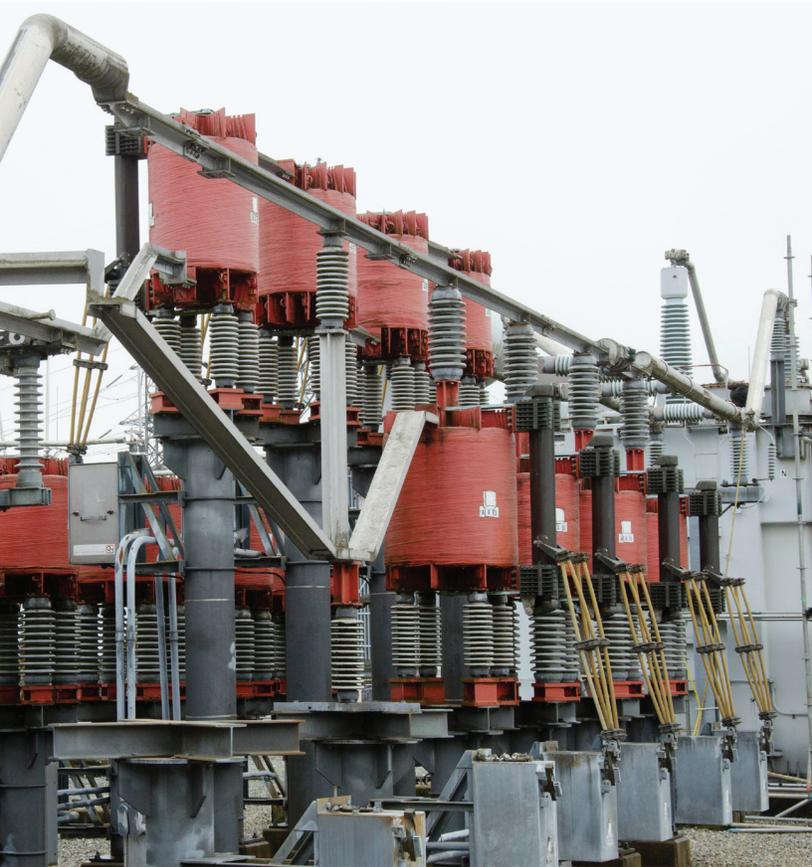
Test services include load- and fault-interrupting tests, arc-resistance tests, momentary and short-time current tests, and failure-mode and

exploratory tests involving applying precisely controlled distribution-level 60 Hz voltage and current to test objects.

Typical equipment tested are switches, breakers, reclosers, metal-enclosed switchgear, fuses, transformers, reactors, insulators, arresters, connectors, junction boxes, cables, and electrical sensors.

The High Power Lab is client-focused, providing confidentiality and flexible scheduling. The lab's experienced team of engineers and technicians supervises each test and offers one-on-one consultation services throughout the planning, execution, and reporting stages of a test program.

In addition, High Power Technology & Testing has the capabilities to conduct research involving advanced, new high-power equipment.



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CAPABILITIES



Waveform analysis



High Power Lab control room

Powertech's High Power Laboratory is a one-of-a-kind grid-fed testing facility that simulates distribution-level short-circuit conditions with precisely controlled simultaneous medium voltage and high current.

The facility comprises a control room, switchyard, and two test cells, and is fed by a 230-kV, three-phase power line directly from a large substation capable of supplying power up to 1,000 MVA.

Test capabilities include three-phase tests up to 38.8 kV l-l and 80 kA rms, and single-phase tests up to 44.8 kV l-g and 100 kA rms at 60 Hz.

FEATURES:

- Stiff three-phase source with three single-phase, short-circuit transformers, providing configurable and precise AC voltage
- Network of selectable circuit elements for precise current, power factor, and transient-recovery-voltage control
- Three make switches for accurately timed energization
- Dedicated team of engineers and technicians for set-up, execution, and reporting
- Comprehensive protection, control, and instrumentation system

- One outdoor and one indoor test cell

The laboratory has ISO/IEC 17025 accreditation and is signatory to the STLNA agreement.

The technical team is skilled at optimally designing and conducting tests to meet customer needs at minimal cost and with transparency. In addition to testing, the team can also provide expert consultation services for obtaining high-quality, reliable, and efficient troubleshooting and technical solutions.

The laboratory can also facilitate witnessed or unwitnessed testing for various product certifications.

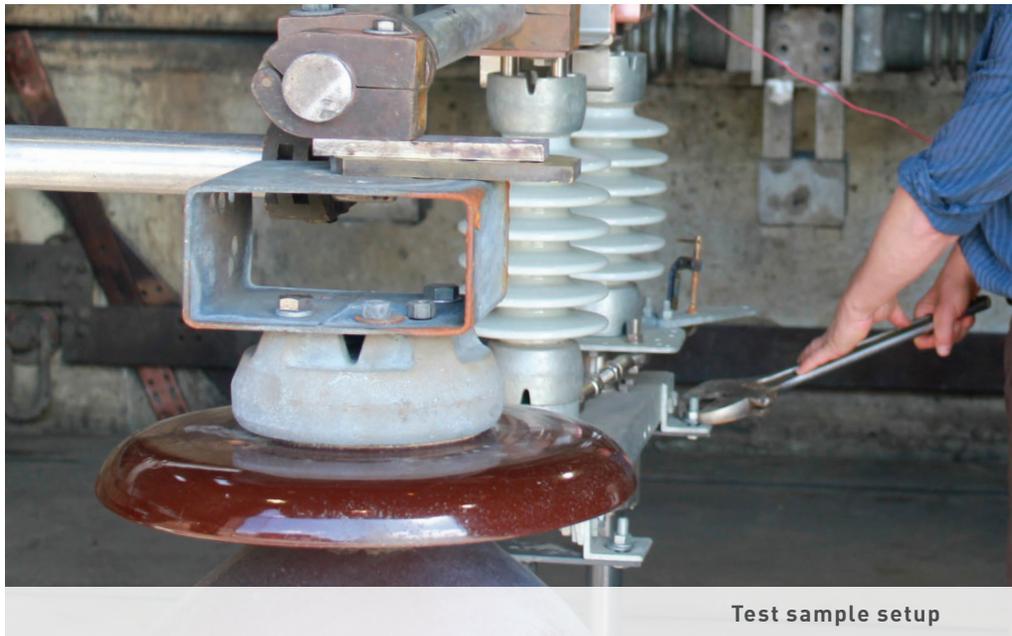
HIGH POWER TESTING CAPABILITIES

TEST TYPE	1 PHASE	3 PHASE
Maximum Voltage	44.8 kV rms l-g	38.8 kV rms l-l
Maximum Current	100 kA rms	80 kA rms

SERVICES



Current source circuit setup



Test sample setup

The High Power Laboratory offers efficient and cost-effective high-quality testing of medium- and high-voltage products to support electrical equipment manufacturers and power utilities.

Tests are conducted to recognized North American and international standards such as ANSI, IEEE, IEC, CSA, and UL, and may also be tailored to customer requirements.

TESTS INCLUDE:

- Load and fault interrupting tests
- Momentary / short-circuit resistance tests
- Arc-resistance tests
- Failure-mode / exploratory simulations

EQUIPMENT TESTED:

- Reclosers, breakers, disconnects, and sectionalizers
- Metal-enclosed and metal-clad switchgear
- Fuses: Power, current-limiting, and cutouts
- Transformers: power, instrument
- Reactors
- Insulators
- Arresters
- Connectors: grounds, separable
- Junction boxes
- Cables
- Fault current indicators
- Non-conventional: smart grid sensors, optical voltage and current transducers, and others

TECHNOLOGY CONSULTING:

- Finite element analysis and advanced numerical analysis for multi-physics electrical device design ("virtual testing")
- Test program and planning advice for standards-based and design verification testing of electrical technologies and products

ADVANTAGES OF GRID-CONNECTION



Largest grid-fed high power test facility in North America

Powertech's High Power Laboratory is a grid-fed testing facility, hosting a much stiffer power source compared to the more common, local-generator-sourced power testing facilities elsewhere in the world.

Generator-fed sources provide power that is in a state of decay at the moment the test begins as the generator slows down due to the sudden introduction of short-circuit load. In contrast, a grid-sourced power supply, which is effectively fed by multiple generators, is virtually constant from the moment the test begins and until it ends.

Test standards specify minimum peak and/or rms values for applied high-current waveforms with durations from a few cycles up to several seconds. As a result of their inherently decaying output, generator-fed sources may need to overshoot these minimum requirements early in the test to ensure still meeting them at the end. So, to satisfy the intent of the standard, the equipment under test may suffer unfair exposure to higher-than-intended wear-and-tear for its rating—e.g., higher electromagnetic fields, forces, and/or heating caused by currents exceeding the rating by up to 10s of percent.

Another advantage of grid-sourced power can be better on-demand availability for repeated testing. It may take a considerable amount of time to ramp up the test generator again to precisely the right speed for the next test in a series, whereas grid-sourced power is readily available in a much shorter time. A good example is capacitor switch testing, where Powertech's High Power Laboratory is much more efficient and sometimes the only practical solution to meeting the standard testing requirements.

Testing that addresses designers' needs to verify behavior of high-current-carrying and high-current-sensing devices in the presence of substation transients is also of particular importance in the product development phase—i.e., in prototype and proof-of-concept verification testing—where finding design margins is critical in the optimization, and possibly even direction, of technology and product development.

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 cross-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.

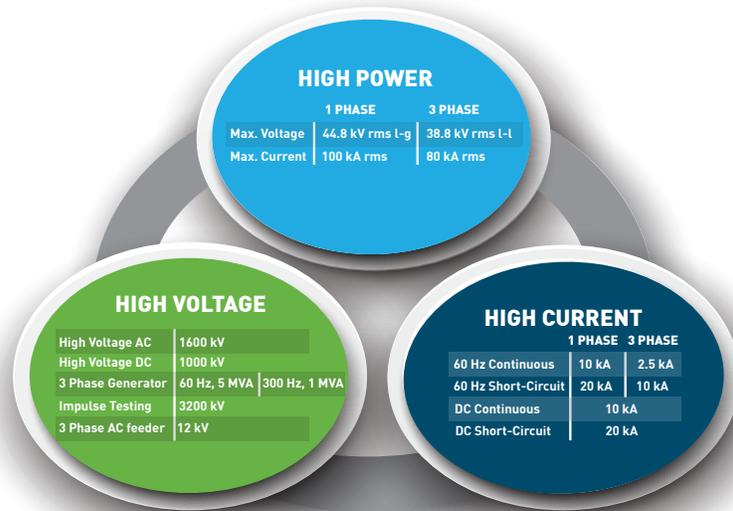
Customers may also realize time and cost efficiencies by having equipment undergo several different electrical tests at Powertech labs.

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
Power

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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