

March 2006
Aftermarket Solutions, Ref. No. [449]

Eaton - Electrical Services & Systems

Contents

<i>Description</i>	<i>Page</i>
Eaton - Electrical Services & Systems Solutions	
Solving the Operating Performance Puzzle	23-2
PowerChain Management™ Solutions	23-2
Power Systems Engineering Solutions	23-4
Predictive Maintenance	23-5
Continuous and Remote Partial Discharge Monitoring for Medium Voltage Equipment	23-5
Medium Voltage Vacuum Replacement Breakers (MVVR)	23-6
Class 1 Reconditioning	23-6
Automation Services	23-7
Integrated Project Solutions	23-7
Replacement and Upgrading	23-8
Consulting and Advisory Support	23-8
Start-up and Commissioning	23-8
Eaton - Electrical Services & Systems	23-8
Further Information	23-8



Protection and Control Solutions

Solving the Operating Performance Puzzle

As electrical equipment and systems become increasingly sophisticated and complex, so too does the challenge of maintaining peak levels of availability, performance, security and protection.

At Eaton - Electrical Services & Systems (E-ESS), it is recognized that superior hardware is only part of the answer. Effective power strategies require intelligent system design, integration, coordination and control. That means working with a dedicated service partner who understands on-site and remote access diagnostics, installation, modernization, and predictive maintenance. Whether it's a single power strategy application or total Integrated Project Solution, E-ESS has the method by which to enhance power performance, reduce operating costs and maximize the reliability, safety and integrity of your electrical equipment and system assets.



Uptime



Reliability

E-ESS is a one-stop service provider focused on integrating and maintaining power quality. In addition to complying with IEEE and ANSI standards, many E-ESS engineers and technicians are 1E-certified to perform a full scope of on-site service operations in nuclear plants, including hardware retrofits.

Eaton - Electrical Services & Systems offers intelligent solutions for maximizing operating performance. Some of these solutions include:

Power Equipment Services

Critical electrical equipment requires systematic maintenance to ensure maximum performance and in-service life...while minimizing unscheduled downtime, aging, wear related hazards, and total operating costs.

E-ESS is the ideal complement to your existing in-house service. For more complex projects, they can act as a single point outsource for all of your facility's ongoing maintenance needs, including:

■ Installation/Start-Up

E-ESS can install any make or manufacturer of power equipment to precise vendor specifications, with minimal disruption of ongoing facility operations.

■ Routine/Emergency Service

E-ESS is on call 24/7, providing an unrivaled array of services, including disaster recovery and crisis response. One call to **1-800-498-2678**, and uptime engineers and technicians can be assembled with the sole purpose of bringing electrical systems back online quickly.

■ Warranty Service

E-ESS delivers a new level of confidence to customers by adding an additional one-year warranty extension to the Cutler-Hammer® products they install.

■ **Strategic Alliances** because Eaton is truly universal in presence, scope and capability, E-ESS offers exceptional partnership opportunities to customers who operate multiple facilities on a regional, national or international level. As a dedicated service extension, E-ESS can establish and maintain consistent levels of availability, reliability and performance across your operation. Additionally, E-ESS can create uniform methods and procedures for performance benchmarking, predictive maintenance programs, inventory management and an array of other services designed to help maximize your investment.



Life Extension

PowerChain Management Solutions



PowerChain Management™
Solutions from Eaton

PowerChain Benefits

How Managing the PowerChain Empowers Business

By actively managing an enterprise's power infrastructure in a holistic manner, PowerChain Management solutions offer a company these advantages:

Greater Reliability

Among the clear advantages of a PowerChain Management solution are enhanced reliability and availability afforded by state-of-the-art technologies, such as predictive analysis and remote monitoring, to ensure business continuity.

Operating Cost Efficiencies

PowerChain Management solutions encompass savings that begin with intelligent design and innovation and continue through heightened energy management and a system-wide approach to cost-effective management practices, including life-cycle management.

March 2006

Aftermarket Solutions, Ref. No. [451]

PowerChain Management Solutions and PowerChain Life-Cycle Approach

Effective Use of Capital

By providing a single point of coordination, a PowerChain Management solution speeds the time from planning to installation and commissioning. In terms of life-cycle management, this approach provides for timely upgrades to avert the high cost of complete rebuilds.

Safety

A PowerChain Management solution enhances safety by working at the system level, applying the right equipment, supporting technology, training and procedures. By definition, it always optimizes system design and engineering for safety.

Risk Mitigation

With a single point of accountability for every aspect of the power chain, enterprises gain broad improvements in managing risks, including: meeting critical schedules, launch windows, and compliance requirements; protecting critical data and equipment; and ensuring safety and regulatory compliance.

PowerChain End-to-End Capabilities**End-to-End Capabilities for Your PowerChain's Entire Life Cycle**

Eaton has over 100 years of experience and support behind its products. Our vast team of field engineers and a global service network ensures the highest level of responsiveness to your power chain needs. In addition, Eaton offers replacement part depots that make it easy to keep your electrical system running at peak performance.

With an exceptionally broad portfolio of award-winning ac and dc products, Eaton is an industry leader. From the invention of the circuit breaker, our roots are steeped in innovation. Our worldwide research centers continue to deliver advanced hardware and software solutions that are enabling new generations of proactive, intelligent electrical systems. And Eaton's global brands are helping our customers meet their needs for global standards such as IEEE, NFPA, UL®, ANSI, IEC, NEMA® and CNCA.

Optimizing your organization's electrical system via PowerChain Management solutions offers you a breadth of resources including the following services and products.

Services

Engineering and Consulting Services provide up-front analysis and design prior to project implementation. Through a PowerChain Management Audit, our power system engineers will help you quickly diagnose problems or proactively identify ways to improve your electrical system's performance and operation. Included are:

- System design engineering.
- Power audits and studies.
- Arc flash and safety studies.
- Energy management.
- Consulting support.

Turnkey and Modernization Services offer field resources to get your project plan underway. From project management on a rebuild or refurbishment to turnkey services for a new facility or upgrade, we can help you reduce time and costs. Included are:

- Project management.
- Switchgear and UPS modification.
- Integrated project solutions.
- Existing equipment upgrades and rebuilding.
- Installation, start-up, and commissioning assistance.

Contract and Support Services ensure your power chain continues to operate optimally around the clock. In addition to scheduled maintenance programs, Eaton offers a world-class service and emergency response capability with 7x24 monitoring so you have peace of mind and confidence. Included are:

- Factory trained and certified field technicians.
- Predictive and calendar-based preventive maintenance programs.
- Spare part kits, modifications and upgrades.
- On-site training and technical support.
- Remote monitoring and diagnostic support.
- Battery monitoring with replacement coverage (asset optimization).
- Parts and labor service contracts with on-site response times.

PowerChain Life-Cycle Approach**Eaton's PowerChain Management Solutions — A Life-Cycle Approach**

Because Eaton's PowerChain Management solutions bring a system-wide view, address all decision points — planning, design, finance, engineering, construction, installation, upgrading, and monitoring—and consider life-cycle impacts to the power chain, they free up businesses to concentrate on core capabilities. This provides a far more strategic partnership, one in which Eaton brings to bear its wide-ranging expertise and field-proven performance for which it has been known for nearly a century.

The ease of doing business with a single point of accountability gains enterprises these advantages: better schedule management over the course of an entire project; an advanced ability to anticipate and solve problems; and a more comprehensive approach to prevention and troubleshooting.

Eaton's electrical group has recognized the criticality of addressing the entire power chain in an integrated way to give organizations the benefits of greater reliability, operating cost efficiencies, effective use of capital, safety and risk mitigation. Through a combination of acquisitions, alliances, and internal development, Eaton now delivers the products, services, in-depth expertise, and exceptional performance to address complete power chain needs.

Eaton's PowerChain Management solutions encompass:

- **Power Audits**
Eaton's extensive audit capabilities assess an enterprise's complete power chain in terms of reliability, safety and energy management issues.
- **System Design/Build/Engineering/Construction/Installation**
Eaton is renowned for innovation. Our specialized knowledge transforms concepts into practical power chain solutions that take into account cost/benefit, multi-vendor integration, and equipment selection. On-site construction management and engineering staff are well versed in the practical aspects of integrating power protection into existing buildings, as well as in new construction.

PowerChain Audit and Power Systems Engineering Solutions
■ Monitoring and Analysis

Assessing the status of equipment, predicting imminent failures, and identifying power anomalies are critical to a PowerChain Management solution. Eaton provides a full complement of these services.

■ Life-Cycle Management

Life-cycle management services begin with product design and engineering and continue through monitoring, maintenance, upgrades, and ultimately replacement.

■ End-to-End Equipment Capabilities

Eaton's PowerChain Management solutions extend from research, design, enhancement and factory testing to on-site installation.

PowerChain Audit
The PowerChain Management Audit

Many facilities have gone through upgrades and changes over the years. Electrical loads have been added to automate processes, computer loads have been added to the facilities, harmonics have been introduced to the system, and the loads are often much more susceptible to power quality issues. Dealing with these issues is most efficiently done systematically by performing a site audit looking for specific problems and potential areas of improvement. By using proven techniques and strategic monitoring, Eaton will identify the areas of greatest vulnerability and will address the options for providing protection from utility issues, as well as system protection from new and ever-changing load requirements.

Eaton offers PowerChain Management Audits to evaluate power system designs and improve the availability and reliability of the power system. This method uses proven IEEE Gold Book methods for analysis and helps determine whether upgrading critical elements of the power system, modernizing the system, or simply rehabilitating the system is the most cost-effective method of improving reliability prior to a failure.

Eaton's PowerChain Management Audits consist of visual inspections, electrical measurements using power quality monitoring equipment, interviews with on-site personnel, and reviews of utility bills and data. Specifically, Eaton will address interruptions, voltage sags, harmonics, surge protection, grounding, energy management, and arc flash safety.

Eaton will investigate methods of improving the reliability of the power system to help you avoid costly downtime and repairs. The present state of the existing personal protective equipment is also evaluated. Cost and pay-back information will be presented where appropriate.

Eaton reviews energy consumption to determine possible savings with utility rate structures, energy usage, time of use (on- or off-peak), power factor correction, and various methods of metering. By monitoring trouble areas of the facility, Eaton will identify other potential areas for improvement and savings.

Eaton's electrical group recognizes the criticality of addressing the entire power chain to give organizations the benefits of greater reliability, operating cost efficiencies, effective use of capital, safety and risk mitigation. With a PowerChain Management Audit, power management problems can be resolved through a single, integrated solution at every level in a facility, delivering products, services, expertise and exceptional performance to address your complete power chain needs. The purpose of this audit is to show areas of improvement in the electrical infrastructure and to point out areas that are well designed, maintained and operating at or above expectations.

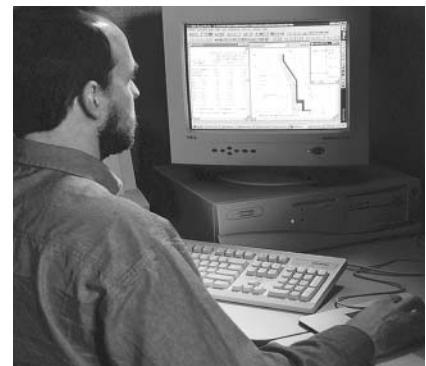
PowerChain Management Audit Features

- Evaluate wiring and grounding methods.
- Evaluate backup protection including the use of UPS power, backup generation, sag correction, and power conditioning.
- Review energy management processes to determine demand-side management opportunities and analyze energy-efficient electrical loads.

- Evaluate surge protection at the utility connection point and at the downstream loads.
- Evaluate the use of harmonic solutions including tuned filters, line reactors, and phase shifting transformers.
- Evaluate and review present arc flash safety compliance status.
- Evaluate the quality of the voltage and current at the main service equipment.
- Interview key electrical personnel on site to determine the type of operating problems, the equipment affected, and time of occurrences.

Power Systems Engineering Solutions

As technology advances and more businesses come to rely on sophisticated equipment, the demand for consistent, top-quality power increases. Power systems that were installed 15, 10 or even 5 years ago were not designed to handle today's power demand. The key to a healthy power system is consistent configuration and familiarity with the operating power system. The most definitive way to accomplish this is through a Protection and Coordination Study by Eaton's Power Systems Engineers.



Energy Efficiency

E-ESS provides methodical testing and monitoring practices on power systems. Tests are run to analyze safety, reliability, power quality and energy management. These services have proven to be an effective way of protecting expensive equipment and preventing downtime.

March 2006

Aftermarket Solutions, Ref. No. [453]

Predictive Maintenance and Continuous and Remote Partial Discharge Monitoring

Preventing future system distress and creating a safe power environment that will be both economical and electrically sound is another reason to bring in the power systems specialists. It is a proactive, system conscious move involving power systems engineers and technicians when upgrading to a new distribution system, adding additional loads or processes to the current power system, or contracting with a utility. Power quality and energy management studies can take place during normal plant operation or scheduled around an annual plant shutdown.

The first step to consistent and safe power is to fully understand the intricacies of the power system. No one can do that better than Eaton - Electrical Services & Systems.



Energy Management

Predictive Maintenance

Eaton predictive maintenance applies the latest technologies to support online condition assessment of critical electrical distribution equipment. Advancements have resulted in new applications that allow for predictive diagnostics measurements via existing electrical components.

- Performance-Based-Maintenance.
- PM program design and implementation.
- Periodic testing and PM services.
- Thermographic survey.
- Troubleshooting.
- Testing.
- Predictive diagnostics.
- Transformer oil processing.

With extensive field experience, E-ESS can quickly develop a customized application to schedule and document essential system services, which allows for cost savings while improving system reliability. Limited maintenance dollars are prioritized for critical and equipment in greater need of service. By implementing our predictive maintenance software with complete monitoring capabilities, equipment outages are anticipated and averted before they happen.

Continuous and Remote Partial Discharge Monitoring for Medium Voltage Equipment



Cutler-Hammer InsulGard

Eaton Corporation understands the pressures you face trying to reduce costs while at the same time maximize your electrical system's uptime and reliability. That's why we invented the Cutler-Hammer InsulGard, a system that changes the rules of power equipment maintenance. Until now, there were only two options.

1. Wait for equipment to break down and fix it and/or
2. Periodically take equipment out of service to perform tests and maintenance — whether it's needed or not.

Now there is a third, revolutionary option. InsulGard is the first continuous, online, medium voltage, predictive maintenance system that can be used in a variety of applications: including switchgear, bus duct, power centers,

generators and motors. Through monitoring, it can ascertain the relative condition of insulation, the deterioration of which is the leading cause of electrical failures. And, it can monitor these conditions better than alternative testing methods. Further, you won't have to take equipment out of service or send personal to conduct tests. In effect, the InsulGard system is a lower-cost alternative to forced outages and rigid, and sometimes unnecessary, maintenance schedules. We believe you will find the InsulGard system the best planning tool available today.

At the heart of the system is the InsulGard monitor. Whether you use it to monitor switchgear or rotating equipment, only some internal circuitry changes. The variable part of the system is the broad array of sensors we've developed to function with key electrical assets. Yet, each sensor is specifically designed to work with the InsulGard monitor to provide seamless and accurate data. They are also designed to work with existing Resistive Temperature Devices (RTDs) already present within the windings of generators and motor. Design integrity is important when it comes to protecting your investment. The InsulGard system has it.

Generators and Motors

The InsulGard system is available with a variety of sensors appropriate for motors and generators. One of these is the RTD Module which connects to existing Resistive Temperature Devices (RTDs) already embedded within the windings of the generator or motor. Another sensor checks for partial discharge is the Coupling Capacitor which is used on the line side. A third sensor, ideal for generators and motors, is the Radio Frequency Current Transformer (RFCT). The RFCT embraces cable shielding and is used in the line part of the winding. Used alone or in combination, the sensors connect to the InsulGard monitor where partial discharges and other variables such as humidity, load and temperature are monitored and recorded for analysis.

Specifically, here are the issues that partial discharge analysis can tell you about your rotating equipment:

- Early stages of insulation deterioration.
- Sparks in voids and between windings.
- Corona on end windings.

Switchgear

Available sensors for switchgear include Coupling Capacitors or a combination of Radio Frequency Voltage Sensors (RFVSs) and Radio Frequency Current Transformers (RFCTs). Coupling Capacitors detect partial discharges in a cubicle and/or adjacent cubicles and are typically installed on the load side of the feeder breakers or on the main bus. Radio Frequency voltage sensors (RFVSs) are also used to detect discharges within the cubicle. They are typically installed on the load side of the feeder breakers, or on the main bus. They are connected to the current or potential transformer's secondary neutral terminal.

Large Power Transformers

Cutler-Hammer InsulGard G is available for transformers that contain a capacitive tap at the base of the bushing. This tap is normally used for power-factor measurements. Transformers with a primary voltage of 13.8 kV can be monitored using our standard partial discharge sensors. For more information, visit www.partial-discharge.com.

Software

InsulGard software is part of the InsulGard system. It allows you to view the dynamics captured by the monitor and analyze the condition of insulation based on the guidelines and parameters provided by Cutler-Hammer Predictive Diagnostics specialists. The eventual goal of Predictive Diagnostics is to create a Web-based service whereby you can statistically compare the relative condition of your equipment to others who have similar equipment in operation by: equipment type, manufacturer, voltage class ratings, partial discharge activity longevity, etc. Users will benefit by comparing their own measured partial discharge data with our extensive database to predict outcomes and plan maintenance. This database will not identify customer sites or locations in order to guard the privacy of our customers.

Medium Voltage Vacuum Replacement Breakers (MVVR)

New Replacement Breakers from the Ground Up

VR-Series Medium Voltage Vacuum Replacement (MVVR) breakers are brand new breakers that have been designed, manufactured, and fully tested to be functional electrical and mechanical replacements for almost any manufacturers' original air magnetic circuit breakers. However, if cell structure modifications are required, they are reversible.

Unnecessary downtime is avoided since the breakers are new, and only require one outage for removal and installation. By only replacing the breakers, equipment costs are reduced while the life of the existing switchgear is extended.

Many circuit breakers require additional contacts, Mechanism Operated Contacts (MOCs), that are mounted external to the circuit breaker mechanism. When these contacts are operated by high speed vacuum breakers, they travel almost four times faster than existing air magnetic circuit breakers and can transfer up to 16 times the kinetic energy to the MOC switch. The increased forces can damage the existing MOC switch and cell components, and in some cases, stall the breaker when trying to close. A patented *SURE CLOSE* MOC system balances the speed and force of the breaker's MOC operator to prevent stalling and damage to the cell and MOC switch.



Replacement

Eaton manufactures over 158 different models of VR-Series MVVR breakers that replace air magnetic circuit breakers originally manufactured by: Westinghouse®, General Electric®, Allis-Chalmers, Federal Pacific Electric®, ITE®, McGraw-Edison®.

Class 1 Reconditioning



Better Than New

The useful life capacity and performance of vintage or damaged motor controls and power distribution equipment can be extended and enhanced through Eaton's Aftermarket Centers of Excellence (ACE). Their strategic locations enable rapid response through a cost-effective program of selective hardware retrofits.

Each Aftermarket Center of Excellence strictly adheres to all national standards and quality processes. Field experts use evolving technology to ensure the most advanced retrofit upgrade possible. Access to vintage parts won't be a problem; each ACE has both Cutler-Hammer and Westinghouse renewal parts available.



Proven

March 2006
Aftermarket Solutions, Ref. No. [455]

Automation Services and Integrated Project Solutions

In the ongoing battle of maximizing operating performance and safety, Eaton's Class 1 Reconditioning service helps to restore the integrity of electrical protection equipment to their required level of reliability.

Automation Services

Effectively applying leading-edge technologies is often the key to enhanced performance, improved output, and reduced frequency and severity of outages. Engineering these new technologies into an existing equipment configuration is a E-ESS specialty.



System Integrator

E-ESS is a full service systems integrator with proven expertise in power and energy management systems.

E-ESS provides a unique alternative to conventional manufacturer-integrator-contractor teams. With project management expertise, E-ESS offers single-point responsibility from a major controls manufacturer. Industry knowledge allows for seamless integration of new products, regardless of equipment manufacturer.



Process Improvement

E-ESS has the capabilities to address the entire scope of integration and automation needs, including:

- Power Management Systems (IQ, IMPACC, PowerNet™).
- Automatic transfer schemes.
- Distributed generation/generator control systems.
- Demand management — load shedding/peak shaving systems.
- Generator and ATS system monitoring and testing.
- Healthcare emergency power supply systems.
- PLC systems (Cutler-Hammer, Allen-Bradley®, Modicon®, GE Fanuc®, Siemens®).

Integrated Project Solutions

The project management group within E-ESS provides Integrated Project Solutions to customers in the Government, Industrial, commercial and utility sectors. Eaton's Federal Systems Group also focuses on mission-critical government installations, providing project solutions, on-going maintenance and remote-monitoring.

- New substation design and construction.
- Integrated emergency power requirements, including UPS, generators and alternate feeders.
- Plant automation.
- PLC control and load shedding.
- Electrical plant monitoring and control.
- Process automation and system integration.



Design

The Integrated Project Solutions engineers manage the technical and commercial risk inherent in meeting project objectives. These engineers focus on performance, cost, and time goals, while controlling or maintaining the scope of the project.



Speed of Response

By hiring the E-ESS project management group, you can release the burden of multi-supplier coordination. E-ESS offers single-point accountability for all technical, financial and commercial coordination within the scope of the project.

Replacement and Upgrading

OEM Equipment Serviced and Upgraded

- Westinghouse.
- Cutler-Hammer.
- Square D®.
- General Electric.
- ITE.
- ABB®.
- Allis-Chalmers.
- Siemens.
- Federal Pacific.
- and others...

Plant Life Extension

- MV vacuum breaker replacement.
- MV motor starter upgrading.
- Generator excitation and motor control.
- System metering and control PowerNet/IMPACC.
- LV breaker (all OEMs) trip systems.
- Class 1 circuit breaker reconditioning.
- Nuclear equipment services.
- UPS or battery systems.

Additional Services

Consulting and Advisory Support

- Arc flash studies and solutions.
- Power system studies, design and analysis.
- Failure/root cause analysis.
- Reliability analysis.
- Power quality and harmonic analysis.
- Reliability Centered Maintenance (RCM).
- Short circuit/coordination studies.
- Power systems training.

Start-up and Commissioning

- Installation support and supervision.
- Acceptance testing (NETA equivalent).
- Start-up and training.
- Ground-fault certifications.
- Installation construction services.

Instant Response CenterSM

- Monitoring and diagnostics.
- 24/7/365.
- Power quality experts.
- Energy management.

Eaton - Electrical Services & Systems

Asset Optimization

Outsource the responsibility for the electrical distribution system and associated equipment to Eaton - Electrical Services & Systems. Offerings involve cost savings and performance guarantees for greater focus on the core business. Asset Optimization uses all the tools and capabilities within the other service platforms, resulting in improved reliability, life expectancy and overall cost.

Knowledge Management

Collect and transform your system data to useful knowledge; allow for proactive planning, energy management, optimized decision making, failure prediction and ultimately, cost savings.

Integrated Project Solutions

Engineering, design, procurement, installation and commissioning of power systems equipment; a total turnkey approach.

Power Systems Engineering Solutions

Power systems automation, design engineering, training, predictive diagnostics, power quality and power systems studies/analysis to decrease costs and increase productivity.

Power Systems Modernization

Keep systems operating at peak efficiency, reliability and safety; extend the life of the electrical asset through equipment life extension and upgrade solutions utilizing new technologies.

New Equipment Services

Installation, testing and commissioning of virtually any electrical equipment.

Field Services

Power system and equipment service, maintenance programs, testing, upgrades and Aftermarket solutions; 24/7 emergency service; crisis response and disaster recovery.

Further Information

For further information on Eaton Service Solutions, call **1-800-498-2678** or visit our Web site at: **www.EatonElectrical.com**.

ABB is a federally registered trademark of ABB Group. Allen-Bradley is a federally registered trademark of Rockwell Automation. Cutler-Hammer is a federally registered trademark of Eaton Corporation. Federal Pacific is a federally registered name of Electro-Mechanical Corporation. GE Fanuc is a federally registered trademark of GE Industrial Systems. General Electric is a federally registered trademark of General Electric Company. ITE is a federally registered trademark of Integrated Technologies Engineering (ITE). McGraw-Edison is a federally registered trademark of Cooper Industries, Inc. Modicon is a federally registered trademark of Schneider Electric Industries SA. NEMA is the registered trademark and service mark of the National Electrical Manufacturers Association. Siemens is a federally registered trademark of Siemens AG. Square D is a federally registered trademark of SNA Holdings Inc. UL is a federally registered trademark of Underwriters Laboratories Inc. Westinghouse is a registered trademark of Westinghouse Electric Company LLC.