

WHITE PAPER

Be Reliable, Stay Compliant: Maintain Electrical Equipment

TEGG®

If compliance hasn't been a pain point for you... Let's keep it that way.

OSHA may not knock on your door tomorrow and demand maintenance documentation, but eventually, somebody will.

It could be your insurance company, because they know electrical incidents are huge liabilities.

If it's attorneys for someone hurt at your facility, a lack of maintenance documentation is exactly what they hope to find.

And when something does happen, the odds of that official visit – and fines – are going up.

Why Do You Need Electrical Maintenance? That's Easy.

It's recommended.

Every insurer is different, but more and more insurers want proof of preventive electrical maintenance. Some refuse coverage without documented maintenance or testing from accredited providers.

It's required.

The National Fire Prevention Association codes and standards, which OSHA relies on per Annex A, require documented electrical maintenance.

It's right.

Most of us have never seen a serious electrical incident. But as assets age and system complexity grows, assuming it's safe because you haven't seen a problem puts people at risk.

https://www.energy.gov/sites/prod/files/2018/05/f51/snapshot2018_troffers.pdf



How Do You Make Sure It's Cost-Effective? That's Harder.

Name any Key Performance Indicator you have. What happens to that number when you lose power? Studies show what you'd expect: without electrical equipment maintenance, the rate of electrical component failures in a facility multiplies.

Your reliability depends on your electrical power distribution. To keep your electrical assets driving your business, they must be maintained. The question is how you'll do it.

Reactive Maintenance

3x

the failure rate compared to preventive maintenance.

Preventative Maintenance

12–18%

cost savings over reactive maintenance programs.

Predicative Maintenance

8–12%

savings over preventative maintenance alone.

The most accurate information gives you the best ROI by maximizing equipment's safe, reliable lifecycle. That time and effort pays off, as long as the time and effort is spent by qualified, efficient experts.

Reactive maintenance, or waiting for it to break to fix it, often incurs the most cost and increases the risk of an incident. So why do so many risk it? 55% of maintenance is reactive, according to the U.S. Department of Energy. Is that because businesses aren't accurately calculating the costs and risks?

Can Anyone Really Predict a Breakdown?

Predictive maintenance uses data to inform an analysis. For any particular asset, however, analysis can't predict a pinpoint date of failure. The analysis is more of statistical measurement of the risk of failure.

To avoid the issue of general versus specific predictions, many maintenance experts are moving to Condition-Based Maintenance. While they share many techniques, Condition-Based Maintenance focuses on collecting real-time data for specific assets and setting clear threshholds for when an asset requires maintenance or replacing.

The term Predictive Maintenance is still used in this context. Be sure to ask your service provider how they approach data collection and analysis to best plan return on investment.

https://www.energy.gov/sites/prod/files/2013/10/f3/omguide_complete.pdf

"A well-orchestrated predictive maintenance program will all but eliminate catastrophic equipment failures."

– O&M Best Practices Guide
FEMP, U.S DOE

How Will You Calculate...

The Cost of an Unplanned Outage?

- Lost Production and Delay
- Employee Productivity Losses
- Failure to Meet Client or Customer Need
- Damaged and Destroyed Assets
- Overtime and Emergency Repairs
- Injury and Medical Liability
- Fines and Litigation Costs
- Increased Insurance Costs

The Cost of Avoiding an Outage?

- Labor
- Tools and Equipment
- Hiring
- Training
- Project Management



Failure Is Always Worse for the Facility

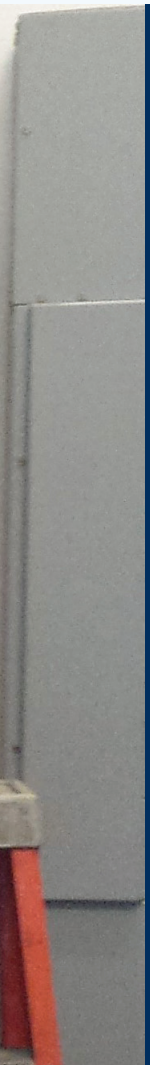
Letting a part fail almost always costs more than the part. Beyond the capital loss of an asset lifecycle cut short, other equipment likely also sustained damage, increasing the risk of a chain reaction of future failures. Also, if parts cannot be repaired and are no longer available, expensive redesigns and modifications may be required.

From Need to Opportunity

Maybe you don't believe the statistics on savings can apply to you or your facility. If basic maintenance only looks like a cost on paper, maybe that's because the returns you're thinking of aren't as dramatic as what you can see with predictive maintenance or condition-based maintenance.

DOE Estimates For Upgrading To Predictive Maintenance





"Training of in-plant personnel to effectively utilize predictive maintenance technologies will require considerable funding."

– O&M Best Practices Guide
FEMP, U.S. DOE

Predictive maintenance and condition-based maintenance go a step beyond preventive maintenance. It's basically the difference between changing a filter on a sensible schedule, and actually knowing when a filter change is optimal for operations and life – cycle costs.

If that sounds like a lot of testing and analysis adding up to more trouble than it's worth, look again at the DOE's estimated results. An experienced solution provider makes it their business to obtain that knowledge efficiently and use it to the best advantage of your business.

But You're Right, That's A Lot to Look After

Every facility is different, of course. Here's a quick rundown of electrical equipment common to many facilities, and the kind of testing needed to know that assets are safely maintained – not to mention how to keep them safely maintained cost-effectively.

Every asset below also needs a (1) visual inspection, (2) cleaning, and where appropriate, (3) tightening. This list is far from a comprehensive testing checklist. For instance, the 2019 NETA guidelines for the visual and mechanical inspection of switchgear has 19 points, not counting additional subpoints.

All Bus Bars and Bus Ducts
- ☐ Connection and contact resistance
- ☐ Insulation resistance
- ☐ Thermographic survey

Automatic Transfer Switches
- ☐ Contact resistance
- ☐ Insulation resistance

Battery Banks
- ☐ Connection resistance
- ☐ Impedance
- ☐ Load bank
- ☐ Voltage to ground and equalizing voltage

Circuit Breakers (Including Main Breakers)
- ☐ Connection, control wiring, and contact resistance
- ☐ Drop values, ground fault, and short- and long-time pickup values
- ☐ Insulation resistance
- ☐ Static contact/pole-resistance
- ☐ Trip unit programming and settings
- ☐ Verify operation

Disconnect Switches
- ☐ Contact resistance
- ☐ Insulation resistance
- ☐ Fuse verification

Generators
- ☐ Connection resistance
- ☐ Insulation resistance
- ☐ Load bank
- ☐ Winding resistance

Grounding Systems
- ☐ Soil resistivity
- ☐ 4-point method
- ☐ 3-point method (fall of potential)
- ☐ 2-point method (dead earth)

Motor Control Centers
- ☐ Connection resistance
- ☐ Insulation resistance
- ☐ Test control devices and motor protection parameters

Power Cables
- ☐ Point to point verification
- ☐ Insulation resistance
- ☐ Phase identification
- ☐ Additional tests for medium voltage:
  - i. High potential (DC and VLF)
  - ii. Partial discharge
  - iii. Tan delta/dissipation factor

Power Meters
- ☐ Current ratio
- ☐ CT performance

Protective Relays
- ☐ Circuit, coil, and contact resistance
- ☐ Overcurrent and overvoltage pickup
- ☐ Pickup times and time delays
- ☐ Trip resistance

Switchgear, Main Panels, Distribution Panels, and Switch Boards
- ☐ Connection resistance
- ☐ Control wiring insulation resistance
- ☐ Insulation integrity
- ☐ Ground resistance and fault relays
- ☐ Test all meters, instrument transformers, and control power transformers

Transformers
- ☐ Insulation integrity (Megger test)
- ☐ Oil analysis (unless dry-type)
- ☐ Power factor (Doble test)
- ☐ Relay testing
  - i. Temperature
  - ii. Pressure
- ☐ Turns ratio
- ☐ Winding resistance

Voltage Meters
- ☐ Insulation integrity
- ☐ Turns ratio

There's So Much More

For instance, the 2019 NETA guidelines for inspecting switchgear lists 19 points.

For a More Complete Look

Please refer to the 2019 Standard for Maintenance Testing Specifications for Electrical Power Equipment & Systems

(ANSI/NETA MTS-2019)

The True Test: Informing Maintenance with Data

Here's a quick overview of key technologies used to earn superior returns for predictive and condition-based maintenance.

Infrared Inspection

Checking for hot spots helps you detect loose connections, failing insulation or components, and unbalanced loads before problems progress. Infrared inspection sees beyond the range of human vision, so issues are caught before they become immediate problems.

Transformer Oil Analysis

Testing the insulating fluid in a transformer identifies factors that degrade the insulating power of the oil, which reduces dielectric strength and leads to breakdown. Transformers are key capital assets, and identifying contaminants helps you avoid catastrophic failure and maximize the capital life of the transformer.

Real-Time Monitoring with Connected Sensors

Why wait to test for problems, when sensor technology could alert you immediately? Wireless and wired sensors monitor for conditions and report to your SCADA or other centralized information system. Types of sensors you can install to monitor key assets include:

- **Heat Monitoring**

  Detects heat caused by insulation issues or conduction problems so you can act before discharge events or arc faults.

©2020 ABM Industries Inc. Reproduction prohibited without permission.

- **Partial Discharge Monitoring**
  Detects early warning signs of insulation breakdown. Partial discharge usually isn't visible, but it destroys insulation over time, which will cause a full and destructive discharge.
- **Circuit Monitoring**
  Measures power and power quality data, including harmonic disturbance in the wave forms and voltage transients (sags and swells) that can damage equipment. Sensitive equipment can be particularly sensitive to these disturbances, such as diagnostic medical equipment, information systems, and more. Recording this data over time gives you the ability to find the cause of transient issues before they become dangerous.



Can You Do It In-House?

Skilled labor, such as electricians, are in high demand. Before the COVID-19 pandemic, unemployment in the U.S. reached a historic 50-year low. Skilled labor shortages, such as in the construction industry, had yet to recover from the Great Recession. Since the pandemic, businesses have dealt with volatile disruptions in economic realities and our working lives, but now the need for skilled technicians is certainly growing. From January to August of 2021, demand for electricians rose 244%.

Qualified people needed for electrical maintenance will remain in high demand. One study estimates that the U.S. will need over 460,000 more electricians by 2050 to meet our service needs than we'll have, projecting from current trends. Even with industry and educational leaders asking for more focus on STEM education and skills, only 32% of parents say their high school promotes a trade school education. In a 2018 report, the median annual wage for electricians was the highest noted for the BLS (U.S. Bureau of Labor Statistics) specialty trade subsector.

As we go forward, it's a certainty that qualified and experienced experts in safe, effective, and efficient testing and maintenance know their worth in the labor market. That puts a lot of pressure on human resources departments to recruit and retain skilled talent.

If your business has beaten the trends and landed an expert in safe, efficient electrical management, do what you can to keep them. Electrical work already requires a sound education and the proper credentials, but that doesn't mean every electrician is qualified to do the kind of testing, maintenance, and hazard analysis that a power distribution system needs.

An electrical testing and maintenance solutions provider will have dedicated human resources to hiring and training the best people, while developing procurement for tools and equipment and keeping top technicians fulfilled and engaged.

https://www.cnn.com/2019/10/04/economy/september-jobs-report/index.html
https://www.bls.gov/careeroutlook/2018/article/careers-in-construction.htm
https://www.prnewswire.com/news-releases/over-90-of-parents-would-support-childs-choice-to-pursue-skilled-trades-career-300973823.html
https://semiengineering.com/engineering-talent-shortage-now-top-risk-factor/
https://www.gartner.com/en/newsroom/press-releases/2019-01-17-gartner-survey-shows-global-talent-shortage-is-now-the-top-emerging-risk-facing-organizations
https://www.cnn.com/2019/10/04/economy/september-jobs-report/index.html
https://fred.stlouisfed.org/series/USCONS
https://www.businessinsider.com/labor-shortage-skilled-trades-carpenters-electricians-plumbers-angi-2021-9
https://data.kleintools.com/sites/all/product_assets/documents/brochures/klein/DarkBy2050_Klein_ResearchPaper.pdf

Electrical Safety

Electrical Resiliency

Electrical Efficiency

Electrical Compliance

Electrical Sustainability

Electrical Maintenance

Closing the Circuit

How do you get a predictive or condition-based maintenance program started?

Check how long it's been since you've had your power distribution system and electrical assets assessed. If you only have data from the initial acceptance testing, it's probably time to do a full power system assessment. That will uncover any immediate safety issues and downtime risks, while building up the data you'll need for the most cost-effective maintenance plan.

Solutions Partner Check

To help you find a partner that can safely improve your reliability and create cost savings, consider these factors.

Certifications and Accreditation: Do they have third-party accreditation and certified technicians? Can they supply Qualified Persons as defined by the NFPA safety codes?

References: Can they show a track record of diagnosing and troubleshooting power issues? Do their clients experience reductions in unplanned downtime?

Brand Agnostic: Do they test, maintain, and make recommendations without bias towards any original equipment manufacturers?

Training and Safety Culture: Have they implemented continuous training programs for their technicians? Have they instilled a safety culture in their ranks and kept their teams on the cutting-edge of testing and maintenance technology?

Integrated and Custom Solutions: Do they have the flexibility and scalability to adapt custom solutions to your changing business needs? Do they have the scope to provide top talent and integrate their services for efficient, productive partnerships?

TEGG®

Find a TEGG contractor in your area.

www.TEGG.com

©2021 ABM Industries Inc.
All rights reserved.
TS-02121-1121