



THE VALUE OF A COMPREHENSIVE MAINTENANCE AUDIT FOR TRANSFORMERS AND OTHER ELECTRICAL EQUIPMENT

Keeping transformers and other electrical equipment running smoothly is essential to the success of every transmission and distribution organization. Whether you are an investor-owned utility, a co-op, a municipality, or even a large industrial facility, you need the ability to repair equipment promptly and get it back into service as quickly as possible.

Just as importantly, you need the ability to anticipate potential problems before they happen, put maintenance plans in place that keep every piece of equipment running optimally, and review the system regularly to spot emerging issues. You also need to stay compliant with the latest regulations and see trends that could help enhance the purchasing cycle.

A comprehensive maintenance audit helps to achieve all of these objectives. By looking at the state of your current equipment assets, your in-house maintenance and repair capabilities, and your existing processes for the procurement of parts and services, the maintenance audit delivers benefits that include:

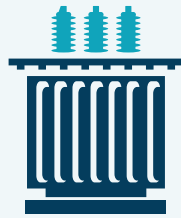
- Increasing operational efficiencies
- Reducing costs for parts and third-party maintenance services
- Fully capitalizing on available warranty services
- Offsetting or replacing new purchases by extending the life of current equipment

In this document, we'll explain the nature of a maintenance audit and discuss who is most qualified to perform it. We'll also share an example of a case in which a maintenance audit delivered significant savings to a utility.

WHAT IS A MAINTENANCE AUDIT?

A maintenance audit is a comprehensive review of an organization's equipment inventory, maintenance and repair processes, in-house facilities, and procurement procedures.

A qualified firm performing a maintenance audit will consider the following issues during the review process:



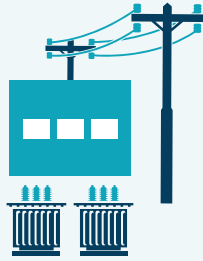
Equipment

- What equipment in the utility's inventory is known to have regular maintenance or reliability issues?
- What equipment is nearing the end of its expected life?
- Could the inventory be streamlined with the removal of surplus or otherwise unneeded equipment?
- Are there opportunities to extend the life of some components with modifications or retrofits?
- Could the addition or more effective use of accessories (IFDs, wildlife protection, secondary arresters, etc.) enhance system performance or safety?



Maintenance and Repair Procedures

- Are a plan and schedule currently in place for the regular maintenance of all equipment?
- What is the breakdown between in-house and outsourced services for maintenance and repair work?
- How much maintenance and repair work is currently handled in the field, instead of in a repair facility?
- Is there a program in place for the regular testing of transformers and other equipment?
- How does the organization handle field decommissioning?
- What kind of lead time is needed for repairs?
- Are parts currently warehoused, or is the utility using a "just-in-time" inventory model?



Facilities

- How does the utility manage its resources in order to maximize system efficiency and minimize the need for inventory?
- Do multiple service centers feed one central location, and how does equipment move through the various stages of use and storage?
- What can be done to maximize the value of in-house storage and maintenance resources and augment this with outsourced capabilities?
- Could improvements in turnaround times for repair and delivery dramatically impact the efficiency and value of in-house facilities?



Procurement

- How many suppliers is the organization currently using for new or refurbished equipment and replacement parts?
- Is the number of suppliers or their distance from the utility having a negative impact on the efficiency of the organization's maintenance and repair activities?
- Are there opportunities to achieve greater efficiency by consolidating parts suppliers or service providers, or by utilizing suppliers with more available inventory and shorter lead times?
- Could existing warranty benefits, including warranty service, be better utilized?

The deliverable for the audit typically includes a report describing the audit's findings and detailing a list of recommendations for increasing efficiency, reducing costs, and extending the life of current equipment. The audit can also serve as a valuable tool for sustainability metrics reporting.

WHO'S QUALIFIED TO PERFORM THE AUDIT?

In most cases, the research for a maintenance audit can typically be completed in just a short amount of time. This means that it doesn't require a large team from the auditing organization, and that it shouldn't demand a large commitment of time and resources from the utility.

Although the firm performing the audit doesn't need to devote a large team to the initial review, it does need an extensive background in the field of transformer and electrical equipment maintenance and repair. This firm should possess the following qualifications:

- Experience with the full transformer and electrical equipment lifecycle, from initial acquisition through end-of-life decommissioning
- An in-depth understanding of the supply chain for transformers, electrical equipment, and replacement parts
- A working knowledge of the strengths and weaknesses of the full range of transformers and other equipment in use today
- A track record of applying national best practices for transformer maintenance, testing, and inventory management
- The capabilities needed to deliver on every aspect of the audit's recommendations

The value of a maintenance audit is largely dependent on the experience and knowledge of the firm performing it. In essence, the audit is evaluating the current programs and equipment of the utility, based on what others are doing in the industry and what is possible to accomplish with the best available technology and most effective procedures.

This means that companies offering a diverse range of services to a large pool of customers will have the best insight into today's challenges and the most effective approaches for addressing them.

AN EXAMPLE OF THE MAINTENANCE AUDIT IN ACTION

To illustrate the potential real-world benefits of a maintenance audit, we offer the following example, which began with a maintenance audit we performed for an electrical cooperative in the Midwest.

During the audit, we identified that the co-op could experience significant savings by converting their CSP transformers to conventional.

The audit offered the following guidance regarding the conversion program:

- It recommended that they convert the transformers in conjunction with a comprehensive refurbishment program, which allowed them to capitalize the cost of the conversions.



- It established detailed criteria for determining which transformers were candidates for conversion.
- It identified a conversion protocol that involved removing an internal switch and capping the resulting opening.
- It detailed what would be done as part of the refurbishment process.

Based on the guidance in the audit, the co-op replenished their inventory of CSP transformers with conventional units and then began converting their existing equipment on a phased basis.

Over a six-year period, Emerald Transformer worked with the co-op to convert nearly 3,000 transformers, saving a total of more than \$1.1 million over the cost of buying new equipment. As shown in the table below (which covers one year of the program), savings ranged from \$305 on a 10 kVA transformer to \$535 for a 37.5 kVA unit.

kVA	New	Refurbished	Difference	2013 Quality	Total Savings
10	\$628	\$333	\$305	150	\$45,750
15	\$692	\$348	\$344	400	\$137,600
25	\$809	\$388	\$421	225	\$94,725
37.5	\$982	\$447	\$535	30	\$16,050
				805	\$294,125

In addition to the cost savings achieved with the conversions, the co-op also experienced very high reliability from the refurbished transformers. Over the six-year period, only 10 of the nearly 3,000 transformers were returned for service, which was covered under one of the top warranties in the industry.

EMERALD TRANSFORMER'S MAINTENANCE AUDIT SERVICES

Emerald Transformer's experience across the full spectrum of maintenance services makes us uniquely qualified to produce comprehensive, actionable maintenance audits.

When the audit is complete, we're also well-suited to providing all of the services and equipment you need to successfully implement its recommendations. We maintain one of the nation's largest inventories of refurbished transformers and other electrical equipment, offer an industry-leading three-year warranty, and provide maintenance and repair services from a network of eight locations around the country.

Our services in the field include the maintenance and repair of reclosers, oil circuit breakers, SF6 breakers and circuit switches, controls, regulators, and other station equipment. Our technicians regularly handle transformer leaks, bushing replacement, fuse replacement, oil retrofills, radiator repair, and gauge replacements, as well as providing complete decommissioning services.

Contact Emerald Transformer at 800-908-8800 to talk about how a maintenance audit can help you improve operational efficiencies, extend the life of your current equipment, and save money.