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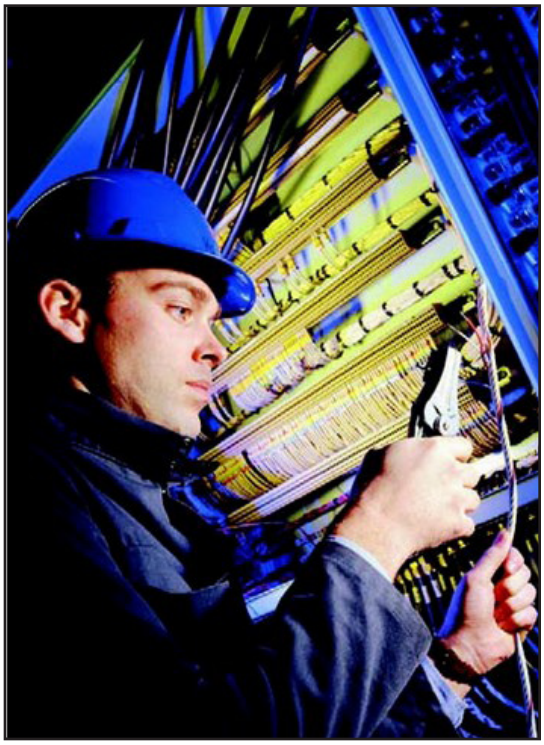

The Value of Maintenance To Mission Critical Systems

Indiana Society for Healthcare Engineering

The Value of Maintenance To Mission Critical Systems

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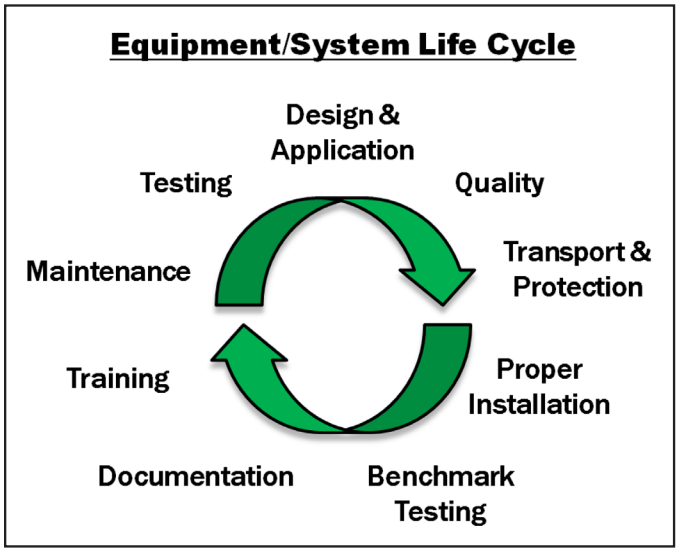


I'm quite certain that anyone reading this recognizes the title play on an old axiom. With the tremendous financial impact and the risk of personal liability, many of those responsible for mission critical operations are rethinking their maintenance program. This paper focuses on maintenance and it's effect on the life cycle of the engine generator / turbine and switching aspect of the emergency power system.

However, maintenance is not the only factor, which effects equipment life cycle. What is the life cycle of a given piece of equipment or a system? It could be simply expressed as the period of time beginning at installation and ending when it is no longer usable. I would submit to the reader that the useful life of a piece of equipment may be significantly lengthened (or shortened) by a cycle of events revolving around maintenance. All of the elements set forth in this brief article directly effect the condition of the equipment, maintainability, reliability and finally useful life.

The factors, which determine the length of the usable life of any piece of gear, begin to occur long before installation.

Proper Design & Application

All too often some aspect of this is lacking. It may be physical restrictions, which prevent proper maintenance, the application, and the type of equipment selected. As Automatic Transfer Switches go there are specific technologies for specific applications. The major types supplied by most manufactures are as follow.

- Standard break before make with no service bypass. Application is limited to non-critical application. The break, which occurs in transition from the "normal" source to the "emergency" source while very brief, may effect other system elements.
- Standard break before make with service bypass. Basically 2 switches (one automatic, one manual) in parallel. The manual switch is used to bypass the automatic for maintenance or replacement of the automatic unit.
- Standard make before break or closed transition with or without service bypass the engine generator / turbine and switching aspect of the emergency power system. However, maintenance is not the only factor, which effects equipment life cycle.

What is the life cycle of a given piece of equipment or a system? It could be simply

- Delayed transition. Stops in mid position to allow for the decay of large inductive loads thereby limiting inrush.
- Softload is basically a closed transition ATS with a synchronizer and power controller.



Used to "walk" the load from one source to the other. Especially useful where the standby source size is marginal or soft like natural gas or methane plants.

For example, closed transition is best for feeding a UPS. While the initial power outage transition to the emergency source of power operates the same a standard break before make ATS.

- When power fails, the ATS controls initiate a signal to start the standby generator.
- After the emergency generator starts, the ATS controls sample the power to insure it is the proper voltage and frequency.
- The ATS controls initiate a transfer to the emergency source.
- After the event, a seamless transfer back to the normal source prevents the UPS from hitting the battery again.
- Should the owner decide to place the facility on standby power, a seamless transition to and from the alternate source is possible while a dual hit to the battery is prevented.
- Should the UPS be in the bypass mode, a no break transition prevents loss of load.
- If the ATS is equipped with isolation / bypass feature, the ATS mechanism and controls may be serviced without effect to critical loads.

Having decided what type is best suited for the system demands; one must consider how the individual ATS will interface with the engine controls.

- How will priority load shed be handled & are the ATSs associated with the system equipped with the proper controls.
- Are the governors and voltage regulators of the proper type to interact with the UPS for example?
- What about communications and monitoring.

Careful Handling & Installation

Here again events occur which can severely effect the useful life of a piece of equipment.

- Did it ship well? Only incoming inspection can tell. Inspection should take place obviously before you accept the gear.
- Store the gear in a dry, safe environment. Moisture or condensation can and will degrade insulators or stand-offs. Moisture also attracts dust and dirt, which may become conductive.
- Those who are charged with installing the gear should be thoroughly familiar with the manufacturer's recommendations. Extreme caution must be observed not to let metal shavings or other debris contaminate the unit or controls.

- Personnel should read the installation and operations manual. Do not force controls or the mechanism. If you're not sure what to do, call the manufacturer for guidance.
- Remove all shipping blocks, bolts etc.

Benchmark Testing

This aspect cannot be emphasized enough. The manufacturer should be contacted to participate in the planning of the benchmark or initial commissioning test. This may well be part of the purchase package, however if it is not, a few dollars invested at this point may save a few thousand later.

- The owner or designer must participate in this task. You must insure that all programmable set points and time delays are understood, properly set and indeed function.
- Test the individual gear as a unit and follow with a system level test. Too often gear works fine by itself but fails to work properly a system. A good example is if the low voltage set point on the ATS is set lower than the same set point on the UPS. A brown out may cause the UPS to go to battery while the ATS remains on a low utility and will not start the engine nor transfer to the alternate source. This condition would result in battery depletion and loss of load
- Are the time delays adjusted properly? Overriding short outages is very important. Again, this feature should match the UPS settings to prevent unnecessary hits to the battery.
- Insure that load priority blocks are properly assigned. This prevents the generator bus from being overloaded while ensuring that critical loads are maintained.
- Document and retain all setpoints and adjustments on each piece of gear.

Document Control

Each piece of gear has documentation. The system also has documentation associated with it. This body of information includes operator's manual, bills of material, one line schematic diagrams, detailed control and power schematics, mechanical details etc.

Maintaining this information is paramount. It is your only reference in an emergency. Control settings as detailed in the section on testing are also part of the record.

A master one line on the wall under glass or plastic and adjacent to shitchgear is a quick reference point in an emergency or when operating the system.

Training

The system survived shipment, installation is complete and testing has been done. Now it will be the province of the personnel who maintain and operate the site.

- The manufacturer should be contacted to determine what training is available.
- Aside from basic operation and automatic features, personnel must understand how to manually operate systems in the event of failure of the automatic features.
- Example: It's the middle of the night, the utility power has failed, the UPS is on battery, the engines have started but not paralleled to the bus. Site personnel must be able to assess the situation and manually synchronize the engine generators before the UPS battery is depleted.

Routine Preventive Maintenance

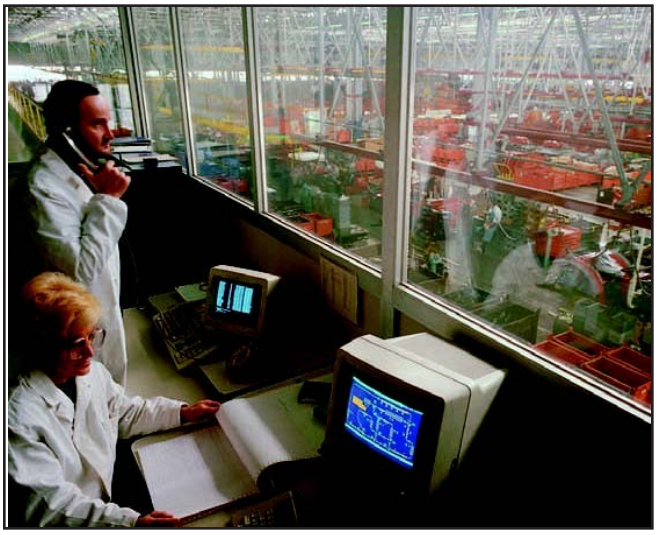
This is one of the most neglected aspects of the critical power system. In this context, neglected can mean that maintenance is simply not done a routine basis, may not be able to be done properly due to improper physical or electrical design or simply because the owner does not understand the process.

Too often the decision made on the maintenance provider or type of program is made strictly on price. The problem is that all programs are not created equal.

In order to understand exactly what you'll be receiving for your maintenance dollar you have to ask some probing questions.

The following 10 questions will help you determine the value of the program.

- **How are your service technicians selected, trained and qualified to work on my critical equipment?** This is important. Some maintenance companies have only a few specialists. While they may have many people, the person arriving at your site in an emergency may not be skilled or trained to effect the repair.
- **How many folks do have on staff?** Are there enough folks to go around in the event of a disaster or heavy schedule?
- **Do you provide 24-hr. service? How? (Have them explain call handling, escalation and response procedures).** The owner must understand how people will be contacted and directed when you need them. A good escalation plan provides for uniform steps and involvement of escalating levels of management.
- **Is your company authorized and or trained by the manufacturer? Prove it.** No big deal right? Wrong. Your emergency power system is the lifeblood of the facility. The people working on it must have the proper skill set and training. Your life may literally depend on it. And let's not forget the personal liability you may have. Civil actions and penalties are becoming the law of the land, protect your facility and yourself.
- **Can your company provide training for my staff?** This is also important. Why? I'm not suggesting that your staff be trained to do the maintenance or repair on critical gear. I'm also not suggesting that they are incapable of learning how. I am suggesting that without constant exposure, they will not remain sharp. They should be taught how the equipment and system is expected to operate under normal and abnormal conditions. They should understand how to operate the system. In the case of a transfer switch for example, one must understand how to operate the bypass if so equipped or manually operate the ATS safely. The engine control system is equally important. The ability to manually start and parallel engines may mean a lot to your data center or hospital in the middle of the night.



- **How do you support the technicians who will be on my site?** (Technical support, parts etc.) What happens when the technician can't figure out the problem? Does the prospective service provider have help available 7 x 24?
- **How does your company become aware of product changes, technical bulletins etc. from the manufacturer?** This is normally limited to the manufacturer's own Service Company or authorized agents. You will want your provider to be aware of anything effecting your system. How well they are connected makes a huge difference.
- **What type of maintenance agreements do you offer?** Too often, the selection of a maintenance vendor is based on price alone. If you rely on a critical system to run your building or business, you must understand how it is being maintained. You must understand the type of agreements available. These range from simple inspection to factory recommended maintenance to full replacement. At some point cost is a factor but don't let it be the "only" factor.

- **What is the average experience of your field force on the equipment I have?** This is another important measure. There are many companies who have general knowledge. Make sure you understand this aspect.
- **What spare parts do you carry for my equipment?** You will find that many companies do not invest in spares. They may bank on the manufacturer having spares available in an emergency. The bottom line is that if you're in the maintenance business, spare parts are a cost of doing business. Will they have the parts you need in an emergency? Maintenance is more important than ever. The dollars associated with critical operations are substantial, the maintenance window is shrinking or non-existent, in certain applications, life may literally depend on a properly operating system (should you find yourself in a hospital on life support you may want to think about that). In any case, the emphasis seems to be on the lowest possible dollar and very little is done to qualify the provider. Personal liability is becoming of concern. Some levels of staff are subject to civil or legal penalties should the system fail.

Medications & Upgrades

A viable option as systems age, technology changes. Advances in technology may mean that new flexibility or features are possible. It may also mean that some manufacturers consider some components obsolete.

The system requirements may also change. The message hear is that modifications & upgrades are viable options, which may be considered as an alternative to costly replacement. Emergency power systems are subject to a unique dichotomy. They are a mixture of durable, robust components (Diesel, gas or natural gas engines, alternators, fuel tanks, mufflers, ATS switching mechanisms, circuit breakers etc. and the systems which control them. With advances in technology, it is the control systems, which are subject to great changes.

There are two basic considerations.

1. New technology offers new more accurate, easier to user components.
2. Advances in technology also lead to obsolescence. As manufacturers look to the cutting edge, some components are replaced and become obsolete as far as the manufacturer is concerned. That's not good news if your system is built round those components. This is not to say that parts are suddenly unavailable. Usually manufacturers will maintain a stock of obsolete parts for a time in deference to their commitment to their customers but eventually stock runs out. This is especially true when dealing with microprocessors. So the point is to understand what you have and whether it is supported.

Some organizations specialize in modifications and upgrades to legacy systems. The cost to modify an emergency engine control system with new control pans & doors is roughly two-thirds the cost of replacement gear. To complete the cost analysis, you must consider the additional expenses associated with electrical disconnect & re-connection, rigging, mechanical work and disruption to the facility. You may also require rental equipment while you are replacing the gear. You will find that the cost of modifications is very small compared to replacement.

Testing

Periodic testing allows for system performance comparison to initial benchmark testing. Carefully performed and controlled tests may also indicate degradation in certain areas.

Conclusions

The conclusion is pretty simple. We began with the premise that equipment and systems have a life expectancy. System design in part will be judged on the useful life provided. A comprehensive maintenance program is much more than dusting off the equipment and hitting the test switch. There are many factors, which develop a cycle of events, which includes traditional maintenance, and will ultimately determine how long a system is viable. Therefore, this package of services or collection of events should be viewed in total and attention paid to all aspects of the cycle. Ultimately, attention to the cycle will yield continued reliable performance. Failure to do so will yield premature failures, which are preventable.

Alas, this all costs money but at the risk of employing another old cliché, Pay Me Now or Pay Me Later.

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