

Managing the Reliability of an Industrial or Commercial Electrical Power System / E 05

by **Chuck Baker**
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Cast

in the order of appearance:

- Andy** Reliability Manager of Electrical Power System
(recently hired by Brian)
- Tim** Electrical Engineer
(reports to Andy)
- Brian** Regional Vice President
(head person for Smith Industries plant)
- Lucy** Brian's Executive Secretary
- Jill** Director of Operations
- Tina** Maintenance Manager
(reports to Brian also)
- Kevin** Director of Reliability



Chuck Baker is the President of PowerPro 360, a company offering power system reliability assessment and reliability maintenance programs for Industrial and commercial organizations. Chuck entered the world of Substation and Power System Maintenance 36 years ago and has spent a majority of that career on the operations side of power and distribution system maintenance and the development of power system maintenance programs.



Good morning,
hoping this finds you well.

I know I have updated you on the Key
People at this Smith Industries plant.
However, it has been a while and I
wanted to go over the team again.



You know me (Andy) and I believe you have met my partner, Tim, who is our plant EE. I've been enjoying working with Tim and as we look at our maintenance program today, I will be working even closer with him.

You have heard quite a bit from Brian, and you understand his passion for Reliability. There are a lot of people who must change the mindset of Senior Management to build Reliability in the Power System, not only at this plant. Lucy keeps him on track.

And the other three (along with me) that are a part of the Reliability Team and report to Brian are Jill, Tina and Kevin. They are solid in their positions and are supporting bringing Reliability into the Power Program.



We sat down with a fresh cup of coffee and started into the first topic – Maintenance Standards. I looked at the two of them and started out by stating that it was my understanding that this Smith Industries plant trusts the vendors that service the electrical equipment to use the proper standards. They also trust the vendor to determine if the results or inspections are acceptable, questionable, or unacceptable. And lastly, they trust the recommendations of the vendors. I was straight forward when I explained that you can trust the vendor as much as you want, the responsibility remains in this room.

If you remember, in the last article I had spent the morning with Tim and Tina. We had talked through the **first four fundamental steps** in the core of our power maintenance program – those were One-line Diagrams, Short Circuit Study, Coordination Study and Arc Flash Study. By the way, did I mention that we have the Arc Flash Study underway? If not, it is, and we will have the results and findings to you in the August update.

I also explained that we are looking at our Maintenance Standards as the foundation, but once we are done with these four topics, and the Arc Flash Study, we are going to start considering the importance and health of each piece of equipment.

The next step was received well; they seemed very interested as I handed them the ANSI/NETA MTS-2019. These are standards for maintenance testing specifications for electrical power equipment and systems. I explained that these are the maintenance standards that I have used for many years and believe they were ahead of the reliability curve. They also have standards for new equipment, but let's concentrate on our maintenance standards.

Well, we are back from a nice lunch and are ready to tackle **the other four** in the foundational program which include:

1. Maintenance Standards
2. Service History and Status
3. Required Actions
4. Implementation

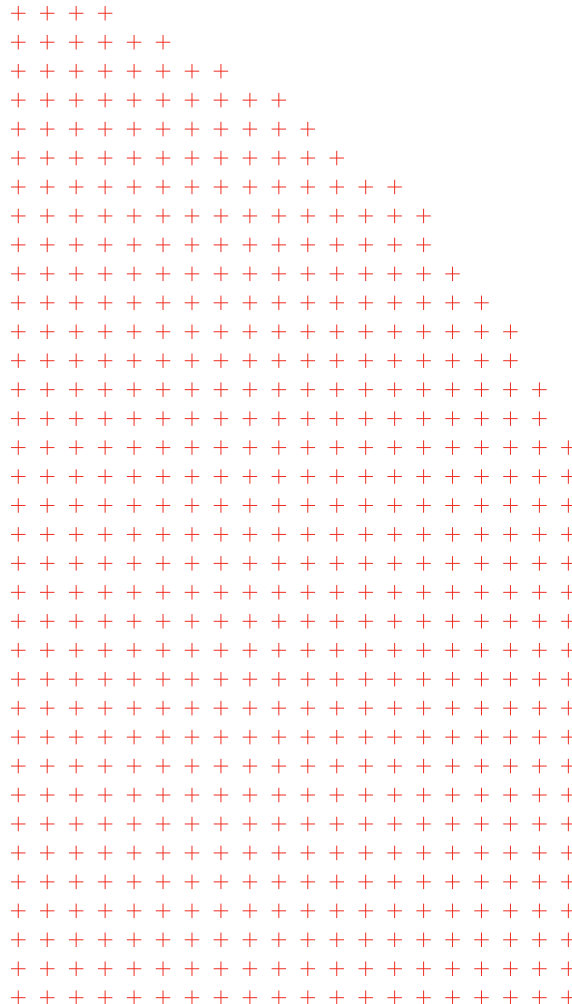


Photo: Shutterstock

I spent the next hour walking through the standards. Some highlights of my presentation and their thoughts and observations included:

1. The General Section

- a. Safety and Precautions:
We need to specify standards to be followed for us and for our contractors.
- b. Test Equipment Calibration:
This needs to be a part of every specification.

2. Power System Studies

- a. Short Circuit and Coordination Studies and Incident Energy Analysis, which will be a part of our Arc Flash Study.
- b. Load-Flow Studies, which is a necessity in our power system maintenance goals.
- c. Harmonic-Analysis Studies, which becomes more and more important and we advance in the equipment we provide power to.

3. Inspection and Test Procedures

- a. Detail of the equipment including switchgear, transformers (dry and liquid filled), cables, switches, circuit breakers, capacitors, arrestors, and the list goes on.

4. I then guided them to the back of the standards where things started getting interesting...

- a. I walked them through the base guidelines on frequency of tests and we looked at "Circuit Breakers – Air, Low-Voltage Power" which we had just read the maintenance standards on and saw the following:
 - i. Visual inspection – monthly
 - ii. Visual and mechanical Inspection – every 12 months
 - iii. Visual, mechanical inspections and electrical testing every 36 months
- b. This made sense to everyone and then I asked them to go back a couple pages entitled "Maintenance Frequency Matrix" which had an interesting table in it:

So, we need to first confirm our standards and review the last data generated on each piece of equipment. What standards have we been using to determine the health of each piece?

Tim replied that we have not actually specified specific standards but have stated that we want the contractors to comply with current industry standards. We get their service and test reports and it always comes with a rating: acceptable, questionable, or unacceptable. We look at the result and decide when we do the repair: immediately, during the next scheduled outage, or when we can get it in the budget.

Tina then jumped in and carried on. She agreed and said that establishing the Poor, Average and Good condition

MAINTENANCE FREQUENCY MATRIX

| | | Equipment Condition | | |
|-----------------------------------|--------|---------------------|---------|------|
| | | Poor | Average | Good |
| Equipment Reliability Requirement | Low | 1.00 | 2.00 | 2.50 |
| | Medium | 0.50 | 1.00 | 1.50 |
| | High | 0.25 | 0.50 | 0.75 |

ANSI/NETA MTS-2019

- b. I randomly opened it up to walk them through an example and found "Circuit Breakers – Air, Low-Voltage Power".
- c. We walked through the steps for inspection (which we perform), mechanical inspection (which is done by our contractors), and the electrical tests and standards.

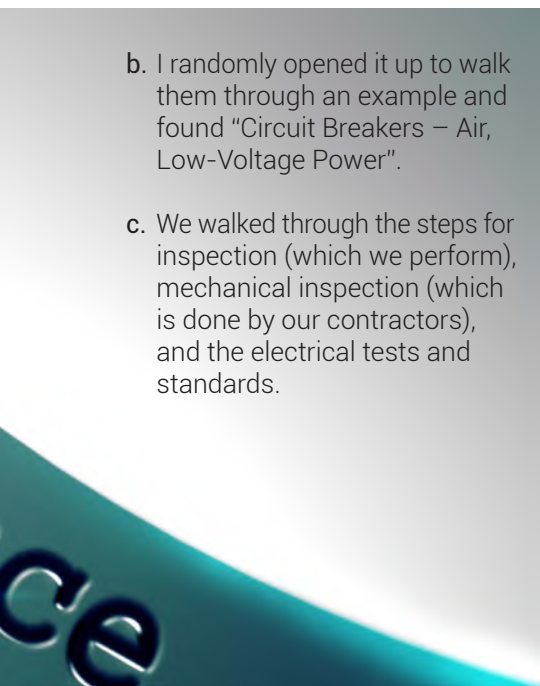
We talked about Equipment Reliability, and this is where we sat back and all agreed that our maintenance strategy needs to be improved, and we have to take control of the equipment and begin to look at it differently.

is important, but, she noted, as I see in the table, we also have to determine a reliability requirement: low, medium or high. What system do we use to rate the reliability requirements?

As you can see, this asks us for two things:

- 1. Current Condition
- 2. Reliability Requirements

Great definition and summary team, as you know, once we are done with the foundational maintenance plan and standards, and have completed the arc flash study, we are going to dig into the reliability side. But let me take a couple of pieces of our current equipment and show the fundamental logic of this process.



We have two 750 kVA cabinet transformers: TC7 and TC23. TC7 feeds the product warehouse and north parking lot, while TC23 feeds the offices, but that also includes the IT center. Here is the example of considerations when choosing reliability requirements:

1. If TC7 were to fail today, the lighting, office power and conveyor transfer system would go down in the product warehouse. I have only watched that process a couple of times, but I know from a few questions and the one-line that:
 - a. The plant can produce at full capacity for 48 hours before exceeding the plant capacity and requiring product to be transferred to the product warehouse, which gives us a little time.
 - b. I know that we have emergency lighting for 24 hours, so safety is addressed.
 - c. As far as office and conveyor and long-term lighting are concerned, it is a rather light load and I know we can rent one of four things:
 - i. Cat generator: this can be delivered within 24 hours.
 - ii. Spare transformer: this is a common voltage and we can find one.
 - iii. Purchase a new one: I know that with this size and voltage class the average is four to six weeks.
 - iv. A combination of these.
 - d. I would say that we can implement a reaction plan that would streamline the process. Furthermore, if we want to increase reliability without increasing cost, we can go ahead today and:
 - i. Get a service agreement and credit check with the generator dealer. If we need one, we can launch a single call and streamline the process. In an unplanned outage, that is priceless.
 - ii. We can contract the manufacturer and ask for a quote on the replacement unit that fits the size, capacity, voltages, and impedance. It will include delivery time, pricing

and we can finalize the terms, conditions, warranty and get the price for them to deliver and install it.

- iii. Thirdly, we can contact a couple of used transformer representatives for the used transformer market, set up agreements with them, and have their number on our phones for a quick text should this happen.
 - e. If we go through this process, we can control the risk to the plant with no expense and just a little effort.
2. If TC23 were to fail, I understand that everyone is comfortable because we have a good UPS system and a spare transformer on a tie breaker. If the unit fails, the power will be uninterrupted. But did you know the financial impact of a total outage on that feed? The cost impact is \$100,000 a day, and 75% of production would be shut down. Keep in mind:
 - a. The UPS system is temporary.
 - b. If the first unit fails and the second unit is put into service, we no longer have a spare.
 - c. We also know from TC7 that it will take four to six weeks to replace.
 - d. We would carefully need to map this out and look at options; would we:
 - i. Auto order the generator for backup of the spare transformer;
 - ii. And here is where I am going to bring us back around to base maintenance: Should the health of this unit be assessed? If it is in poor condition, do we recommend that we purchase a spare 750 kVA transformer? You get the idea.

So, you can see that setting acceptable, questionable, and unacceptable standards will be foundational for our program.

You can also see that we now need to pull up all current data and rate the

equipment in its "as is" condition. We are in the process of purchasing a power system asset maintenance program and will use that program to rate the condition against our standards. We would get temporary help to enter data and then the three of us will look at condition and flag potential immediate problems. Your thoughts?

Tina responded quickly and endorsed the concept with the statement that she needs to make some adjustments in their other reliability maintenance programs; not many, but some adjustments. She also pointed out that when we get to the reliability discussion for the power system, they already have a lot of the required data.

Tim endorsed that explaining that although it is not all together, we probably have 90% of the raw numbers to begin to pull them into our new program.

We set up a meeting for next week to begin to work through setting our standards, inputting historic data (Tim took the lead in working with maintenance to collect data, he mentioned that when I first came on board; I saw the hard copy filing system we use) and identifying where we need to get additional information. We will then develop the detail of what needs to be done today and how we are going to implement corrections.

As we are walking through this process, I have initiated the Arc Flash Study and Tim is working with the contractor and PE that is performing this program for us. We selected a contractor that could provide project assessment and recommendations with the same program and software that we manage our Electrical Power System Analysis with.

Next month, I want to walk you through that arc flash study. We have talked about the overview of key steps such as short circuit and coordination study. I would like to walk you through our experience, our results, but more importantly, how we will use the data generated into our maintenance and reliability program.

In two months, we will get back to the program and tackle reliability. And that is where it really gets fun.

