TIPS AND TRICKS FOR BATTERY SERVICE TECHNICIANS

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ABSTRACT

Battery technicians are faced with a variety of tasks that, in many cases, require on the spot decision making. Others require detailed planning. Over the years, I have been asked a variety of questions by end users and field technicians, relating to maintenance related topics among others. The end user is frequently responsible for the day-to-day maintenance of their battery systems and related equipment. This paper will present four popular "nuts and bolts" topics in a question and answer style format that battery technicians frequently deal with in the field. The tasks and decisions associated with these may appear to be simple on the surface, but the reality of the effects of making a less than informed decision can have serious results and side effects. The purpose of this paper is to draw attention to the fact that not all maintenance related tasks are "slam dunk" situations. All too many times, a seemingly simple situation can result in a complete failure of a battery and the equipment it supports.

INTRODUCTION

The topics presented in this paper include dealing with bolted hardware corrosion, charging replacement cells, isolating a string for maintenance and bolt torque issues. These are but a few of many topics of discussion that were considered for this paper. These were chosen based on available time for a Battcon presentation, relative importance and paper length limits.

BOLTED HARDWARE CORROSION

Evil Corrosion

To many battery service technicians, corrosion is a four letter word, despite how it's spelled. Corrosion, if left on its own will most assuredly create serious operational and performance problems for a battery. What causes corrosion? Basically, it is caused by electrolyte coming in contact with the bolted hardware. Contamination can occur through sloppy use of a hydrometer or leaking post seals. Electrolyte migration or "acid creep" as it is also called, from areas around jar-to-cover seals and poorly seated flame arrestors contributes to the problem. Regardless of how electrolyte makes it way to the connection hardware, corrosion is sure to follow.

Scheduling Corrective Action When Needed

The trick in dealing with corrosion is in knowing the difference between when corrective action is required immediately and when it can wait. Knowing this will help define when a battery can remain in service until a suitable time slot can be scheduled or the situation should be addressed in a timelier manner.

Use Your Instrumentation!

Here's the tip. You should be using a micro-ohmmeter or other instrument to keep track of connection resistance. Use those readings to determine the quality of the connection, not the cosmetic appearance of corrosion. I once had a customer that demanded monitoring of all corrosion by noting where the corrosion was on the connection, the color, and amount of progression in fractions of inches since the last maintenance visit. We even had cute little rulers (plastic of course). This approach is a complete waste of time and provides no useful information. There are many cases when connection resistance cannot be measured. In such cases, you have no choice but to address the condition in a timely manner and correct the problem. Corrosion develops over a long time, not overnight.

CHARGING REPLACEMENT CELLS

Have you ever replaced a failed cell/unit only to find out six months later, its float voltage is still sitting at open circuit? Those without formal training or experience may not know why this happens. If you're an experienced field technician working for a service company, you should know how to prevent that from occurring. That will be addressed later.

Get It Ready

The trick in getting that new cell (or multi-cell unit) to float at its proper voltage is to have it fully charged! But wait! You just got this cell from the factory! It's new! It doesn't matter. The fact is, new cells need to receive a freshening charge. Yes, it's new, but it may not have been charged in weeks or maybe a few months since manufacture, depending upon the situation.

Here's the tip. Charge the new cell/unit *before* you install it in the system with a single cell/unit charger. If it can't wait, charge it after it has been connected into the string. I prefer the former because risk exposure is lower. If you are going to charge the new cell in-service, that is, while it is installed in the battery, you must use a charger that is **line-isolated**. That is, a charger that will not be "seen" by the DC system to which it is connected. Use of a non line-isolated charger can result in a malfunction of the critical battery system charger, loss of connected load, damage to the single cell charger and possible personnel injury. Person performing such tasks must be trained in the use of such equipment and the potential hazards associated with the work to be undertaken.

Why Not Just Put It In The String?

Why won't the new cell charge on its own? When that new cell is installed in the battery system, there is not enough charging current present, even when the system battery charger is operating in equalizing mode. Why? The rest of the battery is already fully charged and won't demand the current the new cell needs to be properly charged.

ISOLATING A PARALLEL STRING FOR MAINTENANCE

Question: If I have a 15 minute UPS battery with 2 parallel strings, then removing one string for maintenance leaves me with 7 ½ minutes, right? That will not likely be the case. Battery support time increases as parallel strings are added, but the relationship between the added strings and the time is not a linear one. The trick is to know the status of several operating conditions before one string can be safely isolated from service for maintenance. Remember, the remaining string(s) must be at the ready in the event of a power interruption.

Operating Conditions

Here's the tip. Get answers before you isolate a string from service for maintenance. Understand the ramifications of isolating the string from service before you do it. If you don't, you might get a surprise that could cost you big time. Business these days has it tough enough.

- Facilities policy and procedure
  - You might not even be able to do this
- System required support time
  - How much time does the site really need?
- System load
  - Do you know it and can you convert that to the demand that will be placed on the remaining string(s)?
- Condition of strings that will remain on line
  - Does the remaining string(s) have what it takes to support the load if the utility fails?
- Battery breaker or fused disconnect ampere rating
  - Can the remaining battery breaker(s) carry the load without tripping?
- Calculated run time with remaining string(s)
  - What do the performance data sheets say about your "new" load?

In a nutshell, you must be confident in knowing the string(s) to remain online are in good condition, can carry the load for the desired amount of time should that occur, will operate within their design limits and not cause any over current protective devices to trip or clear.

When Half the Battery Isn't Half the Time

As an example of the relationship between number of strings and support time, let's take a look at a UPS system configured with two strings in parallel. The system required 2 strings operating in parallel in order to meet the system design for the battery manufacturer selected. One string needs to be removed for maintenance, leaving one string on line.

The original design calls for the ABC battery to supply 417 kilowatts DC. Each string has 234 cells, and the load is divided between the two strings in parallel. Therefore, the load is about 891 watts per cell. Based on the performance data in Table 1, the battery as a system would support the load for about 22 minutes.

Table 1 - Watts Per Cell Data

ABC Battery Company *Model DEF-123 Battery* Constant Power Discharge Data – Watts Per Cell									
Minutes to Final Voltage – 1.63 vpc									
2	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**
N/A	1753	1352	1116	951	817	714	634	572	527

The battery disconnect for string 1 is now open, leaving string 2 on line by itself. The UPS is in full load condition as data centers have merged resulting in the need for full utilization of power system capacity. Oops! No one told you about the line of severe thunderstorms 40 miles West of where you're working? Out go the lights. Dang! Things have gone from a few milliamps on float to a whopping discharge demand of 1782 watts per cell. The load current on that string is now double what it would normally be; initially about 900 amperes. But wait, there's more! By the end of the discharge, assuming a 1.63 volt per cell shut down, (if it goes that long) the battery current will about 1100 amperes. What's the trip rating of that breaker? How much time do you have at this load? Click! That was the under voltage release (UVR) mechanism in the battery disconnect tripping the battery off line because it reached final voltage. Game over. By the way, the calculated support time with one string is less than 5 minutes. Do your homework.

TO RE-TORQUE OR NOT TO RE-TORQUE; THAT IS THE QUESTION

But We Always Did It That Way!

For years, it was common practice to re-torque bolted battery connections on most lead-acid batteries on an annual basis. That was pretty much what the battery manufacturer wanted you to do and the instruction, along with the annual re-torque value was provided in the operation and maintenance manual. It was an automatic task we gladly (or some not-so-gladly) undertook as part of the annual maintenance routine. It can be at times, quite time consuming. Consider a 240 cell UPS battery with 2 bolts per post and 4 posts per cell. Yes, you would have to re-torque 1920 nut/bolt assemblies, not counting the terminal plates and inter-rack, tier and aisle cable groups.

The Times, They Have Changed

Things have changed a bit over the years since I started working in this industry. Nowadays, depending upon the technology, make and model of battery you're working with, performing a re-torque sequence may <u>not</u> be what the battery manufacturer wants you to do. The trick as to whether or not connections should undergo scrutiny by a torque wrench is in knowing where to find that information and have an understanding of what's contained in the current IEEE battery maintenance documents. The recommended practices relating to maintenance for lead-acid batteries are IEEE 1188-2005 for VRLA types and IEEE 450-2002 for VLA. If you are working with Nickel Cadmium batteries, the standard is IEEE 1106-1995. It is also a very good idea to have a copy of the installation, operation and maintenance instructions available for the battery in question.

Industry Standards

IEEE 450 and 1188 do a good job of explaining when the re-torque procedure should be used. Nowadays, the need to re-torque bolted connections hinges on whether or not the interconnection resistance has increased to unsatisfactory values over time. When such a condition exists, the affected connection(s) should then undergo a re-torque procedure. By the way, this may not correct the problem in which case, the connection must be treated as a new one and undergo disassembly, cleaning, and reassembly. The initial torque value is applied. The resistance is again measured and determined whether or not it is within acceptable limits. Cleaning and reassembly usually corrects the problem unless excessive corrosion on the hardware cannot be adequately cleaned. My thinking behind why things are done this way today is that performing a re-torque procedure annually on perfectly good connections is potentially damaging to battery terminals by distorting them.

When Resistance Can't be Measured

What about all those systems that have the battery installed in a cabinet? One of the most common installations is the ubiquitous 12 volt monoblock. Measuring connection resistance is not possible on the majority of these. When do you re-torque? Since resistance values are not available, there is no clear indicator as to when the connection needs attention aside from the appearance of corrosion or obviously loose hardware. In such instances, refer to the battery manufacturer's instructions for guidance. In many cases, you will be directed to perform a re-torque procedure once annually. If you still cannot get a definitive answer by these methods, pick up the phone, or send an email asking for clarification. Failure to properly maintain a battery can and does lead to all sorts of maintenance and operational problems. It is important to have an understanding of the applicable IEEE standards as well as those of the battery manufacturer. It is the author's opinion that the battery manufacturer instructions trump IEEE standards when things get this specific.

SUMMARY

As you can see from this brief paper on only four subjects, things are not always as they seem. Read and understand the IEEE recommended practices as they apply to your battery. Be familiar with the detailed installation, operation and maintenance instructions for the battery type(s) you work with. Know and fully understand the systems you are responsible for maintaining. Above all, put safety first.