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The High Price of Cost Reductions

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INTRODUCTION

The intent of BATTCON is to bring users, battery manufacturers, test equipment manufacturers, test and maintenance service providers, and other related parties together to discuss and solve industry-wide problems.

This presentation will focus on some specific problems that the author believes are important enough to address at this conference. It also urges users who are faced with these problems to take positive, decisive steps to eliminate these problems.

USER PROBLEMS

1. MAINTAINABILITY

No one can argue that batteries and battery powered equipment require periodic maintenance. IEEE Standard 450 describes in detail the recommended testing and maintenance for large, stationary, flooded lead acid batteries and IEEE Standard 1188 describes the recommended practices for VRLA batteries. According to IEEE Standard 1188, VRLA batteries are at least four times more maintenance intensive than their flooded counterparts. It would therefore make sense that we design our batteries and the related equipment to be easily maintained.

Unfortunately, today's designs are dictated primarily by price alone, and this has given rise to a multitude of problems that are now being paid for with poor system reliability and many hours of maintenance and aggravation. In the interest of brevity, I will restrict the discussions to two areas: Battery design problems and battery cabinet design problems.

Battery Designs – Designers of even the newer models of batteries on the market are ignoring the fact that batteries need to be inspected and tested. Terminal posts are not accessible or are very difficult to connect test instruments or monitors to. This leads to either no testing being performed or readings that are not consistent. If test results are not consistent, it is practically impossible to trend the results.

Figures 2 and 3 show typical 12 volt battery modules used in low power applications. These modules are shown strictly to illustrate maintainability problems; they are by no means the worst in the industry. Some of the battery modules being used in cabinet applications do not even have terminal posts; they simply have leads extending out through the battery case and then terminated in a two-pin plastic housing connector. This may be a great design for the battery manufacturer and the cabinet manufacturer, but it is a disservice to the battery user, as it makes testing practically useless.

Even some of the larger VRLA cells are very difficult to work with when reading internal cell resistances and intercell connection resistances. One practice that should be banned is the paralleling of individual cells in a string. (See Figure 1.) This type of installation makes it impossible to identify problems without disassembling the intercell connections.

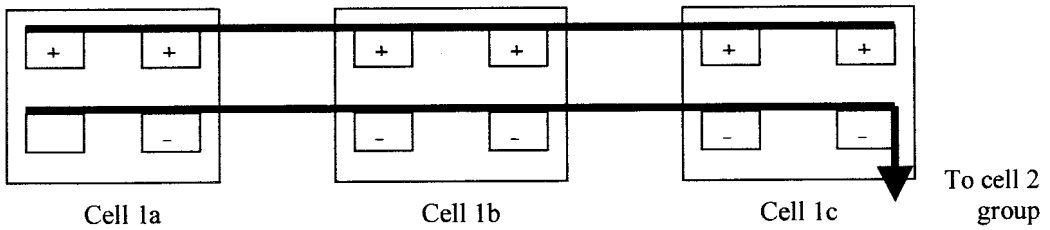
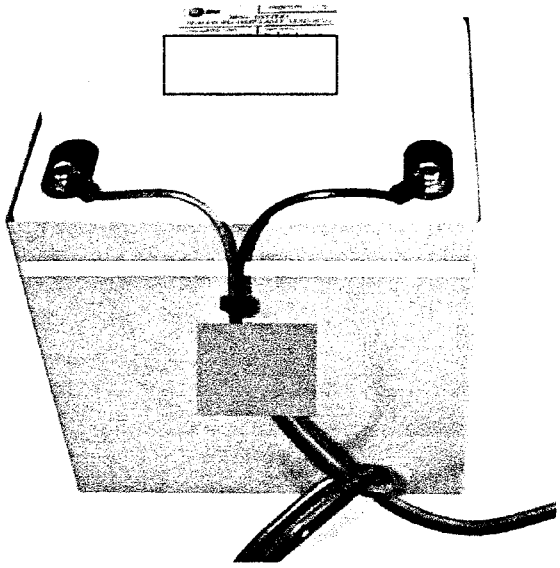
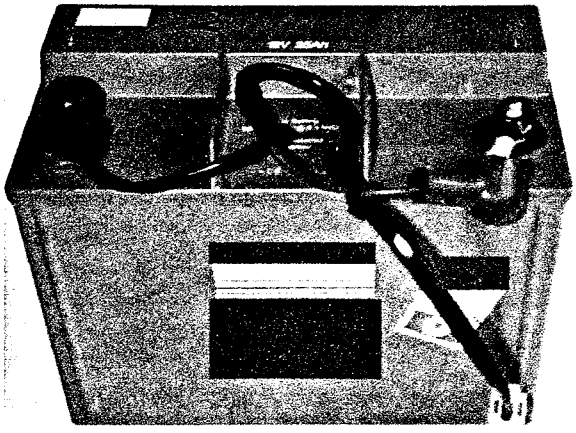


Figure 1



This low Amp-Hour 12 volt module does not allow any access to the terminal posts for test leads.
Figure 2



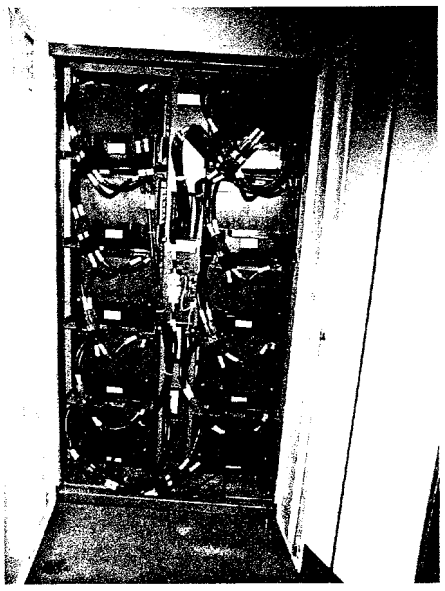
This 12 volt module has protective insulating covers that make access to the terminals more difficult. It also uses a threaded stud design to make intercell connections, which blocks direct access to the terminal posts.
Figure 3

The battery modules in Figures 2 and 3 have no direct access to the terminal posts of the battery. This means that the internal ohmic measurements recommended by IEEE 1188 cannot be performed correctly.

Since test leads have to be connected to the stainless steel hardware, the resistance of the hardware will be included in the measurement. For low ohmic batteries, the resistance of the stainless steel hardware can represent a large percent of the total, therefore making it very difficult to trend any changes in the internal resistance as the battery deteriorates.

For example: A 1000 Amp-Hour, 2 volt VRLA cell has a typical internal resistance of 140 micro-ohms. If the test leads are not placed directly on the terminal post and the stainless steel hardware resistance is included, then the total resistance measured may be 340 micro-ohms. If the internal cell resistance increases to a failing value of 175 micro-ohms, the total measurement would be 375 micro-ohms. The 375 micro-ohm value only reflects a 10% change, and most people would fail to recognize that they have a failing cell.

Battery Cabinet Design - The typical battery cabinets purchased by UPS and telecom users are a maintenance nightmare. The batteries are not only difficult to access, but reaching into these cabinets represents a safety hazard to both maintenance personnel and the power system. Because of the access problems, a lot of maintenance is either ignored or performed improperly.



Typical UPS battery cabinet with 12 volt modules.
There is practically no access to the terminal posts.
Figures 4a and 4b

2. MAINTENANCE SERVICES

Many users outsource the maintenance of their battery system, yet this author has never seen a contract for these services that listed the qualifications necessary to perform these services.

In America today, most people are allowed to perform services without licenses or credentials that guarantee their customers even the slightest degree of competence to perform these services. The average battery service company often times has battery technicians who have little formal training and do not really have a fundamental understanding of batteries. These personnel also may not have any formal training in safety nor an understanding of electrical theory as basic as Ohm's Law.

Many users do not seem to understand the liabilities they create for themselves by not setting formalized minimum requirements for the people they entrust with their critical power systems. The chances of improperly trained maintenance personnel getting hurt are very real, the chances of their hurting the power system are also very real, and the chances of their not identifying problems before it is too late are almost guaranteed.

Since there are no standards at present to measure the competence of service personnel, the author believes that the IEEE standards group should provide the industry with recommended minimum requirements for various levels of battery test and maintenance technicians. I believe they should also provide a fee-based, semi-annual testing service with a pass/fail criteria

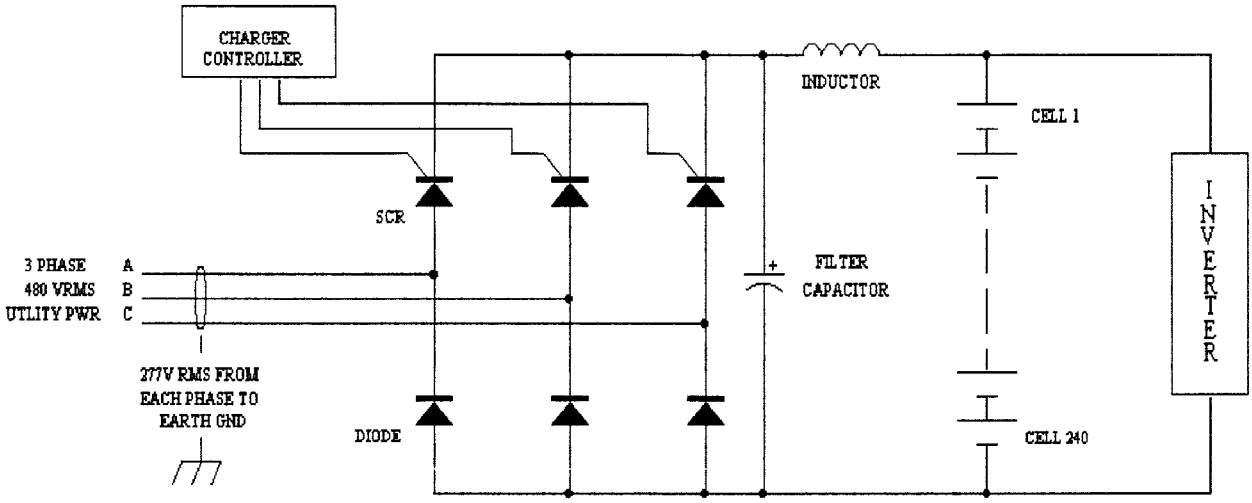
that could be used to qualify maintenance personnel. Training required to pass the tests can be provided by battery manufacturers or independent training companies staffed with competent instructors.

It does not make sense to have recommended standards for maintenance and test and then allow anyone, regardless of experience, to perform these tasks.

3. PERSONNEL AND EQUIPMENT SAFETY

The most important safety issue we face today is **UPS systems without input isolation transformers.**

A lot of new UPS systems are being installed without isolation transformers and are, therefore, placing a high ac voltage on every single terminal post, with respect to earth ground. Figure 5 shows a simplified high voltage charger design.



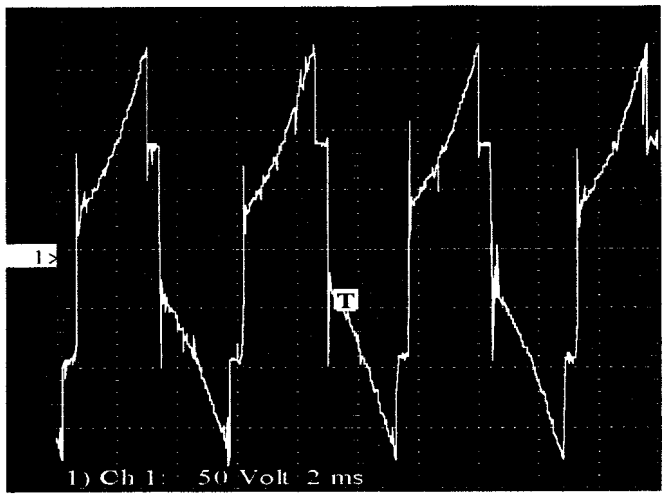
Simplified schematic of UPS charger. Used strictly to illustrate lack of isolation from battery to earth ground. Battery terminals are at high voltage with respect to ground.

Figure 5

Notice that the 480 volt, three phase input voltage comes directly from the utility power grid, which means that there is a high voltage (277 Vrms) present from each of these lines, with respect to earth ground. The three input lines may be stepped down through an auto-transformer to the desired level before the voltage is applied to the full-wave rectifier bridge, but the auto-transformer does not eliminate the presence of the earth ground. This means that a high ac voltage, with respect to earth ground, is applied directly to the batteries, and there is very little to limit the current if something should accidentally bridge from any given terminal post to earth ground.

Figure 6 shows the waveform of the actual voltage present from any battery terminal post to earth ground. This waveform was recorded on a typical installation using 240 cells in series. The rms voltage is approximately 120 volts.

Maintenance personnel face a real shock hazard working on these battery systems, and the UPS system and/or battery would suffer considerable damage if a test lead or a severe electrolyte leakage caused a short circuit. Leakage from some VRLA cells to case has been reported, and this, of course, represents an explosion hazard.



Voltage waveform from all terminal posts to earth ground on non-isolated UPS systems. Peak to peak voltage is 375 volts.
Figure 6

Many users who bought a non-isolated system to reduce cost have not fully realized what they have compromised in the way of personnel and equipment safety. One bad accident is going to raise a lot of ugly questions.

SOLUTIONS

How do we solve the above mentioned problems? The question is not how do we solve these problems. Technically, all of the solutions to the above problems are very easy to implement. The real question is are the users really interested in solving these problems?

Can battery cabinets be made safer and easier to work in, can battery terminals be redesigned for maintainability, and can we insist on using trained maintenance personnel? It will cost a few more dollars, but it can easily be done. Are the manufacturers willing to do their part? I don't think that question even has to be asked. Reputable manufacturers would welcome the opportunity to be evaluated on the merits of their products, rather than just on price. Doing something right is a lot more satisfying than simply trying to be the low bidder.

What about the isolation transformers? The reason they were removed in the last few years is because the users practically demanded it by always awarding the UPS contract to the lowest bidder. The sad part is that most users don't understand what they have sacrificed.

Over the past 15 years or more, the industrial world (especially the U.S.) has been driven by short-term thinking bean-counters who demand lower costs on everything. This has forced manufacturers to cut costs anyway they possibly could.

At one time, the term Price/Performance was very popular, but today it doesn't looks like performance matters much.

It is real easy to blame everything on the bean-counters and hope a major accident or failure does not take place, but that is not the right solution.

I think it is time for users to recognize their responsibility and set minimum standards for performance and safety. A purchase requisition with a technical specification will force the procurement department to purchase the lowest priced product that meets or exceeds the purchase specification.

If procurement personnel insist on purchasing something that does not meet the technical requirements, then ask them to acknowledge, in writing, that they are taking responsibility for the performance of that equipment.

When all the costs of owning a battery backed-up power system are considered, even over just a few years, it should be easy to justify doing things right. That inexpensive VRLA battery installed today will have to be replaced at least once, and most likely twice, over the life of a slightly more expensive flooded battery. The maintenance required to assure a reliable system is at least four times more for the VRLA battery. I don't think even the staunchest VRLA battery manufacturer would try to argue that flooded batteries do not have the better performance record.

To all the users out there: Next time you are preparing a purchase requisition, think of labor savings, fewer safety problems, and increased system reliability. These are decisions that have to make sense to any reasonable businessman.

CONCLUSION

Many of the maintenance, safety and reliability problems that exist in the battery world today have simple solutions, but the solutions need to be initiated by the users.