

UPS in the Central Office
A TelCo engineer's perspective

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Abstract

The telecommunications industry is evolving toward a more distributed system architecture. Stored Program Controlled switching machines will interface with feature processors so new services can be integrated into the network. This is expected to reduce the financial outlays, and lead times previously expended to implement hardware dependent new features. Additionally, computerized Operational Support Systems are increasingly utilized for system testing, troubleshooting, and switch administration.

Most of the computers used for these purposes are AC powered. The "Real time" nature of telephone service, the Volatile nature of some computer memory elements, and the necessity of system reliability accentuate the need for uninterruptible power. Accordingly, these systems are being deployed for use in the central office. For the moment, it appears that UPS is a technology more germane to the data processing side of the business, since this is where it evolved.

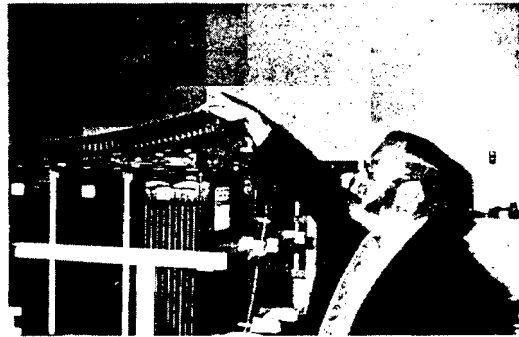
This paper is intended to point out features which make an UPS system more utile to a telephone engineer or Operations Manager. Some features already exist in a few UPS systems, and some do not. Obviously, the systems best suited to the needs of the telecommunications customer, will enjoy a larger share of that market.

Though highly developed, there are design alterations which could make UPS systems better suited to the central office environment.

Battery Safety

UPS Systems in the central office will probably be maintained by a switching equipment technician rather than an electrician. Additionally, nearby maintenance, such as cleaning, would be performed by non-technical personnel. Thus, the battery is of concern. UPS systems for sites with 480 volt AC potentials use very high voltages in their battery strings. Often, these DC potentials exceed 500 volts.

Battery connections are usually exposed, while the various AC leads and connections are in enclosures. Steps should be taken to reduce the risk of contact with this lethal potential.



Wiring duct used as intercell insulating cover (Photo courtesy Panduit Corp.)

Ground isolation is one technique often used to make battery servicing safer. The battery charge voltage is "floated" with no ground reference. This technique is a genuine benefit if that isolation is assured. Ground fault detectors and alarms should be incorporated on all such systems. Some companies use plastic battery stands, these provide significantly increased safety isolation.



Doubled Intercell Connectors
Polyester Battery Stands
Long Life High Rate Battery
Fire Resistant Materials
(Photo Courtesy AT&T Network Systems)

Battery Reliability

Service switches should be used to disconnect and divide the battery into series strings of a lower voltage. Also, insulating covers, protecting the posts and connections, are an inexpensive means of reducing the risk of both electrical shock and fires which could result from an accidental short circuit on the battery. Battery cabinet interiors should be designed with insulating coatings or liners to reduce the risk of accidental contact between the battery and cabinet during installation, and servicing. Battery jars should be made of materials with an oxygen index greater than 28 to reduce the risk of fire.

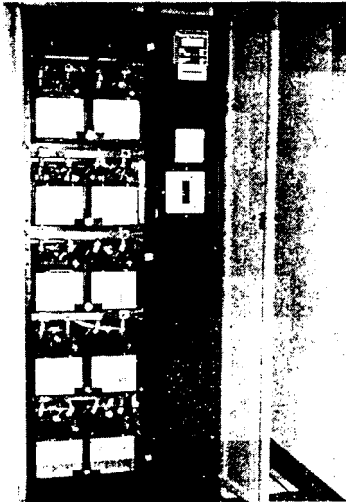
Intercell straps and connections should be redundant wherever possible. UPS batteries tend to be discharged at very high rates. Small voltage drops, caused by poor connections, can cause system failures, and even fires. Annual torque checks occasionally get missed. The cost of intercell connectors is miniscule compared with their value to the system.

Bypass

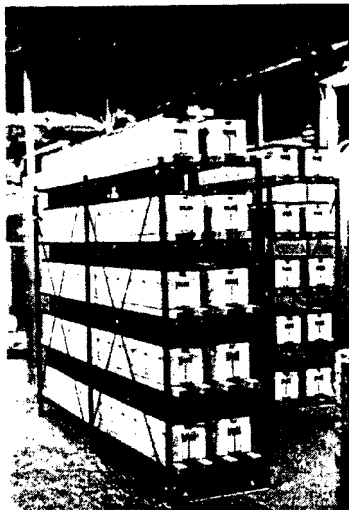
Maintenance bypasses should be provided to permit the UPS system to be totally deenergized during servicing. Alarm systems, both local and remote, should report that an UPS is in the static or maintenance bypass mode.

Modularity

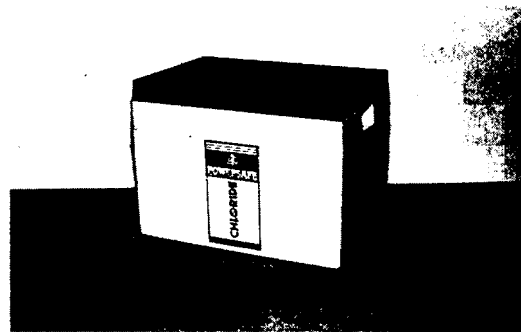
Forecasting remains one of the most difficult aspects of the telephone business, therefore, UPS systems should be modular. This will allow for orderly growth, when it might need to be expedited to meet an unforecasted need. Paralleling will eliminate the "Stranded" capacity which could result from adjacent systems. Systems with ferroresonant rectifiers should not only "Load share". To operate efficiently, they should load as many of the rectifiers to 100% as possible. Thus, the DC bus should be paralleled also.



Battery Cabinet with Service Disconnect
(Photo Courtesy Liebert Corp.)



"Maintenance Free" Battery with insulating covers and flame retardant material (Photo Courtesy Chloride Battery Corp.)



Remote Monitoring

Remote monitoring of the power system is today's reality. Microprocessor governed systems are increasingly used to monitor the various plants, and other elements of the power room. UPS systems used for telephone applications should be designed with microprocessor monitors.

They should have an internal modem which is capable of dialing a user-selected telephone number, and automatic answering at 300 and 1200 baud.

The modem should have an RJ11C modular telephone connection located to facilitate connection to an owner provided RJ11C block. For standardization, the protocol should meet the requirements of Bellcore's Technical Advisory TA- TSY -000370, issued May, 1986.

Security

For security against computer hobbyists and other interlopers, the monitor system should have a two level password system, and very limited command performance abilities. One should be able to run remote diagnostics, for example, but not take any service affecting action. A limited number of missed password attempts should be tolerated, then the system should reject further logon attempts for approximately thirty minutes.

Battery Reserve Monitor

The system's logic should be capable of reporting the time remaining until battery exhaust. The user should be able to input the date, type, and ampere/hour rating of the battery at installation or growth. The algorithm would review the battery data and plot the capacity from an aging curve for the type of battery, to predict how much battery life remains at the present load. This information should be available both locally, and via the monitor system.

Load Shedding

Some large UPS systems feed multiple Power Distribution Units (PDUs) or panelboards. In some telephone centers, there are computer systems which are less vital than others. It would be helpful to apportion power to computer equipment on a priority basis.

To achieve this, load shed accessory boxes could be a popular option if "Shed Load" signals were available from the UPS. Such signals should be the result of reaching user programmable percentages of remaining battery capacity.

ESD Protection

To help avoid damage to electrostatic sensitive devices during servicing, a grounded banana connector labeled "Wrist strap ground point" should be conveniently located in each bay of the UPS system.

Isolated Grounding

Isolated grounding should be available on derived neutral (Wye) outputs to facilitate the single point grounding of the data processing equipment.

A grounding connection should be available on all cabinets and battery racks. If it is a bolted connection, toothed star washers and double hole lugs should be used.

Cooling Airflow

Systems cooled by forced air should be filtered, and equipped with low airflow alarms, such as sail switches or differential manometers.

Fuses and Circuit Breakers

Circuit protection devices should be of the indicating type to save time during troubleshooting. Nonindicating fuses should be supervised by parallel indicating fuses. Fuse or breaker operation should trigger an alarm.

Questionnaires

Once an engineer has decided to buy your product, it should be easy to do so. Ordering questionnaires should be provided by the vendor.

The questionnaire should contain enough information to make the engineer consider all the standard features and available options. This will help to avoid the problems which arise when an option is found to be necessary late in the manufacturing interval.

Turnkey Systems

Many telecommunications firms prefer to utilize the services of UPS vendors who have turnkey capabilities. This gives the engineer better control of the cost, and scheduling, and coordination of the job.

Retrofits

Data process applications for UPS usually require five to fifteen minutes of protection. Normally this provides protection from power line disturbances and time to perform a graceful shutdown of the computer system until commercial power is restored.

Telecommunications applications for this technology differ in that much longer operation times are needed. In this application, UPS is intended to keep equipment in service. Often the engineer will specify a three hour battery to match that which is usually provided for the switching equipment. Aside from this, the system applications are quite similar.

Additionally, the cost of UPS protection is being reduced by technology and mass production. Operational Support and other systems which did not justify protected power are now candidates. There will be many applications where data centers are upgraded by the addition of UPS equipment.

For turnkey providers, this will result in the added complication of installing the UPS and a large battery in the vicinity of working computer equipment. It might be wise to consider locating the UPS remotely, such as in the Telephone equipment power room, and cabling the UPS to a power conditioner in the computer room.

This approach minimizes the physical and environmental disturbance in the computer room. Also, it affords the capability of using flooded electrolyte batteries which have twice the service life of gas recombinant cells.

Consider using a delta input / delta output UPS to feed a delta/gye configured power conditioner for increased transient noise reduction and lowered cable cost. For many retrofit applications, the power conditioner is already in place, and it will be a matter of refeeding it from the output of an UPS.

Current Limiting

Most central offices have standby power plants. These are usually a diesel or a gas turbine and utilize a transfer witch. Any UPS considered for central office use should have a current limiter which operates from dry contacts in the standby plant or transfer switch. The circuit should limit the output of the UPS rectifiers so the batteries are not recharged until commercial power has been restored, thus, protecting the standby plant from overload.

Documentation

Switching Equipment Technicians are trained in a wide variety of telecommunications equipment. Thus, their experience in power systems is limited in proportion to switching and transmission. Detailed system documentation is essential to them as a maintenance and troubleshooting aid. Schematics, circuit descriptions, and flowcharts should be shipped with the UPS and should use standard symbols.

Documentation is a sensitive issue when proprietary new designs must be safeguarded. The documentation should be detailed enough that a technician can isolate trouble to the correct circuit board or modular subassembly. Inductors and transformers should show tap-to-tap values, and there should be legend information to determine the physical orientation of the leads on field-testable parts such as diodes and SCRs which might have an unusual case design.

Microfilm

Most telecommunications engineering centers have converted their files to microfiche and/or aperture cards. Equipment and job drawings prepared for this medium are much more welcome than on paper.

Conclusion

The Telephone Engineer has considered UPS a niche technology for many years. The early electromechanical switching machines of the forties and fifties used motor/alternators to provide battery driven AC power for critical equipment. Today's sophisticated power conversion systems are simply another means to reliable telecommunications service. Expect that we will be a major UPS customer, and that we may surpass our brothers in data process in terms of equipment orders.