AC Power

1. General

1.1 This addendum is issued to change and/or supplement the information contained in Bellcore Practice BR 790-100-660, AC Power for Telecommunications Equipment.

1.2 The architecture and service criteria for providing DC power for telecommunications equipment is well-defined. DC power plants are fed with commercial AC, and backed up with batteries. Most central offices are provided with a standby AC plant, thus affording a redundant and virtually uninterruptible power arrangement.

1.3 AC powered equipment is not normally provided battery backup. If the AC loads are considered essential, meaning these loads must operate during a prolonged commercial power outage, they are connected to the standby AC system. Essential loads are not usually uninterruptible loads. (Note: essential AC is sometimes called preferred power). In the event of a commercial power failure, typical interruption times range from 10 to 90 seconds for automatic start and transfer, and up to 15 minutes or more for a manual start and transfer system.

2. Loads Protected by Inverters or UPS

2.1 If an AC load is deemed “uninterruptible”, it must be fed from an inverter plant or Uninterruptible Power System (UPS).

2.2 AC loads to be protected by an inverter or UPS are:

A. Network elements, defined as components of switching or transport equipment designed primarily to provide or perform services in the telecommunications network.
B. Control equipment, terminals, and data sets used for maintaining or administering network elements, where customer service is threatened by even a momentary loss.
C. Multi-user computers and computer support equipment that must remain in service for the short time frame it takes for the standby AC system to come on line.
D. Life safety equipment (i.e. fire safety and audio alerting equipment).
E. Building automation and security systems (i.e. card key system).

2.3 Administrative terminals or personal computers are not normally provided protected power by an inverter or UPS.

2.4 A group with a need for protected AC power, other than as stated in 2.2 above, must define the service requirements for AC power and provide project funding.

3. Inverters vs. UPS

3.1 A DC power plant equipped with inverters for powering a limited AC load provides the optimum service arrangement, since all loads are driven from a common battery plant with a nominal 4 or more hours of battery reserve. This arrangement is neither economical nor practical with larger AC loads.

3.2 An inverter will be provided for small AC powered network elements if a DC battery plant is available and the load is not expected to exceed 10 KVA.

3.3 For loads exceeding 10 KVA, inverters will only be provided when there is a user-defined need for extended (3+ hours) battery reserve, where approved project funding includes these power costs, and the DC plant can be economically grown to accommodate the need.

3.4 Unless the specific conditions above for inverters are met, UPS will be provided to meet the protected AC requirements.

4. Engineering Responsibility

4.1 At all central office building locations, the Central Office equipment engineer (power equipment engineer), has primary responsibility for engineering inverters and hard-wired UPS systems. This requires close coordination with Real Estate Management, although the equipment engineer assumes the role of project manager. This practice is followed even if the requirement is associated with a system in administrative space. With the advance approval of the impacted department, the equipment engineer may charge to non-C.O. account codes. At all other sites, such as administrative buildings or data centers, Real Estate Management has the engineering responsibility. At these sites, UPS is invariably the only practical option. Consultation with a power equipment engineer is encouraged, especially with respect to battery selection and alarming.

5. UPS Battery Reserve Time

5.1 A UPS is used to assure service from the time commercial AC fails until the standby AC system is on line, or to allow orderly shutdown of a system.

5.2 UPS battery reserve is provided to cover the time required to restore essential AC power. The reserve time is thus dependent upon the type of standby AC system provided.

A. With an auto-start, auto-transfer standby AC system, a nominal 8 to 20 minutes of battery reserve is provided as necessary to assure the standby engine is operating and the load has transferred.
B. With a manual start and transfer standby AC system, local conditions (manned or unmanned site, dispatch time, etc.) must be considered when sizing the

battery reserve. It is still expected that battery reserve will be much less than the reserve provided for the DC power plant.

C. If there is no stationary standby AC system at a location, UPS is provided for power conditioning only, with minimum reserve time.

5.3 If another level of service is required, the planner or user group shall provide the reserve time requirement and assure a non-baseline funding source.

5.4 The typical UPS system is rated in terms of AC output in kilovolt amperes (KVA) at a specific power factor (i.e. 40 KVA at 0.8 power factor). The UPS battery load is provided in terms of kilowatts (KW). The battery must be capable of supplying the inverter output kilowatts plus the inverter losses. If the UPS described above had a DC to AC conversion efficiency of 93%, the battery load is calculated as:

$$\frac{\text{40 KVA x 0.8 power factor}}{\text{0.93 efficiency}} = \text{34.4 KW}$$

5.5 UPS battery discharge tables are provided by each manufacturer, and are based on watts per cell, minimum volts per cell (MVPC), and discharge time in minutes. Unless otherwise specified by the UPS manufacturer, MVPC for UPS applications is 1.67.

5.6 The UPS manufacturer may specify the number of cells required per system, and this requirement is followed when providing cabinetized batteries. When rack-mounted strings are provided, the engineer may size the battery string(s) by first determining the optimum number of cells, then dividing the battery load by the number of cells to determine watts per cell. When doing this it is necessary to know the operating voltage window of the UPS inverter, and the recommended equalization voltage per cell (from battery data sheet).

$$\text{Max. No. Cells} = \frac{\text{Max. Rectifier Output Voltage}}{\text{Equalization Volts per Cell}}$$

$$\text{Min. No. Cells} = \frac{\text{Inverter Minimum Operating Voltage}}{\text{Minimum Volts Per Cell}}$$

5.7 Parallel operation of batteries may be considered. However, batteries should all be of the same part number and each string should be connected to an individual disconnect.

6. Battery Arrangements for UPS

6.1 UPS manufacturers typically provide valve regulated lead acid (VRLA) batteries, contained in battery cabinets. Although suitable in a computer room environment, this arrangement has major drawbacks:

A. VRLA batteries for UPS, mounted in cabinets, have a life expectancy of 3 - 5 years. By comparison, the flooded lead acid batteries for telecom applications offer life expectancies of 20 or more years.
B. Batteries tightly packed in cabinets may be subjected to elevated temperatures, a major factor in premature aging of batteries.
C. Batteries are difficult to inspect, test and clean when mounted in cabinets.

6.2 The preferred arrangement for UPS batteries is to have flooded cells mounted on racks in a power room, maintained by a C. O. Technician. However, this may not be a practical alternative for a specific application. Flooded cells having discharge rates suitable for UPS may have an ordering interval too long to accommodate the immediate need, and have a first cost considerably more than VRLA.

6.3 If flooded cells are not practical, the next best alternative is to provide rack-mounted VRLA batteries. Not only are the rack-mounted batteries easier to inspect and maintain, but longer battery life will be obtained compared with cabinetized products. The equipment engineer should select batteries for UPS applications from the current approved products list or consult with the technical staff.

6.4 VRLA batteries in cabinets are appropriate where the following conditions prevail:

A. The batteries are located in other than C.O. space.
B. The expected application life is three years or less.
C. The UPS is 50 KVA or smaller, with a short reserve time.

6.5 The engineer will consider local circumstances in selecting the battery arrangement, with an objective of providing the most reliable arrangement. For example, suitable C.O. space may be available for flooded cells, even though the space is outside the power room.

6.6 Cabinetized batteries need to be replaced every 3 to 4 years. Rack mounted VRLA batteries shall be replaced at 75 per cent of design life (as indicated by the manufacturer) unless test data is provided that indicates either reduced life, or extended life. The engineer should use the replacement opportunity to upgrade from cabinetized batteries to rack - mounted, or from VRLA to flooded cells, taking into account the expected remaining life of the application (a UPS is typically engineered by the manufacturer for a 15 year design life).

6.7 Replacement batteries shall be selected from the list of approved products, and are normally ordered directly from an approved supplier or distributor. Purchasing replacement batteries from a UPS supplier will likely be more costly. Contact technical staff if in doubt of which approved battery replaces an existing battery.

7. Alarm Standards

7.1 Alarm standards for inverters and UPS are included in the company alarm standards document.

8. Records

8.1 UPS installed in Central Office buildings shall be completely reflected on Central Office "T-Base" drawings (e.g. floor plan, grounding schematic, AC data chart, lighting plan, wiring list and block diagram, front equipment, distribution assignment record, alarm assignment, distributing frame, etc.) and also on Building Electrical Data (BED) sheets.

9. NEBS

9.1 UPS have not been designed to comply with Network Equipment - Building Standards such as Bellcore GR-63 or PBS-003-103.

9.2 Approved UPS products have been designed and tested to comply with U.L. 1778. These requirements cover uninterruptible power supplies rated 600 volts or less ac or dc that are intended for installation in accordance with the National Electric Code, NFPA 70.

9.3 Approved UPS may be installed in central office space without the need for compartmentation. UPS equipment areas should be designed with the same environmental considerations as other equipment locations containing batteries. Sufficient air-handling and /or cooling must be provided to maintain an ambient temperature well below 104°F, the maximum operating temperature of UPS. Consult with Real Estate Management in advance of determining floor space placement to assure cooling and ventilation is adequate.

10. Maintenance and Maintenance Agreements

10.1 The purchase of an approved hard-wired UPS includes a warranty and service agreement. The purchase of a spare parts kit is not necessary to satisfy the warranty/service agreement. However, the engineer must weigh local circumstances that may make purchase of a spare parts kit a prudent investment.

10.2 Extensions or renewals of the service agreement will be the responsibility of the "user" and charged to that department's expense budget. If the system is charged to a central office account the "user" is network operations.

10.3 With the limited number of UPS in place "self-maintenance" is not a practical alternative in most locations, due to the cost and time of developing and maintaining technical expertise.