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COMMON SYSTEMS: AC Power

This revised practice provides the SBC Power Engineer with general guidelines and responsibilities for provisioning AC Power Distribution Service Cabinets; Inverter Systems; demarcation between building and telecommunications network support AC loads; load protection classifications; and UPS considerations.

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1. Introduction

This practice provides the SBC Power Engineer with general guidelines and responsibilities for provisioning AC Power Distribution Service Cabinets; Inverter Systems; demarcation between building and telecommunications network support AC loads; load protection classifications; and UPS considerations.

2. Reason For Current Issue

This addendum is issued to change, delete and supplement specific information contained in BR 790-100-660. This is a merged practice (MP), and provides standards for SBC Companies.

3. Methods & Procedures

3.1. General

3.1.1 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 (COs) are also provided with a Standby AC Power Plant, which provides Standby AC Power in the event of a Commercial AC Power outage, thus affording a redundant and virtually uninterruptible power arrangement.

3.1.2 All DC Power Plants are served by commercial AC through the building house service board via a dedicated Power Distribution Service Cabinet (PDSC). The hand off between CRE & NPE from building power to AC telecommunications power shall reside at the circuit protection device in the PDSC, or if provided, at the junction box between the house service panel (HSP) and the PDSC. This PDSC is used to exclusively support the DC Telecommunications Power System.

3.1.3 Regarding AC Panel accessibility, per the National Electric Code (NEC), all newly placed AC panels and serving equipment with AC input voltages of 150V AC or greater shall maintain a minimum working clearance of 48 inches. This does not include rear or side panels that are non-opening.

3.2. Load Protection Classifications

3.2.1 Essential load:

Loads that must operate during prolonged loss of commercial power and must be connected to the standby AC Engine/Alternator system. It must be able to tolerate an interruption on the order of 5 seconds or more. Typical interruption times range from 10 to 90 seconds, for automatic standby Engine/Alternator systems, and extend to 15 minutes or more, for manual systems.

3.2.2 Protected load:

Loads that must operate during prolonged loss of commercial power and may not be able to tolerate interruption. Interruption times may range from zero to approximately 5 seconds depending on the criticality of the load. For DC fed equipment, the battery plant provides this power; and for AC equipment, a DC fed inverter shall provide the power. The allowable interruption time for protected power equipment should be chosen to match the requirement of the load.

3.2.3 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. Network supporting 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. Power transfer automation systems memory and security access systems (i.e. card key system) specifically related to network safety, security and reliability.

3.2.4 AC Maintenance By-Pass from commercial AC to Inverter/UPS output PDSC may be provided to allow maintenance or removal of the protected AC elements on 10kVA systems or larger.

3.2.5 Inverter fed AC PDSC’s shall be designated with name, number, voltage and type of service. (e.g. PWR DISTG SERVICE CAB 001 208V AC 60 Hz 3 PH 4W.

3.2.6 Dedicated Telecommunications AC PDSC’s shall include a labeled restriction on the cabinet of service assignment exclusive to the direction of the local power equipment engineer (e.g. CONTACT SBC POWER ENGINEER FOR ALL AC CIRCUIT ASSIGNMENTS IN THIS PANEL). This shall include inverter fed PDSC’s as well.

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

3.2.8 Any organization or group, which is not included in 3.2.3 above and which requires Protected AC Power, must define their Protected AC Power service requirements and provide all required project funding.

3.3. Inverters vs. UPS

3.3.1 For small Protected AC Power loads, which are not expected to exceed 21 kVA, a dedicated Inverter or an Inverter Plant, which is fed from a DC Power Plant, is the optimum service arrangement. Within a DC Power Plant system, during a Commercial AC Power failure, all loads are driven from a common battery system, which has a minimum battery reserve interval of 4 hours. However, this arrangement is neither economical nor practical for larger Protected AC Power loads.

3.3.2 For Protected AC Power loads exceeding 21 kVA, dedicated Inverters or Inverter Plants will be provided only when there is a user-defined need for extended (3+ hours) battery reserve, where approved project funding includes these power costs, and the DC Power Plant can be economically grown to accommodate the need. Protected AC Power load requirements with values greater than 21 kVA may be investigated to determine if the equipment served can be designed with -48v DC input in lieu of AC input. Additionally, the use of Inverters with larger capacity may require an economic study to justify the capital expense.

3.3.3 UPS systems are designed for very short interval support (up to 15 minutes, defined by the user). This uninterrupted power supply provides a graceful shutdown of the serving equipment, and nothing more. UPS systems have a usable design/service life of approximately 15 years. Where technically feasible, the use of UPS systems should be avoided as these devices have inherent risks related to failures, maintenance and life expectancies. The DC power network found in SBC Central Office applications provide the highest degree of reliability available.

3.3.4 A Commercial AC Power Maintenance Bypass circuit may be provided to allow maintenance or removal of the Protected AC Power source elements.

3.4. Engineering Responsibility

3.4.1 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 supporting Network Elements. This requires close coordination with CRE; although. the equipment engineer assumes the role of project manager. This practice is followed even if the network equipment load is associated with a system in administrative space in a CO. With the advance approval of the impacted department, the equipment engineer may charge to non-C.O. Field Reporting Codes (FRC's). At all other sites, such as administrative buildings or data centers, CRE has the engineering and project management responsibility.

3.4.2 At all Customer Premise (CP) locations, standby AC power supply systems such as Uninterruptible Power Supplies (UPS), Inverters, or stand-by engine alternators or generators (whether permanent, hard-wired, or portable), are not considered part of the communications network and shall not be provided by any group or department within SBC's Local Exchange Carriers. Suggestions or recommendations for AC systems or manufacturers, intended for CP use, shall not be provided by any SBC employee. These Primary and Back-up AC power supply systems at CP locations are considered customer provided options. Customer provided AC systems or supplies can be used as the AC source for SBC provided DC or AC powered network equipment, however the customer shall provide the termination point for the connection of SBC provided equipment.

3.5. UPS Battery Reserve Time

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

3. 5.1.1 The SBC client requesting the UPS system will define the amount of battery reserve required.

3.5.2 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:

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

3.5.3 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 for flooded lead acid and 1.75 for VRLA battery technology.

3.5.4 The UPS manufacturer may specify the number of cells required per system, and this requirement is followed when providing cabinet-mounted 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).

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

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

3.5.5 Parallel operation of batteries may be considered. However, batteries shall all be of the same manufacturer and model/part number and each string shall be connected to an individual disconnect.

3.6. Battery Arrangements for UPS

3.6.1 UPS manufacturers typically provide valve regulated lead acid (VRLA) batteries, contained in battery cabinets; however, this arrangement includes 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, which are mounted in cabinets, are difficult to inspect, test and clean.

3.6.2 The preferred arrangement for UPS batteries is to have flooded cells mounted on racks in a power room, and that may be 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.

3.6.3 If flooded cells are not practical, the next alternative is to provide rack-mounted VRLA batteries. Rack-mounted batteries are easier to inspect, maintain and provide longer battery life when compared to cabinet-mounted products. The equipment engineer should select batteries for UPS applications from the current approved products list or consult with the technical staff.

3.6.4 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.

3.6.5 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.

3.6.6 Cabinet-mounted VRLA batteries need to be replaced every 3 to 4 years. Rack mounted VRLA batteries shall be replaced at 80% 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 cabinet-mounted 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).

3.6.7 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.

3.7. Alarm Standards

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

3.8. Records

3.8.1 UPS Systems installed in Central Office buildings shall be completely reflected in the site specific PowerPro® database.

3.9. Compliance & Certification

3.9.1 UPS Systems shall be review evaluated based on SBC TP76200 and accepted on site using TP76900MP.

3.9.2 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.

3.9.3 Approved UPS Systems may be installed in central office space without the need for compartmentalization, unless there are regulated space conditioning restriction, e.g., Affiliates, CLEC's, etc. 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 as defined in TP76400 Section 6. Consult with CRE in advance of determining floor space placement to assure cooling, ventilation and floor loading is adequate.

3.10. Maintenance and Maintenance Agreements

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

3.10.2 Extensions or renewals of the maintenance 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. In the planning phase and equipment turn over to the end user, the power equipment engineer shall disclose all necessary maintenance, service, and battery replacements that will occur and be the responsibility of the user. Local SBC practice may include some limited support from the SBC Central Office technician. The definition of this support shall also be identified during the equipment turnover. This will insure the end user retains the service expectation of the equipment purchase.

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

4. Related Documents

SBC-790-100-651 – Introduction to DC Power Systems Engineering

SBC-790-100-652 – Planning & Structure DC Power Plants, AC & DC Generation Sets

SBC-790-100-654 – DC Power Plants

SBC - CO Power Standard Drawings on WoodDuck (SBC-P-05000 Series)

5. Acknowledgements

N/A

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7. Revision Log

N/A

Acronyms

A.1. Document Specific Acronyms

N/A

A.2. Network Acronyms Dictionary

Refer to ATT-000-000-020, Network Acronyms Dictionary.