ATT-TELCO-IS-790-100-654

COMMON SYSTEMS: DC POWER PLANTS

This revised practice provides the SBC Power Engineer with general guidelines for -48V DC Power Plants including: initial sizing; growth; layout; shunts; microprocessor controllers; monitoring points, alarms, and polling; as well as associated Converter Plants; Ringing Plants, and Inverters.

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Points Of Contact:	See Contact List .

Author(s):
Author's name: Bob Burditt - CS Power Team, Phone Number (214) 320-7937 **ATTUID** :rb2883

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1. INTRODUCTION

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2. REASON FOR CURRENT ISSUE

This addendum is issued to change and/or supplement the information contained in BR 790-100-654, DC Plants. This is a merged practice (MP), and provides standards for SBC.

2.1 SBC has created an extensive network of power distribution within the Central Office environment. To take full advantage of this power architecture and the reliability associated with it, network based telecommunication needs, new and future, shall be deployed using –48 vDC as the source of power. However, legacy voltages, such as, +/- 130 vDC and +/- 24 vDC shall continue to be supported until those equipment requirements expire

2.2. Where applicable, the SBC power equipment engineer shall work with transport, data and switching engineers to reduce and remove these secondary voltage requirements from central office applications.

3. ENGINEERING GUIDELINES FOR -48 VOLT RECTIFIED POWER PLANTS

3.1. INITIAL AND ULTIMATE PLANT SIZING

The SBC power equipment engineer shall use the following information to determine the sizing of new DC Power Plants as well as to provide appropriate power plant augmentations.

3.1.1 Make a list of all the equipment loads to be served by the Power Plant being engineered (i.e. converter plants, switching systems, transmission systems, data systems, inverters, DC fans, and etc.).

3.1.2 Determine the normal and emergency DC voltage limits of the equipment. The design criterion of the DC power is based on a normal operating voltage of approximately -50v to -56v DC, with nominal rating of -48v and low voltages of -42.62v DC measured at the termination point of the network element.[1]

NOTE:
[1]TP76450 Common Systems Standards par. 4.1.1 SBC DC Architecture

3.1.3 Determine the List 1 current drains of all equipment to be served. In central office applications that may be up to 10 years. In RT power applications, that shall be the ultimate size of the power plant.

3.1.4 The requirements for power plant capacity are based upon the busy hour load (BHL), power fail load (PFL) and whether it is a new installation or an existing power plant augmentation.

INITIAL POWER PLANT INSTALLATIONS

- Rectifiers: For the initial installation of a power plant the load used to size rectifier capacity shall be the BHL plus 2 years expected growth. The rectifier plant shall be sized so that the calculated load does not exceed 60% of the rectifier capacity without the maintenance spare

- Batteries: The PFL, as defined in SBC 790-100-652 shall be used to determine battery reserve capacity. The required reserve hours for a particular situation is outlined in SBC 790-100-655.

- New Power Plant Installations: All new power plant installations shall include exclusive fused (A and B) distribution equipment (i.e. intermediate PDU's, micro/mini BDFB, BDFB or remote distribution bay) for secondary loads serving network elements. This fused distribution equipment shall not remain in the traditional power plant footprint. For the purposes of fuse assignment record keeping, the first form of distribution from the power board shall be considered a BDFB including appropriate records in TAB/db. This shall serve to formally segregate primary and secondary demands. These BDFBs will be equipped with load monitoring at the BDFB or Power Board.

- Primary Distribution: Modern designed DC power plants include distribution panels with limited choices of available fuse panels (usually 1-150 and 150-600). New power plants should be purchased and equipped at the time of installation with a full complement of distribution panels (no-blank panels). The type and arrangement may be dependant on the chosen power plant and the specific application. Previous cost studies and installation concerns have supported this method of fully equipping distribution bays going forward. Primary Distribution Panels equipped with 150 amp positions or larger, shall include shunt monitoring devices per position.

EXISTING POWER PLANT AUGMENTATIONS

- Incremental Growth: Modifying or adding power equipment shall be performed in the most efficient method basedon the growth pattern of the specific central office. Providing 2 years of planned growth shall be estimated based on the following:

    - PowerPro DC drain information for the previous 5 years

    - Take the average of 5 years of growth, project it forward for the next two years forward in a liner projection. Take that 2 years of projected growth and round up to the next rectifier value. If adequate data does not exist to support this method, the planning data found inthe WCFF can be utilized.

- Rectifiers: As a general guideline, the rectifier plant shall be sized so that the BHL shall not exceed 80% of the rectifier capacity without the maintenance spare, and in COs, also provide 140% capacity with the maintenance spare to meet the required recharge factor. Where it makes economic sense, the Power COE may allow low growth offices to exceed the 80 percentile due to the lack of appreciable growth. However, at no time shall the power plant be in jeopardy of not providing maintenance spare capacity.

- Batteries:The battery reserve time shall be sized to meet the PFL for the required number of hours for that office, as outlined in SBC 790-100-655.

3.1.5 When available, a bus bar plant shall be used if the ultimate sizing of the plant is 4000 amps or greater.

3.2. LAYOUT AND BUILDING REQUIREMENTS

The SBC power equipment engineer shall determine the layout of the ultimate power plant and capacity. The CSPEC floor space planner shall assign the actual location. Due to heat and input voltages, the current generation power equipment has dictated the need to allow for additional aisle space in both the front and rear equipment aisles.

Equipment	Front Aisle	Rear Aisle
DC Power Plants	4’	4’
AC PDSC’s	4’	4’

3.2.1 The SBC power equipment engineer shall request the necessary reserved floor space required for the ultimate growth layout of the power plant from the CSPEC planner. The requirements for forecasting depend on the region. The SBC power equipment engineer shall work with CSPEC planner to determine the optimal location for the power plant.

3.2.2 The SBC power equipment engineer shall request all necessary building studies from Corporate Real Estate Management (CRE). These building studies may be necessary to ensure proper floor loading, minimum number of air exchanges per hour, proper disposal of asbestos or heat dissipation evaluation, as well as others.

3.2.3 The SBC power equipment engineer shall be responsible for adherence to all local, state and federal codes that apply to that office. The SBC power equipment engineer shall verify and meet all necessary requirements for acid spill containment, hazardous material management, and fire codes (including obtaining hazardous material permits when or where required prior to placement of batteries). The current approved method for this process can be found on http://mechteam.sbc.com:8080/docs/Flashes/Flashbatt-spill-permit03.doc This effort should be coordinated through CRE & Environmental Management (EM). EM may be reached at 866-I WANT EM.

3.3. POWER PLANT COMPONENT REQUIREMENTS

General power plant configurations shall utilize equipment-featuring designs with shunt monitors on the supply side in lieu of the return side found mostly in a traditional centralized architecture. Shunts on the ground side have been proven to be inaccurate in reporting plant current, new and future plants featuring supply side shunt designs will alleviate this condition. Some new Distributed Power Plants do not include traditional plant shunts at all, and would not be applicable to this condition.

3.3.1. Rectifier Plant Requirements

3.3.1.1 The SBC power equipment engineer shall use the connected-equipment List 1 BHL to calculate the base number ‘N’ of required rectifiers.

3.3.1.2 The SBC power equipment engineer shall provide a minimum of N+1 rectifiers. ‘N’ representing the minimum number of rectifiers necessary to carry the load and the additional +1 rectifier being the maintenance spare. Regardless of the recharge factor, all plants shall have a minimum N+1. The maintenance spare is a working rectifier intended to insure that the failure of any one rectifier will not cause batteries to go on discharge. The maintenance spare shall be the largest size rectifier deployed within that plant.

3.3.1.3 For Central Office applications, the SBC power equipment engineer shall calculate the rectifier requirement based upon a 1.4 recharge factor. The maintenance (N+1) spare shall be included in the 40% additional charging capacity. The factor of 1.4 will ensure that the batteries will be capable of recharge within a 24-hour period to a minimum of 95% to protect against a subsequent power outage. For RT applications, rectifier sizing is purely based on N+1.

3.3.1.4 When the valve regulated lead acid (VRLA) type battery cells are used, **NO** recharge factor will be used at any time. Excess charge capacity is a significant contributor to the risk and severity of thermal runaway.

3.3.1.5 The SBC power equipment engineer shall engineer the power plant in a manner that no single rectifier is greater than 2/3 of the discharge load as measured at float voltage.

3.3.1.6 The SBC power equipment engineer shall provision all new power plants with rectifiers of the same capacity, and manufacturer. Additionally, augments to existing plants shall also maintain the same integrity as the Ferroresonant rectifier technology evolution approaches the end of a generation, integration and cross-pollination of mixing Ferro and switch mode (SM) is inevitable. This is acceptable within the same manufacturer product family.

3.3.1.7 The SBC power equipment engineer shall provision all new power plants with controllers and rectifiers of the same manufacturer. When adding controllers to existing plants, the manufacturer of the present rectifiers shall determine the manufacturer of the controller.

3.3.1.8 Low Voltage Disconnects **SHALL NOT** be deployed to any SBC power plant.

3.3.2. Microprocessor Controllers

All newly deployed power plants shall be provided with intelligence based microprocessor technology that, as a minimum, meets Telcordia TR-EOP-000221[2] and TA-NWT-000370[3] .These devices serve as the gateway to office power plants systems to monitor plant load(s), status, statistical data and alarms. Additionally, growth to existing DC power plants shall trigger an upgrade to the power plant to add a microprocessor controller technology where one has not previously existed. If the existing power plant currently supports a microprocessor, but is unable to be upgraded to Ethernet connectivity, an upgrade of this equipment shall be considered as well (assuming the office can accommodate the Ethernet connection

NOTE:
[2]Issue 2, November 1993 - Interface and functional Requirements for Microprocessor Control of -24, -48, -130, and -140 Volt Central Office Power Plants

NOTE:
[3]Issue 2, November 1993 – Generic Requirements for Mechanized Power Room Operations Monitor (MPROM) with Remote Monitoring Capability

3.3.2.1 On a going forward basis, new installations of microprocessors shall be equipped with Ethernet connectivity. All efforts should be made to establish this electronic connectivity (Net DCN) through an IP address in lieu of a dial up connection. However, it is recognized that the associated network equipment may not exist in all Central Office locations. In those instances, a dial up connection is still considered appropriate.

3.3.2.2 Listed below are the minimum required SBC monitor points for all newly installed Intelligent Power Plants. Each monitor point needs to be discreet which means individual stand-alone. Monitoring points will be dictated by site conditions and needs.

- **Power Plant: Voltage** and **Load**, Micro processor fail, Major, Minor, Distribution Fuse Alarm, over current, Rectifier Fail 1, Rectifier Fail 2, High Voltage, Very High Voltage, Low Voltage, Very Low Voltage or Battery on Discharge Alarm
- **Rectifier Current** for all rectifiers in the plant.
- **Rectifier Fail Alarms**
- **Converter plants** (+130, -130, +24):Plant **Voltage** and **Load**, Converter Fail 1, Converter Fail 2, Fuse Fail, Over Current Alarm
- **Ringing Plant:** Major, ring transfer, and Distribution Fuse Alarms
- **Power Load** at PBD or BDFB shunt, Distribution Fuse Alarm.

- **Inverters 20KVA and larger:** (inv=Inverter)Inv Transferred, Inv Bypass Not Avail, Inv Fail, Inv Output Fail, Inv Fuse, Inv Output Current and Volts
- **Inverters less than 20KVA:** Inv Fail, Inv Transfer, Inv Output Current and Volts
- **UPS Systems:** High Temp, UPS On Batt, UPS On Bypass, UPS Low Batt, Fan Fail, UPS Bypass not Avail, UPS Output Current and Volts
- **Commercial AC Voltage:**

  Ø A-B

  Ø B-C

  Ø C-A
- **Essential AC Voltage:**

  Ø A-B

  Ø B-C

  Ø C-A
- **Essential AC Current:**

  Ø A

  Ø B

  Ø C
- **Essential AC Kilowatts**
- **Essential AC Frequency**
- **Transfer switch:**

  Commercial or Normal Source Failure

  Transfer Signal

  Proper Operation Alarm
- **Standby Engine:**

  Coolant Temperature

  Oil Pressure

  Fuel Pressure

Start Battery Voltage

- **Standby Engine Alarms:**

  Commercial A/C Power Fail

  Engine running

  Engine Fail

  Heater Fail

  Running

  Start battery rectifier fail

  Switch Off Normal

  Low Fuel

  High Coolant Temp

  Over Speed

  Air Damper

  Oil Pressure

  Coolant Level Alarm

  Intake & Exhaust Louvers

3.3.3. Converter Plants

3.3.3.1 Converter Plants were traditionally used to support +/- 130, +/-24, +48. These existing equipment requirements should be encouraged to migrate to –48 VDC, further reducing the need for any converter requirements. Where required, a converter plant shall be used for non-standard voltage needs with total loads of 100A and under.

3.3.3.2 The SBC power equipment engineer shall size converter plants based upon the connected equipment's peak current drains. Converter plants do not have short term overload capability. Converter plants can not perform under any over current situation, therefore plant capacity must be provided for possible short-term peaks.

Converter plants shall be sized in the following manner:

- List all of the equipment that will draw power from the converter plant.
- Determine normal and emergency DC voltage limits of the equipment.
- Determine and total peak current drains.
- Determine maximum growth for the estimation period.
- Determine initial and ultimate plant necessary capacity.
- Determine initial and ultimate plant layout

3.3.3.3 The SBC power equipment engineer shall provision N + 1 converters for the plant. 'N' being the minimum number of converters necessary to hold the load, and an additional +1 converter as maintenance spare.

3.3.3.4 The SBC power equipment engineer shall size the converter plant with the connected load being no more than 80% of 'N' converters.

3.3.3.5 When a converter plant is installed to replace an existing battery plant, the SBC power equipment engineer shall insure that all discharge fuses are appropriately sized. Unlike battery plants, converter plants have limited output energy available for clearing short-circuit faults. If the load fuses and/or circuit breakers are of too large amperage (individually or cumulatively) with respect to the total available plant output capacity, the plant may be unable to clear short-circuit faults. This could cause the plant to shut down due to low output voltage. No discharge fuses and/or circuit breaker larger than the installed converter capacity less one working spare will be used.

3.3.4. Ringing Plants

3.3.4.1 When placed outside of the traditional Power Plant footprint, the SBC power equipment engineer shall feed any new ringing plants with secondary feeds. It is recommended that the plant be located with the equipment line up that it serves and fed by the nearest BDFB.

3.3.4.2 The ring and tone plant shall provide output fused distribution and equipment local and remote alarms.

3.3.5. Inverter Plants

3.3.5.1 The use of DC to AC inverters are not an efficient method of power delivery and adds another point of failure, however there are limited applications where inverters continue to be the appropriate method of power delivery. Inverters can be classified into two basic categories

- Stand Alone Inverter Systems: Typically configured in 5,10, 20 and 40 kVA hardwired units.
- Modular Inverter Systems: Available in both complete shelf and rack systems
  - Shelf systems typically come with 1.2 kVA modules in 7 kVA shelves
  - Rack systems (used in larger applications) provide added features not found in shelf systems and come equipped with 3.5kVA inverter modules in 7, 14 and 21 kVA systems

3.3.5.2 Inverters that supply power to protected equipment loads such as security access systems or power room emergency lighting will be isolated from the DC Power Plant with an intermediate fuse (CIPP-type) panel.

3.3.5.3 Additional Inverter information can be found in SBC 790-100-660 AC Power.

3.4. POWERPRO POWER EQUIPMENT ENGINEERING CAPACITY MANAGEMENT INVENTORY SYSTEM

3.4.1 PowerPro® is the SBC 13 STATE inventory, planning and capacity management tool for Power Engineering. The power engineer is responsible for the integrity of the power systems related data in PowerPro.

PowerPro® is a standalone application with no interfaces to any other Operational Support Systems (OSS), and is fully supported by SBC- IT.

Information and online PowerPro® training is available by accessing: http://129.245.123.16/powerpro/default.htm

PowerPro® is designed, owned and maintained by SBC NP&E. Access to PowerPro® is strictly controlled. Instructions for obtaining access to PowerPro® are contained on the web site.

User accessibility is defined into 5 categories:

1. Administrator: Full control of user tables, password resets, and program changes.
2. PowerPro® Super User: Power Engineer (in addition to items mentioned in item 3) who serves as first level of support to the local power engineer for initial problem resolution and program support.

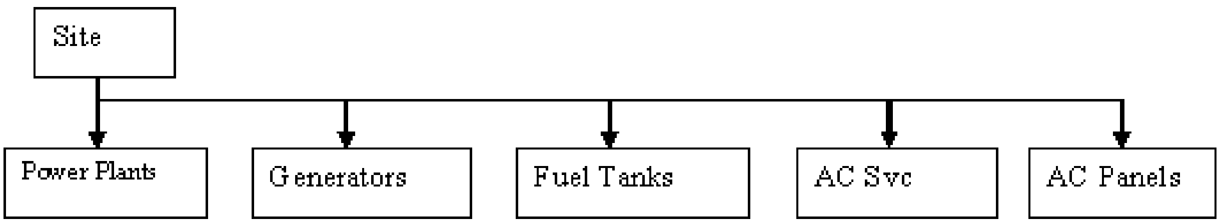
3. SBC Power Engineer: Add, delete and create records and sites. The SBC Power Engineer has sole responsibility for record integrity within the scope of their assignment.

4. 2nd Tier SBC User: View only access to regional databases. These users may be budgetary, CRE, Environmental Management, LFO and METS.

5. 2nd Tier Vendor User: View only access to corporate copy of the PowerPro® database.

PowerPro® is a structured hierarchy database. All power related data is Site specific. The following is a flow of the PowerPro® hierarchy.

Figure 1: PowerPro Hierarchy.gif



The hierarchy design ensures that the inventory of power equipment will always be related to the site or CLLIcode® of the location.

All power equipment located at a site is inventoried according to type of equipment and the hierarchy relationship:

- Engines / Generators are associated with site
- Power plants are associated with site
    - Batteries are associated with power plants
    - Converters are associated with power plants
    - Inverters are associated with power plants
    - Load readings are associated with power plants
    - Primary DC distribution is associated with power plant

3.5. ELECTRONIC POWER PLANT POLLING

3.5.1 The Polling feature through PowerPro® provides the engineer the ability to have up-to-date, on demand load readings. The engineer is able to poll the power plants individually or in a batch process.

Power Plants must be conditioned for electronic polling. This conditioning may include:

- Shunt monitors may require adjusting to insure accurate data collection. The installing equipment vendor of the shunt monitors or microprocessor addition may perform this onsite calibration.
- Adding shunt monitors to power plant loads or BDFB's
- Microprocessor may have to be reprogrammed to accept the standard loads as defined in 3.3.2.2

The Power Equipment Engineer shall be in control of the frequency of the polling commands. Additionally, the Power Equipment Engineer must condition their PC workstation to perform dial up polling:

3.5.2 Requirements for power engineering active polling:

<u>PC (desktop or laptop)</u>

- SBC approved standard desktop or laptop
- FileMaker Pro® software & PowerPro® access
- Modem & phone line
- Ethernet connection

<u>Power Plant</u>

- Microprocessor controller and/or monitoring equipment
- Modem & phone line
- Monitoring points established as per section 3.3.2
- Ethernet connection & Ethernet interface & IP address (future)

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-790-100-655 – Batteries

SBC-790-100-656 – DC Power Distribution

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

5. Acknowledgements

N/A

6. Contact List

Name	SBCUID	Phone #
Bob Burditt	rb2883	(214) 320-7937
Al Bergman	ab9165	(925) 823-4141
Wally Gaines	wg5721	(775) 333-8558
Ed Granger	eg1724	(203) 553-8180
James Jackson	jj1462	(916) 972-3496

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.