Backup Power - Generators are Not Enough

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Outline

- Power Requirements
- Power Disruption
- Solution Types
- AC Generator vs. DC Generator
- Best Practices
- Cost and Considerations
- Examples
- Q&A

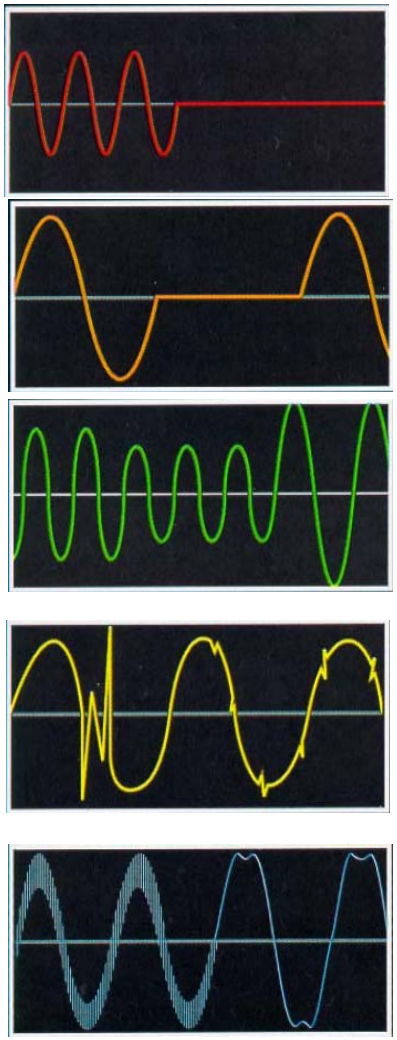
Critical Powering Requirements for Parking

- Electronics to maintain traffic flow
- Safety and security equipment
- Revenue generating devices
- Communications/ Data transfer appliances

Common Causes of Power Outages

- Storms
- High winds
- Lightning
- Ice on power lines
- Traffic accidents
- Construction work
- Digging
- Animals interfering with Hydro infrastructure

Common Power Disturbances



Temporary or Long Term Outage – planned or accidental total loss of power	Systems shut down
Momentary Interruption - very short planned or accidental power loss	Equipment is tripped off
Sag/Swell - Decrease (sag) or increase (swell) in voltage	Memory losses, data errors, equipment shut downs
Transient Notch - a sudden change in voltage up to several thousand volts (also called impulse or spike)	Processing errors, data loss, burned circuit boards
Noise or Harmonic Distortion - alteration of the pure sine wave due to non-linear loads on the power supply	Processing errors, data loss, overheating

Traditional Solutions

- **None**
  - Damaged equipment
  - Lost data
  - Systems down, customers impacted, revenues lost, safety jeopardized
- **Built-in battery backup (some systems)**
  - Taxing on batteries
  - Slow transfer times
  - Short run times; disruption still will occur
- **Generators**
  - Mechanically driven devices with rapid changes in current
  - Damaging to equipment
  - Reliability and service factor into a higher cost of ownership

Generator Systems

- **Recommended Applications**
  - Mission critical systems
  - Emergency lighting
  - Fire Alarms
- **Operation**
  - Self-starting and manual operation
  - Performance varies depending on size and cost
  - Clean burning models available
  - Must be located either outdoors or in a vented room
  - Fuel can be monitored remotely
- **Communications options**
  - Networking
  - SNMP
  - Messaging/Alerts
- **Costly, but a must-have for many facilities that require backup of more than 8 hours**

What is a UPS?

U **Un-interruptible**

P **Power**

S **Supply**

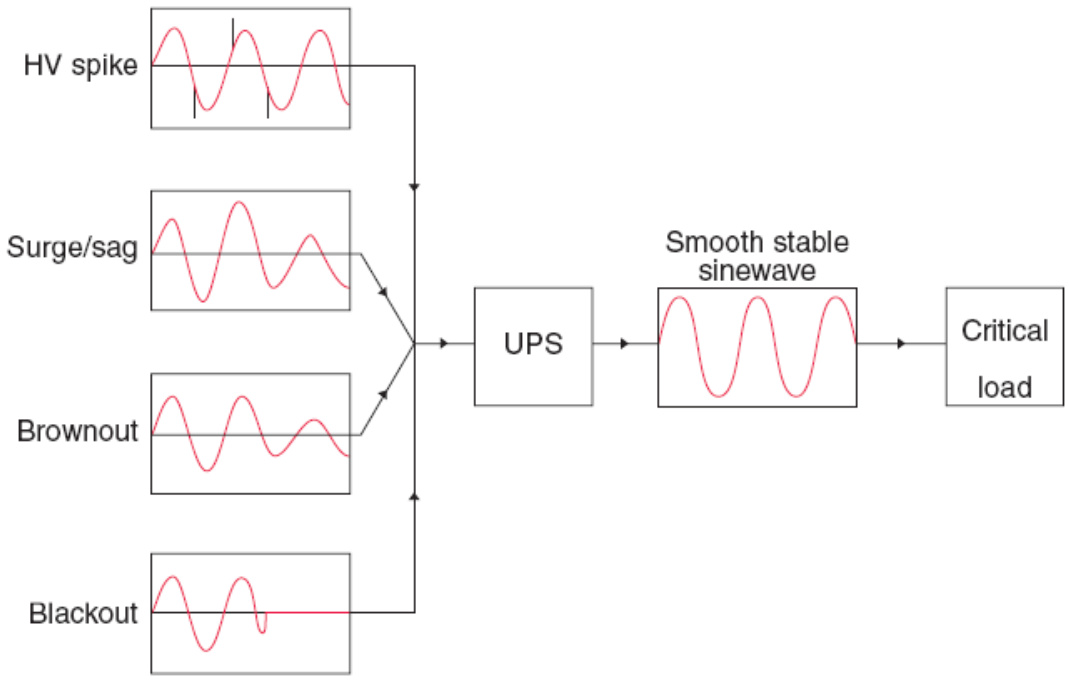
A UPS provides conditioned line power to the load and utilizes reserve battery source in the event of a power failure.

Uninterruptible Power Supplies (UPS)

- **Ensures power when most needed**
  - Cleans the power and protect electronics
  - Transient voltage surge suppression
  - Always ready
  - Fast transfer times
  - Easily deployed in almost any location
  - Broad range of run-time options
- **Provides battery management**
  - Monitors and maintains battery
  - Go to battery only when needed
  - Exercises batteries
- **Communications options**
  - Networking
  - SNMP
  - Messaging/Alerts
- Affordable and easy to maintain
- Scalable

What does the UPS do?

1. Transients (HV Spikes)
2. Interruptions
3. Sag / Undervoltage
4. Swell / Overvoltage
5. Waveform distortion
6. Voltage fluctuations
7. Frequency variations



AC Generator vs. DC Generator

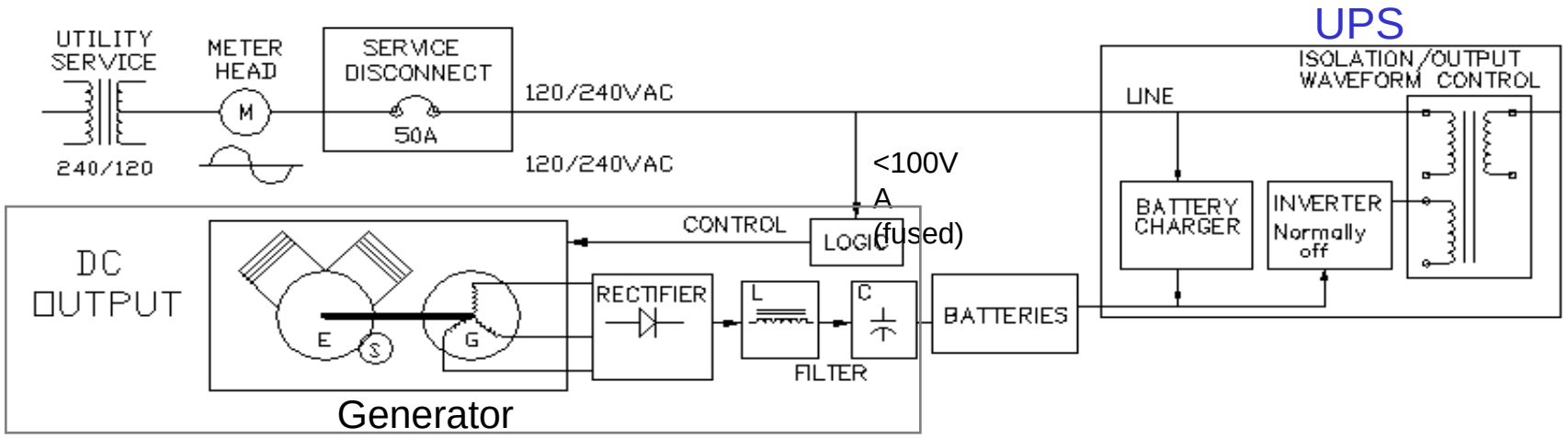
AC Generator

- Generator must be ~2 times the load. (kW)
- Frequency and output able to handle the inrush characteristics
- Larger size = Higher Noise
- Typically requires tight frequency regulation options
- Larger capacity = Larger footprint and higher fuel use
- 120 or 240VAC outputs have after market - theft potential
- 120V or 240V require electrician installation.

DC Generator

- Generator size reduced to ~1.2 times connected load
- Inrush characteristics not an issue for DC Inverter connection
- Smaller size = Lower Noise
- DC rectifier - thus frequency is not an issue
- No excess capacity = smaller physical size & better fuel efficiency
- DC rectifier negate theft value
- Electrician not required for the installation

Typical Configuration of DC Generator with UPS



- DC Generator output is connected directly to the DC bus on the UPS.
- When power fails
  - •UPS runs on inverter mode drawing power from the batteries
  - •When it reaches low battery voltage, a trigger circuit within the generator would perform the auto-start so it provides seamless transfer to the secondary source.

Batteries – Gel vs. AGM

The thermal stability of a battery system is strongly influenced by recombination, with VRLA batteries being more temperature sensitive than traditional flooded designs. The lower the heat generation and higher heat transfer rates of the gelled products make them more thermally stable than comparable AGM designs. The system designer can impact the thermal performance and ultimately the life of the system by carefully specifying the battery type, charger voltage and limits, and by maximizing the heat transfer out of the system.

In order to minimize heat input:

- ✓**Use temperature compensated charging**
- ✓**Limit maximum charger current output**
- ✓**Use Gel rather than AGM batteries**

In order to maximize heat output:

- ✓**Maximize the heat transfer surface area**
- ✓**Provide adequate cabinet ventilation**
- ✓**Use Gel rather than AGM batteries**

Battery Heater Mats

Battery performance is set at normal room ambient temperature of 25°C/77°F. In outdoor installations, as temperatures drop, the ability of batteries to perform the chemical reactions necessary to provide backup also drops. Therefore a battery installation which provides 2 hours backup at room temperatures will only provide 80% (1 hr 36 min) of that backup at 0°C/32°F. As temperatures approach –40 the chemical reaction virtually ceases and no backup could be expected.

Battery heater mats are low wattage heating pads designed to keep the core battery temperature at a level that will maintain at least 70% capacity at -30°C ambient.

Battery heater mats maintain battery backup performance in areas where lower temperatures are prevalent.

Heater Mat On at 40 F. / 5 C.

Heater Mat Off at 60 F. / 15 C.

Best Practices

1) **Combine a UPS and Generator**
   - Longest back up time can be achieved
   - UPS provides backup while the generator is on stand-by. Once low battery voltage is reached, the DC generator would automatically start with no interruption to the load
   - UPS is used to clean the power during regular power disturbances
2) **UPS only (if the generator is not an option)**
   - Reasonably long runtimes can be managed with only a UPS
   - Cleans the power and extends the life of the equipment

How Much Time is Required for Backup?

Numerous standards are in place to identify sufficient back up

(e.g. NFPA 731)

According to the Frost and Sullivan Survey:

Small to Medium-sized businesses surveyed said for ***Security and emergency systems***

- 75% want more than 1 hour
- 44% want 4+ hours

Survey concluding that there is a definite trend toward longer back-up times

Selecting the Correct UPS: Not All UPS Systems are Created Equal

- Not all UPS's can tolerate the impurity of the sine wave from a generator
- UPS may sense a problem and go into battery backup unnecessarily
- Outdoor applications require outdoor rated UPS and batteries (typically -40 to 75C operating range)

Cost for Backup Power

- **UPS**
  - Quality outdoor rated UPS with 4hr. Back-up can range between $1500-$4000 depending on the power requirements
- **Ongoing maintenance**
  - Annual battery testing
  - Minuscule cost to maintain
- **Batteries**
  - Choosing Gel-Cell batteries will prolong the life expectancy beyond 4 years in an outdoor environment. $100-$200 each.
- **Generator**
  - Must be placed outdoors
  - $5000-$200,000+ depending on power requirements
- **Ongoing maintenance**
  - Routine preventative maintenance
  - Question the reliability in older models
  - Prone to failures
- **Fuel**
  - Diesel and petroleum must be burned off on a regular basis

Backup Power Solution Examples

- **Total airport power protection:**
  - Vehicle security identification
  - Full parking lot revenue protection - backup card reader and security gate
  - Display signs
  - Kiosk back-up

Backup Power Solution Examples

- **Backup power for advanced detection solutions:**
  - Advanced Spectroscopic Portal (ASP) – nuclear detection at all ports of entry: detects materials that are potentially threatening in shipping containers as they enter port.
  - Intrusion deflection security barrier

Power Alternatives

Renewable Energy

- Turn-key renewable energy systems for remote off-grid and grid tie applications
  - System design for stand-alone and utility interconnected solar and hybrid power systems
  - Energy production and financial modeling

PV Parking structures


Hybrid Power System


Emergency Communications


On-Grid Commercial PV

Power Alternatives – Cox Communications Solar Project

Alpha Energy worked with a regional prefabricated parking structure installer and electrical contractors to build a series of turnkey Solar Shade Parking Structures for the Cox Communications headquarters in Phoenix, AZ.

This solar project is part of a broader effort to reduce Cox's power demand and energy expenses.