UPS (Uninterruptible Power Supplies)

UPS Applications

Progress Energy
Outline

- Introduction
- UPS Basics
- UPS Applications & Specifications
- Generator Sizing to Serve a UPS
- UPS Maintenance Bypass
- Conclusions
Introduction

What is a UPS

Uninterruptible Power Supplies (UPSs)

- A system designed to automatically provide power, without delay or transients, during any period when the normal power supply is incapable of performing acceptably.  
  IEEE Definition

- Provide reliable power to critical loads

- Improve reliability and power quality
UPS Basics

- Three fundamental topologies utilized for static UPSs
  - Standby power systems (off-line)
  - Line interactive (single conversion)
  - Double conversion (on-line)
UPS Basics

- Standby power systems (SPSs)
  - No power conditioning during normal operation
  - Load sees brief interruption when switching to battery backup
  - Square wave or stepped sine wave output under backup power
  - Typically small (up to 10 kVA), single-phase
Sine Wave vs Square Wave

Sine Wave

Square Wave
Standby Power Systems
(Off Line System)

Utility → Transfer Switch → Critical Load

Storage Batteries → Inverter
UPS Basics

- Line interactive UPSs
  - Power passed to the load through magnetic components (inductors, transformers)
  - Inverter interacts with magnetic components to boost or buck input voltage
  - Provides some power conditioning but frequency variations are passed to load
  - Typically 100 kVA or less, 1- or 3-phase
Line Interactive (Single Conversion)
UPS Basics

- Double conversion (on-line) UPSs
  - Input voltage not passed directly to load
  - Rectifies AC to DC (where Storage are connected) then inverts back to AC
  - Seamlessly draws power from DC storage when input voltage lost
  - Independent, conditioned output power
  - Single-phase or three-phase, ratings can exceed 1000 kVA, higher if paralleled
Double Conversion (on-line)

Utility → TVSS Conditioner → DC Voltage → Inverter & Conditioner → Critical Load

Storage Batteries Flywheel SMES
UPS Application

- **Type Load**
  - Computers
  - Controls
    - PLCs
    - Relays
  - Motors
- **Time of Back-Up**
- **Generator**
UPS Specification

- Voltage
- Load kW & kVA
- Transfer Time
- Transfer Voltage
- Waveform Output
- Type Storage & Time
- Storage Life
  - Batteries 4 to 6 years
Generators Serving UPSs

- Generators serving UPSs will need to be sized for
  - Harmonics
  - Motor starting
    - Voltage drop
    - Slew rate
If a load is important enough to require a UPS it is also important enough to require a proper maintenance bypass path

- External & Internal bypass switches on larger UPSs
- Internal bypass switches (present on most UPSs) are used for smaller UPSs
Conclusions

- UPS Basic Types
- Applications
- Specifications
- Generator Serving a UPS
- UPS Maintenance Bypass