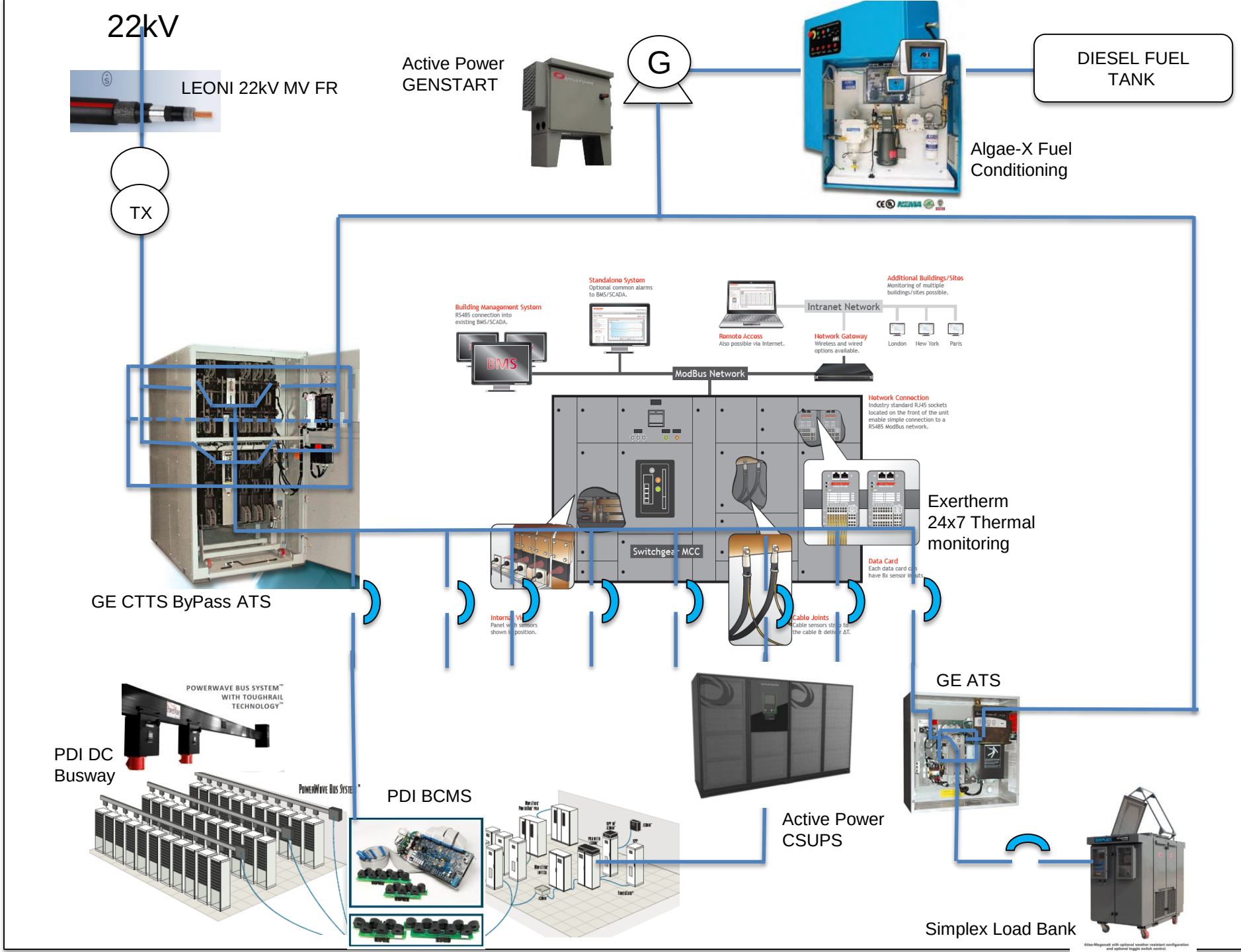


POWER TECHNOLOGIES™ Private Limited

GEORGE LIM & JASON CHIA

Driving Business Performance™


22kV
LEONI 22kV MV FR
TX
Active Power
GENSTART
G
DIESEL FUEL
TANK
Algae-X Fuel
Conditioning
Standalone System
Optional common alarms
to BMS/SCADA.
Additional Buildings/Sites
Monitoring of multiple
buildings/sites possible.
Building Management System
RS485 connection into
existing BMS/SCADA.
Intranet Network
Romoto Access
Also possible via Internet.
Network Gateway
Wireless and wired
options available.
London
New York
Paris
BMS
ModBus Network
Network Connection
Industry standard RJ45 sockets
located on the front of the unit
enable simple connection to a
RS485 ModBus network.
Exertherm
24x7 Thermal
monitoring
GE CTTS ByPass ATS
Switchgear MCC
Data Card
Each data card can
have 8x sensor inputs
Cable Joints
Cable sensors strap to
the cable & deliver AT.
GE ATS
POWERWAVE BUS SYSTEM™
WITH TOUGHRAIL
TECHNOLOGY™
PDI DC
Busway
PDI BCMS
Active Power
CSUPS
Simplex Load Bank

# A Complete System

**More than a box of parts**



CleanSource UPS



Switchboards



ATS




Regulatory & Safety



Air-Conditioning



Lighting



PH.OS Software



Smart Display



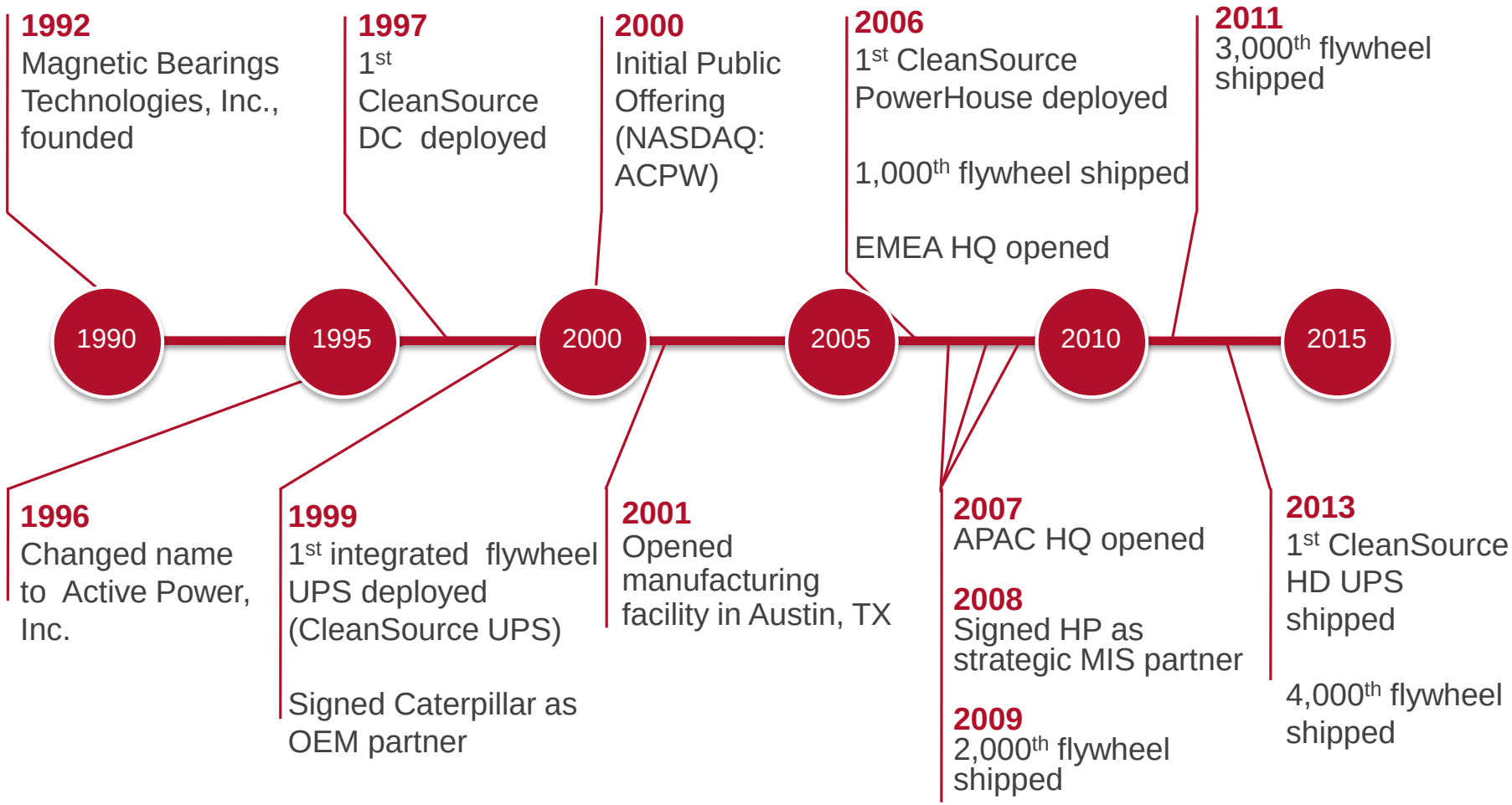
Diesel Generator

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# Corporate Overview

# Company History



# PowerHouse

## A modular power system for your data center




- Replaces your traditional electrical room
- The industry's most complete system
- Scalable for your needs

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# PowerHouse Continuous Power Solutions

- **Complete**, **modular** and **scalable** mission critical power infrastructure.
- Includes standby **generator, UPS, switchgear, cooling and monitoring systems,** which can be packaged in 20’, 30’ or 40’ mobile container configurations.
- Up to **25% CAPEX savings** in the first year and up to **60% TCO savings** over legacy infrastructure.






# PowerHouse Components



ATS



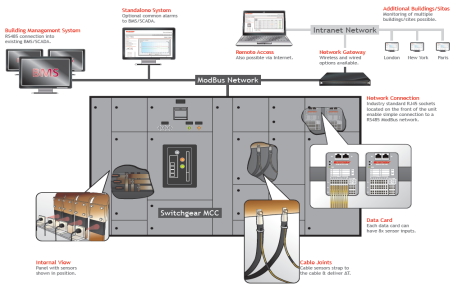
Air-Conditioning



Lighting



Diesel Generator



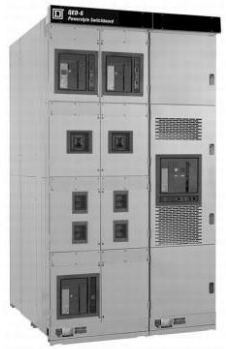

Thermal Monitoring




20’ or 40’ ISO Container



Fuel Conditioning



Switchboard

Regulatory Items









CleanSource UPS



Fuel Tank

# Product Line

» Complete range of systems for any power need

| System | Critical Power Capacity (UPS-backed) | Short-Break Capacity * (Generator-backed) |
|---|---|---|
| PowerHouse 250 | 250 kW | 150 kW |
| PowerHouse 500 | 500 kW | 400 kW |
| PowerHouse 675 | 675 kW | 500 kW |
| PowerHouse 750 | 750 kW | 600 kW |
| PowerHouse 1000 | 1000 kW | 800 kW |

» Flexible configuration options

- Mix and match UPS and diesel generator sizes to suit application
- Multiple output breaker sizes
- Combine multiple systems for larger capacity and Tier II-IV availability

* Typical. Based on generator sized 2x critical power capacity.


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# PowerHouse Design

## Design principles

- Standard components and enclosures
- Standard switchboard & UPS configurations
- Customizable outputs and options

## Standard features

- Purpose built NEMA 3R steel enclosure
- 120 mph wind / 35 lb/sq snow
- NEC compliant
- Fire detection
- Central system monitoring & controls
- N+1 economized HVAC
- Unified EPO control panel
- Advanced system analytics & database
- Side and bottom cable entry

## Options

- UL field listing
- Fire suppression
- System paralleling
- Tier III-IV ATS control
- Enhanced power quality metering
- Enclosure environmental conditioning

**PowerHouse 500**

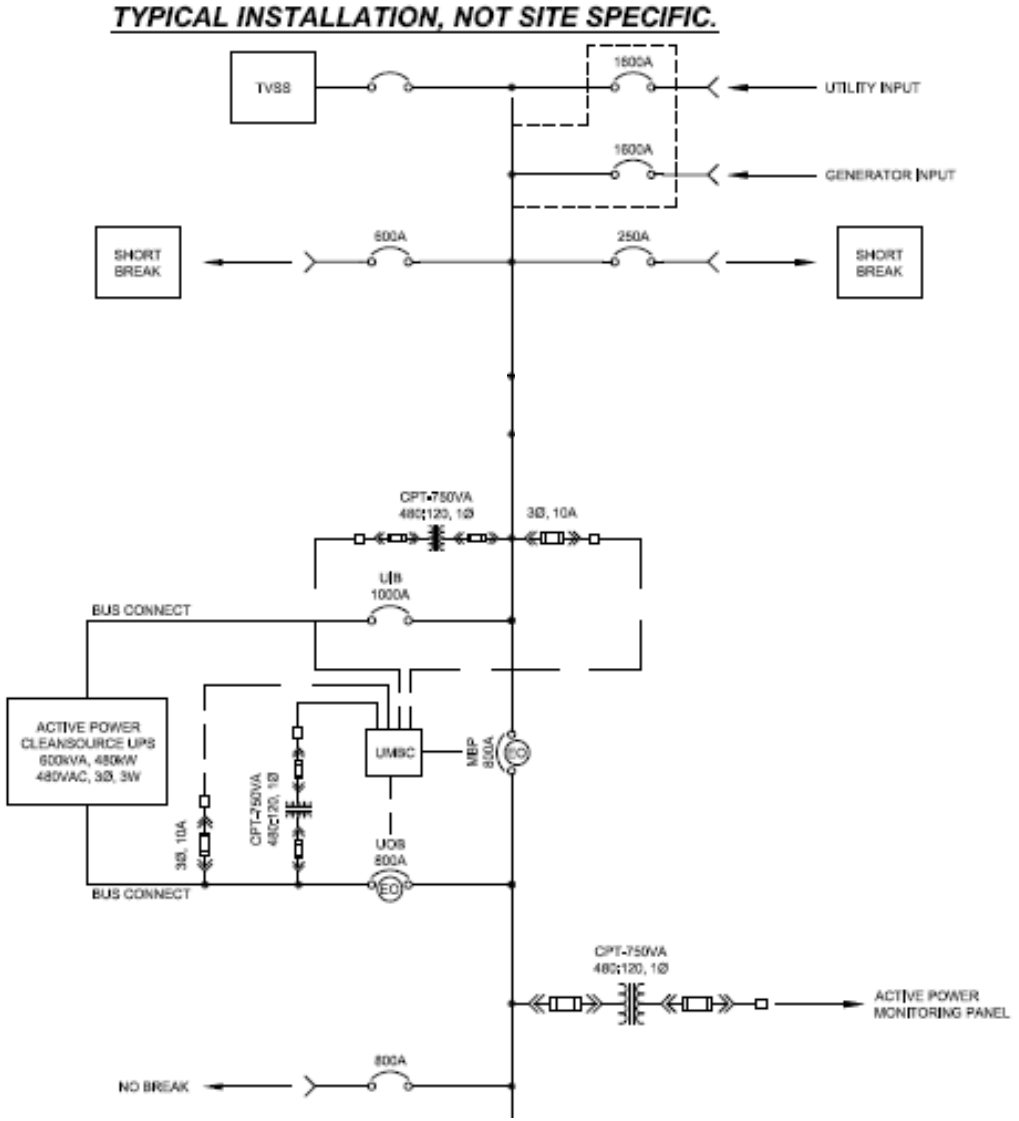
10’ W x 25’ L x 11’ H




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# PowerHouse One-Line

- 2 Input breaker transfer pair
- 800A no break output
- 600A & 250A short break outputs
- External MBP with UMBC controller
- Monitoring panel

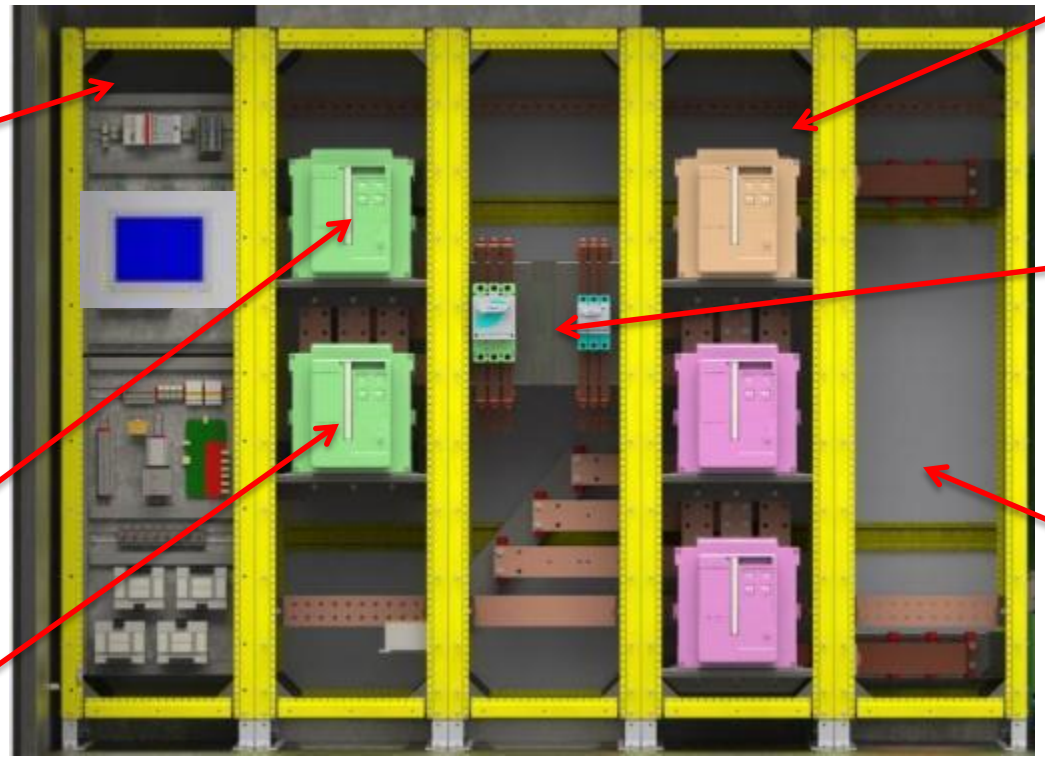





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# PowerHouse Switchboards

- Input, output, maintenance bypass, controls
- 10’ W x 8’ H x 2’ deep
- UL 891 (listing forthcoming)

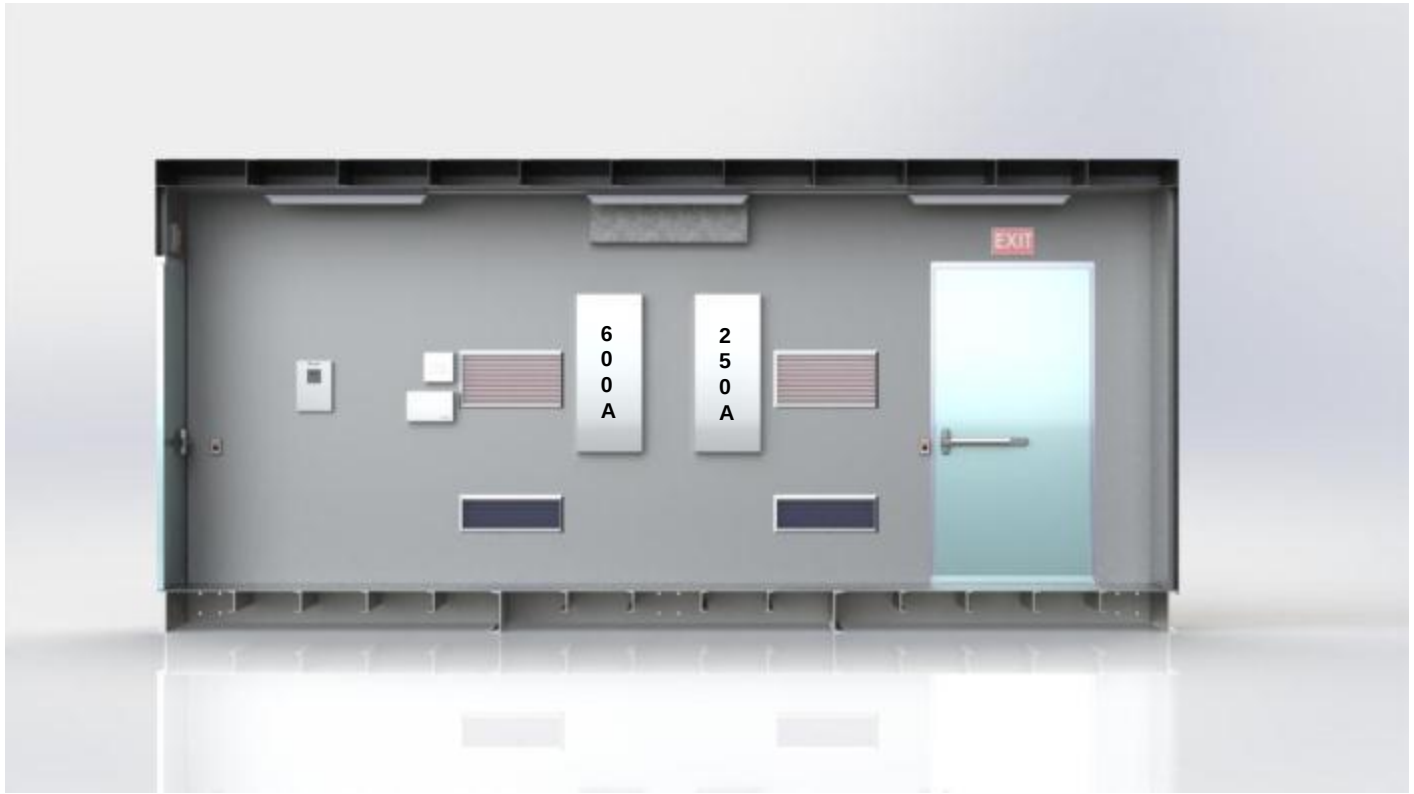




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# Short-Break Output Panels

- Short break panel 1: 600A MLO w/4 bkr positions
  - Number and size of output breakers can be specified by client
- Short break panel 2: 250A MLO w/6 bkr positions





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# Why PowerHouse?




- Available **virtually off the shelf**
- Optimized design **minimizes energy losses**
- Scalable design allows you to **grow your infrastructure as needed**




- Software tools provide **complete visibility and control**
- Proven **less likely to fail** than traditional systems with batteries
- **Factory construction, integration, and testing** reduces complexity, eliminates errors, and improves reliability

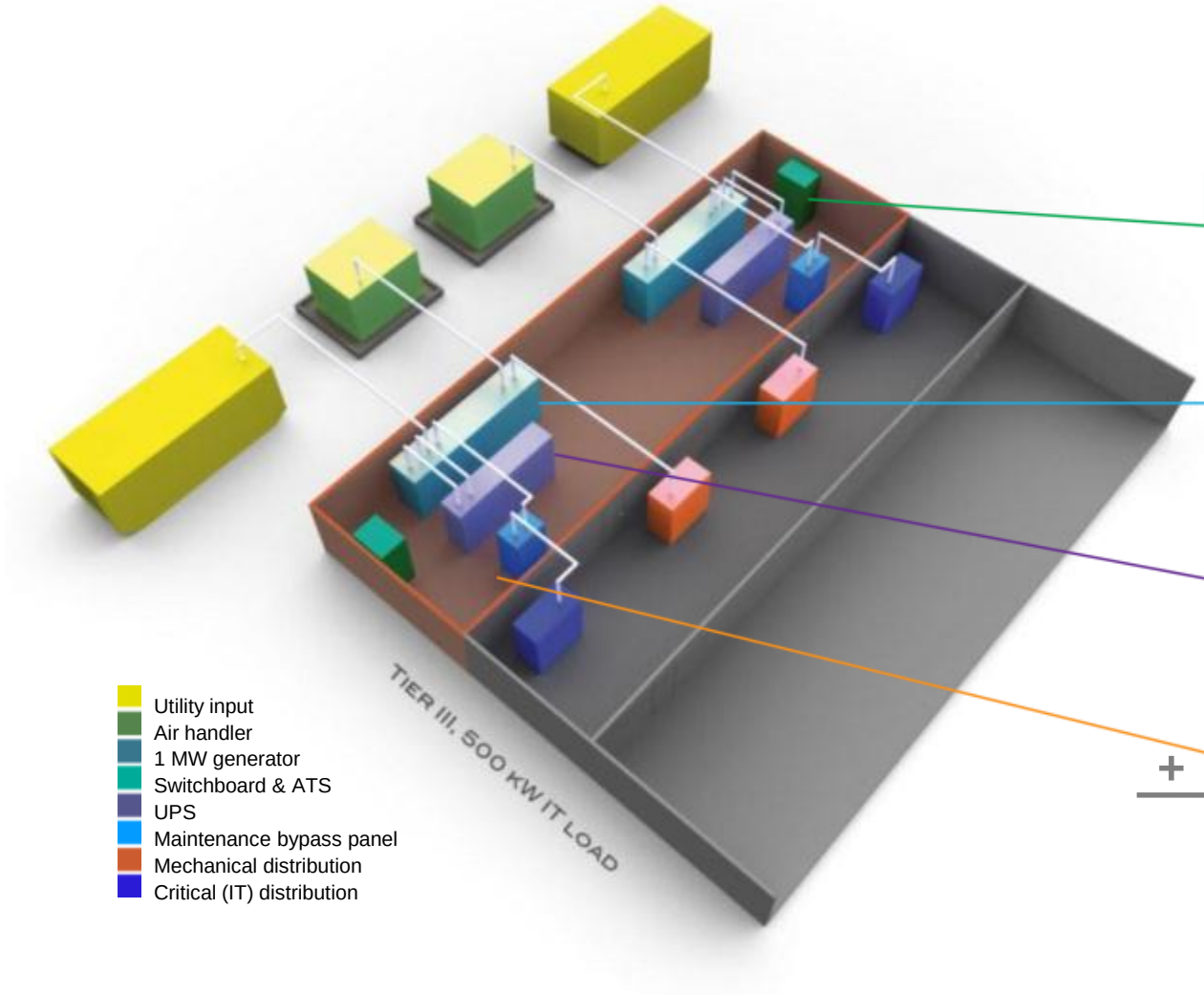



- **Up to 25% first cost savings** vs. traditional electrical room
- **75% reduction** in carbon footprint vs. batteries


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# Less Cost

**PowerHouse reduces the total cost of your electrical room as much as 25%**




**Room prep & air handling**
*Included in PowerHouse price*
**$75,000 savings**

**UPS/switchboard/MBP connections**
*Included in PowerHouse price*
**$50,000 savings**

**Install, test, communications**
*Simplified and lower cost with PowerHouse*
**$25,000 savings**

**Land, design, and construction**
*Not needed with PowerHouse*
**$300,000+ savings**

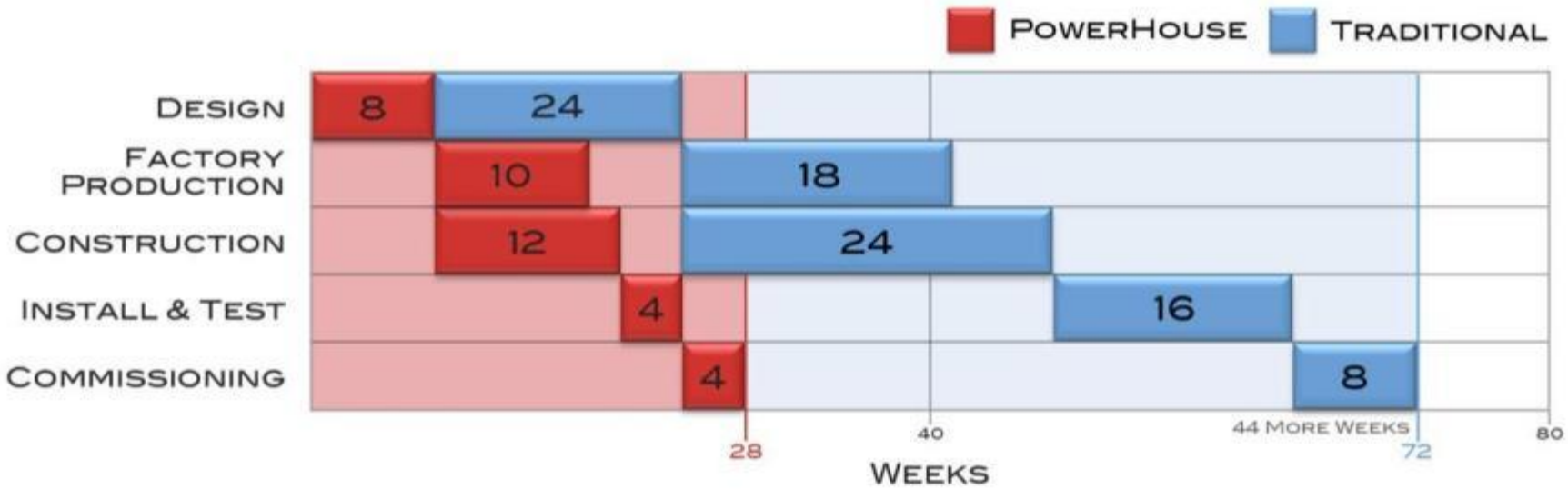
+

**Total Cost reduced from**
**$5.5M / MW to**
**$4.1M / MW**


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# Less Time

**PowerHouse can reduce electrical plant deployment time by 60%**



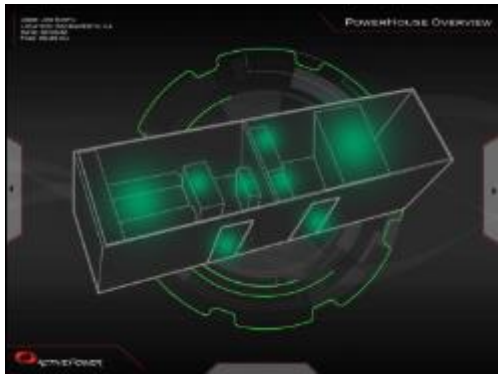

Source: Based on original study by Bill Mazzetti, Rosendin Electric



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# Total Control

**Tools to monitor and operate PowerHouse as an integrated system**



**Smart Display provides visibility and control to operate PowerHouse**



**PowerHouse OS software provides data and analytical tools to optimize performance**



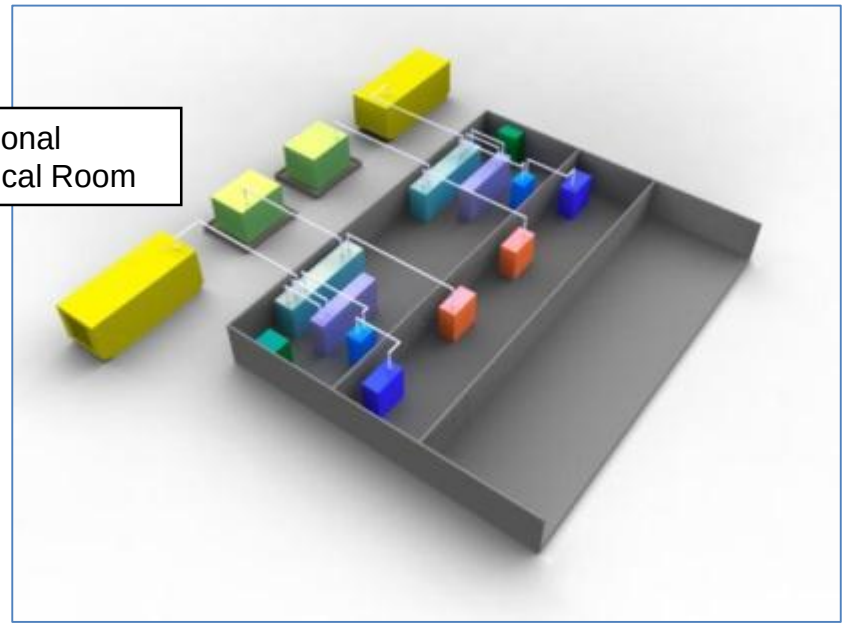
**Unified data output simplifies integration with your BMS**

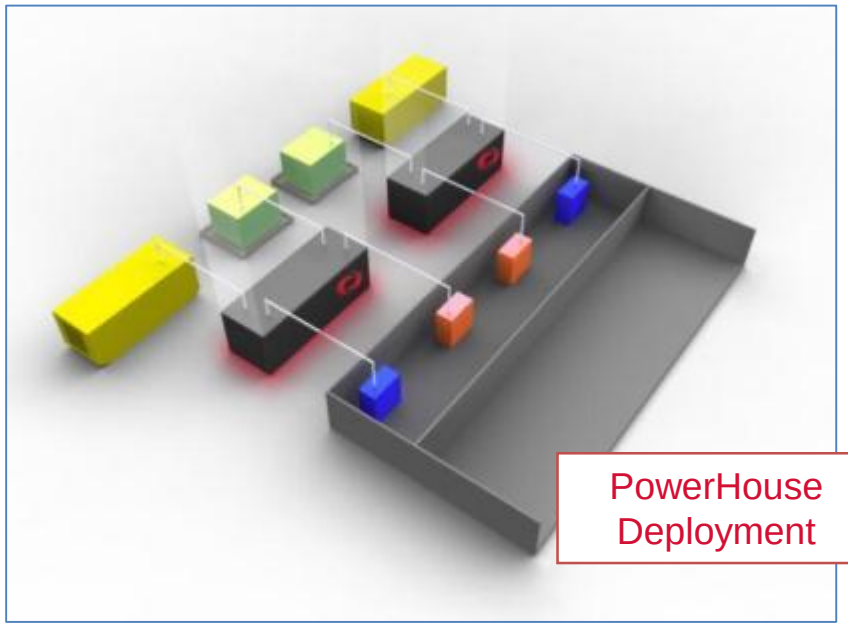

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# Less Space

» Compact footprint allows placement in unused spaces and recovers indoor space

Roof * Parking lot * Plant yard * Loading dock





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# More Efficient

- Critical power path up to 96% efficient at 40% load

- Optimized design improves overall system efficiency
  - Battery-free solution reduces cooling needs
  - AC with economizers
  - High efficiency lighting





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# Less Complex

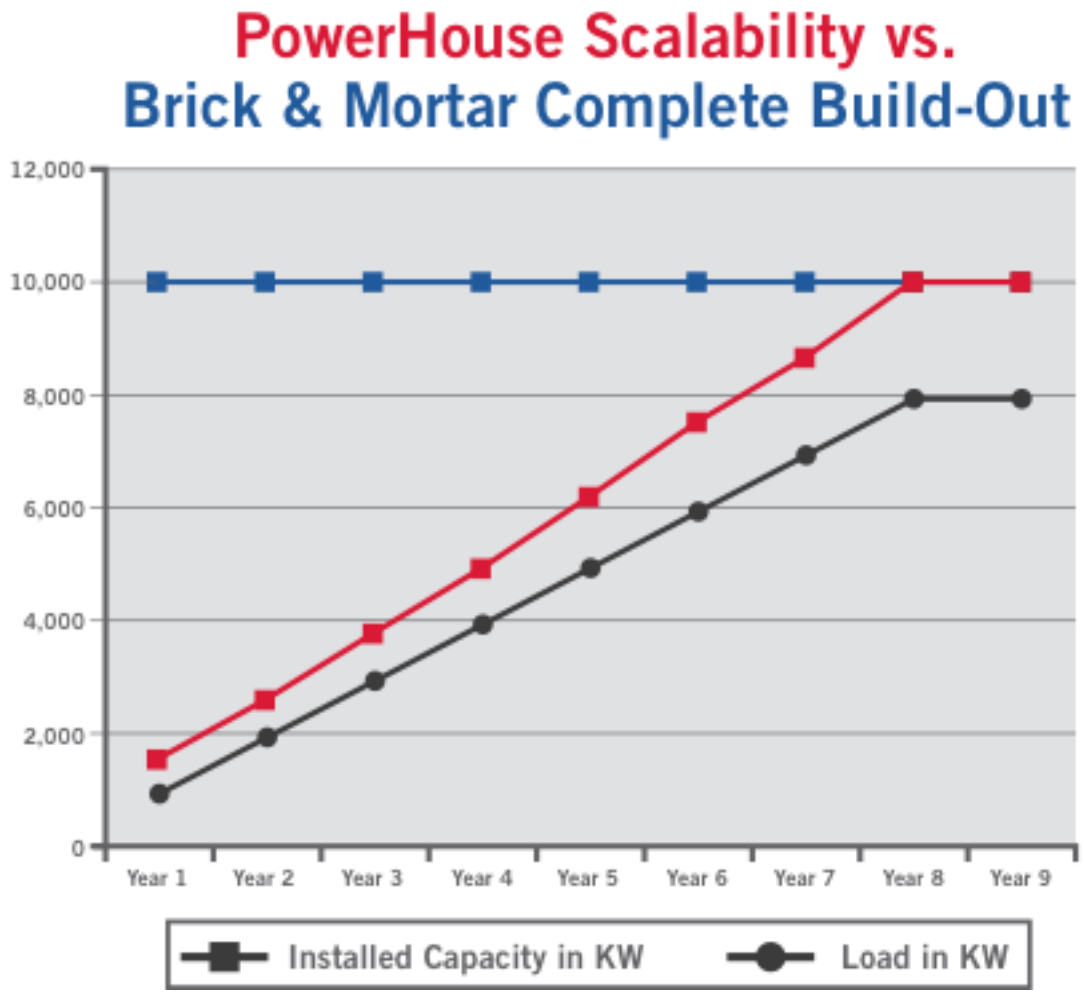
» **Engineered as a system; factory-built and tested**

| | Brick & Mortar Deployment | | PowerHouse Deployment | |
|---|---|---|---|---|
| | Factory Work | Onsite Work | Factory Work | Onsite Work |
| Engineering | | X | X | |
| Component Logistics | | X | X | |
| Testing | | X | X | |
| Installation | | X | X | |
| Site Testing | | X | | X |
| Commisioning | | X | | X |


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# More Scalability

» **Start small, defer cost until capacity needed**





# Flywheel Energy Storage Technology

# Delivering a Set of Tangible Operational Advantages




- High energy efficiencies, low losses
- Power delivered in less space
- Rapid modular deployment model




- Proven less likely to fail
- Rugged field proven design
- Wide ambient operating envelope
- Low maintenance requirement



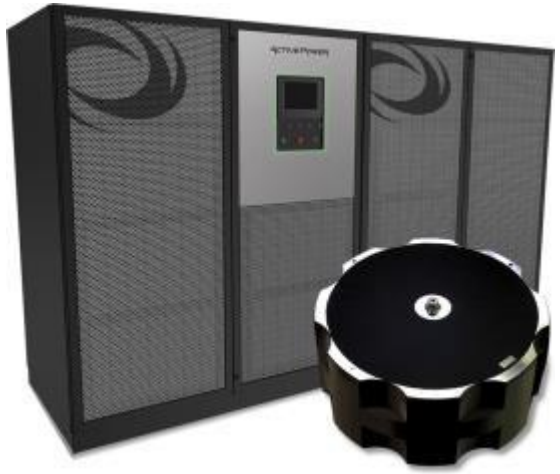

- Low TCO
- Designed for environmental sustainability


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# CleanSource® UPS and CleanSource® HD UPS

- CSUPS 300 Series with nearly 900 MW deployed
- Newly launched CSHD 750 kVA product, targeting higher power applications

- **Delivering unmatched benefits:**
  - Up to 98% energy efficiency
  - ½ the space of legacy UPS
  - CSUPS platform proven 7x less likely to fail than legacy UPS
  - Up to 60% TCO savings over other UPS systems

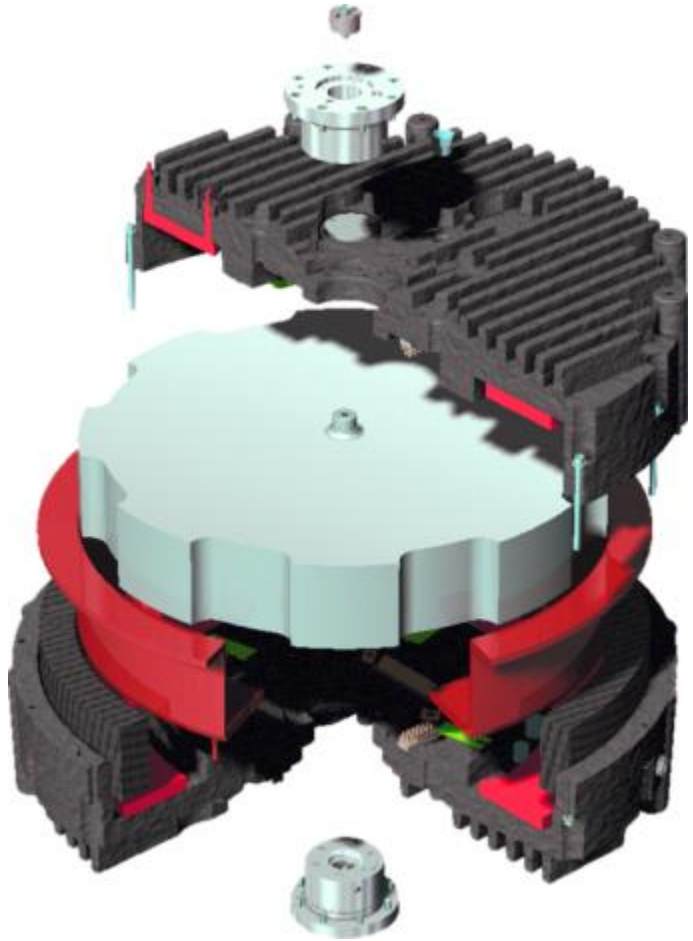





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# Flywheel Technology

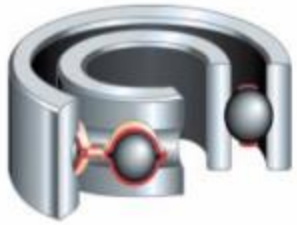
- 4.4” high; 25.5” in diameter; 600 lbs
- Flywheel constantly spins (~ 7,700 rpm) in a vacuum
- Stores energy as motion (kinetic energy)
- When power is interrupted, inertia keeps it spinning
- Acts as a generator and converts kinetic energy to electricity



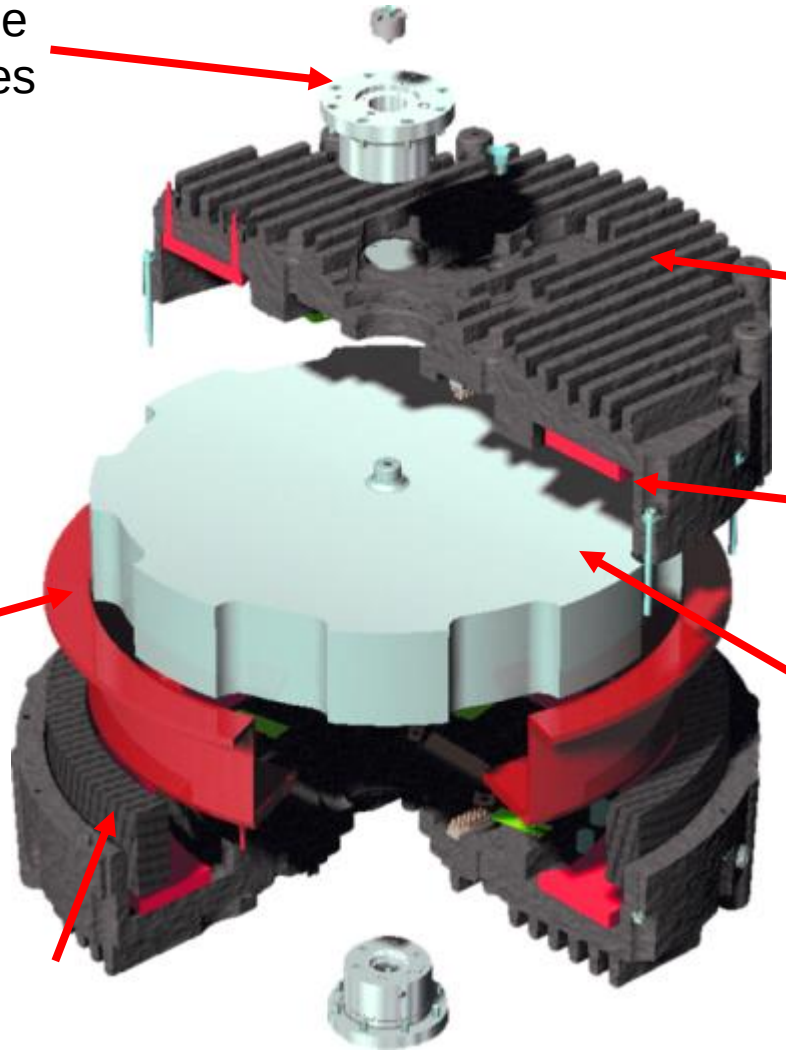

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# Flywheel Energy Storage Unit – 300 Series

Ceramic Ball Bearing



Field-replaceable bearing cartridges



Cast ductile iron housings

Field coils

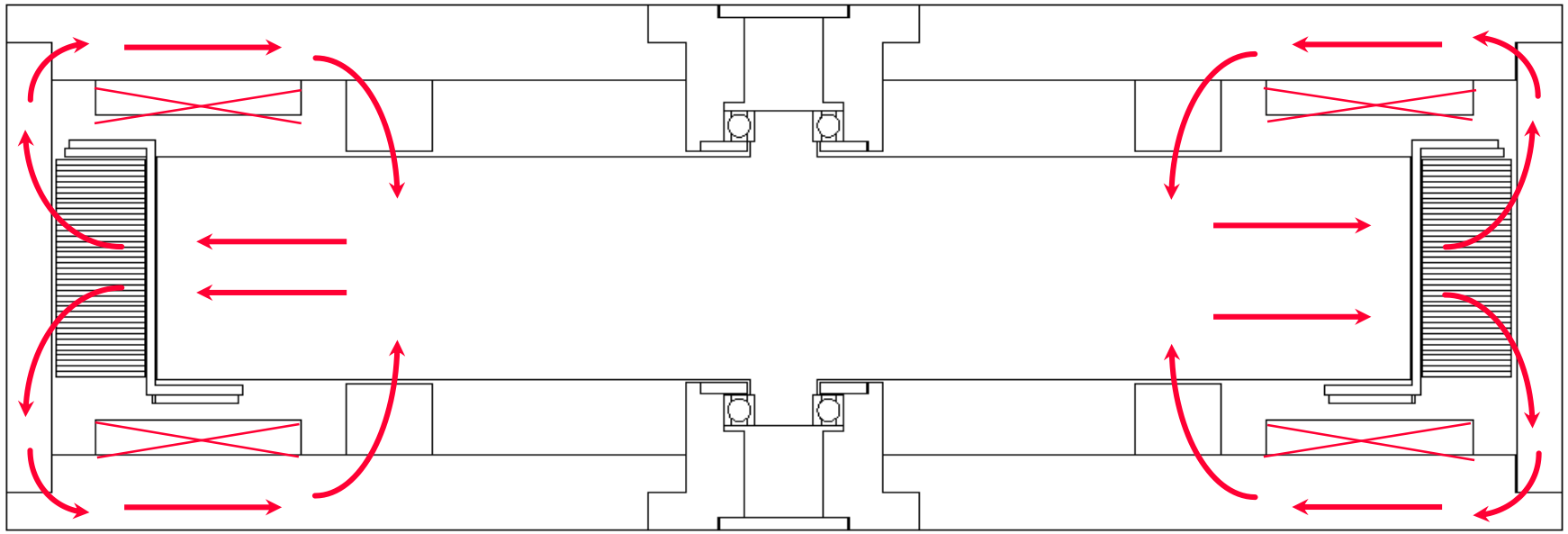
Airgap armature

Solid rotor (4340 steel) enables high tip-speed and high output power

Smooth back-iron, no slots & low loss


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# Magnetic Field Flow



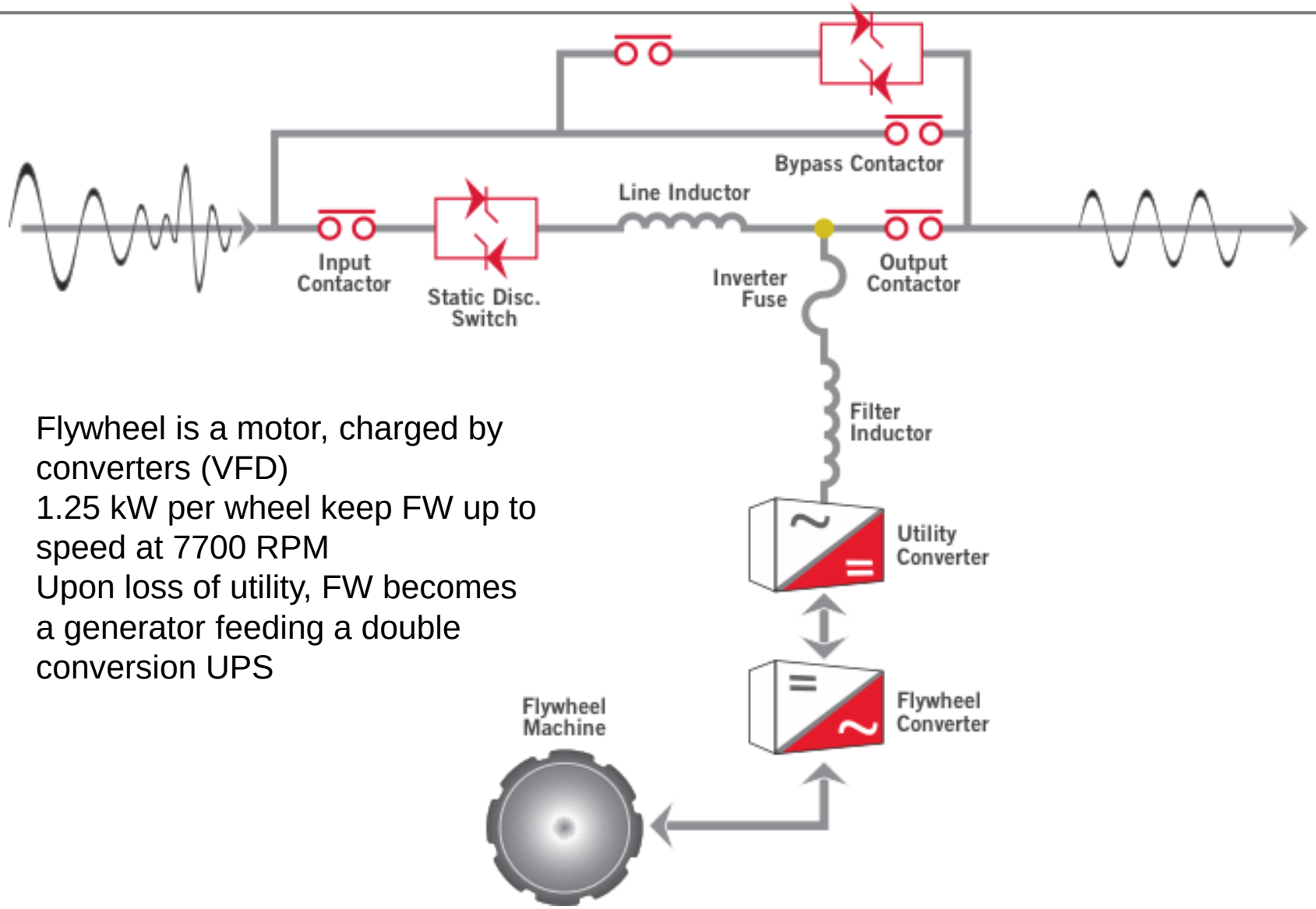
# Flywheel

- Exact capacity known / predictable
- Low weight and small footprint
- Low maintenance
- No air condition required for temperatures up to 40°C
- No degradation
- Lifetime > 20 years
- No special disposal required




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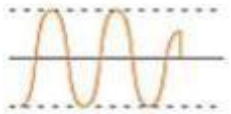
# Flywheel UPS Parallel Online Architecture



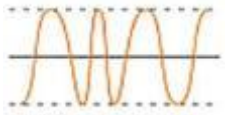

- Flywheel is a motor, charged by converters (VFD)
- 1.25 kW per wheel keep FW up to speed at 7700 RPM
- Upon loss of utility, FW becomes a generator feeding a double conversion UPS


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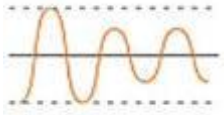
# Power Conditioning



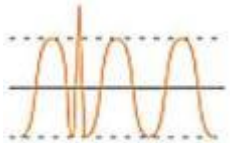
Outage



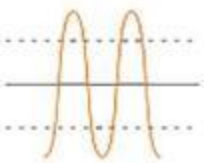
Frequency



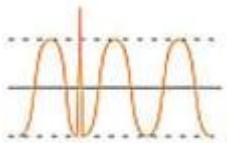
Brownout



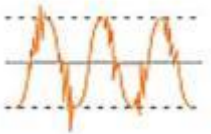
Spikes



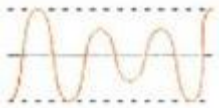
Surge



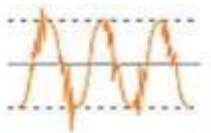
Transients



Harmonic Distortion

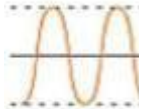


Sag



Line Noise





Corrected Sine wave

CleanSource UPS corrects all 9 IEEE defined power problems by use of TVSS, line inductance, line capacitance, active filtering, power converters and flywheel energy



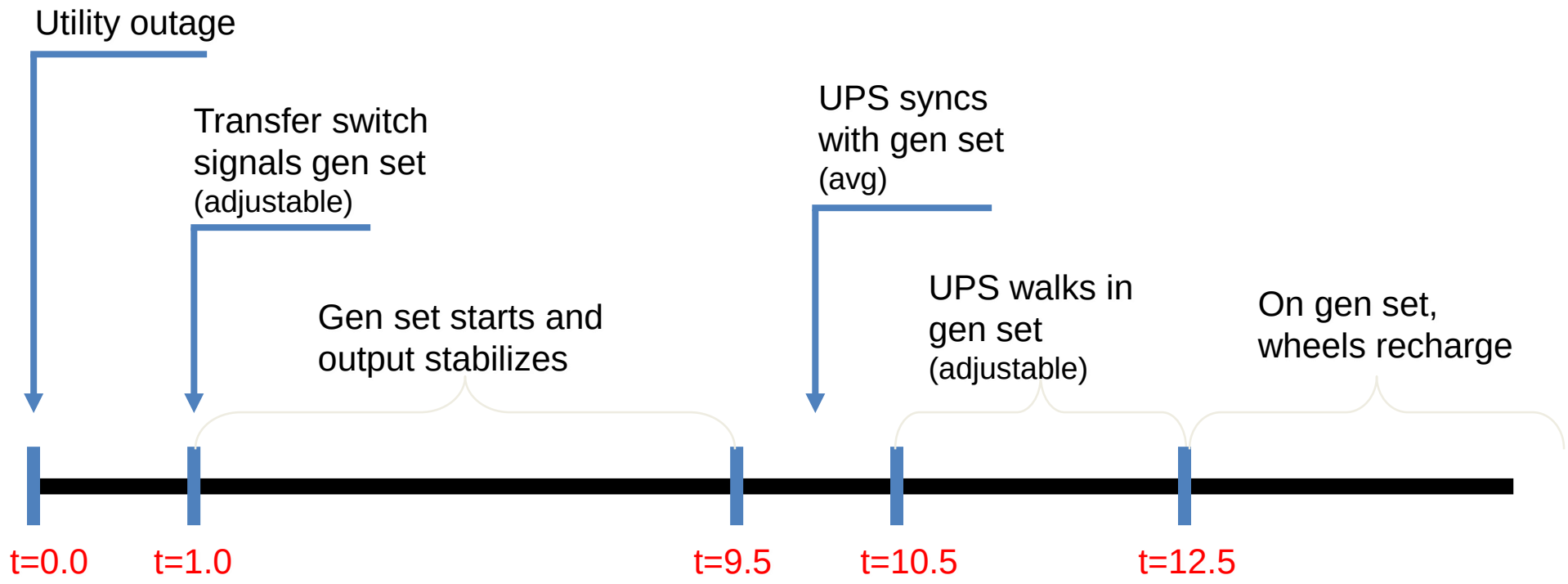
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# How Active Power UPS handles Power Disturbances:

| Power Disturbance | Definition | Why does it happen? | CleanSource UPS Reaction | Flywheel Activation | Load Interruption |
|---|---|---|---|---|---|
| Power Outage | Loss of Utility Power | Lighting strikes, downed power lines, weather | - UPS senses voltage deviation<br>- Immediately derives power from Flywheel | Yes | No |
| Brownout | Low Voltage for Prolonged Period | Peak power demands on the grid or heavy loads that exceed supply | - UPS senses voltage deviation<br>- If voltage is +/- 10% from nominal, UPS regulates voltage with power electronics<br>- If voltage is outside window, UPS immeditaely activates Flywheel | If outside of +/- 10% input voltage window | No |
| Sag | Low Voltage for Short Periods | Utility switching, large load startup, lighting, weather | - UPS senses voltage deviation<br>- If voltage is +/- 10% from nominal, UPS regulates voltage with power electronics<br>- If voltage is outside window, UPS immeditaely activates Flywheel | If outside of +/- 10% input voltage window | No |
| Surge | High Voltage for Short Periods | Rapid reduction of large loads, utility switching | - UPS senses voltage deviation<br>- If voltage is +/- 10% from nominal, UPS regulates voltage with power electronics<br>- If voltage is outside window, UPS immeditaely activates Flywheel | If outside of +/- 10% input voltage window | No |
| Line Noise | High Frequency Noise that distorts waveform | Electro-magnetic interference generated by lighting, welders, SCR devices, | - Through "Active Filtering", the line filter will reduce noise passed through the line and cancel out any noise or distortion by reverse compensating | No | No |
| Harmonic Distortion | Distortion of the sinusoidal waveform by non-linear loads | Non-linear loads such as switch mode power supplies, variable speed drives, PC's -or rectifiers found on double conversion UPS | - Through "Active Filtering", the UPS will eliminate any harmonic distortion through by actively compensating. | No | No |
| Spikes | Spike Increase in Voltage | Primarily caused by lighting which can cause voltage spikes in excess of 6,000V | - UPS uses surge suppressors, line filters and line capacitance to reduce, dampen and absorb voltage spikes | No | No |
| Switching Transients | Rapid Increase in Voltage | Caused by switching events on the utility grid. Shorter and smaller than a voltage spike. | - UPS uses surge suppressors, line filters and line capacitance to reduce, dampen and absorb switching transients | No | No |
| Frequency Variation | Changes in line Frequency | Usually occurs when block loading or unloading a generator or small co-gen facility | - If input is out of tolerance, UPS engages Flywheel and Generator to provide regulated frequency. | Yes | No |


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# Continuous Power Sequence

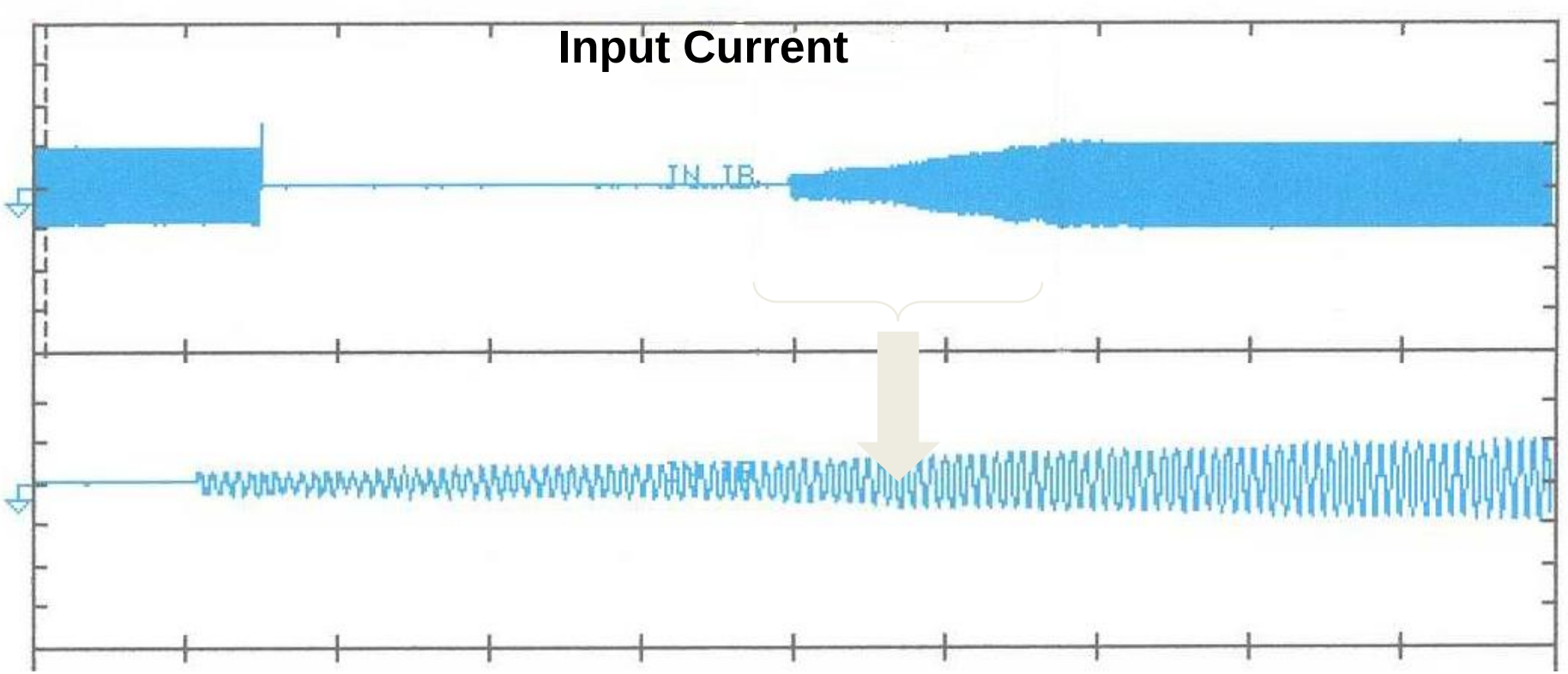




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# Gen set walk in

Eliminates block loads on Gen Set

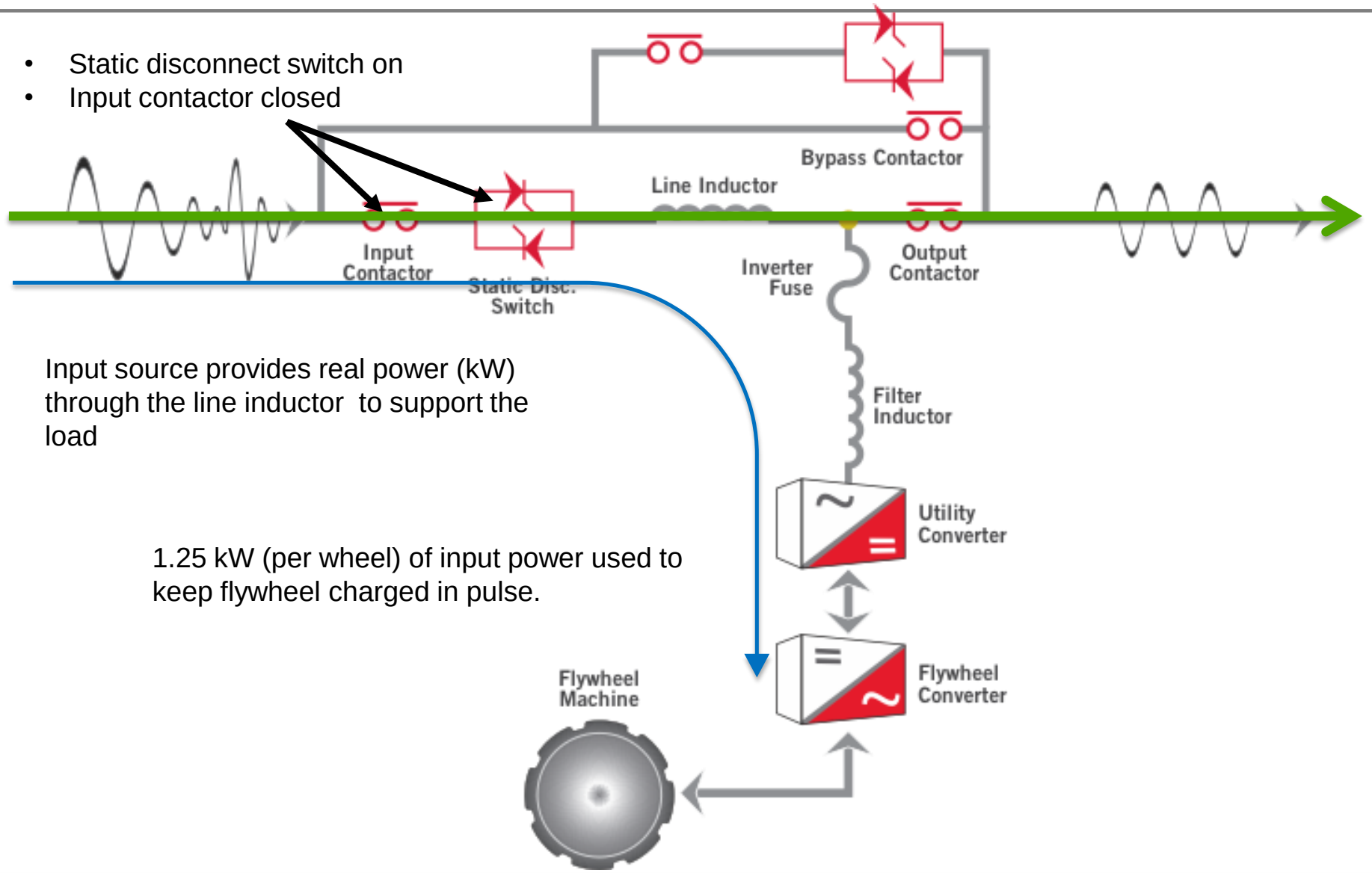




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# Normal Mode

- Static disconnect switch on
- Input contactor closed

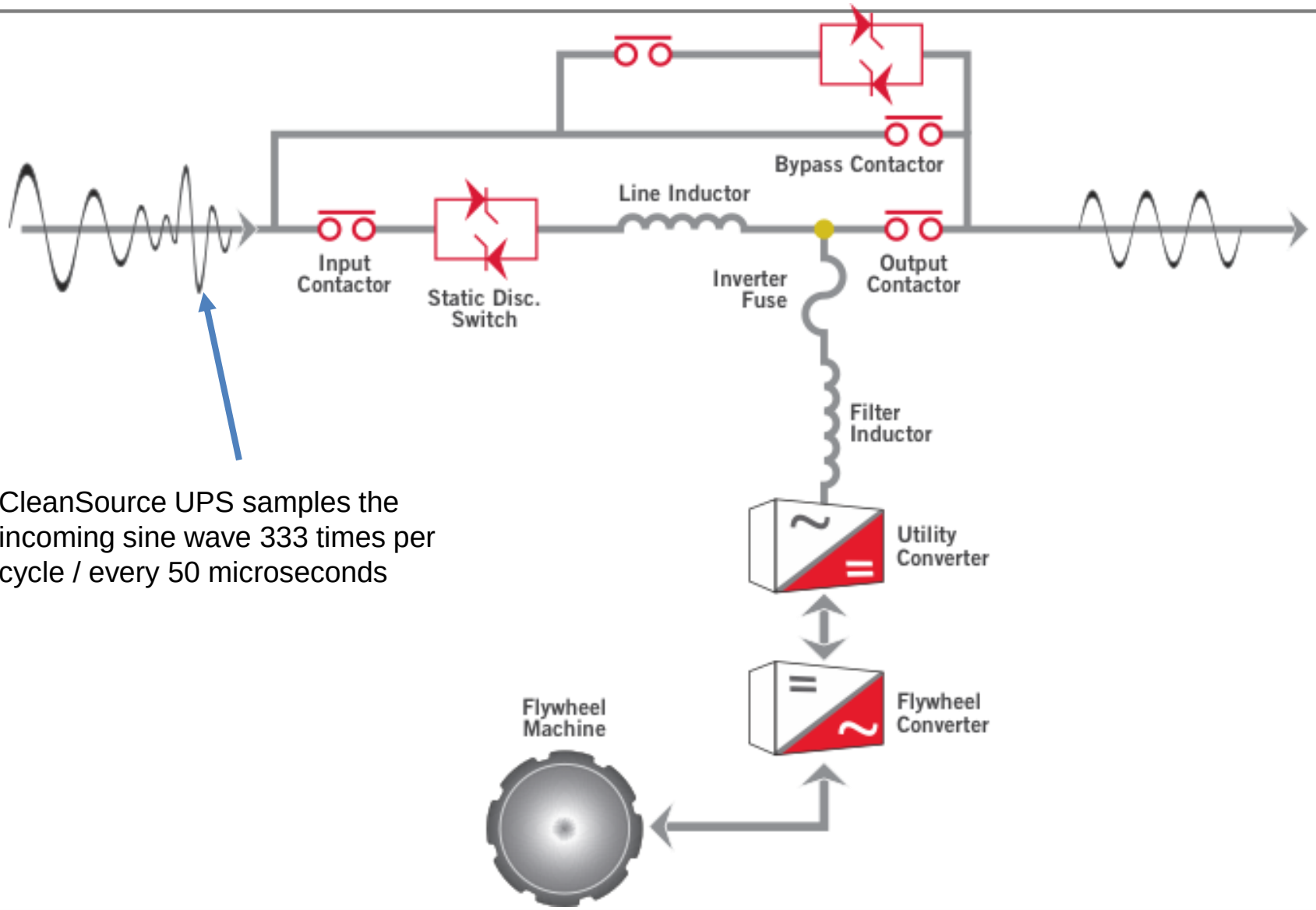



Input source provides real power (kW) through the line inductor to support the load

1.25 kW (per wheel) of input power used to keep flywheel charged in pulse.


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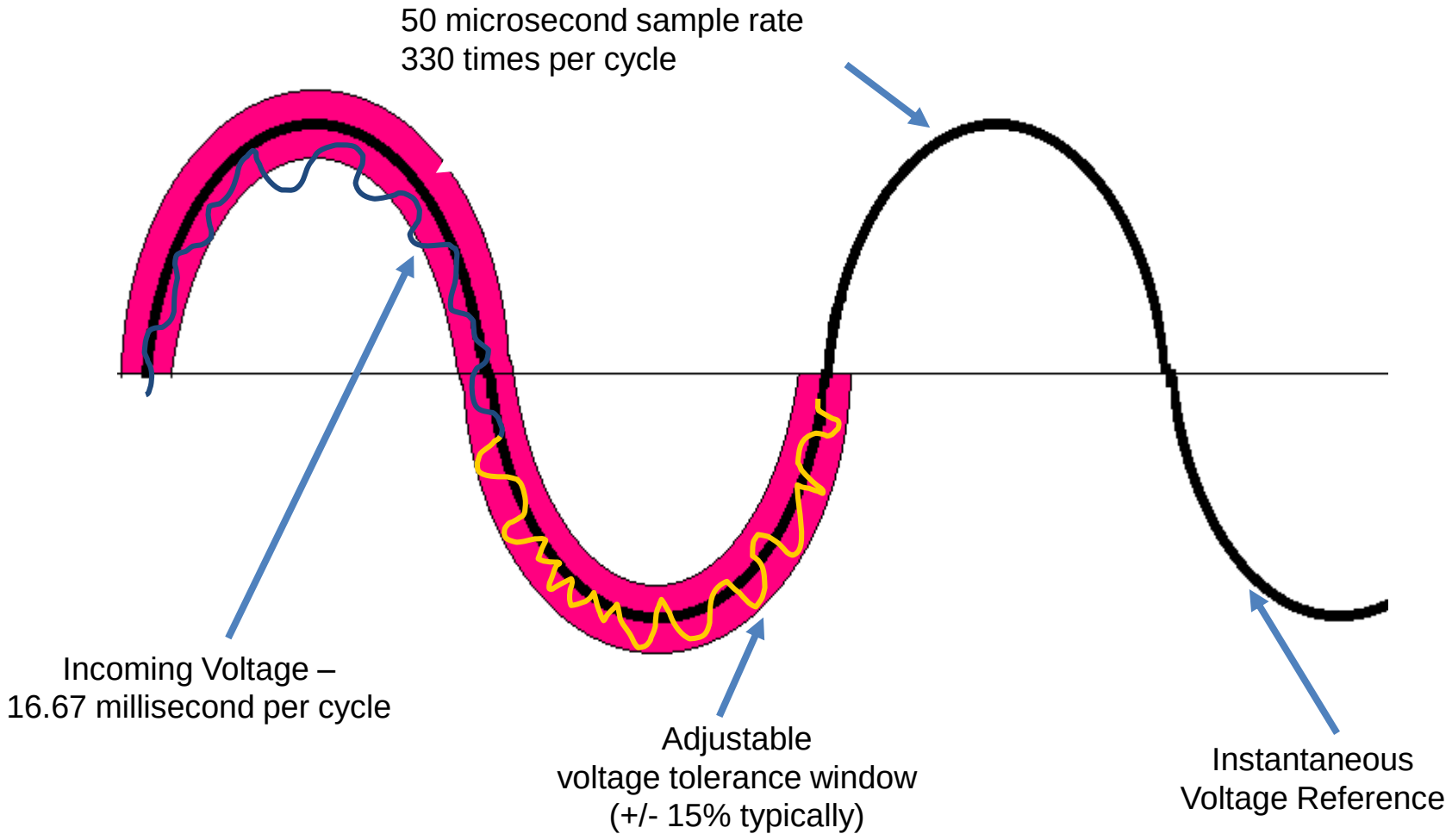
# Power Disturbances




CleanSource UPS samples the incoming sine wave 333 times per cycle / every 50 microseconds


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# Fast Voltage Transient Discharge Window

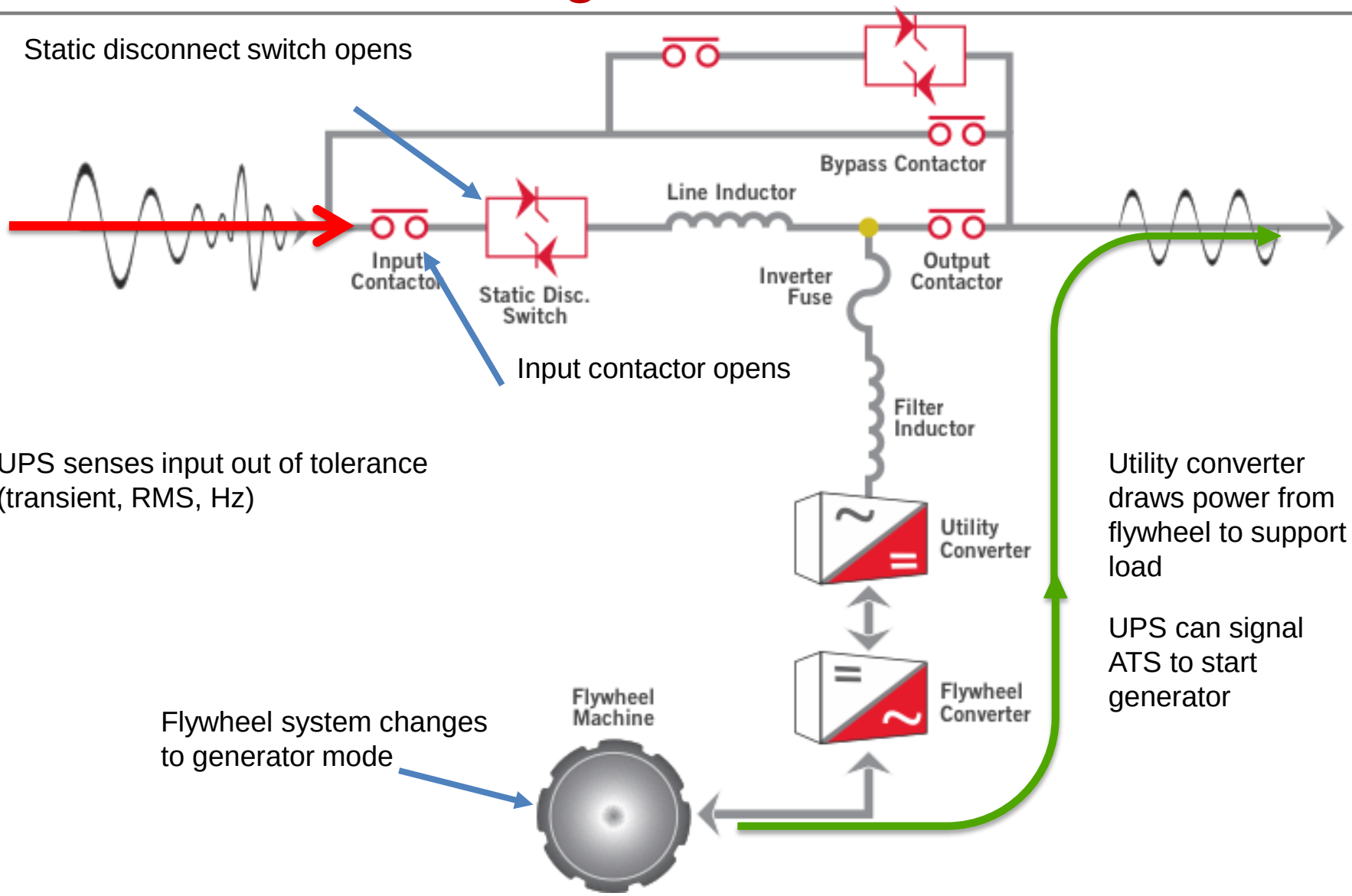




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# Power Protection - Discharge

Static disconnect switch opens




Input contactor opens

UPS senses input out of tolerance (transient, RMS, Hz)

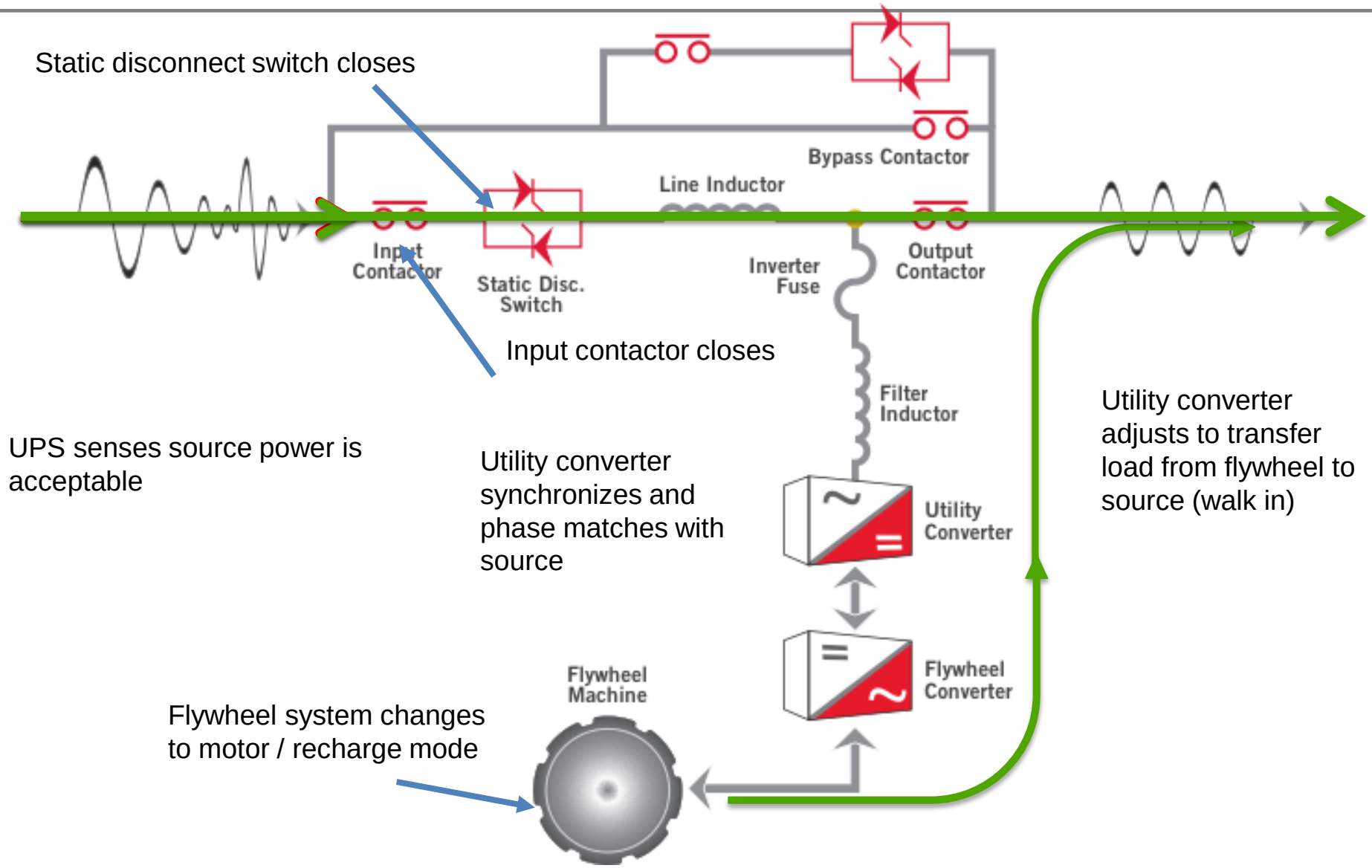
Utility converter draws power from flywheel to support load

UPS can signal ATS to start generator

Flywheel system changes to generator mode


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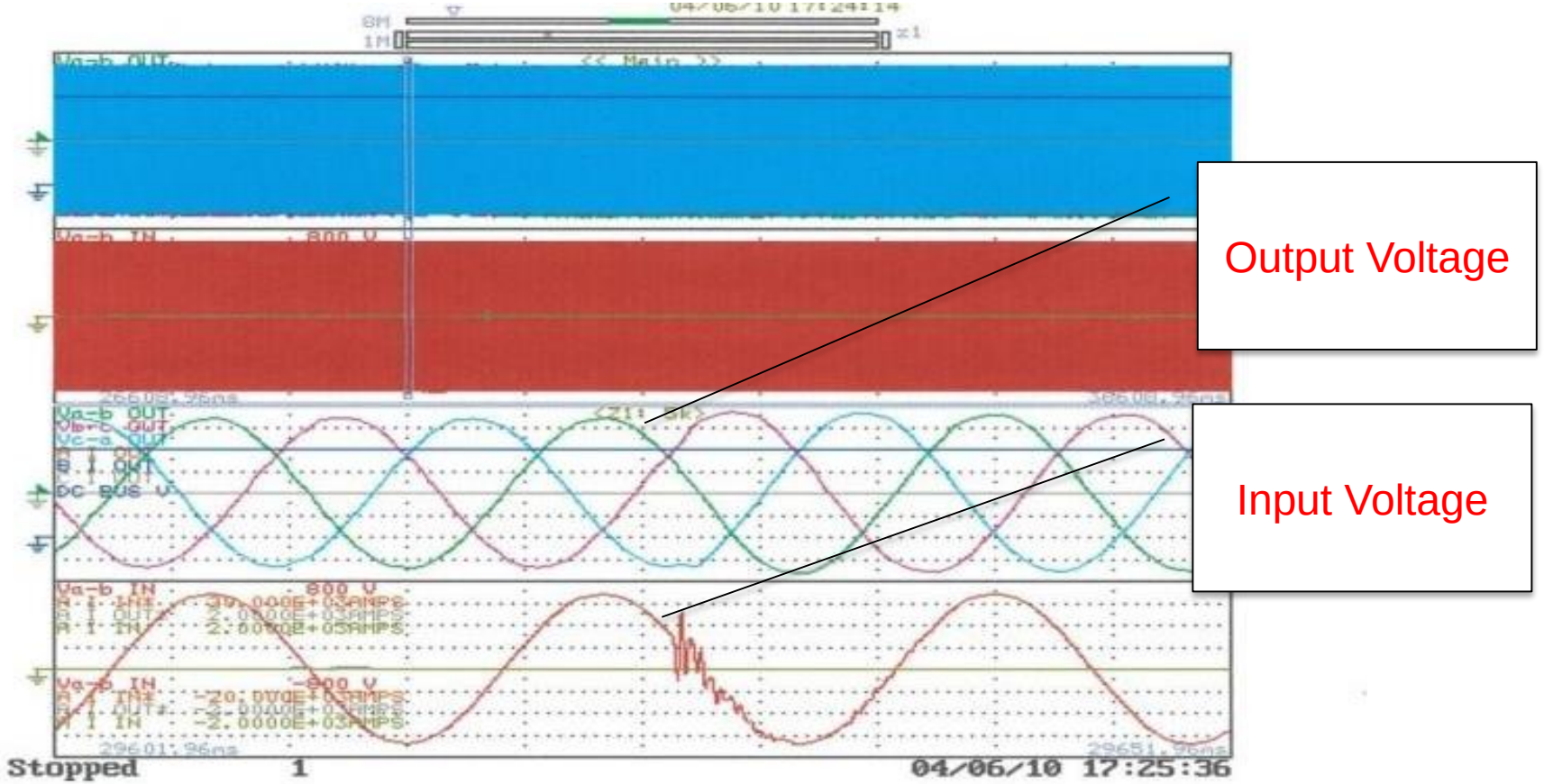
# Power Protection – Transfer to Gen





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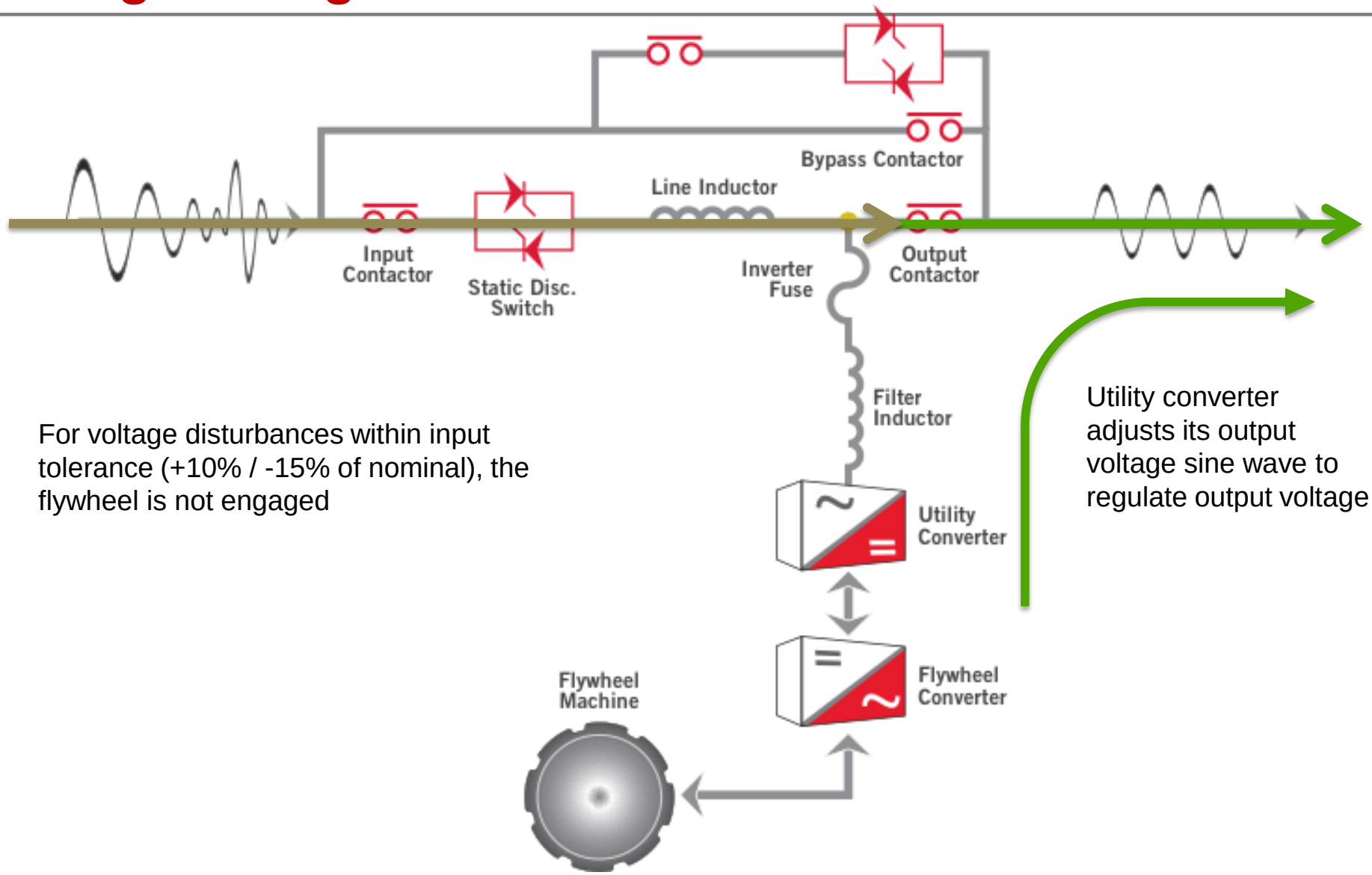
# Input Transient & Step Load Response




| | Expected Values | 50% Step Load Actual Values | 100% Step Load Actual Values |
|---|---|---|---|
| **Output Voltage Distortion** | 5% | 2.40% | 3.00% |
| **Recovery Time** | < 50 ms | 20 ms | 40 ms |


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# Voltage Sags / Surges

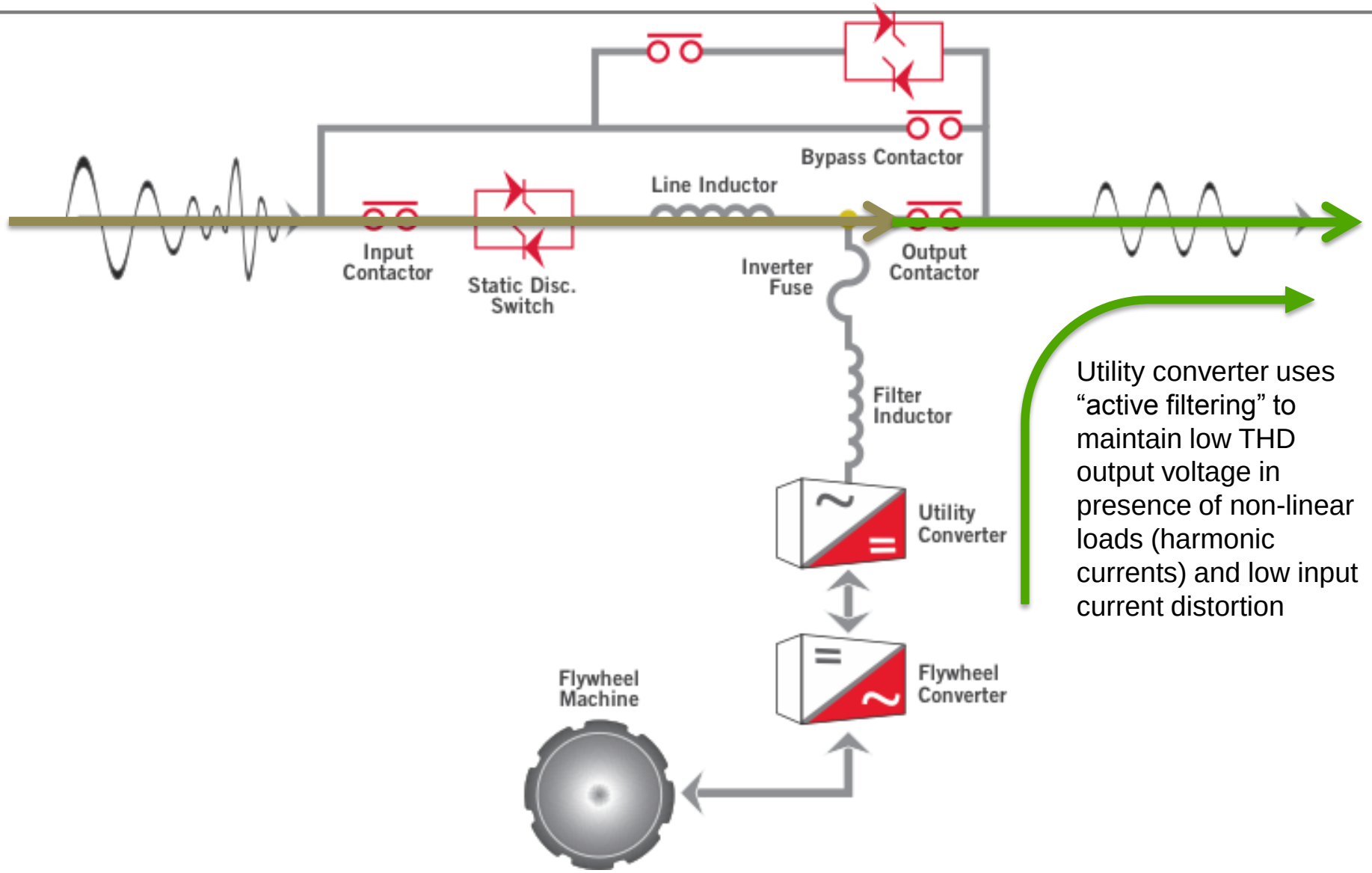



For voltage disturbances within input tolerance (+10% / -15% of nominal), the flywheel is not engaged

Utility converter adjusts its output voltage sine wave to regulate output voltage


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# Harmonic Distortion

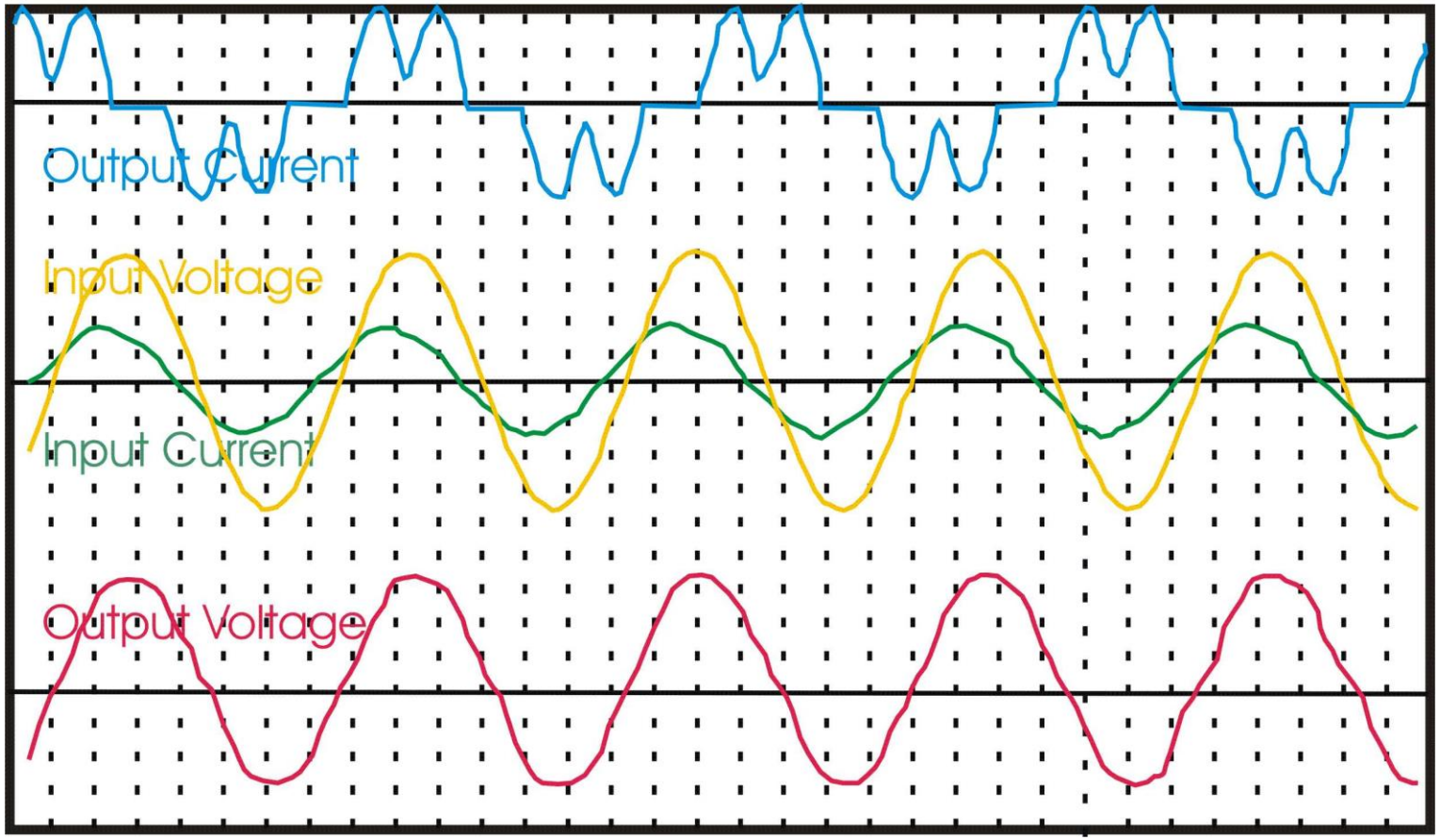



Utility converter uses “active filtering” to maintain low THD output voltage in presence of non-linear loads (harmonic currents) and low input current distortion


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# CSUPS Performance

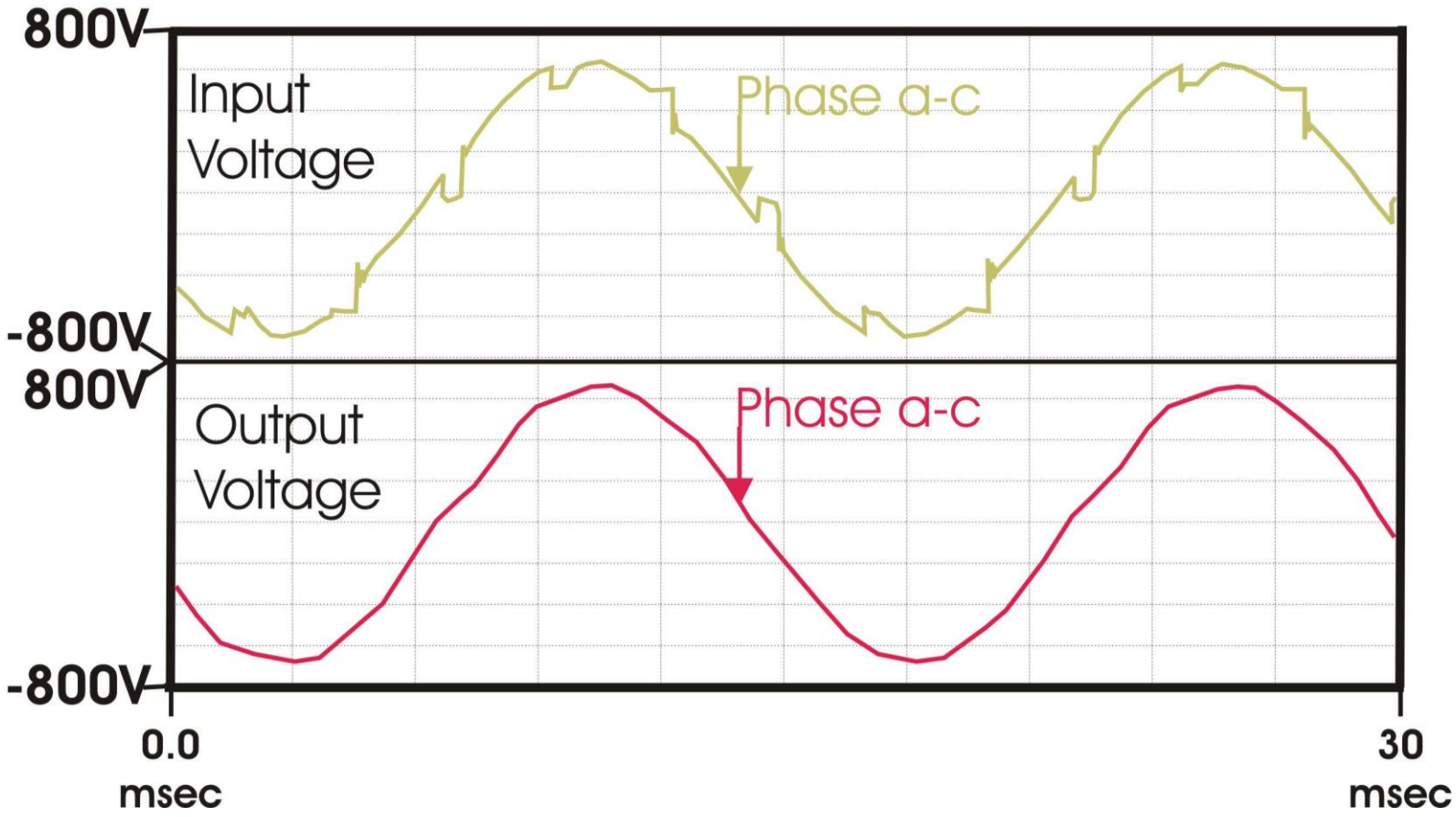
## Harmonic Cancellation





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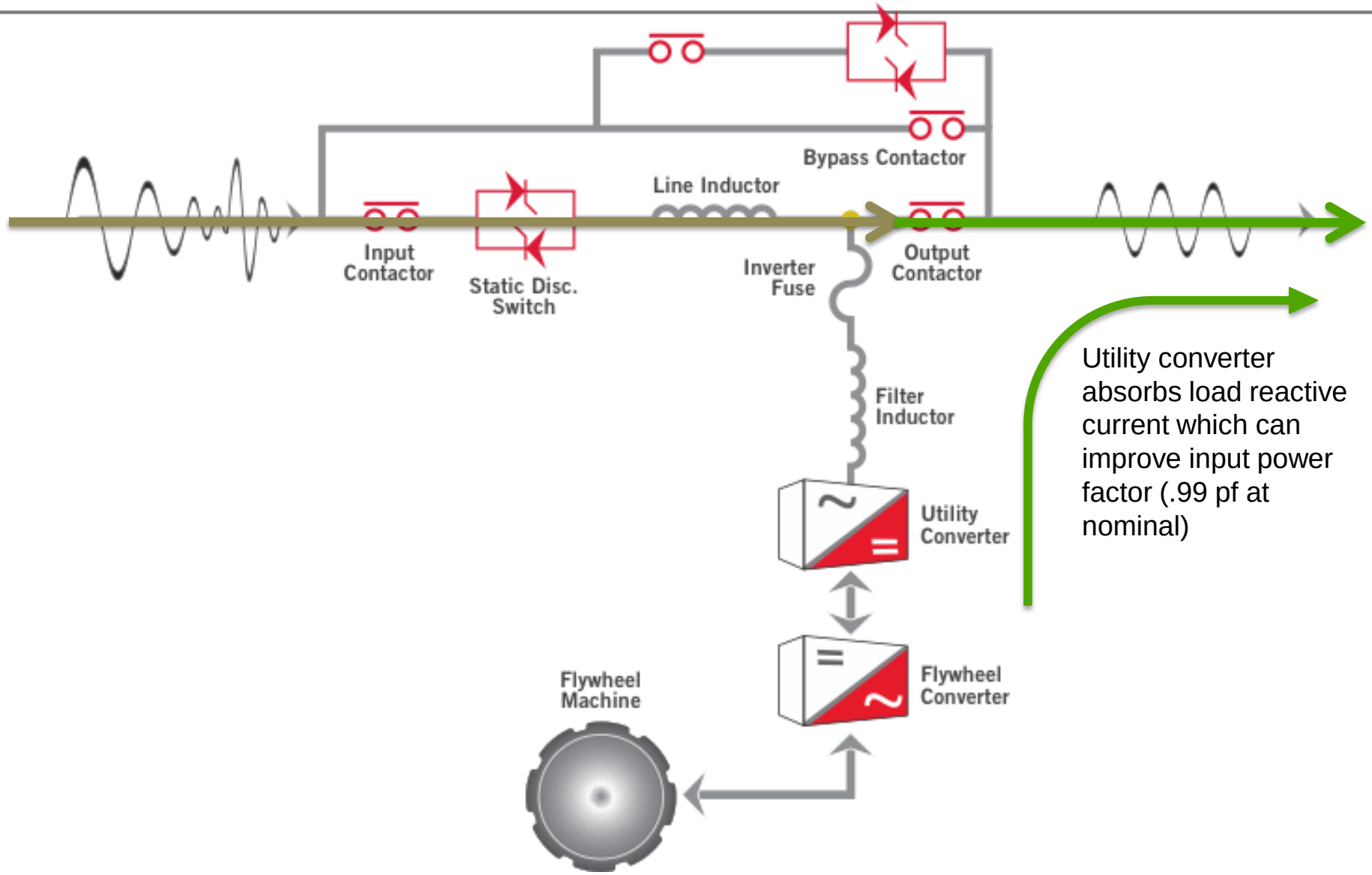
# Input and Output Isolation





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# Power Factor Correction




Utility converter absorbs load reactive current which can improve input power factor (.99 pf at nominal)


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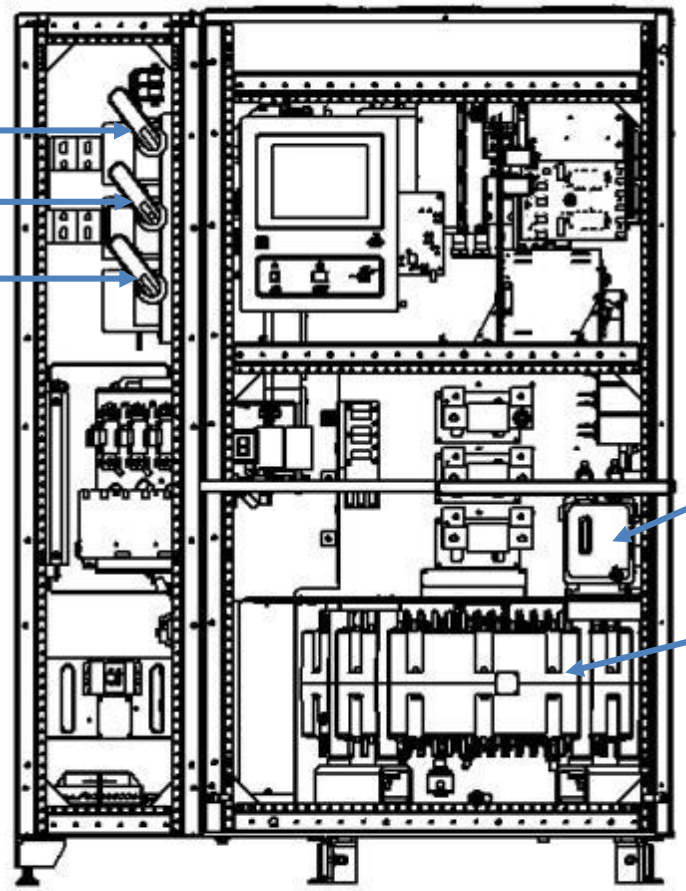
# CleanSource® UPS



- The industry's only patented integrated flywheel UPS
- Single Module Systems
  - 150 kVA, 300 kVA
- Multi Module Systems
  - 300 kVA to 1200 kVA modules
  - Add modules for ride-through, redundancy or capacity in 300 kVA/240 KW increments
  - Paralleling capability for Multi- Megawatt Systems


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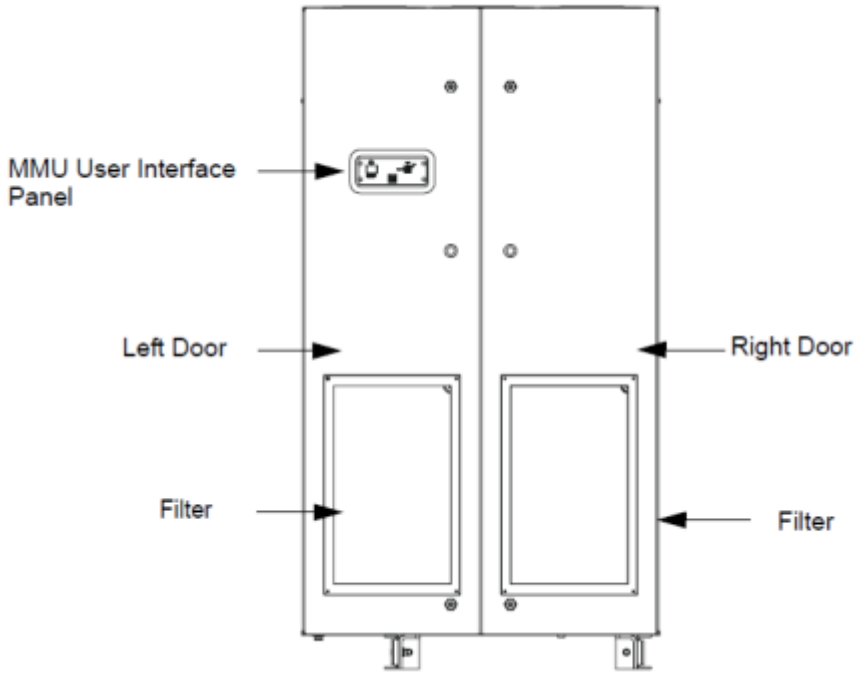
# CleanSource SMS





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# MMU Cabinet



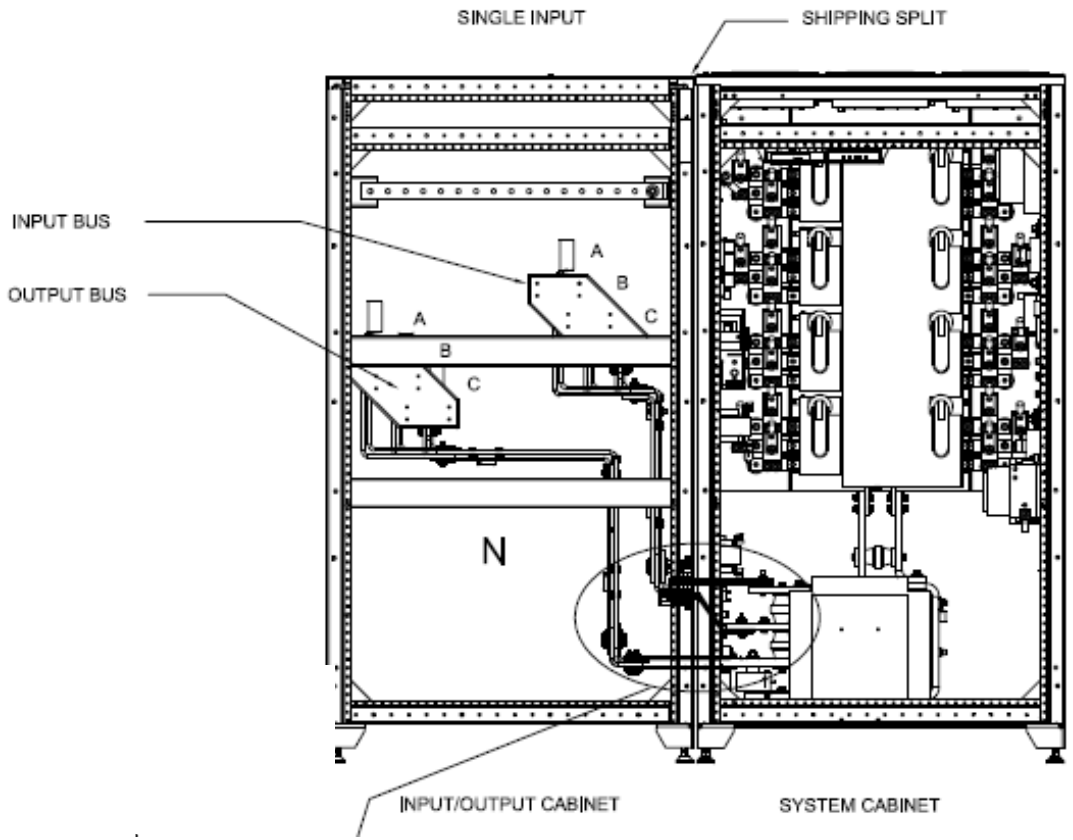




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# IO & System Cabinets

- **Standard**: Single input
- **Option**: Dual input

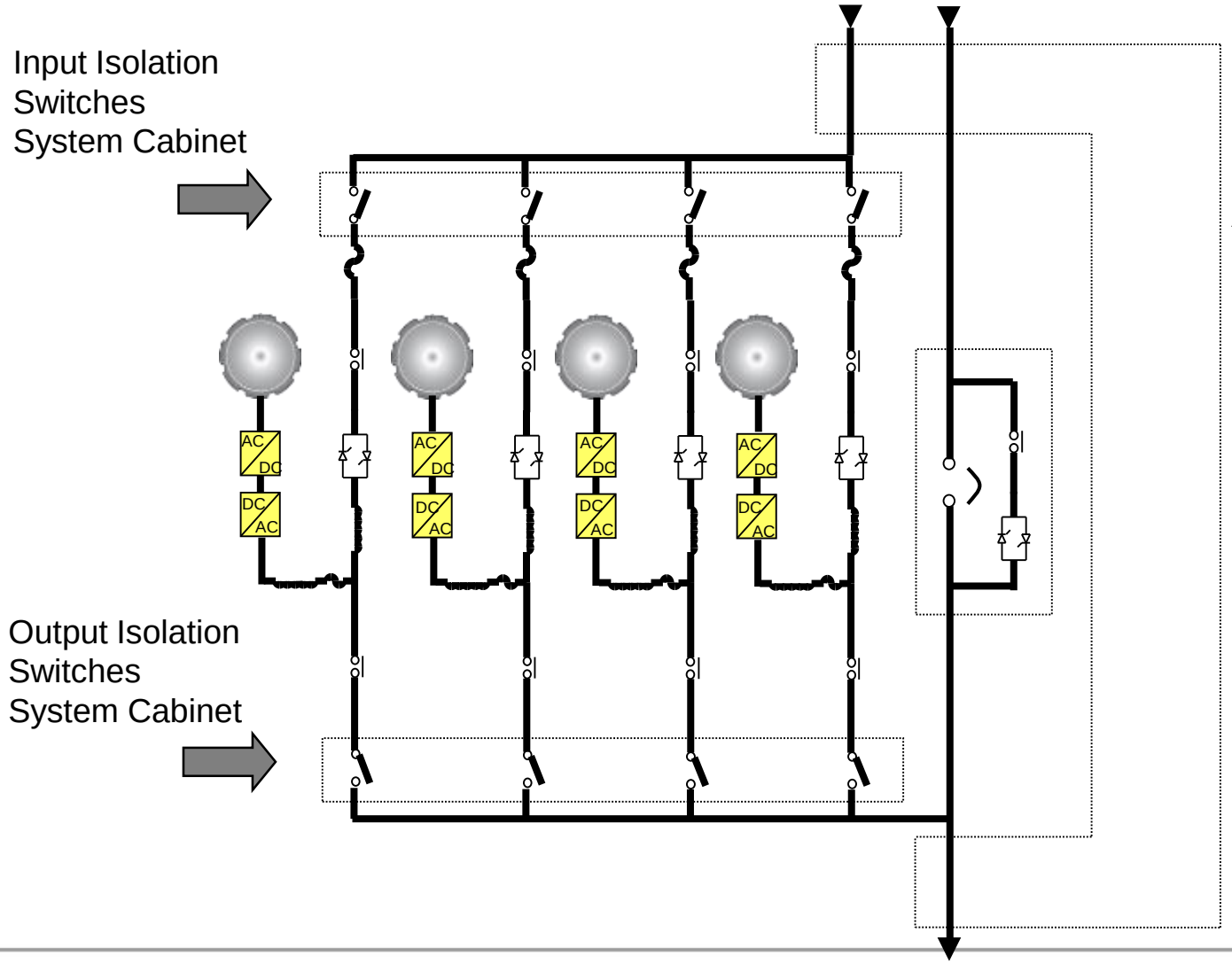




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# CleanSource UPS Multi-module Systems

MMS One-line




Built in:
Maintainability
Scalability
Redundancy


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# Intelligently Efficient

- Modular * Scalable * Flexible
- Field Upgradeable * Grows With Your Needs
- Paralleling Capability for Multi-Megawatt Solutions





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# Key Advantages

| Parameter | Typical Double Conversion with Batteries | Active Power |
|---|---|---|
| Footprint (300 kVA) | 40 sq ft (incl. battery)<br>80 sq ft (w/ clearance) | 14 sq ft<br>29 sq ft (w/ clearance) |
| Operating Temperature | 77F for optimal battery life | 0 – 104F |
| Maintenance | ▪ 2 - 4 PMs / year<br>▪ Hours of service<br>▪ Costly battery replacements | ▪ 1 PM / year<br>▪ 4 yr bearing change out |
| Efficiency | Avg. 94% efficient<br>14.4 kW heat rejection | Avg. 97% efficient<br>7.2 kw heat rejection |


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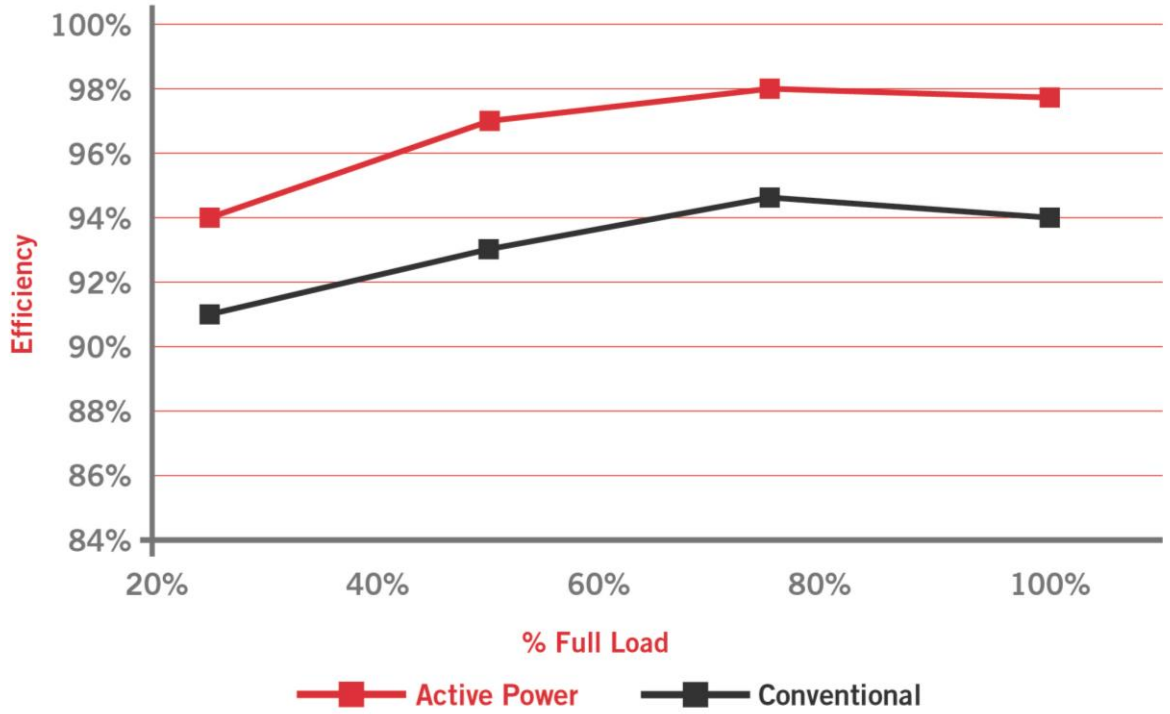
# CleanSource UPS : Efficient

» ***Industry Leading Efficiency***

- Up to 98% energy efficient without sacrificing performance

» ***Less Cooling***

- High efficiency = low heat losses=less cooling required
- No batteries = no battery room cooling requirement




Depending on load, Active Power systems can perform at up to 98% energy efficient or only 2% loss

Conventional systems can literally waste up to 10% of the power input


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# Utility Savings

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Traditional Double Conversion UPS | | | | | | |
| $ / kW/hr | $0.20 | 0.2 X 0.08 | X | 600 | X | 8760 | = | $91,400 |
| kW load | 600 | 0.92 | | | | | | |
| | | | | | | | | |
| Traditional UPS Efficiency | 92% | Active Power CleanSource UPS | | | | | | |
| Active Power UPS Efficiency | 97% | 0.2 X 0.03 | X | 600 | X | 8760 | = | $32,500 |
| | | 0.97 | | | | | | |
| | | | | | | | | |
| | | **Utility savings per year:** | | | **$ 58,900** | | | |


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# Total Cost of Ownership (TCO)

- Lower installation costs
  - Flywheel cables and pull box provided
- Efficiency
- Minimal cooling requirements
  - Less heat rejection
- Small footprint
- Low maintenance costs
- No battery cooling required
- No battery changes


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# More Efficient

- Critical power path up to 96% efficient at 40% load

- Optimized design improves overall system efficiency
  - Battery-free solution reduces cooling needs
  - AC with economizers
  - High efficiency lighting

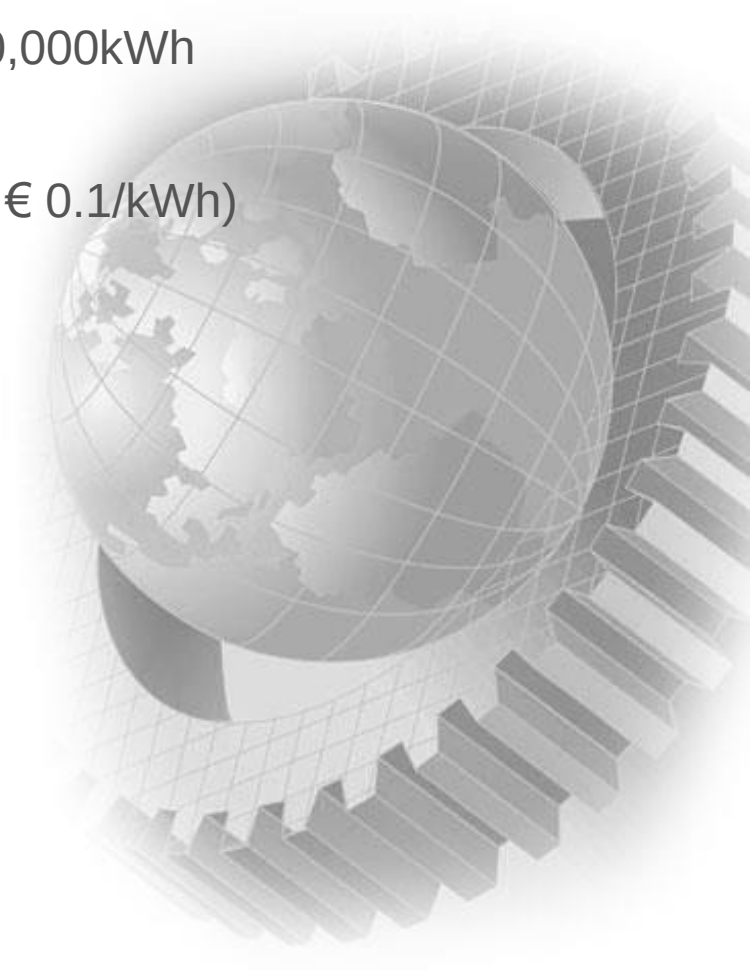




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# Economically Green: Energy Consumption

- Cost savings with higher efficiency:
  - 5% difference in efficiency => saves 5,000,000kWh
    => € 500,000
    (single UPS with 1.350kW load, 10 years, € 0.1/kWh)
- Plus: Less space required
- Plus: No air condition required
- Reduced $CO_2$ emissions
  approx. 2,300 tons over 10 years
  (depending on the mix of energy production in your country)




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# GenSTART Diesel Genset Starting Module

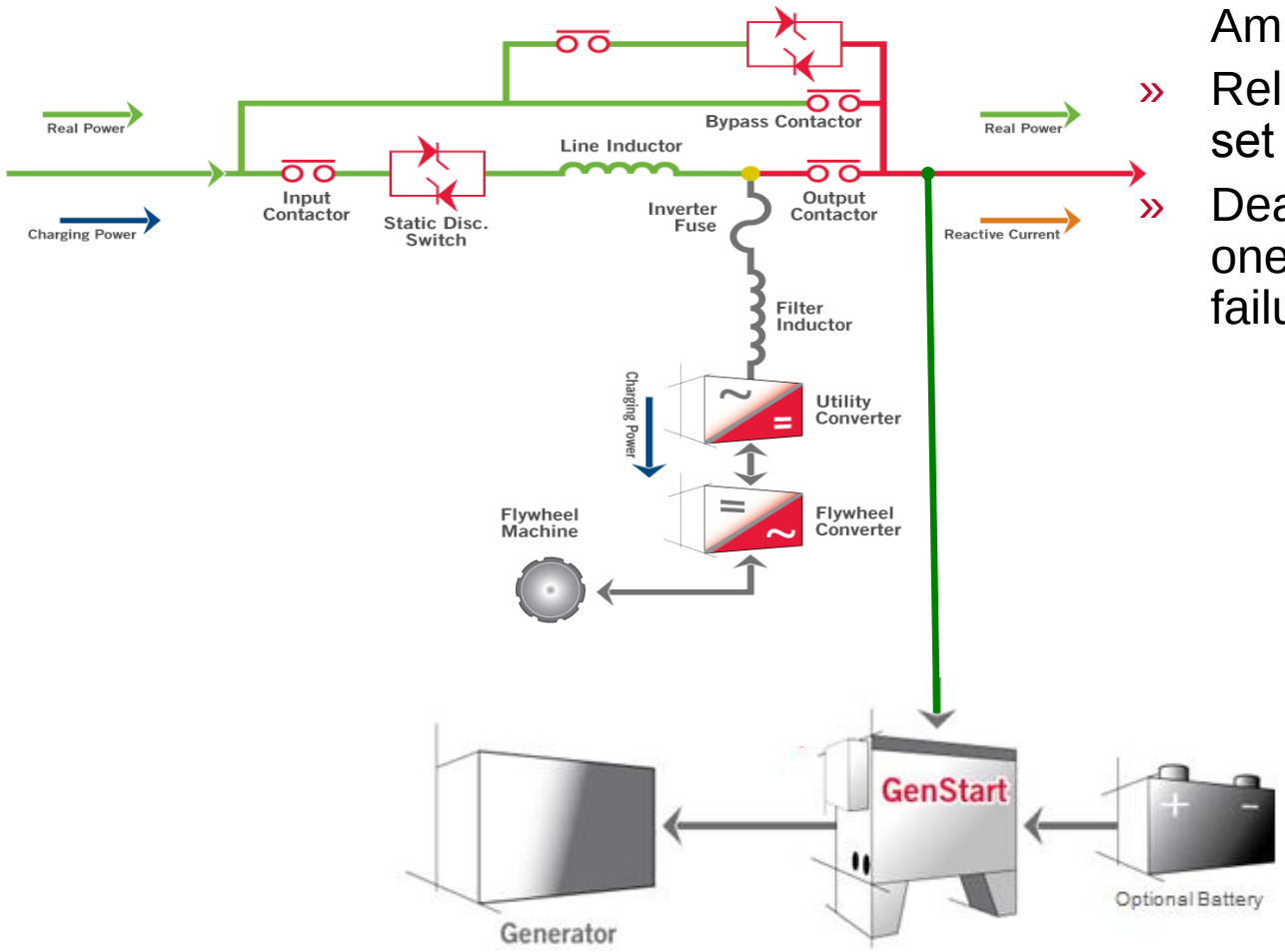



- Improves starting reliability significantly
- Extremely low maintenance
- Built-in AC disconnect
- Thermal protection with automatic reset
- Status monitoring capability
- Continuous control power availability
- Floor- or wall-mount configurations

*Battery-free, starting system that adds additional nines of availability to multiple standby generator sets*


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# GenSTART - Mode of Operation




- 24V DC 1728 cold-cranking Amps
- Reliable power to a generator set engine's starting motor
- Dead batteries are the number one reason for generator start failures


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# Flywheel Depiction







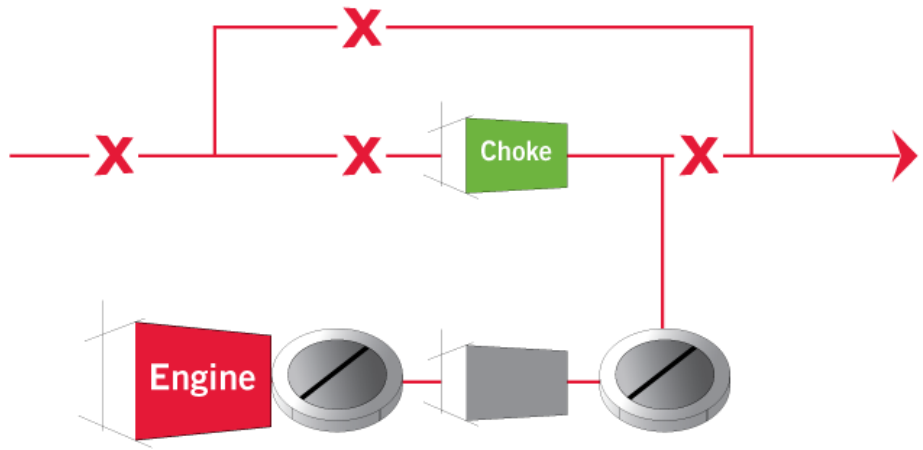





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# Typical Drups

- Line interactive design
- Lower efficiency due to
  - Open rotating machines up to 5400 RPM
  - Large Line Inductor
- Long base frame with four big parts aligned
- Mechanically coupled Diesel Engine
- Bearing in bearing system for the storage device

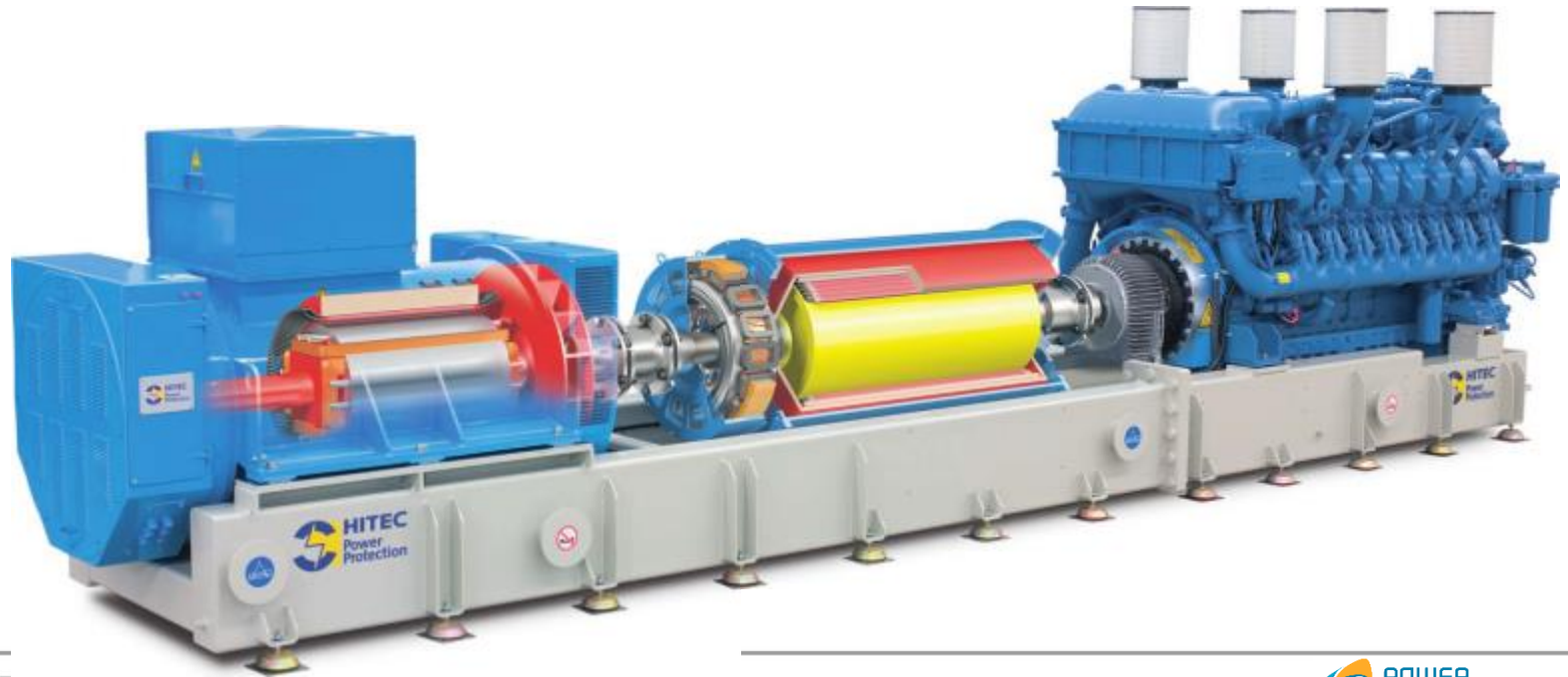



Hitzinger/Hitec/Eurodiesel


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# Typical Drups

- Rotating steel flywheel
- Mechanic double bearing design
- Induction motor/ mechanical discharge
- In air operation
- Precise alignment required to get bearing life
- Manual greasing in stopped mode
- Bearing change in the field with high risk





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# Main Differentiators

| | CleanSource UPS | Competition Flywheel UPS |
|---|---|---|
| Efficiency | Up to 98% | 92-94(96)% |
| Modularity | 300kVA / 250kVA increments | Typically none or limited |
| Maintenance interval | 1 year | ½ year |
| Operation during routine maintenance | On-line or on generator | On bypass |
| Harmonic behavior | Zero impedance | Linear increased impedance with frequency |
| | | |


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# Main Differentiators

| | CleanSource DC 500kW | Pentadyne VSS+ 190kW | Vycon VDC 215kW | Vycon VDC-XE 300kW |
|---|---|---|---|---|
| UPS Solution | CleanSource UPS | Liebert, Toshiba and Socomec | Eaton, MGE, Chloride and Emerson | |
| Flywheel Type | 4340 steel | Carbon fiber composite | 4340 steel | |
| Run Hours | >55 million hours | >3.5 million hours | <200,000 hours | |
| Critical Bus MTBF | 2,250,800 hours | Unknown | Unknown | Unknown |
| Usable Energy Storage | 6,945 kW-sec @ 500kW (14.5 sec) | 1,900 kW-sec @ 190kW (10 sec) | 1,110 kW-sec @ 215kW (5 sec) | 1,212 kW-sec @ 300kW (4 sec) |
| Energy Density | 3.46 kW-sec / sq in | 2.11 kW-sec / sq in | 1.23 kW-sec / sq in | 1.35 kW-sec / sq in |
| Relative Energy Density | 1.00 | 0.61 | 0.35 | 0.39 |
| Standby Losses (Efficiency) | 1,380 Watts (99.0%) | <300 Watts (99.9%) | 1,720 Watts (99.2%) | 1,800 Watts (99.4%) |
| UPS+Flywheel Efficiency | Up to 98% | 91.9% | 91.5% | |
| Cost per Unit Energy ($ / kW-sec) | $15.52 | $17.43 | $40.54 | $37.13 |


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# TIA-942 Data center standards

- **G.5.1.3 Uninterruptible power supply (UPS)**

  UPS systems can be static, rotary or hybrid type and can either be online, offline or line interactive with sufficient backup time for the standby generator system to come online without interruption of power. Static UPS systems have been used almost exclusively in the United States for the last several years, and are the only systems described in detail herein; the redundancy concepts described are generally applicable to rotary or hybrid systems as well, however.

  UPS systems may consist of individual UPS modules or a group of several paralleled modules.

  Each module should be provided with a means of individual isolation without affecting the integrity of operation or redundancy. The system should be capable of automatic and manual internal bypass and should be provided with external means to bypass the system and avoid interruption of power in the event of system failure or maintenance.

  Individual battery systems may be provided for each module; multiple battery strings may be provided for each module for additional capacity or redundancy. It is also possible to serve several UPS modules from a single battery system, although this is typically not recommended due to the very low expected reliability of such a system.

- TIA-942 96

  When a generator system is installed, the primary function of the UPS system is to provide ridethrough during a power outage until the generators start and come on-line or the utility returns.

  Theoretically, this would imply a required battery capacity of only a few seconds. However, in practice, the batteries should be specified for a minimum of 5 to 30 minute capacity at full-rated UPS load due to the unpredictable nature of battery output curves


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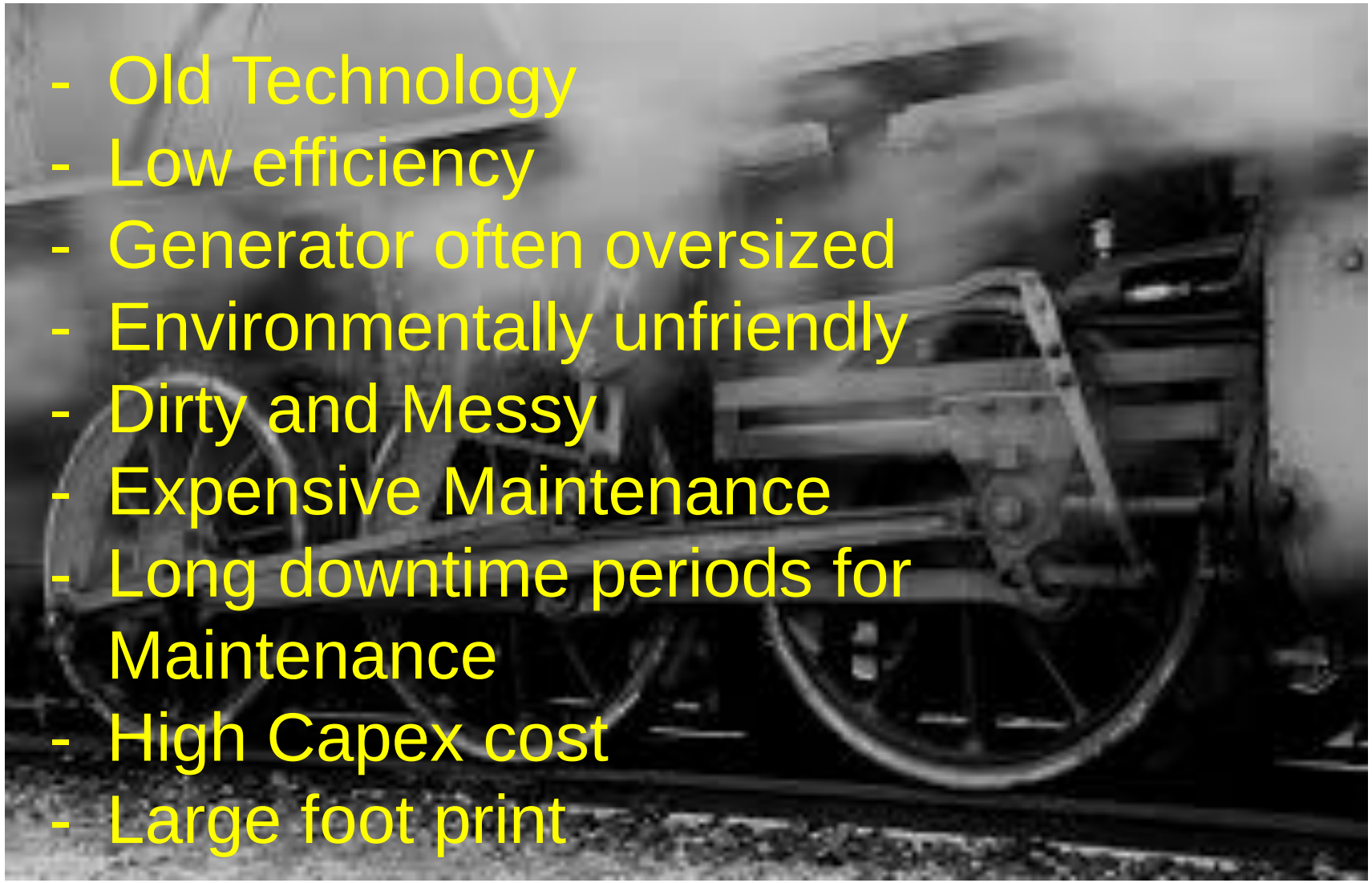
# TIA- 942

ANSI/TIA-942-A

| | TIER 1 ($E_1$) | TIER 2 ($E_2$) | TIER 3 ($E_3$) | TIER 4 ($E_4$) |
|---|---|---|---|---|
| ***Uninterruptible Power Supply System*** | | | | |
| Redundancy | N | N | N+1 | 2N |
| Topology | Single or Parallel-Modules | Single or Parallel Modules | Distributed Redundant Modules or Block Redundant System | Distributed Redundant Modules or Block Redundant System |
| Automatic Bypass | Not required | Yes with non dedicated feeder to automatic bypass | Yes, with dedicated feeder to automatic bypass | Yes, with dedicated feeder to automatic bypass |
| Maintenance Bypass Arrangement | Not required | Non dedicated maintenance bypass feeder to UPS output switchboard | Dedicated maintenance bypass feeder serving UPS output switchboard | Dedicated maintenance bypass feeder serving UPS output switchboard |
| Output Power Distribution | Panel board incorporating standard thermal magnetic trip breakers | Panel board incorporating standard thermal magnetic trip breakers | Switchboard incorporating removable circuit breaker with adjustable long time and instantaneous trip function | Switchboard incorporating removable circuit breaker with adjustable long time, short time and instantaneous functions with provision to turn off instantaneous function |
| Battery String | Common String for multiple modules | Dedicated String for each module | Dedicated String for each module | Dedicated String for each module |
| Battery type | 5 Year valve regulated lead acid or flywheel | 10 Year valve regulated lead acid or flooded type or flywheel | 15 Year valve regulated lead acid or flooded type or flywheel | 20 Year lead acid flooded type or flywheel |
| Battery minimum back up time with design load at end of battery life | 5 minutes | 7 minutes | 10 minutes | 15 minutes |
| Battery Monitoring System | Not required | Not required | String level by UPS System | Centralized automated system to check each cell for, voltage, and impedance or resistance |
| ***Power Distribution Unit*** | | | | |
| Transformer | Standard high efficiency | Standard high efficiency | K-Rated or harmonic cancelling, high efficiency | K-Rated or harmonic cancelling, low Inrush high efficiency |
| ***Automatic Static Transfer Switch*** | | | | |
| Over-current Device | Not required | Not required | Circuit Breaker | Circuit Breaker |
| Maintenance Bypass Procedure | Not required | Not required | Manual Guided with mechanical interlock | Automatic operation |
| Output | No requirement | No requirement | Dual Circuit Breaker | Dual Circuit Breaker |


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# Drups


- Old Technology
- Low efficiency
- Generator often oversized
- Environmentally unfriendly
- Dirty and Messy
- Expensive Maintenance
- Long downtime periods for Maintenance
- High Capex cost
- Large foot print

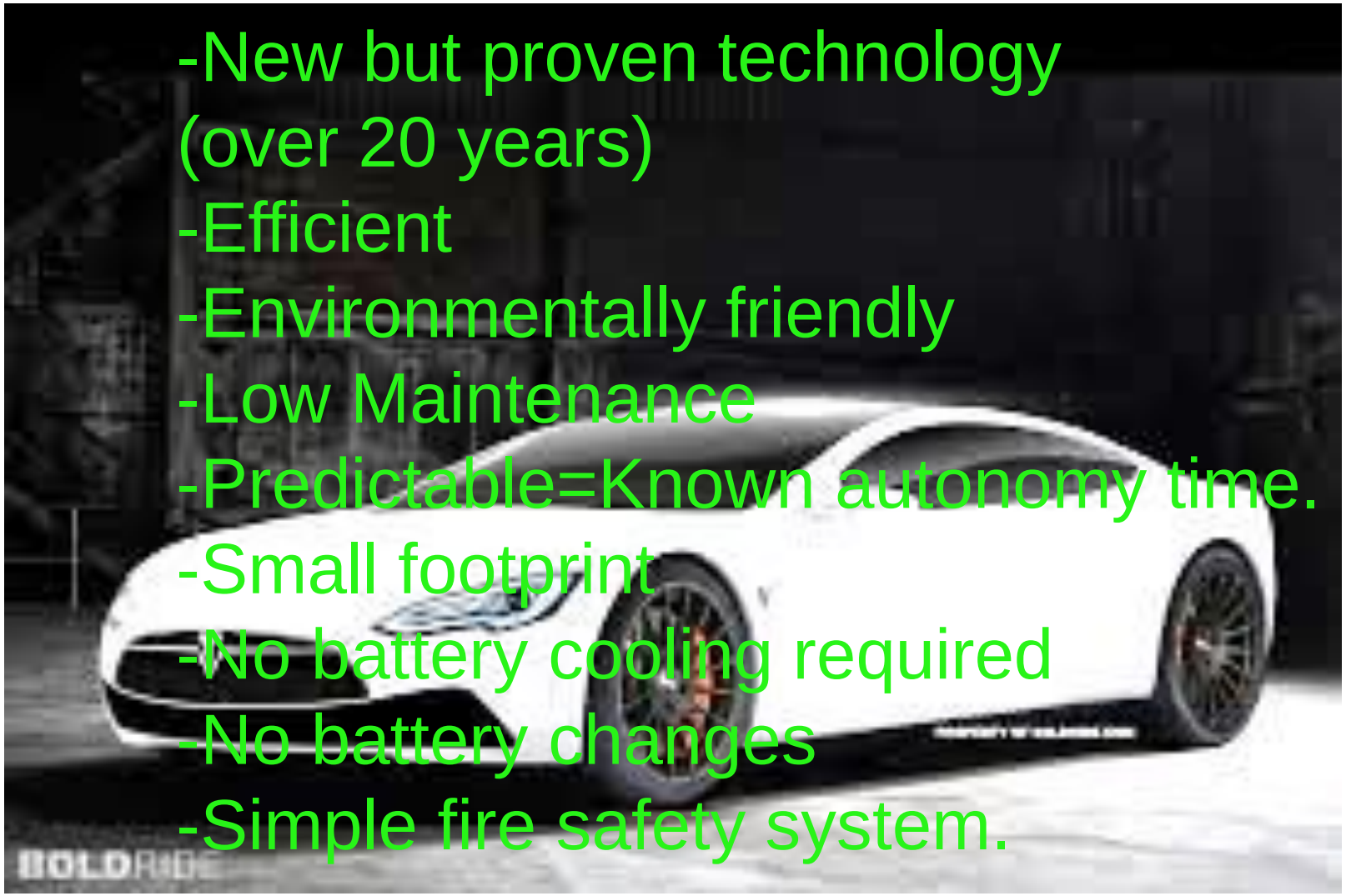
# Double Conversion UPS





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# Flywheel UPS



# Who is Using the Technology

# Select US UPS Customers

- Medical/Pharmaceutical
  - Sanofi, Human Genome, Baxter,
  - Morristown, **Novartis**, Amylin,
  - **Novo Nordisk**, Wyeth Pharm.
  - AstraZeneca, Eli Lilly, **Merck**
  - **Parkland Hosp, Geisinger Med**
- TV Broadcasting
  - KVEA , Univision, CTN, WCYB
  - KLAS, Telemundo, WNBC, WPXN
- Banking/Finance
  - Dean Witter, Visa, MBNA
  - Community 1st Bank
  - **AIG**, **Barclay's**

Electronics Manufacturing

- Sun Microsystems, Dell, Xilinx
- Seagate, Ionics, **Hewlett Packard**, Solectron, Sprint, Emcore, Kodak

Process Manufacturing

- NuFern Fibers, Shaw Industries
- **Goodyear**, Mac Steel, Court Valve
- Cardinal Glass, Viking Range,
- Advanced Poly Bag,
- Michelin

Data Centers

- NETAPP, M&A Tech., **BP**, Silicon Graphics, AIG, **US NAVY**, NYCDOT, Raytheon, **Stanford University**,
- Advanti.com, MONSTER.com, **Brookhaven NL**, Search Engine Co.
- Redmond Schools, **Princeton**, ND State. Lehman Brothers, HEB, **Verizon/Terremark**


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# Who trusts in Active Power?





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# Partial Project Ref In Singapore

| Customer | Country | Model | Year |
|---|---|---|---|
| Caterpiller Singapore Training Centre | Singapore | CSUPS250i | 27-Nov-01 |
| Powerware Singapore | Singapore | CSUPS-250 | 8-Jan-02 |
| Caterpiller Singapore New office Building | Singapore | CSUPS250i | 16-Aug-02 |
| Caterpiller Singapore New office Building | Singapore | CSUPS250i | 16-Aug-02 |
| Caterpillar Singpaore(Thai Agri) | Singapore | CSUPS250iE | 20-Dec-02 |
| Invensys Singapore (SSMC) | Singapore | CSUPS250 | 14-Feb-03 |
| Invensys Singapore (SSMC) | Singapore | CSUPS250 | 14-Feb-03 |
| Invensys Singapore (SSMC) | Singapore | CSUPS250 | 14-Feb-03 |
| Invensys Singapore (SSMC) | Singapore | CSUPS250 | 14-Feb-03 |
| Invensys Singapore (SSMC) | Singapore | CSUPS250 | 14-Feb-03 |
| Cat Singapore Office | Singapore | CSUPS250i+1 | 8-Dec-07 |


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# Applications and References

# State Grid - Beijing

## State Grid Corp of China – Beijing

### Background

State Grid Corporation of China (SGCC) is the largest state owned utility in the world responsible for the transmission and distribution of power across the country via its subsidiaries. Headquartered in Beijing, the distributor is listed #7 on the Fortune 500 Global 2014 rankings.

### Challenge

With the upcoming 2014 APEC (Asia Pacific Economic Cooperation) Forum in Beijing, China Central Television (CCTV) would be responsible for constant, uninterrupted broadcasting of all forum activities at multiple meeting venues across the city including Beijing National Stadium. To support CCTV at these broadcast sites, SGCC required a mobile critical power solution that could be deployed and redeployed within hours; however, 10 $m^2$ allocated for UPS made for tight quarters in addition to lack of conditioned space.

### Solution

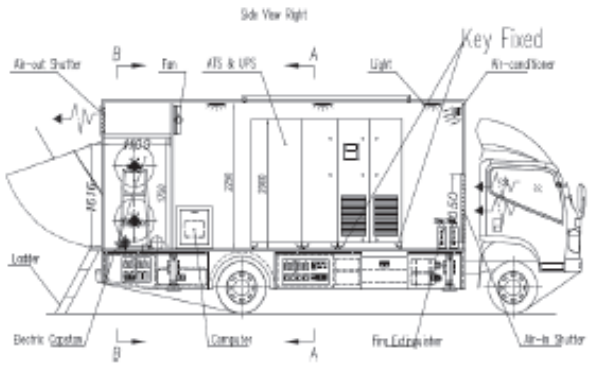
SGCC, with the support of Active Power and its distributor Beijing Honest Credibility Electric Technology Co., turned away from conventional approaches to electrical design and creatively designed and built "flywheel trucks." These truck mounted modular power systems include Active Power's CleanSource 500 kVA UPS and automatic transfer switch all installed in approximately 10 $m^2$. The 500 kVA flywheel UPS consumes just 3.7 $m^2$ compared to nearly 6 $m^2$ for an equivalent legacy UPS with four standard battery cabinets. Space and an unconditioned environment deterred use of legacy UPS.

SGCC's fleet of 17 trucks provided critical power support to CCTV's broadcast operations, lighting, and other critical equipment. These trucks leverage the unique attributes of the flywheel UPS including industry leading power density in a compact footprint, high reliability, and operating efficiencies of up to 98 percent.

### Result

These mobile power solutions enabled CCTV to deliver on its promise of an uninterrupted broadcast of APEC Forum events worldwide. Outside of APEC Forum, these trucks have been used to support a number of national events and have delivered temporary critical power following severe weather events.





# WFF-TV

## WFFF-TV / WVNY-TV (Burlington, VT)

### Background

WFFF-TV (FOX) and WVNY-TV (ABC), properties of Nexstar Broadcasting, serve major portions of Vermont, northern New Hampshire, and upstate New York with significant viewership in Montreal. The station is located in Colchester, VT, a suburb of Burlington.

### Challenge

The stations had two specific goals as it embarked on building out their digital television network – deliver the highest quality television service available and create a reliable service infrastructure for its viewers with no interruptions. The station also required a UPS system with very low maintenance.

### Solution

To meet these requirements, WFFF-TV and WVNY-TV chose to deploy an **Active Power CleanSource 150 kVA UPS system** to ensure continuous availability and uptime of its transmitter signal.

### Result

Active Power delivered a more reliable and cost effective solution with lower maintenance requirements versus a legacy battery UPS. The system has enabled the two stations to deliver on their promise of providing a high quality product with no interruptions to their growing viewership base.

**We felt CleanSource UPS was a more affordable solution with lower maintenance than conventional battery UPS systems. We had more than 200 power incidents over a period of six months following installation with no interruption in service to our viewers. This machine is just a workhorse.**

– Matt Servis, Director, Engineering





# WCBD- TV

## WCBD-TV (Charleston, SC)

### Background

WCBD-TV is the NBC-affiliated television station for the Low Country and Charleston area of South Carolina and broadcasts a high definition digital signal from a transmitter in Awendaw, South Carolina. The station is owned by Media General, Inc.

### Challenge

The station's transmitter site is located at the end of a utility cooperative line so sags were a constant caused primarily by switching transients upstream from the site. Also, crowbar events (10 millisecond short to ground of high voltage power supply) resulting from sags or spikes would at times interrupt broadcasts and/or bring the transmitter site down partly or completely, requiring a restart. This downtime would result in a loss in advertising dollars and unplanned pay and time to dispatch a technician out to the site to make repairs – 52 miles roundtrip and approximately one hour to make repairs. The station at times could make 3-4 visits out to the site in a single week due at times to power disturbances.

### Solution

To achieve continuous, long term steady power and protect against crowbar events, the station deployed an **Active Power CleanSource 300 kVA UPS** to protect the site's transmitter, transmitter studio links (TSL/STL), electronic news gathering (ENG) microwaves, fiberoptics, and other critical electrical components. The parallel online architecture of CleanSource UPS is uniquely designed to manage crowbar events and the overloads and step loads typically seen with these events versus a legacy UPS with batteries. CleanSource UPS will switch to bypass to supply desired current from the lowest impedance source with no interruption to transmitters on the same circuit in the event of an overload from a crowbar event.

### Result

The flywheel UPS has experienced approximately 1,300 discharges since being deployed in February in 2012 with no interruption to the transmitter site. In fact, trips out to the site are rare except to conduct routine maintenance.

*We are pleased with the operation of the UPS since its installation and reliability of the transmitter. There is a lot to be said for equipment that works right out of the box and that certainly is the case here.*

**– Art Smith, Chief Engineer**

Count on News 2 HD
WCBD-TV Charleston





# Telecommunications | Containerized Datacenter

*Who?*
Major wireless telecom provider (California)

*Need?*
Supports containerized datacenter deployment

*How was the customer's problem solved?*
Rapid delivery of 2x PowerHouse systems (rated at 480 kW each) and chillers

*Key Drivers*
- Time to market
- Full turnkey continuous power solution
- Energy efficiency

*Unique Fact*
Teamed with one of Active Power's strategic IT partners; 10 weeks to get up and running




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# Data Centers

# BendBroadband Vault

## The Vitals

- Located in Bend, OR
- 30,000 sq ft carbon neutral enterprise class data center
- Colocation, disaster recovery, dedicated managed services, and cloud computing
- Financial, healthcare, and telecom clients

## Certifications

- Uptime Institute Tier III Certified – Constructed Facility and Design Documents
- USGBC LEED Gold certified
- EPA Energy Star (pending)
- SSAE 16 Type II, stringent auditing standards for service companies (preliminarily audited)

bendbroadband™ Vault a GREEN Data Center

TIER III FACILITY™
BendBroadband Vault Data Center Phase One
June 14, 2011
UPTIME INSTITUTE CERTIFIED




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# BendBroadband Vault





## Enabling UPS Technology

- 1x 600 kVA high efficiency flywheel based CleanSource UPS

## The Ingenious Infrastructure

- 1 of only 5 data centers worldwide to achieve LEED Gold cert
- First facility on west coast to achieve Tier III cert of Design Documents
- PUE of less than 1.2
- 35% reduction in cooling due in part due to battery free UPS deployment, additional cooling not required


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# Large Enterprise | Datacenter

*Who?*
Capgemini Merlin facility (Swindon, UK)

*Need?*
Datacenter protection

*How was the customer's problem solved?*
Fully containerized high efficiency CleanSource UPS 1500 kVA; 3 continuously rated diesel engines; transformers and switchgear

*Key Drivers*
- Single contract, turnkey solution
- Energy efficiency
- Space
- Benefits of containerization

*Unique Facts*
- Certified Tier 3 by Uptime Institute
- Low PUE of 1.11
- Datacenter Dynamics Green Data Centre Award
- Uptime Institute Green Enterprise IT Award

Capgemini
CONSULTING.TECHNOLOGY.OUTSOURCING

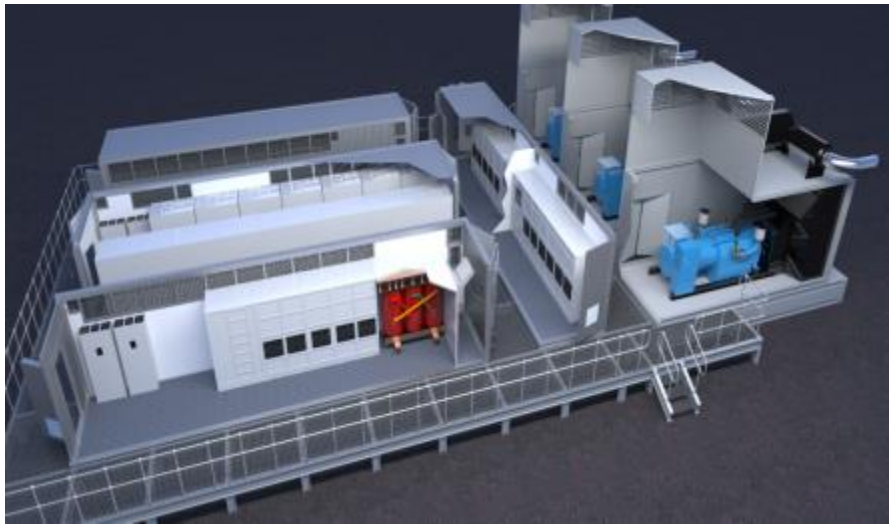





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# Capgemini – Project Merlin





## Enabling Power Infrastructure

- Fully containerized high efficiency CleanSource UPS 1500 kVA
- 3 continuously rated diesel engines with transformers and switchgear, containerized and acoustically treated

## The Ingenious Infrastructure

- First modular data center and plant configuration design to be awarded Tier III cert of Design Documents
- 1 of only 7 data centers in UK to earn Tier III cert of Design Documents
- Low PUE of 1.11
- Uptime Institute Green Enterprise IT Award for Data Center Design, 2011
- Datacenter Dynamics Leaders Award for Green Data Center, 2010


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# Challenge – Space Efficiency

- Global colocation and managed hosting services provider with 8 cloud-enabled facilities, 35 regional data centers worldwide

- ***We're in the business of selling square footage, not consuming it ourselves."*** **- Ben Stewart, Terremark**

- Leveraged CleanSource UPS and PowerHouse across three sites

- Approx. 34 MW UPS capacity deployed to date:
  - NAP of the Americas – Culpeper, VA
  - NAP West – Santa Clara, CA
  - NAP Amsterdam



# Challenge – PUE Below 1.1

- Design requirement: PUE < 1.1
  - Industry-best in 2010

- Key innovations
  - Site selection (Lockport, NY) to support year-round free-air cooling
  - Yahoo! Computing Coop – ~ 50 200 kW modules with integrated IT, UPS, and cooling
    - Small modules keep utilization and efficiency high
    - Each module with application-driven availability (Tier I-III)
  - **Active Power CSUPS selected to provide energy- and space-efficient power protection**

- Achieved PUE of 1.08





Yahoo! Computing Coop
200 kW critical power
20 racks @ 10 kW/rack
AP CSUPS 300


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# Colocation Facility – Phoenix, Arizona

## The Vitals

- More than 538,000 sq ft of available space
- High density colocation, private cloud computing, network services, and remote support

## Certifications

- Uptime Institute Tier III Certified – Design Documents
- SSAE 16 Type II, stringent auditing standards for service companies



# Colocation Facility – Phoenix, Arizona





## Enabling UPS Technology

- 6x 900 kVA high efficiency flywheel based CleanSource UPS

## The Ingenious Infrastructure

- Considered one of the largest data centers in the world
- Largest commercially available data center in the U.S. to achieve Tier III cert for Design Documents
- 41 MW of power capacity deployed, expandable to 120 MW

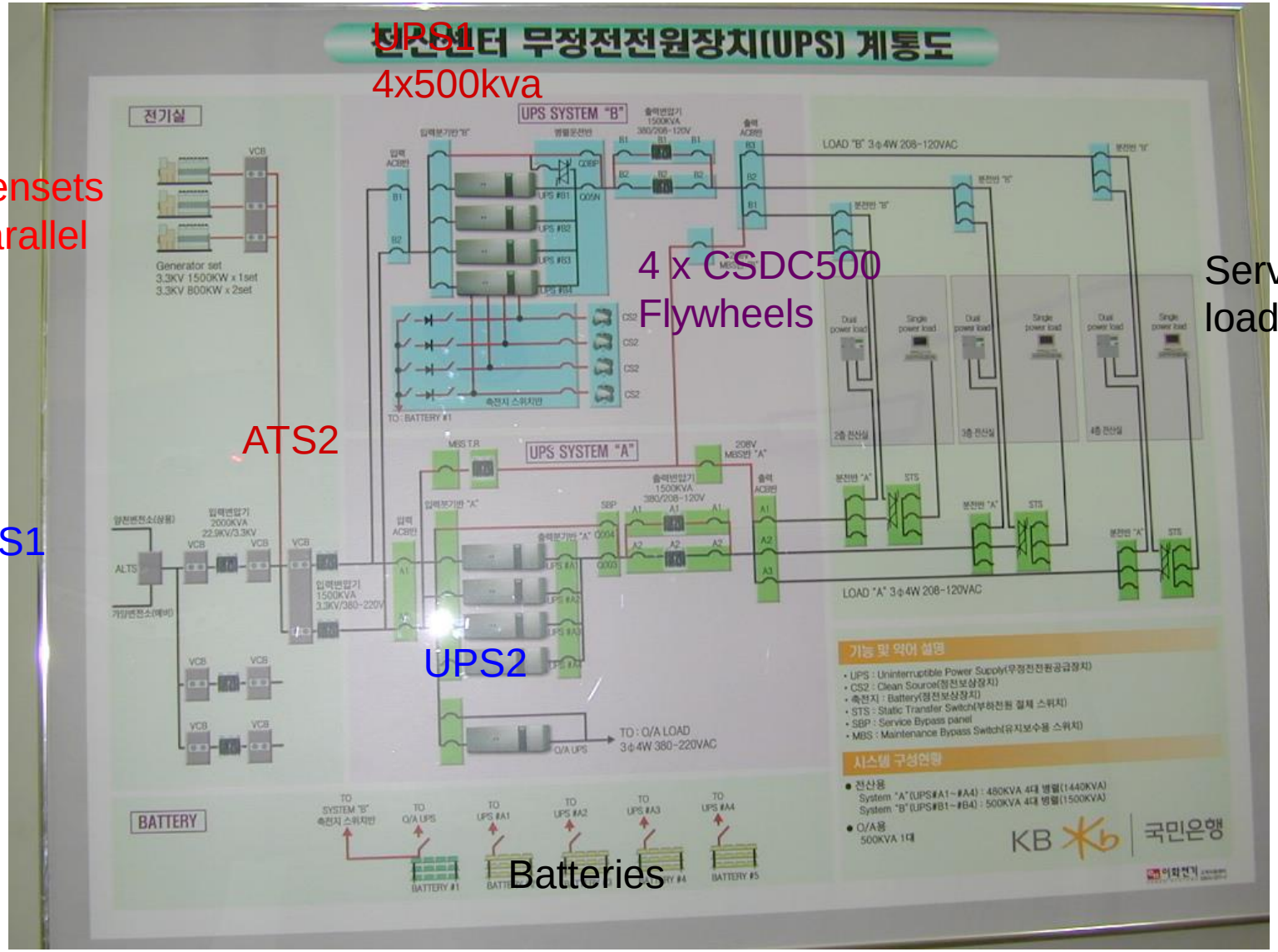

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# GDS Data Center in Shanghai




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# Major Bank in South Korea



# Major Bank in South Korea



# Major Bank in Beijing….




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# Datacenter | Corporate

*Who?*
Tesco (London)

*Need?*
Datacenter protection

*How was the customer's problem solved?*
2x PowerHouse systems (stacked) each containing CleanSource 1500 kVA UPS, 1900 kVA standby diesel, and fuel tank

*Key Drivers*
- Energy efficiency
- Reliability
- Green

*Unique Facts*
Final assembly and tie in occurred over two successive weekends





# Corporate | Datacenter

PowerHouse
1 x CleanSource UPS 750kVA
1 x Diesel Generator

For supply of datacenter
- 750kVA  no-break
- 300kVA  short-break

Installed mid 2006

Service
Full-service maintenance contract with ability of remote access





# Corporate | Datacenter

*Who?*

Transportation organization (Malaysia)

*Need?*

Datacenter protection

*How was the customer's problem solved?*

- CleanSource UPS 1500iC kVA 1250 N+1
- Diesel engine generator (3 x 885 kVA)
- Generator Starting Module
- Generator Controller

*Key Drivers*

- Cost effective redundant configuration
- Space efficiency
- Energy efficiency

*Unique Fact*

First complete Active Power system solution in Asia; many individuals from various Asian countries have visited the site





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Industrial

# HK Power Utility





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# Solar Panel Factory in China…





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# Petrochemical

*Who?*
Pemex Refinacion (Madero, Tamaulipas, Mexico) (repumping stations)

*How was the customer's problem solved?*
2x CleanSource UPS 900 kVA systems

*Key Drivers*
- Reliability
- Energy efficiency

*Unique Fact*
Each system protects one 600/4160V horsepower motor that is 50% of its production; all of northern Mexico stations would stop if this station goes down because it is the first station after Madero refinery; no other available system that could protect motor loads and keep at least 50% of the station pumping fuels to northern Mexico




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# Industrial | Steel Production

*Who?*
Iron and steel producer (Zonguldak, Turkey)

*Need?*
Process manufacturing

*How was the customer's problem solved?*
1x CleanSource UPS 120i system

*Key Drivers*
- Infinite discharges
- Energy efficiency
- Reliability

*Unique Fact*
End user had never deployed flywheel or rotary based UPS systems onsite




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# Industrial | Process Manufacturing

*Who?*

Consumer and commercial products manufacturer (Newport News, VA)

*Need?*

Contract manufacturing and mold making

*How was the customer's problem solved?*

1x CleanSource UPS 600 kVA system

*Key Drivers*

- Efficiency
- Footprint
- Reliability

*Unique Fact*

One million square foot facility employs more than 1,400 employees




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# Industrial | Chemical Manufacturing

*Who?*

Chemicals manufacturer (Nunchritz, Germany)

*Need?*

Silicon production

*How was the customer's problem solved?*

2x CleanSource UPS 750iZ kVA systems

*Key Drivers*

- Space efficiency
- Modularity

*Unique Fact*

Facility produces pyrogenic silica, siliconates, chlorosilanes, silicone fluids, and antifoam agents for the semiconductor market





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# Industrial | Process Manufacturing

*Who?*

IRCE (Milano, Italy)

*Need?*

Process manufacturing

*How was the customer's problem solved?*

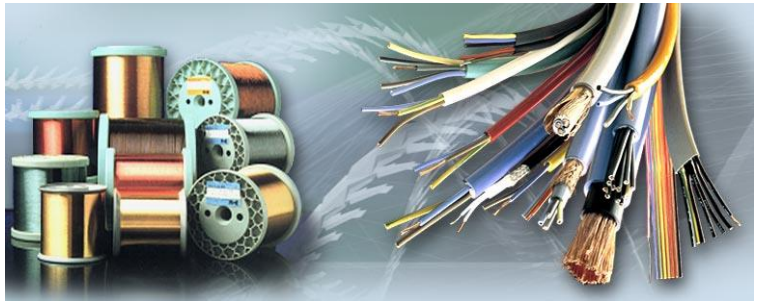
3x CleanSource UPS 500i kVA systems

*Key Drivers*

- Reliability
- Energy efficiency

*Unique Fact*

End user had never deployed flywheel or rotary based UPS systems onsite





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# Industrial | Process Manufacturing

*Who?*

Glass and ceramics manufacturer (NY)

*Need?*

Glass manufacturing equipment

*How was the customer's problem solved?*

2x CleanSource UPS 1200 kVA systems

*Key Drivers*

- Reliability
- Energy efficiency

*Unique Fact*

Systems will protect end user's mission critical kiln facility




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# Industrial | Printing Processes

*Who?*
Commercial printer (Baku, Azerbaijan)

*Need?*
Printing equipment

*How was the customer's problem solved?*
1x CleanSource UPS 750i kVA systems

*Key Drivers*
- Rugged, ability to operate in harsh environment
- Reliability




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# Industrial | Welding Processes

*Who?*

Industrial manufacturer (Mexico City)

*Need?*

Automated welding equipment

*How was the customer's problem solved?*

1x CleanSource UPS 300 kVA system

*Key Drivers*

- Reliability
- Energy efficiency

*Unique Fact*

End user commented the efficiency and reliability of double conversion UPS system with a flywheel was exactly the same and topology and Active Power design is unique




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# Mobile Power Infrastructure

# Utility | Mobile Power Infrastructure

*Who?*
Large utility (China)

*Need?*
Short bridging power for grid

*How was the customer's problem solved?*
1x CleanSource UPS 250i kVA

*Key Drivers*
- Green
- Reliability
- Energy efficiency

*Unique Fact*
Goal is to introduce solar and wind power as new sources into China's intelligent grid pilot project, but also evaluating flywheel and compressed air as potential technologies






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# Utility | Mobile Power Infrastructure

*Who?*

Large utility (Shanghai, China)

*Need?*

Special event support and onsite power infrastructure as needed

*How was the customer's problem solved?*

PowerHouse system (with CleanSource UPS only)

*Key Drivers*

- Highly mobile solution
- Reliability
- Low maintenance

*Unique Fact*

Utility owns thousands of power systems with containerized generator sets already for event support; customer needed containerized generator sets to protect short break loads and both UPS and generator containers working together to protect no  break loads







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# Mobile Power System In China





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# Mobile Power System






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# Telecommunications | Containerized Datacenter

*Who?*
Major wireless telecom provider (California)

*Need?*
Supports containerized datacenter deployment

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Rapid delivery of 2x PowerHouse systems (rated at 480 kW each) and chillers

*Key Drivers*
- Time to market
- Full turnkey continuous power solution
- Energy efficiency

*Unique Fact*
Teamed with one of Active Power's strategic IT partners; 10 weeks to get up and running




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# Thailand Water Resources Project
## Mobile Data Centre Power System





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# Special Applications

# Suvarnabhumi Airport, Bangkok




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# Transportation | Aviation

*Who?*

International airport (Hungary)

*Need?*

Airport concourse

*How was the customer's problem solved?*

1x CleanSource 1000iz

*Key Drivers*

- High efficiency
- Reliability
- Low maintenance

*Unique Fact*

With this deployment, a total of seven Active Power flywheels have been installed in Hungary







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# UPS for Metal Halide High Mast Lighting System

## South Korea - Jamsil and Mok-Dong Baseball Stadiums





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# Healthcare

# Healthcare – Datacenter

*Who?*
Life sciences firm (Houston, TX)

*Need?*
Datacenter protection

*How was the customer's problem solved?*
1x CleanSource UPS 600Z kVA system

*Key Drivers*
- Space efficiency
- Reliability

*Unique Fact*
Customer develops solutions to help improve efficiencies for clinical drug trials






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# Healthcare | Hospital Infrastructure

*Who?*

Healthcare facility (Chesterfield, MO)

*Need?*

Power protection for facility infrastructure

*How was the customer's problem solved?*

2x CleanSource UPS 1200 kVA systems

*Key Drivers*

» Reliability





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# Healthcare | Hospital Infrastructure

*Who?*

Healthcare facility (South Korea)

*Need?*

Power protection for facility infrastructure

*How was the customer's problem solved?*

1x CleanSource UPS 1500iC kVA 1250 N+1

*Key Drivers*

- TCO
- Cost effective redundancy
- Reliability
- Easy maintenance
- Many references for big hospitals in Korea

*Unique Fact*

Flywheel UPS is uniquely suited to support sensitive MRI equipment






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# Case Overview

- PARKLAND HOSPITAL

- **Principals**
  - **Owner – Dallas County Hospital**
  - **Engineer – HDR**
  - **Electrical Contractor – McDean**

- **Discussion**
  - **Double Conversion vs. Parallel Online**
  - **Public RFP**
  - **Footprint**
  - **Future Proof**




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# The Opportunity disguised as a Problem

- **New Hospital construction needing flywheel, battery free solution, high efficiency and GREEN**
- **Load profile included central electrical plant to serve;**
  - Internal Hospital Data Center
  - Distributed IT and Telecom Loads
  - Medical Equipment
- **Public "County" RFP process**
- **High profile site in Dallas**
- **Footprint constraints**
- **19 Second Ride Through Requirement**

Parkland




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# The Solution Overview

- **IT Load (2.4 mVA)**
  - (2) 600kVA N+1 (expandable ) CSUPS – IN PARALLEL for main hospital data center
  - 2500 amp Custom Switchboards w/ UMBC
  - (2) 600kVA N+1 CSUPS – for building IT and Telecom loads

- **Medical Equipment Load (1.8 mVA)**
  - (2) 600kVA N+1 CSUPS – IN PARALLEL
  - 2500 amp Custom Switchboards w/ UMBC
  - (1) 600kVA N+1 CSUPS

Parkland



# UPMC

- First UPS in 2002 for Emergency area – 300
- Second UPS for main data center in 2003 – 300E
- Two more UPS purchased since then (600 and 300E), with more planned
- “Couldn’t stand more battery failures”



# Westmoreland Memorial Hospital

Westmoreland Regional Hospital

Frick Hospital

- Protection of data center in 2004 with 130 kVA flywheel UPS
- Just purchased 300 kVA for imaging department


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# Selected Hospital Installations

| | |
|---|---|
| BioControl | St. Alexis Hospital |
| Jefferson Medical Center | Kuakini Hospital |
| Prostejov  Hospital | Mission Bay Hospital - SF |
| Czech Army | Johnson City Medical Ctr |
| St. Mary's Hospital | Orange City Health |
| Valleyview Hosp | Geisinger Medical |
| UPSHS Indian Health Service | Turnhout Hospital |
| Children's Hospital – Boston | Johnson City Medical |
| Deaconess Hospital | Oakwood Hospital |
| Frank Howard Hospital | Rebsaman Hospital |
| Union Memorial Hospital | VA Med Ctr |
| Health South | Children's Hospital |
| Central Peninsula General | Sheba Hospital |
| Cook Children's Medical | Marion Community Hospital |
| Geisinger Medical | St. Joseph’s Hosp |
| Mayo Clinic | Sinai Hospital |


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# Questions & Answers

*Thank you for your attention!*




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