DRUPS Yard

# Innovative Technologies - Alternative UPS for Critical Building Systems - Diesel Rotary UPS UNIBLOCK UBTD+

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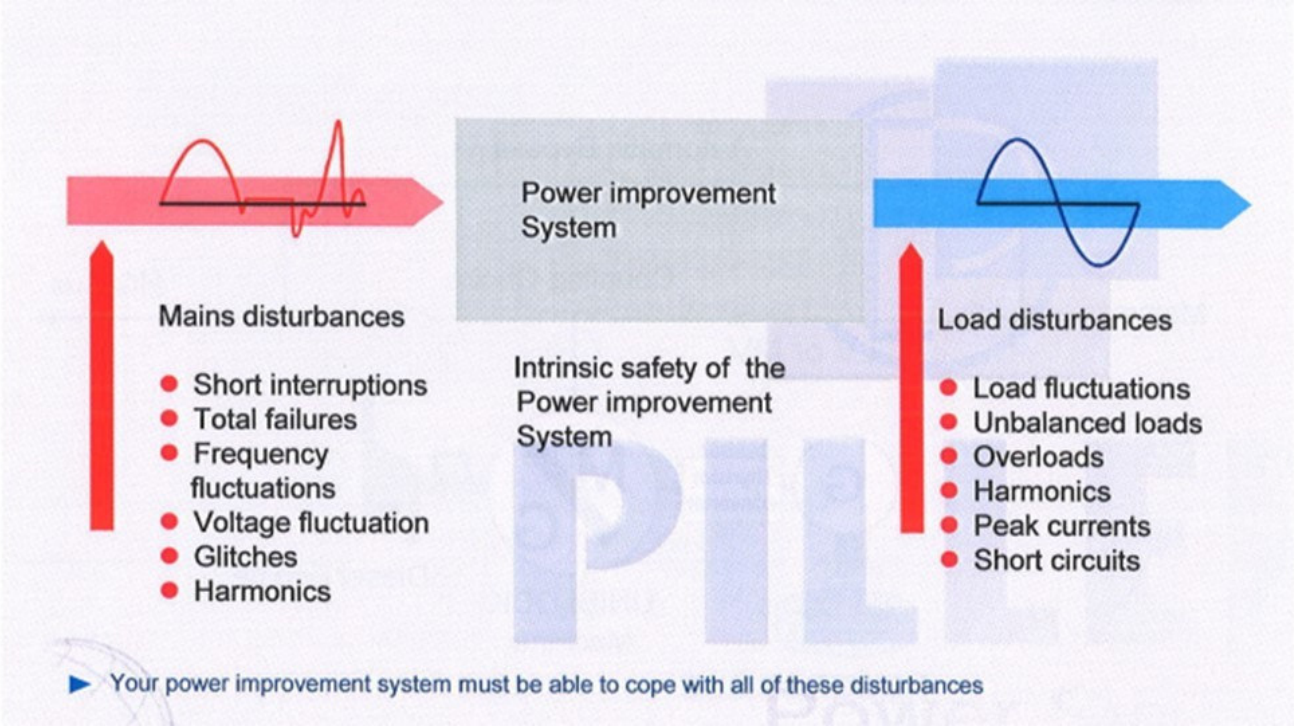
+ Folgen

Why do we need a power conditioning system?




Preamble:

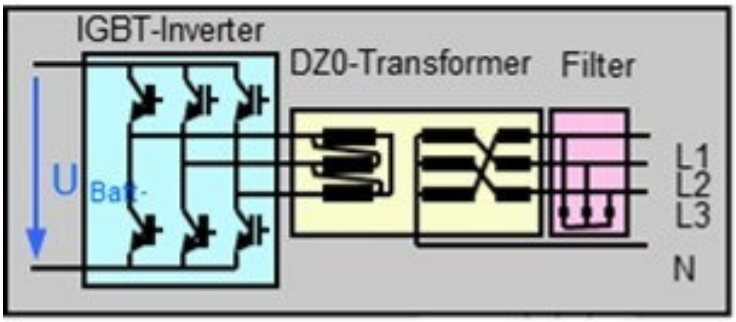
Power systems are extremely critical in running IT campus and Data Centers especially in India as the reliability of power supply and quality from the grid is a huge concern. We have done extensive study in identifying the right solution by keeping our vision in mind. We decided to use Piller's **UNIBLOCK™ UBTD+ Diesel Rotary** UPS system as this system provides flexibility for expansion of Lab Size & Load, Power Quality, Reliability, Power Factor, Easy Maintenance, Sustainability etc.

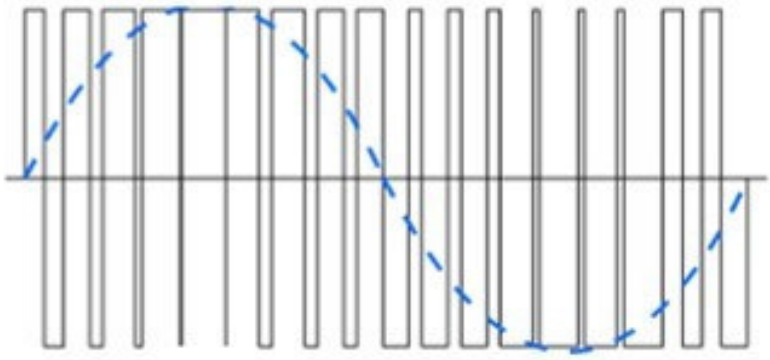
We often get this question "**cost**" for the system? Yes, this system is over 2 times the cost of a typical Diesel Generator + IGBT UPS system, however the ROI is approx 3 to 4 years considering the over all aspect of the system including Space Reduction, Battery Maintenance/Replacement Cost, Air-Conditioning for the Typical System, Flexibility of Expansion and **System Performance.** Unfortunately, our Lab load is significantly reduced from the designed capacity and we would require waiting of 6+ years to recover the additional cost.

The next challenge was the acceptability of non-traditional UPS System by end users (IT and Engineering). We have demonstrated the system reliability of n+1 IP bus system is equal to n+n with proven back up study by Piller (MTBF Figures of 39.4 Million Hours).

**UPS Technologies: Static vs Rotary**

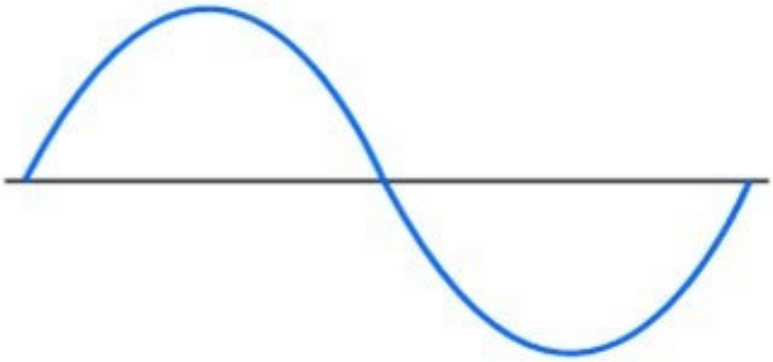
*Static UPS Systems:*



Artificial sine-wave generated by power electronics, thyristors or IGBT´s (Insulated Gate Bipolar Transistors), combined with external batteries. Maximum size of the unit available is 500kVA.

*Rotary UPS systems with natural voltage generation*:

Natural sine-wave generated by modern, robust electrical machines in combination with reliable power-electronics, and additional external power-sources

Maximum size of the unit available is 2500kVA/ 2250 kW (50 Hz)

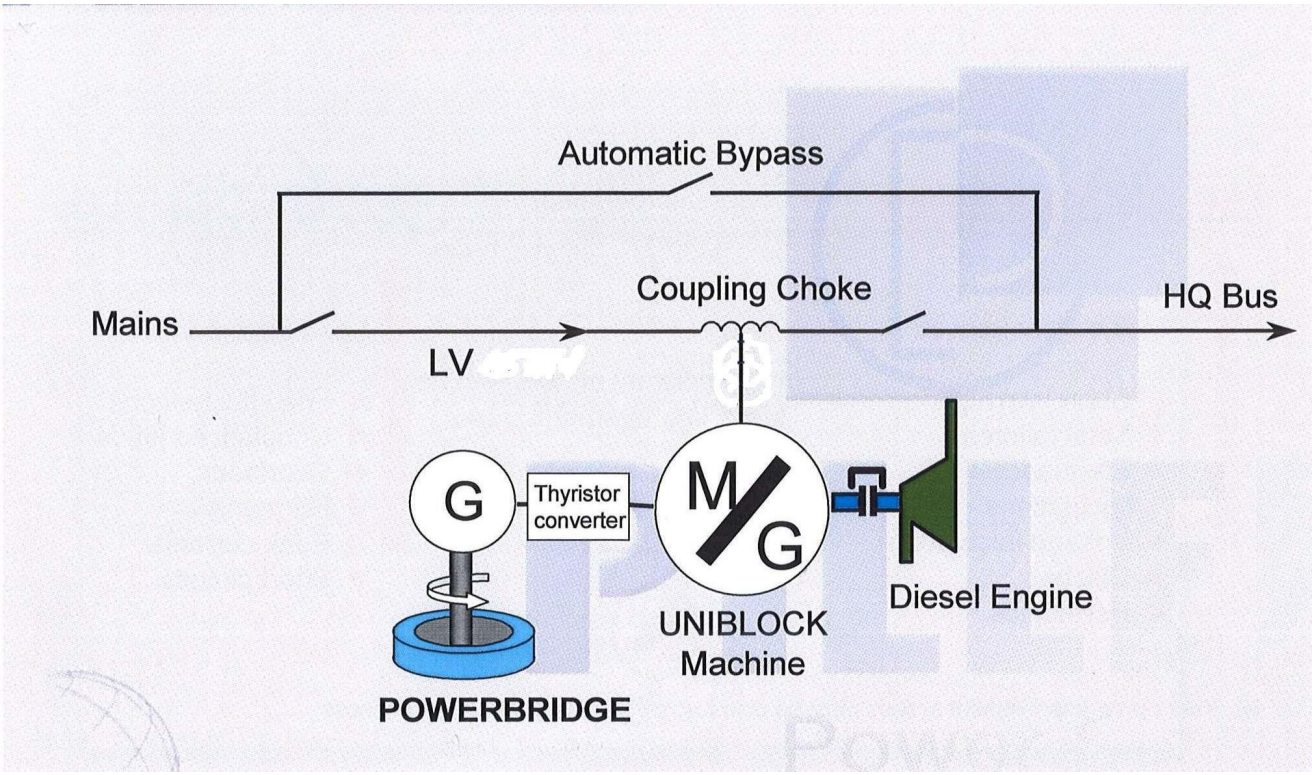
**What is DRUPS?**

Diesel Rotary Uninterruptible Power Supply devices (DRUPS) combine the functionality of a battery-powered or flywheel-powered UPS and a diesel generator. When mains electricity supply is within specification, an electrical generator with a mass functions as motor to store kinetic energy in an electro-mechanical flywheel. In combination with a reactor or

choke coil, the electrical generator also works as active filter for all sorts of power quality problems, like harmonics, RFI and frequency variations. When the main electricity supply fails, stored energy in the flywheel is released to drive the electrical generator, which continues to supply power without interruption. At the same time (or with some delay, for example 2 to 11 seconds, to prevent the diesel engine from starting at every incident), the diesel engine takes over from the flywheel to drive the electrical generator to make the electricity required. The electro-magnetic flywheel can continue to support the diesel generator in order to keep a stable output frequency.

The main advantages of DRUPS equipment, compared to battery-powered UPS combined with a diesel-generator, are the higher overall system energy efficiency, smaller footprint, use of fewer components, longer technical lifetime (no use of power electronics) and the fact it does not result in chemical waste (no use for batteries).

A DRUPS can provide a ride-through time of 15–40 seconds. A flywheel UPS can be installed ahead of typical UPS battery systems to reduce the effects of lightning and switching transients and to increase battery life.




**UNIBLOCK™ UBTD+ Diesel Rotary UPS**

Principle of Operation:

The UNIBLOCK™ UBTD+ Diesel Rotary UPS combines all the benefits of a rotary UPS with a diesel engine in one integrated unit. The system consists of the UNIBLOCK™ motorgenerator (MG) connected via a free wheel clutch to a diesel engine, all mounted on a single short base frame. The load is normally fed via an isolating and coupling choke connected to the utility supply. The choke has a second tapped connection to the motor-

generator. In the event of short interruptions or complete outages, the load is supported initially by a ride-through source which can be either a conventional battery system or a POWERBRIDGE™ electrically-coupled kinetic energy store. With the load safely supported, the diesel engine is then given a command to start. Once up to speed, the system hands over the long-term support of the load to the engine by seamlessly engaging the clutch.

The UNIBLOCK™ Motor-Generator:

At the heart of Rotary UPS lies the pre-eminent UNIBLOCK™ synchronous motorgenerator with its unique low-distortion, high fault-clearing characteristics. The UNIBLOCK™ machine's motor and generator windings share a common stator and a single brushless rotor to provide a highly compact double winding machine with unique electrical characteristics. The combination of special electric steel and combined stator windings gives rise to a machine with exceptionally high efficiency whilst exhibiting the sub-transient reactance required for low harmonic distortion and high fault clearing capacity. An incorporated damper cage reduces harmonics and the standard bearing design ensures long operational performance with minimal maintenance.

System Reliability:

A design free of power capacitors eliminates the common failure component generally found in static UPS. The durable rotary machine technology is far less sensitive to damage from overload and other electrical disturbances and uses no brushes, slip rings or complex bearing arrangements. The power electronics employ rugged semiconductor technology with no need for internal device paralleling or multiple power capacitors. Bypass operation is not required for any aspect of the UPS function and in most cases electric cooling fans are eliminated by using the impeller of the UNIBLOCK™ machine for the system cooling. All of these factors combine to provide a UPS which exhibits a level of reliability that cannot be matched by other technologies.

Power Quality:

Improvement The UBTD+ will compensate for the supply of very low input voltages, including voltage sags to 50% of nominal voltage, without disconnection. It can protect against brownouts to -30% without even having to use the ride-through stored energy. The unit easily handles 100% non-linear loads as well as 100% step loads while maintaining a stable output. Acting as a bi-directional filter inside the UPS, the choke eliminates the passage of nearly all harmonics between load and source.

Power Factor Correction:

Power factor correction is automatic with the UBTD+. The MG and choke combination compensates for poor power factor loads so that the utility sees near unity across all load levels. This means no electricity tariff penalties need apply and additional power factor correction units are not required.

Fault Handling:

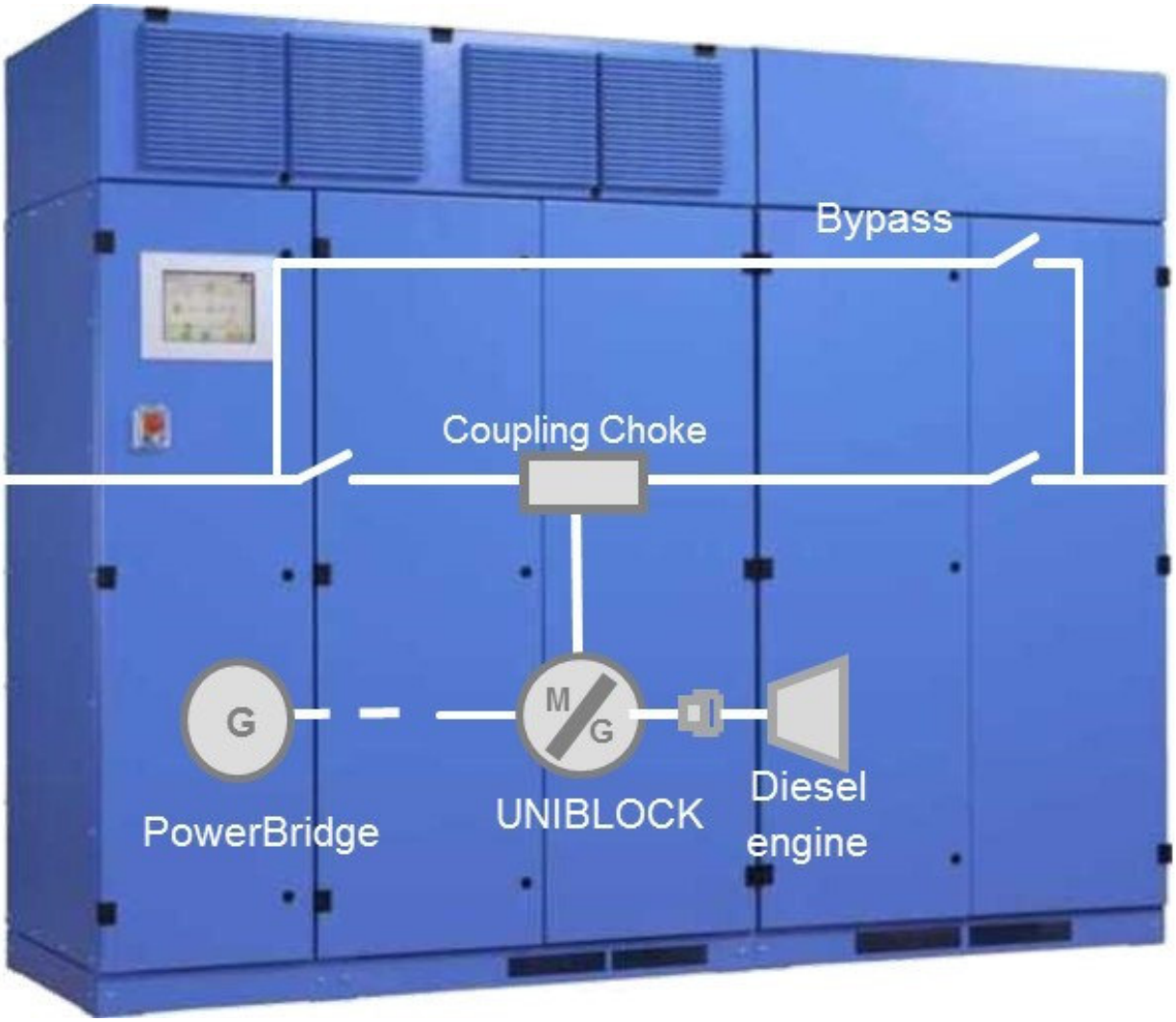
The UBTD+ is inherently capable of clearing short circuit faults by virtue of extremely low sub-transient reactance, that approximates towards normal supply transformer impedances, ensuring fault clearing current can be generated internally by the UPS. This capability represents a step improvement in fault tolerance of the power system when compared for example, to a conventional static UPS solution.

Maintenance:

Nothing in the standard UBTD+ design requires off-site refurbishment and the maintenance requirements are less than most alternative topologies, with no power capacitors or fans to be periodically changed. As per Piller's claim life expectancy of the UNIBLOCK™ easily exceeds 20 years.

Here is the link for Piller - UNIBLOCK UBTD - Rotary Diesel UPS Simulator - **https://www.youtube.com/watch?v=VqnDis66lrI**

UNIBLOCK UBTD+ Single Line Diagram:




UNIBLOCK UBT+ range

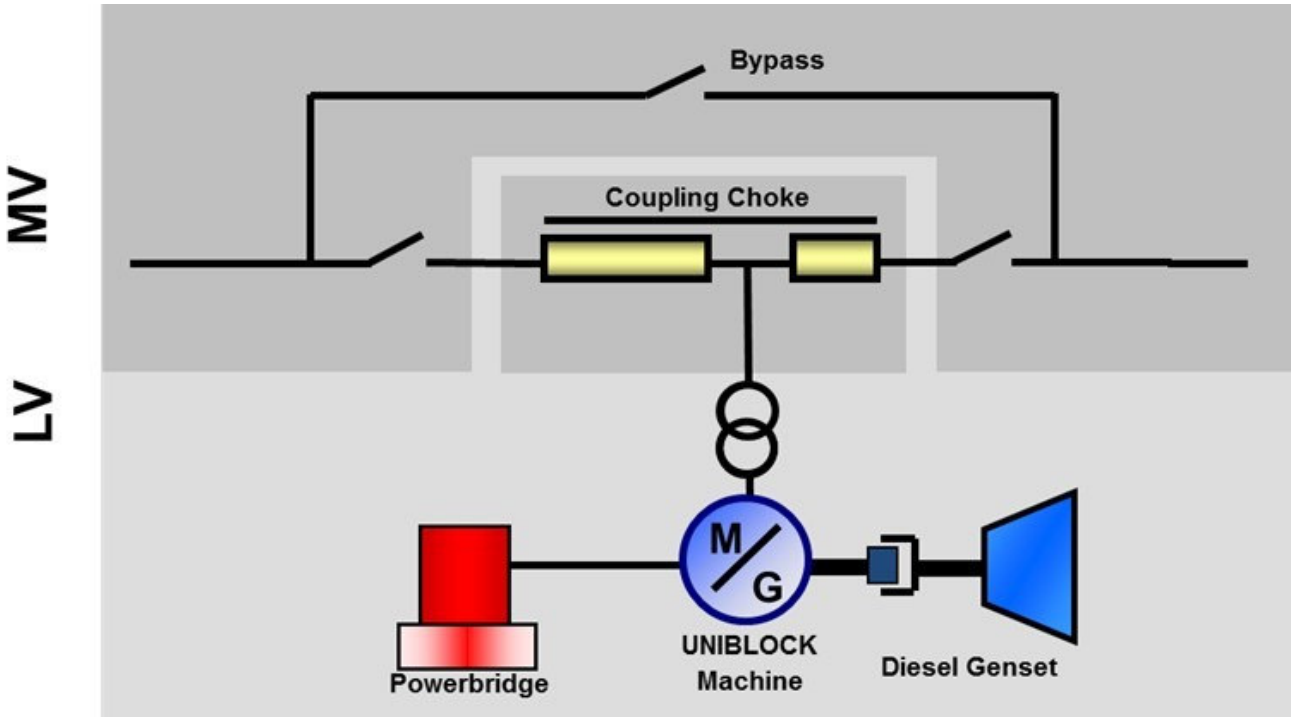
Frequency: 50 Hz

Voltage:  380 V up to 25 kV

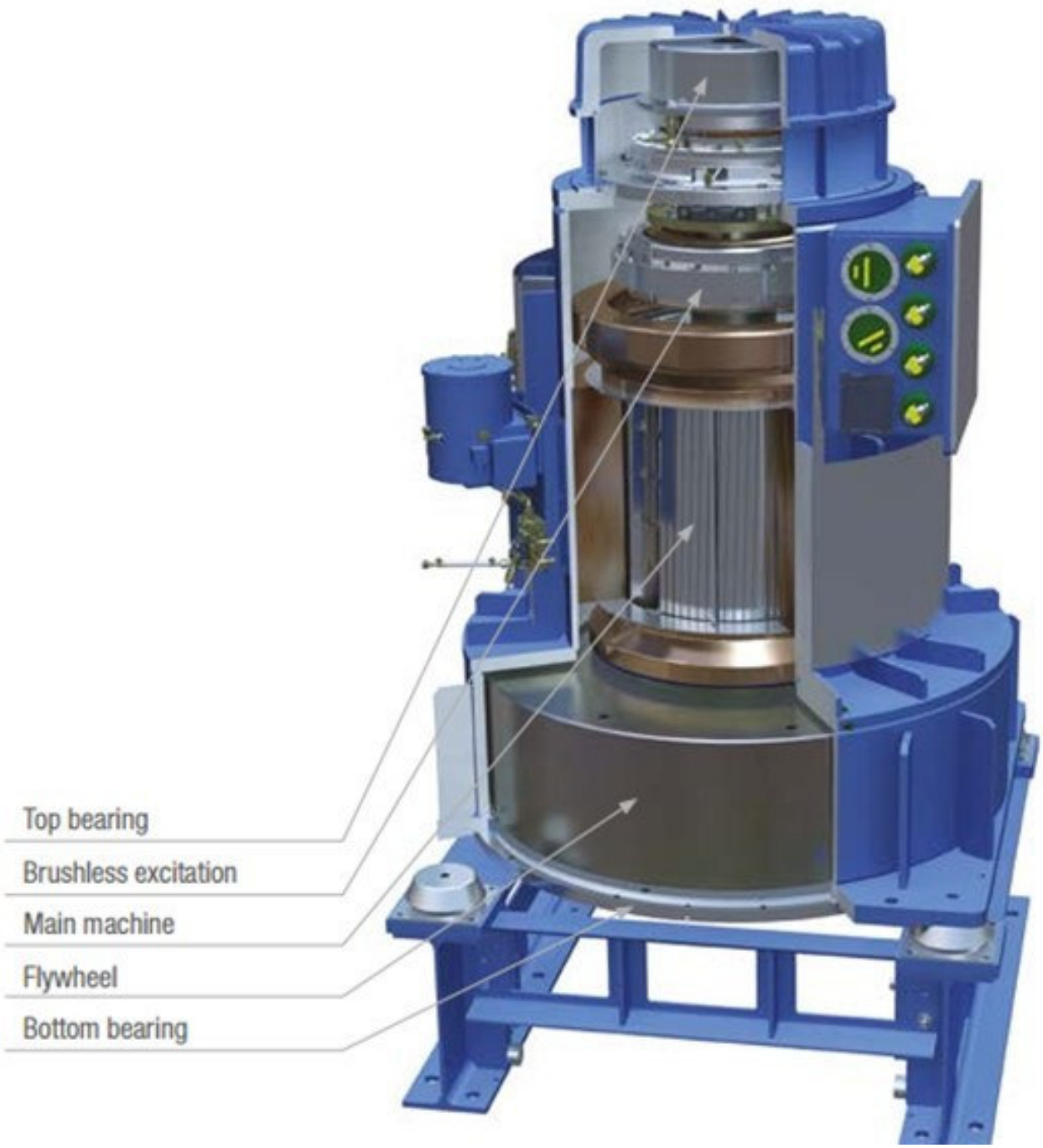
Ratings: 625 kVA – 2.5 MVA

Ratings: 560 kW – 2.25 MW

UBT(D)+ Electrical Schematic Diagram:

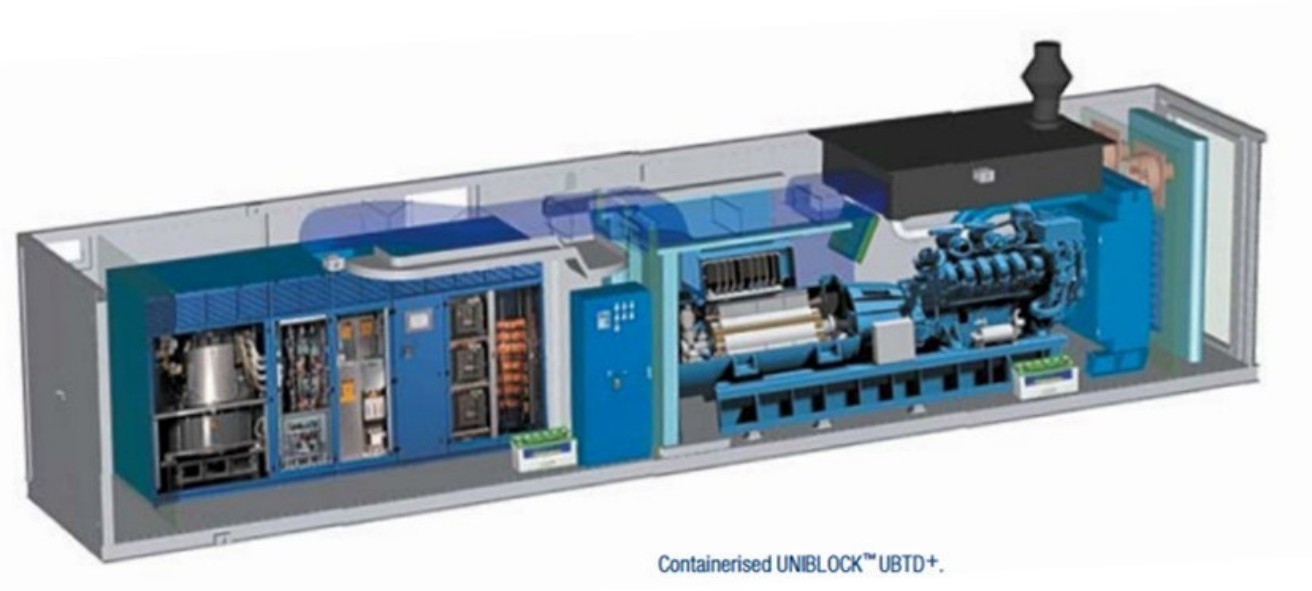



Energy Storage - POWERBRIDGE ™:




Electrically-connected kinetic energy storage option offers designers the chance to save space and maximize power density per unit. The POWERBRIDGE ™ comprises a vertically mounted synchronous generator whose rotor is connected to a flywheel to provide the energy storage. Whenever stored energy is needed, it is discharged though the generator into a converter stage that ensures a stable frequency into the UNIBLOCK ™ motor-generator. Recharge works similarly in the opposite direction. With a POWERBRIDGE ™, stored energy levels are guaranteed, air-conditioned battery rooms can be avoided and there is no environmental disposal issue to manage in the future. Significantly, a POWERBRIDGE ™ can absorb energy at the same rate as it can dissipate and can do so on an indefinite basis. No other electrical storage solution can equal this. This capability acts as a cushion for the engine to provide unequalled frequency stability under dynamic load conditions. Magnetic-lift technology significantly reduces forces on the main bearings,

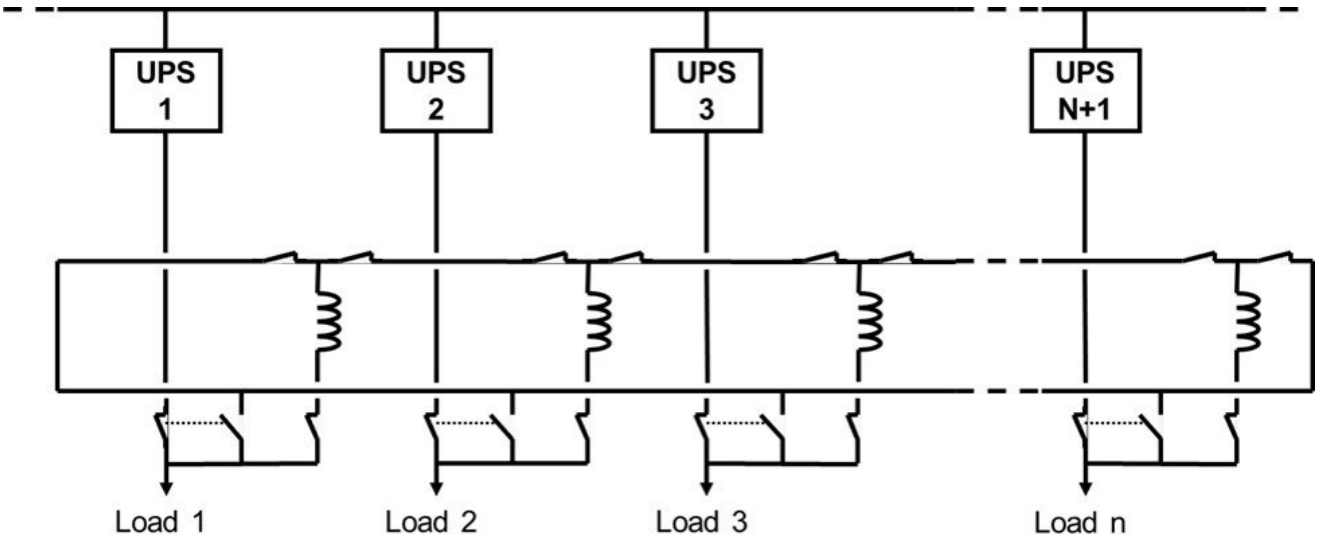
resulting in extremely high efficiency. This also serves to extend the bearing life ensuring many years of continuous operation. A vertically mounted flywheel and generator utilizing magnetic bearing technology, the POWERBRIDGE ™ is available in several sizes for different power ratings and ride-through autonomy.



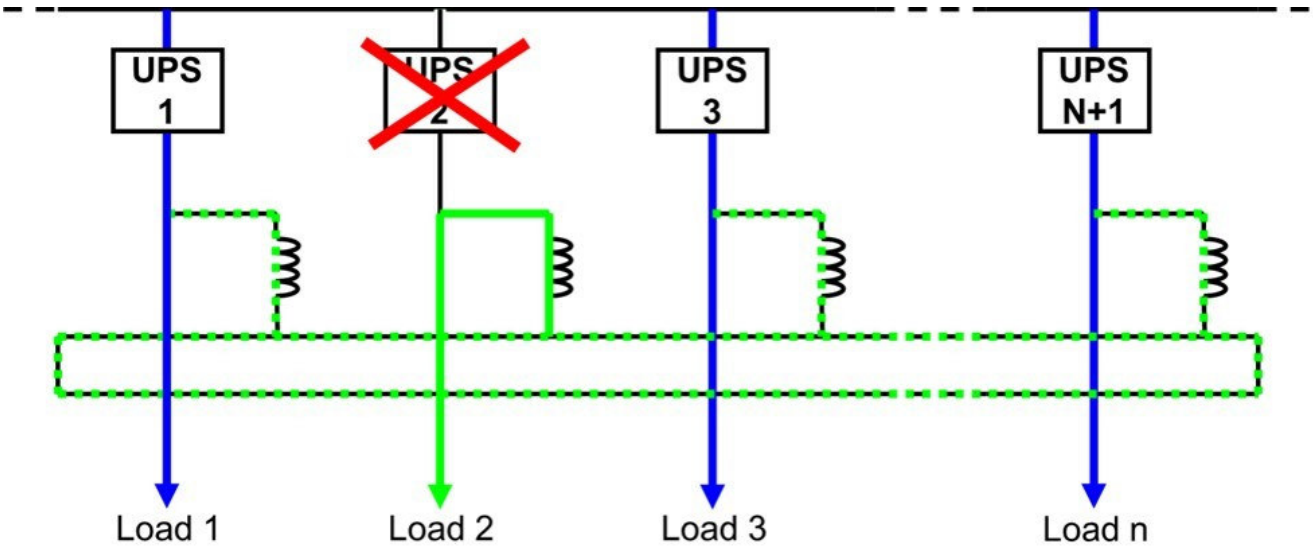

**Innovative Redundency - Isolated Parallel UPS-System**

One of the most unique feature that convinced IT/Engineering teams to agree to this system is IP Bus. Each DRUPS supplies their individual loads at the same time and they are connected to a common bus via isolating choke (IP Choke).

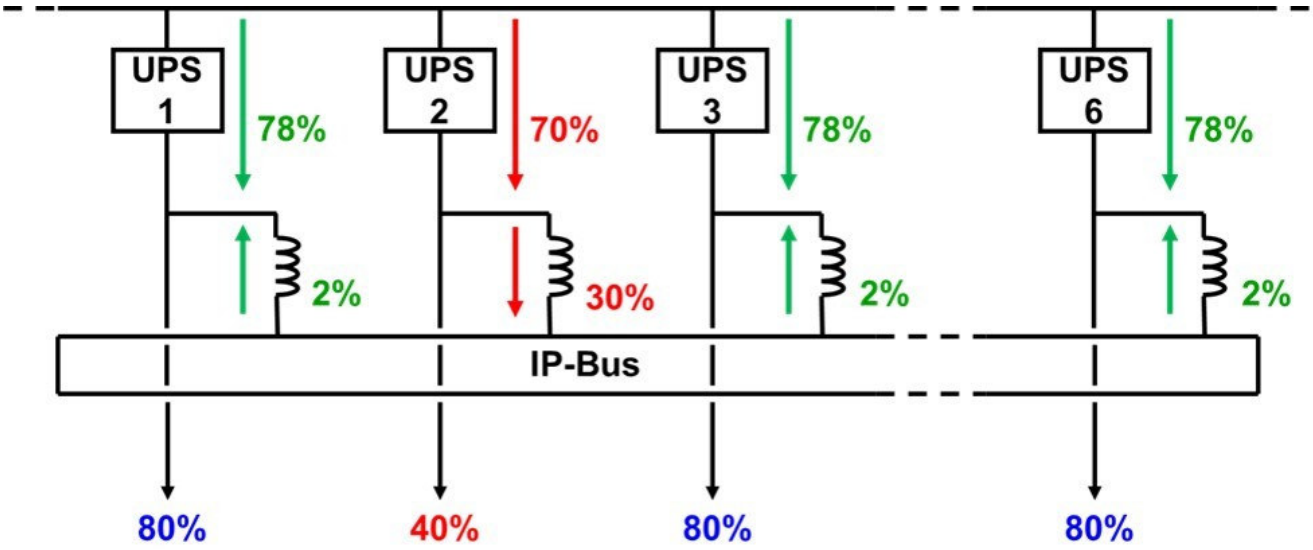
Basic configuration of IP bus:




Power flow in case of UPS shut-down:




Load sharing in an IP-System under unbalanced load conditions:




Merits of IP Bus:

- No single point of failure

- reliability and availability as high as n+n configuration

- redundant (A-B) supply down to the load with just n+1 ups units

- High serviceability - all components concurrently maintainable

- Higher system efficiency

- all UPS modules are running with almost full load and therefore with their maximum efficiency; No unit running without load.

- no air con for ups and batteries required. Cooling by ambient air sufficient.

- higher utilisation of ups, because n+1 redundancy is sufficient

- Reduced number of diesel engines and UPS compared to a (n+n) configuration

- space saving, more area for IT-loads

- higher reliability due to less components

- less components to be maintained

- less installation efforts, because of less components

- An UPS shutdown can be handled without using switching devices
- High system flexibility

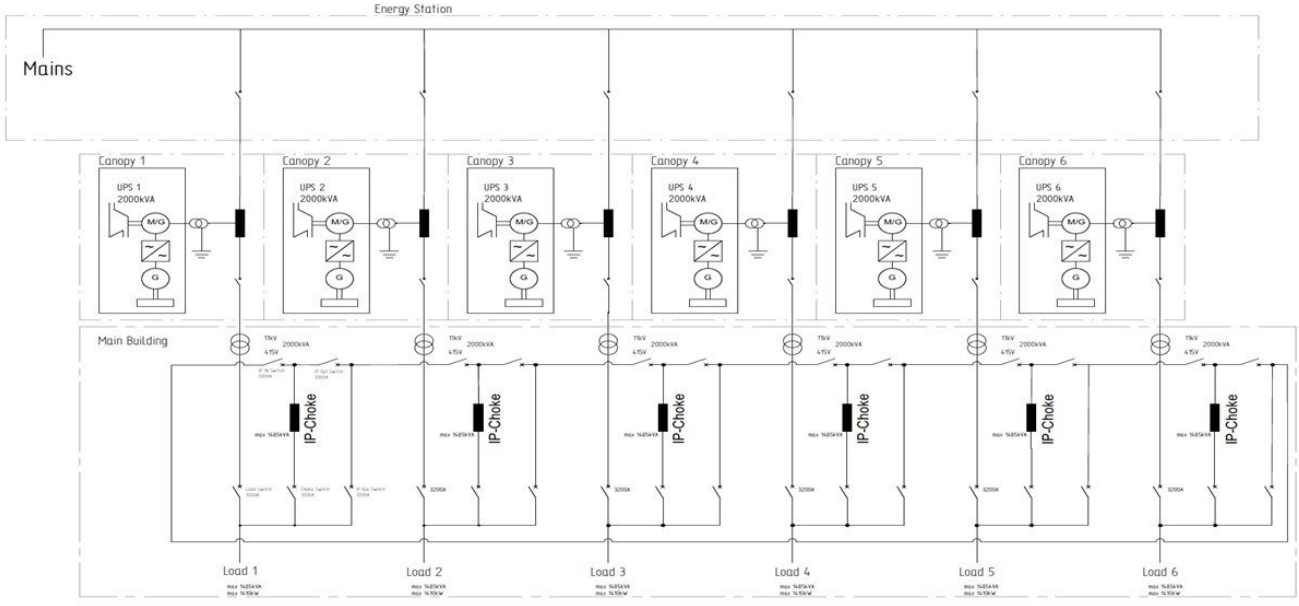
- adding of additional units during operation possible

- flexible load distribution on different levels (e.g. 1800 kW on one level)

- IP-Return-Bus can be used as ups protected bypass, even in case of a mains outage
- High short circuit capacity
- LV installation possible even with very high total power demand

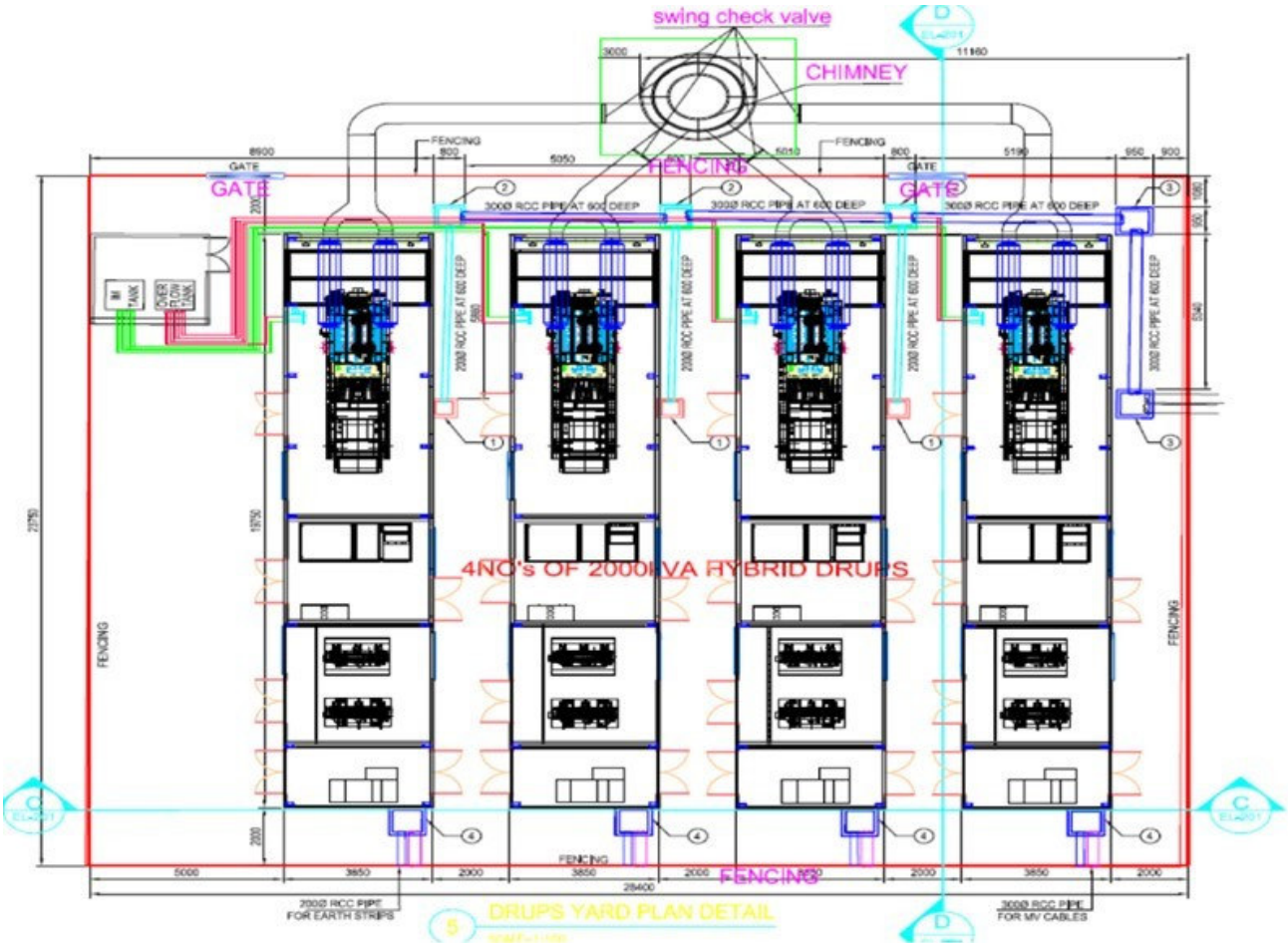
**System Configuration at NetApp Bangalore Campus:**

We have located DRUPS system at the far end of the campus for various reasons and we had to design the system uniquily Hybrid. Typically IP Bus configuration done in two ways, 1. LV (Low voltage 415 V) DRUPS with LV IP Bus 2. MV (Medium Voltage – 11kV) DRUPS with MV IP bus, however we have designed MV (Medium Voltage 11kV) DRUPS with LV IP Bus system considering the distance beteen DRUPS yard and building. This configuration also eliminates single point of failure of MV/LV step down transformer.

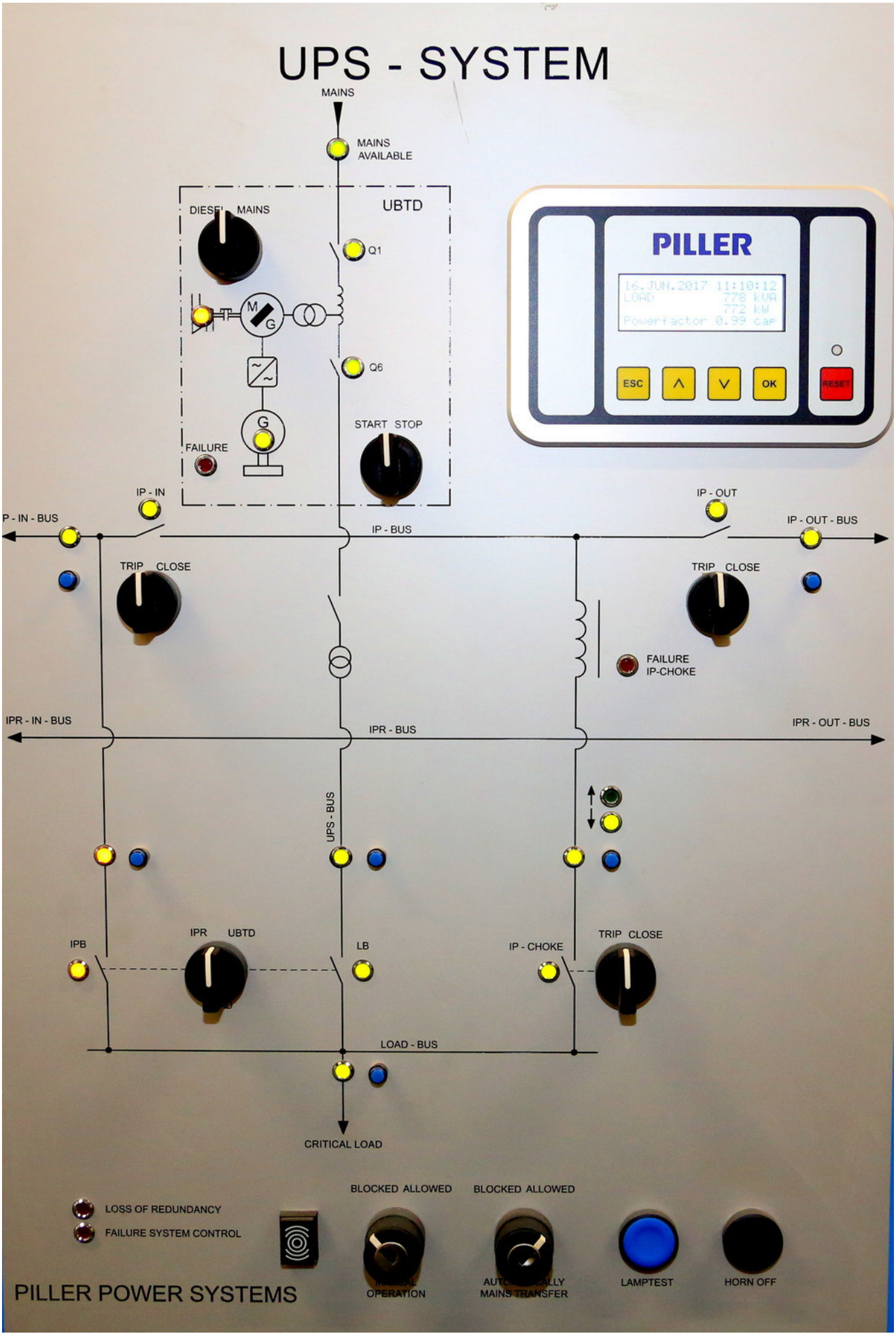


Day 1 - 8 MVA/ 7.2 MW and Future expansion of IP Bus for 2 more units

Canopy and Chimney Design:




DANGER


UPS - SYSTEM
MAINS
MAINS AVAILABLE
UBTD
DIESEL MAINS
Q1
Q6
START STOP
FAILURE
PILLER
16.JUN.2017 11:10:12
LOAD 778 kVA
772 kW
Powerfactor 0.99 cap
ESC
OK
RESET
IP - IN
IP - OUT
P - IN - BUS
IP - BUS
IP - OUT - BUS
TRIP CLOSE
TRIP CLOSE
FAILURE IP-CHOKE
IPR - IN - BUS
IPR - BUS
IPR - OUT - BUS
UPS - BUS
IPB
IPR UBTD
LB
IP - CHOKE
TRIP CLOSE
LOAD - BUS
CRITICAL LOAD
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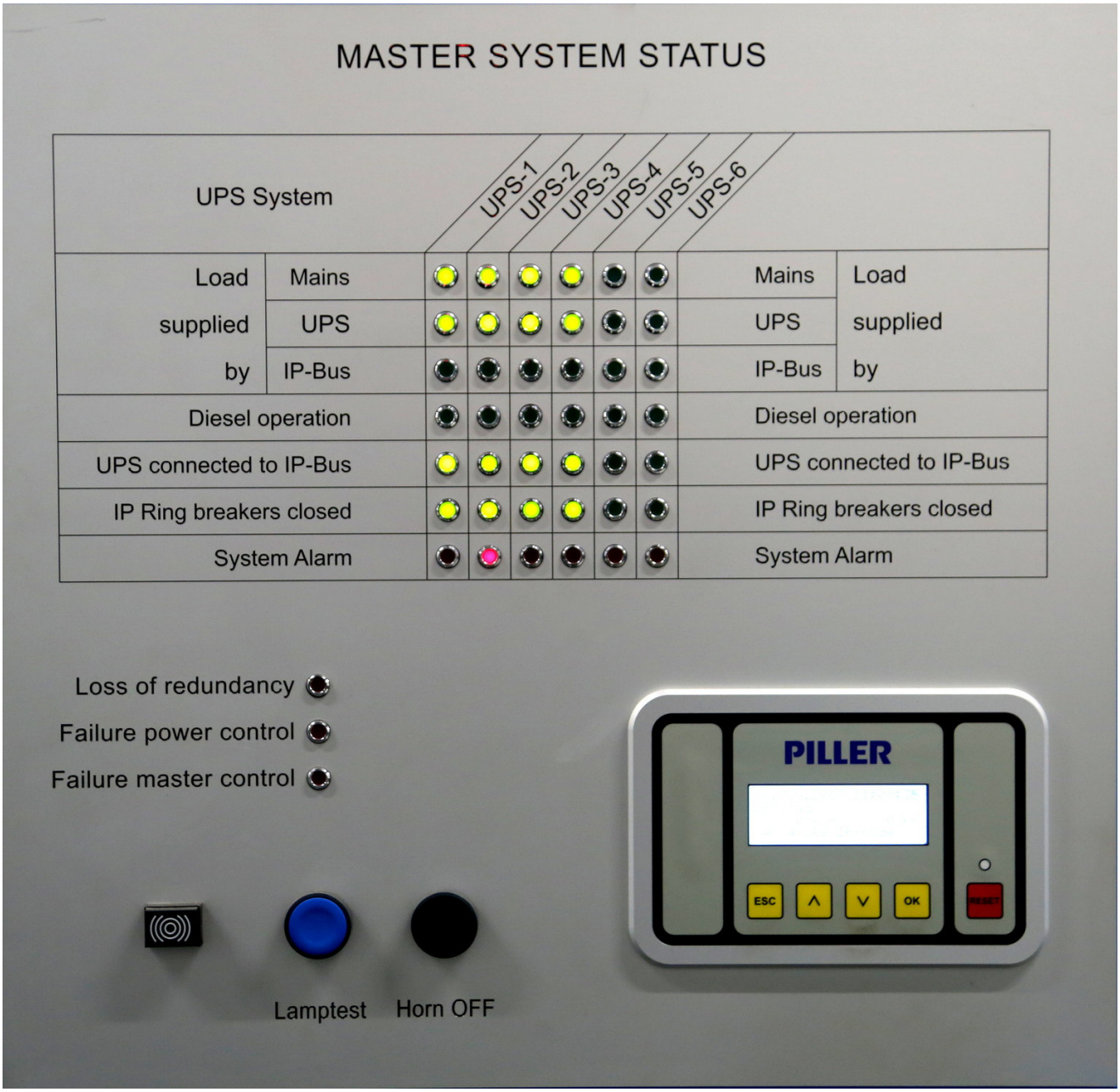
PILLER POWER SYSTEMS




**Conclusion:** We have designed and implemented one of the most innovative system for critical loads (Data Center) first time in Asia and Hybrid IP Bus system first time in the world.

Our system offers:

- IP-bus: Flexible configurations of highest reliability
- Very high efficiency (96.7%)
- Low space consumption (75% space saving)
- Fault tolerant: No single-point of failure
- n+1 redundancy adopted, however n+n reliability available (MTBF Figures of 39.4Million Hours)
- Concurrently maintainable