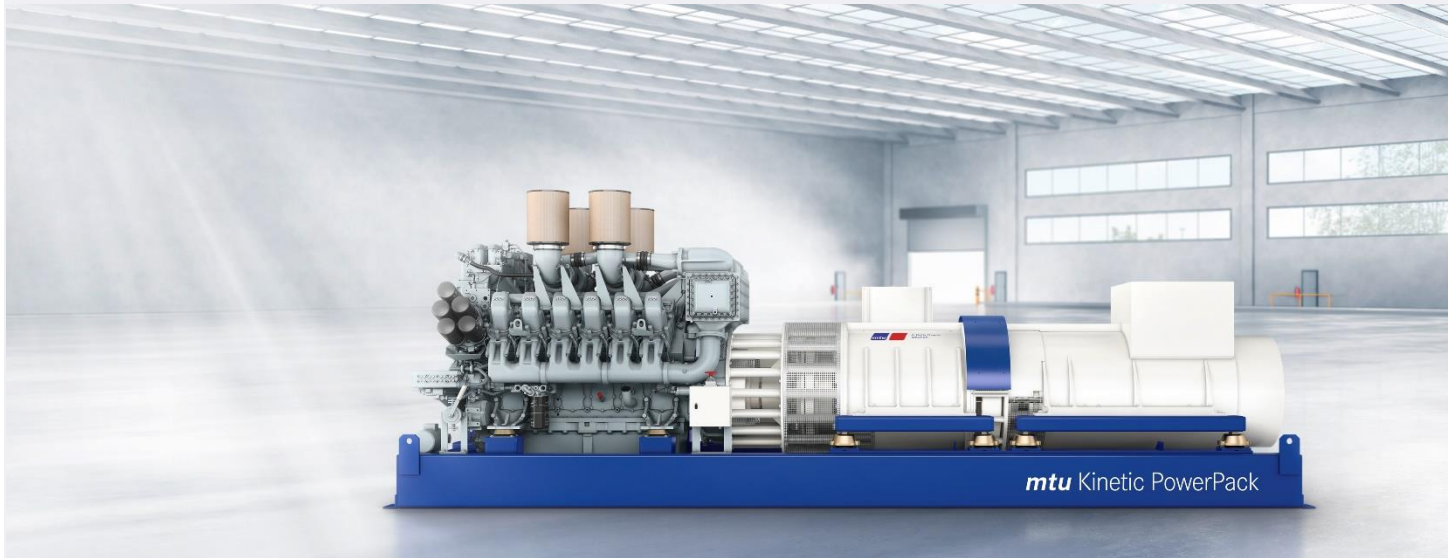




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The power of kinetic energy

Instantaneous, high-power quality without batteries

Bernard Hanssens & Christoph Webinger



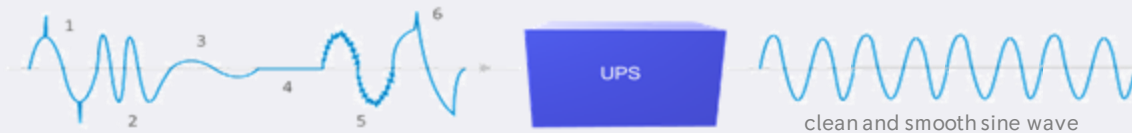
A Rolls-Royce
solution

01

Introduction to *mtu* Kinetic PowerPack

Main functions of UPS

- 1 Spikes
- 2 Frequency deviations
- 3 Sags
- 4 Outages
- 5 Harmonics
- 6 Transients



Power



Power protection



Power quality



Power conditioning



Overview *mtu* Kinetic PowerPack business

**Established
in 1989**

**Part of
Rolls-Royce
since 2020**

**Competence
center in
Liège, Belgium
(~160
employees)**

**Offering
customized
dynamic UPS
solutions**

**Installed base
of >1,400 units
across 57
countries**

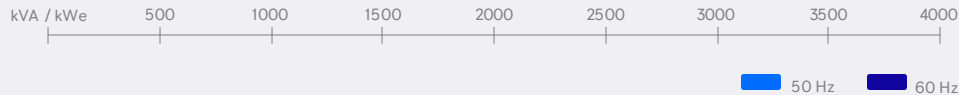
mtu Kinetic PowerPack



Dynamic UPS Power Range



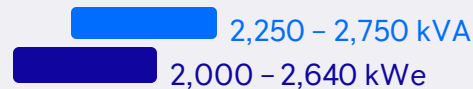
Dynamic UPS



mtu Kinetic
PowerPack KP5



mtu Kinetic
PowerPack KP7



50Hz: Low voltage: 380 – 415V
 Medium voltage: 6 – 36kV

60Hz: Low voltage: 208 – 480V
 Medium voltage: 4 – 36kV



**mtu Kinetic PowerPack
provides significant
benefits to a high
variety of applications**



Data Centers & IT

Collocation Data Centers

Hyperscale Data Centers

Enterprise Data Centers

Supercomputers

...



Critical Process Manufacturing

Semiconductors

Pharmaceuticals

Refining & Petrochemical

Food

Textiles

...



Infrastructure & Logistics

Airports

Tunnels

Logistic & Distribution Centers

Healthcare

Casinos

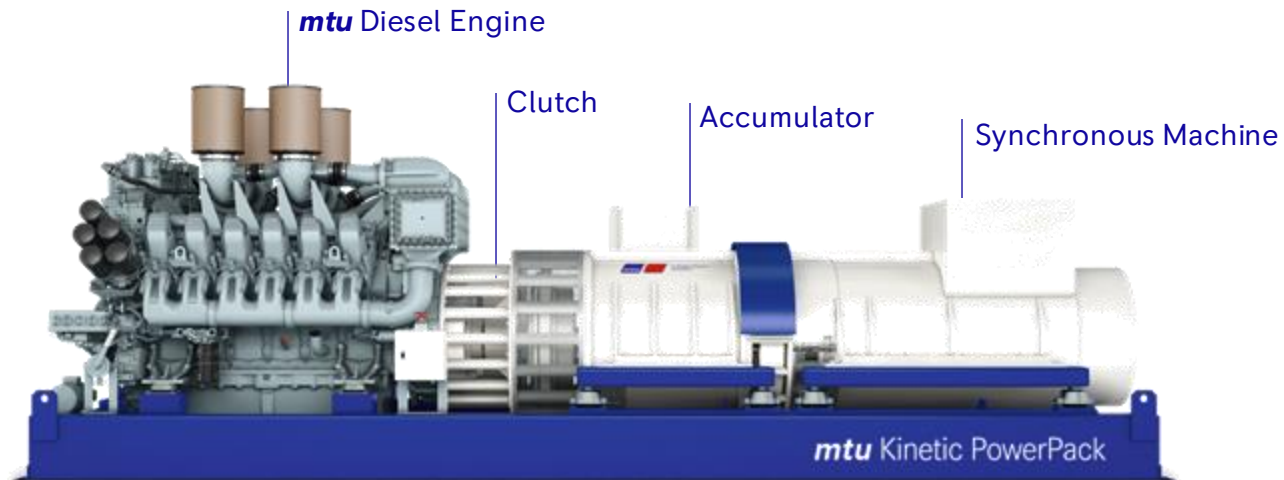
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02

Working principles of *mtu* Kinetic PowerPack

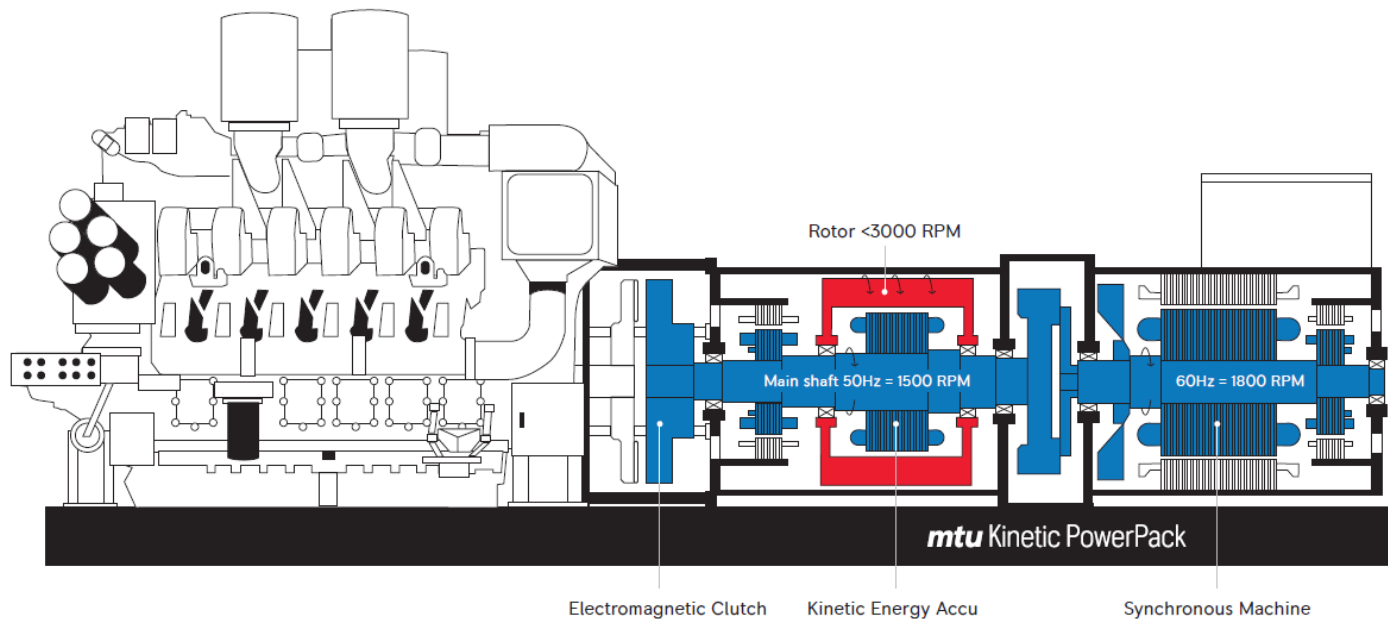
Design of *mtu* Kinetic PowerPack

The *mtu* Kinetic PowerPack combines DUPS system and diesel backup generator in one single integrated and compact solution.



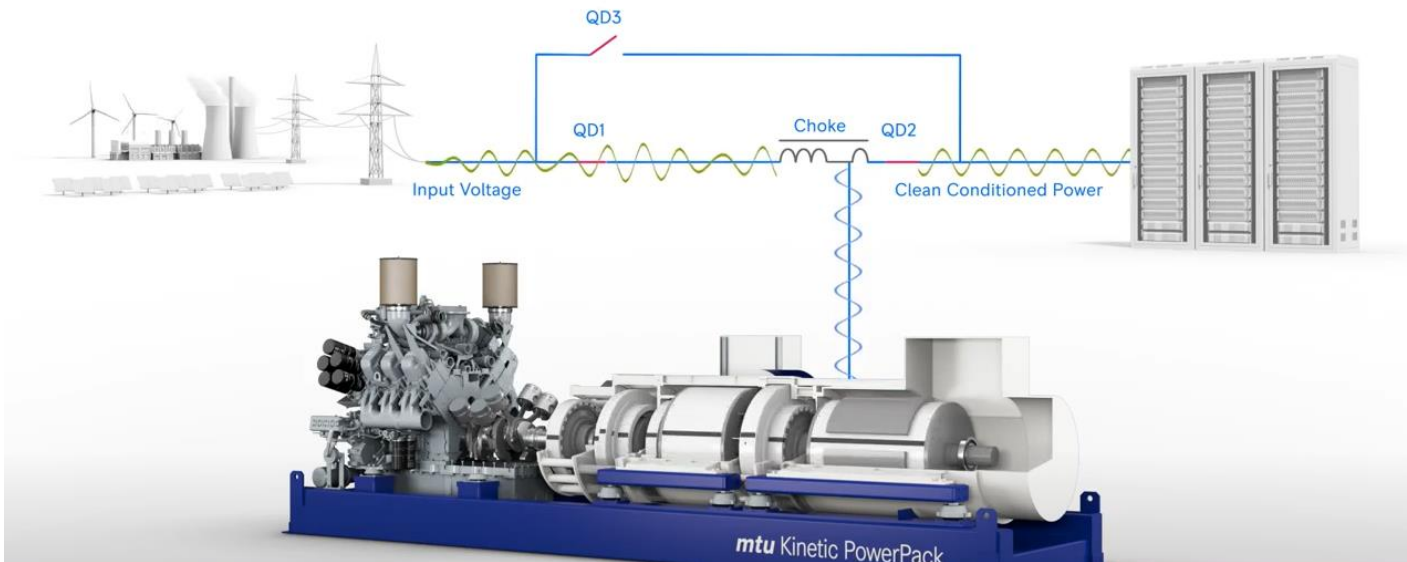
Design of *mtu* Kinetic PowerPack

- Synchronous machine is coupled to the Kinetic Energy module and works as an alternator or as a motor depending on the operation mode
- *mtu* KPP is running at <3,000 RPM
- Electromagnetic clutch ensures maintenance free – **redundant start** of engine



Conditioning mode of *mtu* Kinetic PowerPack

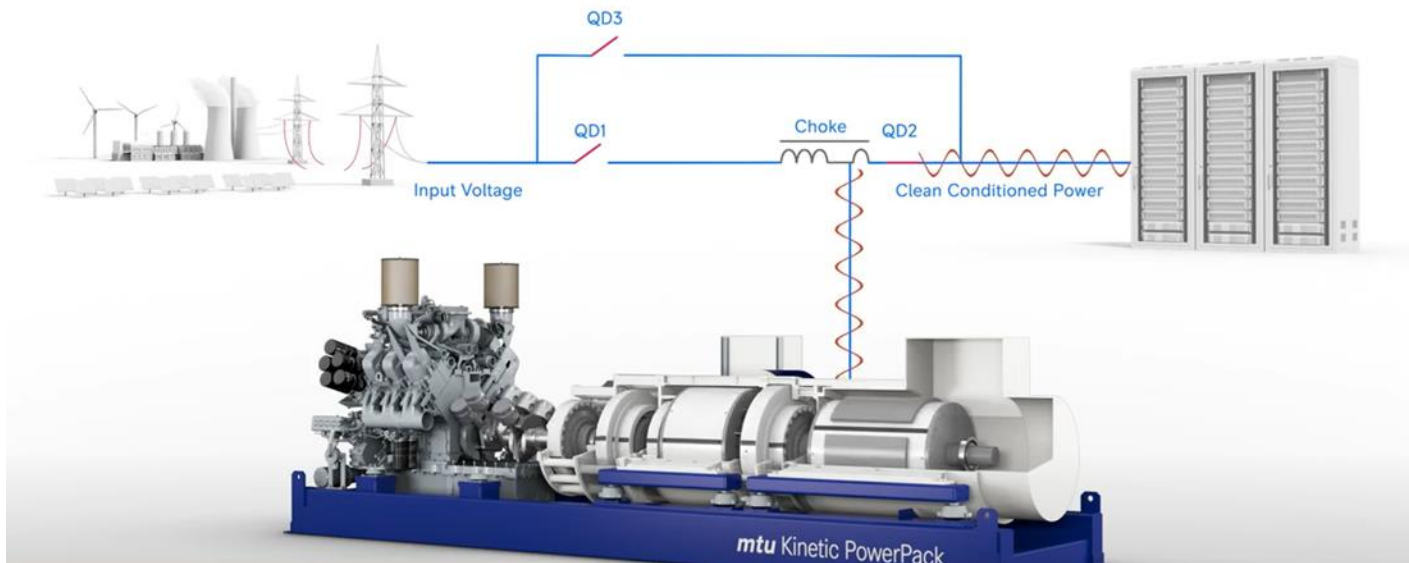
- QD1 input breaker & QD2 output breaker are closed; QD3 auto by-pass breaker is open
- Power is supplied from mains
- Synchronous machine running @1,800 rpm @60Hz
- Accumulator running @3,000 rpm is the UPS
- Clutch is open and diesel engine is stopped



- DUPS conditions (improves) the quality of the voltage that is available from the grid to provide a high quality power supply to the critical load
- Combination of choke and low impedance synchronous machine, acts as a dynamic filter and makes the power factor improvement
- Elimination of micro-cuts

Transfer mode of mtu Kinetic PowerPack

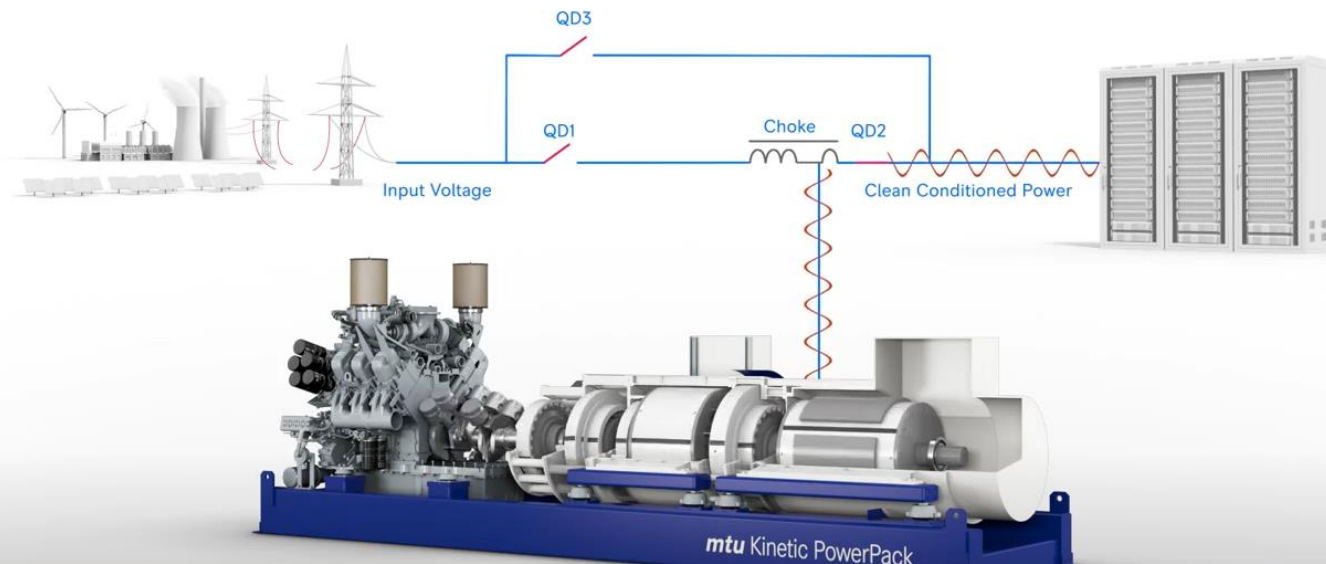
- In case of mains failure, the DUPS will switch (transfer mode) from conditioning mode to independent mode
- QD1 opens and accumulator maintains frequency
- Diesel engine starts and clutch closes



– Smooth transfer with high quality uninterrupted power supply provided to the critical load

Independent mode of *mtu* Kinetic PowerPack

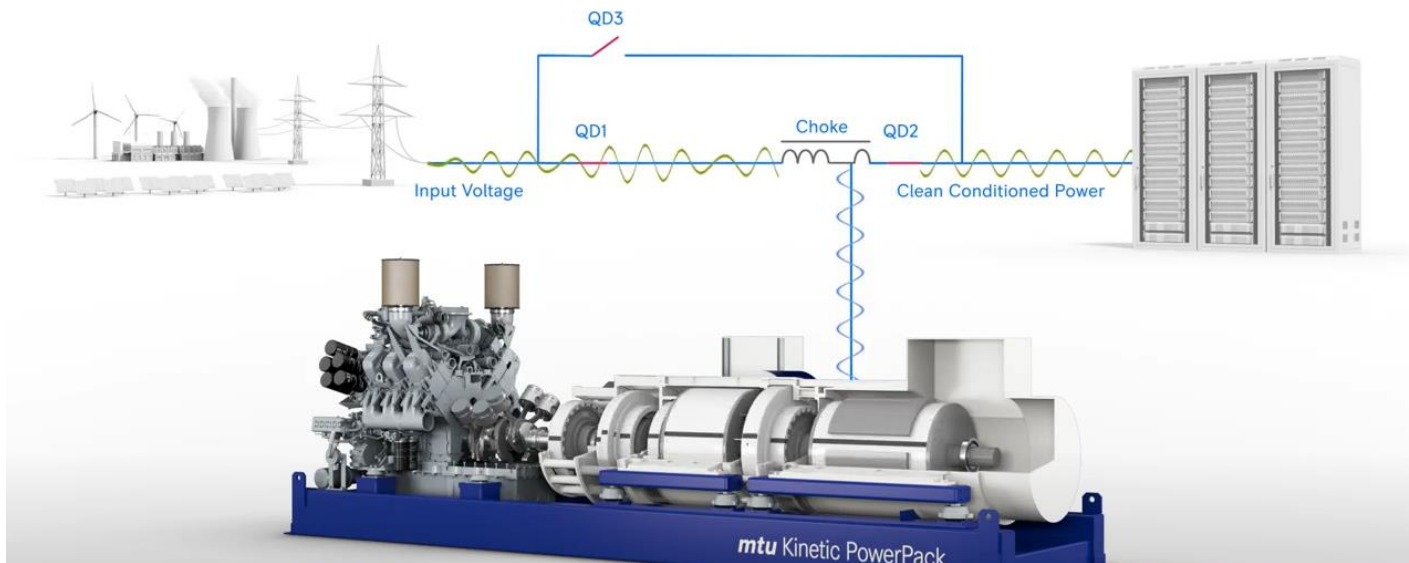
- Diesel engine provides power to the loads
- Kinetic energy is stored by increasing its speed



– DUPS provides high quality power to the critical load

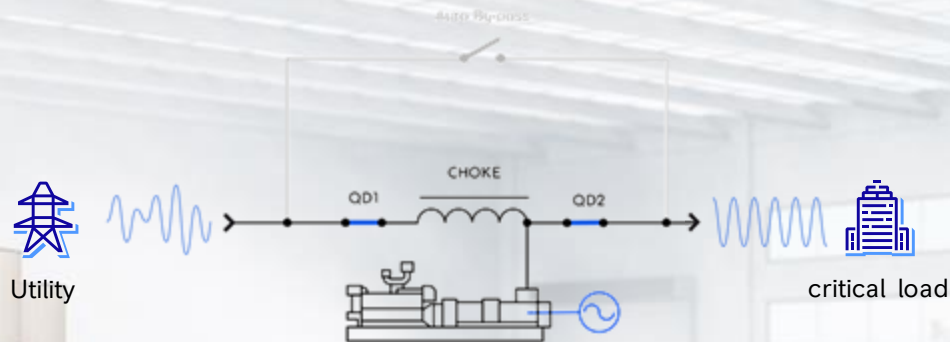
Mains returns and back to Conditioning mode

- Once power outage is resolved, synchronization across QD1
- If the accumulator has reached its nominal speed, QD1 closes and clutch opens
- Diesel engine run at idle speed for cooling down and then it stops.
- DUPS is back on Conditioning mode



- Smooth transfer with high quality uninterrupted power supply provided to the critical load
- The DUPS secures the load against an unlimited number of repeated mains failure

Technical advantages of the *mtu* Kinetic PowerPack



Redundant start

Use of special electromagnetic clutch



Filter function

Voltage & harmonics



Power factor correction

Only active power consumed



Non-linear consumers

Low impedance of the alternator prevents oscillations



Robustness

Overload capacity & high short circuit contribution

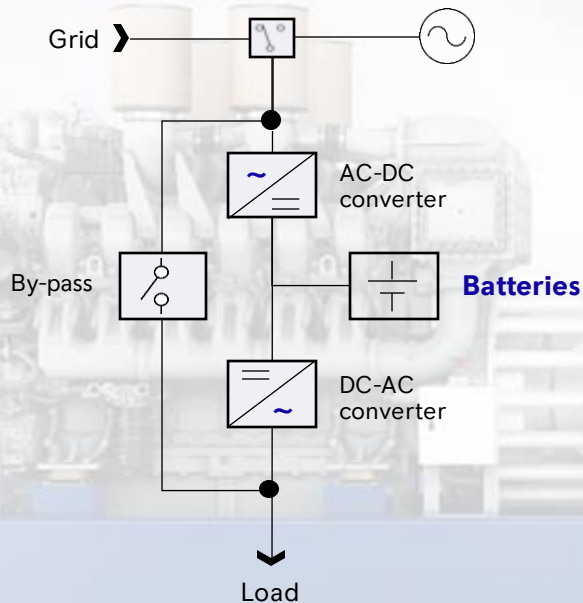
03

Key benefits of *mtu* Kinetic PowerPack vs. battery UPS

Basic principles of static & dynamic UPS systems

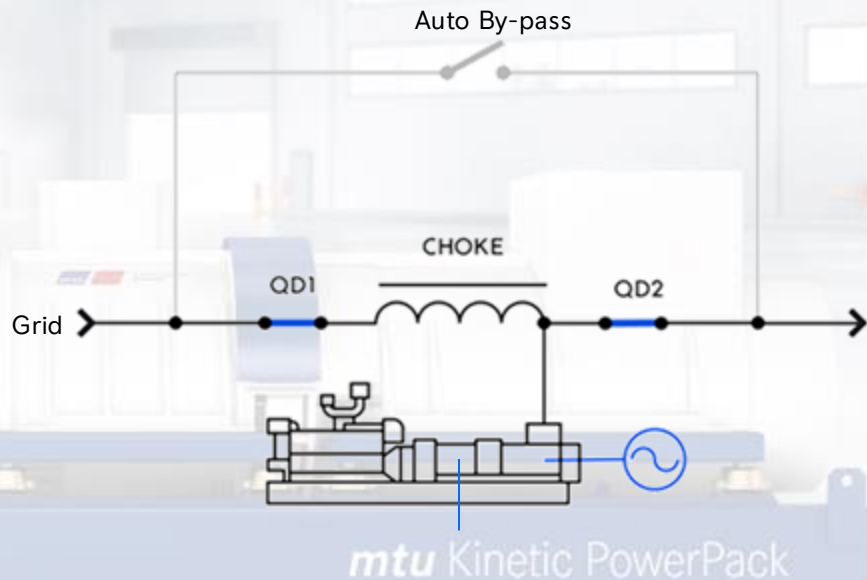
Static UPS

based on electronic components and electrochemical battery energy storage



Dynamic UPS

based on electromechanical components and kinetic energy storage



Important benefits of *mtu* Kinetic PowerPack



Maximum reliability

Simple design
with low
component count



Small footprint

Up to 40%
space saving



Low TCO

At medium &
higher power
ratings



Great flexibility

Low & medium
voltage, fully
containerized
solutions



Optimal sustainability

Elimination of
batteries & 25+
years lifetime

mtu Kinetic PowerPack



Best sustainability



Dynamic UPS

- Typical design life 25+ years
- Bearing replacement at overhaul after 10 years of operation
- Minimal environmental impact
- No power degradation with use



Static UPS

- Battery replacement after 5-7 years increases TCO
- Several days of downtime during replacement
- Batteries lose capacity over lifetime



Reduced carbon footprint with DUPS

- Elimination of batteries avoids tons of waste material and pollution during production and disposal
- Battery recycling is highly energy intensive and limited to certain battery types

04

References from around the globe



References around the globe

Semiconductor

Customer: **GlobalFoundries**
Location: **New York State, USA**
Year of installation: **2011**

Pharma

Customer: **Bayer Healthcare**
Location: **Leverkusen, Germany**
Year of installation: **2017**

Super Computer

Customer: **King Abdullah University of Science & Technology**
Location: **Thuwal, Saudi Arabia**
Year of installation: **2021 & 2022**

Data Center

Customer: **Ascenty**
Location: **Hortolândia, Brazil**
Year of installation: **2015 & 2021**

Logistics

Customer: **Large supermarket chain**
Location: **Sydney, Australia**
Year of installation: **2021**



1 x mtu Kinetic PowerPack

Output per unit: 2.500 kVA; 400 V, 50 Hz

Single unit configuration

PHARMA

Customer: Bayer Health Care

Location: Leverkusen, Germany



Project background:

- New pharmaceutical filling line for a new drug
- Maintaining sterility of the laboratories & clean rooms as well as protecting the control & monitoring systems is essential for production
- In case of a power outage, the production volume of 5-6 weeks would be lost & extensive cleaning to reestablish sterility would be required



Less risk for financial losses



Filtering & power quality improvement



High inrush currents

Key customer benefits:



Technical details:

- Turnkey installation inside the building
- 1 x KP7 (2.500 kVA, 400 V, 50 Hz)
- Single unit configuration

PHARMA

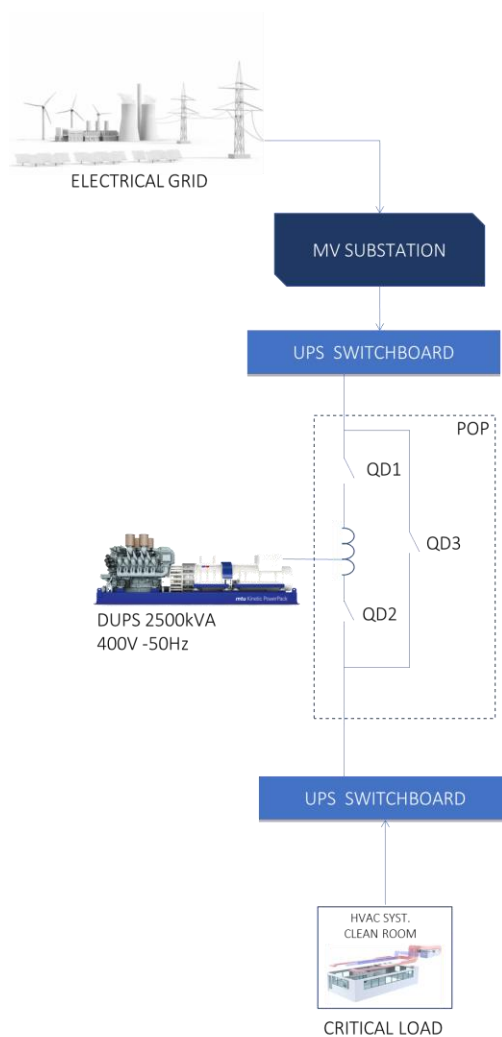
Customer: Bayer HealthCare

Location: Leverkusen, Germany



A Rolls-Royce
solution

System layout:





9 x *mtu* Kinetic PowerPack

Output per unit: 1.700/2.250 kVA

DATA CENTER

Customer: ASCENTY

Location: Hortolândia, Brazil



- The datacenter of Hortolândia 1 was designed according to Uptime Institute TIER III with 10MW total power and 4000sq.m/43,000sq.ft
- The colocation datacenter destined to wholesale has 4 data halls with a total of 950 racks

Key customer benefits:



Reduced
footprint



Container
solutions



Low
TCO

Technical details:

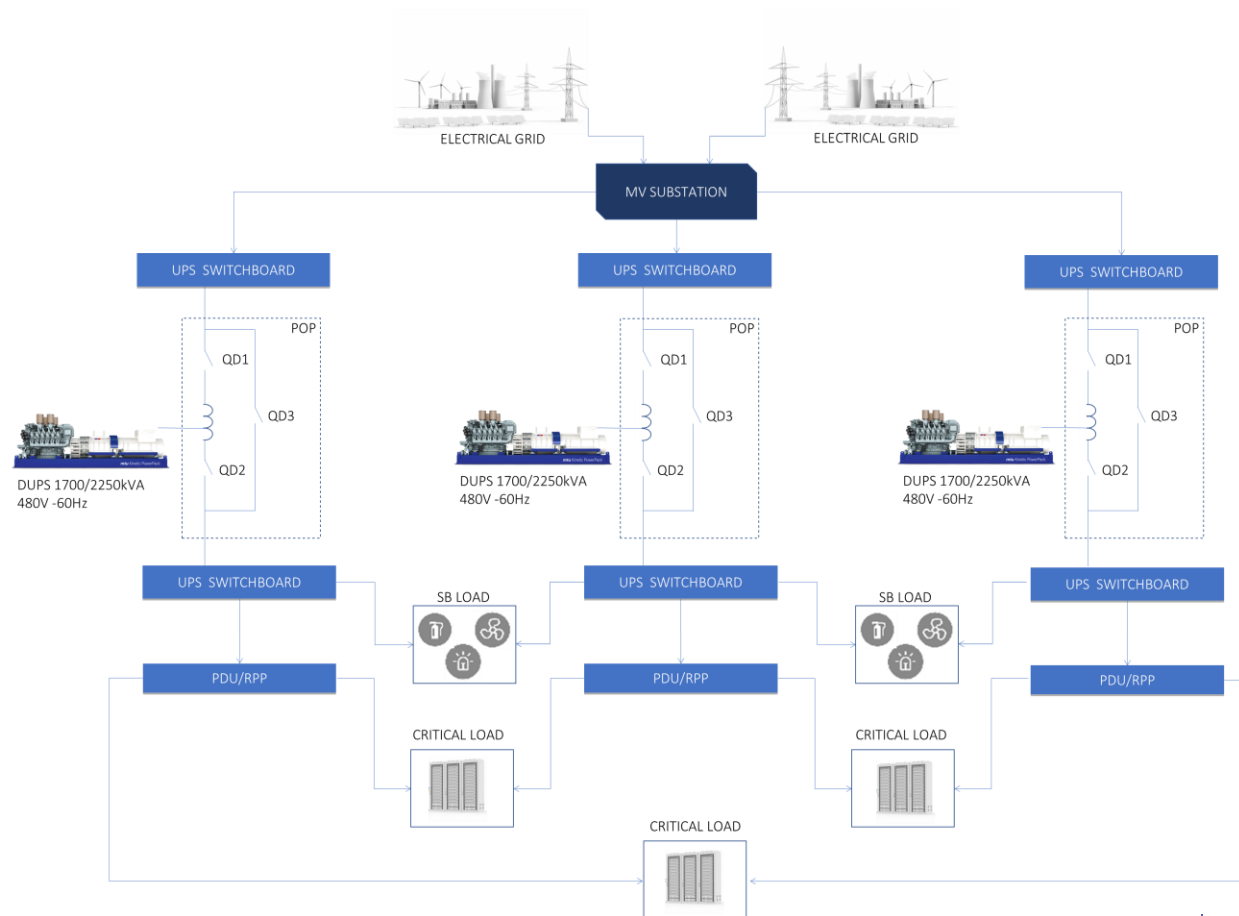
- Containerized solution
- 3 x 3 x KP5 SB1 (1.700/2.250 kVA, 480 V, 60 Hz)
- Distributed redundant in N+N configuration

DATACENTER

Customer: ASCENTY

Location: Hortolândia, Brazil

System layout (for 1 out of 3 power stations):





DATA CENTER

Customer:
King Abdullah University of
Science and Technology

Location:
Thuwal, Saudi Arabia



12 x *mtu* Kinetic PowerPack

Uninterruptible power output:
12 x 1.600 kW (2 Stations N + 1)

Project background:

- Turnkey solution to provide the university's supercomputing facility and data center with clean, conditioned, uninterruptible power
- 60Hz medium voltage system (13.8 kV) incl. switchgear, transformers and two control stations

Key customer benefits:



Medium
voltage
system



Container
solutions



Turnkey
Solution



A Rolls-Royce
solution



King Abdullah University of Science and Technology

12 x *mtu* Kinetic PowerPack

Uninterruptible power output:
12 x 1.600 kW



12 x mtu Kinetic PowerPack

Output per unit: 2.000 kVA
13.8kV 60 Hz

2 independent power stations
of 6 KP5 each with N+1 redundancy

SEMICONDUCTOR

Customer: GlobalFoundries

Location: New York State, USA



Project background:

- Most advanced semiconductor manufacturing facility of GlobalFoundries in upstate New York (Malta)
- Dynamic UPS protecting semiconductor production against highly sensitive **voltage fluctuations & power outages**

Key customer benefits:



Maximum
reliability



Low
TCO



Medium
voltage
system

Technical details:

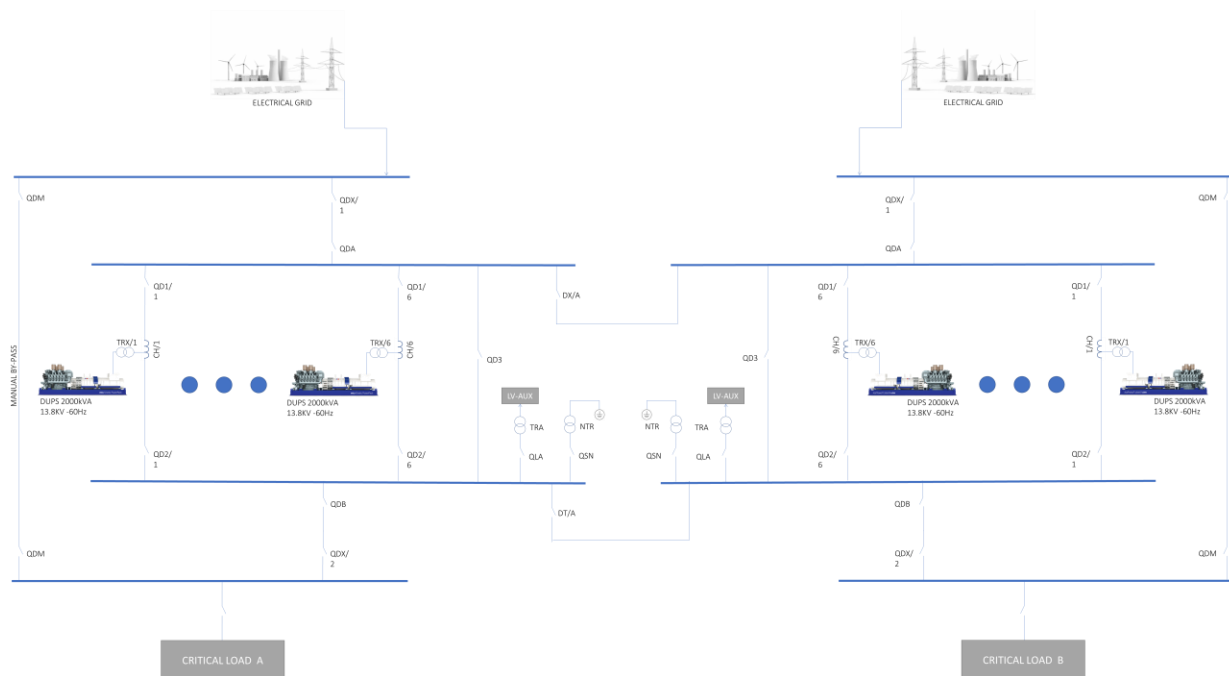
- 2 independent power stations of 6 KPS (2.000 kVA, 13,8 kV, 60 Hz) each with N+1 redundancy
- Possibility to couple both power stations together to have one system of 12 KPP in parallel

SEMICONDUCTOR

Customer: GlobalFoundries

Location: New York State, USA

System layout:





4 x *mtu* Kinetic PowerPack

Output per unit: 2.000 kVA;
415 V, 50 Hz

Isolated Parallel Ring in N+1
configuration

LOGISTICS

Customer: Large supermarket chain

Location: Sydney, Australia



Project background:

- Giant state-of-the-art automated warehouse (highly automated shuttle and conveyer belt technology system)
- Due to the high automatization level of the warehouse, it would take several hours to restart & recover the system in case of a power loss

Key customer benefits:



Reduced
footprint



Less risk for
financial
losses



Fast fault
clearing
capability

Technical details:

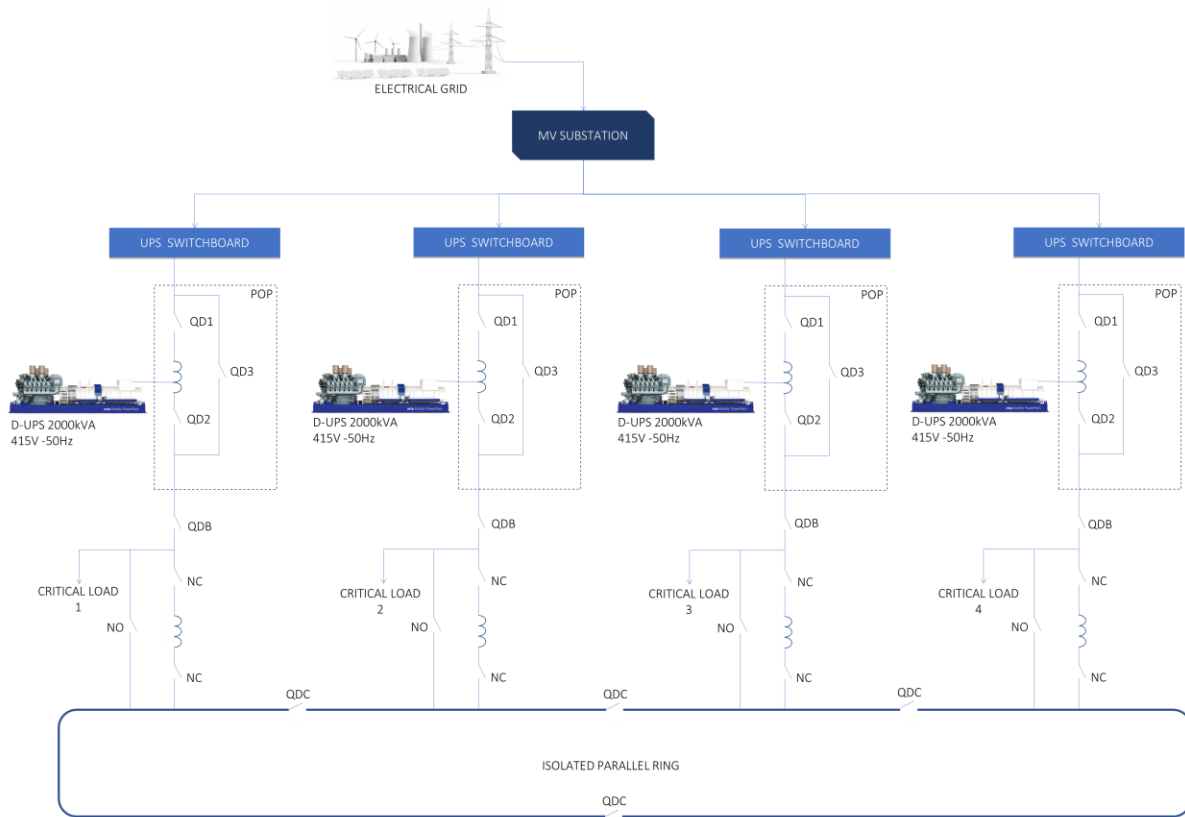
- 4 x KP5 (2.000 kVA, 415 V, 50 Hz)
- Isolated Parallel Ring in N+1 configuration

LOGISTICS

Customer: Supermarket chain

Location: Sydney, Australia

System layout:





Thank you for your attention!