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UPFC

Low Voltage, Three-Phase, 500KVA Unified Power Flow Controller

As the energy industry faces increasing demand through electrification coupled with the continued growth of low carbon technologies (LCTs) along the low voltage network, new solutions are necessary to keep energy affordable, while achieving critical decarbonization goals. The ERMCO GridBridge Unified Power Flow Controller (UPFC) is a next-generation power electronics solution designed to enable a more agile, flexible, and resilient distribution network. Delivering AC and/or DC power with simultaneous voltage regulation, power factor correction, and power flow control, the UPFC provides a viable alternative to costly, time-consuming infrastructure upgrades.

The UPFC serves as the central point of active and intelligent control at the LV substation for the local distribution network, maximizing performance and efficiency of power delivery. Utilizing the low voltage, 3 phase wye 400VL-L (230VL-N) feed from an existing transformer, the UPFC actively monitors and adjusts voltage and reactive power to meet dynamic network optimization needs. In addition, the UPFC delivers simultaneous DC service and 4 quadrant power flow control in radial or mesh configurations based on user defined intelligent service prioritization and by driven real-time network conditions.

LV Network Voltage Control

With the industry facing extraordinary times of load growth and grid management complexity, greater voltage variation has become of on the common symptoms across LV networks. Supporting the fast uptick of new EV customers and their charging needs is one example. Combined with greater reliance on LCTs along the LV network, wider voltage variation in shorter time spans will become increasingly common.

The autonomous operation of the UPFC allows for smooth voltage regulation of individual phases at the LV busbar of a secondary substation in real-time. The overall voltage profile of an LV feeder can be optimized by intelligently adjusting the phase voltage at the secondary substation in response to monitored voltage data points at the LV substation and along the length of each LV feeder.

Provision of an LVDC Network

With the UPFC providing dynamic control at the LV substation, the simultaneous ability to deliver DC power serves as a key enabler of an increasingly decarbonized network. This DC connection can be made available to satisfy any local DC demand such as EV charging, lighting, and/or energy storage without repeated AC-DC conversation and the resulting losses on the network and customer side. Running the LV network with DC can also increase the transfer capacity allowing more EV load to connect to the network before costly reinforcement is required - lowering maintenance costs and reducing complexity.

KEY INDUSTRY CHALLENGES

- **Electrification of transport** – the global growth of electric vehicles and the home as the main charging location will in many cases double the demand on a customer property
- **Electrification of heat** – off-gas grid customers using heat pumps could impact network peak demand at 5Xs greater than EVs
- **Network Planning**– Delivering a net zero economy means significantly increasing electricity demand and better understanding how the network can reliably adapt
- **Decarbonization goals** – More LCTs will need to be incorporated to achieve decarbonization targets safely over time from the deployment of devices like smart street lighting, batteries and solar
- **Equity and cost effectiveness** – Investing in areas to oversize the network before necessary will continue to be difficult to justify

KEY OUTCOMES WITH THE UPFC

- Better utilization of existing network infrastructure for voltage compliance, load sharing and capacity planning
- Facilitates the integration of LCTs with LVAC & LVDC networks
- Prevents or defers infrastructure upgrades avoid major investment costs
- Empowers the ability to meets or exceed aggressive decarbonization timelines
- Enhances network visibility and operational awareness through data capture / intelligence

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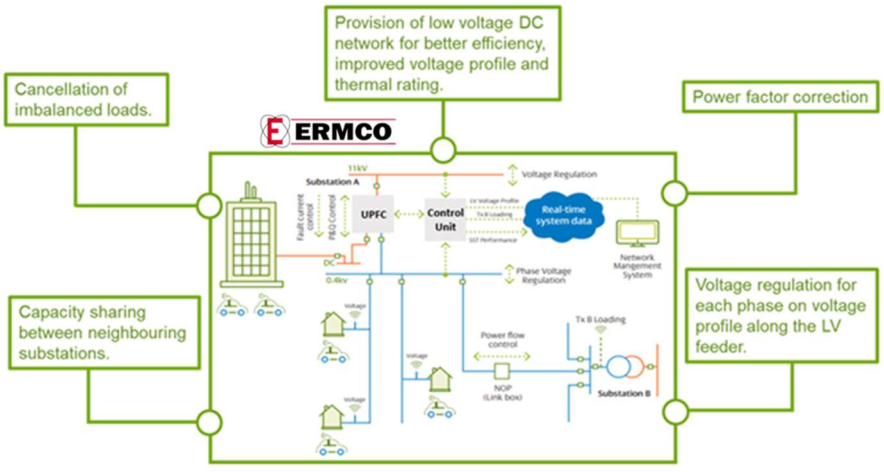
Capacity sharing with Mesh LV Networks

Given the diverse nature and complexity of load and LCT growth within service territories, the UPFC provides the critical function of LV network capacity sharing. This enables network operators to load share with traditional transformer infrastructure in real time. In conventional network design, LV substations cannot easily be operated in parallel arrangements for grid resiliency due to poor power flow control and the potential high fault levels. However, UPFC active capacity sharing overcomes these limitations across interconnected LV substations providing thermal stability and safe/predictable fault levels – enabling the flexibility to reliably adapt to changing network conditions.

The Modern, Low Carbon Alternative

Given these unprecedented times of load growth combined with global and local commitments to decarbonization, existing approaches alone for maintaining network reliability, resiliency, and efficiency are obsolete. Dynamic, precise voltage and power control to balance demand with available capability has become a requirement to meet today's network operational needs. As an alternative to reconductoring and building new substations, the UPFC is installed at the existing LV substation to act on voltage control, power factor correction, and balancing the grid – driving faster deployments at lower costs and deferring infrastructure upgrade until truly necessary.

The UPFC also adds a new layer of intelligence to the LV substation by gathering real time data to provide enhanced visibility to the overall system that can actively control the grid to deliver the right amount of capacity on a wider scale. This real-time data allows operators to plan, forecast and drive grid responsiveness to meet demand more accurately.



Key capabilities of the ERMCO GridBridge UPFC as shown provisioning an LVAC and LVDC network

SPECIFICATIONS

Nominal Input/Output AC Voltage	230/400 VAC 3 Phase, 4 wire Wye
Rated Power	500 kVA
Rated Frequency Range	47-52 Hz
Input Voltage Range	230Vrms +15%, -15%
Output Voltage Range	230Vrms +10%, -6%
Output AC Voltage Buck-Boost Range	36.8 VAC L-N or 16%
Power Factor Correction @ 50Hz	0.893 to 1.0 PF Per Phase
Imbalance Correction	Maximum of 30% Phase to Phase
DC Output Power	150 kW
DC Output Voltage	±475/950 VDC
Operating Temperature	-20° to +40° C
Management Interface	Remotely upgradeable User Interface with Dashboard, SCADA (via DNP3)
Communication Modules	3rd party wired or wireless (via Ethernet)
Local Interface	Lock Out Switches and LED Status Indicators
Data Integrity	SSL & TLS Protocols
Enclosure	IP53
Dimensions	1400mm (W) x 1650mm (H) x 1400mm (D)
Weight	1550 kg

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