Hybrid Var Compensators

Hybrid var compensators (HVC) are the ultimate answer to power quality problems caused by waveform distortions, low power factor, voltage variations, voltage fluctuations and load unbalance for a wide range of segments and applications. They are a high performance, compact, flexible, modular and cost-effective type of active power filters (APF) that provide an instantaneous and effective response to power quality problems in low or high voltage electric power systems. They enable longer equipment lifetime, higher process reliability, improved power system capacity and stability, and reduced energy losses, complying with most demanding power quality standards and grid codes.

Typical Applications

HVCs have many low and high voltage potential applications where their use offers many benefits.

- Equipment using variable speed drives (VSD).
- Arcing devices: Electric arc furnaces (EAF), discharge-type lighting (fluorescent, sodium vapor and mercury vapor) and arc welders.
- Switch mode power supplies: Computers, TVs, battery chargers, LED lighting, PLCs, etc.
- UPS systems.
- Solar inverters and wind turbine generators.
- Modulated phase controllers, cycloconverters and thyristor-controlled AC voltage regulators.
- Saturable/rotating devices: Induction heaters, transformers, generators, reactors and motors.
- Installations with fast changing reactive power demand or highly dynamic loads like ball mills.
- Correction of leading power factor like in data centers allowing back-up generators operation
- Railway electrification systems: Trains & trams
- Loads with low power factor: Motors, cables, lightly loaded transformers, lighting, etc.

Comparison With Conventional Solutions

	Capacitor banks, reactor banks or passive harmonic filters	Hybrid var compensators
Response time	• Contactor-based solutions take at least 30s to 40s to mitigate the problem and thyristor-based solutions 20ms to 30ms	• Real-time mitigation of power quality problems as the overall response time is less than 100μs
Output	• Depends on step sizes, cannot match load demand in real time • Depends on grid voltage as capacitor units & reactors are used • Steps inject extra capacitive reactive power in the system	• Instantaneous, continuous, stepless and seamless • Grid voltage fluctuation has no influence on the output • No injection of extra capacitive reactive power
Harmonic filtering	• One filter needed for eliminating each single harmonic order • Characteristics affected by network impedance and unbalance	• 2nd to the 50th order simultaneously (odd and even) • Unaffected by network impedance or unbalance
Power factor correction	• Capacitor banks needed for inductive loads and reactor banks for capacitive loads. Problems in systems with mixed loads • Not possible to guarantee unity power factor as they have steps, system will be having continuous over and undercompensation	• Corrects simultaneously from -1 to +1 power factor of lagging (inductive) and leading (capacitive) loads • Guaranteed unity power factor at all times without any over or undercompensation (stepless output)
Unbalance	• Do not correct load unbalance	• Can correct by selecting the amount of load balancing
Design & sizing	• Extensive harmonic studies needed to size the proper solution • Usually oversized to better adjust to changing load demands • Need to be designed taking into account system harmonics • Custom-built for specific load and network conditions	• Not required extensive studies as it is adjustable • Mitigation capacity can be exactly what load demands • Unaffected by harmonic distortion in the system • Can adapt to load and network conditions & changes
Resonance	• Parallel or series resonance can amplify currents in the system	• No risk of harmonic resonance with the network
Transients	• Caused by the switching of capacitor units or shunt reactors	• Not created (no switching of passive components)
Overloading	• Possible due to slow response and/or variation of loads	• Not possible as current limited to max. RMS current
Footprint & installation	• Medium to large footprint, especially if several harmonic orders • Not simple installation, especially if loads upgraded frequently	• Small footprint and simple installation as modules are compact in size. Existing switchgear can be used
Expansion	• Limited and depends on load conditions and network topology	• Simple (and not dependant) by adding modules
Maintenance & lifetime	• Using components that need extensive maintenance like fuses, circuit breakers, contactors, reactors and capacitor units • Switching, transients and resonance reduce lifetime	• Simple maintenance and service life up to 15 years as there is no electro-mechanical switching and no risk of transients or resonance