Zenergy Power – Fault Current Limiter
A surge protector for the electric power grid

Fault Current Limiters (FCL) have numerous and far-ranging applications throughout the entire electric grid.
The risk of damaging electrical faults is increasing throughout the electric grid. More and more, utilities need technology solutions to protect their grid while increasing network connectivity to improve overall grid reliability and efficiency.

Fault current limiting within first ¼ cycle
- Self-triggered – entirely passive operation instantly boosts impedance during fault
- Low steady-state impedance – low losses during normal unfaulted operation
- Instantaneous and automatic recovery to normal operation – full recovery to low impedance state when fault clears
- Instantly available to limit faults - protection against prolonged or multiple fault events

Demonstrated and proven performance
- Extensive testing since 2007
- Protecting a distribution circuit in California since 2009
- Online in a distribution circuit in England in 2010
- Online in a transmission circuit in Ohio in 2011

Economic advantages
- Delay circuit breaker and bus bracing upgrades to defer capital investment
- Limit fault levels below substation ground mat ratings to protect equipment and personnel
- Extend the lifetime of substation equipment without upgrading circuit breakers and transformers
- Avoid interruption to circuits and critical loads

Broad range of technical capability
- 11 kV to 154 kV rated nominal voltage
- 1000 A to 4000 A continuous normal current
- 10 kA to 100 kA prospective unlimited fault current
- 20% to 50% reduction in fault current

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Fault Current Limiters, 11 kV to 154 kV

Specifications	Value	Notes
Line voltage	11 kV to 154 kV	Line-to-Line
Line current	1 kA to 4 kA	Continuous normal current
Line frequency	50/60 Hz	50-Hz units slightly larger
Fault current	10 kA to 100 kA	Prospective unlimited fault current
Fault current reduction	20% - 50%	Dependent upon application
Asymmetry factor	no set range	Higher K factors have slightly less first peak current limitation
Normal (unfaulted) voltage drop	0.25% to 1.5%	For example, 80V = 1% at 15 kV L-L
Fault duration	up to 3 seconds	Typical maximum
Fault sequence	multiple faults per event	Compatible with automated recloser schemes
Recovery time	immediate	Instantaneous recovery
# of operations	unlimited	Over lifetime
Auxiliary power	75 kVA	Typical for 11-15 kV devices; higher for larger devices
Service life	> 20 years	Expected to be comparable to typical transformer with proper maintenance
Maintenance interval	Annual	Preventive maintenance of refrigeration units
Dimensions	3.5 x 3.5 x 3.5 meters	Typical for 11-15 kV devices. Small auxiliary equipment enclosure is separate.

Comparing Zenergy Power Fault Current Limiter to Conventional I_s-Limiter

Zenergy Power FCL	Conventional I_s-Limiter
Fault Current Reduction Instantly inserts impedance to reduce current. Instantly recovers when fault is cleared.	Fault Current Interruption Instantly interrupts current. Requires manual reset.
Automatic recovery Able to recover under load and provide protection during multiple reclosure sequences.	Single use devise Requires operator intervention to reset.
Completely passive No fault current detection required. Limitation is due to a materials property.	Requires detection of fault current Electronic triggering of explosive change. Statistical failures possible.
Fail safe operation If device fails, it becomes iron-core reactor and continues to limit current.	Requires redundancy If device fails, circuit is a risk. Redundancy required.

Comparing Zenergy Power Inductive FCL to Resistive FCL

Zenergy Power Inductive Fault Current Limiter	Resistive Fault Current Limiter
Completely passive No fault current detection required. Limitation is due to a materials property.	Requires detection of fault current Fast switching is required to protect superconductor elements.
No liquid cryogens "Dry" magnets eliminate pressure vessel and closed spaced consideration.	Requires Liquid Nitrogen Rapid vaporization of cryogenic liquid creates safety concern.
Instantaneous recovery, even under load Superconductor magnet never heats up during fault; always on for instantaneous recovery.	Requires time to recover Superconductor element heats up during fault; switched out and requires time to recover.
Extendable to higher voltage or current Superconductor magnet is separated from high voltage and high current elements.	Challenging to work at high voltage or current Superconductor elements must carry full voltage and current at cryogenic conditions.

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