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Energy recovery systems with feedback to the grid

A system to recover kinematic energy in railway systems which solves existing energy recovery limitations, to be integrated into current substations without the need to modify the existing system

Nowadays, there is an ever-increasing need to improve the energy efficiency of transport systems, aimed at improving the efficiency of said systems, in what concerns sustainability.

During recent years, railway transport has improved the efficiency of their systems by applying regenerative braking to their electric traction rail vehicles, thus converting the kinetic energy produced by said vehicles' braking into reusable electric power.

However, in direct current catenary systems, this energy cannot be recovered in an optimal manner. Since these are equipped with unidirectional power substations, it is not possible to recover energy with feedback to the grid. Therefore, energy recovery is limited to situations where a vehicle is in the network consuming energy at the same time as another vehicle is generating it.

Studies carried out in metropolitan networks confirm that it is possible to save 30 % to 50% of the energy consumed by the system.

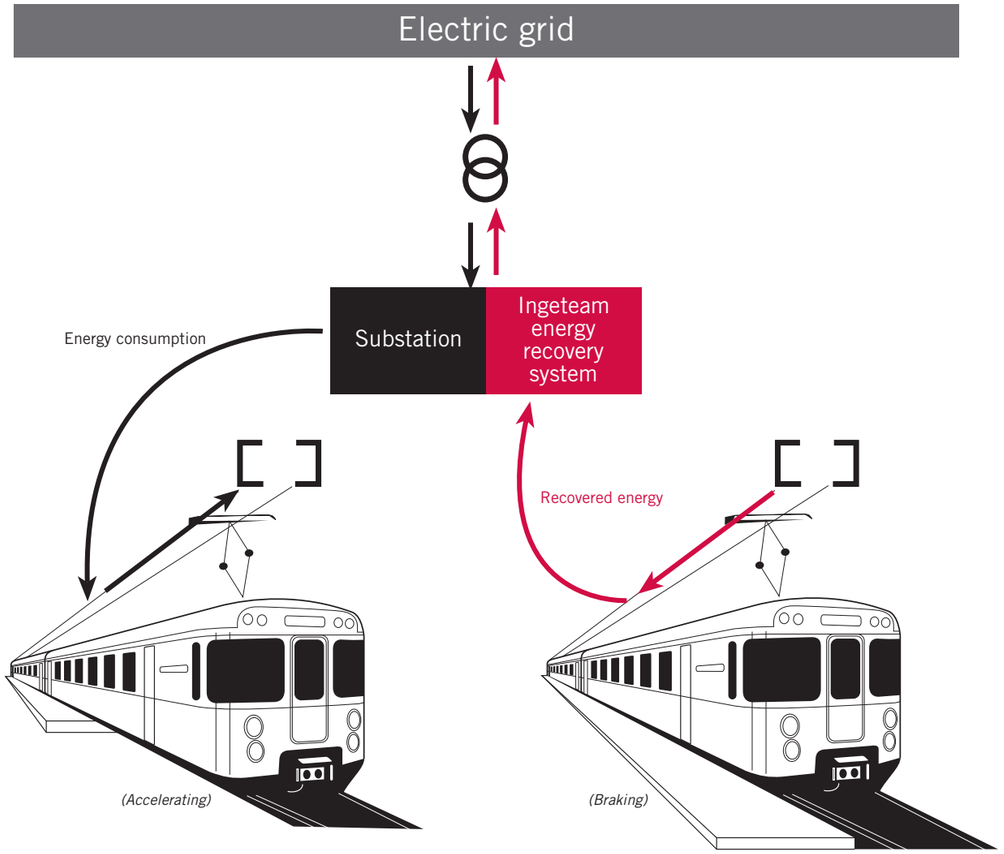
Ingeteam Traction has developed a system to recover kinematic energy in railway systems. This system solves existing energy recovery limitations and can be integrated into current substations without the need to modify the existing system.

The system is made up of a double converter, connected to the catenary in parallel with the substation's rectifier, and to the same already existing transformer. This system monitors the state of the catenary at all times, and if there is energy to be recovered, converts it into high quality alternate current, which is fed back to the general three-phase grid.

The system also allows for the control of harmonics present in the three-phase grid, by acting as an active front, that allows for reversible actuation by supplying energy to the catenary even during power consumption peaks, resulting in quality power consumption for the alternate grid.

Main advantages of the system

- Its use does not modify the current substation installations, thus high-cost elements like the transformer can be reused.
- Its operation is transparent to the existing system; therefore in cases of breakdown it is possible to isolate it without interrupting the operation of the system.
- Its elements do not require an exhaustive maintenance because sensitive elements like condensers are not in contact with harmonic currents.
- The device is not affected by short-circuits produced in the catenary.
- The system's power is planned based on the previewed savings and not on total installed power, hence costs are adjusted.
- The current transferred to the three-phase grid is of high quality, generated from a stable d.c. voltage.
- It can be used in aerial grid voltage environments, without affecting the quality parameters of the energy fed back.
- Also, the device can be used as an active filter that will regulate substation consumptions (with additional savings due to COS φ improvements).
- The device can be used during peak power consumption periods, supplying energy to the catenary with a high quality alternating grid consumption.
- With this device, it is possible to separate the train's energy saving function from the train's operating function, by not linking its recovery and consumption operations.

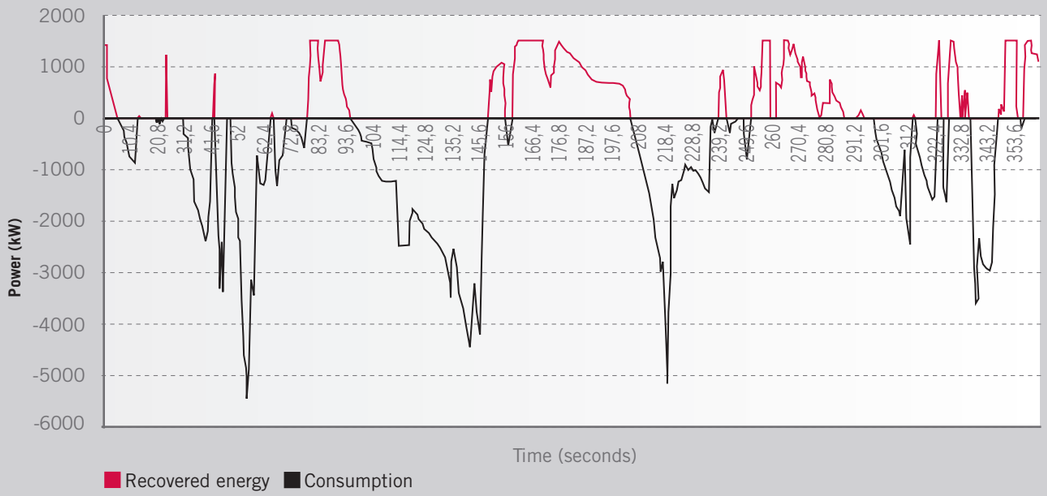


Technical data for a 1,500 Vdc catenary

1 Unit characteristics

Catenary voltage	1,500 Vdc	Direct current, max.	1,000 A
Alternating voltage	1,150 Vac	Total harmonic distortion(THD)	< 3%
Maximum power	1,500 kW	Output frequency	50 Hz
Rated power	800 kW	Cooling system	Air
Alternating current, max.	850 Arms		

Power flow profile on substation



Power diagram