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Kinell introduces HVDC Coupling System to bridge a critical gap in special vehicle electrification segment

Presentation at IVT Expo 2026 on June 10th & 11th (Booth 1190, Hall 1)

The accelerating electrification of special vehicles is exposing a critical gap in today's market: the lack of flexible, high-performance solutions for integrating external high-voltage (HV) systems. Addressing this unmet need, Kinell has developed an innovative HVDC coupling system designed to enable seamless integration of connectable external electric loads and range extenders.

Kinell will showcase its HVDC coupling system at the IVT Expo 2026 on 10. & 11. June (Hall 1, Booth 1190). The solution is engineered to extend the functionality and operational range of electric vehicles by allowing the safe and efficient integration of additional power sources and electrically driven equipment.

The HVDC coupling system:

A generic system approach to enable the extended functionality and range of electric vehicle through connectable electric implements and range extenders.

Special vehicles are undergoing a rapid shift towards electrification, bringing new technology challenges. At the core of this transformation is the high voltage direct current (HVDC) system, which serves as the power backbone of modern electric vehicles. These HVDC systems typically consist of power sources such as a HV battery, a power distribution unit (PDU), an HVDC bus, and connected loads such as electric inverter / drives and auxiliary functions. Within this architecture, the HV grid ensures controlled energy distribution, system protection and continuous monitoring of electrical parameters.

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Traditionally, HVDC systems have been designed to operate independently and have a fixed system scope. Each system includes its own E- System and all components are firmly connected.

In practice, however, there is a growing need to flexibly extend the HVDC system scope or to connect independent HV systems. This is driven by two key motivations:

- extending machine functionality by connecting electrically powered implements or subsystems (consumers)
- extending operating range by connecting range extender systems or reducing charging time by connecting swappable energy sources (suppliers).

Existing approaches focus on integrated, bespoke and integrated solutions for system extensions. A more generic approach for interconnecting two HV systems concentrates all required functions for the coupling, operation and decoupling into a dedicated subsystem, the HVDC coupling system. This way the two HV systems to be coupled can largely remain unchanged, while for the HVDC coupling system the generic coupling functions (e.g. HV switching) can be reused and at the same time the specific realization ca be adopted to the concrete coupling application with limited effort.

For a HVDC coupling system, a simple physical HV connection is not sufficient. The interface must provide a robust and safe mechanical and electrical connection, but moreover also ensure that the entire process of coupling, operating, and de-coupling is actively and safely managed and monitored. This means the HVDC coupling system must check whether conditions are safe before the initiation of the HV connection (e.g. connector plug detection, isolation resistance measurement), manage the connection process (e.g. pre-charging, voltage level balancing), monitor conditions during the operation (e.g. monitor power flow and temperature levels), and ensure a controlled disconnection. Additionally, the coupling interface must also rapidly react to any misuse of the HV connection, such an unintended plug disconnection or an interface power overload, protecting the user from any safety threats and at the same time protecting the HV systems from any damage.

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Kinell HVDC Coupling System: Architecture and Solution

To fulfil these requirements, a dedicated HV coupling system solution is needed that combines a suitable HVDC connector with the overlaying HW and SW functionality for coupling of two HV systems and ensuring safe and reliable performance.

The HVDC coupling system developed by Kinell builds upon this concept by enabling the controlled interconnection of external HV systems and extending the overall vehicle architecture. A typical HV coupling system configuration consists of a coupling unit (a specialized HV interface box with sensor and actor capabilities), an integrated DC/DC conversion (for coupling of two active HV-systems), a safety coupling controller responsible for system operation and a suitable physical HV connector with built-in safety features, such as pull-off mechanisms and interlock pins for plug detection interface. Together, these elements transform a simple connection point into an actively controlled part of the overall vehicle HV architecture.

Building on this architecture, Kinell has implemented its HV coupling system in a practical application on a battery-electric MAN 4x4 truck for agricultural and forestry use. In this use-case, the coupling system utilizes an AEF/ISO 23316-2 high-power interface to connect swappable HV batteries to the e-truck's main HV system as range extender.

"The key advantage of our HVDC coupling system is its ability to seamlessly integrate independent HV systems into a unified, safe and efficient architecture, through a self-contained solution that handles all aspects of the connection process" explains Dr. Michael P. Schmitt, Managing Director of Kinell. *"In this application, we demonstrate how external battery units can be flexibly deployed to extend vehicle range while maintaining full system integrity."*

The vehicle and the external battery units each represent two HV systems that can be operated independently, i.e. the e-truck is able to operate without external batteries being connected, and the swappable batteries can be charged through other power sources (e.g. solar power). Utilizing the coupling system, both systems can be safely connected and operated as one integrated HV system, allowing an energy transfer from the external batteries to the main HV system ("range extender"). The coupling system also supports safe connect and disconnect during the vehicle operation ("hot plug capability"), as such allowing a swap of the external batteries while the main HV system continues to power the e-

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truck's stationary operation purely powered by the integrated HV batteries ("rapid recharging").

In summary, HVDC coupling systems provide the technical basis for safely connecting and operating independent HV systems in a controlled and reliable way. Through the "outsourcing" of the coupling functions, they keep the required design changes for the main systems to a minimum, while at the same time protect the main HV system from potential damage through misuse. By this HVDC coupling systems provide simple and easy to integrate possibilities for the extension and range extension of electrified special vehicles.

About Kinell
Kinell is the FÉTIS Group brand dedicated to decarbonization, electrification, automation and software development for off-highway machinery and specialized vehicles.
Structured around several specialized activities (Mobility and Engineering), Kinell offers comprehensive solutions and technological building blocks. Kinell supports OEMs in the design, integration and development of high-performance, reliable machines in their energy transition. Its offering covers the entire innovation cycle: design of low-carbon propulsion systems, development of embedded software, connected services, etc.
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About Fétis Group
FÉTIS Group is a privately-owned international engineering group focusing on the industries of heavy mobility, marine and on-site power. From its base in Nantes, France, it has growth to over 700 employees in 9 countries.
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