Locomotive flywheel energy storage

At the present time, trains in heavy haul operations are typically hauled by several diesel-electric locomotives coupled in a multiple unit. This paper studies the case of a typical consist of three Co-Co diesel-electric locomotives, and considers replacing one unit with an alternative version, with the same design parameters, except that the diesel-electric plant is replaced with flywheel ...

Beacon Power is building the world"s largest flywheel energy storage system in Stephentown, New York. The 20-megawatt system marks a milestone in flywheel energy storage technology, as similar systems have only been applied in testing and small-scale applications. The system utilizes 200 carbon fiber flywheels levitated in a vacuum chamber.

The introduction of flywheel energy storage systems in a light rail transit train is analyzed. Mathematical models of the train, driving cycle and flywheel energy storage system are developed. ... Sizing and energy management of a hybrid locomotive based on flywheel and accumulators. IEEE Trans Veh Technol, 58 (8) (2009), pp. 3947-3958. View in ...

The Center for Electromechanics (UT-CEM) is currently developing and testing a 2 MW, 130 kWh flywheel energy storage system as a critical element of the Advanced Locomotive Propulsion System (ALPS) Program.[1] The hybrid electric locomotive propulsion system consists of two major sub-systems: a gas turbine prime mover directly coupled to a 3 MW high speed ...

Application of flywheel energy storage for heavy haul locomotives. Appl. Energy (2015) ... The flywheel energy storage system (FESS) offers a fast dynamic response, high power and energy densities, high efficiency, good reliability, long lifetime and low maintenance requirements, and is particularly suitable for applications where high power ...

This paper modelled flywheel and battery energy storage systems for heavy-haul locomotives. Three heavy-haul trains with their traction power provided by diesel, diesel-flywheel, and diesel ...

(UPS), hybrid locomotives, and power pulsation. FESSs are introduced as a form of mechanical ESS in several books [2,4]. Several review papers address different aspects of FESS ... An overview of system components for a flywheel energy storage system. Fig. 2. A typical flywheel energy storage system [11], which includes a flywheel/rotor, an ...

Larger electric locomotives, e.g. British Rail Class 70, have sometimes been fitted with flywheel boosters to carry them over gaps in the third rail. Advanced flywheels, such as the 133 kWh pack of the University of Texas at Austin, ... Flywheel Energy Storage Systems (FESS) are found in a variety of applications ranging from grid-connected ...

use of flywheel as an ESD (Energy Storage Device) in WAP-7 Locomotives ... In Regenerative Braking of a

WAP-7 locomotive, if we get energy back from the Traction motor, it acts as a generator, generating electrical energy from the kinetic energy when braked upon. So, in the case of regenerative braking, and

Application of flywheel energy storage for heavy haul locomotives. Maksym Spiryagin, Peter Wolfs, Frank Szanto, Yan Quan Sun, Colin Cole and Dwayne Nielsen. Applied Energy, 2015, vol. 157, issue C, 607-618 . Abstract: At the present time, trains in heavy haul operations are typically hauled by several diesel-electric locomotives coupled in a multiple unit.

Flywheel energy storage (FES) can have energy fed in the rotational mass of a flywheel, store it as kinetic energy, and release out upon demand. The superc ... A 2 MW flywheel for hybrid locomotive power [C]// 2003 IEEE 58th Vehicular Technology Conference. Orlando: IEEE, 2003: 3231-3235.

Flywheel energy storage (FES) can have energy fed in the rotational mass of a flywheel, store it as kinetic energy, and release out upon demand. ... A 2 MW flywheel for hybrid locomotive power. IEEE Vehicular Technology Conference, 2003 IEEE 58th Vehicular Technology Conference, VTC2003-Fall, Orlando, United States, October (2003), pp. 3231-3235.

While many papers compare different ESS technologies, only a few research, studies design and control flywheel-based hybrid energy storage systems. Recently, Zhang et al. present a hybrid energy storage system based on compressed air energy storage and FESS.

Trevithick"s 1802 steam locomotive, which used a flywheel to evenly distribute the power of its single cylinder. A flywheel is a mechanical device that uses the conservation of angular momentum to store rotational energy, a form of kinetic energy proportional to the product of its moment of inertia and the square of its rotational speed particular, assuming the flywheel"s ...

[87] M. Spiryagin, Q. Wu, P. Wolfs, Y. Sun, C. Cole, Comparison of locomotive energy storage systems for heavy-haul operation, International Journal of Rail Transportation 6 (1) (2018) 1 ... An integrated flywheel energy storage system with homopolar inductor motor/generator and high-frequency drive, Ph.D. thesis, University of California ...

Thanks to the unique advantages such as long life cycles, high power density and quality, and minimal environmental impact, the flywheel/kinetic energy storage system (FESS) is gaining steam recently.

The diesel, flywheel, and battery locomotives have traction powers of 3100 kW, 2000 kW, and 3100 kW, respectively. Energy storages for the flywheel and battery ESSs are 500 kWh and 5000 kWh, respectively. Traction performance, fuel consumption, and emissions were compared for the three simulated trains.

2.6 Hybrid energy-storage systems. The key idea of a hybrid energy-storage system (HESS) is that heterogeneous ESSes have complementary characteristics, especially in terms of the power density and the energy density . The hybridization synergizes the strengths of each ESS to provide better performance rather

than using a single type of ESS.

Flywheel is often applied in heavy-haul locomotive , . For example, Spiryagin et al. propose a simplified control strategy for a FESS-assisted heavy haul locomotive. The study concludes that "FESS can be a very good solution" because battery"s limits on "specific power, cost efficiency and service lifetime". 3.2.3. Marine

The operation of the electricity network has grown more complex due to the increased adoption of renewable energy resources, such as wind and solar power. Using energy storage technology can improve the stability and quality of the power grid. One such technology is flywheel energy storage systems (FESSs). Compared with other energy storage systems, ...

The ALPS energy storage system consists of a high speed energy storage flywheel, a 2 MW high speed induction motor/generator, and a high frequency bi-directional power converter. In the ...

A novel design for heavy haul locomotive equipped with a flywheel energy storage system is proposed. o The integrated intelligent traction control system was developed. ...

Today, the cost of a composite flywheel system does not scale in proportion to the benefits for lower energy systems. The high-energy end is being pushed upward, but technical challenges are significant. Material strength is a significant design constraint across this energy range.

The introduction of flywheel energy storage systems in a light rail transit train is analyzed. Mathematical models of the train, driving cycle and flywheel energy storage system are developed. These models are used to study the energy consumption and the operating cost of a light rail transit train with and without flywheel energy storage.

The flywheel draws input energy from an external electrical source, speeding up as it stores energy and slowing down as it discharges the accumulated energy. This is particularly useful in conjunction with renewable energy generation such as wind and solar power since optimal conditions fluctuate seasonally and even annually, making it ...

This review presents a detailed summary of the latest technologies used in flywheel energy storage systems (FESS). This paper covers the types of technologies and systems employed within FESS, the range of materials used in the production of FESS, and the reasons for the use of these materials. Furthermore, this paper provides an overview of the ...

Flywheel Energy Storage Systems (FESS) work by storing energy in the form of kinetic energy within a rotating mass, known as a flywheel. Here"s the working principle explained in simple way, Energy Storage: The system features a flywheel made from a carbon fiber composite, which is both durable and capable of storing a lot of energy.

A comparative study of the proposed structure with a flywheel and the existing structure of the locomotive (diesel generator, accumulators, and ultracapacitors) is presented. The French National Railways Company (SNCF) is interested in the design of a hybrid locomotive based on various storage devices (accumulator, flywheel, and ultracapacitor) and fed by a diesel ...

Pe r-review u er responsibility of the sci ntific committee of the 8th International Conference on Applied Energy. 4562 Nima Ghaviha et al. / Energy Procedia 105 (2017) 4561 âEUR" 4568 Nomenclature EMU Electric Multiple Unit DMU Diesel Multiple Unit ESS Energy Storage System SESS Stationary Energy Storage System OESS On-board Energy ...

Thanks to the unique advantages such as long life cycles, high power density, minimal environmental impact, and high power quality such as fast response and voltage stability, the flywheel/kinetic energy storage system (FESS) is gaining attention recently.