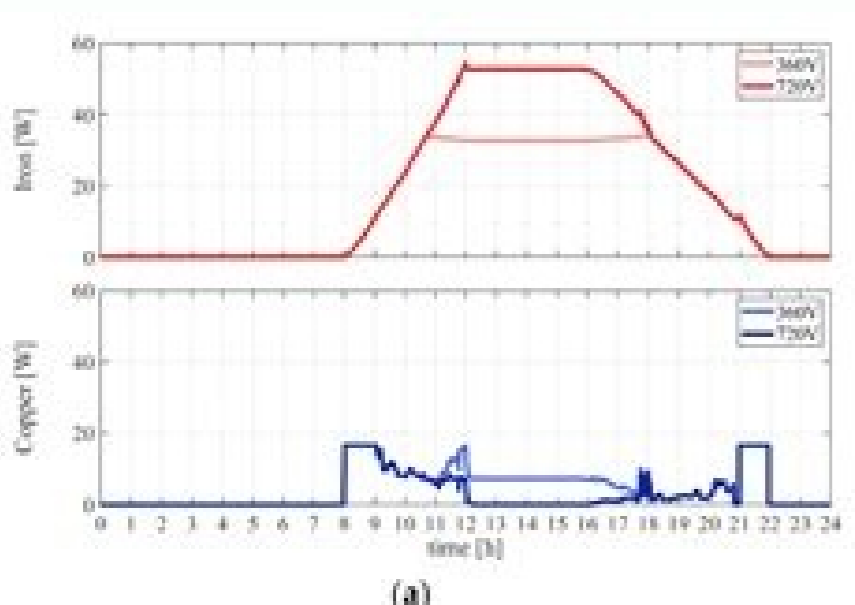
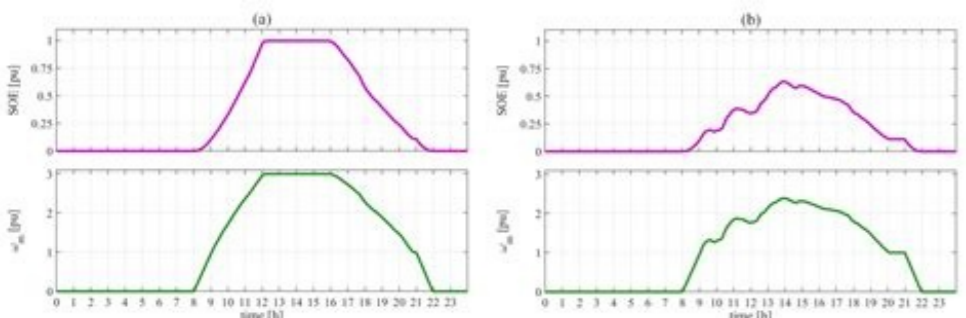
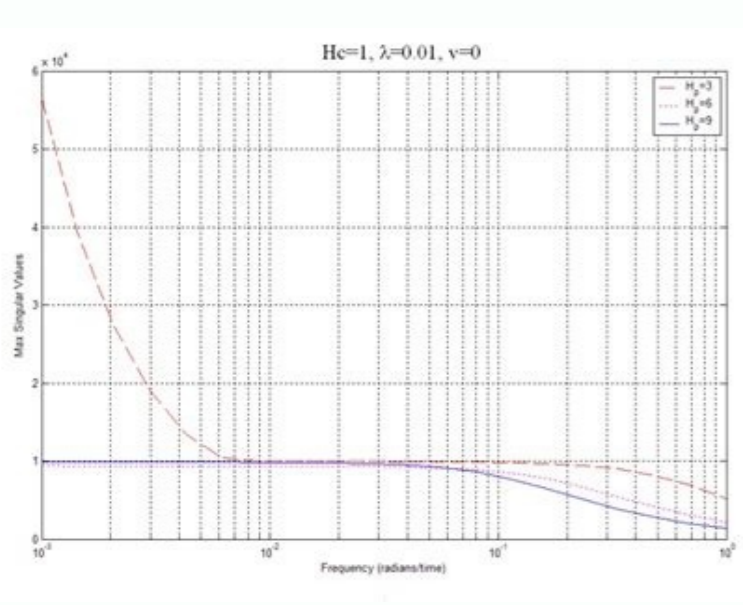
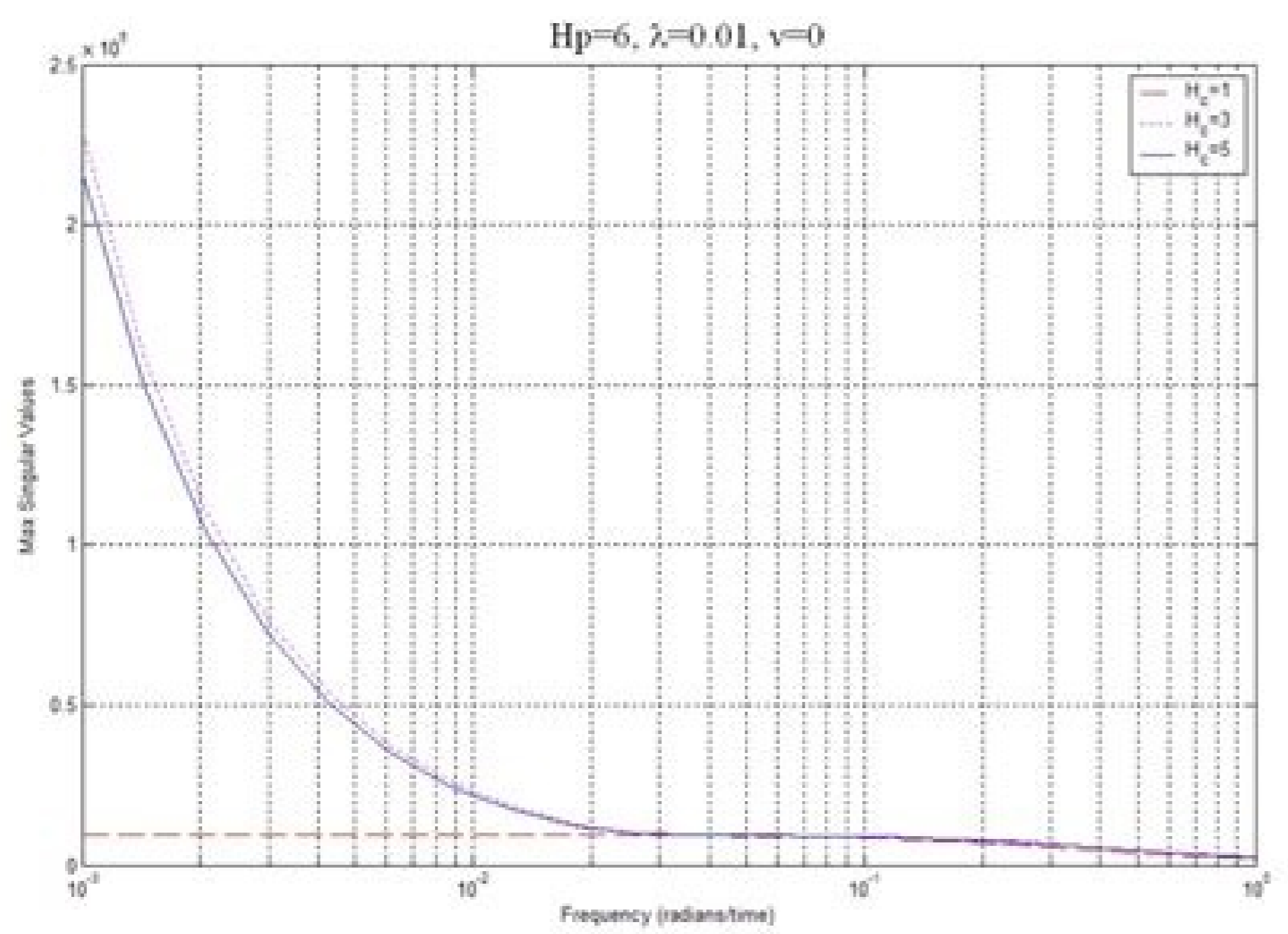
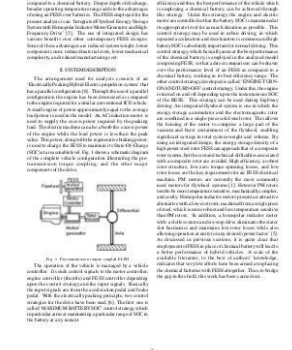


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Download your Reports for Flywheel Flywheel energy storage systems store kinetic energy (i.e. energy produced by motion) by constantly spinning a compact rotor in a low-friction environment. When short-term back-up power is required (i.e. when utility power fluctuates or is lost), the rotor's inertia allows it to continue spinning and the resulting kinetic energy is converted to electricity. Active Power's CleanSource? Flywheel Technology, as shown below, integrates the function of a motor, flywheel rotor and generator into a single integrated system. The motor, which uses electric current from the utility grid to provide energy to rotate the flywheel, spins constantly to maintain a ready source of kinetic energy. The generator then converts the kinetic energy of the flywheel into electricity. This integration of functionality reduces the cost and increases product efficiency. The flywheel rotor spins in a near frictionless environment, created by Active Power's patented magnetic bearing technology. This innovative technology unloads a majority of the flywheel's weight from the field-replaceable mechanical bearing cartridge. The efficiency in the chamber is further enhanced by the creation of a rough vacuum, which reduces drag on the spinning flywheel. As power is transferred to the load, the flywheel's speed decreases. Additional current is then supplied to the field coil to ensure that the voltage output remains constant throughout discharge. This enables the flywheel system to provide ride-through power during power disturbances. Active Power's flywheel-based systems provide ride-through power for the majority of power disturbances, such as voltage sags and surges, and bridges the gap between a power outage and the time required to switch to generator power. Download your Reports for Flywheel Advertisement 1. Flywheel Energy Storage System Subject-EE001. Seminar Prepared By: Karansinh Parmar (Id No:-16EP819 M.Tech. in Electrical Engineering 2. Paper Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 2 3. Content • Introduction • Basic block diagram of FESS system • Structure of FESS • Component used in flywheel storage system • Different Flywheel Material Characteristics • Different shapes and shape factor of flywheel • The setup for flywheel energy storage system • Hardware • Conclusion • Reference Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 3 4. Introduction • Flywheel store electrical energy into kinetic energy release out upon demand, FESS system can charge or discharge in quick time and give large amount of energy. • Flywheel storage system store electrical energy as kinetic energy in the rotational mass can gives in or out of flywheel with help of ac or dc electrical drives. • It works in two modes • generator and motor. • In motoring mode electrical energy supply to the stator of motor which produced torque and rotate rotating mass with high speed and store kinetic energy and • In generator mode this kinetic energy used to convert into electrical energy by faradays law electromagnetic induction. Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 4 5. Cont.... • kinetic energy (K.E.) store in flywheel given by, • $E_k = \frac{1}{2}J\omega^2$ - Where J- moment of inertia - ω - angular velocity • so, K.E. is directly proportional to the product of moment of inertia and square of angular velocity, is given by • $J = Mr^2$ - Where, r- radius of flywheel - M- function of mass Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 5 6. Basic block diagram of FESS system Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 6 7. Structure of FESS Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 7 8. Component used in flywheel storage system • electrical drive like motor/generator set • Bearing • Flywheel • Supply • Permanent magnet Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 8 9. • The maximum spinning speed ω is determined by the capacity of the material to withstand the centrifugal forces affecting the Flywheel, which is the material tensile strength σ lighter material develops low inertia at given angular velocity (ω) therefore composite material with low density and high tensile strength is excellent for storing kinetic energy. • The maximum energy density with respect to volume and mass are, • $eve = K \sigma \cdot me = CoI \cdot \sigma = r^2 \omega \cdot$ Where, V. - eve is the kinetic energy per unit volume me is the kinetic energy per unit mass . - K is the shape factor Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 9 10. Kinetic Energy For Different Material Of Flywheels Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 10 11. Table shows that composite material is best suitable for FESS system Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 11 12. Different Flywheel Material Characteristics Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 12 13. • In order to obtain high kinetic energy from flywheel system, flywheel material must have high tensile strength and low mass density result into high angular velocity like modern composite material. • In comparisons with composite material metals are heavy and less in cost. Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 13 14. Different shapes and shape factor of flywheel Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 14 15. ELECTRIC MACHINE • The design, construction, and test of an integrated flywheel energy storage system with a homo-polar inductor motor / generator and high-frequency drive is shown in this paper. • The motor design features low rotor losses, a slot-less stator, construction from robust and low cost materials, and a rotor that also serves as the energy storage rotor for the flywheel system, was implemented by Perry Tsao et.al. • flywheel motor design high frequency drive design and sensor less control design, figure shows the rotor for homopolar induction motor Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 15 16. The setup for flywheel energy storage system • In the study brushless motor with permanent magnet used as motor generator set, this FESS system stored about 4 MJ of energy and the rotational speed was 6000rpm. • R. okou therefore composite surface mounted axial flux brushless dc machine main advantageous simple control strategy and highly efficient. Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 16 17. • Various machine used for high speed application like permanent magnet synchronous motor, switch reluctance motor. • Permanent magnet motor widely used motor to develop flywheel energy storage system. • Permanent magnet synchronous motor having two part like every motor stator and rotor. • Stator is like ordinary motor having 3 phase or single phase winding and having armature winding on it and rotor is made with permanent magnet like alnico, neodymium iron-boron NdFeB magnets or samarium-cobalt alloys SmCo. • When PMSM run as generator then there is no need to give field excitation and also not require slip ring due to use of permanent magnet S • Highly efficient • Brush losses Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 17 18. Constructed flywheel structure with the help of universal motor and steel flywheel Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 18 19. Basic circuit diagram of above hardware Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 19 20. Working • Here we are using two ways switch with the help of this switch we can rotate rotor in motoring and generating mode. • In first position of two way switch it gives 220v to armature winding of motor and it start rotating . • when it reached to rated speed and stored K.E. In flywheel after that switch position changed to second position. • 24 volt dc given to the field winding then it start generating give to bridge rectifier and then load. Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 20 21. Result Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 21 22. Uses • Due to unsymmetrical faults and unbalance load power quality issue occur, to counter this issues we can use flywheel energy storage system. • Used in : - paper mills - Food processing industries Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 22 23. Conclusion • The calculation for kinetic energy from that we can conclude that composite material is best suitable for flywheel based energy storage system due to high tensile strength and high angular velocity. • FESS is a basically energy converting system which convert kinetic energy into electrical and vice-versa. Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 23 24. Reference • "Design OF Energy Storage System With Flywheel And Electrical Drives" Nishigandha. M. Ingale, Vijay. M. Mankar Department Of Electrical Engineering, Rajiv Gandhi College Of Engineering, Nagpur, India • International conference on Signal Processing, Communication, Power and Embedded System (SCOPES)-2016 Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 24 25. Karansinh Parmar, M.Tech. Electrical Power System Engineering, Birla Vishvakarma Mahavidyalaya, VVNagar 25

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