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FLYWHEEL ENERGY STORAGE SYSTEM

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Abstract: Using a flywheel and a squirrel-cage induction motor, this paper proposes two inverter-less applications for electrical power quality improvement by compromising a little frequency fluctuations; (1) a voltage sag compensator using a capacitor self-excited induction generator without semiconductor power converters, (2) blackout delay system for industrial robots safety shutdown.

Keywords: UPFC model, stability, PSS.

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INTRODUCTION

With the increased automation of factories, load side electrical power quality is becoming more and more important. The main factors contributing to the electrical power disturbances are divided into two parts. One is voltage sags (dips) which are approximately 0.2 seconds in duration, and another is blackouts. From a statistics during 7000 day in Japan [1], 90% of voltage sags are within 0.25 s. These power disturbances lead to serious errors in the automation system of the factories. This paper deals with two different duration disturbances (1) voltage sag compensator (2) blackout compensator fig. Block diagram. VOLTAGE SAGS AND BLACKOUTS COMPENSATION

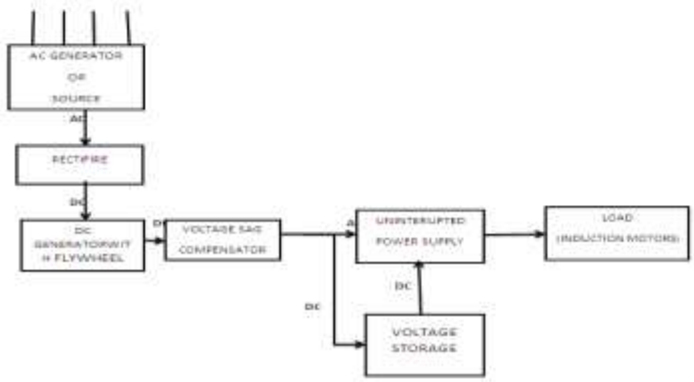


FIG.1 BLOCK DIAGRAM

CASE STUDY

In the protection mode, the SEIG generates the output voltage resonating with the self-excited capacitor and its magnetizing inductor. The self-excited capacitor is an exciter of the induction generator. Therefore, the output voltage of SEIG varies with the capacitance of self-excited capacitor. In order to comprehend the output voltage characteristics with varying capacitance of the self-excited capacitor and the load capacity, a basic test model composed of an 11-kW, 200-V (line-to-line rms) squirrel-cage induction motor with a heavy flywheel of 220kJ was manufactured. Under the condition of idling mode after the flywheel speed becomes approximately synchronous speed, the SW1 is opened and the flywheel discharges the stored energy to a resistive load.

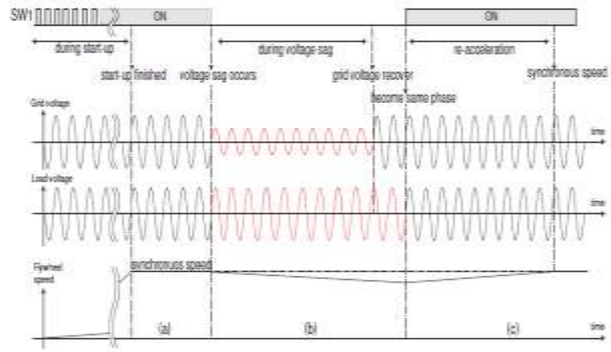


Figure 2: Operation chart of the inverter-less voltage sag compensator. (a) is idling mode and (b) is protection mode, and (c) is re-acceleration and idling mode.

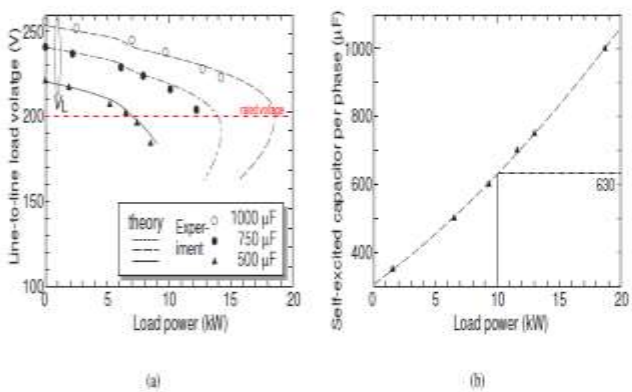
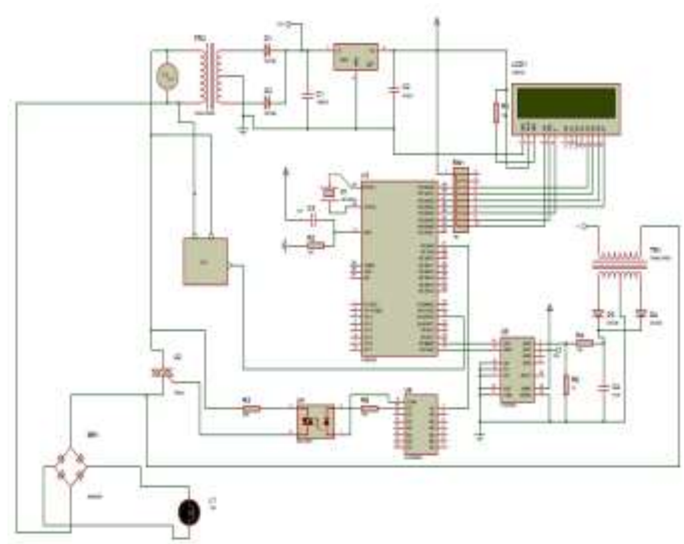


Fig. 3 basic characteristics of flywheel

During 0.3 seconds after the open test starts, the flywheel keeps approximately synchronous speed because of the test model with the heavy flywheel. Thus, optimal capacitances of self-excited capacitor depending on the load capacity are investigated by measuring the line-to-line load voltage at 0.3 seconds after the SW1 was opened.

Fig. 3(a) shows that the load voltage decreases with a heavy loading. Fig. 3(a) also indicates that the optimal capacitances exist versus each load capacity in order to compensate the load voltage as rated voltage of line-to-line 200 V. Experimental results are in good agreement with steady state calculations

of the SEIG by an iterative method[5, 6]. Fig. 3(b) shows the optimal relationship curve between the capacitance of self-excited capacitor and the load capacity. From these results, in order to compensate the 10-kW resistive load, the capacitor of 630 μF (2.6 kvar/phase) is optimal. When the load capacity changes largely in the idling mode, shift to the optimal capacitance according to the Fig. 3(b) is important.



CONCLUSION

This paper clarifies the following points about the inverter-less flywheel system;

(1) The optimal stored energy design for the inverter-less voltage sag compensator composed of off-the shelf squirrel-cage induction motor and flywheel is established and experimentally verified.

(2) The effectiveness of the flywheel system is confirmed by the voltage sag test using tap changing of the auto-transformer.

(3) The concept of blackout delay system is proposed and the usefulness of this system is experimentally verified by the field tests of the real industrial robot.

REFERENCES

1. Jimichi, T., Fujita, H., Akagi, H. �Design and Experimentation of a Dynamic Voltage Restorer Capable of Significantly Reducing an Energy-Storage Element,� in IEEE Trans. IA, Vol. 44, Issue 3, pp. 817 � 825 ,2008

2. S.S. Murthy, O. P. Malik, and A.K. Tandon, �Analysis of self-excited induction generators,� in IEE Proc-C Gener., 1982, Vol. 129, No. 6, pp. 260�265

3. T.F. Chan, �Analysis of self-excited induction generators using an iterative method,� in IEEE Trans. Energy

4. M. Bollen, Understanding Power Quality Problems, Voltage Sags and Interruptions. Piscataway, NJ: IEEE Press, 1999.

5. Nielsen, J.G., Blaabjerg, F, “A detailed comparison of system topologies for dynamic voltage restorers,” in IEEE Trans. IA, Vol. 41, Issue 5, pp. 1272–1280, 2005

6. P. Cheng, C. Huang, C. Pan, and S. Bhattacharya, “Design and implementation of a series voltage sag compensator under practical utility conditions,” IEEE Trans. Ind. Appl., vol. 39, no. 3, pp. 844–853, May/Jun. 2003.

7. E. K. K. Sng, S. S. Choi, and D. M. Vilathgamuwa, “Analysis of series compensation and DC-link voltage controls of a transformerless self-charging dynamic voltage restorer,” IEEE Trans. Power Del., vol. 19, no. 3, pp. 1511–1518, Jul. 2004.

8. J. Shimomura, H. Zaitsu, H. Nara, M. Ohbe, R. Hatano, and S. Sugimoto, “Development of high voltage capacity uninterruptible power supply system utilizing electric double-layer capacitors,” in Proc. IEEJ Tech. Meeting SPC/IEA, 2004, pp. 55–60. (In Japanese).