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لم ترد بالأصل

DSP BASED INTELLIGENT FIRING CONTROLLER FOR SMES POWER CONDITIONING SYSTEM

A Thesis prepared By

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ABSTRACT

The use of SMES systems to enhance both generation system and transmission and distribution system assets can translate into significant strategic competitive advantage for the power system industry in the next century. Similarly, the expected growth of wind and direct solar technologies, and of non-utility generators, as well as of traditional needs of outage backup and system stability protection all argue for the development of reliable, broadly applicable SMES system.

The main challenge is to design and implement a powerful firing system controller for the proper SMES power conditioning system which can handle the time critical requirements of the control and the firing circuits operations. Therefor, achieving such benefits and more through on-line control algorithms will be an easy task.

In the research reported in this thesis, the major effort has been devoted to design, built and test intelligent real time digital signal processor system controlled the GTO's firing signals for the multi-phase chopper-VSI SMES power conditioning system. The developed system is designed to handle SMES utility interactive operation as well as, stand-alone operation requirements. It promises to be the ultimate realization of the power system industry quest for an advanced, rapid response, high efficiency and flexible architecture SMES PCS firing controller in order to achieve an applicable high dynamic performance multiple benefit SMES system. Eventually, this will yield to a substantial positive benefit-to-cost ratio for the overall SMES system and increase its attractiveness for utility

applications. Moreover, that would set the stage for more-cost-effective generation and delivery systems in the next century.

The main unique features of this controller are:

1. It has an efficient, new synchronization technique. The controller is intelligently choose between the equidistant synchronization scheme or the individual phase synchronization scheme according to the precise measuring of the utility mains operating conditions. This technique will greatly enhance PCS-utility interface problems. Therefore, the SMES system adopted this controller will operate successfully through all type of utility disturbances with Minimum harmonic generation as much as possible which will increase SMES system reliability and availability. Also, That will improve the power system security even during emergency conditions and it may avoid blackouts of the bulk power system. Moreover, it accommodates the specific requirements of any implemented control algorithm.
2. It has an efficient VSI delay angle updating technique. The controller is almost updating the VSI delay angle commands intelligently (every 0.25 ele. degree) without creating a sever voltage notch. That will insure the rapid response and high precision performance of any implemented algorithm.
3. The controller software is designed to meet the needs of measuring the line frequency. Also, it has the capability of updating the VSI operating frequency.
4. The controller software design has many of inherent system protection features such as dc link short circuit protection and voltage notch generation

A new approach of the multiphase chopper firing controller operation has been designed to handle the chopper phase current sharing problem instead of using the chopper phase inductors. This approach is founded upon the simultaneous selection of the most suitable chopper individual phase duty cycle to achieve an equal phase current sharing. Also, the chopper firing scheme is capable of operating at the harmonic free points spectrum.

A high speed data acquisition system has been accomplished by the digital signal processor along with the firing control algorithm calculations. A system of ten A/D channels, for the AC and DC system parameters measurements, and ten D/A channels, for system parameters monitoring scheme, has been built up

The experimental results which show the effectiveness of the developed real time DSP controller are to be presented with a brief description of the controller hardware and software.

A digital simulation of the SMES system model utilizing the chopper-VSI power conditioning system when equipped with the proposed firing system is to be developed and executed on the digital computer to explain the capabilities and benefits of the SMES system to the utilities.

TABLE OF CONTENTS

TABLE OF CONTENTS