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Intensify the Voltage Stability by SSSC with SMES

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ABSTRACT

Premier concept of this paper is intensify the dynamic voltage stability by using of static synchronous series compensator with super-conducting magnetic energy storage device. At any point of time, a power system operating condition should be stable, meeting various operational criteria, and it should also be secure in the event of any credible contingency. Present day power frameworks are being worked nearer to their security restricts because of financial and natural requirements. Keeping a steady and secure activity of a force framework is in this way a vital and testing issue.

Keywords: SSSC, FACTS, SMES

Introduction

The central concept in the maintenance of synchronism is stability. There are number of stability issues that limit the transmission capabilities.

1. Transient Stability
2. Dynamic Stability
3. Steady State Stability
4. Voltage Stability
5. Sub-Synchronous Resonance

1. Transient Stability

The transient stability studies involve the determination of whether or not synchronism is maintained after the machine has been subjected to severe disturbance. This may be sudden application of load, loss of generation, loss of large load, or a fault on the system. In most disturbances, oscillations are of such magnitude that linearization is not permissible and nonlinear swing must besolved.

2. Dynamic Stability

A transmission system is said to be dynamically stable if it recovers normal operation following a specified minor disturbance. The degree of dynamic stability can be expressed in terms of the rate of damping of the transient components of voltages, currents, and the load angles of the synchronous machines

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3. Steady State Stability

The Steady state stability refers to the ability of the power system to remain in synchronism when subject to small disturbances. It is convenient to assume that the disturbance causing the changes disappear .The motion of system is free ,and stability is assured if the system returns to its original state such a behavior can be determined in a linear system by examine the characteristics equation of the system.

Theory

A large power system has many interconnections and bulk power transmissions over long distance. Due to this there low frequency inter area oscillations which make system vulnerable to cascading failures. Many different methods have been proposed to alleviate the oscillations in the power system. For many years, power system stabilizer (PSS) has been one of the traditionally devices used to damp out the oscillations. It is reported that during some operating conditions, PSS may not mitigate the oscillations effectively; hence, other effective alternatives are required in addition to PSSs .On the other hand, the advent of flexible ac transmission system (FACTS) devices has led to a new and more versatile approach to control the power system in a desired way. FACTS controllers provide a set of interesting capabilities such as power flow control, reactive power compensation, voltage regulation, damping of oscillations, and so forth. The static synchronous series compensator (SSSC) is one of the series FACTS devices based on a solid-state voltage source inverter which generates a controllable ac voltage in quadrature with the line current.

Objective

The aim of this paper is to study Enhancement of voltage instability by using static synchronous series compensator (SSSC) with super conducting magnetic energy storage device (SMES).And how the performance of SSSC increases with SMES that we have to discuss.

ProblemDefinition

The advent of FACTS has to lead to new & more versatile approach to control power system in desire way. FACTS controller provides sets of interesting capabilities such as power flow control, reactive power compensation, voltage regulation, damping of oscillation and so on. The SSSC is one of the series FACTS device based on solid state voltage source inverter which generates a controllable AC voltage in quadrature with the line current.

This way the SSC emulates as an inductive or capacitive reactance & hence control the power flow in the transmission line. If the line voltage is in phase quadrature with the line current the series controller absorb or produce real or reactive power.

Examples of such controllers are

1. Static Synchronous Series Compensator(SSSC)
2. Thyristor Switched Series Capacitor(TSSC)
3. Thyristor Controlled Series Reactor(TCSR)

All above can be used to control the current and power flow in system & to damp system oscillation , from which SSSC is solid state voltage source inverter injects an almost sinusoidal voltage of variable magnitude in series with transmission line.

Concept of SMES

Superconducting magnetic energy storage (SMES) is an energy storage technology that stores in the form of DC electricity that is the source of dc magnetic field, the conductor for carrying the current operates at cryogenic temperature. Where it is a superconductor and thus has virtually no resistive losses as it produces the magnetic field. The overall technology of cryogenics and superconductivity today is such that the components of SMES device are defined and can be constructed. The integrated unit appears to be feasible for some utility application at a cost that is competitive with other

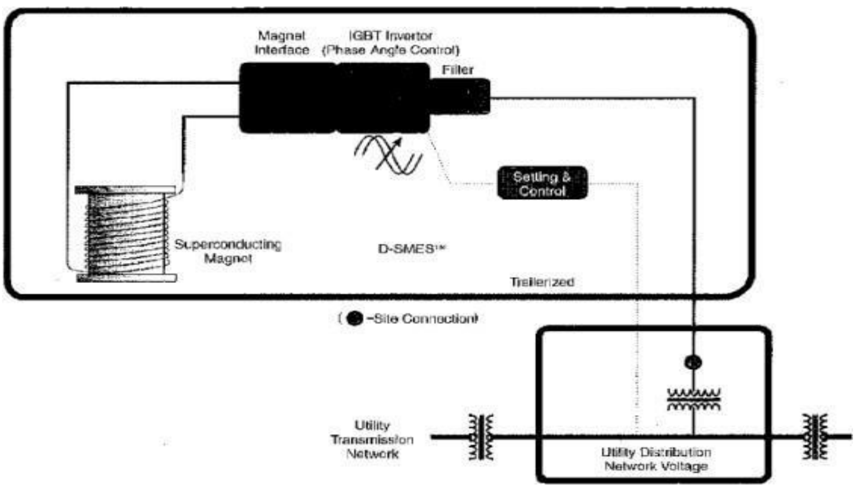

Fig. 1 The schematic diagram of SMES

technologies. SMES is the only technology based on superconductivity that is applicable electric utilities and is commercially available today. As a result, more pages of this issue are dedicated to this technology. In addition to today's power quality application, the historical development of SMES starting with the concept of very large plants that would store hundreds of megawatt of energy.

5.1 SMES with FACTS

The new Energy Storage System (ESS) is interface with FACTS device to increase its performance. In bulk power transmission systems, power electronics based controllers called FACTS, used to simultaneous control of real and reactive power flow control, has been proposed in recent years. Presently, FACTS devices are a viable alternative as they allow controlling voltages and current of appropriate magnitude for electric power system at an increasingly lower cost. However, a comparable field of knowledge on FACTS/ESS control is quite limited. Therefore, in this work a methodology is proposed to control the power flow, which uses FACTS controllers with energy storage. Using switching power converter-based FACTS controllers can carry this out. Among the different modelling of FACTS devices, SSSC is proposed as the most adequate for the present application. The DC inner bus of the SSSC allows incorporating a substantial amount of energy storage in order to enlarge the degrees of freedom of the SSSC device and also to exchange active and reactive power with utility grid. Based on a previous study of all energy storage technologies currently available, the use of SMES is proposed for the considered application.

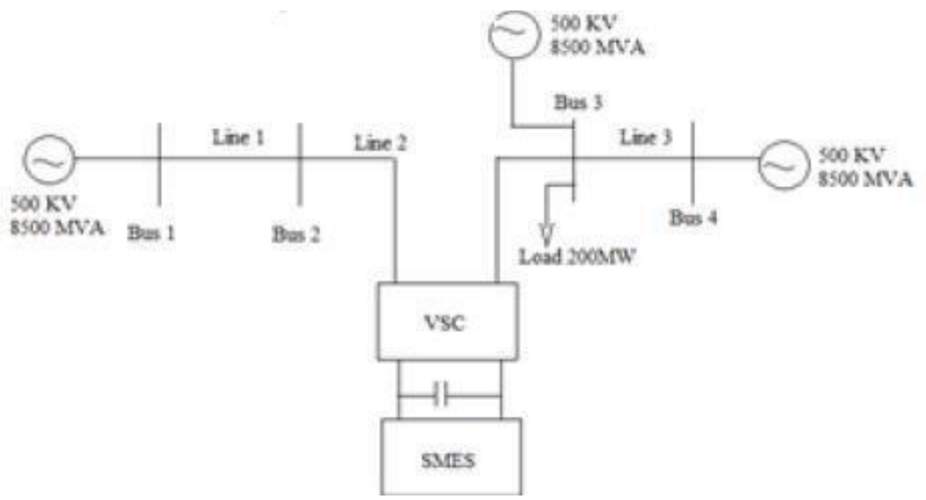

Fig.2 Single line diagram of the test system with SSSC with SMES.

As we use the SSSC without energy storage system it performs the following function like

1. Active powercontrol
2. Limited voltagecontrol
3. Good impact on oscillationsdamping
4. Limited impact on voltagestability

If we use SSSC with energy source the result obtained are as follows

1. Active powercontrol
2. Improved voltagecontrol
3. Good impact on transientstability
4. Good impact on oscillationdamping

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