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FACTS (Flexible AC Transmission System) by using TSR (Thyristor Switch Reactance)

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ABSTRACT: The project aims at achieving FACTS by using TSR (Thyristor Switch Reactance). It is done when there is very low or minor load at receiving end while charging the transmission line. Since the presence of low load, small current flows through transmission line therefore the shunt capacitance becomes more prominent. Due to this voltage amplification or Ferranti Effect occurs and the voltage at receiving end increases two times than the voltage at sending end. For this reason to compensate, shunt inductors are automatically connected across the transmission line. The project requires an operational amplifier that generates lead time between zero voltage pulse.

KEYWORDS: Transmission System (FACTS), FACTS Controllers, Power Transmission, Power Flow Control, Power Electronics, Modern Power Systems.

I. INTRODUCTION

The electricity supply industry is undergoing a profound transformation worldwide. Market forces, scarcer natural Resources, and an ever-increasing demand for electricity are some of the drivers responsible for such unprecedented Change. Against this background of rapid evolution, the expansion programs of many utilities are being thwarted by a Variety of well-founded, environment, land-use, and regulatory pressures that prevent the licensing and building of new Transmission lines and electricity generating plants. The ability of the transmission system to transmit power becomes impaired by one or more of the following steady State and dynamic limitations: (a) angular stability, (b) voltage magnitude, (c) thermal limits, (d) transient stability, and€ dynamic stability. These limits define the maximum electrical power to be transmitted without causing damage to Transmission lines and electrical devices. In principle, limitations on power transfer can always be relieved by the Addition of new transmission lines and generation facilities. Alternatively, flexible alternating current transmission System (FACTS) controllers can enable the same objectives to be met with no major alterations to power system layout. FACTS are alternating current transmission systems incorporating power electronic-based and other static controllers. To enhance controllability and increase power transfer capability. The FACTS concept is based on the substantial Incorporation of power electronic devices and methods into the high voltage side of the network, to make it electronically controllable. FACTS controllers aim at increasing the control of power flows in the high-voltage side of the network during both steady state and transient conditions.

II. OBJECTIVES OF FACTS CONTROLLERS

The main objectives of FACTS controllers are the following: 1. Regulation of power flows in prescribed transmission routes as per controlled conditions. 2. Secure loading of transmission lines nearer to their thermal limits. 3. Prevention of cascading outages by contributing to emergency control. 4. Damping of oscillations that can threaten security or limit the usable line capacity. The implementation of the above objectives requires the development of high power compensators and controllers. The technology needed for this is high power electronics with real time operating control. The realization of such an overall system optimization control can be considered as an additional objective of FACTS controllers.

III. TYPES OF FACTS CONTROLLERS

Series controllers: The series controller could be variable impedance, such as capacitor, reactor, or a power electronics based variable source of main frequency, sub-synchronous and harmonic frequencies (or a combination) to serve the desired load. In principle, all series controllers inject voltage in series with the line. As long as the voltage is in phase



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quadrature with the line current, the series controller only supplies or consumes variable reactive power. Any other phase relationship will involve handling of real power as well. Series controllers include SSSC, IPFC, TCSC, TSSC, TCSR, and TSSR. Shunt controllers. As is the case of series controllers, the shunt controllers may be variable impedance, variable source, or a combination of these. In principle, all shunt controllers inject current into the system at the point of connection. Even variable shunt impedance connected to the 400 Applied Electromagnetic Engineering line voltages causes a variable current flow and hence represents injection of current into the line. As long as the injected current is in phase quadrature with the line voltage, the shunt controller only supplies or consumes reactive power. Any other phase relationship will involve handling of real power as well. Shunt controllers include STATCOM, TCR, TSR, TSC, and TCBR.

IV. FACTS CONTROLLERS STATCOM

STATCOM is a static synchronous generator operated as a shunt-connected static VAR compensator whose capacitive or inductive output current can be controlled independent of the ac system voltage. The use of STATCOM as a FACTS controller is proposed in SVC. SVC is a shunt-connected static VAR generator or absorber whose output is adjusted to exchange capacitive or inductive current so as to maintain or control specific parameters of the electrical power system (typically bus voltage). SVC is an important FACTS controller already widely in operation. Ratings range from 60 to 600 MVAR. SVC can be considered as a "first generation" FACTS controller and uses thyristor controllers. It is a shunt reactive compensation controller consisting of a combination of fixed capacitor or thyristor-switched capacitor in conjunction with thyristor-controlled reactor.

TCR: TCR is a shunt-connected thyristor-controlled inductor whose effective reactance is varied in a continuous manner by partial-conduction control of the thyristor valve. TCR has been used as one of the economical alternatives of FACTS controllers.

TSC: TSC is a shunt-connected thyristor-switched capacitor whose effective reactance is varied in a stepwise manner by full- or zero-conduction operation of the thyristor valve. TSR: TSR is a shuntconnected thyristor-switched inductor whose effective reactance is varied in a stepwise manner by full- or zero-conduction operation of the thyristor valve.

TCBR: TCBR is a shunt-connected thyristor-switched resistor, which is controlled to aid stabilization of a power system or to minimize power acceleration of a generating unit during a disturbance.

SSSC: SSSC is a static synchronous generator operated without an external electric energy source as a series compensator whose output voltage is in quadrature with, and controllable independently of, the line current for the purpose of increasing or decreasing the overall reactive voltage drop across the line and thereby controlling the transmitted electric power. The SSSC may include transiently rated energy storage or energy absorbing devices to enhance the dynamic behaviour of the power system by additional temporary real power compensation, to increase or decrease momentarily, the overall real (resistive) voltage drop across the line.

TCSC: TCSC is a capacitive reactance compensator, which consists of a series capacitor bank shunted by a thyristor controlled reactor in order to provide a smoothly variable series capacitive reactance. TSSC: TSSC is a capacitive reactance compensator, which consists of a series capacitor bank shunted by a thyristor switched reactor to provide a stepwise control of series capacitive reactance. TCSR: TCSR is an inductive reactance compensator, which consists of a series reactor to provide a smoothly variable series reactor.

TSSR: TSSR is an inductive reactance Compensator, which consists of a series reactor shunted by a thyristorcontrolled reactor to provide a stepwise control of series inductive reactance.



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V. DIAGRAMS

(1)block BLOCDIAGRAM



Figure 1 : (1)block diagram



(2) SCR IN ANTI-PARALLEL



Figure 2 : (2) SCR IN ANTI PARALLEL (3) LCD LAYOUT DIAGRAM (4) LAYOUT DIAGRAM



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Resistor

(11) 1N4148 DIODE (12)PIN DIAGRAM (13) THYRISTOR (SCR)



(14) PIN DIAGRAM OF MOC

(15) MOC

Figure 4 : (14) PIN DIAGRAM OF MOC (15) MOC



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VI. BENEFITS OF FACTS CONTROLLERS

FACTS controllers enable the transmission owners to obtain, on a case-by-case basis, one or more of the following benefits:

- 1. Cost: Due to high capital cost of transmission plant, cost considerations frequently overweigh all other considerations. Compared to alternative methods of solving transmission loading problems, FACTS technology is often the most economical alternative.
- 2. Convenience: All FACTS controllers can be retrofitted to existing ac transmission plant with varying degrees of ease. Compared to high voltage direct current or six-phase transmission schemes, solutions can be provided without wide scale system disruption and within a reasonable timescale.
- 3. Environmental impact: In order to provide new transmission routes to supply an ever increasing worldwide demand for electrical power, it is necessary to acquire the right to convey electrical energy over a given route. It is common for environmental opposition to frustrate attempts to establish new transmission routes. FACTS technology, however allows greater throughput over existing routes, thus meeting consumer demand without the construction of new transmission lines. However, the environmental impact of the FACTS device itself may be considerable. In particular, series compensation units can be visually obtrusive with large items of transmission equipment placed on top of high-voltage insulated platforms.
- 4. . Control of power flow to follow a contract, meet the utilities own needs, ensure optimum power flow, minimize the emergency conditions, or a combination thereof.
- 5. Contribute to optimal system operation by reducing power losses and improving voltage profile.
- 6. Increase the loading capability of the lines to their thermal capabilities, including short term and seasonal.
- 7. Increase the system security by raising the transient stability limit, limiting short-circuit currents and overloads, managing cascading blackouts and damping electromechanical oscillations of power systems and machines
- 8. Provide secure tie line connections to neighboring utilities and regions thereby decreasing overall generation reserve requirements on both sides.
- 9. Provide greater flexibility in sitting new generation.
- 10. Reduce reactive power flows, thus allowing the lines to carry more active power

VII. APPLICATION

- 1. Grid integration of renewable power
- 2. Implementation of HVDC converter terminal performance.
- 3. Load compensation alleviation of voltage instability limit.
- 4. Short circuit current mitigation of sub synchronous.
- 5. Resonance improvement of system transient stability limit.

VIII. ADVANTAGES

- 1. FACTS increase the reliability of AC grid.
- 2. They reduce power reliability costs.
- 3. They supply inductive or reactive power to the grid and improve transmission quality and efficiency of power transmission.
- 4. There is fast voltage regulation.
- 5. Increased power transfer over long AC lines.

IX. RESULT

The ability to accommodate changes in electric transmission system or operating conditions while maintaining sufficient steady state and transient margin.

X. CONCLUSION

- 1. Future system can be expected to run at higher stress level.
- 2. FACTS could provide means to control and alleviate stress.
- 3. Reliability of existing systems minimize risk but not risk free.



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- 4. Interaction between facts devices need to be studied.
- 5. More demonstration needed.
- 6. R&D needed on avoiding security problems.
- 7. Energy storage can significantly enhance facts controller performance.

XI. FUTURE SCOPE

- 1. Large scale grid integration of renewable energy resources.
- 2. Implementation of small grids.
- 3. To provide reliable quality power at minimum cost
- 4. It will be more efficient to investigate the performance of combination of UPFC and FACTS using
- 5. TSR in large network.

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