FERRANTI EFFECT OVERCOME BY USING THYRISTOR SWITCHED REACTOR (TSR) IN FACTS

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Abstract

In this project, the behaviour of the transmission line tower subjected to various types of load combinations is examined. This model will be used to observe Ferranti effect . The project is designed to implement FACTS by TSR (Thyristor Switch Reactance). This method is used either when charging the transmission line or when there is very low load at the receiving end. Due to very low or no load, very low current flows through the transmission line and shunt capacitance in the transmission line becomes dominant. This causes voltage amplification (Ferranti Effect) due to which receiving end voltage may become double than the sending ends voltage (generally in case of very long transmission lines). To compensate this, shunt inductors are automatically connected across the transmission line.

Key Words: *TSR, Flexible AC Transmission System (FACTS), FACTS Controllers, Power Transmission*

1.INTRODUCTION :

Transmission line is one of the major parts of power system. Electrical power system is vast subject having various theoretical concepts. Reactive power is either generated or consumed in almost every component of the system, generation, transmission, and distribution and eventually by the loads. The impedance of a branch of a circuit in an AC system consists of two components, resistance and reactance. Reactance can be either inductive or capacitive, which contribute to reactive power in the circuit .Most of the loads are inductive, and must be supplied with lagging reactive power. It is economical to supply this reactive power closer to the load in the distribution system. Facts A flexible alternating current transmission system (FACTS) is a system composed of static equipment used for the AC transmission of electrical energy. It enhances the controllability of the system as well as the power transfer capability. FACT-system is very much efficient to reduce our existing problems and will increase both the power transfer capability and the techno-economic efficiency.

1] Ferrenti Effect :
A long transmission line has a large capacitance. If such a line is open-circuited or connected to the very light load at the Reactive power compensation has compensation, if we require more current then it will be uneconomical receiving end, the magnitude of the voltage at the receiving end becomes higher than the voltage at the sending end. This phenomenon is called Ferranti effect. When the voltage is applied at the sending end, the current drawn by the capacitance of the line is more than current associated with the load. Thus, at no load or light load, the voltage at the receiving end is quite large as compared to the constant voltage at the sending end.

2] TSR

To overcome the power quality problem of distribution system, we have number of power quality solution techniques by using FACTS controllers, which use newly available power electronics devices. TSR is one of them. This method is used either when charging the transmission line, or, when there is very low load at the receiving end. A shunt connected thyristor-switched inductor whose effective reactance is varied in a stepwise manner by full- or zero conduction operation of the thyristor valve. Due to very low or no load a very low current flows through the transmission line. Shunt capacitance in the transmission line cause Ferranti Effect. The receiving end voltage may become double the sending end voltage (generally in case of very long transmission lines). To compensate, Shunt inductors are connected across the transmission line.

1.1.EXISTING SYSTEM

This effect is also overcome by this reactive power compensation technique. Reactance can be either inductive or capacitive, which contribute to reactive power in the circuit. FACTS has a lot to do with reactive power compensation, and indeed, that used to be the term utilized for the technology in the old days. If we can minimize the flow of reactive power over the transmission system, we can make the system more efficient and put it to better and more economical use. To get the correct grid voltage, we need the right amount of reactive power in the system. If there is not enough reactive power, the voltage will sag. And vice versa, if there is too much of it, the voltage will be too high. So, to have it in the right amounts at all times, and in the right places of the grid, that is the task to be performed by means of Reactive Power Compensation. Reactive power (VAR) is required to maintain the voltage to deliver active power (watts) through transmission lines.

Disadvantage of Existing System

- lagging power factor. But in present, we have required leading power factor. more losses.
- Reactive power compensation has
- The current carrying capacity is less in reactive power

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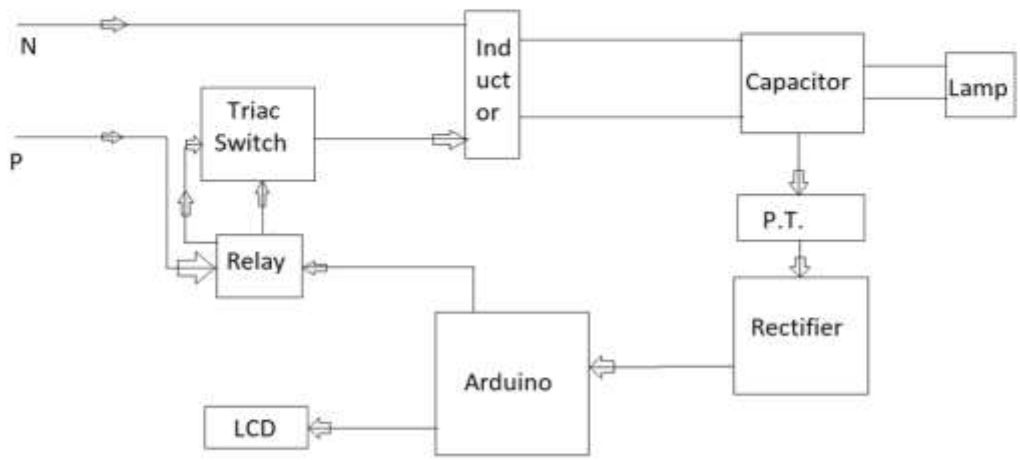
1.2 Objective

- The Objective of the project is to compensate the reactive power using thyristor switched reactor.
- By compensating the Reactive Power we can improve the Power factor as well as the transmission efficiency.
- Using the LCD display we can identify the type of load and voltage level.
- Hence by implementing this project we can reduce the Ferranti Effect and other transmission line losses.
- Instead of using conventional methods for introducing reactive power compensator in transmission line, we can use micro - controller for better response.
- Study the Keil software for programming the micro-controller.

1.3 DESIGN & IMPLEMENTATION



A. Components

1) Choke
In electronics, a choke is an inductor used to block higher frequency alternating current (AC) in an electrical circuit, while passing lower-frequency or direct current (DC). A choke usually consists of a coil of insulated wire often wound on a magnetic core, although some consist of a donut-shaped "bead" of ferrite material strung on a wire.The choke's impedance increases with frequency. Its low electrical resistance passes both AC and DC with little power loss, but it can limit the amount of AC due to its reactance.

2) SCR
A silicon controlled rectifier or semiconductor-controlled rectifier is a four-layer solid-state current-controlling device. SCRs are unidirectional devices (i.e. can conduct current only in one direction) as opposed to TRIACs, which are bidirectional (i.e. current can flow through them in either direction). SCRs can be triggered normally only by currents going into the gate as opposed to TRIACs, which can be triggered normally by either a positive or a negative current applied to its gate electrode.

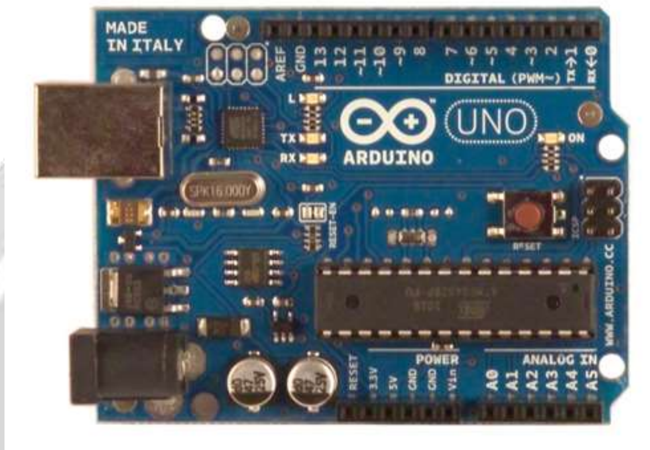
3) Rectifier
A rectifier is an electrical device composed of one or more diodes that converts alternating current (AC) to direct current (DC). A diode is like a one-way valve that allows an electrical current to flow in only one direction. This process is called rectification. A rectifier can take the shape of several different physical forms such as solid-state diodes, vacuum tube diodes, mercury arc valves, silicon-controlled rectifiers and various other silicon-based semiconductor switches. Rectifiers have many uses, but are often found serving as components of DC power supplies and high voltage direct current power transmission systems.Rectification may serve in roles other than to generate direct current for use as a source of power. As noted, detectors of radio signals serve as rectifier.

4) RELAY
A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal

5)Shunt capacitor banks

Shunt capacitor banks are used to improve the quality of the electrical supply and the efficient operation of the power system. Studies show that a flat voltage profile on the system can significantly reduce line losses. Shunt capacitor banks are relatively inexpensive and can be easily installed anywhere on the network.

6) ARDUINO



The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

1.4 WORKING

This method is used either when charging the transmission line, or, when there is very low load at the receiving end. Due to very low or no load a very low current flows through the transmission line. Shunt capacitance in the transmission line cause Ferranti Effect. The receiving end voltage may become double the sending end voltage (generally in case of very long transmission lines). To compensate, shunt inductors are connected across the transmission line. The lead time between the zero voltage pulse and zero current pulse duly generated by suitable operational amplifier circuits in comparator mode are fed to two interrupt pins of the microcontroller where the program takes over to actuate appropriate number of opto-isolators interfaced to back to back SCRs at its output for bring shunt reactors into the load circuit to get the voltage duly compensated. The microcontroller used in the project is of 8051 family which is of 8 bit. The power supply consists of a step down transformer 230/12V, which steps down the voltage to 12V AC. This is improved to DC using a Bridge rectifier. The ripples are removed using a capacitive filter and it is then regulated to +5V using a voltage regulator 7805 which is required for the operation of the microcontroller and other components.

1.5 APPLICATION.

- Power control.
- Reducing generation cost.
- HVDC link application
- Reduces Power Losses and Improving Voltage Profile.
- Improvement in Power Factor.

- Reduces Reactive Power Flow.
- Ensure Optimum Power Flow.
- Improvement in Voltage Regulation

2. CONCLUSION

- The Project Basically explains about "Compensation of Reactive Power" using the pure inductance with the help of "Thyristor Switched Reactor".
- It also explains how to overcome the "Ferranti Effect" whenever there is charging of transmission line.
- The introduction of inductive reactance in transmission lines is done through switched thyristors (TSR).
- Whenever there is a dominating capacitive load, with the help of inductance we can compensate the overall power.
- We studied and observed the characteristics and behavior of individual components which are used for our project.
- With the help of microcontrollers/microprocessors we can achieve maximum accuracy in readings of input and output and therefore drawing a stable output.
- As TSR is the simplest and the most efficient method for power compensation in transmission line, we have tried to study the TSR method in particular.
- Using FACTS we could simplify the ease of transmitting power in transmission lines and therefore increasing the efficiency of power lines.
- The power factor of the underlying load can be improved using capacitive banks to facilitate more inflow of current.

3. ACKNOWLEDGMENTS

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4. FUTURE SCOPE

Advanced optimization techniques can be used for modelling of controllers. Further the project can be enhanced by using firing angle control methodology for smooth control of the voltage. Thus, this is better than switching reactors in steps where voltage control (also in steps) is not very precise

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