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SHUNT COMPENSATION TECHNIQUE FOR IMPROVED POWER FACTOR BY THYRISTOR SWITCHED CAPACITOR IN FLEXIBLE AC TRANSMISSION SYSTEM

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Abstract:

This project provides continuous power factor correction without manual capacitive bank loading. In an electric power system, a load with a low power factor draws more current than a load with a high power factor for the same amount of useful power transferred. The higher currents increase the energy lost in the distribution system, and require larger wires and other equipment. Because of the costs of larger equipment and wasted energy, electrical utilities will usually charge a higher cost to industrial or commercial customers where there is a low power factor.The Reactive Power charge on your electricity bill is directly targeted against those companies who do not demonstrate clear energy efficiency use. You will find this charge itemized on electricity bill. Reactive power charges can be made significantly smaller by the introduction of Power Factor Correction Capacitors which is a widely recognized method of reducing an inductive load and minimizing wasted energy, improving the efficiency of a plant and reducing the electricity bill. It is not always necessary to reach a power factor of 1. A cost effective solution can be achieved by increasing your power factor to greater than 0.95. We are using AT89S52 as our controller to keep on monitoring the power factor. When that value decreases external capacitor bank is switched on using thyristor to balance that and maintain the value. We have connected a temperature sensor for monitoring.This project uses regulated 5V, 500mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/12V step down transformers.

Keywords: Facts controller, Voltage regulation, shunt compensation, Thyristor switch capacitor (TSC), embedded system

I. INTRODUCTION

The transmission of electrical energy using AC started at the end of the 19th century and replaced smaller existing local DC distribution systems. By extending local supply areas and providing energy transfer over longer distances various problems regarding mainly voltage control and stability were observed caused mainly by reactive power unbalances in the systems(3). Electrical power distribution systems are responsible for supplying power to dispersed residential, commercial and small industrial customers in a safe, reliable and economical fashion. This is achieved by maintaining a reliable voltage level, correcting the power factor through use of reactive compensation and offering as close to continuous service as possible in order to meet demand. Daily activities are mostly depending on electrical energy(1). Electricity is needed to light up houses, buildings and even transports. Electricity comes from generators which produce power that are useful for loads. But, not all power that flow from generators is useful for a power system. . The system will distribute electricity via power line by considering the reliability and economic wise based on need or demand required by consumer. Buildings such as production factories and hospitals need a continuous supply of voltage and cannot afford to lose them. Oncethere is no electricity supplied to these buildings, it might cost a lot of money because devices and motors need electricity to operate. But, the existence of these devices and motors would cause the power system to not perform efficiently. Most loads that are being used are of the inductive type. Inductive loads when connected to the power system will cause induction to occur and this will make the power factor to drop. In order to overcome this problem, we need to install a capacitor which is commonly known as compensator to make the power factor correction. Compensation is a widely used technique in power system to improve the power system performance. There are two types of compensation techniques, namely series compensation and shunt compensation. The usage of a compensator can help to control the reactive power on a transmission line and even at the distribution level. Compensation is proven to solve problem such as maintenance of the flat voltage profile. This technique could also improve the transmission efficiency and the stability of the power system. But, the main reason that compensation is implemented is to improve the Voltage(1).

Although reactive power is needed on power system, a high amount of it will cause problems such as the reduction of active power generated and poor voltage regulation. The reactive power consumption by loads must be compensated and this could be done by installing shunt compensator on the electrical network. An approach has been done to study about the performance of the system with compensator installed. Now-a-days Flexible AC Transmission Systems (FACTS) has become a subject of interest for the power system engineers(4). To maintain the voltage;

the receiving end voltage is sensed and compared with the prescribed limit value, and then accordingly the compensation is carried out. In transmission line the losses are appeared in terms of heat i.e. temperature of transmission line will increase. When the current exceed a certain value the heat generated due to ohmic loss start to melt the conductor. So, to avoid such damage here, we monitor the temperature which rise above the threshold value to trip the circuit immediately before any losses.

II. FACTS CONTROLLER

Improved utilization of the existing power system is provided through the application of advanced control technologies. Power electronics based equipment, or Flexible AC Transmission Systems (FACTS), provide proven technical solutions to address these new operating challenges being presented today. FACTS technologies allow for improved transmission system operation with minimal infrastructure investment, environmental impact, and implementation time compared to the construction of new transmission lines.

For maximum utilization of any FACTS device in power system planning, operation and control. Power flow solution of the network that contains any of these devices is a fundamental requirement. The FACTS controller are mainly divided into four types.

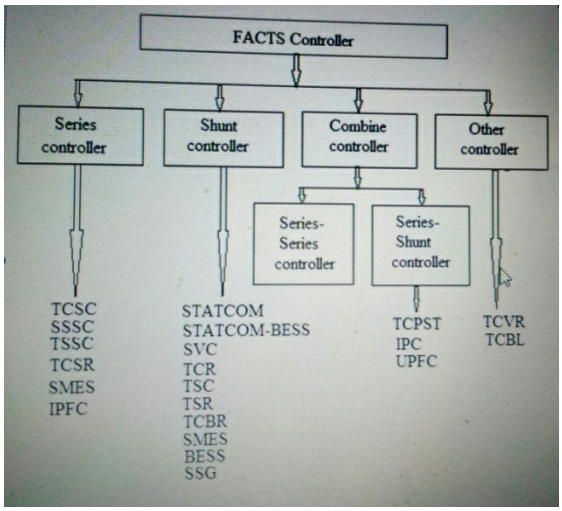

Fig. 1: Block diagram ofcontrollers

FACT controller may be based on thyristor devices with no gate turn off (only with turn on)(7)

III. SHUNT COMPENSATION

Load flow through a AC transmission line is a function of line impedance, the magnitude of sending and receiving end voltages, and phase angle between the two end voltages.

$$P=\frac{Vr.Vs}{Xl}\sin\partial$$

A shunt compensation system ideally performs the following functions:

1) It helps produce a substantially flat voltage profile at all levels of power transmission,
2) It improves stability by increasing the maximum transmissible power,
3) It provides an economical means for meeting the reactive power requirement of transmission.(8)

IV. PRINCIPLE OF THYRISTOR SWICHED CAPACITOR

Thyristor Switched Capacitors are shunt compensators that can supply reactive power. The TSCs have following properties: cheaper devices achieving appropriate results in the reactive power compensation, average delay of one half a cycle and no generation of harmonics.Fig.3, shows the TSC is the combination of two thyristors connected in

antiparallel and capacitor to be swiched.Here also used series inductance and small resistance. The inductance used here is to limit incoming current by reason of mis-firing.

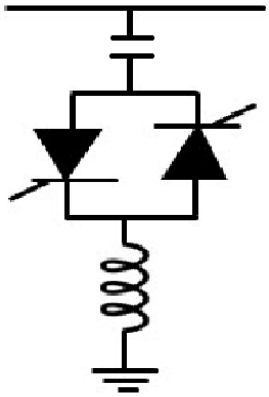

Fig. 2: Thyristor Switched capacitor

The control technique of TSC is on/off control. The capacitor is precharged to the peak value of the source voltage for maintaining with low transients in the supply system (5).

V. EMBEDED SYSTEM

There are many things we hear about industrial internet of things as it is new emerging technology. We use sensors to continuously monitor industry appliances which is highly impossible to manage by human.

An Embedded System is a combination of computer hardware and software, and perhaps additional mechanical or other parts, designed to perform a specific function. A good example is the microwave oven. Frequently, an embedded system is a component within some larger system. For example, modern cars and trucks contain many embedded systems. One embedded system controls the anti-lock brakes, other monitors and controls the vehicle's emissions, and a third displays information on the dashboard. In some cases, these embedded systems are connected by some sort of a communication network, but that is certainly not a requirement(10).

Application Areas:

Nearly 99 per cent of the processors manufactured end up in embedded systems. The embedded system market is one of the highest growth areas as these systems are used in very market segment- consumer electronics, office automation, industrial automation, biomedical engineering, wireless communication, data communication, telecommunications, transportation, military and so on.

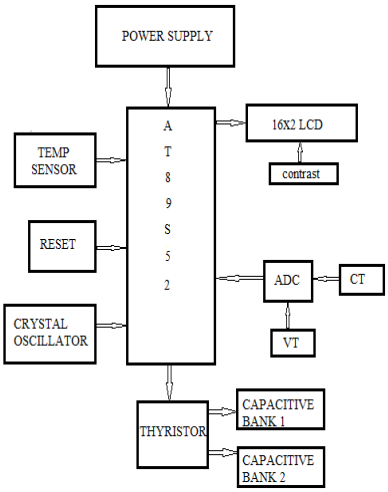

Fig. 3: Embedded system

VI. EFFECTS OF PLACING SHUNT CAPACITOR

1) The receiving end voltage at each bus increased by a lot after compensation. This happens because the reactive power that flows from the generators has been cut down by the shunt capacitors.
2) Power factor is the ratio of real power to the apparent power. The best power factor is indeed the unity power factor which is equal to one. The initial objective to increase the power factor was successfully achieved.
3) By installing the shunt capacitor, the reactive power flowing from the generator could be reduced. The capacitor shares the role of supplying reactive power to the load, making the generator to supply less reactive power. Real power or the active power generation can be reduced since reactive power has decreased.

VII. APPLICATIONS

1) Industry motors.
2) Irrigation pump sets.

VIII. CONCLUSION

1. To maintain constant load voltage, sen ding- end voltage to be maintained is low with
   Series– capacitive arrangement than with Shunt- capacitive arrangement.
2. Shunt- capacitive arrangement reduc es the total active power loss while Se ries–
   capacitive arrangement does not affec t it.
3. Series- capacitive arrangement reduc es the total reactive power loss by a la rge
   margin as compared to Shunt- capaci tive arrangement.
4. Shunt- capacitive arrangement impro ves the system power factor by a large margin
   as compared to Series- capacitive arr angement.
5. Load power factor remains always con stant with and without any compensati on technique.

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REFERENCES

1) Analyzing of a Shunt Compensator Installation
Authors: R. H. S. Soeprapto, A. F. A. Abd. Rahman, M. N. M. Nasir, Z. H. Bohari 4 The International Journal Of Engineering And Science (IJES) || Volume || 3 || Issue || 12 || December – 2014
2) Implementation of Thyristor Switched Capacitors for Power Factor Improvement Aashish Goyal1, Neharika Kapil and Sheila Mahapatra Advance in Electronic and Electric Engineering. ISSN 2231-1297, Volume 4, Number 3 (2014)
3) Historical overview on dynamic reactive power compensation solutions from the begin of AC power transmission towards present applications Heinz K. Tyll, SM, IEEE, and Dr. Frank Schettler
4) Closed loop control of Thyristor Switched Capacitor (TSC) for instantaneous Reactive Power Compensation Avdhut D. Baing, Dr. J.G.Jamnani | ISSN: 2321-9939
5) Significance of TSC on Reactive power Compensation Mr.B.Vamsi Krishna, Asst.Prof, Dept.of.EEE, Bharath University, Chennai, India.
6) Shunt versus Series compensation in the improvement of Power system performance Irinjila Kranti Kiran 1 , Jaya Laxmi.A 2
7) Power flow control in power system using facts device thyristor controlled series capacitor(TCSC) Priyanka Kathal, Arti Bhandakkar
8) Application of series and shunt compensation to Turkish National power transmission system to improve system loadability Hasan Dag, Banu Ozturk, Aysu Ozyurek
9) How FACTS controller benefit AC transmission system John J. Peserba, Fellow, IEEE
10) Embedded System by Raj Kamal