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Design and Implementation of Relay Switched based SVC for voltage regulation and reactive power compensation

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Abstract— ***In long transmission line (π type); at receiving end problem of over voltage and increase in reactive power occurs. In this paper we are going to introduce relay switched reactor for the Static VAR Compensation (SVC). To compensate reactive power and obtaining voltage regulation; reactors are made. Using relay circuit automatic switching of reactor can be achieved .Through controlling circuit reactors injected in the circuit. As reactor; capacitor and inductor banks are used. No losses occur due to this circuitry.***

***Key Words*:VAR SV; Reactive Power Compensation;π type Transmission line; Voltage Regulation; SVC.**

1INTRODUCTION : In power system it is necessary to control voltage level because it effects on conductor, ultimately it unstable the system. Similarly reactive power also introduce in the system, to overcome this problem, SVC are used. Due to this compensation can be achieved. The reactive power requirements increase with the increase in length of line. Transmission lines require shunt and series compensation in long distance transmission mainly to overcome the problems of line charging and stability limitations. Shunt type of reactor is used to either absorb or inject reactive power into the system and provides reactive power compensation. reactors and static var compensators is a shunt type of facts device which behaves like a shunt-connected variable reactance, which either generates or absorbs reactive power in order to regulate the voltage magnitude. This injection of reactive power can be achieved through relay controlling circuitry by using arduino

2 TENTATIVE DIAGRAM OF SYSTEM

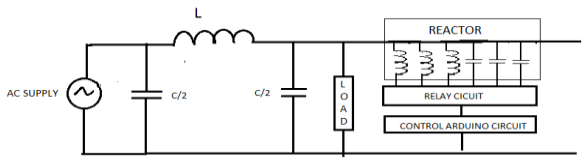

Fig. 1 Tentative diagram of system

Above, simple system diagram is given. In this at load side reactor bank is connected which switched through relay circuit by control arduino circuitry

3 ELEMENT OF CIRCUITRY:

Transmission line- In our circuit it is πtype. In which between two line capacitance is formed this is C/2 of both. Also line having inductance L and resistance R.

Load- load which we have considered here is RL load. One 750mili Henry inductance is series with resistive load R, Which we have considered here is 10W, 20W, 40W, 110W, 200W, 300W.

Control Circuit-In control circuit there is relay circuit, one arduino, CT, PT, Zero Crossing Detector (ZCD), 16*2 LCD display is used

Reactor-Reactor is bank of capacitor and inductor for voltage sag ; capacitive bank will switch ON and for voltage swell inductor bank will switch ON

RELAY- Relay is nothing but switch which is operate through programming .In our circuit we have used 12V. relay. Relay has three terminals; NC, NO, C. and other side GND, VCC AND IN1 terminal. According to programming feeded

CT- current transformer, is sensing device which sense current and give information to the arduino

PT- Potential transformer, which sense the voltage and give information to arduino here we have used up to 450V sustainable PT.

ARDUINO-It is allied to the micro controller .It has 16 digital pins and 6 analog pins. It can operate by giving 5V supply through pc or 9V dc battery also sufficient. Program can be feeded in arduino, through which automatic control can be given

ZCD- Zero Crossing Detector, which can give angle between voltage and current at time of any one parameter i.e. voltage or current, is at zero position

LCD DISPLAY-It used to display required output of the system which operates through control circuitry. Here 16*2 LCD display used

4 SIMULATION OF TRANSMISSION LINE

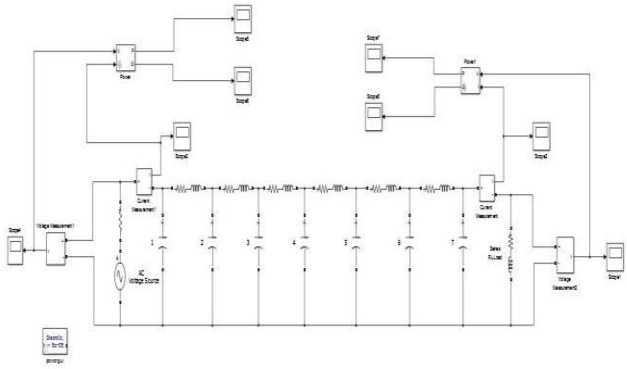

Fig.2 Simulation arrangement of transmission line

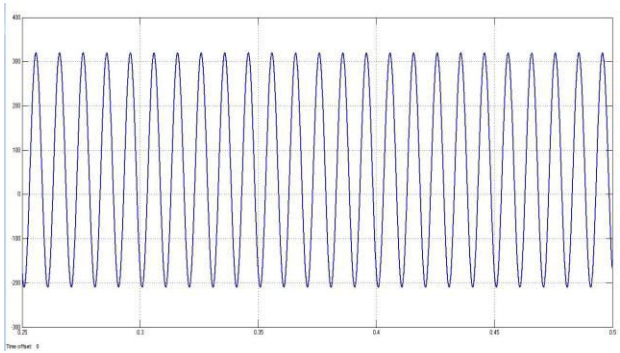

Fig.3 Sending end active power

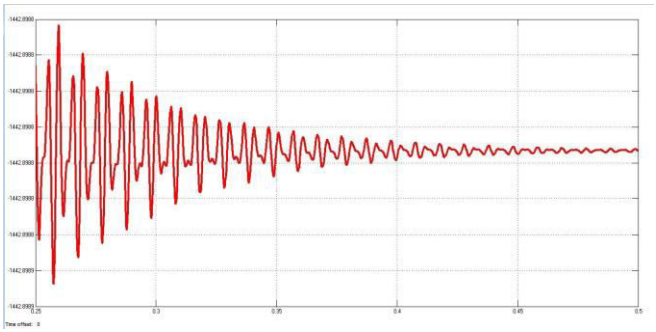

Fig.4 Sending end Reactive power

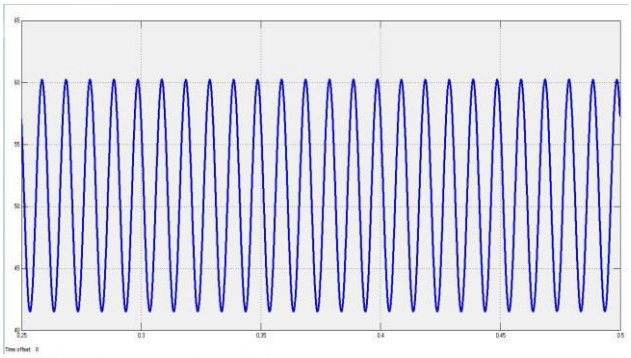

Fig.5 Receiving end Active power

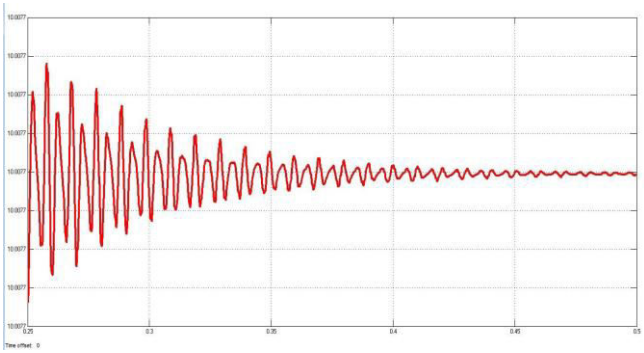

Fig.6 Receiving end Reactive power

5 CALCULATION PERFORMED TO TRANSMISSION LINE

The current in the line =Current (I), Iph=P ÷ √3 Vph

Base Impedance (*Z*)= Z ph = Vph ÷ Iph

Series Inductance =XL= 2πfL

Shunt Capacitance=Xc = 1 /2πfc

Shunt Admittance= Y=Ωc

Propagation Constant = Y= √LC

Rpu = *R* × Base MVA / (Base KV) ^2

XLpu = XL × Base MVA /(Base KV) ^2

Scaled down model for 60VA and 240 Volt

I = P ÷V

=60 ÷240

I=0.25A

Base Impedance

Z =V ÷I

= 240 ÷0.25

Z=960 Ω

The actual values of Resistances & Reactance's

Rsd = Rpu × Z

= 6.32 ×10^-5 ×(960)

= 0.0606 Ω/km

XLsd = Xpu × Z

= 7.8281× 10^-4 ×(960)

=0.751 Ω/km

Lsd = XLsd × (1 ÷2πf)

= 0.751

LOAD	OVER VOLOTAGE	COMPENSATED VOLTAGE	VALUE OF INDUCTANCE
10W	330	235	1.5HENRY
20W	276	228	2.30HENRY
40W	250	228	3.22HENRY

=2.390 mH/km

Csd =Y^2 ÷Lsd

INPUT VOLTAGE	OUTPUT LOAD SIDE VOLTAGE (SWELL CONDITION)			OUTPUT LOAD SIDE VOLTAGE (SAG LCONDITION)		
	10W	20W	40W	110W	200W	300W
230V	330V	276V	250	157V	144V	140V

= (3.38 ×10^-6)^2

=0.00477 µF

The Line Parameter for each π Section

RL = Rsd × 300 = (0.0606) ×300 = 18.18 Ω

LL=Lsd ×300 = (0.00239) ×300 = 717.6 mH

CL=Csd ×300 = (0.00477 ×10^-6) ×300 = 1.5 µF

6 VOLTAGE OBSERVATION

TABLE 1. UNCOMPENSATED VOLTAGES

TABLE.2 VOLTAGE COMPENSATION FOR SWELL CONDITION

TABLE.3 VOLTAGE COMPENSATION FOR SAG CONDATION

LOAD	UNDER VOLTAGE	VOLTAGE COMPENSATION	VALUE OF CAPACITANCE
110	157	230	3.15µF
200	144	235	4.65µF
300	140	232	5.15µF

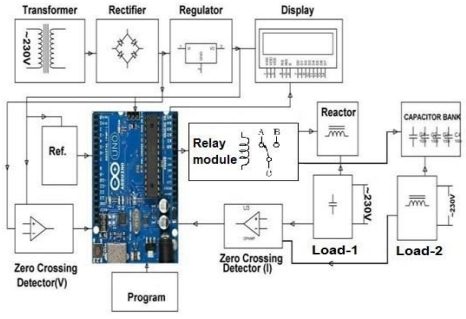

Fig.7 Control Circuitry

7 CONCLUSION

Power and voltage measurement is done for RL loads up to a maximum load of 300 watts using Relay and Arduino. Results for three loads are shown in Tabular form. Arduino Power Measurement advanced method of determining power which uses the programming part is easier than language C. The advantages of Arduino then

software's are it simplifies the amount of hardware and software development needed in order to get a system running .It is open source software and can be extendedby experienced programmers. Arduino has easy programming and also has a quick writing codes. Hence From the above information Arduino Power Measurement is an advanced method of measuring power and can also observe it graphically can be implemented for laboratory scale.

8 ACKNOWLEDGEMENT

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