KABARAK UNIVERSITY 5TH ANNUAL INTERNATIONAL CONFERENCE

GENERAL THEME:

RESEARCH, INNOVATION FOR SUSTAINABLE DEVELOPMENT AND A SECURE WORLD

A PRESENTATION ON;

THE PENETRATION LEVEL OF ASVT SUBSTATION ON A POWER NETWORK FOR RURAL ELECTRIFICATION.

Presented
By
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INTRODUCTION

- In most SSA rural areas, the concentration of electricity users is low.

- The cost of deploying a conventional substation high.
- Power utility is not capable of generating enough return on investment.

- Large number of rural communities live along H.V transmission lines but are not supplied with electricitv.

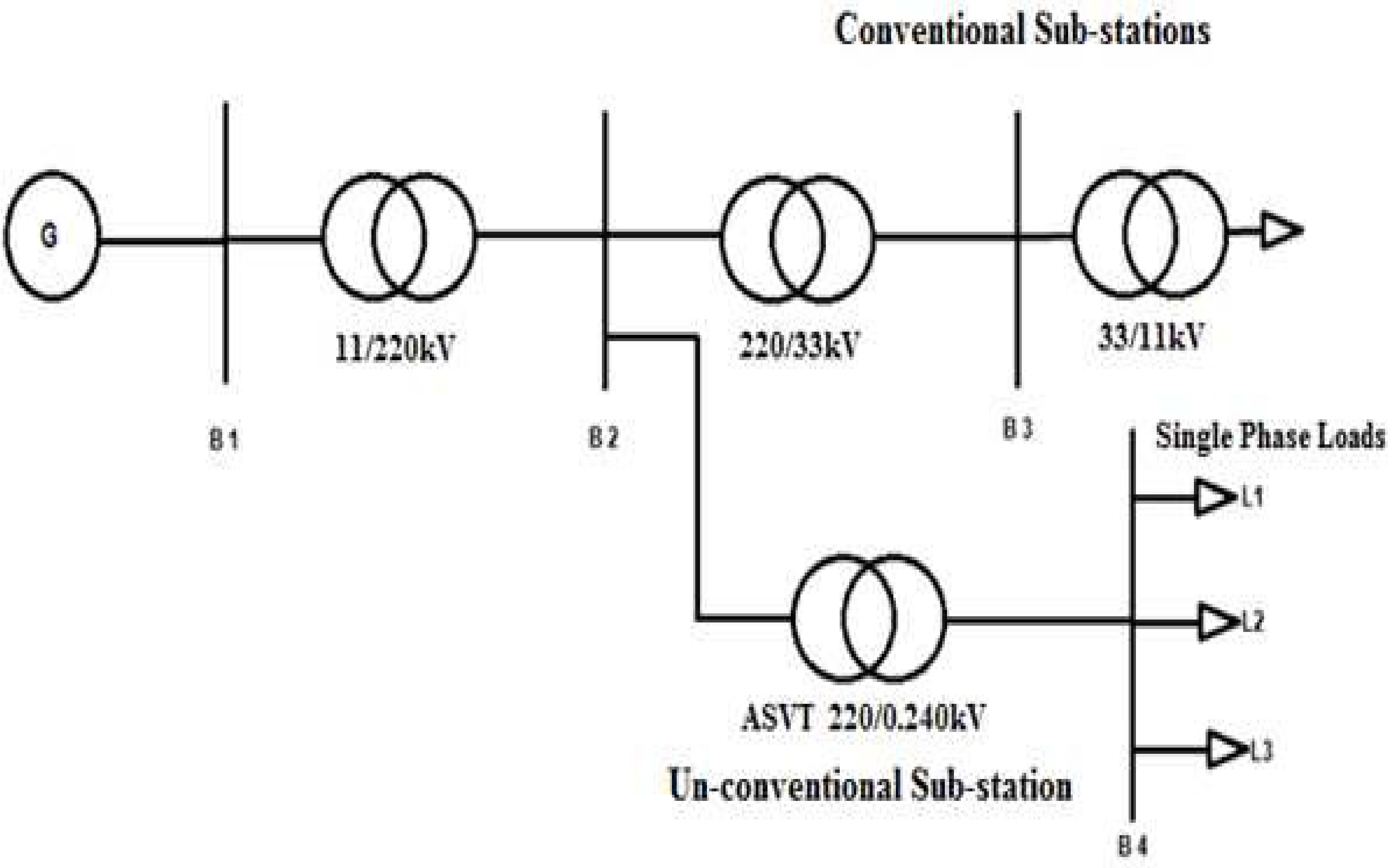
INTRODUCTION

- Kenyans population is around 40 million, with about 43% living in rural areas.
- 8% of rural population live in close proximity to high voltage transmission lines.
- ASVT substation considered as an alternative source of electricity.

ASVT SUBSTATION

- It combines the characteristics of instrument transformer with power distribution capability.
- ASVT (220KV or 132KV to 240V, 480V or 600V) in one step.
- Developing countries with H.V line infrastructure but lacking wide spread distribution infrastructure.

ASVT VS CONVENTIONAL SUBSTATION



PENETRATION LEVEL OF ASVT SUB-STATION

- ASVT substations have been sited by researchers and Engineers as reliable, and cost effective for rural electrification.

- ASVT substations remain pilot projects in countries where they were tried and are not expanding to other countries despite being said to be economical.

- The ASVT substation technology is currently being used in Brazzaville village of Congo and Chihuahua village of Mexico.

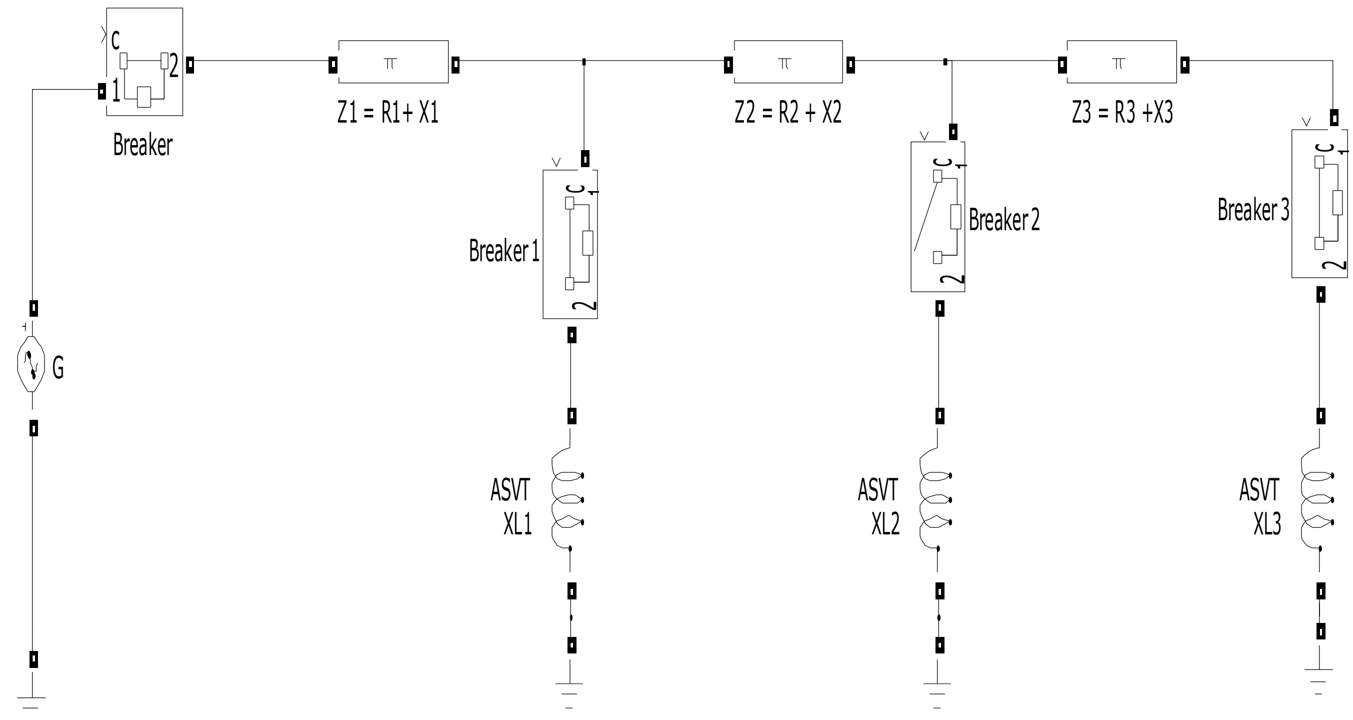
SURGE IMPEDANCE LOADING

- **SIL** is defined as the amount of active power that is transfered to a load at unity power factor.

- In this case the line capacitance provides all the reactive power that is absorbed by the inductance of the line.

- **Balance** of both **consumption** and **production** of reactive power results in a flat voltage profile along the H.V line.

TERMINATION OF REACTIVE COMPONENTS



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TERMINATION OF REACTIVE LOADS ON LINE

- **BREAKER 3 ON:**

$$X_l = X_1 + X_2 + X_3 + Xl_3$$

- **BREAKER 3 AND 1 ON:**

$$X_l = X_1 + Xl_1$$

TERMINATION OF REACTIVE LOADS

- Termination of a reactive system on a transmission line changes the reactance of the transmission line.

- Since **2πf** are constants, changes in reactance of a line are due to changes in **C** and **L** of a line.

- This leads to change in surge impedance of the H.V line .

$$Z_c = \sqrt{\frac{L}{C}}$$

TERMINATION OF REACTIVE LOADS

•A change in the surge impedance of a transmission line leads to a corresponding change in **SIL** of the line.

$$\mathrm{SIL} = \frac{(VL)^2}{\sqrt{L/C}}$$

•A change in surge impedance loading of the line affects the **voltage profile** of the line hence instability.

SIL CURVE

- The size of reactance support needed to sustain a certain load on the line.

- Stability limit of the transmission line.

- The current loading on the line.

VOLTAGE STABILITY

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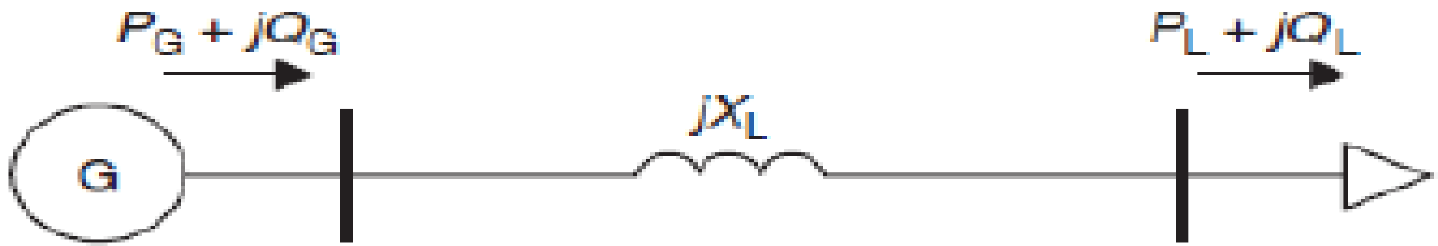
▪Voltage stability is the ability of power system to maintain steady voltages at all buses in the system after being subjected to a disturbance.

▪Voltage stability is a problem in power systems which are heavily loaded.

▪Nature of voltage stability can be analysed by examining the production and consumption of reactive power

VOLTAGE STABILITY



$$P_L = \frac{V_1 V_2}{X_L}\sin\delta \text{ and } Q_L = \frac{V_1 V_2}{X_L}\cos\delta - \frac{V_2^2}{X_L}$$

where $\delta = \delta_1 - \delta_2$

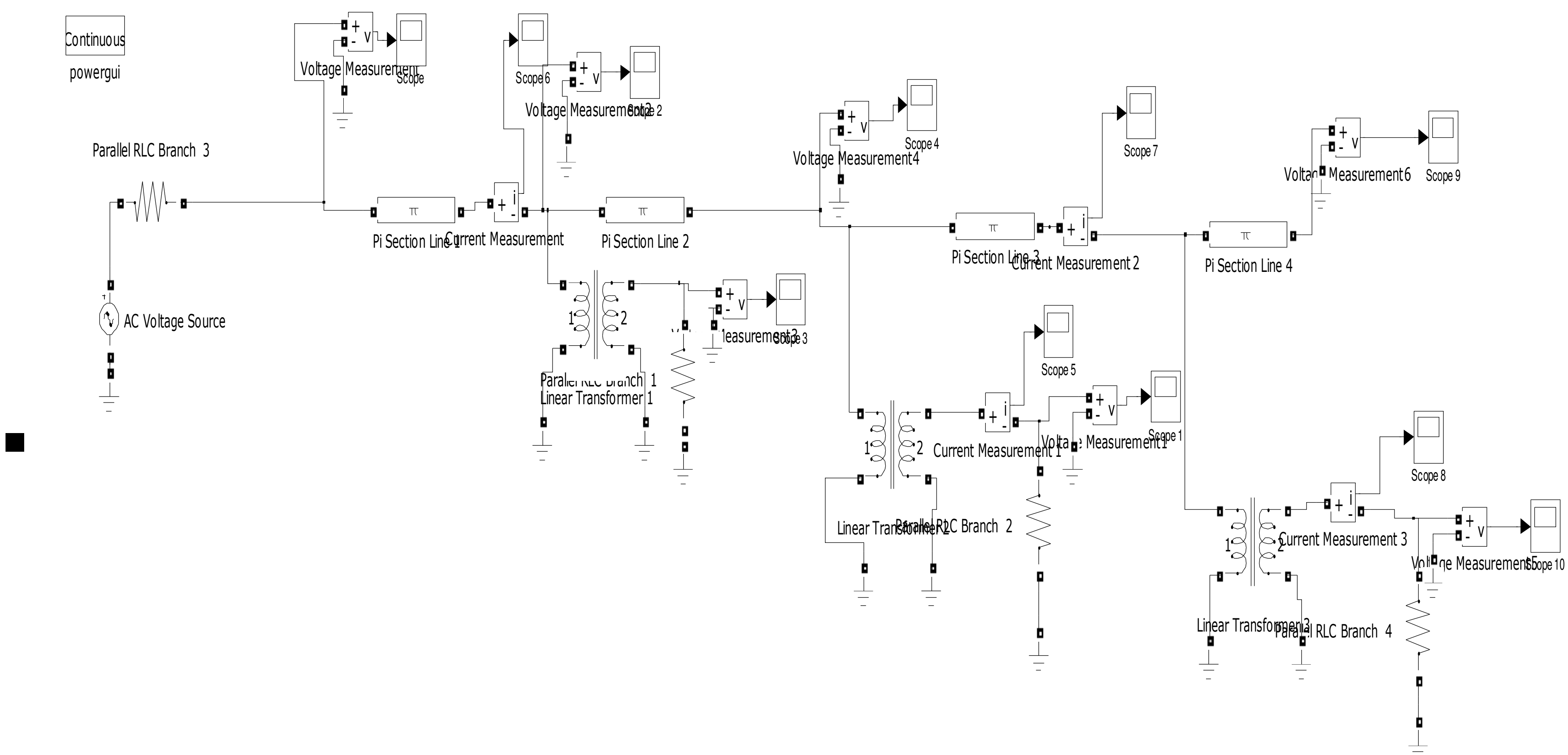
$$V_{\max} = \frac{V_1}{\cos\theta_L} \cdot \sqrt{\frac{1-\sin\theta_L}{2}}$$

SPECIFIC OBJECTIVES

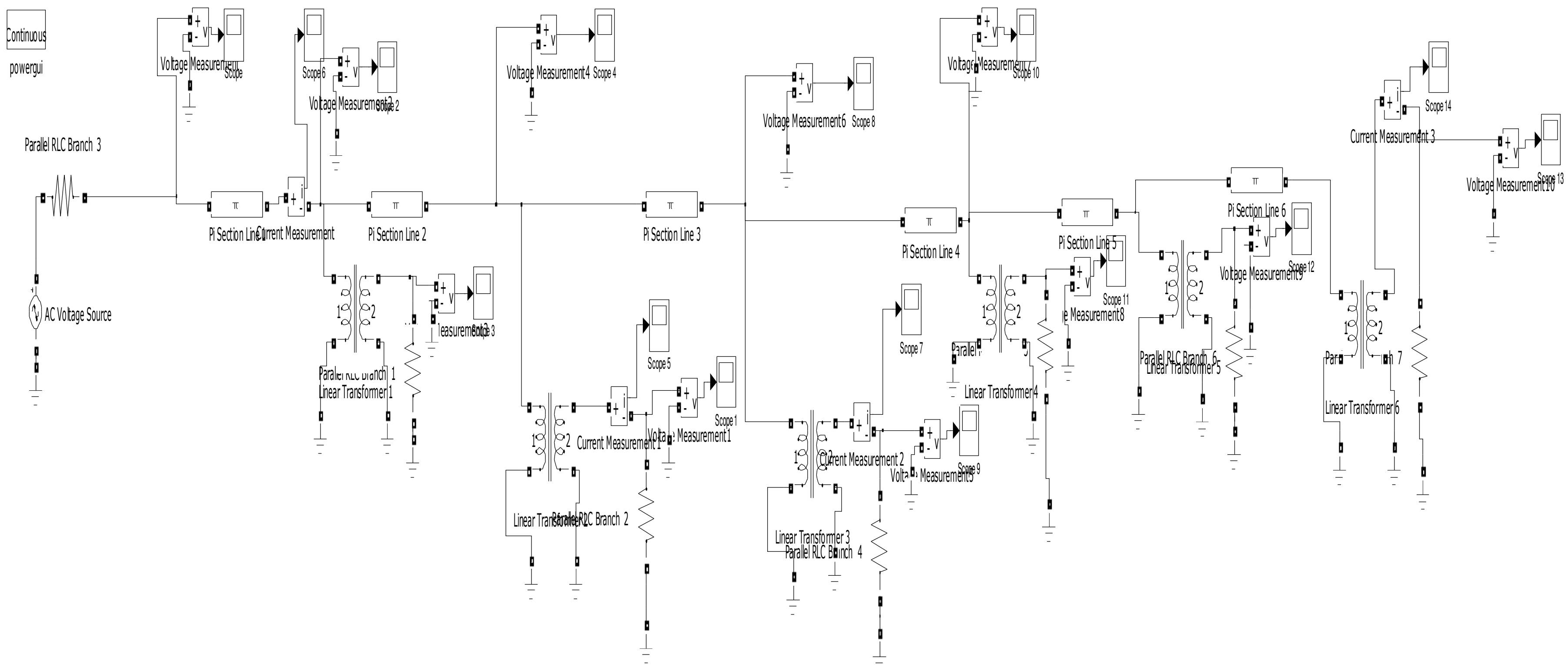
- (i)Determine the termination point of the first ASVT substation on a transmission network.

.(ii)analyze the maximum number of Auxiliary service voltage transformer (ASVT) substation that can be terminated on a transmission line without violating the voltage profile of the line.

TERMINATION OF THREE ASVT SUBSTATIONS



TERMINATION OF SIX ASVT SUBSTATIONS



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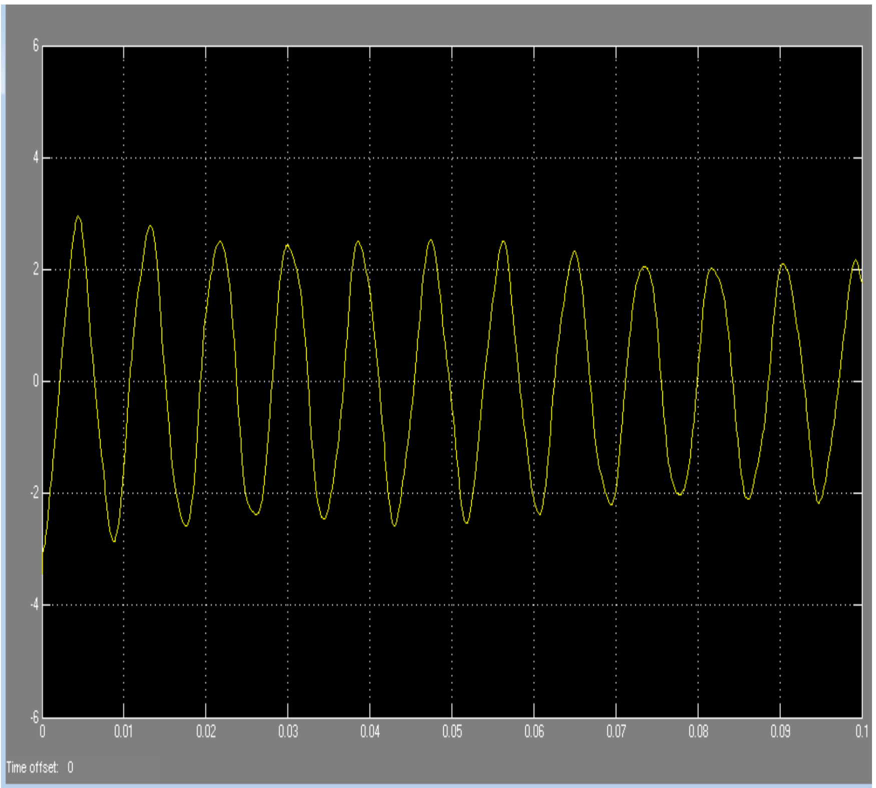
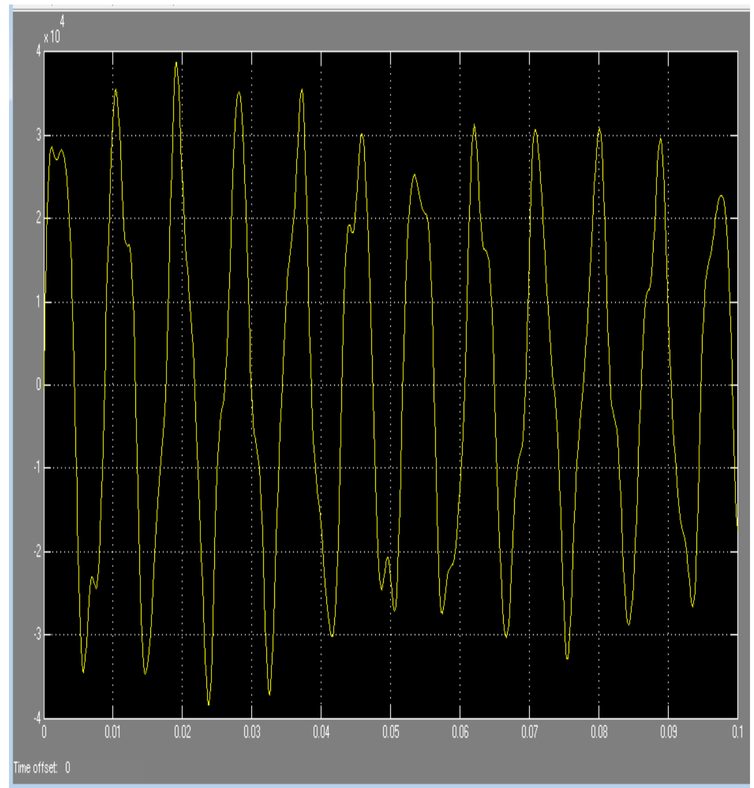
STEADY STATE RESULTS

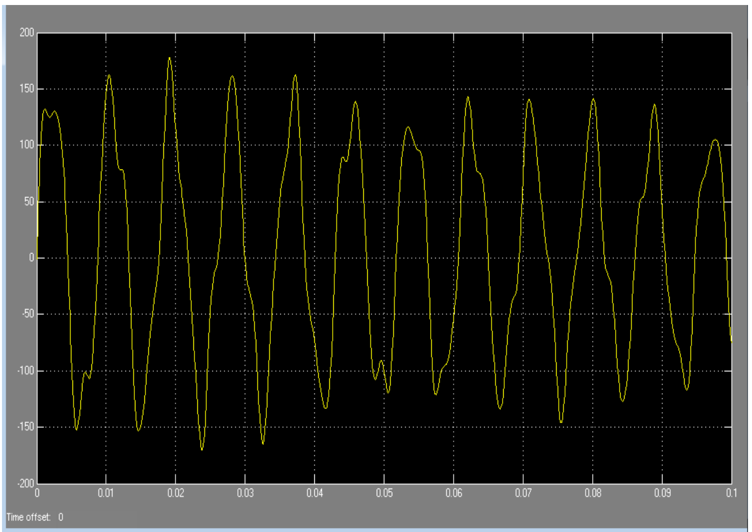
		LENGTH OF TRANSMISSION LINE IN KM									
NO OF ASVT	VOLTAGES IN KV	110	146.7	220	265	293.4	310	330	355	400	440
1	VT VL										139KV 0.564KV
2	VT VL			137KV 0.67KV							139KV 0.564KV
3	VT VL		152KV 0.68KV			164KV 0.55KV					140KV 0.564KV
4	VT VL	147KV 0.68KV		159KV 0.54KV				167 0.55			140KV 0.564KV
6	VT VL			137KV 0.64KV	137KV 0.58KV		137KV 0.58KV		137KV 0.58KV	137KV 0.56KV	137KV 0.564KV

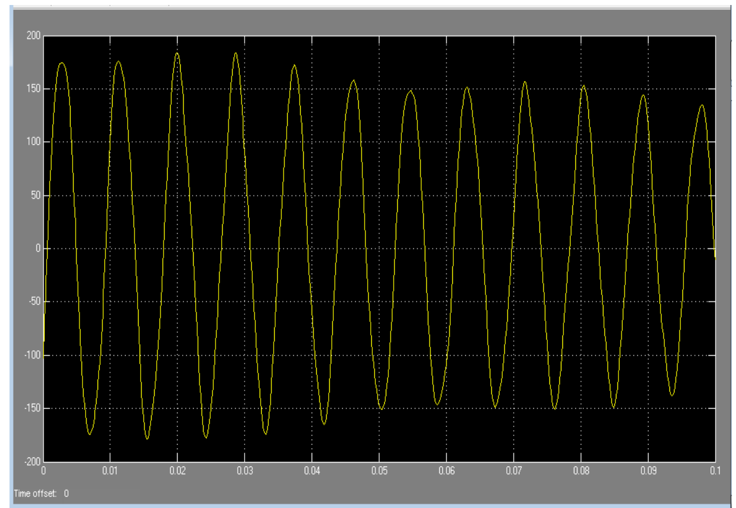
TL WAVEFORM BEFORE AND AFTER TERMINATING

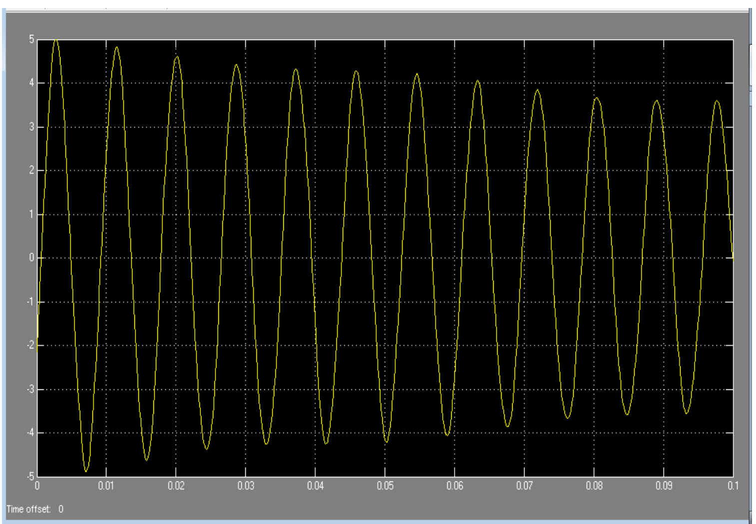




ASVT 1,2,3 VOLTAGE WAVEFORMS







TL LINE VOLTAGE WAVEFORM AFTER AND BEFORE

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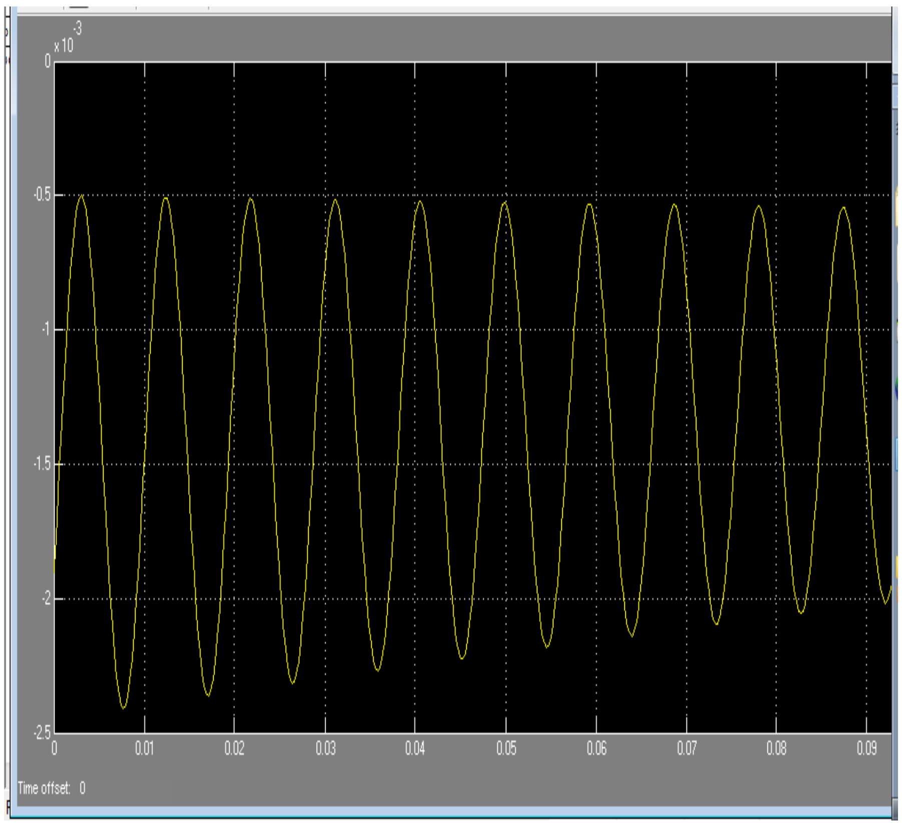
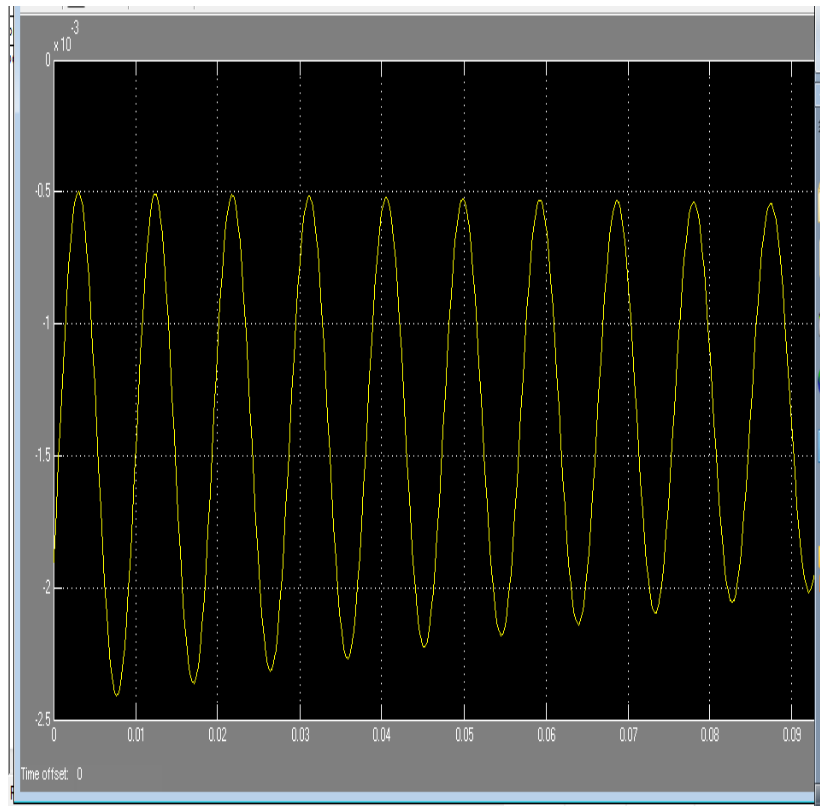
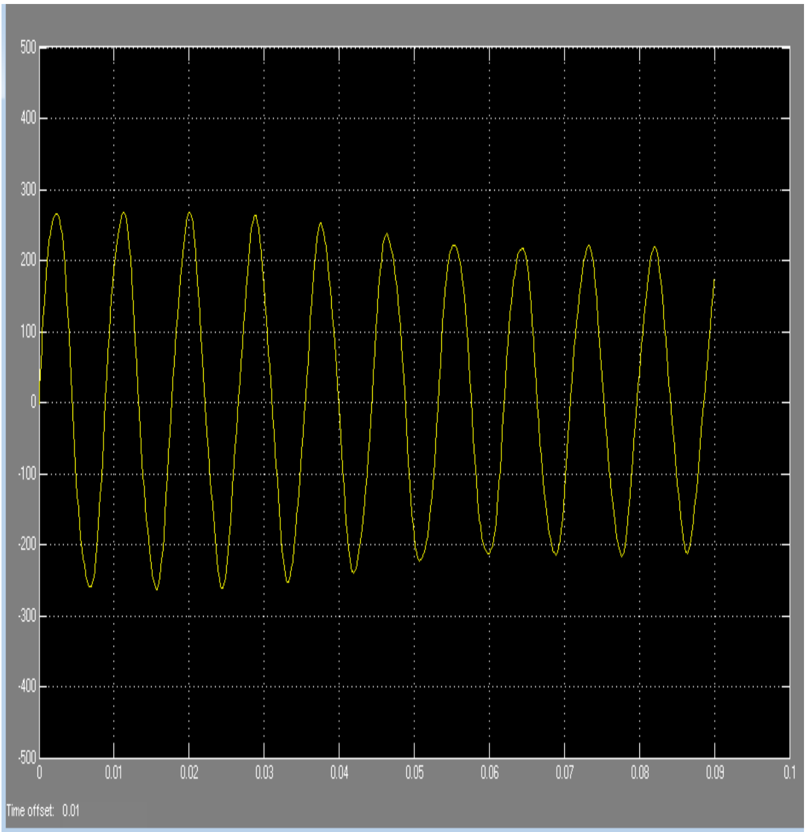
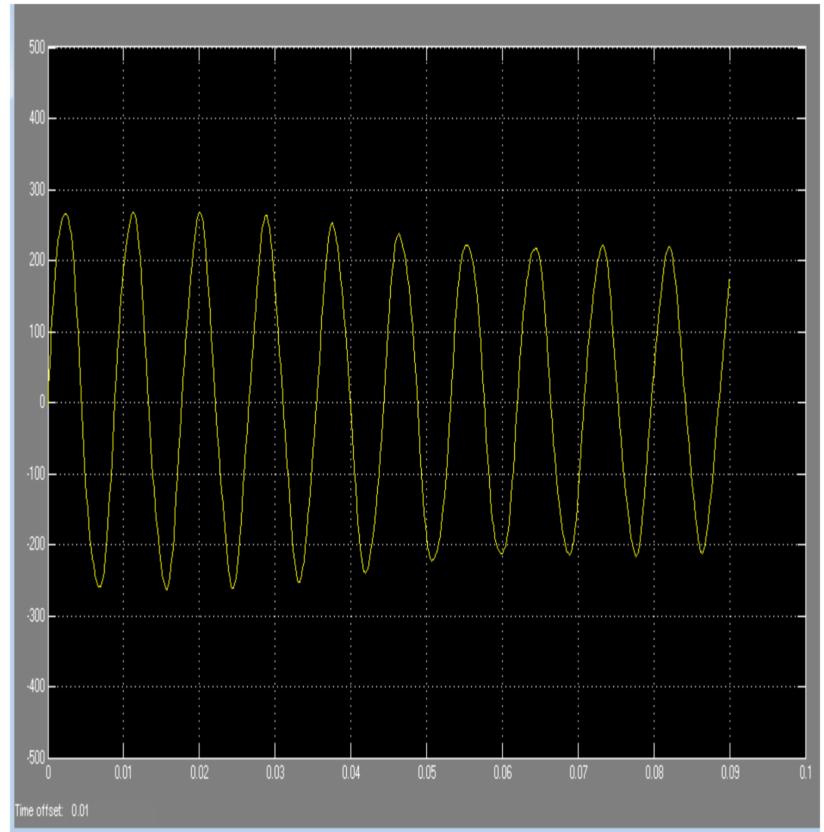




ASVT VOLTAGE WAVEFORMS

■ 



OBSERVATION

- If the first ASVT substation is terminated before the mid point of the transmission line, the voltage profile is violated and resulting wave form is not sinusoidal.

- If the first ASVT substation is terminated past the mid point of the transmission line, the voltage profile of the line is maintained..

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CONCLUSION

If ASVT substation is terminated before the mid point of the line, the surge impedance loading of the transmission line is affected and the voltage profile is violated.

terminating the ASVT substation past the mid point, the surge impedance loading is not affected hence voltage profile is not violated.

Six ASVT substations can be terminated without violating voltage profile.

THANK YOU