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Analysis of Voltage Sag in Sub Transmission System

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Abstract— *The disturbances created in A C Transmission line power flow due to various faults and unavoidable natural circumstances has to be monitored carefully for uninterrupted power supply to the consumer and to avoid hazardous situations. The subtransmission system with standard 33kv, 66kv, 132kv and 220kv transmission lines which are usually out of sight are considered for analysis purpose. The various faults which occur in transmission lines leading to voltage sag are simulated, modelled and analyzed using MATLAB/SIMULINK tool.*
Keywords— Circuit Breakage Fault, Phase Fault, Simulink, Subtransmission Voltages, Voltage Sag.

I. INTRODUCTION

Most of the power system faults (85-87%) are occurring in transmission lines and hence their protection becomes an important issue in power system engineering [2]. This paper aspires at analysing the power system faults leading to voltage sag in the sub transmission system through simulink modelling.The various power system faults can be classified as single phase to ground, two phase to ground faults and three phase to ground faults which are of major concern to be recognized in order to provide better power quality. The voltage sag which happens because of the above said faults is defined as long term reduction in voltage and this can be mainly attributed because of lightening, electric grid switching, arc welding etc., and its major effects are damage to electronic equipment's and system failure [3,4,6].Circuit breakage faults are also considered for analysis purpose and these faults are analyzed for a time period of 0.02sec to 0.1 sec as most of the power system faults exist for time duration less than 1sec [1]. Hence for the betterment of power system operation and good health of transmission lines, the behavior of power system faults are analyzed using MATLAB/Simulink tool considering the subtransmission voltages of 33kv, 66kv, 132kv and 220kv. [2] considers a 400kv, 50hz transmission line for fault analysis which has been simulated using PSCAD/EMTDC software.

II. ANALYSIS OF POWER SYSTEM FAULTS AND VOLTAGE SAG

In present scenario power quality issues are the areas of major concern which seeks solution to its various problems. Quality of power can be ensured only with quality supply.The various faults considered which hampers the quality of supply and contribute significantly for the voltage sag are

a) Single phase to ground fault
b) Two phase to ground fault
c) Three phase to ground fault

There are many types of equipments which are affected by voltage sag [5] and hence monitoring its effects and communicating the same to the concerned plays a key role in power industry. The power system faults are modelled as in fig 1. using Matlab/Simulink tool for 33kv, 66kv, 132kv and 220kv and its characteristic behaviour are analyzed. The faults are created for the duration 0.02 to 0.1sec after which the normal flow resumes back. The simulation results of single phase to ground fault considered for the subtransmission system are as depicted in fig 2, 3, 4 and 5. The analysis of its effects are summarized in Table 1. Similarly the simulation results and its analysis for two phase to ground fault and three phase to ground fault are summarized as in figures 6, 7, 8, 9, 10, 11, 12, 13 and Table 2 and 3 respectively.

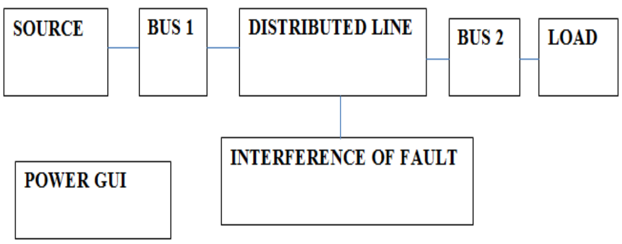

Fig.1: The model for determination of power system faults

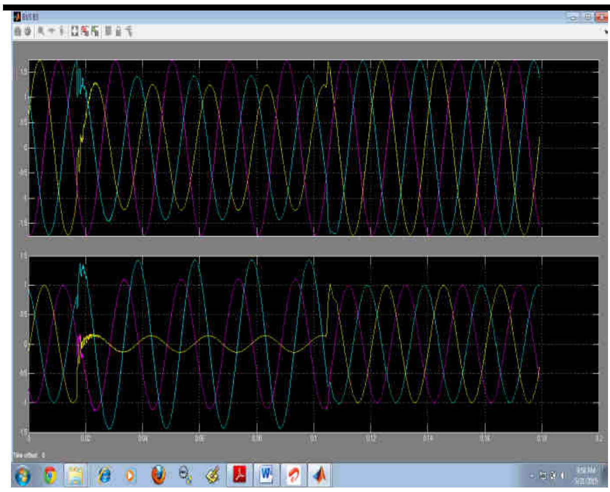

Fig.2: Single phase to ground fault (33kV)

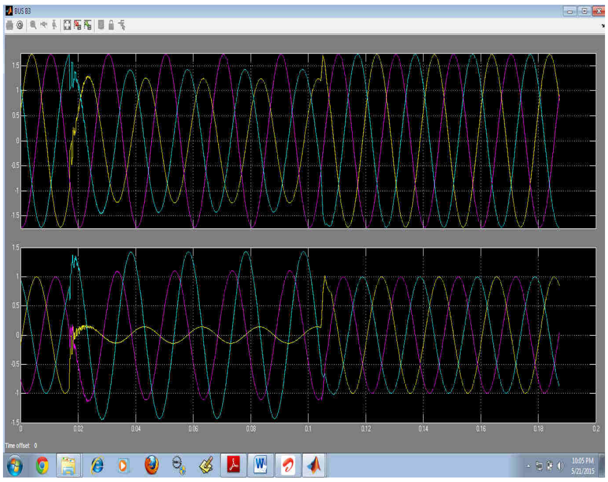

Fig.3: Single phase to ground fault (66kV)

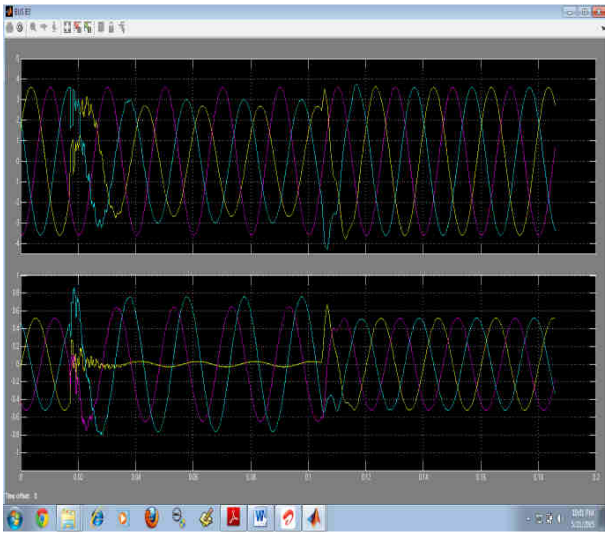

Fig.4: Single phase to ground fault (132kV)

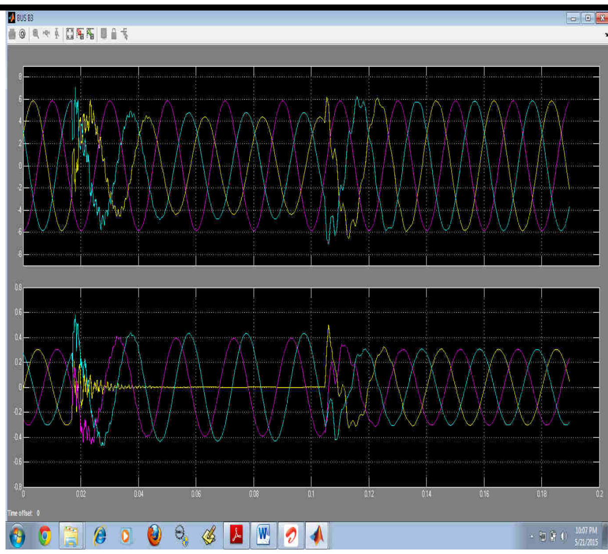

Fig.5: Single phase to ground fault (220kV)

Table.1: Single phase to ground fault

Source considered	33kV,66kV,132kV and 220kV
Fault considered	Phase A and ground
Measured parameter	Voltage and Current
Inference	Current at phase A is zero in case of 220kV and is very less in all the other cases.

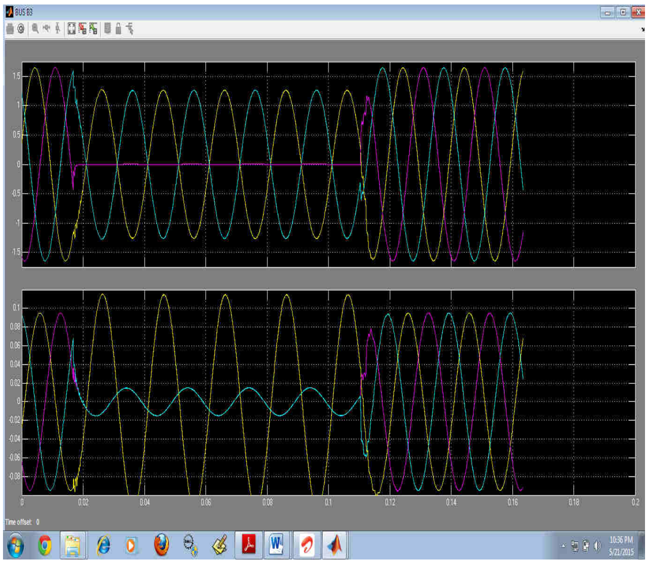

Fig.6: Two phase to ground fault (33kV)

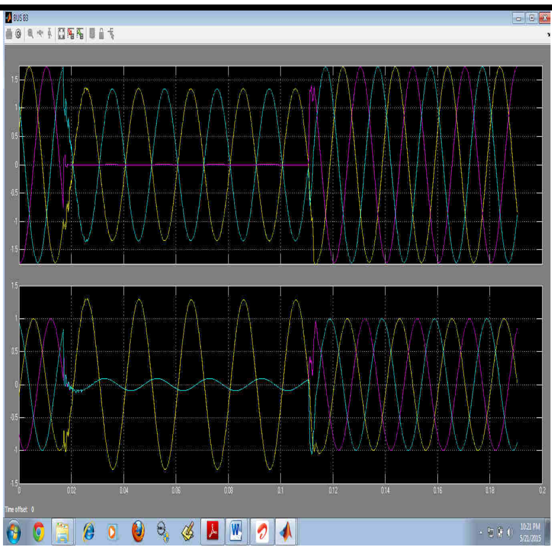

Fig.7: Two phase to ground fault (66kV)

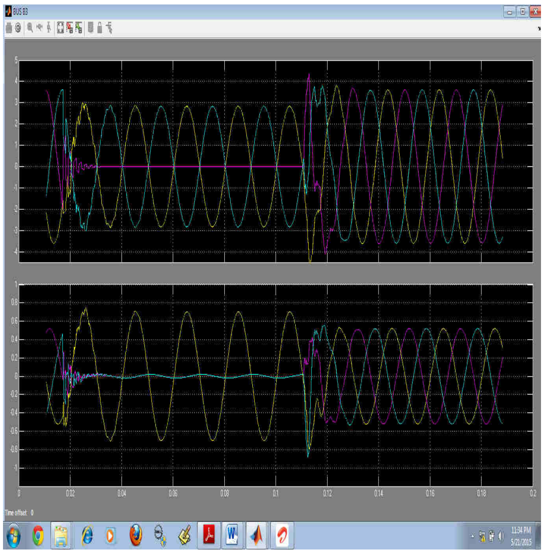

Fig.8: Two phase to ground fault (132kV)

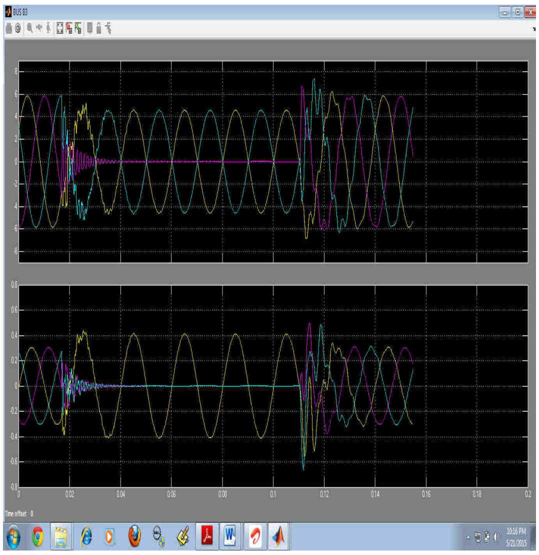

Fig.9: Two phase to ground fault (220kV)

Table.2: Two phase to ground fault

Source considered	33kV,66kV,132kV and 220kV
Fault considered	Phase B,C and ground fault
Measured parameters	Voltage and Current
Inference	Current is zero for two phases in case of 132kV and 220kV and less in the other two cases

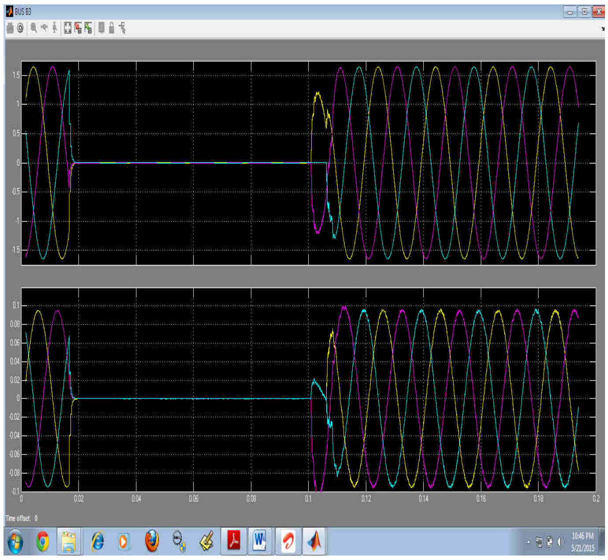

Fig.10: Three phase to ground fault (33kV)

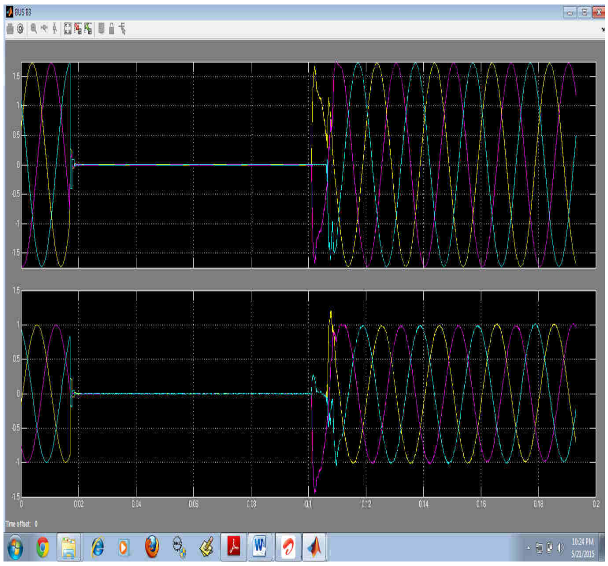

Fig.11: Three phase to ground fault (66KV)

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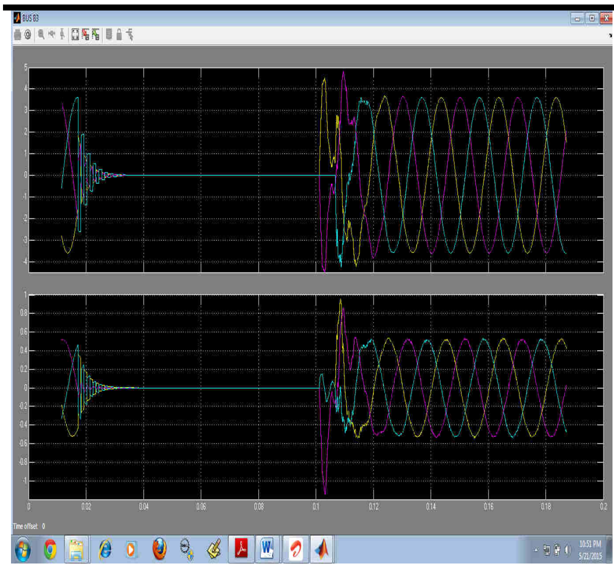

Fig.12: Three phase to ground fault (132KV)

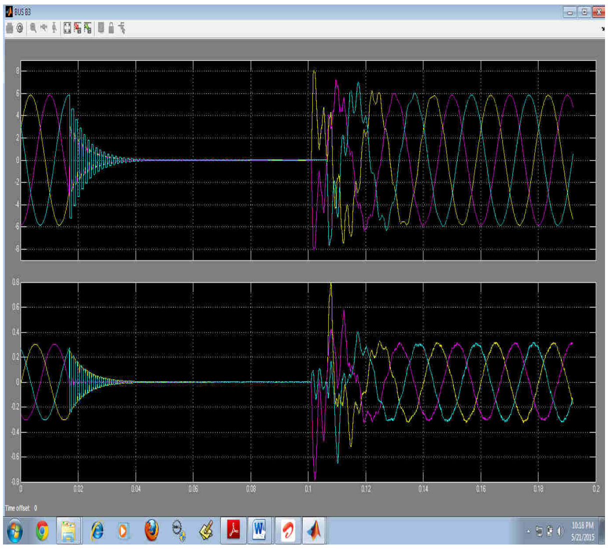

Fig.13: Three phase to ground fault (220kV)

Table.3: Three phase to ground fault

Source considered	33kV,66kV,132kV and 220kV
Fault considered	Phase A,B,C and ground fault
Measured parameter	Voltage and Current
Inference	Voltage sag i.e reduction in the voltage is zero in all the cases considered. Current is also zero when observed in the simulation.

III. VOLTAGE SAG DUE TO CIRCUIT BREAKAGE

The transfer of voltages from substation over to the transmission lines is always bifurcated with the help of switchgear such as circuit breakers for safety purpose[6]. The switching over of voltages between three phases always leads to voltage sag for a prefixed small duration and if this exceeds, it is a measure of circuit breakage fault. This fault is modelled using Simulink for subtransmission voltages as shown in figure 14 and the simulation results and inference obtained is as depicted in figures 15, 16, 17, 18 and Table 4.

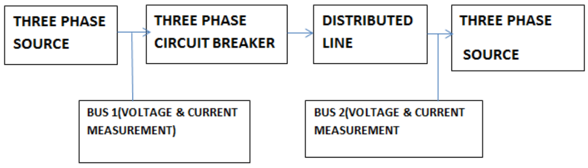

Fig.14: Circuit breakage model

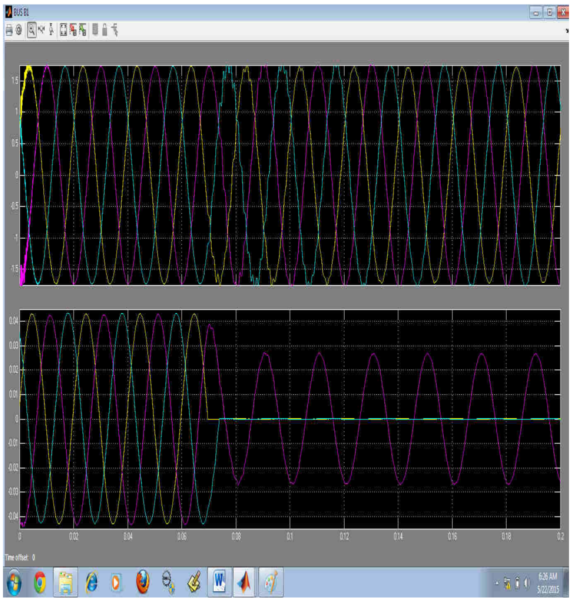

Fig.15: Circuit Breakage fault at 33kV line

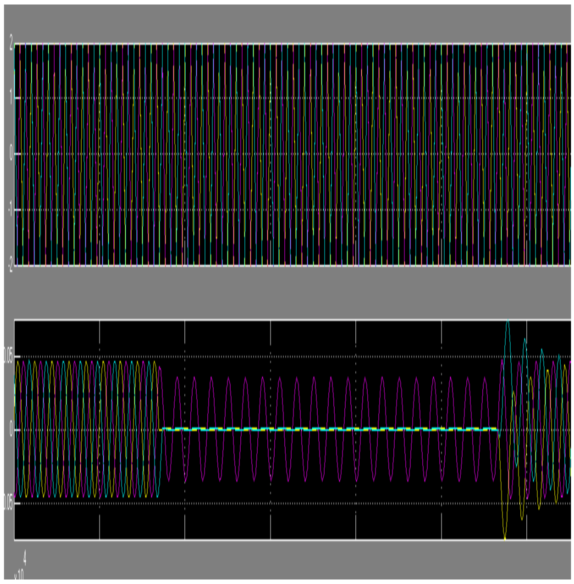

Fig.16: Circuit Breakage fault at 66kV line

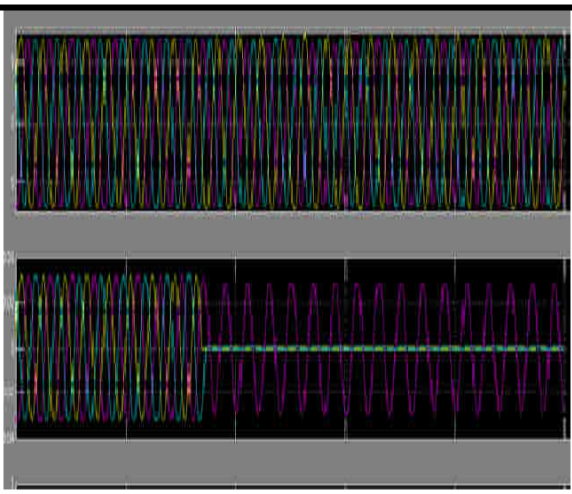

Fig.17: Circuit Breakage fault at 132kV line

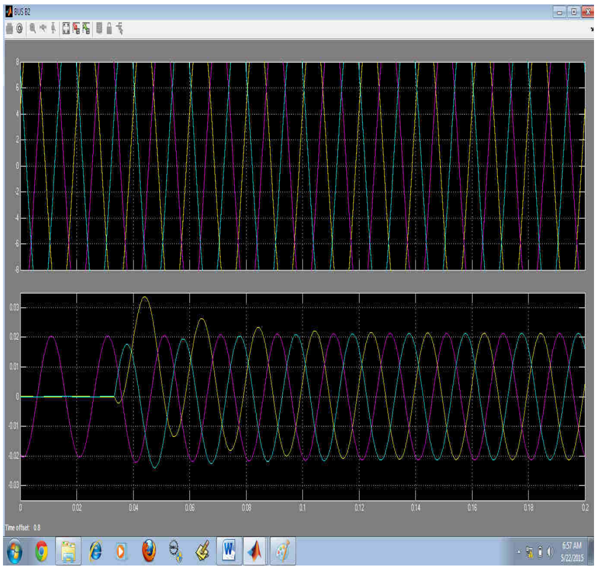

Fig.18: Circuit Breakage fault at 220kV line

Table.4: Circuit Breakage model

Three phase Source considered in series with RL branch	33kV,66kV,132kV and 220kV
Three phase breaker circuit	Switching of phase A and phase C. Initial status of the breaker is closed. Breaker timing can be directly set in the dialog box
Measured parameter	Voltage and Current
Inference	It is observed that the current decreases during the breakage timing and in phase A and C it is almost zero

IV. CONCLUSION

From the above results and discussion we can confine that the subtransmision voltage lines of 33kv, 66kv, 132kv and 220kv were modelled using Matlab/Simulink. The various power system faults and circuit breakage faults were successfully modelled and its analysis were tabulated. We can conclude that the magnitude and frequency of voltages during voltage sag reduces to zero at a faster rate with the increase in source voltage.

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