

Harmonic & Transient Stability Analysis of GIS TRANSCO Network Using ETAP

Deepak Kumar Goyal¹, Abhishek Chaturvedi²

¹Assistant Professor, Dept. of Electrical Engineering, Government Engineering College, Bharatpur, Rajasthan, India

²Faculty, Dept. of Electrical Engineering, Government Engineering College, Bharatpur, Rajasthan, India

Abstract: In this paper we are focusing on the power flow, harmonic, transient analysis & reduce the power losses by using different techniques in the GIS TRANSCO network in which the transmission done from 400KV to the distribution of 66KV. With the help of power flow analysis we are able to know about the buses voltage either it is suffer from over voltages or under voltage, it also gives the idea of the ratings of all the equipment and the power flow direction as well as the losses created in the system in megawatt (MW). With the help of ETAP we can also determine the value of current in every branch of the network and also give the idea of flow of reactive power in the system. In this paper we are reducing the loss by changing the taps of the transformer used in the whole system. By changing the taps of the transformer we also increase the load capacity of the whole system as well as reduce the power loss in the system. Transient stability analysis & harmonic analysis has been done to reduce the losses in the system by ETAP.

Keywords: Power flow Analysis, Harmonic Analysis, Transient Stability Analysis, ETAP, Power losses, Tap changer, Harmonic filter, transient analysis.

1. Introduction

In the study of the power system the study of Power Flow is very much significant for the engineer. The study of power flow gives the idea about various power system quantities such as real power, reactive power, power angle, over voltage, under voltage and losses etc. From Power flow studies we can ensure that bus voltage should be near to the rated values and the generation operates within the operating limits. We can also ensure that the transmission line and transformer are not overload.

Recent advances in engineering sciences have brought a revolution in the field of electrical engineering after the development of powerful computer based software. This research work highlights the effective use of Electrical Transient Analyzer Program (ETAP) software for analyses and monitoring of large electrical power system which comprises of large power distribution net work.

2. System Model

In this single in diagram there are two buses one is main bus –I and, other is main bus –II. This whole is divided into the three sections according to the voltage level such as 400KV, 220KV and 66KV respectively. Every section has its own two buses at each voltage level. At the first voltage level that is 400KV incoming from the grid is divided into two feeders and sends to the main bus I and main bus II respectively in parallel connection from the grid to the buses. From those buses again four feeders send the power to the next buses which is at the voltage level of 220KV. From the 220KV level there are seven feeders are coming to send the power at the distribution level of 66KV with the help of three winding transformer. At the output of the buses at 66KV six feeders are available for sending the power at the customer end. The whole single line diagram is shown in Fig 1.

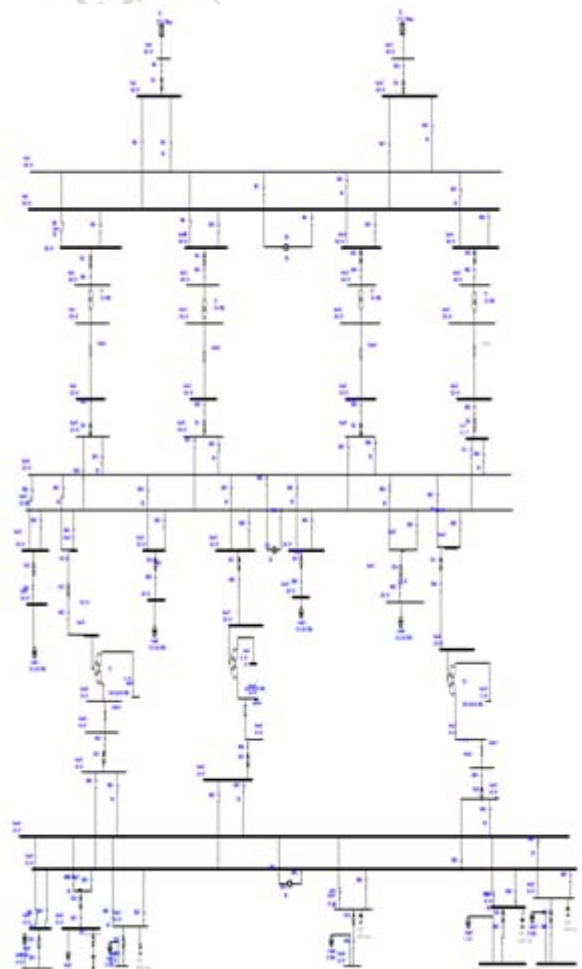


Figure 1: Single line diagram of GIS system.

3. Simulation & Results on ETAP

3.1 Power Flow Analysis

Here Power Flow Analysis of the whole system is done through ETAP in which Newton Raphson is used by the

software. The result and report generated after the power flow is shown in fig. 2. In the results it is clearly visible that some buses are overloaded.

The result of the power flow is shown in the table.1. In Table 1, sixty five buses are used in the whole system with sixty five branches. Here ten loads are used along with two grids inputs. The load in MW is 979.614. We observed that the losses of the whole system are 10.056 MW.

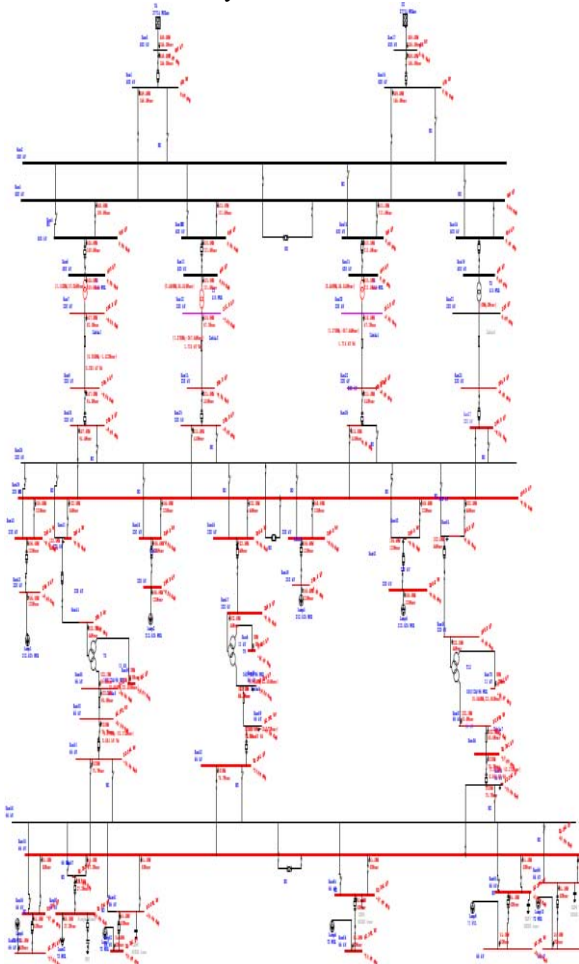


Figure 2: Single line diagram after power flow

Table 1

| | |
|-----------------|----------|
| Buses | 65 |
| Branches | 65 |
| Generators | 0 |
| Power Grids | 2 |
| Loads | 10 |
| | |
| Load-MW | 979.614 |
| Load-Mvar | 372.703 |
| Generation-MW | 0 |
| Generation-Mvar | 0 |
| Loss-MW | 10.056 |
| Loss-Mvar | -354.466 |

Case 1 Power flow analysis after changing transformer taps -In Fig. 3 it is shown that on the secondary side of the two winding transformer tap in % is changed from 0 to 5 in the ETAP.

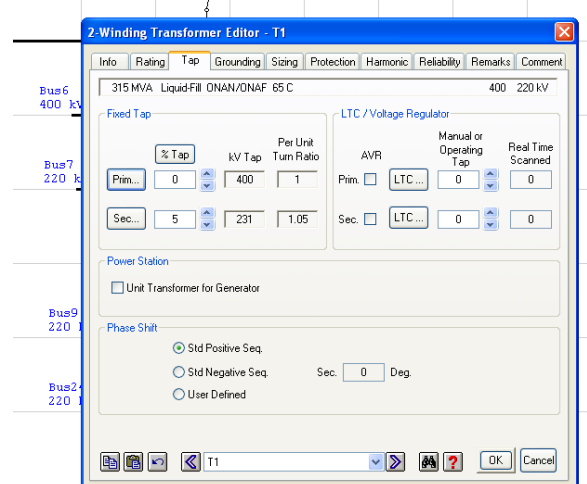


Figure 3

Here in Table.2 after changing the taps of the transformer the losses is reduced to 9.501 MW and also increase the load capacity to 1012.806

Table 2

| | |
|-----------------|----------|
| Buses | 65 |
| Branches | 65 |
| Generators | 0 |
| Power Grids | 2 |
| Loads | 10 |
| | |
| Load-MW | 1012.806 |
| Load-Mvar | 315.271 |
| Generation-MW | 0 |
| Generation-Mvar | 0 |
| Loss-MW | 9.501 |
| Loss-Mvar | -437.207 |

Case 2 Power flow analysis after connecting the capacitor bank-The presence of Capacitor bank in the system will increase the power quality of the system. In Fig. 4 it is clearly visible that before connecting capacitor banks at bus 66 and 65 the buses voltage is 52.391kV. After connecting them to the different four buses the bus voltage is improved to 58.011kV in Fig. 5

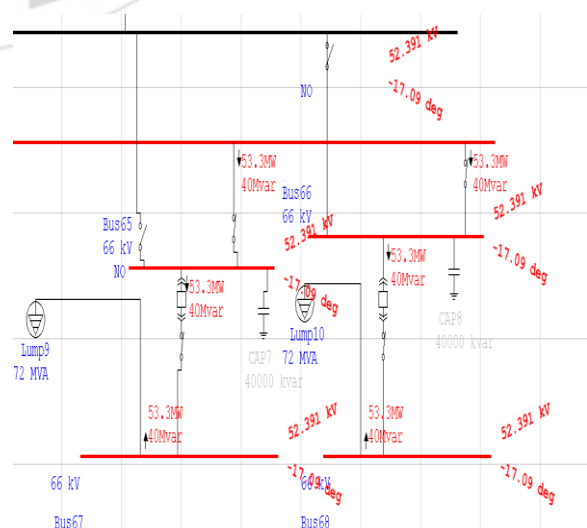


Figure 4

If we calculate the power flow of the whole system with capacitor bank then the overall power loss again reduced to 8.049MW which is shown in Table. 3.

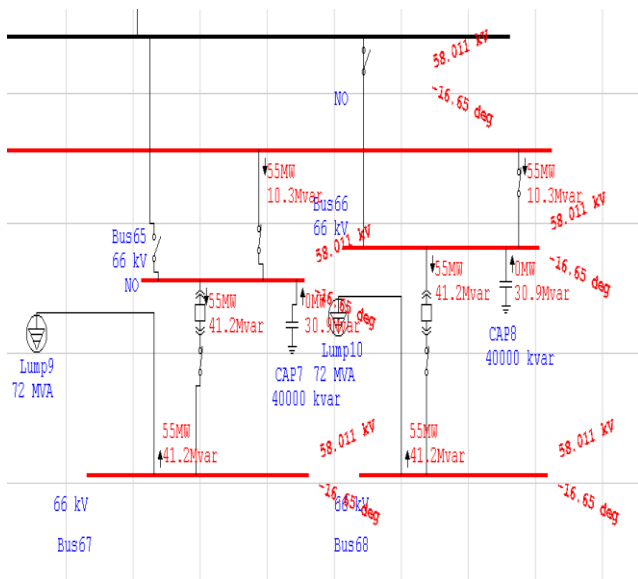


Figure 5

Table 3

| | |
|-----------------|----------|
| Buses | 65 |
| Branches | 65 |
| Generators | 0 |
| Power Grids | 2 |
| Loads | 10 |
| Load-MW | 1000.666 |
| Load-Mvar | 195.427 |
| Generation-MW | 0 |
| Generation-Mvar | 0 |
| Loss-MW | 8.049 |
| Loss-Mvar | -425.426 |

3.2 Transient Stability Analysis

In transient stability we studied about the behavior of the system during the disturbance for large interval. Here we analysis the LG fault at bus 1. Here in Fig. 6 a LG fault is occurring at bus1at 0.3 sec and it is clear at 0.7 sec. During the LG fault the voltage dip to zero and at 0.7 sec the fault is cleared and regains its previous value.

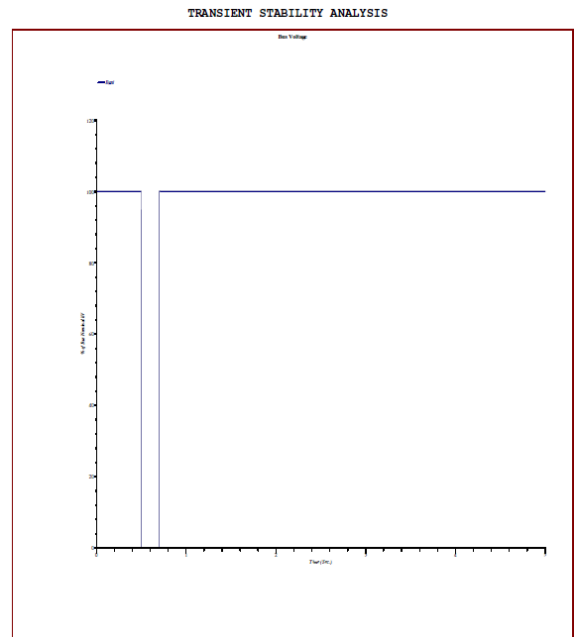


Figure 6

3.3 Harmonic analysis of the system

Harmonic analysis is done for identify the behavior and effectiveness of harmonics on system.

Case 1 Here in Fig. 6 shows that the 5th order harmonic is very much high due to which there is distortion in the voltage and current wave form. In Fig. 7 the waveform of voltage is shown which having harmonics in it.

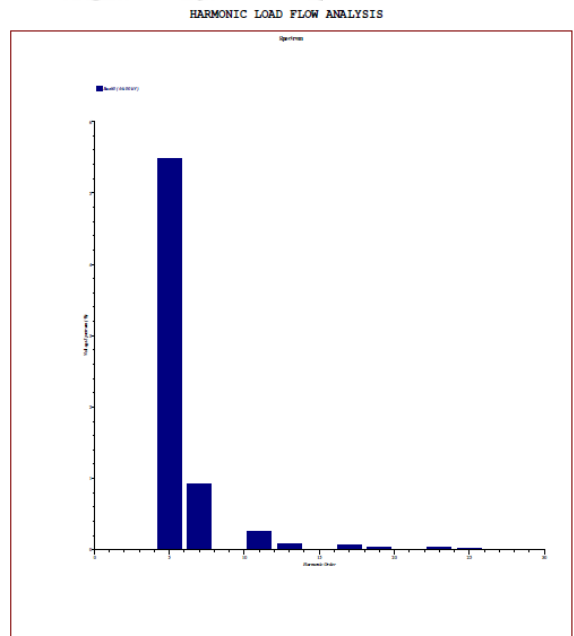


Figure 7

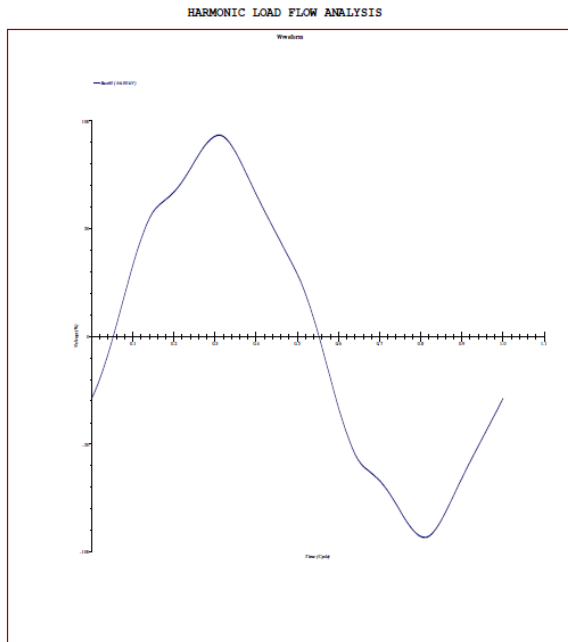


Figure 8

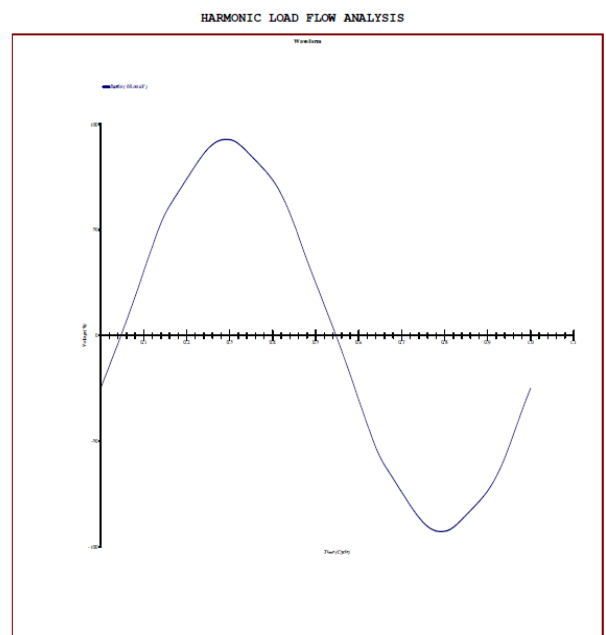


Figure 10

Case 2 For improving the stability condition such as reduce the 5th order of harmonic and reduce the harmonic content in the waveform in the bus voltage which is shown in Fig. 7. Harmonics in the system is reducing by using harmonic filters. The result after the harmonic filter is shown in Fig. 8 in which the 5th order harmonic is reduced very much and also in graph in Fig. 9 in which the harmonic content is reduced and wave is more sinusoidal as compared to the previous graph in Fig 7.

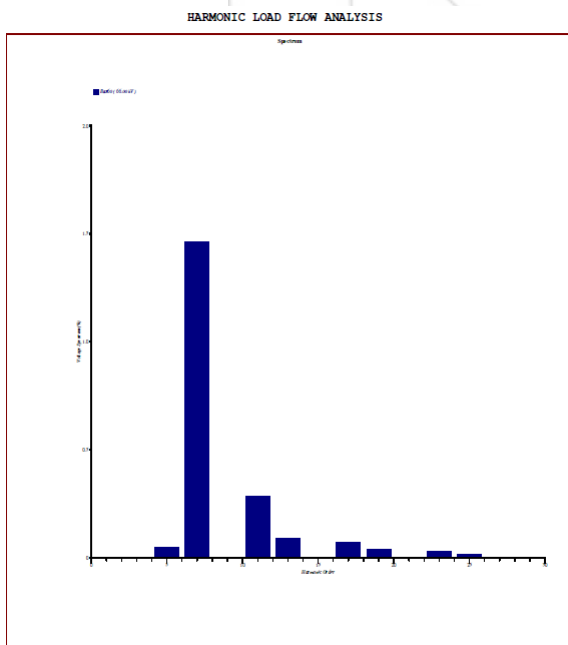


Figure 9

4. Conclusion

In this paper we are mainly focus to reduce the losses and harmonics in the system. Losses and harmonics are analyzed by the power flow and harmonic analysis by using ETAP. By using taping of the transformer and capacitor banks in the system we reduce the losses up to 3.5 MW. Here we also analyzed the Transient stability in which we know the behavior of the system after the long disturbance. In harmonic analysis we analyzed that the harmonic content is higher in the system which is reduced by using harmonic filters in the system.

References

- [1] Rohit Kapahi, Load Flow Analysis of 132 Kv substation using ETAP Software, International Journal of Scientific & Engineering Research Volume 4, Issue 2, February-2013, ISSN 2229-5518
- [2] Aswani R, Sakthivel R, Power Flow Analysis of 110/11KV Substation Using ETAP, International Journal of Applied Research and Studies (IJARS) ISSN: 2278-9480 Volume 3, Issue 1 (Jan - 2014)
- [3] Swaroopkumar. Nallagalva, Mukesh Kumar Kirar, Dr. Ganga Agnihotri Department of Electrical Engineering, MANIT Bhopal, Transient Stability Analysis of the IEEE 9-Bus Electric Power System, International Journal of Scientific Engineering and Technology (ISSN: 2277-1581)
- [4] Pravin Chopade and Dr. Marwan Bikdash, "Minimizing Cost and Powerloss by Optimal Placement of Capacitor using ETAP", 978-1-4244-9593-1/11/ ©2011 IEEE 24.
- [5] M.A.Pai, "Computer Techniques in Power System Analysis", second edition, ISBN: 0-07-059363-9, Tata McGraw Hill [22005].
- [6] D.M. Tagare Reactive power management Mc-Graw Hill 2000. [9] Rani and Vijaya, "Distribution system loss reduction by capacitors", Proceedings of National Conference on Emerging Trends in Engineering (2000), Husur

Author Profile

Mr. Deepak Kr. Goyal, received his B.E. degree in Electrical Engineering from M.B.M Engineering College Jodhpur (Raj.) in 2002 & M.Tech in Power Apparatus & Electric Drives from Indian Institute of Technology, Roorkee in 2005. Presently he is Head of Electrical Engineering Department, Government Engineering College, Bharatpur(Raj.). His areas of interest are Automation, A.C. Drives & Modulation Techniques.com

Mr. Abhishek Chaturvedi, received his B. Tech. degree in Electrical & Electronics Engineering from B.M.A.S. Engineering College Agra (U.P.) in 2010 & M.Tech in Power System Amity University ,Noida (U.P) in 2014. Presently he is working as a Faculty in Electrical Engineering Department, Government Engineering College, Bharatpur(Raj.). His areas of interest are Automation, Photovoltaic up gradation techniques.

