IIJSR PROGRESS THROUGH RESEARCH

Irish Interdisciplinary Journal of Science & Research (IIJSR)

(Quarterly International Journal) Volume 4, Issue 1, Pages 01-07, January-March 2020

A Brief Investigation on Power Quality Analysis for TND System

P.Meenalochini[1], C.Sonia[2] & S.Tamilselvi[3]

[1,2]*Assistant Professor, Department of EEE, Sethu Institute of Technology, Madurai, Tamilnadu, India.*
[3]*Associate professor, Department of EEE, SSN College of Engineering, Chennai, Tamilnadu, India.*

Article Received: 07 October 2019 Article Accepted: 12 December 2019 Article Published: 14 January 2020

ABSTRACT

This paper introduced a case study analysis of the radial distribution system in the Delhi region. This is part of a research project on the Delhi region of India. The aim of this project is to improve the energy quality of important radial distribution systems in the Delhi region by measuring and analyzing system data. Thus, solving the energy quality problem of this system. This article describes the measurement and actual analysis of a radius distribution system that includes critical tasks with high energy quality disturbances. In this study, the study and analysis of personal voltage disturbances that consider overvoltage and undervoltage are presented as impairments in energy quality. In addition, voltage drops and power losses during the simulation are calculated. Proposals for appropriate solutions to mitigate these issues were also discussed. The energy distribution system is designed to simulate and analyze models using Matlab / Simulink.

Keywords: *Capacitor Placement, Reactive Power Compensation, Power Quality, Distribution Power System.*

I. INTRODUCTION

Increasing demand for high-quality, reliable power and an increasing number of distorted loads can lead to increased awareness of power quality by both customers and utilities. Power quality issues are a major concern between researchers and engineers. In order to improve the power quality of distribution systems, it is useful and necessary to monitor and investigate power quality disturbances to mitigate these problems. Recently, power quality has become increasingly important for a variety of reasons [1-3]. There were various changes in the nature of the electrical load. With the integration of power electronics equipment, load characteristics have become more complex and voltage and current disturbances have occurred. Meanwhile, equipment has become more sensitive to power quality. According to the IEEE-defined standard (IEEE Std. 1100, 1999), power quality is "powered to electronic equipment, suitable for the operation of the equipment, and grounded in a manner compatible with local wiring systems and other connected equipment. Concept of doing". Some authors use the term "voltage quality", while others use "supply quality" to indicate the same issue of power quality. Others use the term "clean power" to refer to unbearable, uninterrupted supply. Definition of power quality disturbance by standard [3-10]: IEC (International Electrotechnical Commission), IEEE Std. 1159: 1995, IEEE Std. Table I lists the 1346-1998 and GOST Indian standards.

Disturbance	Short-definition
Interruption	Voltage magnitude is zero
Under voltage	Voltage magnitude is below its nominal value
Over voltage	Voltage magnitude is above its nominal value
Voltage sag	A reduction in RMS voltage over a range of 0.1-0.9 pu for a duration greater than 10 ms but less than 1 s
Voltage swell	An increase in RMS voltage over a range of 1.1-1.8 pu for a duration > 10 ms but < 1 s
Flicker	A visual effect of frequency variation of voltage in a system
Voltage/Current unbalance	Deviation in magnitude of voltage/current of any one or two of three phases
Ringing waves	A transient condition which decays gradually
Outage	Power interruption for not exceeding 60 s duration due to fault/maltripping of switchgear system
Transients	Sudden rise of signal
Harmonics	Non-sinusoidal wave forms

Because there are various types of power quality impairments that all users may encounter, analysis must be performed to evaluate the types of power quality issues that have an impact on the power distribution system. These analyzes include measuring, monitoring, and mitigating system power quality issues. Installing shunt capacitors in the power grid is essential for improving power flow control, system stability, power factor correction, voltage profile management, and loss minimization. Many techniques have been developed to solve the capacitor placement problem, including analytical techniques, numerical programming, heuristics or artificial intelligence (AI) based techniques [11]. Of these methods, heuristic or AI optimization techniques are widely applied to solve the optimal capacitor placement problem. AI is a powerful knowledge-based approach that can address the nonlinearities of practical systems. AI can be used for transient analysis because it reduces mathematical complexity and has a fast response time. In addition, optimal capacitor planning based on fuzzy logic algorithms has been implemented, indicating the inaccurate nature of parameters or solutions in real power distribution systems [4]. References [5] applied a tabu search approach to determine the optimal capacitor plan for Chiang et al.'S [14],[15] power distribution system and compared TS results with SA. In [6], a genetic algorithm (GA) was implemented to obtain the optimal capacitor selection, but the objective function considers only the cost and power loss of the capacitor without any operational constraints Did. Reactive power is minimized using a particle swarm optimization (PSO) algorithm [16],[17]. The purpose of this project in the Delhi region of India is to improve the power quality of the largest and most important distribution systems suffering from various power quality issues. This paper presents a case study of a radial distribution system in the Delhi region. This system includes significant users (loads) who are suffering from many types of power quality issues. An actual measurement of the distribution system in the Delhi area was performed. In addition, based on the GOST standard and Table I, the investigation and analysis of voltage profile disturbances taking into account overvoltage and undervoltage, furthermore, voltage drops and power losses are present in this network and have the same causes as voltage profile disturbances . Proposals for appropriate solutions to mitigate these issues are also being discussed. Here's an overview of the rest of this book: Section II, History of Power Distribution Systems in the Delhi Region, Section III, Analytical Power Distribution System Results and Impact on Power Quality, Section IV, Proposal of Appropriate Solutions to Improve Power Quality through Mitigation, Issues, Section V, Conclusions.

II. THE DELHI REGION DISTRIBUTION SYSTEM HISTORY

Most of the current use of distribution networks in the Delhi region was designed and built in 60-70. These networks were planned for 15-20 years from the date of installation and did not anticipate a fundamental change in current load. Generally, the load in this area was rural or small towns. The load density was low and a long grid was used. The network is being rebuilt with the development of appliances and the increase in the total power of household consumers and technical electrical receivers. The grid structure remained the same. In 2000, the load increased anew and the structure of energy consumption changed accordingly. Once rural areas were rebuilt for housing and industrial estates, and small towns expanded and grew. At the end of the year 2000, there was a situation where heavy loads were connected to "weak" networks and long networks, and this situation has become even worse. In 2014, a large-scale study on the power quality of distribution networks was conducted in the Delhi area. As in section I, the measurements were made in two weeks, taking into account the power quality standards of

GOST [6-8] in India. One week is winter and another week is summer season. This white paper shows one of the feeders considered. Power quality was measured at the six nodes of the primary substation (6 KV) and the secondary substation (0.4 KV) evenly distributed on the grid in the case study of this paper. Based on the measurements, the network regime was modeled with maximum and minimum loads.

III. ANALYSIS OF DISTRIBUTION SYSTEM RESULTS AND IMPACT ON POWER QUALITY

Table I shows the disturbances that occur in the power distribution system and cause the power quality to deteriorate. This affects the performance and longevity of end-user equipment. In order to improve the power quality of distribution systems, problems due to the development of technology and the increasing demand for active and reactive power are measured and analyzed. Monitoring and analyzing power distribution systems can help you understand the type of problem and how it affects power quality performance [7], [8], [9]. These measurements were made using the power quality analyzer shown in Figure 1.

Fig.1. The power quality analyzer device (UF2M-3T52-5-100-1000)

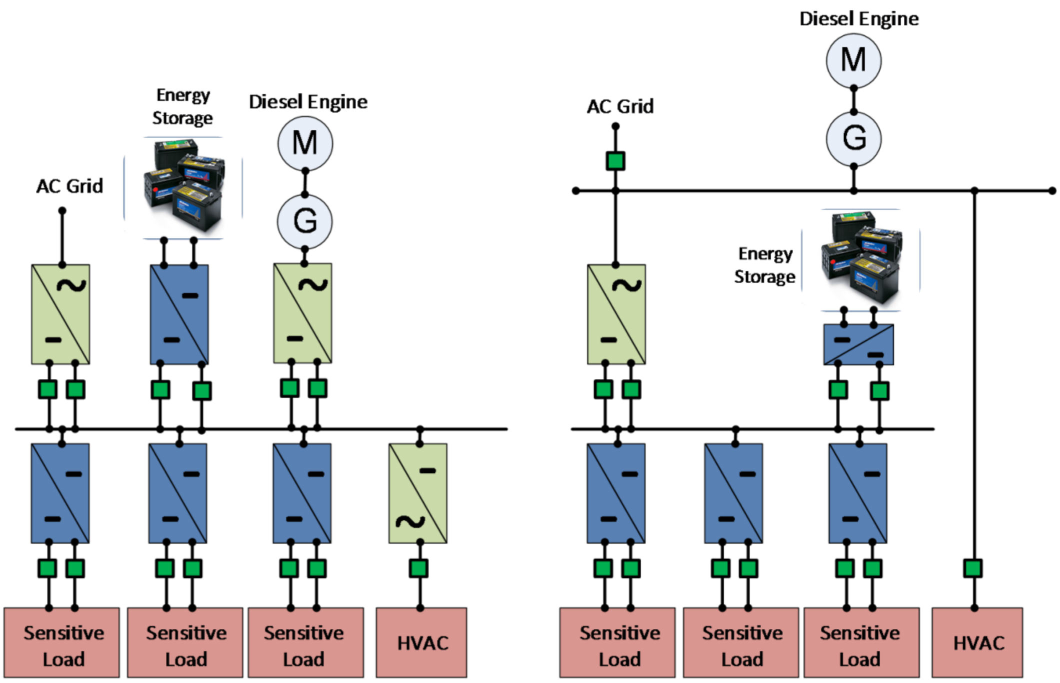

Fig.2. A Novel micro grid power quality in DC power measurement.

 ISSN: 2582-3981

The cost of low or weak power quality can range from tens of thousands to millions of dollars, depending on the sensitivity of the customer and, consequently, the sensitivity of power quality failures in large and small networks [10] and [11],[12],[13].It is estimated. Measurements have been made on a number of distribution systems in the Delhi region to assess power quality and to reduce and improve problems with these systems, taking into account the Indian GOST standard [6] as in section I. The power distribution and power quality parameters indicated that 111 nodes (buses) were selected. The critical load nodes (buses) are recorded for two weeks, one week in summer and another week in winter to evaluate the rest of the node system.

Random nodes were tested to make sure the other nodes evaluated correctly. This white paper presents a measurement and analysis case study showing the voltage profile (U), voltage drop (ΔU), and power loss (ΔP) of a radial distribution system. Figure 3 shows a small screen of the voltage profile over time on only six load buses (buses: 29, 34, 50, 56, 67, 111, and the main substation bus "PS") from all measurements as a case. Study shots in winter and summer to show some from actual project measurements. It is important to know that the primary substation bus "PS" was measured at a medium voltage of 6 KV and the load bus was measured at a low voltage of 0.4 KV. The transformer and low-voltage bus are not modeled in this case study. As shown in Figure 3, in winter, the voltage profile falls below the standard limit compared to summer, and in summer, the voltage profile almost exceeds the standard limit, increasing power quality disturbances. Measurement of summer and winter voltage profiles on the load bus of the radial distribution system. In winter, the voltage on the load bus is much less than the limit (<0.9 U, p.u.) than in summer, disrupting the voltage profile, increasing voltage drop and power loss. Therefore, this paper provided a worst case study from winter measurements to show the voltage profile, voltage drop, and power loss, as shown in Figure 4. In the evaluation, the base of the Slack Bus 1 radial distribution system: voltage base = 6 KV, apparent power (S) = 3158,58 KVA, active load power = 2370 KW and reactive load power = 2088 KVAR. Figure 4 shows the distribution line voltage drop. Due to long distribution lines, distribution lines 2-3, 6-7 and 12-13 are higher than other distribution lines. Power loss always involves the supply of power from the power supply to the consumer. Losses directly affect financial issues and the overall efficiency of distribution utility systems. In addition, power loss has a tremendous effect on the distribution system, causing loss of power distribution system units and increasing power costs on the generating side.

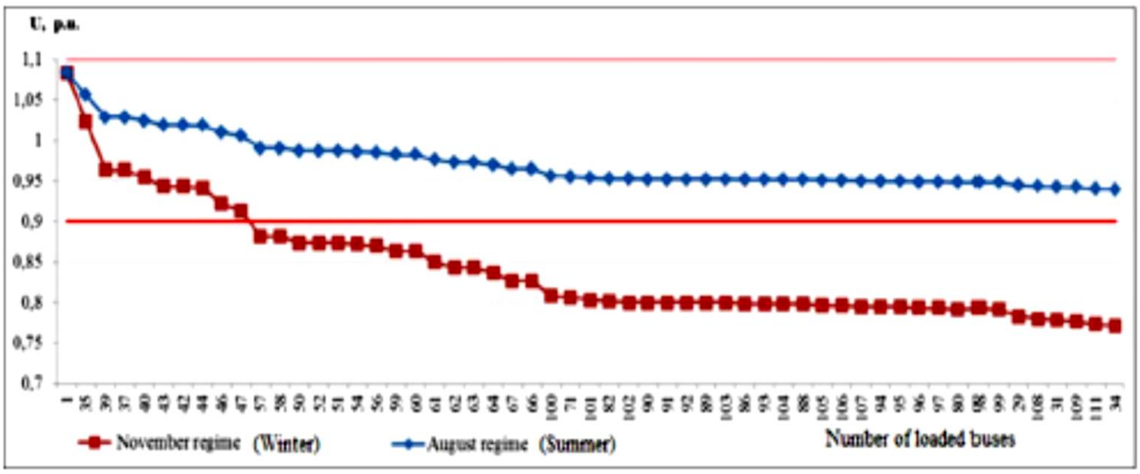

Fig.3. Measurement of voltage profile at the loaded buses of radial distribution system in the summer and winter seasons

As shown in Figure 7, bus power losses are higher in distribution lines 2-3, 6-7, 4-5, and 12-13 than others. As a result, from FIG. As can be seen in Figures 5, 6, and 7, the power flow at the start of the distribution system (near the primary substation) is greater than at the end of the system. Therefore, from the first diagram of the distribution system, if there is a long distribution line with a large power flow, there is a large voltage drop and power loss, but if there is a long distribution line at the end of the distribution system, there was a small power flow. , Voltage drop and power loss will be appropriate. Therefore, a long line carrying large power is the worst case. Figure 8 shows the active and reactive load power load data on the load bus of a 111-bus radial power distribution system.

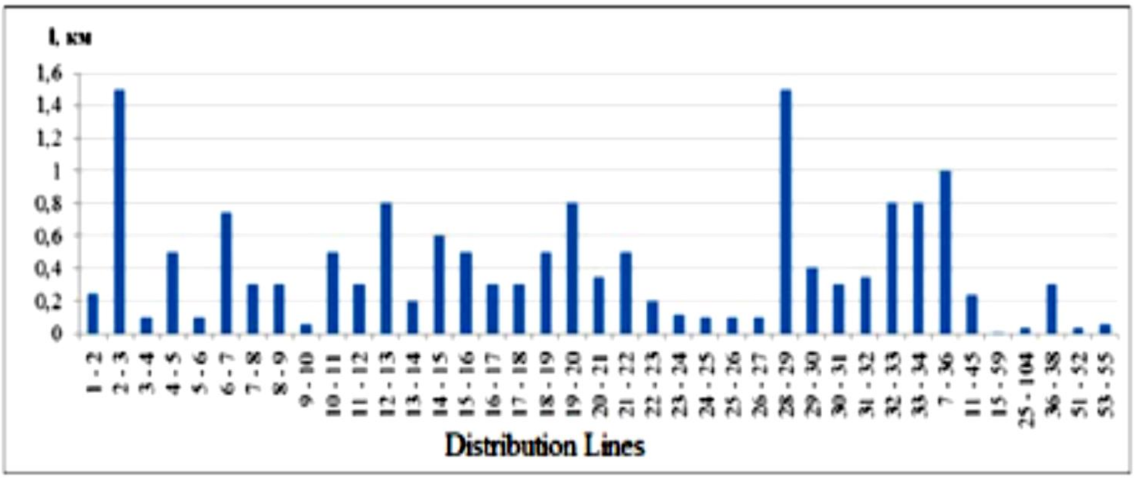

Fig.4. The lengths (L, KM) of distribution lines

IV. SUGGESTING A SUITABLE SOLUTION TO IMPROVE THE POWER QUALITY BY MITIGATION OF ITS PROBLEMS

Currently, as load demands increase, power distribution systems become more complex, and increasing loads tend to increase system losses, thereby significantly reducing the voltage profile. In an overload condition, the reactive power flow causes large losses and reduces the voltage level. Therefore, it is the duty of distribution company electrical technicians to minimize power loss and create an appropriate voltage profile. Many mitigation techniques are recommended to mitigate power quality issues [3]. But there is a big problem with this case study. Low voltage and large losses due to large overflow of active power and reactive power in most of the network. The power system case study has the following solutions: (I) Increase the network voltage rating to 10 kV instead of 6 kV, as in the case study of increasing the cross section of the wires, but this method is very expensive ((non-logical solution)). (Ii) Active power generation by a distribution power source (distribution generator) such as a reference. [24], but very expensive. (Iii) Line voltage regulator [4] to improve the voltage profile, but power loss has still been found. (Iv) Reactive power compensation is a good solution for case studies because of the following major problems in power distribution systems [17]: High reactive power (VAR) demands, high voltage drops, reduced system capacity, high system losses, and inherently unbalanced distribution systems. Reactive power is required for power distribution systems [3] and [7-8]. Because reactive power (VAR) is needed to maintain the voltage to supply active power (WATT) through the grid. Power consumption is called reactive power, and electromechanical devices and other loads require reactive power, and a lack of reactive power causes a voltage drop. The importance of reactive power compensation [3] and [7-8] has a significant effect on system voltages. It must be balanced in the grid to prevent voltage problems. Reactive power levels also affect voltage collapse because of the lack of reactive power in grids where power outages occur. Reactive power compensation source types are discussed in Table II [16-17]. Therefore, the cheapest and most economical is the capacitor bank .The slow response problem was solved by a special application such as Ref. [16]. There, reconnect them and introduce the support voltage of the power system. Another problem is that the capacity of the capacitor bank is low and degrades at U2. In addition to installing shunt capacitors, the total amount of current that needs to be transferred through the equipment of the distribution network is reduced. These problems are due to the distribution system capacitor allocation [3]. These problems can be solved in [3]. Based on intelligent technology, determine the optimal location, size and number of capacitor banks to be installed in the power distribution system. Also, to increase the reliability of the capacitor bank and reduce the monthly charging fee, it must be installed close to consumers. This project is economically feasible as a cost reduction. Capacitor bank types for radial distribution systems are series or shunt capacitors. While series capacitors cause an increase in the maximum power limit, shunt capacitors have several advantages. Some advantages of shunt capacitors are reduce the actual reactive power loss of the system, improve voltage regulation, increase load voltage level and source power factor, improve stability Improve and improve the power factor of the system. Many methods have been implemented to solve the problem of capacitor placement.

V. CONCLUSION

Practical power distribution systems are being considered for review and analysis. Actual measurements of the distribution system in the Delhi area are presented. The distribution system has been modeled. Power flow is calculated based on actual measurements and data. Proposal of an appropriate method to improve power quality using capacitor bank compensation. In addition, the optimal allocation and size of the capacitor bank can be determined based on optimization techniques such as PSO and genetic algorithms. Disturbances in the voltage profile are very widespread in the Indian grid. In networks with high demands for reactive power, compensating for reactive power can solve this problem. To adjust the reactive power in steady state, a capacitor bank can be used. These devices are the most economical and appropriate solution to this problem. Proper placement and selection of the power rating requires the use of intelligent optimization methods. You also need to consider the load curves that define the number of fixed and variable capacitor banks.

REFERENCES

1. Karthick, R and Sundararajan, M: "A Reconfigurable Method for Time Correlated Mimo Channels with a Decision Feedback Receiver," International Journal of Applied Engineering Research 12 (2017) 5234.

2. Karthick, R and Sundararajan, M: "PSO based out-of-order (ooo) execution scheme for HT-MPSOC"Journal of Advanced Research in Dynamical and Control Systems 9 (2017) 1969.

3. Karthick, R and Sundararajan, M: "Design and Implementation of Low Power Testing Using Advanced Razor Based Processor," International Journal of Applied Engineering Research 12 (2017) 6384.

4. Karthick, R and Sundararajan, M: "A novel 3-D-IC test architecture-a review," International Journal of Engineering and Technology (UAE)7 (2018) 582.

5. R.Karthick, P Selvaprasanth, A ManojPrabaharan, "Integrated System For Regional Navigator And Seasons Management," Journal of Global Research in Computer Science 9(4),2018(11-15).

 ISSN: 2582-3981

6. Karthick, R and Prabaharan, A.Manoj and Selvaprasanth, P. and Sathiyanathan, N. and Nagaraj, A., High Resolution Image Scaling Using Fuzzy Based FPGA Implementation (March 15, 2019). Asian Journal of Applied Science and Technology (AJAST), Volume 3, Issue 1, Pages 215-221, Jan-March 2019 . Available at SSRN: https://ssrn.com/abstract=3353627

7. Karthick, R and Sundararajan, M., Hardware Evaluation of Second Round SHA-3 Candidates Using FPGA (April 2, 2014). International Journal of Advanced Research in Computer Science & Technology (IJARCST 2014), Vol. 2, Issue 2, Ver. 3 (April - June 2014). Available at SSRN: https://ssrn.com/abstract=3345417.

8. Karthick, R and and Prabaharan, A.Manoj and Selvaprasanth, P.,Internet of Things based High Security Border Surveillance Strategy (May 24, 2019). Asian Journal of Applied Science and Technology (AJAST), Volume 3, Issue 2, Pages 94-100, Apr-June 2019. Available at SSRN: https://ssrn.com/abstract= 3394082. 9. Karthick, R and Sundararajan, M: “SPIDER based out-of-order (ooo) execution scheme for HT-MPSOC” International Journal of Advanced Intelligence paradigms, In Press.

10. Karthick, R and John Pragasam, D “Design of Low Power MPSoC Architecture using DR Method” Asian Journal of Applied Science and Technology (AJAST) Volume 3, Issue 2, Pages 101-104, April -June 2019.

11. Karthick, R and Sundararajan, M., Optimization of MIMO Channels Using an Adaptive LPC Method (February 2, 2018). International Journal of Pure and Applied Mathematics, Volume 118 No. 10 2018, 131-135. Available at SSRN: https://ssrn.com/abstract=3392104

12. Karthick, R and Rinoj, B. Micheal Vinoline and Kumar, T. Venish and Prabaharan, A.Manoj and Selvaprasanth, P., Automated Health Monitoring System for Premature Fetus (July 27, 2019). Asian Journal of Applied Science and Technology (AJAST) (Peer Reviewed Quarterly International Journal) Volume 3, Issue 3, Pages 17-23, July -September 2019. Available at SSRN: https://ssrn.com/abstract=3427756

13. Karthick, R.,Deep Learning For Age Group Classification System, International Journal Of Advances In Signal And Image Sciences. Volume 4, Issue 2, Pages 16-22, 2018.

14. R. Karthick, N.Sathiyanathan, “Medical Image Compression Using View Compensated Wavelet Transform” Journal of Global Research in Computer Science 9(9), 2018(1-4).

15. P. Meenalochini and S. P. Umayal ,Comparison of Current Controllers on Photo Voltaic Inverters Operating as VAR Compensators, Journal of Electrical Engineering The Institution of Engineers, Bangladesh Vol. EE 38, No. I, June, 2012.

16. R. Karthick, P. Meenalochini, A. Manoj Prabaharan, P.Selvaprasanth, M.Sheik Dawood, “A Dumb-Bell Shaped Damper with Magnetic Absorber using Ferrofluids” International Journal of Recent Technology and Engineering 8(4S2), 2019(317-320).

17. R.Karthick, R. Senthamil Selvan ,R. S. D. Wahidabanu , B. Karthick, M. Sriram , “Development of Secure Transport System Using VANET” Test Engineering and Management, Vol.82(Jan-Feb 2020), 2020(2073 – 2078).