International Journal For Technological Research In Engineering
Volume 10, Issue 1, September-2022 *ISSN (Online): 2347 - 4718*

PROTECTION OF DISTRIBUTION SYSTEM FROM UNDERVOLTAGE: A REVIEW

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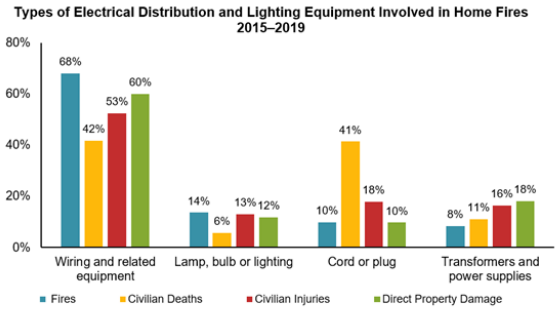
Abstract: ***Load has to be protected in the power system from uneven disturbances and poor power quality, the above issue can reduce the life of the load and can be hazardous, it is identified that under voltage is a cause for many life risks which are covered in this paper .also for this a literature survey is done in this paper which covers the industrial and domestic approaches of various authors for the Under voltage protection.in this paper around 35 papers were reviewed out of which 17 are studied and drafted in this paper.***

Key words: Review paper, under voltage issues

1. GENERAL INTRODUCTION

Modern civilization makes use of large amounts of energy to generate goods and services. From the industrial plants, the providers of public services to the ordinary man, all of them need energy to satisfy and create the wellbeing of modern society. The purpose of electric power systems is to provide energy for human use in a secure, reliable and economic manner. Electric power systems are made up of facilities and equipment that generate, transmit and distribute electrical energy. Electric power systems are one of the largest and more complex systems man has ever built.

The importance of the services that power systems offer and the high number of investments that represent the facilities and equipment, make the normal and constant operation of power systems critical and strategic for every society. Faults and failures normally occur in power systems. Due to the great amounts of energy involved, faults represent a threat to the operation and security of power systems if the faults are not promptly corrected. Power systems need an auxiliary system that must take corrective actions on the occurrence of a fault. This auxiliary system is known as protection system.



2. REVIEW OBJECTIVE AGENDA

The objective of this thesis is to identify the protection of the power system Coded Relay System. In this thesis the output waveform of the protection of the power system is analyzed after implementation of faults and the results are checked that the place or the bus were load protection relay system is used that load is protected in under voltages rather other loads are not protected as the relay does not trips off the circuit breaker

3. LITRATURE SURVEY

Over the last ten decades a large number of papers have published in the area of fault section identification in power network. Here in this chapter, an attempt has been made to review some of major contribution in this area. Apart from this I have mentioned the fault section identification in power network with fuzzy logic controller, PI controller and PID controller. And I have done the comparative analysis of the same using fuzzy logic controller, PI controller and PID controller.

Y. S. Cho, C. K. Lee, G. Jang, and T. K. Kim et.al [1] This paper presents our work involving the development of a real-time operator training system using a protective relay implemented by the user defined component (UDC) model of a Real-Time Digital Simulator (RTDS). Operator training, within a real-time environment for the principles and behavior of protective relaying with respect to power system stability and protection, can provide a very strong benefit in facilitating operators' understanding of the basic concepts of a protective relay as well as handing undesirable operations.

T. P. Sari, A. Priyadi, M. Pujiantara, and M. H. Purnomo et.al [2] To overcome this problem, under-frequency and under-voltage relay are installed as a backup relay, but it also do not give the best result. This paper focused on the addition of reverse power relay to improve the system performance. Transient stability analysis is necessary to set reverse power relay because optimal power flow analysis cannot give proper parameter when a failure in grid happen. By arranging the delay time between those relays according to IEEE 242-2001, adequate coordination can be done. Moreover, the frequency and the voltage of the system stable at 100.04%, and 100.01%

D. Celeita, M. Hernandez, G. Ramos, N. Penafiel, M. Rangel, and J. D. Bernal et.al [3] The increasing research work on power networks has produced important challenges on distribution systems. These multiple advances bring an inevitable need to reshape and modernize teaching

methodologies in order to understand the different issues of the smart grid complexity. This paper presents the design and implementation of an interactive platform to assess Advanced Distribution Automation (ADA) with applications and solutions focused on relaying solutions for educational purposes on smart grid. The proposed architecture integrates hardware/software tools to emulate the distribution system's behavior and recreate selected signals. Different features are presented and validated from a basic case study, where the students are able to comprehend the main concepts of relaying devices.

A. Estebsari, E. Pons, T. Huang, and E. Bompard, et.al [4] Different schemes for voltage control under emergency are adopted in different jurisdictions around the world. While some features, such as Automatic Voltage Regulation (AVR), are common in all countries, for what concerns undervoltage load shedding (UVLS), to contrast voltage instability or collapse, different schemes are adopted. Most US transmission system operators (TSOs) adopt automatic UVLS schemes, with different capabilities and settings while TSOs in EU usually do not implement automatic UVLS but leave the decisions to the control room operators.

A. Raqeeb, A. Bonetti, A. Carlsson, C. Harispuru, M. Pustejovsky, and N. Wetterstrand et.al [5] . In this paper we will focus on what has been achieved today in these two topics with an insight into future possibilities. From a training perspective, a digital twin of protection relays and a relay test sets can greatly increase accessibility to all technicians and engineers. It will provide a means to get hands on experience and greatly reduce the cost. This will provide opportunity to many more employees instead of a chosen few due to the complexity of resources that are necessary when performing these types of training. Form a remote support perspective, enable the possibility to replicate a remote customer setup which can be used for troubleshooting and give expertise guidance of how to proceed to the engineers that need help in the substation. The virtual tests can be performed at home during normal work hours and the support specialist can provide a validated solution which the test engineer can repeat independently during their own work hours. In both these applications it is of fundamental importance that the twins can share the same data. This paper will detail on this important concept as well.

A. Estebsari, E. Pons, T. Huang, and E. Bompard, et.al [6] Microgrids are considered a prospective way towards improving electric service resiliency, reducing costs, and upgrading service reliability. DC microgrids offer many advantages rather than AC microgrids. In spite of the numerous features and advantages of DC microgrids, their protection faces significant challenges such as selflimited current of photovoltaic (PV) systems, long time constant of wind energy systems, dependability on communication systems, etc. The paper introduces a new protection scheme for DC microgrids using the rate of power (dP) and rate of voltage (dV) and mapping them as dP-dV profile

E. W. Nahas, D. E. A. Mansour, H. A. Abd el-Ghany, and M. M. Eissa, et.al [7] Different schemes for voltage control under emergency are adopted in different jurisdictions around the world. While some features, such as Automatic Voltage Regulation (AVR), are common in all countries, for what concerns undervoltage load shedding (UVLS), to contrast voltage instability or collapse, different schemes are adopted. Most US transmission system operators (TSOs) adopt automatic UVLS schemes, with different capabilities and settings while TSOs in EU usually do not implement automatic UVLS but leave the decisions to the control room operators. The two options may lead to different impacts in terms of trajectory and final status of the transmission grid under emergency, with different unserved energy. In this paper we analyze the impacts from a technical and economic perspective, modeling the grid behavior with different UVLS schemes (none, manual and automatic). The comparison between the different schemes is done resorting to the Incident Response System (IRS), a software tool developed by the authors in the EU-FP7 SESAME project. An illustrative example to a realistic test case is presented and discussed. This paper shows that automatic UVLS is superior to Manual UVLS, from both technical and economic point of view, due to the fast evolution of voltage collapse phenomena and insufficient time for system operators' manual reaction. The benefits of the scheme involving the automatic UVLS can be then compared with the investment costs of equipping the network with those devices.

E. W. Nahas, D. E. A. Mansour, H. A. Abd el-Ghany, and M. M. Eissa, et.al [8] . The paper introduces a new protection scheme for DC microgrids using the rate of power (dP) and rate of voltage (dV) and mapping them as dP-dV profile. The new scheme is titled as smart power/voltage relay (SPV-Relay). The proposed scheme is applicable for all types of renewable energy sources (RESs) and energy storage systems independent of the power rating and configuration of the DC microgrid. The proposed concept of SPV-Relay is described and the method used for fault discrimination is explained. The relay characteristics are developed considering all the DC microgrid components. Three operating zones are identified on dP-dV profile to discriminate between various fault types and locations. The sensitivity and stability of the proposed relay are evaluated under different fault conditions as well as different control schemes and operational scenarios for DC microgrid.

M. H. Sadeghi, A. Dastfan, and Y. Damchi et.al [9] This approach aims to minimize an objective function which comprises three key elements: operating time of relays, voltage sag energy index, and voltage sag duration. The impedance of FCL and the time setting multiplier, current setting and characteristic of DOCRs are the optimization variables. Voltage tolerance curve and voltage sag energy index are also used to show the improvement of voltage sag characteristics and prioritization of answers. Simulation results show that, the operating time of DOCRs and voltage sag characteristics are significantly improved

H. Beder, E. A. Badran, A. Y. Hatata, and M. M. Elsaadawi, et.al [10] This paper proposes a novel inexpensive solution by incorporating an additional circuit with the old version over-current relays. The proposed circuit applies a second harmonic

restraint function for detecting the inrush currents as in the modern digital relays. The modified overcurrent relay is applied to a test system picked from North Delta Electric Distribution Company (NDEDC) Network in Egypt. The results demonstrate the successful operation for the proposed circuit along with the overcurrent relay in normal operation, switching cases, permanent faults, and in case of faults during energization. Furthermore, the proposed circuits integrated with old version overcurrent relays are successfully tested and verified in the presence of grid-connected Distributed Generation (DG) for both switching and fault operation modes. Also, it provides a cost-effective solution for the old version digital overcurrent relay in NDEDC.

M. Kezunovic and S. Vasilic et.al [11] This paper presents a new design for over/under voltage (OV/UV) protection scheme using Arduino microcontroller. The protection scheme is designed to protect the solid-state transformer (SST) branch of a Future Renewable Electric Energy Delivery and Management (FREEDM) system. It is used as backup protection for the instantaneous, momentary and temporary voltage fluctuation of distribution medium voltage loop. Very simple, user-friendly software and hardware simulators are created to represent a branch of the FRREDM network with the designed OV/UV relay. A software program is formulated using c-code through Proteus software package and easily integrated to the hardware circuit. The designed microcontroller monitors the network voltage and the OV/UV relay energies in case that its value exceeds a preset limit according to IEEE 1159. To validate and prove the effectiveness of the proposed system, different tests are performed for both software and hardware simulators at instantaneous, momentary and temporary OV/UV operation conditions. The results are compared with IEEE 1159 standard values and shows fine and high accuracy. The underlying approach is based on an advanced modelling and simulation environment as well as the use of digital power system simulators capable of interfacing with physical relays. Such advanced analysis techniques are needed to provide improved protective relaying reliability and system performance.

T. Jacob and B. D. Oluwatimilehin et.al [12] This paper presents the development of household power quality monitoring system. The quality and quantity of power consumption by a consumer on real time is displayed and stored for future reference, whenever the quality of power is compromised the supply to the end user is interrupted and an alarm is raised at the end user side. This was achieved by using a voltage sensor, current sensor and operational amplifier to measure required fundamental quantities while the derived quantities are determined by microcontroller programmed in C language which displays and store the reading obtained at intervals, also a buzzer and relay was interfaced with the micro-controller to raise alarm and cut-off epileptic power supply. With this project, household equipment and sensitive devices can be operated without the risk of been damaged; also record of power parameters measured can be obtained from the storage unit for further references and data modeling.

E. A. Panova and A. T. Nasibullin et.al [13] The article discusses the development of a mathematical model of a hub substation. Achieving the required parameters of stability and reliability of power supply is not always possible to achieve only the design and mathematical calculations of the power supply system. The use of a mathematical model allows achieving the accuracy of computing the parameters of the power supply system in various modes of operation, and makes it possible to use a single model to solve various problems that have the same mathematical description. The paper considers a nodal substation of an industrial enterprise with consumers having a powerful alternating load. To build a mathematical model, a graphical simulation environment MATLAB Simulink is used. In this environment, using standard blocks, a mathematical model of a substation with equivalent power sources is modeled based on load graphs and asymmetric modes. The paper assesses the adequacy of the model.

A. A. Voloshin, E. A. Voloshin, A. I. Kovalenko, S. A. Danilov, and V. S. Sazanov, et.al. [14] In order to reduce the time required for making calculations relative to the boundary points (branches) of the considered section of the electric network, the equivalent of the external electric network is automatically formed, and the parameters of this equivalent are determined and subsequently updated. The study was funded by a grant for state support of the NTI Competence Centre for the «end-to-end» technology “Technologies for Electricity Transportation and Distributed Intelligent Energy Systems”, created on the basis of the MPEI.
W. Fan, X. Xiao, and S. Tao et.al [15] Taking this into account can improve the accuracy and credibility of the existing assessment methods. Based on the characteristics of relay protection configuration scheme, this paper analyzes the influence of stage distance protection and inverse time current protection action on voltage sag amplitude and duration, and derives the calculation formula of the sensible load failure rate. Based on IEEE 30-bus system, the voltage sag amplitude and duration are calculated by MATLAB program, whose results are then compared with the simulation results of PSCAD. The sensitivity load failure rate of a 66-bus isolated network, under the condition of with and without protection device operation, are evaluated and compared

M. F. Kotb, M. M. El-Saadawi, and E. H. El-Desouky et.al [16] This paper presents a new design for over/under voltage (OV/UV) protection scheme using Arduino microcontroller. The protection scheme is designed to protect the solid-state transformer (SST) branch of a Future Renewable Electric Energy Delivery and Management (FREEDM) system. It is used as backup protection for the instantaneous, momentary and temporary voltage fluctuation of distribution medium voltage loop. Very simple, user-friendly software and hardware simulators are created to represent a branch of the FRREDM network with the designed OV/UV relay. A software program is formulated using c-code through Proteus software package and easily integrated to the hardware circuit. The designed microcontroller monitors the network voltage and the OV/UV relay energies in case that its value exceeds a preset limit according to IEEE 1159. To validate and prove the effectiveness of the proposed system, different tests are

performed for both software and hardware simulators at instantaneous, momentary and temporary OV/UV operation conditions. The results are compared with IEEE 1159 standard values and shows fine and high accuracy.

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