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PROTECTION OF DISTRIBUTED POWER SYSTEM WITH OVERCURRENT AND FREQUENCY VARIATIONS: A REVIEW

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Abstract: An attempt has been made in this paper to review those articles in a group which focused on issues of Overcurrent's damages to load and the processes to eliminate these issues. Codes and algorithms are evaluated and studied by researchers of various domain to pertain issues of overcurrent. Also, under over frequency shoots are also examined in these papers. the literature survey covers the frequency variations in a power system model also and overcurrent effects in the house Holds upto 5 KW. the extension also carried on larger loads where the current variation is large and damages the system. This paper will help in understanding an implementing the Software models for frequency and current variation and to protect them.

Key words: Overcurrent, Under / Over frequency, Review paper

1. INTRODUCTION

on September 28, 2003. The Italian grid was separated from the rest of the continent because some transmission lines tripped. This caused a deficit in active power, which led to a frequency decline that caused generators to trip, resulting in a general blackout. According to [3], the automatic UFLS program was not properly designed for the loss of imported power and did not arrest the frequency decline. About 60 million people were affected by this blackout for more than 3 hours.

On November 4 2006, the inadequate planning of the disconnection of a power line in Germany so that a ship could cross the Ems River safely caused the European transmission grid to split into three areas. The western area was the most affected, with a 22% power imbalance that caused the frequency to drop to

49 Hz [4]. About 15 million households were affected by the power outage, but the system was restored and a complete blackout was prevented by the fast action of the automatic UFLS scheme. The historical under-frequency events presented in this section show the importance of UFLS plans in preventing blackouts.

Causes of Under over currents and Frequency Fluctuations

There are various causes for which under voltages are created in system voltage [1].

1.Closing and Opening of Circuit Breakers:

When the circuit breaker of a phase is opened suddenly, then the line which it is feeding will be temporarily disconnected. The other feeder lines from the same substation system will act as an under voltage.

2. Due to Fault: Under voltage due to fault can be critical to the operation of a power plant. The magnitude of under voltage can be equal in each phase or unequal respectively and it depends on the nature of the fault whether it is symmetrical or unsymmetrical.

3.Due to Motor Starting:

Under voltage due to motor starting are symmetrical since the induction motors are balanced three phase loads, this will draw approximately the same high starting current in all the phases.

4.Due to Transformer Energizing:

There are mainly two causes of under voltage due to transformer energizing. One is normal system operations which include manual energizing of a transformer and another is the reclosing actions. These under voltages are unsymmetrical in nature.

5.Equipment Failure:

Failure of electrical equipment occurs due to insulation breakdown or heating or short circuit etc.

6.Bad Weather:

Lightning strikes in the power line cause a significant number of under voltages. A line to ground fault occurs when lightning strikes the line and continues to ground.

7.Pollution

Flash over takes place when there is storm in the coastal regions, where the power line is covered with salt. This salt formation acts as a good conductor of electricity and faults occur.

8.Construction Activity:

Generally, all power lines are undergrounded in urban areas, digging for doing foundation work of buildings can cause damage to underground cables and create under voltages

According to Institute of Electrical and Electronic Engineers (IEEE) Recommended Practice for Monitoring Electric Power Quality," IEEE Std. 1159 -1995, June1995, Power quality is defined as "The concept of powering and grounding sensitive electronic equipment in a manner suitable for the equipment". In the last few decades power quality has become an important issue since many equipment's are semiconductor based and controlling is done with power electronic equipment's. All the equipment's were heating, lighting and motors, which were not very sensitive to voltage variation. In the past the term reliability and quality was same as because there were no power electronic equipment and all the equipment's were linear in nature Causes of Power Quality Problem. Some common disturbances which may cause power quality problems are listed below:

1. Operation of non-linear and unbalanced loads.
2. Failure of equipment, e.g., transformers and cables.

3. Wrong maneuvers in distribution substations and plants.
4. Lightning and natural phenomena
5.Formation of snow on transmission line, storm etc
6.Energization of capacitor banks and transformers.
7.Switching or start-up of large loads e.g. Induction motors.

2. LITREATURE REVIEW

Menaa, M. ; Hasni, M. [1]
illustrated that In an interconnected multi-region power system, as a power load request fluctuates arbitrarily, on account of any little sudden load change in any of the ranges, both area frequency and tie-line power stream trade additionally shift. The fundamental objectives of Load Frequency Control (LFC) are, to hold the frequency and the wanted power yield in the interconnected power system at the planned qualities and to control the adjustment in the tie-line power stream between control ranges.

Karun, D. Sindhu, T.K. [2]
found that with the continually expanding interest for force, ordinary vitality sources alone can't be relied on for power generation. Disseminated renewable vitality power system are recognized as a suitable option. However, the irregular way of these sources builds the frequency deviations which encourage add to the deviations brought on by burden varieties. Consequently, it is an essential to keep the system frequency consistent. By actualizing Load-frequency control (LFC), the frequency deviations can be constrained. The principle point of the LFC in an interconnected force framework is to keep the frequency deviations in the control ranges inside of the preindicated limits and to keep up tie-line power streams inside of as far as possible while obliging fluctuating burden requests.

Ravi B Kumar [3]
observed that the parameters of PID controller and inclination coefficient for Load Frequency Control (LFC) are outlined utilizing another methodology. In the proposed technique, the power system instabilities and nonlinear impediments of governors and turbines, i.e. Valve Speed Limit (VSL) and Generation Rate Constraint (GRC), are considered in planning. Varieties of indeterminate parameters are considered between - 40% and +40% of ostensible qualities with 5% stage to outline the proposed PID controller, another target capacity is characterized. MATLAB codes are produced for GA based PID controller tuning, the aftereffects of which are utilized to think about the system step reaction. All these are through in Simulink based foundation.

Yaikine Kouba [4]
presented that the portrays a use of Artificial Bee Colony (ABC) to load frequency control (LFC) in single, two and multi-zone interconnected power system. And the proposed ABC calculation is utilized to get the ideal estimations of the corresponding fundamental inference (PID) controller parameters-based load frequency control (LFC). The primary capacity of the LFC loop is to control the frequency and reactive power. The principle point of this work is to smother every one of the vacillations of the system because of the unsettling influence and get back the frequency at ostensible worth. Keeping in mind the end goal to break down the framework frequency and the tie-line power stream with the changing of the load, the reproduction is performed under load unsettling influences. Reenactment results indicated great execution as far as settling time and crest overshoot of the proposed approach contrasted with the conventional Ziegler-Nichols, Genetics Algorithm (GA), Particle Swarm Optimization (PSO) and Bacterial Foraging Optimization (BFO) routines, and the capacity of the proposed calculation to take care of burden recurrence control issues under various aggravations is affirmed

El Kouba Yakine, Menaa,Hasni. Boudour [5]
illustrated that in this paper the ideal tuning of the Proportional Integral-Derivation (PID) controller for both Load Frequency Control (LFC) and Automatic Voltage Regulator (AVR) of two-range interconnected power system utilizing Particle Swarm Optimization (PSO) calculation. The dynamic and receptive forces are controlled independently. The LFC loop controls the frequency and dynamic force and the AVR circle alters the voltage and receptive force. So as to dissect the framework recurrence, the tie line power stream, and the system voltage, the two-range interconnected power system is mimicked for a stage load aggravation in Area-1.

Sreedhar. Allu. [6]
observed that a single area power system is considered to investigate the better performance of the fractional order PID (FOPID) controller compared to PID by using root locus technique. And in the next step, the study is extended to a three area or multi area thermal power system with non-linearity of Generation Rate Constraint (GRC).(FOPID) controller is used to improve the dynamic response of the system and the improved values are tuned by using (BFOA) employing Integral Time multiplied Absolute Error as an objective function. Then finally, the robustness of proposed controller is investigated by introducing Transport Delay (TD).

J. Syaamala, I.E.S. Naidu [7]
observed that Automatic Generation Control (AGC) or Load Frequency Control is a very important issue in power system. AGC is a feedback control system for maintaining a generator yields power to remains defined frequency. One of the objectives of AGC is to maintain the system frequency at desired value and in the steady state performance of power system. An extended power system can be divided into a number of load frequency control areas interconnected by means oftie lines. Without loss of generality one can consider a three- area case connected by tie line. Here we are considering system, which is integration of two thermal power systems with hydropower system.

Kumari, N. Jha, A.N. [8]
observed that the scientific demonstrating of two area system with interconnected warm power system has been

done on the state space and an ideal control system procedure known as Linear Quadratic Regulator (LQR) alongside relative indispensable (PI) controller is intended for the frequency reaction upgrade of the system in this paper. The PI controller increases are taken as the ideal state-input picks up alongside other state variables of the system for AGC. The warm turbine for warm area has been considered for the system. At the point when

Maiji and Ghosh [9],
studied the simplest kind of fault including maximum current, but fortunately it takes place infrequently. For this cause, balanced short-circuit computation is achieved to find these high currents. The article has displayed the modeling and simulation of over current relay on MATLAB/SIMULINK. The suggested model offers poignant means for articulating the actions of over current relay. It is declaring that these model offer effective mans for articulating the post of over current relay under different operating scenarios. Additionally, the systematic unfolding diction of model development and deportment analysis name lies that this article could also ministering as guide to develop homologue relay models and benchmark performance. The relay has good fortuitous in term of it sensitivity.

Akhikpemelo, Evbogbai and Okundamiya [10]
studied the effect of the relays in the transmission line in order to be coordinated exactly to save primary supply like the backup protection to avoid multifunction. Relay operating time is calculated by using MATLAB GUI model. They concluded that the exact coordination of the various OCRs characteristics can be obtained from simulation results. The purpose of this paper is to modulate, and simulation the transmission line with OCRs based on Matlab/Simulink. Depending on the results that obtained by Matlab/Simulink is selected due to its lability to model power system components.

Y. S. Cho, C. K. Lee, G. Jang, and T. K. Kim et.al [11]
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 [12]
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 [13]
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 [14]
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 [15] .
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 [16]
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 [17]
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 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 [18]
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 [19]
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 [20]
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.

3. CONCLUSION

An attempt has been made in this paper to review those articles in a group which focused on issues of Overcurrent's damages to load and the processes to eliminate these issues. Codes and algorithms are evaluated and studied by researchers of various domain to pertain issues of overcurrent. Also, under over frequency shoots are also examined in these papers. the literature survey covers the frequency variations in a power system model also and overcurrent effects in the house Holds upto 5 KW. the extension also carried on larger loads where the current variation is large and damages the system. This paper will help in understanding an implementing the Software models for frequency and current variation and to protect them.
The technology is increasing day by day and the need to protect devices is also increasing, the logic presented can be implemented in any protection circuit with change in the rating in the code hence those sensitive devices which have protection system can have a parallel safe protection system as threshold protection and these logics can be implemented in various IOT enabled devises and even for all set of combined devices.

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