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THE OVERVIEW OF THE LOAD DISTRIBUTIONMETHODS IN POWER SYSTEM

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ABSTRACT

There are different conventional load shedding approaches, such as under frequency control, but these have a slower response and are unreliable in correctly sharing load in the event of any disruptions or faults. This leads to a rise or decrease in loads, leading to a failure to satisfy the demand for electricity. The paper, titled Intelligent Load Shedding, focused on a more modern approach to load shedding. From the perspectives of architecture, engineering, implementation, and operation, a thorough comparison of traditional versus intelligent load shedding systems was conducted. It has been demonstrated that the intelligent process of load shedding overcomes all of the disadvantages of traditional approaches, is highly efficient, and requires very little maintenance.

KEYWORDS: *Traditional Load Shedding, Intelligent Load Shedding, Frequency Relay, Programmable Logic Controller, Power System Monitoring, Power System Simulation, Traditional Load Shedding, Intelligent Load Shedding, Frequency Relay, Programmable Logic Controller*

INTRODUCTION

Load shedding refers to a system in which electrical power demand is distributed across a number of power sources. Load shedding is utilized to lessen the pressure on the power source to the greatest extent possible when the energy demand exceeds what the power source can offer. A service provider sells electricity to a customer. Two conditions must be met in order for the expense to be negligible: the lowest cost of electricity and an uninterrupted supply of power. The customer or operator will then arrange with the supplier to shed a minimal amount of the load on a voluntary basis on a defined timetable or on-demand basis[1]. To make the load shedding phase possible, the user side would acquire electricity from different secondary sources rather than the main supplier. On-site diesel generators, contracted or on-site photovoltaic, or another renewable energy source are examples of secondary sources. Consumers receive automatic load shedding during blackouts, whether the suppliers completely halt or restrict energy delivery for a shorter period of time. Brownouts occur when a supplier reduces voltage delivery during peak hours to maintain a balance between demand and supply. This results in automated load shedding for consumers.

Customers experience automated load shedding during brownouts when the supplier decreases the voltage distribution during peak hours to maintain a balance between demand and supply. The part of the load that can be taken away instantly in order to maintain appropriate operation of the necessary components is referred to as load shedding. Any disruption that results in a drop in generation, such as a fault, generation loss, switching problems, or lightning strikes, causes a reduction in load. There are two methods for controlling the transient and dynamic responses of a system whenever exposed to any kind of disturbance[2].The first one is an excitation loop in which the reactive power and voltage level of the system is controlled and varied. Second one is a prime mover loop where the active power of the generator and frequency of the system is controlled and varied. Both these techniques are discussed below[3].Excitation loop: There will be a dip in the reactive power if a fault occurs in the device. For the conversion of electrical energy into mechanical energy, reactive power is used and vice versa in the electro-mechanical domain.

The flux energy of the system is then decreased due to fault as soon as the fault is cleared. As soon as the fault is cleared, there is pressure on the rotating machine for proper balance between the generation and demand as well as maintain the level of magnetic energy. The reactive power that the system can produce determines the requirement for operating voltage and voltage regulation. When there are large disruptions, generators use their over-excitation capability to restore system stability and return to normal conditions[4]. Prime-Mover: In the event of a malfunction, prime mover type and turbine governor will have an impact on the machine's performance. Mechanical energy is provided to the generator in order for it to move past any fault or disturbance, and this energy varies depending on the type of turbine, such as gas, turbo, or hydro. This change in energy might cause a disturbance in the system's transient and steady states. More disruptions can also be caused by lightning strikes or network switching strikes [5].

A range of strategies for load shedding have been discussed on the following pages. One of the techniques is a breaker interlock arrangement. A breaker is linked to a group of load-breakers that have previously been designated to fly or is interlocked by remote signals. If a generator breaker or grid link is lost, signals are transmitted to the breakers to open them. Because the amount of load to be shredded has already been decided, this device can work with no additional processing in a short period of time[6].In figure 1, the approach for load shedding via breaker interlock is shown as a line diagram. A signal will be transmitted to the interlocked load breakers as soon as the main circuit breaker opens, regardless of the time. Because no research was conducted prior to selecting the interlocked breaker, its opening and tripping will not be a function of the system's transient reaction, resulting in unwanted and unnecessary load shedding. The following are some disadvantages of this load-shedding technique:

1. The amount of material that has to be shredded is estimated using the worst-case scenario and is hard-wired. As a result, changing the load's priority is difficult.

2. Only single-stage load shedding is available.

3. Load shedding occurs on a regular basis..

The concept of sub frequency relay is another way used for load shedding. These relay any change in frequency or reduction in frequency rather than detecting any disturbances. After the first stage, the frequency is given time to recover while waiting for a predetermined amount of time to avoid any annoyance tripping. If the frequency continues to decay, an extra delay in time will be added, and time will be allowed to recover.The under frequency relay load shedding approach is presented, with a series of stages for connecting to various circuit breakers one by one until the frequency returns to its normal operating frequency. This method has a number of limitations, including a few frequency relays' slower response time, as well as extra or under load shedding, which creates further disruptions[7]. A flow chart depicts the architecture for load shedding. To determine the quantity of load that must be shed and the time it will take, a pre-calculation is performed. The selection of the load that must be rejected takes precedence.The decline in frequency will continue, and the next group in the priority hierarchy will shed. The process of shedding loads based on priority will continue until the specified stability value is reached [5].

There are different terms used in power system like load shedding, load sharing etc... So first we have to differentiate between load shedding and load sharing.

- Load shedding.
- It is process of cut-off the loads on the approximated area according to the load priority to reduce the increase demand greater than the supply.
- Load sharing
- Load sharing means generally equally share the load in power system. In power system load sharing of transformer is achieved with different techniques. It means in distributed power system if two transformer is connected. One transformer share the load in normal condition. If load demand is increasing and one transformer is connected not able to fulfill demand than another transformer is directly connected with main transformer in parallel and share the load. In power system it is called load sharing of transformer.

Main transformer is called power transformer and another transformer that are connected with the main transformer are called slave transformer in power system. For supplying a load in more than the rating of an existing transformer, two or more transformers may be connected in parallel with the existing (main) transformer. The transformers are connected in parallel when load on one of the transformers is more than its capacity. Due to the parallel operation of transformer reliability of power system is increase and damage to the various equipment in substation like transformers are reduces. To archive parallel operation of transformers some conditions are to be satisfied compulsory. Fig 1 shows the two transformers are connected parallel. There are total two buses in the system one is supply bus and another one is load bus. At the load bus, load is connected. E1 is primary side voltage and E2 is secondary side voltage. If a condition occurs and load is suddenly increased, then second transformer is in parallel with the main transformer to supply the load demand.

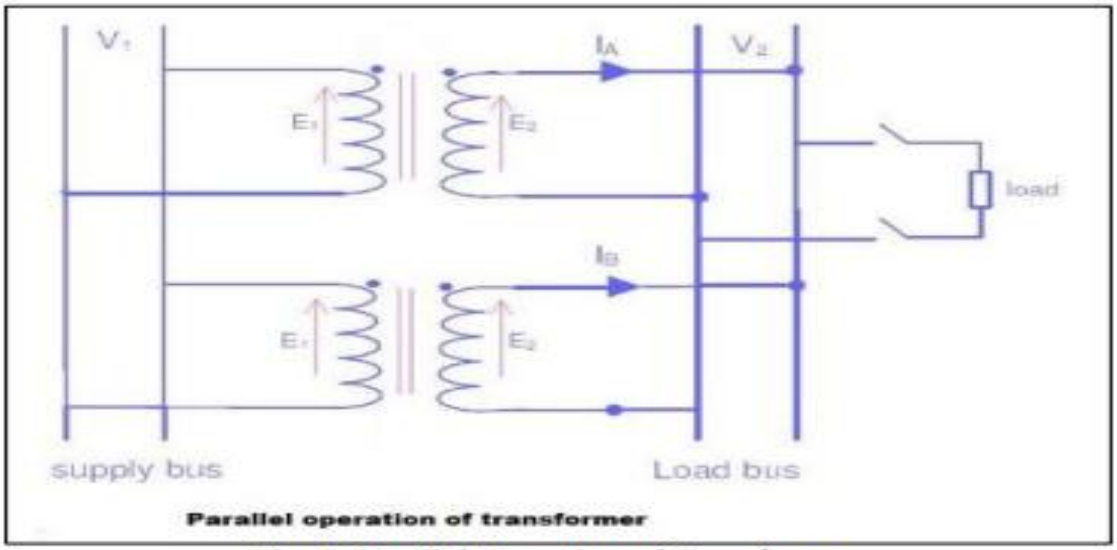

Fig. 1: Parallel Operation of Transformer.

II. NEED OF PARALLEL OPERATION OF TRANSFORMER

- If a large size means large rating of transformer is not available which can actually fulfill the total requirement of load, two or more small size transformers can be connected in parallel to increase the capacity.
- If installation place like substation is located far away, then transportation of smaller size of transformer is easier and may be economical. It will directly affect the cost
- If more than one the transformers run in parallel, is out due to fault of other parallel transformers is the system will share the load, hence power supply may not be interrupted
- If numbers of transformers run in parallel, we can shut down any one of them for maintenance purpose. Other parallel transformers in system will fulfill the load without total interruption of power.

III. CONDITIONS FOR PARALLEL OPERATION OF TRANSFORMER

When two or more transformers run in parallel, they must satisfy the following conditions for satisfactory performance

Voltage Ratio or Turns Ratio

If the transformer connected in parallel have voltage ratio different than this will not good condition for system. Due to the different voltage ratio induced emf generated at the secondary side will be different. Which cause circulating current flows in the loop which are formed by the secondary windings under no-load conditions. The value of this circulating current is much higher than no load current. So chances of damage the winding of transformer. Circulating current cause the losses and damage the insulation of the winding. So the voltage ratio should be proper manner to achieve better parallel operation of transformer. V1 V2 = N1 N2

Same Polarity

Polarity of all transformers that run in parallel, should be the same otherwise huge circulating current that flows in the transformer but no load will be fed from these transformers. Polarity of transformer means the direction of induced emf in secondary. If the directions of induced secondary emf in two transformers are opposite to each other when same input power is fed to both of the transformers, the transformers are said to be in opposite polarity. If the directions of induced secondary emf in two transformers are same when same input power is fed to the both of the transformers, the transformers are said to be in same polarity.

Same Phase Sequence

The voltage between two phases is called line voltages. In this case the phase sequence of line voltages of main transformer and auxiliary transformer which are connected parallel with main transformer must be identical for parallel operation in case of threephase transformers. If the phase sequence is not same, in every cycle each pair of phases will get short-circuited.

Same Impedance Ratio

We know the relation of current with impedance. Current is inversely proportional to the impedance. If we consider two transformers which has different per unit impedence.one transformer have less impedance will draw more current and which has more per unit impedance will draw less current. This leads unequal load sharing. This is not beneficial. Due to this condition, the transformers will not share the load according to their kVA ratings. In that case, it can be corrected by inserting proper amount of resistance or reactance or both in series with either primary or secondary circuits of the transformers where the impedance is below the value required to fulfil this condition.

LITERATURE REVIEW

FarrokhShokooh, J J Dai, ShervinShokooh, Jacques Tastet, Hugo Castro, TanujKhandelwal, and Gary Donner proposed a state-of-the-art load-shedding system that uses real-time data and is updated in the system's model. The technology has generated an optimal approach for shedding the required quantity, which is referred to as intelligent load sharing[2]. The programmable load shedding system (PLSS), which is a fundamental component of Hydro-protection Qu6bec's system and performs monitoring and control functions, has been described by authors Pierre C6te, Simon-Pierre C&e, and Marc Lacroix. Their job include keeping an eye on the frequency and voltage levels, as well as carrying out any necessary shedding if one of these is disrupted. However, if the spare components are unavailable, the cost and procedure of these have become hard chores [3]. Authors Dennis Michaelson, HishamMahmood, and Jin Jiang presented an energy management system based on a micro grid that provides energy through photovoltaic cells and battery storage. Experiments and simulations verified the technique, demonstrating the scenario's potential and viability [4]. Authors Ali Parizad, Hamid Khoshkhoo, ShahabDehghan, and RasoulMoradtalab discussed an isolated power network that is particularly vulnerable in terms of stability. A smart load shedding technique based on a smart load management system for proper functioning in islanded mode has been presented. The intelligent load sharing strategy is presented using a block diagram. The knowledge base of the system is fed by input and output databases from an offline simulation and study system. The knowledge base's outputs are complicated system responses like frequency variation.An automated monitoring system that runs a professional knowledge base system in the background keeps track of all of the system's working conditions.

CONCLUSION

Load shedding is the only safeguard for the safety of a system induced by an overload after impact in industrial power systems. The mechanism is protected from collapse by using breaker interlocks, under-frequency relays, and several other PLC-based technologies. However, these are traditional load-sharing solutions, which have their own set of limits and drawbacks. Real-time configuration, pre-fault, and post-fault data unavailability are a few examples. As a result, an intelligent load shedding strategy was presented, which integrates system online data, system dependencies, online and offline simulation information, and a comparison analysis.This system is capable of executing load shedding in less than a hundred milliseconds from the moment a disruption occurs. In Indonesia, PT Newmont installed a functioning model of an intelligent load shedding system. Thirty-four megawatt steam turbines driven by generators and nine five megawatt diesel generator engines provide power to the power system. The eleven-kilovolt power plant distributes electricity via two 150-kV transmission lines. The entire system operates at a frequency of 50Hz, and the voltage is stepped down to 33kV before being sent out.The system employs the multistage frequency approach described in table 2. A comparison of intelligent load sharing and under frequency control is shown in table 3.

REFERENCES

1. T. Klingler, "Sharing the load," *J. Libr. Adm.*, 1999, doi: 10.1300/J111v26n03_06.

2. T. McCormack, E. Karaikovic, and R. W. Gaines, "The load sharing classification of spine fractures," *Spine (Phila. Pa. 1976).*, 1994, doi: 10.1097/00007632-199408000-00014.

3. M. N. Marwali, J. W. Jung, and A. Keyhani, "Control of distributed generation systems - Part II: Load sharing control," *IEEE Trans. Power Electron.*, 2004, doi: 10.1109/TPEL.2004.836634.

4. R. Majumder, "Modeling , Stability Analysis and Control of Microgrid .," *Control*, 2010.

5. H. Han, X. Hou, J. Yang, J. Wu, M. Su, and J. M. Guerrero, "Review of power sharing control strategies for islanding operation of AC microgrids," *IEEE Trans. Smart Grid*, 2016, doi: 10.1109/TSG.2015.2434849.

6. J. M. Guerrero, L. García de Vicuña, J. Matas, M. Castilla, and J. Miret, "Output impedance design of parallel-connected UPS inverters with wireless load-sharing control," *IEEE Trans. Ind. Electron.*, 2005, doi: 10.1109/TIE.2005.851634.

7. C. K. Sao and P. W. Lehn, "Control and power management of converter fed microgrids," *IEEE Trans. Power Syst.*, 2008, doi: 10.1109/TPWRS.2008.922232.