International Journal of Innovative Research in Engineering & Management (IJIREM)
ISSN: 2350-0557, Volume-8, Issue-6, November 2021
https://doi.org/10.55524/ijirem.2021.8.6.81
www.ijirem.org

An Overview on Power System Load Sharing Approaches

Deepak Singh
SBAS, Sanskriti University, Mathura,
Uttar Pradesh, India
Email Id- deepak.ee@sanskriti.edu.in

Lakshmi Goswami
SBAS, Sanskriti University, Mathura,
Uttar Pradesh, India

ABSTRACT
Load shedding refers to a system for which electric energy demand is distributed among several power sources. Load shedding is used to reduce the strain on the energy source to the greatest extent possible when the energy demand exceeds what the power source can supply. A service provider sells power to a client. Traditional load shedding methods, and even under voltage regulation, have a longer reaction time and are inconsistent in properly distributing load in the case of any interruptions or failures. This causes an increase or reduction in load, resulting in an inability to meet the energy demand. The study, titled Intelligent Load Shedding, focused on a more contemporary approach to load shedding. A thorough comparison of conventional versus intelligent load shedding methods was conducted from the perspectives of operation design, engineering and implementation. It consumes remained revealed that the intelligent technique of load shedding overcomes all of the disadvantages of traditional techniques, is extremely efficient, and requires very little maintenance.

Keywords
Controller, Frequency Relay, Load Shedding, Monitoring, Simulation, Traditional Load Shedding.

1. INTRODUCTION
Two criteria must be met for the expenditure to be negligible: a continuous supply of electricity and the other is a minimum cost of energy. The customer or operator will then make arrangements with the provider to release a minimum portion of the load voluntarily at a specified time or on-demand. [1]. The operator side would receive electricity from various secondary sources rather than the primary provider to make that load shedding phase possible. On-site diesel producers contracted or on-site photovoltaic, or another renewable energy source are examples of indirect sources. Consumers receive automated load shedding during blackouts, whether the providers completely cease or decrease energy delivery for a shorter period of time. Brownouts occur when a provider reduces voltage delivery throughout peak hours to maintain a balance between demand and supply. This results in automated load shedding for customers [2]. During brownouts, consumer's capability automatic load shedding when the provider reduces the voltage distribution during peak hours to retain a balance between demand and supply. The portion of the load that may be taken away instantly in order to preserve the good functioning of the essential components is referred to as load shedding. Any disruption that results in a decrease in generation, such as a generation loss, fault, lightning strikes and switching failures, or causes a reduction in load. When a system is subjected to any type of disturbance, there are two ways for regulating its transient and dynamic reactions [3]. The primary is an excitation loop, which controls and changes the system's reactive power and voltage level. The second type is a prime mover loop, which controls and changes the system's frequency as well as the active power of the generator. [4].

Excitation loop: If an error occurs in the means, the reactive power will drop. In the electro-mechanical domain, reactive power is used to convert electrical energy into mechanical energy and vice versa. As the fault is cleared, the flux energy of the system decreases as a result of the fault. As the fault is resolved, the rotating machine is pressurized to maintain the magnetic energy level as well as the proper balance between production and demand. The voltage regulation and operating voltage demands are determined by the reactive power of the system. If significant disturbances occur, generators use their over-excitation capability to restore system stability and return to normal operating conditions [5].
Prime-Mover: In the event of a failure, the prime mover style and turbine governor will affect the machine's performance. Motorized energy is supplied to the generator in order for it to undergo any malfunction or disruption, and the amount of energy varies depending on the type of turbine, such as gas, turbo, or hydro. This change in energy can cause disturbances in the system's transient and stationary states. Furthermore, network disruptions can be caused by lightning or switching strikes. [6].
For the load shedding process, several approaches have been considered. One of the techniques is the breaker interlock scheme. A breaker is interlocked by an isolated signal or hardwired to a group of load-breakers that have already been selected to fly. If for any reason the generator breaker or the grid link fails, signals are sent to open the breaker. Because the amount of shredded load has already been determined, this equipment can operate in a short period without necessary processing [7].When the chief circuit breaker unlocks, a signal must be sent to the interlocked load breakers immediately. Because no research was conducted before selecting an interlocked breaker, it's tripping and opening will not be a function of the system's transient response to shed unwanted and excess load. Some of the disadvantages of this load reduction technique are as follows:

- Only single-stage load shedding is available.
- The amount of shredded load is calculated using the worst-case scenario and is also hard-wired. As a result, changing the load's priority is difficult.
- Load shedding occurs frequently.

Another method for load shedding is the low-frequency relay scheme. As a substitute of detecting turbulences, these relay any frequency increase or decrease. After the first stage, there is a time delay to prevent nuisance tripping and allow the frequency to recover. If the frequency continues to fall, there determination be an extra period interval, and time will be allotted to recover. [8].

The load detaching system of under-frequency relays is demonstrated, which consists of several steps connecting various circuit breakers one by one until the frequency is restored to the regular frequency of procedure. This technology has a number of drawbacks, including some frequency relays with slow response times and additional or low load shedding, which causes additional disturbances. [9]. The load flow structure is depicted in the form of a flow chart. A pre-calculation is performed to determine how much load is to be shed and the time required to shed it. The load to be shed is chosen in order of priority. Load shedding is a function of setting the voltages of the thresholds under-voltage and frequency and depending on their priority to be done by a number of studies such as static or dynamic stability. The proposed load groups of highest and lowest load are chosen from a list of load shedding in this study. The least significant load group is shed when the frequency of the rate of change of frequency decreases. If the frequency continues to fall, the group after that in the priority ranking will be eliminated. The technique of reducing the load based on priority will continue until the desired level of stability is reached (5).

1.1. Parasitic Elements' Impacts

Every electrical component has parasitic components, which differs out from ideal-part models employed in the prototype study. Because describing all of these parasitic components would take up a whole paper, this section focuses only on the parasitic elements related to MOSFET transistors. The fact that the MOSFET transistor in the power system at band produces the greatest heat justifies this simplification. The MOSFET transistor, being the main source of system heating, is also the principal cause of system dependability degradation. To keep things simple and fit inside the page restriction, this paper's study concentrates on the conduction losses produced by the temperature-dependent MOSFET ON resistance. Despite the fact that switching losses are temperature dependent, they contribute much less to load sharing temperature variation than conduction losses. According to datasheets from transistor manufacturers, the nominal value of the MOSFET ON-resistance ROspq may vary by up to SO percent from one batch to the next. When it comes to thermal system problems, this is a reality that must be recognized. The difference in RoXoM between semiconductors from the same hatch, on the other hand, is typically considerably less.

1.2. Shared thermal burden

The suggested thermal load sharing method compensates for the unbalanced power losses caused by the existing sharing technique's implementation. The load current provided by each converter in the parallel configuration may be modified to take into account parasitic components, physical architecture, and working environment by monitoring the temperature of the heat-producing component. This method ensures that each converter operates at the same temperature, resulting in equal converter dependability in a parallel arrangement. For the EPS area, an MLS method is suggested. In order to simplify control and improve system dependability. The following are the paper's main contributions.

- The suggested MLS method reduces the complexity of active and reactive power-sharing, as well as harmonics and unbalanced loads.
- Even if there are load disruptions at local EPSs, the area EPS's frequency and voltage are maintained.
- It improved the system's dynamic responsiveness.
- Under load disturbances, the transient free area EPS is maintained.
- Local EPS reduces field EPS disturbances caused by local EPS, resulting in improved power quality of EPS field disturbances.

Based on the AC system's power flow theory, load sharing methods established in stand-alone AC power systems include drop control and average power control. To ensure proper load sharing performance current /voltage measurement error mismatch, underwire impedance mismatch, and interconnection tie-line impedance effects, a combined droop control and average power management technique has been proposed. To ensure the sharing of the harmonic content of the load currents, a harmonic droop sharing method is also proposed. To figure out how much power the inverter can take, a criterion for determining reactive power is presented, which avoids the need for complex magnitude and phase detections of the basic elements of a nonlinear load current.

1.3. Diagram of the Basic Building Blocks

Figure 1 depicts a PV power inverter system connected to a utility grid and a load. Xg is the sum of the generator's synchronous reactance and the transmission line's reactance.

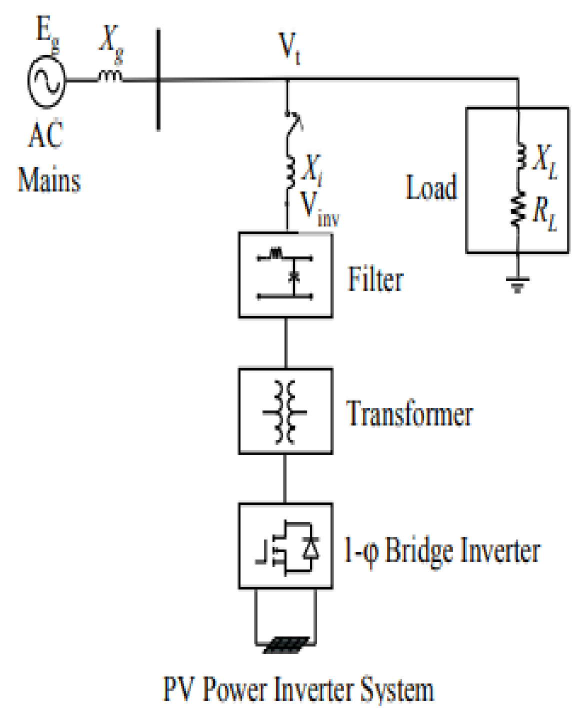

Figure 1: Block diagram of the grid-connected PV system

To begin, it is critical to comprehend the purpose and benefits of load-sharing methods and parallel power supplies in a standard power system design.

1.3.1. Standardization

Load sharing allows lower-power, standardized modules to be used across many systems, allowing for design reuse. Power system solutions are readily transferable across various end equipment platforms because to the standardized methodology, which substantially reduces time-to-market. At about the same power, it expands component choices by enabling users to choose from a broader range of lower-power components from a number of vendors.

ISSN: 2350-0557, Volume-8, Issue-6, November 2021
https://doi.org/10.55524/ijirem.2021.8.6.81
www.ijirem.org

1.3.2. Modularity

The resultant modularity gives the user a lot of options. System configurations are simple to change to suit a wide range of load current and output voltage combinations. The scalability of such a system makes it easy to keep up with rising load current demands.

1.3.3. Redundancy

When used in essential applications, it increases system availability. A redundant system includes one reserve module, which provides additional output current above the maximum current requirement of the load. Improved maintainability is another advantage of redundant power systems, since defective units may be swapped out without disrupting the system. Furthermore, the modules' dependability is improved by running them at a lower output current than their maximum output current rating, which reduces power dissipation and temperature increase.

1.3.4. Controlling the Temperature

The main driver in all paralleling systems for low-power applications is the decentralized heat dissipation of parallel power stages. Airflow and thermal management requirements can be met at a lower cost by spreading power dissipation across a greater number of power components and a larger surface area.

1.3.5. Bringing the Temperature up to Par

As reliability experts are well aware, the operating temperature has a significant impact on the life expectancy of electronic components. The load current is distributed evenly across the parallel linked power sources thanks to a well-designed load sharing circuit. Matching currents means comparable power dissipation, which means a similar temperature increase, which improves the system's long-term dependability.

1.3.6. Keeping Component Ratings to a Minimum

The uninterruptible power rating of both circuit is proportional to the current and voltage ratings of computer devices in the power supply. Since load sharing accuracy has a direct impact on the maximum power that each power stage can handle, the load sharing method chosen has a direct and quantifiable impact on the system's cost. The cost of all of these benefits is the additional complexity provided by the load-sharing circuit, which varies greatly depending on the method used.

1.3.7. Power Stages in Parallel

Figure 2 depicts parallel operating power stages controlled by a single control loop, demonstrating the fundamental concept of parallelism. A pulse width modulator and A single feedback control system are used in the operation. The duty cycle D is generated by the controller and delivered to the main power switches.

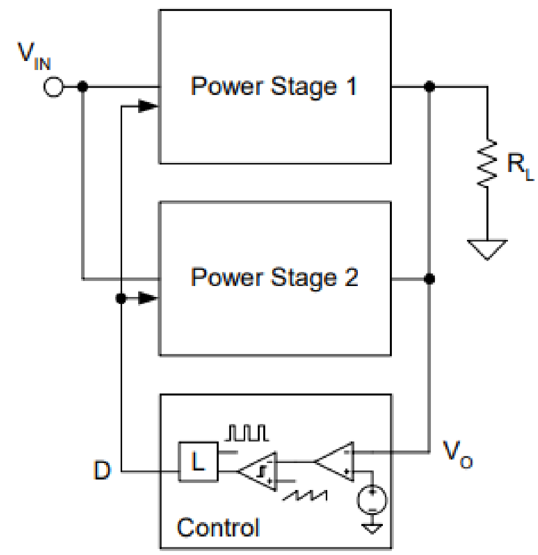

Figure 2: illustrate the concept of parallel power stages

2. DISCUSSION

An adaptive drupe controller built on superimposed frequencies is presented in this paper for secondary and primary power-sharing in LVDC microgrids. Both the secondary and the primary layers share power by using current, local voltage and charged frequency information without the use of an additional communication network, implying greater reliability than communications-based power-sharing approaches. The converters' output current is proportional to the rated current. The output voltage is closely regulated to the reference value. The proposed control system's small-signal model for a simple DC microgrid is obtained, and its stability is investigated in order to design control parameters. The proposed control approach is guaranteed to be feasible for uniform and unequal DG ratings, dissimilar line impedances, and resistive and constant power loads. [10].

3. CONCLUSION

Load shedding is the only protection to protect a system triggered by an overload after impact in industrial power systems. The mechanism is protected from collapse by using breaker interlocks, under-frequency-based relays and other PLC-based systems. However, because these are traditional load-sharing strategies, they have limitations and drawbacks. Post-fault data and pre-fault unavailability and real-time configuration are some examples. As a result, an intelligent approach known as intelligent load shedding was proposed, which combines system online data, system dependencies, online and offline simulation information, and a comparative analysis. The system is capable of load shedding less than one hundred milliseconds from the time of occurrence of any disturbance. In Indonesia, PT Newmont installed a working model of an intellectual load shedding system. The power system is powered by four thirty-four MW steam turbines powered by generators and nine five MW diesel generator engines. Two 150 kV transmission lines carry electricity from the eleven-kilovolt generating plant.

REFERENCES

[1]. Klingler T. Sharing the load. J Libr Adm. 1999;

[2]. Arul PG, Ramachandaramurthy VK, Rajkumar RK. Control strategies for a hybrid renewable energy system: A review. Renewable and Sustainable Energy Reviews. 2015.

[3]. McCormack T, Karaikovic E, Gaines RW. The load sharing classification of spine fractures. Spine (Phila Pa 1976). 1994;

[4]. Marwali MN, Jung JW, Keyhani A. Control of distributed generation systems - Part II: Load sharing control. IEEE Trans Power Electron. 2004;

[5]. Majumder R. Modeling , Stability Analysis and Control of Microgrid . Control. 2010;

[6]. Han H, Hou X, Yang J, Wu J, Su M, Guerrero JM. Review of power sharing control strategies for islanding operation of AC microgrids. IEEE Trans Smart Grid. 2016;

[7]. Guerrero JM, García de Vicuña L, Matas J, Castilla M, Miret J. Output impedance design of parallel-connected UPS inverters with wireless load-sharing control. IEEE Trans Ind Electron. 2005;

[8]. Lim CT. R L R L R L. Packag Technol. 2004;1(65):678–83.

[9]. Sao CK, Lehn PW. Control and power management of converter fed microgrids. IEEE Trans Power Syst. 2008;

[10]. Balogh L. Paralleling Power: Choosing and Applying the Best Technique for Load Sharing. 2003;31.

