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Interaction between Technical and Economic Benefits in Distributed Generation

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Abstract. The definition of a restricted power supply area for a distribution network disqualifies this scheme as a distributed product even though it is a very common dg scheme. Power system quality is a key issue for low and medium voltage power companies and consumers, to minimize power network losses; this paper provides guidelines for guaranteed allocation and distribution of distributed generation (DG) in distribution systems for an acceptable reliability level and voltage profile. The optimization process involves the use of genetic algorithms (GA) techniques and is solved by combining systems to estimate system reliability, losses and dg impacts on the voltage profile. The fitness evaluation process leads to the determination of the ga's relationship between investment and operating costs as a benefit of setting numerical units. Estimation based on current flow method for radial networks reconciliation of scattered generator losses with profile of voltage profile.
Keywords: Distributed generation, Voltage Control, Protection, Power quality, Islanding,

1. Introduction

Refers to the distributed generation of various technologies that generate electricity at or near the locations where electricity is used, such as solar panels and combined heat and power. In the residential sector, common distributed generation systems include solar panels, small wind turbines. However, the definition of distributed generation (DG) is not used in a uniform manner in the literature. This article presents a discussion of relevant aspects of DG and provides necessary definitions. Small-scale generation technologies (eg solar, wind, CHP, hydro or new technologies) integrated with the power grid are called distributed generation (DG). DG systems allow customers to generate some or all of the electricity they need. A customer can effectively reduce their electrical load by generating part or all of the electricity used by a customer (e.g. HVAC, consumer electronics, lighting) as part of their electrical load.

2. Distributed generation

In addition to energy storage and demand, distributed power generation (DG) researchers play a role in the future of power systems. However, due to this DG and other distributed energy resources, the extent of change in future power systems depending on the scale of deployment are uncertain. Fens and Bauknecht focused on the location of productive resources and functions of system equilibrium and provided a typology to illustrate visions of decentralized power systems. [2]. One of the reasons for introducing digitization is to maintain the customer's voltage, improve the system voltage profile and range acceptable terminals By introducing DG in the system, the voltage profile can be improved. If DG can supply a portion of real and reactive power to the load, it helps to reduce the current in a portion of the supply. This will increase the voltage level of the customer. [3]. Study of DG Definitions, Technologies, Applications, Sizes, Locations, DG Practical Operational Limits Functions Focuses on the research and economic benefits of DG concepts and their impact on existing safety devices. [4]. Generating Distribution Generating resources are primarily used to modernize and strengthen power networks in micro grids or adequate systems at distribution levels. Expensive distribution and/or transmission lines provide alternatives to create and reduce congestion, especially in remote areas. DGs are small power plants that generally use combustion based technologies, micro-turbine, gas internal combustion engine, fuel cells, DG types include Riau photovoltaic, small wind turbine, large wind turbine, compression turbine and combined cycle system. [5]. Power quality (PQ) refers to the output supply and continuity of loads that exceed constant and transformers, increasing frequency and voltage causing losses in cables and motors. Creates interruptions in communication lines. The use of various power electronic devices and the use of non-linear loads on the PCC create PQ problems in the system. Common PQ problems include harmonics, flicker, voltage sags, and swelling. [6]. Think of Distributed Generation (DG) as taking power to the load High efficiency and low pollution DG promises to produce electricity. Unlike large central power plants, DG can be installed at or near the load. DG ratings range from 5 kW to 100 MW. Due to the absence of moving parts, maintenance costs for DG are very low, as are fuel cells and photovoltaics. Many recent developments in power generation and distribution systems have encouraged the entry of energy storage.

- Retail competition through application framework
- The expanded selection, Customers tailored to their needs Customized power supplies can be requested
- New Central Power Stations And for generating transmission lines Postpone large capital investment

- Reduced environmental impacts and greater change efficiency the advent of many technologies with.
- Efficiently improve reliability and power quality and the advent of low-cost power electronic interfaces.
- Sophisticated computers capable of effectively controlling multiple components and sub-systems to manage load requirements.

DG Many technologies are at different stages of development. These include micro-turbines, photovoltaic systems (PV), wind turbines (WECS), gas turbines, gas-fired IC engines, diesel engines and fuel cell systems. Currently, wind power has become the most competitive of all renewable energy technologies. [7]. Electricity regulation and restructuring has created a growing interest in distributed generation (DG). It is expected to play an important role in power system infrastructure planning and market growing activity. Distributed output means that a distribution company (DISCO) is an energy source connected to the distribution network at any point in time by the customer at the customer side. Distributed resources are strategically located to postpone or eliminate system updates, optimize the voltage profile and reduce system losses, strengthen and optimize the grid, and improve system reliability and performance. Recent studies have predicted that by 2010, distributed generation will account for up to 25% of all new generation. DG has made significant contributions to research in the field of resource planning over the past few years. Generally, DGs are integrated into the existing distribution system; studies are planned on optimal location and size to provide maximum benefits to DGs. [8]. Major advantages of DG are discussed below.

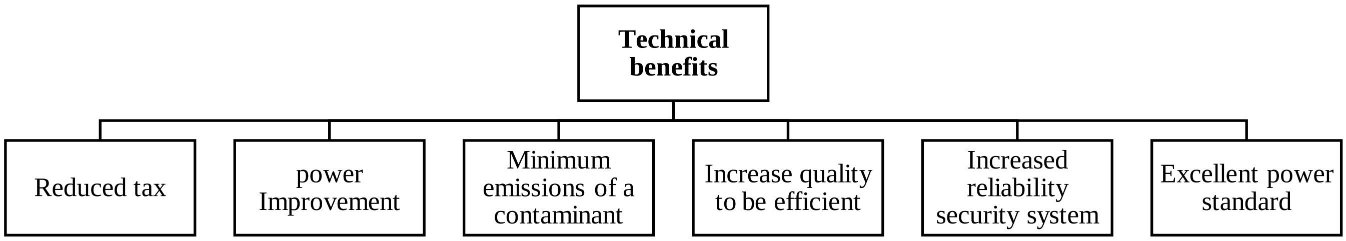

FIGURE 1. Distributed generation system Technical benefits.

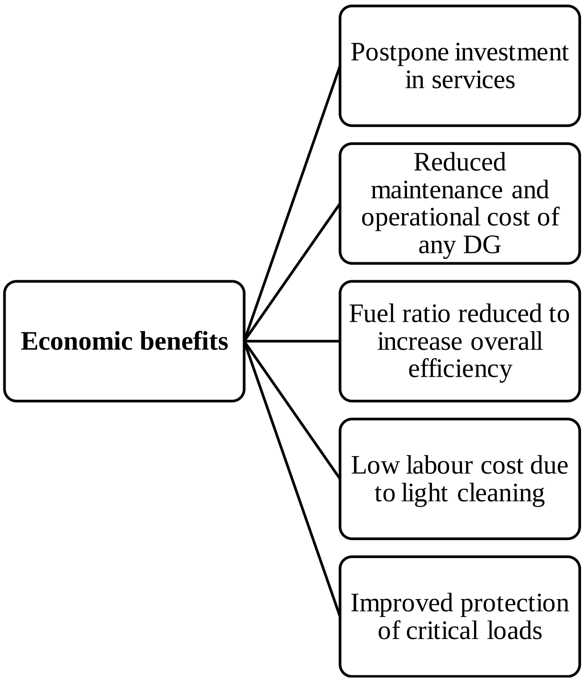

FIGURE 2. Distributed generation system Economic benefits

DG size and location are characterized by balancing effects in the distribution system. With the upcoming reforms, it will be difficult for basic fixed price distributors to reduce system losses and minimize the negative impact of DG on the system. Wrong location and wrong size of DG can have adverse effect on system performance. System security and reliability is the type of DG point. And their point loading varies depending on the DG and size. Combining two or more DG technologies can provide greater economic and environmental benefits. Therefore, installation and maintenance costs must be considered.

[9]. Distributed generation includes electricity supplied by alternative energy sources beyond conventional sources such as hydropower, coal, oil and nuclear power due to its low power, at the distribution level, which is typically 25 kW.

- Wind Power Systems: Resources are plentiful and these systems are becoming popular. Energy ratings continue to rise.
- Photovoltaic cells: than wind power systems although less powerful they are very flexible and passive.
- Micro Turbines: Many of these organizations are for the military Receive the created from settings.
- (d)Solar foods: Because they generate heat, they are non-solar like natural gas Can be combined with fuel, the result is lower cost and uninterrupted electricity Hybrid systems that can deliver are formed.
- Other types of gas turbines Diesel engines and gas burning Includes internal combustion engines.

Hybridization of DG and DS units led to the concept of distributed resource (DR), distributed storage (DS) or distributed resource (DR) units leading to the concept of micrograms. Micrograms are TR units and dispensed by dispensing system. And 1 is defined as grid-connected mode, 2 as island autonomous system and 3 as riding between the two modes. The idea behind supporting microgram development is that a prototype with multiple generators and integrated loads is operationally reliable and economically viable as a power system. Based on the development of primary drivers and DG operation of electric power system and its integration with planning can be divided into three main categories. Environmental, commercial and national/regulatory. These drivers are briefly discussed below. [12]. The first power stations provided rum The first phases were DC based, so the supply voltage was low and there was a usable distance between the generator and the consumer. Over the past decade, economic and technological innovations in DG have stimulated renewed interest in a dynamic, regulatory environment. This has been confirmed by the International Energy Agency. [13]. The need for more flexible energy systems, the need to change regulatory and economic conditions, and the need to protect energy loads, emotional loads against environmental risks and network disturbances are based on various technologies. have spurred the development of distributed generation and storage systems. In particular, the term DG is used throughout the service area. It refers to using any modular technology of the application to reduce service cost. Increasing in some areas, the purpose of these plants is to meet the demand for electricity. Self-sufficiency in some functions of power generation, thereby achieving energy savings. [14]. Electronic applications are now available to their customers. They are developed with acceptable power quality and have redesigned new technologies to provide greater reliability in the environment. Due to low volume, low cost and high energy with low environmental impact, non-conventional generations are rapidly developing around the world. Many phenomena in the electric power system, such as system efficiency, environmental benefits and transmission congestion management, have created a new arena. The main feature of this new arena is the expansion of the medium generation station. Instead the load runs several DG units near the canters. DG comes from a variety of sources and technologies. Wind, solar, and renewable sources of bio ram tags are often referred to as green energy. Currently, wind power has become the most competitive renewable energy source of energy available to us. DG refers to small sources ranging from 1 kW to 50MW. A DG is a high voltage transmission network that is more than just a generation unit connected to a distribution network.

3. Voltage Control

The voltage measurement in the distribution network should be within a certain range. The power system and customer equipment can only function properly if the voltage is maintained within this range. The voltage range for normal operation is different and is defined by international standards. When voltage fluctuations occur in the distribution system, the line resistance and reactive resistance vary with the load current flowing through it. Voltage variations in distribution networks over time in the distribution network. They are caused by variations in activity and reaction. Irregularities are usually larger at the end of the line and are more pronounced when the load is concentrated at the end of the system. In addition, according to voltage variations, the power factor can be used to control the voltage internally by changing the digit. This is already done in some wind power projects where the electronic converter is used for voltage control in the distribution system. [16]. To use these voltage control systems for high currents or long transmission lines in the middle of the line, the load on each feed must be proportionally balanced. If several DG connections are concentrated in a given line, the current gap between the feed lines widens as it flows backward from the DG. This differential voltage on the feeder lines may deviate the profile from the correct range. (b) Voltage Fluctuations if the output of the digit changes over a short period of time, the voltage of the local line system will be unstable. And it is of particular concern for systems that create natural conditions when interconnected with the local system, such as wind power or solar power generators, where the customer receives more or less voltage. Distribution systems typically control voltage by tap switching in substation transformers. Feeders use voltage regulators and capacitors. This form of voltage regulation carries current from the substation to the loads. Interference with reverse energy flows in traditionally used regulation procedures introduces DG. Network causing under or over voltage on the other hand installation of DG efficiency compensation, voltage control, loss reduction, balancing rotates in case of a major system failure.

Alternating Voltage Control: Keepsakes and Wallace proposed a voltage control system for DGs. It takes a more flexible approach to voltage control from DNOs to DGs capable of keeping Digs light or on-line in high demand. The authors' goal was to develop a voltage control system. Its steady-state response voltage approaches legal limits. The starting point (vector node) of the generator is always thick, moving along the line. Adjusts output of reactive power when voltage approaches legal limits or supports DG voltage where PGC turns off. The generator rate decreases which must be controlled between the minimum and maximum dynamic factors. The main advantage of this approach is that it relies entirely on the voltage signals at its own terminals and does not require knowledge of the distribution network. Therefore, the approach does not require an elaborate array of sensors and communication devices and the intelligence controllers must be set up to be inconsistent with others.

Centralized voltage control: In theory, the distribution network centralizes voltage control, transmitting active and reactive power components such as distributed generators and transmission systems from another network. Such an active management plan includes a distribution management system controller that accepts voltage, current, and device status measurements at selected locations in the selected distribution network. Such an active management plan includes a distribution management system controller that accepts voltage, current, and device status measurements at selected locations in the selected distribution network. Disadvantages of the approach include sensors, communication and commitment, sufficient investment and balance required to ensure state estimator accuracy in controllers. [18]. In order for the power system and the customer's equipment to function properly, the voltage levels of the supply grids must be within a certain range. This is a voltage range well defined by international standards. Phases face different loads. Voltage fluctuations occur. A variable current is produced by the resistance and reactance of the feed to different loads. This causes the voltage in the feeder to change. Connection of DG with feeder can affect proper voltage control in distribution grid voltage control. Effect of DG on network with respect to current flow. Less than the feeder load does not have much effect when the current transmitted through the DG or equal to the voltage profile. In this case, the current is reduced by the power supplied by the grid and the feed, resulting in a reduced voltage drop. As the load on the feeder is generated, however, when the current is high, a voltage rise occurs. This voltage rise is caused by the reverse current, which is the phase between the DG, which is a function of the short circuit force and the power generated by the interconnecting phase. The effect of reverse current is strengthened when DG reactive power is also used. This is demonstrated in the 10-kV simulation. [19]. Direct AC to matrix converter can be converted and different systems can be interfaced with control techniques. This paper proposes a direct matrix converter renewable energy based DG. LC filters provide a constant sinusoidal voltage supply to the load connected to the output terminals. This program is capable of micro grid applications. Predictive voltage control is developed which incorporates sinusoidal output voltages for various control purposes. Various input and load conditions including unbalanced and non-linear loads The main control objective is to supply constant voltage to different loads below. TG may be affected by interference and unbalance of spattering power which are also investigated in this work. Various tests confirm the performance of the matrix converter when used in Island Digital. Durenberger observes that the task of reducing the number of required sensors when using a predictive voltage regulator and their performance is verified. Future work acknowledges input current enhancement, grid-connected mode, and micro grid operation.

4. Protection

Ferro-sensing detection can take place in a substation interrupting device where the breaker or parts are already tripped and can be short-circuited at that location. If the pheromone is detected in the trip interrupt device on the load side (island feeder), the size of the inductor connected to the island feeder and / or synchronous generators and the capacity to connect to the island feeder will be advantageous. Ferro resonance occurs. Investigate the safety engineer detection event and develop a remedial plan such as changing the capacitor bank value or providing additional protection in island and Ferro zone detection DG installations. General safety concerns of DG interfaces for utility distribution systems. The interconnection of DGs with the system reduces the sensitivity of the protective equipment to other utility sources. The application process and wrongful contributions of DGs should be checked to ensure the effects of coordination against tax protection and harassing tripping. Adequate number of relays between series protection devices should be arranged to maintain coordination time. If there are automatic and utility source closing devices between the DG, steps should be taken to protect the grid from previous resets. Closing timeout depends on device and integration requirements. To prevent obscuring the outline of the face, regloss blogging programs have been established. DG units are required to detect underground faults in the utility system. Direct transfer travel is recommended as a safety precaution against island conditions. [21]. Generic MV and protection system design makes conventional protection irrelevant. In most cases, the problem is investigated by synchronous generators. At the same time there are other double fed induction generators (DFIG) and other types of generators induction generators. Generators of digit systems can significantly affect the results of fault feeding capability during interruptions. Analysis of different types of DG generators as mentioned above in this paper the results of different types of specific problems are compared to explain the effect of DG. This study is useful in terms of applications. Because it does not need to draw their attention to extreme conditions. In some cases, the type of DG sources may be limited and overlooked for their contribution to the fault condition, and in some cases the influence of another type of generator on the DG may not be reduced. [22]. DG Interconnection Protective Relay Selection is based on several criteria of power system characteristics, application protection policy and integration requirements.

The contact security IED design can be summarized as follows:

- Parallel to the application phase Disconnection of DG plants when not running,
- Protect the application phase from damage caused by the merger of DG plants.
- Protection from damage to the DG plant application phase.
- Must be integrated with other safety relays to prevent unnecessary trips.

When a DG is connected, the possible impacts on the safety of the application should be analyzed [23]. Adaptive security is an online function that adapts a preferred security response to changes in system conditions or requirements in a timely manner through externally generated signals or control action. A microprocessor for adaptive protection of distribution system with distributed generation can sense fundamental directional current through relay (DOCR). Opportunity for DOCR to select different tripping characteristics Modern digital over current relays for low voltage applications consist of 2-4 system groups. Settings can be changed using communication. However, implementing a communication system between relays can be complex and costly and may not be economical for small distribution systems. Therefore, this paper makes a simple proposed adaptation to current security that only uses changes in system conditions or local information. Selects the relay tripping characteristics based on the loss of certain generators. One of the advantages of using local information is that any problems with the relay are confined to the relay. This is not the case when communication-based protection is used for a solid grounding where fault currents are the same for all types of faults. Negative series or zero series currents are used to detect fault faults. [24]. Most relays are basic frequency components of voltages and currents, as it is based on analysis; phase estimation plays an important role in the protection of power system. Fourier transform based instantaneous current protection compares absolute current with instantaneous current. The time delay of over current protection usually follows an inverse time characteristic function when the absolute current is greater than the time delay pick up current. Due to the high sampling rate and fast response of the scaling coefficient of energy from the onset time of the voltage to the new current level, it is faster than the frequency-based Fourier current protection speed. Current protection based on boundary scaling coefficient Es was up to 12 ms faster than Fourier based current protection. The proposed current protection reduces the risk by adding false start time detection information with a power limit bandwidth coefficient of 20 ms on average compared to Fourier based current protection. [25]. One of the main challenges in a distribution network with DG is the security issue, which needs to be safely isolated from the central level in case of a fault. In addition, island operation and utilization and grid-connected operation are more demanding to meet local needs, limiting flexibility and optimal quality delivery. Thus, many researchers have, in the past, studied DG security issues in distribution systems. An improved integration method for standardizing protection time based on new non-standard tripping characteristics for existing protection relays is described. Protected by current relays without communication links. The objective is to reduce the tripping time of selective fault elimination in distribution networks.

5. Power quality

[26]. Disadvantage Inverter direct compensation provides the current effects of integration of power quality aspects, overall current and cost increase. A current limiting mechanism should be implemented to reduce the harmonic current supplied if the inverter output current exceeds the rating. The rated current of the inverter is mainly used for active injection. Distributed generation systems such as single-phase H-bridge inverters require power quality features to compensate harmonic and reactive power of the connected operation. The proposed control scheme is Sinusoidal Signal Integrator (SSI) and it uses current reference generator based on Instantaneous Reaction Power (IRP) theory. Test results were obtained from a 4 k VA inverter prototype. Test results are consistent and consistent performance is best shown in terms of phase current THD and transient response. [27]. A DG system is provided with functions to improve power quality. The size of the power grid built for this purpose with a rated power of 5 kW based on PEMFC was evaluated for its network behavior. The advanced control system also regulates the power sent to the lift module based on the available source power and load demand. It provides dynamic response to any type of micro sources with integrated Prime Trio based on load-monitoring capability. Micro grid provides high power quality for advanced control system with electronic interface and regulation of output power of generator while connecting variable speed synchronous generator based micro source with CERTS. [29]. Solved with the help of interfaces of custom power devices through existing PE interfaces with existing power grid networks, which allows providing various benefits such as capacity auxiliary services and DG. Increased energy efficiency with improved power quality and increased efficiency with voltage / VAR support, improved power system reliability and flexibility in operations with different DE sources by reducing contributions DG allows customer choice while reducing overall connection costs. The study looks at distributed demand. Proven to be highly efficient in handling all power quality issues. Several topographical combinations of UPQC for different purposes have yet to be explored.

6. Islanding

[30]. The main principle for determining the islanding condition is the DG output parameters and the system parameters should be monitored if the islanding environment is affected by the change of these parameters. Island detection techniques can be divided into remote and local techniques and local techniques into passive, active and hybrid techniques. Remote Island Detection Techniques Remote Island Detection Techniques In terms of applications and interactions between DGs these techniques are better than local techniques despite better reliability. They are more expensive to implement, so use sparingly. [31] Active detection techniques Methods that interact directly with motion by introducing obstacles Power System It is desirable to allow such islanding operations to increase customer reliability of the idea of active detection system. Intentional islanding, including part of the island's primary structure and other loads, requires considerable engineering effort, control activity, and communication infrastructure. Coordinating the operations of more than one DG on an island requires large requirements generally, provision is not made for operation on islands beyond the burden of the local facility, and inadvertent primary system islanding is undesirable. [32]. Failure to travel on Island DR can cause many

problems with this resource and associated loads. Current practice is to disconnect all DR connections when islanding occurs, leaving one line energized. EPS can be damaged when resources distributed on the island are configured outside the island. The island interface can be used to manually or automatically restore normal service to neighboring clients. [33]. Reactive power control, which moves the system into transient states during automation, can also be used to detect fires. Diagnosis time may exceed standard requirements and may not be met. [34]. Use of frequency and voltage DG sources of distribution systems is helpful in maintaining low islanding operation. It shows that the systems can respond very quickly to islanding conditions and that the frequency and voltage stabilization of distribution systems can work effectively under islanding conditions. In addition, there are several specific challenges to control the project based on the proposed multi-agent, which are related to multiple sets of DG units and loads, coordination techniques and scalability. [35]. Sandia frequency switch (SFS) two types of inverter in anti-islanding mode, based on distributed generation (DG) interface controllers based on impact inverters equipped with an SFS scheme, the anti-islanding detection performance of fixed power-controlled DG and fixed-current controlled DG is compared and analyzed. The detection time for this type of inverter is more constant current than that obtained for a time-controlled inverter normally controlled by the interface. Therefore, one can conclude that the SFS program is more effective for a constant current controlled inverter than a constant current controlled inverter.

7. Conclusion

DG is a high voltage transmission network more than a generation unit connected to the distribution network. On the other hand, installation of DG contributes to efficient compensation, voltage control, loss reduction, frequency regulation and provides rotating reserve during major system outages. The safe must be isolated from the cantor. In addition, island operation and utilization and grid-connected operation require greater control flexibility and better quality of supply to meet local needs. A DG system is provided with functions to improve power quality. A small perturbation during the DG island can cause significant changes in the system parameters, while the change is less when the DG is integrated with the grid. Hybrid detection schemes Hybrid methods use both active and passive detection techniques. The active technique is invoked only when the island is suspected by the passive technique. One of the new technical problems created by distributed generation (DG) interconnection is the inadvertent islanding that occurs when power is isolated. It is continuously powered by a DG connected to an isolated subsystem. Islanding is a situation where part of the network is disconnected from the rest of the EPS, but more power is obtained from the distributed resource (DR).

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