Constant & Reliable Power Supply by the Smart Grid Technology in Modern Power System

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Abstract. Modern technology depends on the constant and reliable power supply of which is a vital element of the economic development of the country. The quality of power structure under fault unsafe condition has turned into a significant analysis for the power division units. The parameter as well as current, voltage, and frequency to achieve of the power system, it will be considered value due to the electrical power distribution system is failing to obtain the continuous and reliable electrical power supply. In perspective of these, propose of the smart uninterruptible Power Supplies (SUPS) with control of self-healing is a fundamental component of the smart grid. The smart grid works with an automatic technique to deal with enhancing the reliability, efficiency and power quality of the system. In the proposed concept can interface with the sustainable power sources to achieve the cost-effective energy moreover detecting the fault earlier and providing an achievable respond for self-healing in the smart grid. This paper tries to clarify the continuous and reliable power supply with providing the conceivable solution from Smart-UPS (SUPS) with self-healing control over Smart Grid. The control system has approved through the different case studies of the functional implementation of SUPS and the self-healing control in a smart grid system.

1. Introduction
The Continuous power supply UPS that is not accessible longer protected will be smart even when electricity demand increases that cannot compensate for demand times. However, the smart grid network system functions as a backup system and proposes a smart -UPS structure to more readily meets the electrical power demand issues. The dynamic demonstrative plans for monitoring and assessing the online states of system parts are one of the critical prerequisites for rising Smart Grid [1]. More prominent application for framework reliability and vitality the quality requires a change of existing techniques for assessing system conditions. The Self-healing capabilities of Intelligent Systems are radical solutions to expanding system uncertainty. Traditionally, the idea of self-healing in the vitality distribution system has restricted to the recognizable proof, isolation and rapid reclamation of the faulted framework or system part to reduce interruption and keep up system reliability [2]. Smart-UPS has outlined in such a way; it operates in various multi-useful methods as indicated by the necessary conditions. This system is separate from another UPS framework has no transformer and make a structureless demanding and more efficient with cost-effective, the sustainable powersource/distributed generation. This proposed framework will not pull in the supply of the cause that also inputs to the system or Utility when countless are accessible in battery storage. However, the advanced ideas of the self-healing system additionally require a successful technique for an early finding of fault improvement and make the correction before fault occur. The last idea is known as dynamic star selfhealing[3]. Every one of these ideas requires a consistent and reliable power supply for modern powersystem network.
2. Smart Grid
The Smart grid is an innovative idea of the power grid, which can smartly coordinate the activities of all clients associated with it (generators, customers, and so on — the end goal to viable power supply, financial support, and protection power supplies system [4]. A smart power system utilizes intelligent items and operator side smart observing, control, communication with self-healing advances. The objective is to give necessary changes to connect new and elective energy sources, decrease the customary generation of petroleum derivatives. Enhance the supportability of the island with the waste treatment plant and electric vehicles, To build the insight and the level of computerization, making the electrical system ready to convey and connect with the requirements of the diverse incorporated operators inside [5]. A smart system is the utilization of sensors, correspondences, computational capacities and control somehow to enhance the general usefulness of the power supply system. An oiseless system winds up noticeably keen by distinguishing, imparting, applying insight, practicing control and through the input, consistently changing. For an electrical system, this permits a few capacities that permit advancement in the combine with the utilization of mass generation and capacity, transmission, appropriation, distributed assets and last utilization for destinations that assurance steady quality and improvement or limit the utilization of energy, moderate ecological effect, oversee assets and diminish costs [6]. The stable quality of energy generation is an essential parameter for energy utilization and financial improvement. Nowadays, the activity of the power framework restricted in interoperability between applications [7]. Along these lines are the implications of this outcome in another analysis for the High Power Quality, Reliability, and Availability of Security (PQRAS). Intelligent network reliability stands out among the most important fields of application of there liability theory. If the climate and various variable boundaries present the risk that the power framework does not try to survive, it can be ascertained that any disappointment will occur at any time from time to time. Reliability technology provides a vital commentary tool that can be used to evaluate and evaluate smart grid planning and implementation. The model must be as simple as expected in this situation but must speak with all the highlights that are the basis of the reliability of the framework [8].

Reliability parameters change to situations for each segment and each situation. Information about tribal reliability is very prominent among the most critical parameters of intelligent network reliability valuation. In our survey, we use recorded utility information, producer test information, trained associations (such as IEEE), professional meetings, and reliability data depending on diary procedures. Information on the reliability of electrical equipment has generally obtained from a summary of reports on modern technology disappointments. Collection of reliability information is a consistent procedure as a result of the basic idea of keeping accurate updates [9]. One of the desires of the smart grid is that it is more effective and stable than conventional electricity networks. The electricity distribution framework needs to be changed reliably. Including current rapid response and computing applications, the speed of filtering activity on the grid has increased [10]. The exceptional network reliability is used to evaluate disturbances maintained. Short-term power outages from some clients (such as healing facilities and various contemporary clients) can result in the termination of a complex framework. Overall, clients have adopted various ways to introduce additional age and cause short-term outages. In particular, it is this type of blackout that benefits from approaching the age of sowing and the supply of vitality. In this way, a list of reliability must evaluate reliability improvements for supported intrusions and measure reliability improvements for short-term power outages [11]. Smart grids can offer significant benefits by combining various innovations such as sustainable electricity supply, accumulators, and control devices.

3. UPS Integrate with Smart Grid
The methods and trades utilized as a part of the individual rectifier units, storage space, inverters and jumper elements of these two UPS models for the different working elements of the UPS framework. Site arranging and versatility numerous consumers find that the UPS group without Transformers offers more prominent adaptability in obliging future problematic fundamentals. Implementing a UPS with out a transformer to a vital power distribution system is not removing all transformers in the power supply line, but the system designer can install the transformer only if needed [12]. Figure 1 demonstrates the graphic portrayal of smart-UPS for the Smart grid. In perspective of this, the
proposing smart uninterruptible power supplies (SUPS) for the smart grid system to attain the sustainable energy that works in multifunctional particular. Smart-UPS framework in the smart grid system contains four lines paralleled H-bridge converters. When it resolved where transformers required in the framework; the transformer less UPS can permit an ideal position in the direction of the power distribution. However, it ought to recollect that transformer-based UPS have a segment of these capacities in side coordinated as a component of the system configuration, a potentially preferred standpoint of reliability [13]. Reliability and Accessibility Transformer-based UPS have naturally higher reliability on account of a lower, hearty and excess number of pieces [14]. All major UPS units deliver the two topologies for mission-basic applications to meet the UPS architect’s preference. The transformer connects with UPS operates a combine of inactive and dynamic interference diagnoses, which are planned by a non-transformer framework [15]. Extended control methodology and power conversion format in, DC/DC converters, SPWM rectifier and without connecting transformer UPS.

4. Operation Procedure of Smart-UPS
The smart SUPS it is running in the individual multifunctional methods as per the essential condition it provides entirely operational in the associated approaches as follows:

SUPS method - A:
The Smart-UPS is a fault condition, the H-1, H-2, H-3 and H-4 converter/inverter stations supply the network supply directly to the load via a static bypass switch that continues to supply power. H-4 does not apply.

SUPS Method - B:
The electrostatic deviation switch is not active, and the relocation of all converters/inverters operates in UPS power supply system. H-1 operates as a converter to convert AC-DC and H-2 inverters. The battery saves energy by switching the AC-DC below the H-3 and H-4 converters from this approach entering the photo and supplying energy to the battery bank.
SUPS Method-C:
In damage to network supply, this battery is supplied positively and guarantees consumer demand. In this situation, H - 3 and H - 4 and H - 2 convert dc - ac to security and assurance demands during the fault conditions under the power grid.

SUPS Method-D:
In this method, the continuous power-producing interface, the load demands are low, and the energy taken in the battery is sufficient. This converted into direct current (D / C) to the grid - Supply to the grid in this state (A / C) Conditioning Grid Capacitor to the condition of this converter H - 4, H - 3 H-1 appears. As a result, the smart grid is the best concept for future electric power systems.

SUPS Method-V:
In this method, it is not practical to send sources to the load because the H-1 converter station is short. However, in cases where the grid is needed, the supply mode controls the battery where the load can raise without disturbing when it is necessary to full-fill the grid which takes time for the grid that can be sustained here it also hold the network effectively to build an efficient power supply.

SUPS method-V1:
This method executes three additional functions, as indicated by the fundamental conditions of maintaining load through H - 1, H - 2 and H - 4 converter stations. Also, in Smart-UPS, H - 1 and H – 2 power supply modes are used to support the load. Furthermore, it can also operate in static substitution mode using H-3 batteries, and all three H-4 station tests. If conditions supported, activate the specific method of the process and turn on continuous power if necessary. This supports the grid when needed. Therefore, it more efficient and smart UPS mechanism is sensibly determined.

5. Self – Healing in Distribution Network
Self-healing or self-restoration sequence from conventional methodologies, for instance, automatic loadex change and loop sectionalizing to more modern professional based restoration plans, including DER determined to island [16]. Self-restoration can execute by using switches (no fault current recognition or intruding on capacity), Re-closers or a combination of both. The benefits of utilizing switches for acting restoration is that it abstains from managing issues relating to insurance coordination that may happen when power move through a device reversed because of exchanging load to a neighbor feeder. If legitimately is not considered this circumstance may prompt miss coordination as well as disturbance trip up re-closers[17]. With regards to the modern grid, "self-healing" refers to an engineering outline that authorizes the risky components of a system to be detached and, in a perfect world, restored to regular activity with next to zero human interference. These self-healing activities will result in insignificant or no interruption of service to consumers. It is, generally, the modern power grid is the resistant system. The cutting-edge, self-healing grid will perform constant, online self-evaluations to predict potential issues, recognize existing or rising issues, and start quick corrective responses [18]. The self-healing idea is a natural expansion of power system defensive relaying, which shapes the core of this technology. However, the modern remote-controlled re-closers permit defeating this issue, being the disadvantage the need to ascertain and program different overcurrent assurance settings relying upon the potential feeder designs. This can be overwhelmed by the usage of versatile assurance systems[19]. Innovations, including pulse and single-phase reclosing, present further options in contrast to executing self-restoration plans. Even though single-phase reclosing permits identifying and cut off the influenced phases in single-phase or two-phase breakdown conditions, there are viable confinements, for instance, crew security that withdraws from executing this sort of activity for self-restoration purposes, and point of confinement it just to specific applications [20]. A self-healing framework will frequently use a set plan connecting different energy sources. Propelled sensors on controlled equipment will recognize a breakdown and impart to adjacent devices when a fault or other issue occurs[21, 22]. The Sensors will as well recognize designs that are precursors to issues, serving the capacity to mitigate conditions before the occurrence take place.
6. Operation Procedure of Self-Healing

Smart electronic devices currently used as the primary fraction of a smart grid throughout the system for automation of observation, protection in distribution systems. Power quality instruments with the ability to verification transient currents introduced at different focal points by the feed line. The proposed system coordinates the estimated voltage of the sag wave design at a different focus. For verification, compare the results with all nodes and use errors to calculate the power flow and voltage drop. The most extraordinary similarity is considered the real field of break down. Relevant equation scan provide voltage differences:

\[ \beta_{k}^{i,j} = E_{k,med}^{i,j} - E_{k,sim}^{i,j} \]

Where,
The breakdown voltage droop magnitude on node i
The breakdown voltage droop magnitude on node i
Be relevant deficit on node j

Therefore, records of damaged areas are used to ensure that the nodes found are precisely by the relevant conditions.

\[ \mu_{k} = \frac{1.0}{\max(\max(\beta_{k}^{i,i}) - \min(\beta_{k}^{i,j})]) + \Delta} \]

In order for this algorithm to switch the proper damage area, the correct current phasor and voltagephasor needed for time adjustment, which can achieve with the phasor measurement unit (PMU).

**Fault Detection and Isolation**

In smart grid coordinates because of the contribution of the distributed generation, the damaged area can be controlled from several directions. This requires a multiparty travel methodology that produces various tripping breakers. With the modern topology system and the condition of the circuit breaker, it is important to remember the final goal to clear which breaker must trip up the fault point. The modern fault is detecting and disconnecting algorithm of the distributed system with distributed generation anticipated. The "Q" matrix (network branch node event) and "D" error data matrix are used to represent the system topology. The failure segment matrix "S" is obtained by multiplying "Q" and "D" as:

\[ S = Q \times D \]

Promote two matrices M and R are utilized to characterize the conditions of switch controllers and breakers in the system as indicated by the connection

\[ R = S \times M \]

Here, 'M' represents the connection between the load line and the switch controller, 'S' is the same damage region matrix; 'R' turns off the result of the broken switch and segment.

For fault detection algorithm analysis, consider the regarding system shown in Figure 1 with different distribution line source areas.
Network topology makes the matrix mentioned above with segment six details. The matrix component which characterized as a component of matrix D means the current of the fault in the direction of positive, negative and general zero. A similar algorithm is performing in other cases to adjusting the vector D data component when the tiebreaker is turned on. Depending on the meaning of the positive bearing, it is necessary to change the matrix D to reduce the estimates needed to separate positive and negative errors. Numerical supervisors must be accompanied and modified with a D matrix.

Where, OR (XOR) supervisor,

\[ d'_i = d_i \oplus 1 \quad \text{For the branches} \quad d'_i = d_i \oplus (-1) \]

In Figure 2, S1 to S7 counting with the address D1 to the segment using K as the binding switch. L1 to L7 is a branch of the system view. The components of the Q matrix are

\[
(Q) = \begin{pmatrix}
1 & 0 & 0 & \cdots & 0 & 0 \\
-1 & 1 & 0 & \cdots & 0 & 0 \\
0 & -1 & 1 & \cdots & 0 & 0 \\
0 & 0 & -1 & \cdots & 1 & 0 \\
0 & 0 & 0 & \cdots & -1 & 1
\end{pmatrix}
\]

Errors in segments 6, S1, S2 and S6 identify the positive lane off the breakdown current through S3 and S7 to identify the negative path of fault current that is not recognized by S4 and S5. Therefore, an increase in the interference data matrix D is \(D = [11001]\). Currently, when the condition \(S = D\), \(Q\) is used, it is found that the matrix of the position of the defect is \(S = [00010]\). This is because the matrix \(S\) explicitly deals with the damaged component when its value is 1. This algorithm can identify the error point. Because the damaged S segment matrix only provides fault points in those segments, it is typical to find switches and breakers that can take important positions in solving fault points. For cancellation errors, the M matrix component is:

Currently, in Figure 2, if estimating that an error appears in segment 6, it is shown as \(S1 = S7\), and if the backup power problem occurs, the tie switch K dies. Failure of the S 6 point matrix is \([0 \ 0 \ 0 \ 1 \ 0]\).

\[
(M) = \begin{pmatrix}
1 & 1 & 0 & \cdots & 0 & 1 \\
0 & 1 & 0 & \cdots & 0 & 0 \\
0 & 0 & 1 & \cdots & 0 & 0 \\
0 & 0 & 0 & \cdots & 1 & 0 \\
0 & 0 & 0 & \cdots & 0 & 1
\end{pmatrix}
\]
The circuit breaker must trip over with a matrix $R = S \cdot M$, which results in $[0 \ 0 \ 1 \ 0]$. Replace $S_6$ tripped to isolate the error correctly. The tie switch improves the system's power quality and stays open under normal operating conditions. The L2 failure point of the system investigated, $S_2, S_3$ with $S_6$ switches must be turned off to limit failure completely. In this situation, the tie switch is applying to an extraordinary voice segment. This algorithm can be customized to adapt to changes in system topology by describing a $Q$ matrix that represents the state of the system breaker. Components that have the following characteristics:

Segment failure 3 - L3, $S_3$ breaker from the main source, tie switch $k'$ turn off, matrix $D' = [0 \ -1 \ 0 \ -1]$ and matrix adjusted to $[1 \ 1 \ 0 \ 0 \ 0]$ There. The matrix $S$ segment is broken now determined by $[0 \ 0 \ 1 \ 0 \ 0]$, indicating that the error in segment 3. The modified trekking vector, $R'$ is $[0 \ 1 \ 0 \ 1]$. $S_3, S_4, S_7$ must be turned off to isolate errors correctly. This algorithm works effectively in cutting multiple system errors with distributed sources and is done even after changing the system topology.

7. A Case Study of Smart Grid

Smart-UPS is considered by operating the Matlab Simulink tool and built by recommended work. The basic Smart-UPS model consists of two fractions, the first fraction is the controller fraction and the second fraction is the UPS framework. The smart UPS operates in a unique control mode using the SPWM system and is provided by giving an input signal to the converter and providing a connecting pulse that produces pulses with contrast and reference signals. The final model of a smart UPS framework for smart networks is in Figure 3. By building this framework to work in a modular manner under unique conditions, if grid needs additional sources of information to meet additional load requirements related to the grid that can use loads, and UPS grid online Implement the interface.

![Figure 3. Simulink Model of Smart-UPS for Smart Grid](image-url)
Result:

Figure 4. Input voltage

Figure 5. Static bypass power supply mode

Figure 6. Load current and voltage mode

Figure 7. Battery power supply mode

Figure 8. DC - BUS Voltage
The figure (4) demonstrates the grid is a source for voltage, fig (7) demonstrates the all modes function is running with D.C voltage that is 240 volts consistent, only excluding of in deviation control supply mode. The other figures such as (5), (6), (7), (8), (9), (10) and (11) is demonstrating various kind of mode such as the output current and voltage in static deviation mode, UPS mode, battery control supply mode, Battery feed control supply mode, Battery control feed and Battery supply mode if H-3 breakdown and UPS and the battery control supply mode if H-1 breakdown individually.

8. A case study of Self -Healing
In this paper, setting the MATLAB model to expand self-healing designs that can present as extended concepts of smart grids has been made. The original system consists of a programmable three-phase voltage source, a circuit breaker, and a three-phase RLC load and by the MATLAB model. To clarify the design of self-healing, make details in the section of the burden with the help of a timer and find an estimate of the value associated with the unit estimation assistance VI. Here, present the Simulink view used for case studies.
To produce a closing operation that gives the output signal to the circuit breaker to ensure self-healing operations shown in Figure 12 and 13. Even if this subsystem considers some conditions are damaged, it escapes after a three-phase operation cycle that is similar to setting the closing activity, before the collapse is not clean. In the case of a model, if the system failure completed before closing, it tries to rebuild the system's self-healing supply. On the Simpower Toolbox, various types of faults mainly executed from one line to ground (SLG) disturbances, line to line (LL) errors or double lines to the ground, and the effects associated with the system can observe.

The system models in MATLAB is simulating similarly in discrete and in continuous modes. The power framework demonstrates that the continuous model is more reliable than the discrete model.

**Result:**
Further for the implementation of the model for the final goal that is introduced break-downs and results from the three simulation stages. In the first phase analysis, since the setting parameters of the generator and the failure of the line become compact, it will indicate the system will travel if the error
has not resolved before the three work cycle. The pulse clock condition to stimulate the system is \([0 0.2 0.44]\) with an amplitude \([0 1 0]\), which stimulated by 0.2 seconds, which means that fully aroused after 0.44 seconds. The main state of the electric switch is also turned on. Set the clock pulse and amplitude (per unit) \([1 4 1 4 1]\) hours plus \([0 0.25 0.29 0.36 0.42]\). Therefore, the two-cycle failure is 0.29 seconds 0.25 seconds, from 14, the output signal from the electrical circuit breaker is found to be not a signal other than the three cycles from 0.36 seconds to 0.42 seconds cycle and relay turn on.

![Figure 14. Circuit breaker turns on by a fault](image1.png)

Context analysis of self-healing activities from the power framework follows a failure situation. This parameter is not only adjusted to the system supply in the phase of damage after three cycles of work failure but also to recover power after completing failure using clock pulses (implemented in Simulink) run the Simulink model. Figures 15 and 16 indicate fault errors that occur in the system when closing in the system.

![Figure 15. Self-healing action in Current wave](image2.png)

![Figure 16. Self-healing action in the Voltage wave](image3.png)

9. **Discussions**

**Smart-UPS (SUPS):** The current electric current pattern also functions for smart networks. The proposed uninterruptible smart power supply (SUPS) will take an important function, proposing this as a smart UPS and evaluating the entire framework with continuous equipment support that confirms various activity methods. A unidirectional UPS power supply framework, which cannot meet the “Green” energy requirements energy storage, measurement, and Smart-UPS frameworks turn out to be an essential improvement movement. All the fundamental elements of a general UPS framework are not like a smart UPS system that planned. It also bridges between electricity and battery storage capacity to the power grid.
**Self-Healing:** The Self-healing technology in smart distribution systems has become more important for development in intelligent system networks, and a considerable amplify probably in the second half of the past. The smart grids bring various favorable circumstances by giving a higher opportunity to monitor and observe the framework condition. The critical element of the smart grid is self-healing. The method of self-healing expressed about careful attention best utilization of the system resources can accomplish. Operation of smart technology in the power system takes into an automated framework which can adapt to the catastrophic circumstances rapidly.

10. Conclusions
In this paper, proposed the constant and reliable of a power framework using the smart UPS as a self-healing in the smart grid system. This paper recommends a self-healing technique considering with the smart UPS. At the point when the breakdown takes places in the distribution line in the meantime it cleared by self-healing technique, and after that electrical power provided to the load by smart UPS. The present current model in power demand also facilitates to the smart grid. The proposed smart uninterruptible power supply (SUPS) accepts a significant capacity, in context of this proposed the smart UPS and self-healing evaluated, the whole system by creating the structure with the assist of the uninterruptible device that acknowledged for the various techniques for activity. Conservation of "green" energy, speculation, the structure of the Smart-UPS will change to an important change of change. A stable, intelligent UPS system not only separates all the important components of a normal UPS structure but also considers the impact of "green" consumers on the electricity network. Self-healing strategies within the framework of smart networks have recognized significant changes in the past with the early widespread development in smart network systems. Smart grids provide different ideal conditions because of the higher possibility of monitoring and observing system conditions. The primary component of a smart grid is a smart self-healing UPS. Self-healing strategies can communicate about best practices from careful consideration of system assets. The operation of intelligent technology in the power framework adopts an electronic structure that can quickly adapt to adverse conditions. The constant and reliable uninterrupted power supply can effectively switch to various modes according to operating needs. This can be applied to sort the driving system and other application applications, which ultimately encourage the development of the national economy.

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