Unwavering Quality Appraisal and Distributed Generation in Bus Dissemination Framework by LOLP Procedure

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Abstract. Distributed generation is a small scale generation unit connected nearer to the consumer. The ideal procedure utilized for the assignment of the Plug-in Hybrid Electric Vehicle and Distributed Generation in the appropriation framework is Voltage Stability Index. The dependability of the dissemination framework is assessed with the effect of Distributed Generation and Plug-in Hybrid Electric vehicle. This paper presents the unwavering quality appraisal of the dissemination framework incorporated with Plug-in Hybrid Electric Vehicle and Distributed Generation in 12 bus dissemination framework by Loss of Load Probability (LOLP) procedure. The viability of the proposed strategy is dissected by MATLAB.

Keywords: Plug-in Hybrid Electric Vehicle; bus dissemination systems; voltage stability index; loss of load probability; sweep algorithm.

1. Introduction

Dissemination system is the electrical network which interconnects the transmission system and the consumer end. The power source to the dissemination system may be either high voltage transmission line, feeding a substation or local generating plant which decreases the high voltage to a voltage which is suitable for local dissemination. Dissemination of electric power to the individual consumers is done by dissemination networks. The dissemination network consists of feeder, distributor and service mains. Because of the recent trend in PHEV, PHEV is introduced in the dissemination system which increases the load in the dissemination system.

PHEV is a hybrid electric vehicle whose battery can be recharged through external power source by plugging into charging station. It reduces the fuel consumption and decreases the harmful emission in the surroundings. PHEV is the alternative way for the reduction of consumption of fossil fuels. PHEV reduces fossil fuel usage, decrease pollution, and use of renewable energy sources for the purpose of transportation Alan Millner et al (2010). The design methodology of PHEV deals with battery energy and design of power capacity. Control strategies deals on electric range and charge depletion range operations Yimin Gao &MehrdadEhsani (2010). Impact of PHEV in electrical power system is investigated by Curtis Roe et al (2009). It mainly focuses on the impact on infrastructure of the electrical power system and impact on fuel utilisation because of PHEV charging. The development of a PHEV model which considers the driving distance, charging times, charging locations, battery state of charge, and charging requirements of a PHEV is discussed by Xue Wang& Rajesh Karki (2016). When PHEV is introduced in
the dissemination system, the voltage drops and losses are increased. In order to compensate the losses and enhance the system reliability distributed generation is introduced in the dissemination system.

Distributed generation reduces the energy lost during the transmission of electricity because the electricity is generated at a place near to the place where it is used that may even be in the same building. This decreases the number and size of power lines used for the transmission. A Solution for the optimal DG siting and DG sizing issue was discussed by Fazelpour F et al (2014). During heavy loading hours, the energy stored in PHEV support the network, thus the optimal charging and discharging method is suggested by. For the allocation of distributed generation in the dissemination system the weakest branch is selected based on Steady state voltage stability index technique M. Abdel-Akher et al (2011). The optimal allocation of DG unit in an already existing dissemination system plays a vital role in the enhancement of system performance. Thus, proper allocation of DG is considered as most crucial in DG planning Y. M. Atwa et al (2010).

Distributed generation can be classified into four types based on real and reactive power delivering capacity. The types of DG are classified as follows

- **Type 1**
  This type of DG delivers only active power when integrated to the grid with the help of inverters/converters. Photovoltaic power generation is the method of generating direct current energy from solar energy. When the grid is supplied by photovoltaic power, the inverter converts direct current into alternating current. Photovoltaic power generation takes place by two grid-connected modes. One mode is grid connected with current source inverter and other mode is grid connected with voltage source inverter. Fuel cell is a type of power plant where electrical energy is produced from the chemical energy by electrochemical process. The output of this plant DC. When it is connected to the grid, it should be controlled by the converter and converted to alternating current.

- **Micro gas turbine**
  High frequency alternating current is produced by micro gas turbine. The power electronic components can be converted into high frequency alternating current for the purpose of entering the grid.

- **Type 3**
  When distributed generation capable of delivering only reactive power it comes under this category. Synchronous compensators i.e gas turbines are the example of this type of DG and they will operate at zero power factor.

- **Type 4**
  This type of DG consumes reactive power but delivers active power. Induction generators used in wind farms come under this type. Doubly Fed Induction Generators (DFID) delivers active power by consuming reactive power i.e. similar to synchronous generators. Wind power generation is the eco-friendly way of generating electricity from wind. The generation of electricity from renewable sources is considered as the most potential DG. Wind turbine normally uses asynchronous generator which does not
produce reactive power can absorb the reactive from the power network. Normally, the reactive power is compensated by adding capacitor and then the losses in the network are reduced.

The purpose of integrated distributed generation is to enhance voltage profile, voltage stability and to decrease power losses Alka Yadav & Laxmi Srivastava (2014). The impacts of DG units, their location, number of DG units in each location and their availability, on dissemination system reliability are investigated using a real dissemination network Mahmud Fotuhi-Firuzabad, (2008). The connection of DG to the dissemination system has many impacts on the power system protection and causes power losses in the dissemination system K. Vijeta & D.V.S.S Siva Sarma (2012). The introduction of DG in the dissemination system with only PHEV not only enhances the system performance but also enhance the system reliability.

Reliability means the ability of a power system to give adequate, stable and reliable power to the given dissemination system. A general overview of power system reliability and analytical method and simulation techniques for the evaluation of power system reliability and their limitations are explained by Preet Lata & Shelly Vadhera (2015) and reliability evaluation in power system along with the failure of protection devices was discussed by Xingbin Yu & Chanan Singh (2002).

The main objective for the evaluation of reliability is to give qualitative analysis and indices in the performance of power supply for the operation and planning in power system.

- The conductors used in dissemination system carries more current, because of high R/X ratio in dissemination lines and this leads to higher losses.
- Due to recent trend in “Plug-in Hybrid Electric Vehicles”, the loads in dissemination system become unbalanced and hence losses are further increased.
- The main motivation is to enhance the performance in 12 and 33 bus dissemination system.
- The charging station and distributed generation is introduced in the dissemination system.
- This implementation reduces the substation stress, increase voltage and enhance reliability.

Organization of the paper is section 2 explains the problem formulation. Section 3 describes the proposed methodology followed by Simulation results and discussion.

2. Dissemination System And Distributed Generation (DG)

Dissemination systems are classified according to feeder connection namely,

- Radial dissemination system
- Ring main dissemination system
- Parallel feeders’ system
- Interconnected dissemination

Here, Radial Dissemination system with Distributed Generation is used.

2.1 Radial Dissemination System:

When Generating station or Substation is situated at the mid of the consumers, then this type of dissemination system is used. From this system, different feeders transmit and feed distributor at one end.

In Radial Dissemination system, power flow is only in one direction. It is used for medium density load
areas to provide the light in primary and secondary circuits where they usually carried overhead on poles. Often the system is radial only from the dissemination substation to the transformers. In radial system, if any failure occurs beyond the fault, the supply system can be protected. An alternate way for power supply is provided in the faulted system when the system is protected or fault rectified. The radial dissemination system has an advantage of simplicity and lower cost. It requires fewer amounts of cables and less maintenance.

2.2 Distributed Generation:

Distributed Generation is a small-scale generation unit connected nearer to the consumer. Distributed Generation reduces the energy lost during the transmission of electricity because the electricity is generated at a place near to the place where it is used that may even be in same building. This decreases the number and size of power lines used for the transmission. A Distributed Generator has an advantage of lower power electricity cost and higher power reliability with less environmental impacts than traditional power generators.

Distributed Generation system employs numerous and small plants can supply power onsite with fewer dependence on the dissemination and transmission grid particularly in large scale generating stations. Distributed Generation technologies give in power ranging from 1 kilowatt [KW] to 100 megawatts [MW]. Power supplied to various areas from Distributed Generation First, to solve local supply power problem to remote regions and rural areas. Second, with high reliability in grid failure gives back-up supply source for customers. Third, during the time of peak demand by giving power supply, in supporting of levelling out peaks to reduce peak loads. Fourth, to meet customer needs and efficiency improvement via a multi generation system provides diverse energy products. Fifth, supports improvement of power factor, reduction in power losses and modifying grid voltage.

In addition to efficiency, Distributed Generation technologies provide benefits more reliable power for industries. In transmission of electricity, the loss of energy is decreased by Distributed Generation. This decrease the size and number of power lines used for transmission line. Distributed energy resource has an advantage of high efficiency, low maintenance and low pollution. Several types of batteries are included for the application of distributed energy storage systems.

2.3 Plug-In Hybrid Electric Vehicle (PHEV):

A Plug in Hybrid Electric Vehicle is energized by plugging an external power source with a battery and also recharged by on-board engine and generator. The battery charger type may be on-board or it is externally connected to the vehicle. Along with the beneficial of plug in electric vehicle, the charging increases the effect on reliability in the dissemination system. The modes of operation for Plug in Hybrid electric vehicle are charge depleting and charge sustaining modes. These two modes are together called blended mode or mixed mode.

In all electric modes, either at low speeds or at all speeds, these vehicles are created to run at an increased range. The operation of charge depletion mode is to allow a fully charged PHEV until the charge of the battery is exhausted. At start up condition, the plug-in hybrid vehicle operates in charge
depletion mode, but when the battery attains a threshold state of charging, the vehicle converts to charge sustaining mode. Blended mode is the charge depleting action in which the battery supplements from medium to large loads. The advantage of blended mode is the option to use a smaller battery pack and it may offer the vehicle designer.

A hybrid electric vehicle is a combination of internal combustion engine system and electric propulsion system. The mixed mode is a multiple mode and it is described by an example. At starting condition, a car has its charge depletion mode with low speed and later it enters into blended mode with a freeway. Until all electric range is worn out, the driver may escape from the freeway and handle the car without internal combustion system engine. When the final target is reached, the vehicle must return to the charge sustaining mode. Some of the batteries used for plug in hybrid electric vehicle are nickel metal hydride and lithium ion batteries and also supercapacitors. These capacitors are used to supply high power density of energy.

A single unit consists of lead acid battery and supercapacitor which is the hybrid car battery. The advantage of this battery is less cost, more powerful and longer life. The plug-in hybrid electric vehicle has larger potential and more efficient than conventional hybrid vehicles. Plug in hybrid electric vehicle allows the internal combustion engine system to achieve maximum efficiency. Electricity generation, charging and discharging of battery and motor controller are the factors for achieving the actual efficiency. The operating modes and the driving amount of charges in all electric range give the actual fuel economy. With the increase in usage of plug in hybrid electric vehicle, pollution is expected to decrease.

The greenhouse emissions have a complex effect on plug in hybrid electric vehicle. The plug-in hybrid vehicle does not emit harmful pollutants. To recharge the batteries, zero emission sources are needed which are renewable and coal fired plants are also used to energize. There are several advantages for plug in hybrid electric vehicle such as noise is reduced, air quality is improved and greenhouse emissions are decreased. The charging and discharging of plug in hybrid electric vehicles need deeper battery compared to conventional hybrid vehicles. The plug-in hybrid electric vehicle in comparison with the conventional vehicles profits the cost of energy from 40% to 60%.

### 3. Hybrid Electric Vehicle and Distributed Generation in 12 bus dissemination framework by Loss of Load Probability (LOLP) procedure

#### 3.1 Forward and Backward Sweep Algorithm:

Forward and backward sweep algorithm includes forward sweep and backward sweep. In backward sweep, the current is calculated by Kirchhoff’s current law from the source node and voltage is calculated using Kirchhoff’s voltage law from the farthest node. In forward sweep voltage is computed starting from the source node to the farthest node. D. Rana et al(2014).

Listed below are the major steps involved in forward and backward sweep algorithm:

**STEP 1**
For 1\textsuperscript{st} iteration consider rated voltages at end nodes and update the voltage values calculated in forward sweep for subsequent iterations.

**STEP 2**
Starting from the farthest node, calculate the node current by equation (1). Apply Kirchhoff’s current law to compute current flowing from \(i\textsuperscript{th}\) node to \((i+1)\textsuperscript{th}\) node using equation (2).

\[ I_i = \left( \frac{V_i}{V_r} \right)^* \]  
\[ I_{(i+1)} + I_{i+1} + \sum \text{branch current flowing from } i + 1 \text{th node} \] \tag{2}

**STEP 3**
By using this current, voltage at \(i\textsuperscript{th}\) node can be calculated by equation (3). Continue this step till the junction node is attained. Computed voltage is stored at the junction node.

\[ V_i = V_{i+1} + I_{(i+1)} \times Z_{(i+1)} \]  
\tag{3}

**STEP 4**
Starting with other end node, voltage and current are calculated as same as that of in step (2) and (3).

**STEP 5**
The voltage at the junction node is computed and current is calculated by equation (1).

**STEP 6**
Similarly calculate until reference node is reached.

**STEP 7**
Specified source voltage is compared with the computed rated voltage magnitude at the reference node.

**STEP 8**
Stop if the difference in voltage is minimum compared to specified criteria.

### 3.2 Methodology:

The methodology for the proposed method is as follows:

1. Select the dissemination system model.
2. Bus data is collected and it consist of bus number, real power and reactive power.
3. Line Data is collected and it comprises of line number, from bus and to bus, resistance and reactance of transmission lines.
4. After collecting the required data, Load flow analysis is performed. Here, backward and forward sweep algorithm is used for the load flow analysis.
5. In backward sweep, current is calculated by Kirchoff’s current law and in forward sweep, voltage is calculated by Kirchoff’s voltage law.
6. As a result of load flow analysis, voltage, real power, reactive power, real power losses and reactive losses are evaluated.
7. For the optimal allocation of CS and DG in the dissemination system, voltage stability index technique is used.
8. For the integration of CS in the dissemination system, index values are calculated by the VSI technique. The charging station is placed at the bus with minimum index value i.e. in the bus with higher stability.

9. After the integration of CS in the dissemination system, again index values for the system with CS is calculated for the optimal allocation of DG. The DG should be placed at the bus where the index value is maximum.

10. For the optimal allocation of DG in the system, the size of DG is calculated using analytical method.

11. The voltage, real power, reactive power, real power losses, reactive losses are evaluated and compared for the system without both CS and DG, with only CS and with both CS and DG.

12. The voltage is enhanced, losses are minimized after the introduction of DG in the dissemination system with only CS.

13. The above steps are performed again for different dissemination system models.

4. RESULTS AND DISCUSSION

4.1 IEEE 12 bus radial dissemination system:

The proposed work is validated through 12 bus radial dissemination system connected to an 11kV substation as shown in Figure 1. Dissemination system is integrated with charging station and distributed generation. The location of charging station is identified by Voltage Stability Index technique. The charging station is placed at the bus where the Voltage Stability Index is minimum because the stability of that region is maximum shown. The instability region is selected for the allocation of DG that is the weakest branch in the dissemination system.

![Figure 1 IEEE 12 bus radial dissemination system](image)

Figure 2 shows the variation of Voltage Stability Index at each bus. The unit of VSI is p.u. The placement of Charging Station is identified by VSI technique. The charging station is fixed at the bus VSI is minimum i.e. at the bus12. Figure 3 shows the variation of load for 24 hour. Hyundai Kona requires 6 hours for complete charging as it allows traveling a distance of 312Km. The load is varied based on the usage of vehicles (load) for a day.
Figure. 2 VSI graph with CS  
Figure. 3 Load variation graph  

The table.1 shows the variation of load percentage for 24 hours. During peak hours the usage of vehicles is more so the number of vehicles for charging decreases i.e. less consumption of load. Except the peak hours the consumption of load is high i.e. the number of vehicles for charging is more.

| Time (hour) | Load (%) | Time (hour) | Load (%) | Time (hour) | Load (%) |
|------------|----------|------------|----------|------------|----------|
| 1          | 100      | 9          | 100      | 17         | 65       |
| 2          | 100      | 10         | 100      | 18         | 55       |
| 3          | 90       | 11         | 98       | 19         | 50       |
| 4          | 100      | 12         | 95       | 20         | 60       |
| 5          | 85       | 13         | 100      | 21         | 100      |
| 6          | 80       | 14         | 100      | 22         | 96       |
| 7          | 70       | 15         | 75       | 23         | 97       |
| 8          | 45       | 16         | 70       | 24         | 100      |

Figure.4 shows the variation of real power loss with respect to Distributed Generation size. Real power loss decreases with increase in Distributed Generation size. At certain point, real power loss begins to increase with increase in Distributed generation size. The point where the real power loss drops at last is fixed as optimal DG size. Hence, 400 kW is concluded as DG size for this 12 bus system. The Figure.5 shows VSI of the dissemination system with CS and DG. After the allocation of Charging Station, the size of Distributed Generation is calculated and it is placed where the VSI of Dissemination System with charging station is maximum.

Figure.6 IEEE 12 bus radial dissemination system with CS and DG  

Figure. 4 DG size graph  
Figure. 5 VSI graph with CS and DG  

Figure. 6 shows the 12 bus radial dissemination system with CS and DG. The placement of DG and CS is fixated by Voltage Stability Index technique. DG is allocated at bus9 and CS is allocated at
bus12. The real and reactive power losses after the allocation of DG and CS is 18.922kW and 6.4721kW, respectively.

4.2 Performance Evaluation:

Figure 7 shows the variation of voltage at each bus in 12 bus dissemination system without both distributed generation and charging station, with only charging Station, and with both distributed generation and charging station. It is shown from the graph that after the allocation of charging station the voltage drops when compared to the voltage in dissemination system without both distributed generation and charging station. The introduction of DG in the dissemination system with CS enhances the voltage by compensating the losses caused by the backward power flow. Thus, the voltage is improved after the allocation of both charging station and distributed generation. Allocation of DG at bus9 causes the maximum voltage at bus9 and increase in voltage at nearest buses.

Figure 8 Real power loss graph    Figure 9 Reactive power loss graph

The loads in dissemination system become unbalanced by the introduction of CS in the dissemination system and hence the losses are further increased. Figure 8 shows, the losses reduced by the allocation of DG in the dissemination system. Reactive power loss graph is similar to real power loss graph. Losses in the Dissemination System are increased by integrating it with Charging Station. These losses are reduced by the installation of Distributed Generation.

From the Table 2, real power from the substation for Dissemination System with Charging Station is increased by 39.30% and real power loss is increased by 51.9% when compared to real power and real power losses in Dissemination System without Distributed Generation and Charging Station. But after the installation of Distributed Generation the real power from substation and real power losses are decreased by 86.5% and 56.1% respectively. The minimum voltages are identified at bus9 for
Dissemination System without Distributed Generation and Charging Station and system with Charging Station and bus4 for Dissemination System with Distributed Generation and Charging Station.

Table 2 Performance Analysis

|                           | Without DG&CS | With CS | With DG&CS |
|---------------------------|---------------|--------|------------|
| **DG Location**           |               | 5      | 9          |
| **DG Size (kW)**          |               |        | 400        |
| **CS Location**           |               | 12     | 12         |
| **CS capacity (kW)**      |               | 156.8  | 156.8      |
| **Real Power from Substation (kW)** | 455.7138     | 634.9223 | 85.6682 |
| **Reactive Power from Substation (kVar)** | 413.0411     | 421.0105 | 413.1343 |
| **Real Power Loss (kW)**  | 20.7138       | 43.1223 | 18.922     |
| **Reactive Power loss (kVar)** | 8.0411       | 16.0105 | 6.4721     |
| **Minimum voltage (p.u) @ bus** | 0.9434@9     | 0.9056@9 | 0.9964@4 |

CONCLUSION:

This paper proposes the effectiveness of the introduction of charging station and distributed generation in dissemination system. The proposed method is tested on 12 bus radial dissemination system. Distributed Generation is integrated with charging station to reduce the impact on the dissemination system. By the introduction of new technologies such as distributed generation, electric vehicle, microgrid and automated protection devices gives an opportunity for improving the reliability. Distributed Generation should be placed at the farthest bus from the source to reduce the transmission losses. Backward and Forward sweep algorithm gives the value of voltages at each bus, real and reactive power losses of the system. VSI technique is implemented for finding the optimal allocation of distributed generation and exact loss formulas are implemented for finding the optimal size of distributed generation. The results have been developed for without both charging station and distributed generation, with only charging station and with both charging station and distributed generation. The result graph shows that after the integration of charging station and distributed generation, the voltage profile is significantly enhanced; losses and stresses are reduced in the dissemination system.

REFERENCES

[1] A. D. Rana, J. B. Darji, Mosam Pandya, Backward / Forward Sweep Load Flow Algorithm for Radial Dissemination System, International Journal for Scientific Research & Development, Vol. 2, 2014.
[2] Alan Millner, Nicholas Judson, Bobby Ren, Ellen Johnson, William Ross, Enhanced plug-in hybrid electric vehicles, Conference on Innovative Technologies for an Efficient and Reliable Electricity Supply, 2010.
[3] Alberto Escalera, Barry Hayesa, Milan Prodanovic, A survey of reliability assessment techniques
for modern dissemination networks, Renewable and Sustainable Energy Reviews, vol. 91, pp-344-357, 2018.

[4] Alka Yadav, and Laxmi Srivastava, Optimal Placement of Distributed Generation: An Overview and Key Issues, International Conference on Power, Signals, Controls and Computation, 2014.

[5] Anirban Chowdhury, Ranjit Roy, Kamal Krishna Mandal, S. Mandal, A comprehensive review on Dissemination System, International conference on modelling and simulation, vol. 749, pp-133-143, 2017.

[6] Anton Johannes Veldhuis, Matthew Leach, Aidong Yang, The impact of increased decentralised generation on the reliability of an existing electricity network, Applied Energy, vol. 215, pp-479–502.

[7] S. M. Alizadeh, C. Ozansoy, T. Alpcan, The impact of X/R ratio on voltage stability in a dissemination network penetrated by wind farms, Engineering 2016 Australasian Universities Power Engineering Conference (AUPEC).

[8] Babesh Kumar Jha et al (2018) , “Coordinated effect of PHEVs with DGs on dissemination network”, International Transactions on Electrical Energy Systems, Dec 2018.DOI: 10.1002/etep.2800

[9] Mamdouh Abdel-Akher, Ahmad Eid, Abdelfatah Ali “Effective demand side scheme for PHEVs operation considering voltage stability of Power Dissemination systems”, IET Generation Transmission & Dissemination, vol.7(3), pp.309-317, 2017.

[10] Hemakumar Reddy Galiveeti, Arup Kumar Goswami, Nalin B Dev Choudhury, “Optimal distributed generation placement in dissemination system to improve reliability and critical loads pick up after natural disasters”, Engineering Science and Technology an International Journal, vol. 20(3), May 2017.

[11] G. A. Quiroga ; H. Kagan ; J. C. C. Amasifen ; C. F. M. Almeida ; N. Kagan ; E. Vicentini, “Study of the Distributed Generation Impact on Distributed Networks, focused on quality of power” , 17th International Conference on Harmonics and Quality of Power (ICHQP), 10.1109/ICHQP.2016.7783376, 2016.

[12] Hemakumar Reddy Galiveeti, Arup Kumar Goswami, Nalin B Dev Choudhury, “Impact of plug-in electric vehicles and distributed generation on reliability of dissemination systems”, Engineering Science and Technology an International Journal, vol. 21(1), 2018.

[13] Escalera, Alberto & Hayes, Barry & Prodanovic, Milan, “A survey of reliability assessment techniques for modern dissemination networks,” Renewable and Sustainable Energy Reviews, Elsevier, vol. 91(C), pages 344-357, 2018.

[14] Anton Johannes Veldhuisa, Matthew Leach, Aidong Yanganga, “The impact of increased decentralised generation on the reliability of an existing electricity network”, Applied Energy, vol. 215, pp.479-502, April 2018.

[15] Ali M. Eltamaly, Yehia Sayed Mohamed, Abou-Hashema M. El-Sayed, Amer Nasr A. Elghaffar, “Impact of distributed generation on the dissemination system network”, International Journal of Engineering Science, 2019.

[16] Jaser A. Sa’ed, Mohammad Amer, Ahmed Bodair, Ahmad Baransi, Salvatore Favuzza and Guetano Zizzo “A simplified analytical approach for optimal planning of distributed generation in electrical dissemination networks” Applied Science, vol. 9(24), pp.544, 2019.

[17] Omid SADEGHIAN, Morteza NAZARI-HERIS, Mehdi ABAPOUR, S. Saeid TAHERI & Kazem ZARE, “Improving reliability of dissemination networks using plug-in electric vehicles and demand response”, Journal of Modern Power Systems and Clean Energy, vol.7, pp.1189–1199, 2019.

[18] Kirubarani& A. Peer Fathima, “Dissemination system reliability assessment for improved feeder conFigure.urations”, International Journal of Engineering and Advanced Technology (IJEAT), vol.8(6), pp.4416-4421, 2019.

[19] Rajmund Drenyovszki, Lóránt Kovács, István Pintér, “Power system reliability assessment based on large deviation theory bounds” European Union, 2016.

[20] Daniel Fiorese Botelho, Leonardo W. de Oliveira, Bruno Henriquez Dias, Camile Aredes, “Distributed Generation planning in dissemination system with focus on reliability” Conference on Simposio Brasileiro de Sistemas Eletricos (SBSE), 2018.
