The Role of The Intelligent Reconfiguration of Distribution Network on Reduction The Energy Not Supplied Costs in the electricity market through case studies using softwares NEPLAN & DIgSILENT Power Factory

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Abstract

One of the main challenges of distribution companies in the electricity market, the costs imposed on them by outages in the distribution of electrical energy and energy not supplied (ENS). One way to reduce the ENS costs is switching for reconfiguration the distribution network and thus reduce the time of the outages. Something that has been discussed in this article. The proposed method by case study reviews, simulations, and the results have been analyzed. Software was used to simulate NEPLAN&DIgSILENT Power Factory.

1. Introduction

Energy losses and energy not supplied are major challenges in the distribution networks. With the advent of electricity markets and the prevalence of smart grid accurate calculation of these parameters is provided more accurately.

In fact, we can say that the main current challenge in distribution networks is to improve these parameters. There are soft and hard techniques for reducing energy not supplied. In this article, we have tried to study the reduction of the amount of energy not supplied and resulting costs of the Intelligent Reconfiguration of Distribution Network [1, 2].

Considering that equation of the market is as follows:

$$S=B-C \tag{1}$$

S as social welfare
B as benefit in the electricity market
C as costs in the electricity market

2. The Cost Function

One of the important issues in the electricity market is to reduce costs. Since costs are varied, in this paper, according to the electricity market, we have focused on reduction of energy not supplied costs.

Distributed energy is one of the additional factors of reliability. Additional factors are detailed; however, what is important in the electricity market and energy market is, energy not supplied index, so, it is important to calculate the index. Taking the concept of reliability, probabilistic methods are used to calculate reliability. Accordingly, if possible states of a system were *A* (Availability) or normal duty and *U* (Unavailability) or failure of the (repairing) [3-5]:

$$P(A)+P(U)=1 \tag{2}$$

System availability is:

$$P(A)\overset{\Delta}{=}\frac{m}{T}=\frac{\lambda}{\lambda+\mu} \tag{3}$$

System unavailability is:

$$P(U)\overset{\Delta}{=}\frac{r}{T}=\frac{\mu}{\lambda+\mu} \tag{4}$$

λ_i Failure rate of i^th bus

If the mean time to repair is shown with r, as the equation of fault, μ can be considered the as fixing index.

$$r=\frac{1}{\mu} \tag{5}$$

The relationship between the system un-accessibility (U: mean time the device breaks during the year) and the main indicators of reliability are as follows:

$$U=\lambda.r(hour/year) \tag{6}$$

energy not supplied (ENS): is the total energy not supplied with a system that is characterized by the following equation:

$$ENS=\sum_{i=1}^{n}L_iU_i \tag{7}$$

L_i The average bus load of i^th [1]

3. The Method of Calculating The Cost of Energy Not Supplied

To calculate costs of energy not supplied in a feeder, all parameters in the calculation of not distributed power, especially costs of outages announced by per subscriber per kWh based on a contract in the electricity market has been considered.

$$C_{ENS}=\sum_{i=1}^{k}ENS_i*C_i \tag{8}$$

where
CENS: cost of total energy not distributed
ENSi: Energy not distributed for each Customer

Ci: cost of outages announced by the per Customer per one kWh of electricity based on contracts in the market
k: The number of Customers

3.1. Different Levels Of Computing Relaability and Enerdy Extra of Energy Not Supplied

For the calculation of the reliability of the power system, there is levels of computing.

Connection Check: This method studies the network only from the perspective of the connection.

Capacity Flow: This method not only assesses connections, but also assesses the ability to withstand the current and heat of the load, so this is appropriate for distribution networks.

AC Load Flow: This method is used to detect flow. In this way, parts of the network with the voltage drop or illegal use are considered as outages. In fact, this method is more complete than the other two methods. [4] Given the importance of supplying high quality electrical in the electricity market for subscribers, the third method is used for the reliability calculation.

In this paper, the calculation of the energy not distributed, this method is used. [6, 7, 9]

4. The Proposed Function ro Determine The Location of DGs

In this article, the installation of DGs, based on reducing the cost of energy not supplied is documented regarding the outage cost per subscriber according to the documentation of the electricity market. The purpose of this article is:

$$MinC_{ENS} = \sum_{i=1}^{k} ENS_i * C_i \quad (9)$$

5. Case Study

For example, the case of a feeder (1) is selected. With certain conditions during a year can be extracted reliability indices. As can be seen in the feeder studies, two points and two points, maneuver to maneuver inside the feeder, which is adjacent feeders in the feeder network Baarayy studies of the sample are operational. Using AC Load Flow and taking into consideration all the possibilities exercises, feeding the sample is located. The feeder pattern as a clever maneuver by softwares NEPLAN & DIgSILENT Power Factory apply and just when keying the different scenarios developed for the rearrangement of the case by considering three scenarios were applied. [6]

λ = (The length of the conductors / number of faults /year)

(10)

r=(number of faults at specified time / Total outages at a time)

(11)

Feeder studied is over 10.18 km and the main parameters for reliability in NEPLAN & DIgSILENT Power Factory softwares are ($\lambda = 0.389$ and r=0.475)

Table 1. The average cost of outages reported for a variety of applications based on sample contracts on the electricity market [8]

Customer Type	The average cost of outage Rial/KWh
Household	3570
Commercial	5460
Industrial	7200
Agricultural	7000
General	5800

Accordingly, given that the load of feeder is about 1225 KVA.

Regarding the distribution of loads over the feeder in table (2), energy not supplied costs (Rials) per hour outages per node was extracted according to the share of subscribers with different application of node load and the average costs in accordance with Table 1. For the study of sample feeder, Tree scenarioes have been applied on the network, manual switching in 40 min, intelligent switching in 3 min and online switching, and calculations were done with NEPLAN & DIgSILENT Power Factory softwares and were compared in Table 3.

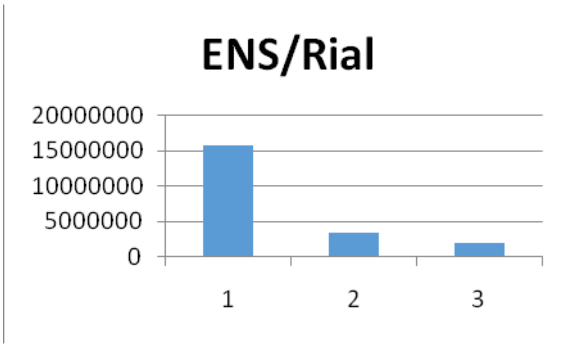

Fig.2. Reduced cost of ENS in different scenarioes

In the sample feeder as can be seen by simulation, third scenario with minimal ENS cost are the best scenario. according to the purpose of this article and the network structure, type of contract of subscribers in the electricity market and types of outages occurred in the feeder, you can see the successfuly of each scenarios.

6. Conclusion

In this paper, the intelligent rearrangement of the electrical power distribution networks in order to reduce the cost of distributed energy in the electricity market through the case study were analyzed using the softwares NEPLAN & DIgSILENT Power Factory .

The results show the speed and reduce network rearrangement distributed energy costs resulting from reduced electricity market.

Results show that intelligent switching and reconfiguration of network can reduce the ENS costs in power market.

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