

Challenges in implementation Power Distribution System for Smart Grid

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Abstract—The distribution system provides major opportunities for smart grid concepts. One way to approach distribution system problems is to rethinking our distribution system to include the integration of high levels of distributed energy resources. Power distribution systems should meet demands such as high reliability, efficiency, and penetration of renewable energy generators (REGs) in a smart grid. In general, power distribution systems are radial in nature. One-way power flow is the advantage of a radial system. However, the introduction of REGs causes bidirectional power flow. Furthermore, there are limits to improvements in reliability and efficiency in a radial system. Therefore, the upgrading of primary feeders from a radial to a loop configuration has been considered in Smart Distribution Project. Challenges which has to be meet to improve the power distribution system , has been explored in this paper. First, the design scheme of a conventional power distribution system configuration that adopts distribution automation is introduced. Secondly, what can be improve system and challenges for its implementation specifically for India.

1. Introduction

Today distribution system is undergoing major changing to adopt new energy generation system because of concern about lack of conventional energy resources and increasing power demand we have to move toward renewable energy generation. Certain change have to be made in our distribution system to adopt this REGs(Renewable Energy Generation).

In conventional power distribution system, a service restoration scheme using normally opened tie switches useful for minimizing interruption time. However, REG operation is sensitive to momentary interruptions due to anti-islanding detection. Therefore, the service restoration process in an improve power distribution should reduce momentary interruption to assure continuous operation of REGs.

Revolutionary changes are however not expected in power transmission and distribution system but improvement through continued evolution can greatly reduce the effects like blackout 2003. Distribution system provides major opportunities for smart grid concept. Public policies involving global climate change initiatives, reductions in CO₂ and other polluting emissions, and incentives for renewable energy will increase issues related to the distribution system. The retail customers also have increasing sophisticated energy service requirements that require much higher power quality than in the past. The distribution system needs to be redesigned assuming high levels of distributed energy resources, creating a smarter and more flexible system. Basic objectives of an advance distribution system are improved reliability, high penetration of renewable sources, dynamic islanding, distributed control and increase generation efficiencies.

There are certain challenges or difficulties to meet the requirement of a smart grid, because its not efficient to operate conventional distribution system for smart grid. Therefore, need to improve the distribution system and the challenges which has to be meet In this process of improving distribution system in a country like india is capital cost, time ,technology etc. which we discuss in this paper further.

2. Distribution System

Power distribution is the final and most crucial link in the electric supply chain and, unfortunately, the weakest one in the country.it assumes great significance as the segment has a direct impact on the sector's commercial viability, and ultimately on the consumers who pay for power services. The sector has been plagued by high distribution losses (30% overall) coupled with the theft of electricity, low metering levels and poor financial health of utilities with low cost recovery. Due to the above, the distribution companies have not been able to undertake corresponding investments in infrastructure augmentation.

The distribution segment continues to carry electricity from the point where transmission leaves off, that is, at the 66/33 kV level. The standard voltages on the distribution side are therefore 66kV, 33 kV, 22 kV, 11 kV and 400/230 volts, besides 6.6 kV, 3.3 kV and 2.2 kV. Depending upon the quantum of power and the distance involved, lines of appropriate voltages are laid. The main distribution equipment comprises HT and LT lines, transformers, substations, switchgears, capacitors, conductors and meters. HT lines supply electricity to industrial consumers while LT lines carry it to residential and commercial consumers.

In India power distribution system is radial which mainly consist 11kv feeders in urban area. This feeder supply power from substation to the area to be feed. Because, this system is radial any fault in feeder will cause interruption in supply to the user this will leads in supply discontinuity and also this system is not suitable for Smart grid system in which REGs are used which are sensitive to momentary interruption.

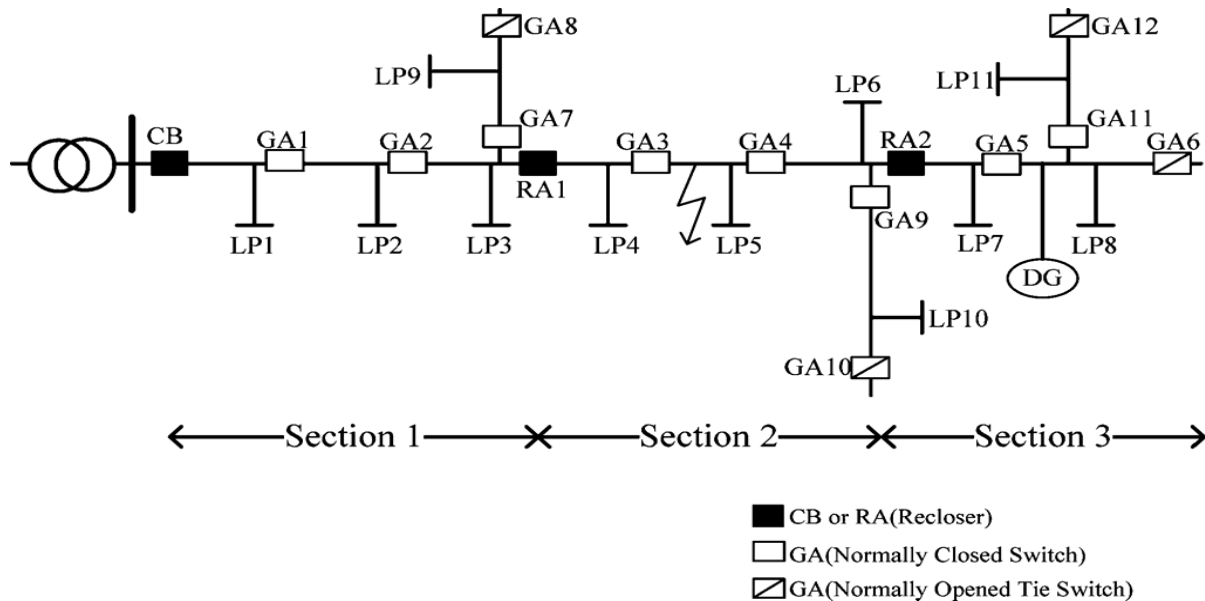


Fig.1 Conventional power distribution system

3. Improved Distribution System

Conventional power system is radial because of its simplicity. There is need to upgrade this system because of number of problem with radial structure to accommodate many REGs. In Korea, conventional power system is upgrade by giving opened tie switches in primary feeder where primary feeders have at least three normally opened tie switches. By closing the opened tie switches, the radial distribution configuration can be upgraded to a loop structure without installing additional electric power lines. Fig. (2) Shows the upgrading scheme of an Advance Distribution Power System, which includes a loop feeder structure as an example. If tie switch GA4 is closed, feeder1 and feeder2 form a loop structure. In this case, other tie switches should be opened to avoid a mesh structure. Although additional electric power lines do not need to be installed, the protection devices should be upgraded to operate the power distribution system in a loop structure. Therefore, the optimum tie switches should be selected to maximize the profits of ADPS upgrading for the loop structure.

However, loop system is also used in India but it is manually not automatic and it is used only for emergency operation only. There is nothing to deal with the losses and anti-islanding operation. So its necessary to adopt automation in distribution system to make it perfect for meet the requirement of Smart Grid and to adopt new technology.

4. Challenges In Implementation

There is certain challenge which has to be meet to upgrade power distribution system in a country like India which has second largest population in world and one of the fast developing economic power. Government of India set up target in 11th and 12th plan for system augmentation shown in table.

Following point shown requirement for implementation

Financing

Financing, in our opinion, should be provided partially by the private sector, as it will also gain from research results. The following financing scheme is proposed:

- 15 % of funds from distribution system operator and utilities and
- 85 % of funds from public-private partnership. For demonstration projects a clear interest comes from the private sector, therefore all funds should come from public-private partnership:
 - 50 % from industry,

- 50 % from state development funds.

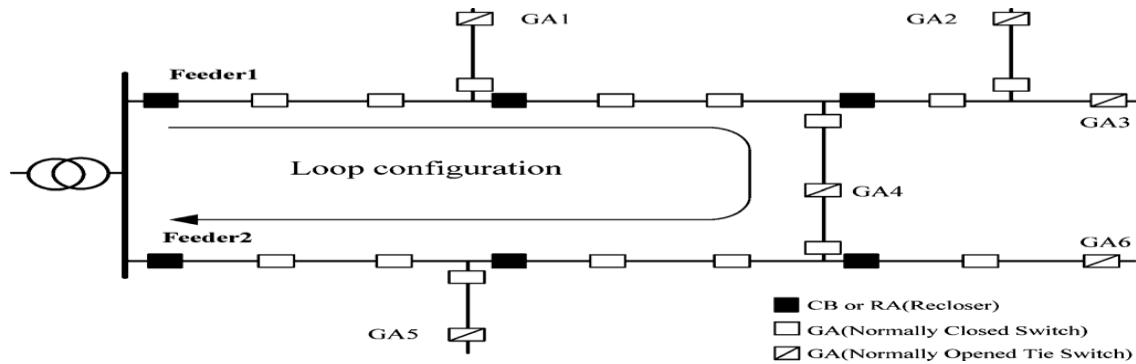


Fig.2 Loop configuration of power distribution system

Particular	11 th plan	12 th plan
Line(ct km)		
66 kv overhead	23335	30546
33 kv overhead	113936	149142
6.6/11/22 kv overhead	1036396	1356638
LT lines	2080106	2722857
Total	3253773	4259183
Transformer capacity(MVA)		
Power transformer	86000	108000
Distribution transformer	128000	162000
Total	214000	2700000

Personnel requirements

For smart grids advance distribution system tasks, additional personnel will be required at least in the following fields:

- project management, including coordination among DSO's,
- ICT experts (measurements, network control, customer services...),
- experts from the industry and research institutions (introduction of new concepts, education, customer approach...), on-site workers (installation, maintenance...).

For the successful implementation of the advance distribution program, a coordinated approach of distribution systems operators is essential. It is important to bear in mind that beside technical and economy knowledge also experiences from the field of sociology will be important which is due to the involvement of customers in different smart grids activities and due to the importance of public acceptance of smart grids in general.

Regulatory changes

It is clear that the regulation must accompany and actually enable the employment of smart grid concept and include a systemic solution for financing. A special consideration of smart-grids projects is also required, covering the projects that facilitate that result in lower costs compared to network reinforcement. Regulatory changes should include the fields of personal information safety, legislation for new service (e.g. virtual power plant) and the use of advanced tariff systems.

Motivate consumer's participation

For implementation advance distribution system consumer participation is require. New distribution system adopts new technology and metering system. It is shown in India that consumer always oppose new technology not only because of their personal perception but also by some others political motivated reasons. This entire factor creates difficulties in improvement of distribution system.

So consumer's participation is requiring for upgrade system.

Others

- (1) Issues and solutions while integrating solar and wind energy,
- (2) Optimization of Load Management (LM) , Demand Response (DR) and Energy Efficiency (EE) issues,
- (3) Automated LM/DR techniques,
- (4) Facilitating existing power system towards Smart Grid while considering power quality and efficiency issues and
- (5) Developing Smart.

5. Conclusion

In this paper, we analyzed a conventional distribution system, what can be an advance distribution system and the challenges to implementation power distribution system for smart grid. Obstacles which are occurs in upgrading a conventional distribution system to an advance power distribution system are discussed while keeping main concentration on Indian std. also with keeping in view international standard.

All factor discuss are necessary while planning or upgrading a distribution system for a smart grid.

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