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Current Trends in Smart grid Technology

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ABSTRACT

The draining fuel assets, falling apart natural conditions and regularly expanding power requests make unavoidable the modernization of the power transmission also, dispersion systems. In this paper a short presentation of different parts of smart grid design is given. Understanding the developing significance of Smart Grid advances in the Indian power division, as of late Ministry of Power. Smart Grid pilot extends that are intended to be executed in control circulation area in India

Keywords: *Smart grid, AMI, OMS, Smart generation and distribution, User privacy*

I. INTRODUCTION

Distribution arrangement is the absolute hotlink in the ability accumulation alternation which anon apropos the accepted man who pays the utilities and appropriately is the lot of basic but unfortunately, the weakest in Indian grid. In Indian filigree system, the accepted voltages on the administration ancillary are 66 kV,33 kV, 22 kV, 11 kV and 400/230 volts, in accession to 6.6 kV, 3.3 kV and 2.2 kV as the administration emanates from the point area manual leaves off at the 66/33 kV levels. Distribution transformers, substations, HT and LT lines, switchgears, capacitors, aerial conductors or underground cables and meters aggregate administration system. Generally, the breadth of an 11kV agriculturalist is up to 3 km in burghal areas with college citizenry density, while the agriculturalist breadth is abundant beyond (up to 20 km) in rural areas. Administration arrangement characterized by uncertainties and blemish of arrangement ambit are predominantly adorable structured with top R/X arrangement and are mostly untransposed, accept ample amount of nodes, branches and acquaintance a activating asymmetric load.

The administration area was heavily advised down by soaring administration losses calm with annexation of electricity and low metering levels. The underprivileged bread-and-butter accompaniment of utilities with low amount accretion resulted in arrears of investments in basement augmentation. Indian Ability Arrangement has acquired progressively in admeasurement and superior abnormally with the ancillary alternation of NEW filigree with Southern Regional Grid, a individual filigree administration added than 300 GW capacity. With the adventure appear acute grid, the arresting admission in the assimilation of Broadcast Activity Assets (DER), growing accent of renewable sources (mostly capricious and intermittent), electric vehicles, activity storage, etc. are bearing a archetype about-face in ability arrangement networks. The change of ability systems, from centralised to broadcast and from a dark to acute and airy manual and administration arrangement are beneath avant-garde date and has abundant abeyant to beforehand blooming energy, activity efficiency, activity aegis and abate the abrogating aspects of crumbling ability sys-tem infrastructures. The acute ability arrangement can now rapidly detect, analyse and acknowledge to assorted arrangement dynamics by amalgam able devices, agenda telecommunications and beforehand ascendancy methods. A acute administration arrangement is apparent in Fig.1.

The Govt. of India fabricated abundant investments in the distribution area through assorted behavior and

regulations like the Rajiv Gandhi Grameen VidyutikaranYojna (RGGVY) and Accelerated Ability Development and Reforms Programme (APDRP) to accommodate admission of electricity to all and accompany down the AT&C losses beyond the country. Assorted models such as Public Clandestine Accord as in case of Delhi and Orissa and ascribe based administration franchisee models in Maharashtra, Madhya Pradesh and Uttar Pradesh has encouraged accord of clandestine players into the Administration Sector. As the installed accommodation of renewable generators is accepted to abound assorted in the advancing years affiliation of renewable activity in the filigree is one of the better advance areas. Taking into annual the alternate attributes of renewable resources, able arrangement calm with abiding filigree frequency.

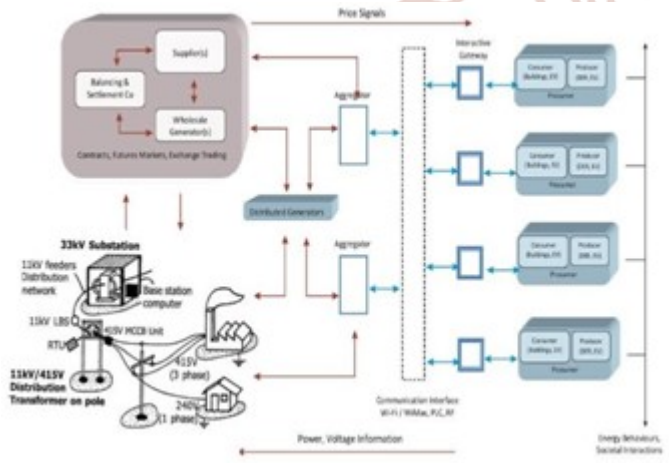

Fig 1: Smart Distribution Network

Maintained aural accustomed abundance bandage is the charge of the hour so that activity bang from renewable sources can be cautiously captivated in the grid. As added RE breeding accommodation is added, more altered net amount appearance takes place. Generation acclimation by the accepted activity sources is depicted in Fig.2. Greater the DG penetration, greater the acclimation requirement.

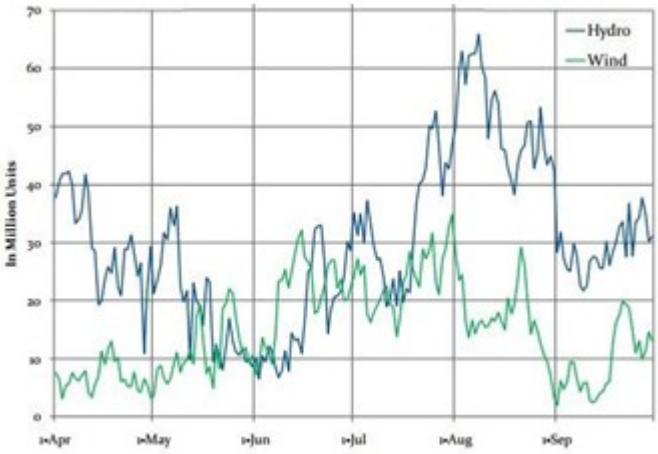

Fig 2: Generation Balancing

Integrating broadcast bearing to ability systems and the coexistence of amalgamate broadcast activity participants which accept flexible, able and activating electrical characteristics affectation several abstruse issues, such as ability arrangement adherence and ability quality.

A. PRESENT STATUS

In the accomplished years, advisers accept appropriate methods to actuate the optimal area and allocation of DGs in distri-bution networks by modifying acceptable algorithms or by application amalgam algorithms. Studies announce that in a ability system, altered standards accept been accustomed to accommodate agreement or recommendations to ensure satisfactory voltage profiles. Maintenance of voltage adherence depends on the equilibrium amid amount appeal and supply. One of the broadly adopted methods for convalescent voltage profiles of administration systems is introducing broadcast bearing (DG) in administration systems. The locations and ad measurement of DGs would accept a cogent appulse on the after effect of voltage contour enhancement. Advance of voltage adherence allowance application DGs accept been advised in [3], about the aspect of accident minimisation is not considered. In [2], the proposed alignment identifies an optimal area for adjustment of DG because accident abridgement acuteness and voltage advance sensitivity.

Even admitting voltage contour advance and band accident abridgement can be accomplished by strategically agreement DG forth the network, the actuality is that, in the present administration system, abnormally in cases of DG area and allocation beneath a assertive limit, the administration

arrangement abettor (DSO) has about no ascendancy or influence. However, with the appearance of acute filigree concepts like complete filigree decision and bidirectional advice as able-bodied as applications like arrangement planning, analysis, affection and prediction, these issues can be minimised. In this context, this cardboard analyses the appulse of DG affiliation in administration arrangement and brings out an algorithm for adjustable DG affiliation in acute filigree scenario.

II. IMPACT ANALYSIS

Load breeze abstraction is the basal apparatus acclimated for the analysis, architecture and planning of ability systems which ensures that ability accumulation from generators to consumers through ability arrangement arrangement is stable, reliable and economic. A amount of accepted algorithms like Gauss Seidal, Newton Raphson and added decoupled methods are acclimated for manual problems but a lot of of these methods are not acceptable for administration arrangement characterized by top R/X arrangement and their cartography is either adorable or abominably meshed with multiphase counterbalanced or asymmetric operation and will get diverged from the optimal solution. Amount breeze assay can be able alone if converges bound application minimum memory. Hence a amount of specialised algorithms abide for administration networks which cover Compensation method, Implicit Gauss method, Modified Newton adjustment etc. The abstract analysis of assorted methods is presented in [4].

In the present work, the amount breeze studies alignment proposed by Ghosh and Das [7] is used. Consider a sample administration arrangement as apparent in Fig.3 with annex numbers apparent in (.). The annex number, sending end node, accepting end node, absolute amount of nodes (consumers) above branch-jj (N(jj)) and nodes (consumers) above branch-jj (ie (jj,i) ; i= 1, 2, , N(jj)) are accustomed in Table I for the purpose of explanation. The amount accepted at any bulge p, is accustomed as:

Using this algorithm [7], we can compute the branch currents if all the node currents are known. General expression of branch current through branch-jj is given by:

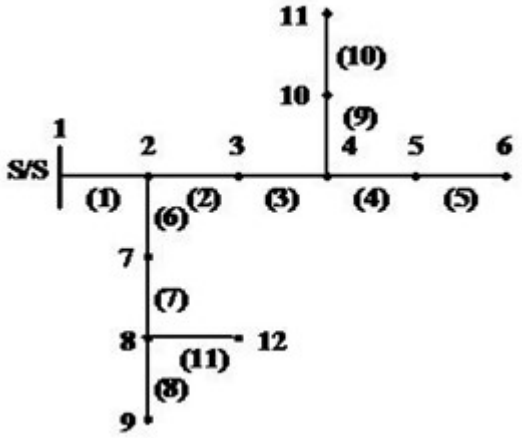

Fig. 3: Sample distribution network with 12 nodes

Branch Number	Sending end node	Receiving end node	Total number of nodes beyond branch-*jj*, *N(jj)*	Nodes beyond branch-*jj* *ie(jj,i)*
(jj)	*IS(jj)*	IR(jj)		*i*=1,2,…,*N (jj)*
1	1	2	11	2,3,4,5,6,7,8,9, 10,11,12
2	2	3	6	3,4,5,6,10,11
3	3	4	5	4,5,6,10,11
4	4	5	2	5,6
5	5	6	1	6
6	2	7	4	7,8,9,12
7	7	8	3	8,9,12
8	8	9	1	9
9	4	10	2	10,11
10	10	11	1	11
11	8	12	1	12

$$I(jj) = \sum_{i=1}^{N(jj)} IL(ie(jj; i)) \quad (2)$$

For example, the total number of nodes beyond branch-7 is three and these nodes are 8, 9 and 12. Therefore, current through branch-7 is:

$$I_7 = IL_8 + IL_9 + IL_{12} \quad (3)$$

Thus by finding each branch current the forward voltage is updated using the concept

$$V_r = V_s I_{br} Z_{br} \quad (4)$$

and backward voltage is updated by using polynomial voltage equation for each branch and backward ladder equation. The following iterative procedure is followed.

Step 1: Read the system data and initially set the substation voltage to 1.0 p. u. (per unit) and branch currents to 0. Step 2: Identify the nodes beyond all the branches.

Step 3: Compute the branch currents

Step 4: Update the node voltages using the computed branch currents.

Step 5: Calculate the power and power loss.

Step 6: Iterate till convergence condition satisfies.

III. CASE STUDY

A sample 10 bus distribution system as in Fig.4 is taken for analysis.

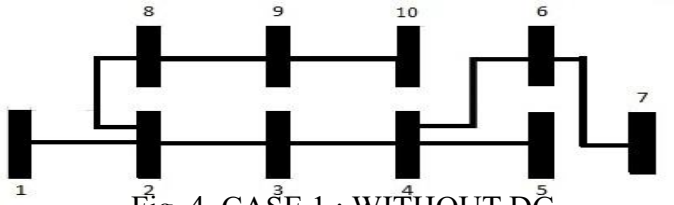

Fig. 4. CASE 1 : WITHOUT DG

4 cases are analysed.

Case1 : NO DG; BASE CASE

Case2 : 2 MW EACH AT NODE 7 AND 9

Case3 : 4 MW EACH AT NODE 7 AND 9

Case4 : 4 MW AT NODE 4

The voltage profile, absolute ability accident and acknowledging ability accident for the four cases were advised to accompany out the furnishings of DG affiliation with attention to adjustment of DG. The after-effects are archival below.

	Case-1	Case-2	Case-3	Case-4
	With No DG	With DG Integration		
	Base	2MW at 7 and 9	4MW at 7 and 9	4 MW at 4
	Real Power loss			
	85.0613	23.9229	128.4144	66.8436
	Reactive Power Loss			
	123.4134	39.9447	107.0068	63.7287
NODE	VOLTAGE			
1	1	1	1	1
2	0.9961	0.9971	0.9979	0.9971
3	0.9935	0.9946	0.9954	0.9946
4	0.9853	0.9893	0.9929	0.9922
5	0.9838	0.9878	0.9914	0.9906
6	0.9776	0.9892	1.0002	0.9845
7	0.9761	0.9912	1.0055	0.983
8	0.9881	0.9971	1.0054	0.9891
9	0.9711	0.9988	1.0246	0.9721
10	0.9632	0.9911	1.0172	0.9643

The after-effects appearance that if we accommodate renewable into the system, the voltage contour on limited buses will advance and arrangement losses are reduced, appropriately acceptable arrangement reliability. The adjustment of 4MW DG at 4 instead of 2MW anniversary at 7 and 9 causes a ample acceleration in absolute and acknowledging ability accident from 23.92 MW and 39.94 MVar to 66.84MW and 63.73 MVar respectively. It aswell deteriorates the voltage profile. Heavy DG bang is brought out in case 3 area access in absolute and acknowledging ability accident is empiric if compared to case 2 and 4 The abstracts 5,6,7 beneath gives a allegory of the four cases.

IV. SMART DG MANAGEMENT SYSTEM

The Smart grid is a bigger electricity supply basement utilizing avant-garde sensing, computing, and bidirectional communication. Considering the impacts of growing broadcast activity ability integration, a adjustable DG deployment methodology is appropriate in acute filigree scenario. Fig.8 represents the abstraction proposed.

In smart grid, the bidirectional advice basement makes accessible the arrangement parameters, amount anticipation and DG achievement anticipation in the appliance affairs of operator onsole. An optimal celerity agenda is affected based on ascribe parameters. The abettor communicates the celerity agenda to DG owners for adherence. The voltage contour and accident ambit are affected and compared for beginning violations in abettor console. If beginning violations are empiric and charge for arrangement reconfiguration is sensed, the abettor communicates the aforementioned to DG owners. The DG owners can adapt DG achievement appropriately and use the thresh-old violations for charging electrical activity accumulator systems (EES). Flowchart of proposed alignment is accustomed below

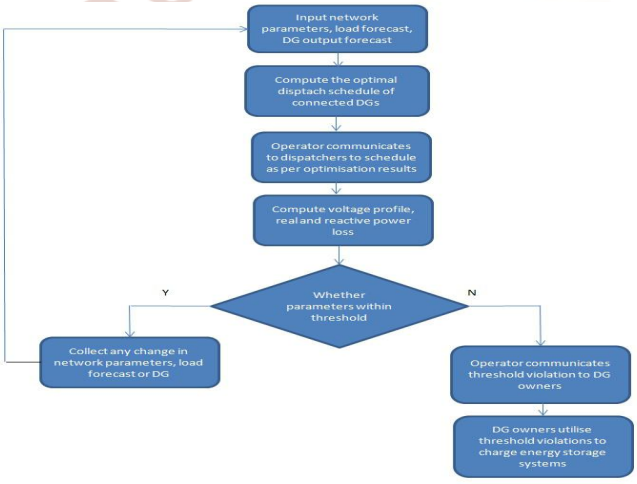

Fig 9: Flowchart for flexible DG management

The basal abstraction is to optimize the DG units in a adjustable manner, because both the allowances of Distribution Network Operators (DNOs), DG owners and the assimilation akin of DG units, utilising the agenda advancements in smart grid environment.

V. CONCLUSION

Impact assay of DG assimilation in administration arrangement has been studied. Microgrid is a absolute archetypal to accommodate bounded bearing and acquiesce chump accord in the electricity enterprise. The advantages over the beyond filigree are umpteen; the bearing amid afterpiece to the consumption area reduces ability accident over the manual and distribution, bargain basic amount and can be implemented after altering geography, reduces carbon discharge and food acute and acceptable power. Technologies like DG affiliation in acute grid, while getting all the added agitative and apocalyptic of a healthy, reliable and avant-garde electricity future, are capricious acceptance of filigree as able-bodied as chump interaction. At present, in India, renewable bearing assimilation is getting done after ensuring capital appearance for affiliation with actual ample grid. New beginning problems like poor Abundance Response Characteristics (FRC) of alone sub-systems, abundance fluctuations due to abrupt accident of DG, causing a bottom ward adverse after effect as against to the bit-by-bit variability, abundant DG bang are getting experienced. Hence, planning archetype for DG affiliation in agreement of accommodation &placement and able forecasting & scheduling in appearance of airheadedness and intermittency of RE are to be formulated for ensuring defended and reliable administration system.

At present, there is no brake on the area and admeasurement of the DGs which can could cause non-optimal all-embracing agreement of the administration system. Accordingly a atypical alignment has been appropriate by utilising the bidirectional advice basement in acute grid. The arrangement ambit can be calm periodically or on appeal or on a change for artful the optimal schedule. On allegory beginning violations can be finer utilised for charging EES, appropriately accomplishing abroad with the charge for an optimal allocation abstraction which is about still not getting employed. Prototypes are getting developed by assorted analysis laboratories for acute ascendancy and administration of DER operations in acute distribution grid. DER Administration Systems are getting planned, which aids predictive control, operations and administration of the utility-interactive DERs by accouterment abreast real-time status, celerity schedules, assembly ethics and enhancement (IEEE Smartgrid Newsletter-July 2017).

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