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A REVIEW ON PLACEMENT OF DISTRIBUTED GENERATOR USING OPTIMIZATION TECHNIQUES FOR CONGESTION MANAGEMENT

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Abstract : Evaluation criteria for sizing a standalone PV system Selecting the evaluation criteria for designing standalone PV system for a required locality is one of the important works for obtaining optimum PV design.In this study, a hybridization of the firefly methodology and differential evolution optimization search has been studied. For distribution networks to reduce power loss, distributed generation (DG) is a crucial problem. However, current methods continue to struggle with the size and placement of generators. In this article, we studied several scenarios to determine where a distributed generator on a radial feeder operating at medium voltage would be most beneficial. It has been shown that the hybrid technique is a useful tool for managing CM, allowing for a secure operation that reduces flows in the severely laden lines with little system loss and improves network stability by managing power flows.

Keywords: Cost minimization, Congestion management, Distribution generation, Optimization.

I. INTRODUCTION

Since reorganising the power market was primarily motivated by concerns about security and profitability, appropriate solutions based on power system needs must be developed to achieve the goals. Utilizing a range of market-available services, such as meeting power needs with renewable sources or energy storage devices, may help ensure security in the deregulated power market (ESS). Security is improved by using economics in the electricity market properly. In order to guarantee system security and optimise the societal benefits, careful planning is necessary. The ISO has significant duties in the deregulated energy market, including ensuring network dependability and security, regulating transmission-related services in congested networks, reducing the danger of market power, and many more. To create real-time or pre-defined methods for improved network congestion management, the ISO makes use of several simulation and analysis technologies.

The continuance of the congestion issue suggests that more transmission infrastructure or new generating capacity are required to reduce congestion. In a location that is heavily crowded and where LMPs are higher than elsewhere, decentralised production sources or renewable energy sources might be quite valuable. In this article, we studied the best location of the solar power plant to reduce transmission line congestion using LMP analysis and congestion rent. When placed in the best possible position within a crowded system, solar power plants have the potential to greatly enhance the voltage profile, power quality, and grid dependability while also assuring the maximisation of societal welfare and congestion management. The unpredictable and intermittent nature of solar energy is due to the continual change in irradiance and temperature, which presents a new problem for the scale of solar power plants.

II. PREVIOUS STUDY

Nappu M.B. et. al in 2010 [1] have presented exercise of market power by one ormorepartieswithmajoreconomicconcernofmarketpar ticipantsofrestructuredenvironments. This method is based on a shift-factor optimum power flow strategy forlocational marginal price (LMP) design. The societal cost of congested markets and market concentration are assessed. The transmission usage tax is an extra cost in theLMP-TUTmodel'slocationalmarginalpricing.Transmissionusetariffandtransmission congestion fee have an inverse connection.

Murali M. et.al. in 2014 [3] used DCOPF objective function for spot pricing method for fuel cost minimization in just one auction model. Results obtained using heuristic technique (Bat algorithm) are compared with other two techniques (PL and GA) inpooled scenario of energy market.

Abirami A. et al in 2016 [4] have studied the modelling of a realistic power system pricing structure which is critical for providing financial signals to electrical utilities.TheproposedmethodincludeslossesinDCOPF model.Anoptimization-basedQuadratic Programming (QP) technique was used to tackle this LMP problem.

Kumar S. et al. in 2017 [5] presented work utilizing the best setup of OPF control variables, an optimization approach called MAWPO. The wolf hunting procedure in spared this met heuristic optimization strategy. The results are also compared withPSOandconventionalapproaches,indicatingthat,providestheoptimumpowerstreamsolutionamong all methodologies described earlier.

Yan X. et al. in 2018 [6] presented helping tool to make easy the PV integration by LMP-pricing using ESSs. It proposed BSM to control charging and discharging of ESS to manage congestion. This also reflects in the congestion cost of the system if persist for long duration.

Deng L. et al. in 2019 [7] presented a simplified market clearing scenario, withoutnetwork restrictions to show the price connection between two markets (heating and electricity) through costs of CHP in suitable areas. By maximizing their individual producer surplus, rational producers also provide exact ISO prediction.

Narimani M. et al. in 2020 [8] presented clear idea of reliable economic indicationby LMP to the market participants. Meanwhile, nodal prices are influenced by active power losses and transmission congestion, both of which can be influenced by harmonic pollution. The traditional technique assumes that the power system and loads are linear, and nodal prices are calculated using the results of optimum power flow (OPF) at the power frequency.

III. OPTIMAL SIZING OF GRID-TIED SOLAR POWER

Solar power depends on meteorological conditions such as irradiance; ambient temperature which are directly related to geographical location. For effective utilization of PV arrays the characteristics should be seriously analyzed.

Locational Marginal Price

LMP gives in the liberated power market, the value procedure is at first given, and afterward a proportion of organization congestion is given. LMP is habitually used in serious power markets since it has a few advantages over other evaluating frameworks. While nodal and zonal evaluating are two broadly utilized ways to deal with work out congestion costs, it's additionally basic to consider the strategies used to decide market-based use charges and access expenses related with specific plans, especially to decide the beginning rate. Many states, including California, New Britain, New York, ERCOT, Midwest ISOs, and others, have previously started utilizing this LMP procedure [5].

The following is the formulation of the issue to determine the locational marginal price of the electricity:

Minimize

$\sum f_m(PG\ m)\ nG_m=1$ (1)

The aforementioned purpose is to reduce production cost (PG) active power while taking the following limitations into consideration:

Power balance constraints

$\sum_i P_{G-}^i\ P_{loss}(P_G^i) = \sum_i P_D^i$ (2)

Power transfer capability constraints

$flow_L^{min} \leq flow_L \leq flow_L^{max}$ (3)

Bus voltage limits

$V_I^{min} \leq v_i \leq\ V_i^{max}$ (4)

Power generation limits

$P_{Gm}^{min} \leq v_i \leq P_{Gm}^{max}$ (5)

Where$f_m\ (P_G^m) = a_m + b_m * \ (P_G^m) + c_m *\ (P_G^m)$^2 (6)

An equation may be written to determine the price of active electricity from generator m at a certain dispatch point (4.6). Node i's active demand (PG I is equal to its entire active power generation (PD I) FlowL represents the direction of the power current. The apparent power flows $flowL^{min}$ minand $flowL^{max}$, and, are the lowest and highest bounds, respectively. Comparison of minimum and maximum voltage limitations at i are $V_I^{min}\ andV_i^{max}$Respectively.Whereas the $P_{Gm}^{min}$and P_{Gm}^{max} represents the minimum and maximum generator m active power. The total number of generators is denoted by nG. The generator's cost indices are denoted by am, bm, and cm.

IV. CALCULATION OF LMP

The ISO objective means to bring down the expense of congestion by representing extra parts like as transmission and negligible misfortunes, as well as different attributes that impact LMP disparities. Minimal misfortunes for the framework are the continuous variances in misfortunes got on by little changes request. As a result, the LMP might be addressed as the amount of the expenses of negligible misfortune, minor energy, and congestion.

$LMP = LMP_{energy} + LMP_{loss} + LMP_{congestion}$ (7)

Where, LMP_{energy} : Marginal energy

LMP_{loss} : Marginal loss LMPcongestion : Congestion

In the equation above, the only factors that affect bus ranking are losses and congestion, but because every bus contributes the same amount of marginal energy, there is no effect on bus ranking. Losses of small magnitude have minimal influence on LMP, but losses of high magnitude have a greater impact.

LMP is a crucial component for 83 since it reflects congestion, its cost, and how much more significant it is than energy or loss.

V. FUTURE SCOPE

Research on congestion management is as of now happening in many created and emerging nations all over the planet. In any case, strategy under liberated climate varies around the nations. Furthermore, there is broad reception of sustainable power sources and electric vehicles all over the planet. Consequently, planning all inclusive congestion management procedures is a difficult errand. There is enormous degree for work in the congestion management region. While doing introduce research work, it has been seen that to refine the work did such a long ways in the space of congestion management in de-directed power market the issue should be tended to right away. A portion of the significant perspectives that can be tended to in this space are:

- Time-based incentives for electric vehicle charging and discharging. Time-based incentives can help in managing the loads on the grid.
- Identify appropriate hybrid technique for a particular type of congestion using AI techniques based on data available in respect of various congestion scenario especially in the context of demand pattern, weather forecast data, availability of network and generation resources at that instance. More efforts need to be put on real-time prediction of load/demand in the power system network using forecasting models and artificial intelligence techniques.
- Incentives for installing rooftop solar panels to meet the local demand. This can encourage the residential/industrial areas to install more and more renewable sources to meet their demand and sell the surplus energy to the grid.
- An artificial intelligence-based congestion forecasting tool. Forecasting congestion in transmission networks can help ISO to develop better congestion management strategies to deal in real time mode.

REFERENCES

[1]. Nappu I. Hydropower for sustainable water and energy development. Renewable and Sustainable Energy Reviews. 2010;14(1):462-469. doi:10.1016/j.rser.2009.07.025

[2]. Kang C.Q, Campbell J, Lobell D. Biomass energy: the scale of the potential resource. Trends in Ecology & Evolution. 2013;23(2):65-72. doi:10.1016/j.tree.2014.12.001

[3]. Murali. Disadvantages and Advantages of Hydrogen Fuel Cells. The Next Galaxy; 2014.

[4]. Abirmani MS, Abas N, Kalair AR, et al. Design and optimization of hybrid solar-hydrogen generation system using TRNSYS. Int J Hydrogen Energy. 2016 ;45(32):15814-15830.

[5]. Kumar, WWEA. World wind capacity at 650,8 GW, Crisis will slow down markets in 2017, renewables to be core of economic stimulus programmes. Published 2017. Accessed September 9, 2017.

[6]. Yan MI. Direct power control of SRG-based WECSs using optimised fractional-order PI controller. IET Electric Power Applications. 2018;14(3):409-417.

[7]. Deng.M, The U.S. Energy Information Administration (EIA)., 2019. 4578-247.

[8]. Narimani MB, Barakat S, Samy MM, Wahba WI. Optimization of an off-grid PV/biomass hybrid system with different battery technologies. Sustainable Cities and Society. 2020 ;40:713-727. doi:10.1016/j.scs.2018.01.012.

[9]. Anjali, Raj Kumar Kaushik and Deepak Sharma, "Analyzing the Effect of Partial Shading on Performance of Grid Connected Solar PV System," 2018 3rd International Conference and Workshops on Recent Advances and Innovations in Engineering (ICRAIE), 2018, pp. 1-4, doi: 10.1109/ICRAIE.2018.8710395.

[10]. Kaushik RK, Pragati. Analysis and Case Study of Power Transmission and Distribution. J Adv Res Power Electro Power Sys 2020; 7(2):1-3.

[11]. R. Kaushik, O. P. Mahela and P. K. Bhatt, "Events Recognition and Power Quality Estimation in Distribution Network in the Presence of Solar PV Generation," 2021 10th IEEE International Conference on Communication Systems and Network Technologies (CSNT), 2021, pp. 305-311, doi: 10.1109/CSNT51715.2021.9509681.

[12]. Simiran Kuwera, Sunil Agarwal, Rajkumar Kaushik, "Application of Optimization Techniques for Optimal Capacitor Placement and Sizing in Distribution System: A Review" International Journal of Engineering Trends and Applications (IJETA)– Volume 8, Issue 5, Sep-Oct 2021.

[13]. P. K. Bhatt and R. Kaushik, "Intelligent Transformer Tap Controller for Harmonic Elimination in Hybrid Distribution Network," 2021 5th International Conference on Electronics, Communication and Aerospace Technology (ICECA), 2021, pp. 219-225, doi: 10.1109/ICECA52323.2021.9676156.

[14]. Rajkumar Kaushik, Om Prakash Mahela and Pramod Kumar Bhatt, "Power Quality Estimation and Event Detection in a Distribution System in the Presence of Renewable Energy" By Book Artificial Intelligence-Based Energy Management Systems for Smart Microgrids, Edition 1st Edition, 2022, Imprint CRC Press, Pages20, eBook ISBN 9781003290346.

[15]. Mokhtara C, Negrou B, Settou N, Settou B, Samy MM. Design optimization of off-grid Hybrid Renewable Energy Systems considering the effects of building energy performance and climate change: case study of Algeria. Energy. 2021;219:119605. doi:10.1016/j.energy.2020.119605

[16]. el-Raouf MO abed, Mosaad MI, Mallawany Adel, Al-Ahmar MA, Bendary FME. MPPT of PV-Wind-Fuel Cell of Off-Grid Hybrid System for a New Community. In: Twentieth International Middle East Power Systems Conference (MEPCON). IEEE; 2018:480-487. doi:10.1109/mepcon.2018.8635165

[17]. Kharrich M, Kamel S, Alghamdi AS, et al. Optimal design of an isolated hybrid microgrid for enhanced deployment of renewable energy sources in Saudi Arabia. Sustainability. 2021;13(9):4708. doi:10.3390/su13094708

[18]. Samy MM, Elkhouly HI, Barakat S. Multi-objective optimization of hybrid renewable energy system based on biomass and fuel cells. Int J Energy Res. 2021;45(6):8214-8230. doi:10.1002/er.5815

[19]. Samy MM, Mosaad MI, Barakat S. Optimal economic study of hybrid PV-wind-fuel cell system integrated to unreliable electric utility using hybrid search optimization technique. Int J Hydrogen Energy. 2021;46(20):11217-11231. doi:10.1016/j.ijhydene.2020.07.258

[20]. Samy MM, Alkhuzaii KA. Optimization and sizing of an island microgrid based on photovoltaic/fuel cell (PV/FC) in KSA. Yanbu Journal of Engineering and Science. 2020;17:15-26. doi:10.53370/001c.23728