A Survey on Impact Assessment of D-FACTS Controllers with Electric Vehicles in Distribution Networks: A Review

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Abstract - *Transport electrification is gaining popularity as a technique to enhance the effectiveness, efficiency, and longevity of transportation networks. While EVs might aid in de-carbonization efforts, the low-voltage distribution network may experience technical difficulties due to the increased demand for electricity. Using probabilistic load flow, we can put a number on the inherently unpredictable effects of electrification on transportation. When dealing with the probabilistic uncertainties brought on by fluctuating EV charging patterns, Monte Carlo-based simulation is used. Standards for power quality fluctuations (voltage drop, voltage imbalance factor, and voltage sag) are monitored while high-power charging (up to 11 kW) is considered at the residential level. Because of the importance of identifying the anticipated repercussions due to high EV charger proliferation at household locations, this work focuses on the Irish and UK, distribution system operator's-transmission system operator's viewpoints. The findings show that 40% of all residential consumers may safely connect electric vehicles to the distribution network using a 3.68 kW charger, with no impact to power quality. In addition, if EVs are restricted to the beginning and centre of the network, their spread can be accelerated by as much as 100 percent (relative to the feeder substation transformer). There is a limitation due to the voltage imbalance factor for greater charger capabilities (up to 11 kW).*

Key Words: D-FACT, power, Electric vehicle, network distribution, control of power flow.

1. INTRODUCTION

More widespread usage of electricity in transportation might reduce demand for fossil fuels and consequent emissions of greenhouse gases. Similar to the challenges the transportation sector has with scheduling, the introduction of electric cars might introduce additional complications to the planning and administration of power networks, where supply and demand must be matched on a minute-to-minute basis (EVs). Conventional energy grids are being forced to undergo a major makeover as more and more low-carbon technologies (LCTs) emerge at the distribution level. Distribution-stage consumers 'presume' an active role beyond passively consuming. Transmission-level technical effects from LCTs, such as electric vehicles (EVs) offering ancillary services, may be communicated to the distribution level.

TSO and DSO (distribution system operator) collaboration is required here. A sensible line of action would be to look at distribution-level solutions that may help alleviate technical worries. In order to mitigate the impact of technical faults on the TN, the DSO has to be aware of the penetration limits of LCTs well in advance of their manifestation [1]. If you know this, you can estimate how many individuals may be affected by technological problems. The impact of distribution networks (DNs) on transmission networks (TNs) cannot be accurately monitored in real time due to a lack of observability at the DN level [2]. DSO operations and planning tactics are influenced by uncertainties associated to LCTs, especially when using present assets. This research considers several intensities of EV charging to find the best way to use existing infrastructure.

Several results are generated using a mathematical model of the network's response to the addition of EV chargers. A probabilistic research is conducted to ascertain the number of consumers affected by a certain penetration level in order to establish conclusions on the maximum EV penetration that a DN can support without suffering technical challenges.

1.1. Contribution

The vast majority of researchers who have contributed to the body of published work assess the performance of DNs in terms of fluctuations in PQ, including voltage loss, voltage imbalance, cable loading, and other factors. There have only been a few of studies done to measure the performance of networks in terms of severe condition occurrences like voltage sag and voltage swell. The authors combine the realistic topology of the Irish DN with the usage of an MCS in order to forecast the effect of PQ changes and occurrences of EV charging on the legacy grid. This fills a gap in the study as well as makes a contribution to the field. This technique is intended to provide assistance to the DSO in the process of evaluating the effect that various EV chargers have on the network. The various voltage measurements are investigated, which enables a better comprehension of the various electric vehicle (EV) chargers and the consequences they have on the network. This work can further facilitate novel approaches for DSOs to implement an energy transitive framework featuring the presence of utility-owned electric vehicles; as a novel planning model based on programming, which is suitable to properly utilise their existing (and future) assets. This work can also help facilitate novel approaches for DSOs to implement an energy transitive framework featuring the presence of utility-owned EVs.

1.2. Generation of Facts Devices and Their Classification

The conventional method that is used by the power system has been subjected to a number of alterations as a direct result of the huge increase in power consumption that has occurred over the course of the previous few decades. We will be able to satisfy the need for energy if we are able to enhance the amount of power flow that is being managed now that the FACTS controller has been constructed. These devices improve the capacity of power transfer up to the thermal limit and make more efficient use of the power transmission lines that have already been installed. These devices have the capability of effectively modifying the properties of the transmission line [15], such as the impedance, bus voltage, and phase angle.

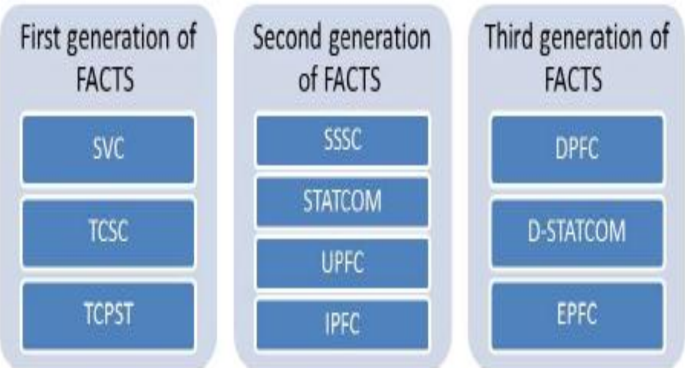

Figure-1: Generation of FACTS devices

2. LITERATURE

After studies research paper related to project work, the summary of all research work are given below:

[1] Gupta, Ashwani: the researchers drew the following findings after looking at all of the available studies on the spread of DG and D-FACTS equipment in DS: However, there is scope for research expansion in both UBRDS and MDS, and the majority of the researchers focused their attention on the distribution of DG within the balanced distribution system. The most efficient method of disseminating D-STATCOM inside BRDS is the subject of a debate that follows. There is no mention of a research having been conducted on MDS or UBRDS in combination with D-STATCOM. Before making an accurate evaluation of DS, one must first carry out a cost-benefit analysis and then get in touch with D-STATCOM. In addition to this, it is essential to carry out a comparative study applying many different optimization methodologies in order to determine the best way to distribute D-STATCOM. Only a relatively limited number of authors have researched the impact that may be created in DS by strategically deploying DVR and SSVR resources. Aside from this, there have only been one or two authors who have analysed UBRDS with the installation of DVR or SSVR. Other than that, there isn't much research available. Up to this time, the DVR / SSVR allocation process in MDS has not been made public by any of the writers working on the project. In this article, a suggestion for the most effective UPQC allocation technique as well as a comparison with D-STATCOM are provided. UPQC is capable of delivering better results in comparison to D-STATCOM in terms of voltage profile improvement, decrease in line losses, and annual savings in energy consumption. These benefits may be achieved via the use of UPQC. When investigating BRDS, the overwhelming majority of the studies have relied entirely on UPQC. On the other hand, UPQC has not yet been used to carry out studies on either UBRDS or MDS. As a direct consequence of this, there is an urgent need to explore, in addition to UPQC allocation, not just UBRDS but also MDS. The overwhelming majority of contributors have conducted their own separate investigations into their DG and UPQC assignments. Despite this, RDS and MDS, in addition to the distribution of DG and UPQC, have not been investigated together up to this moment. There has been no research done to this day to identify how the probabilistic load impacts the allocation of unique D-FACTS devices or how it affects DG and D-FACTS devices simultaneously. This is because there has never been a need to find out this information.

[2] Haley: The research that was done on the EV industry revealed that there are now just 0.01% of automobiles in the United States that are electric vehicles. This information was gleaned from the outcomes of the study that was carried out (EVs). Moreover, there are a great many disadvantages connected with electric vehicles for buyers, which prohibits EVs from achieving the same degree of market penetration as their rivals. The most obvious negatives are the steep price tag, the limited distance that can be travelled on battery power, and the extended period of time that is required to fully charge the battery. As a consequence of government incentives, electric vehicles (EVs) are becoming more accessible to customers; nevertheless, these subsidies will not be available for an unlimited amount of time. Rather, their only purpose is to encourage the early development of electric vehicles in the hope that prices for such vehicles would become more affordable in the not-too-distant future. Despite this, there are a variety of economic and political factors that may make it unlikely that the cost will decrease in the very near future. The fact that China has a monopoly on the production of rare earth minerals is a topic that is generating a significant amount of concern. Electric vehicles (EVs) provide a lot of advantages, one of which is an improved fuel economy. According to an initial evaluation of the effectiveness of the methods used to deliver energy by both types of vehicles, it was found that gasoline-powered vehicles (GV) use approximately 25 percent more energy than electric vehicles (EVs), which led to the conclusion that EVs may save somewhere in the neighbourhood of 25 percent more energy than GVs. Despite the fact that the efficiency estimates were not especially accurate, they nevertheless revealed that it is highly likely that electric cars utilise less energy than gasoline-powered vehicles do. Electric cars have the potential to significantly reduce carbon emissions as well as the rate at which fossil fuels are being depleted. However, in order to take full advantage of this benefit, a greater percentage of nuclear or renewable resource energy generation should be utilised.

[3] Noor et.al: Electric cars have a big possibility to become the method of transportation of the future while simultaneously saving the globe from the looming tragedies that are the consequence of global warming. This is because electric vehicles do not produce any harmful emissions. They provide a viable alternative to conventional automobiles, which operate on fossil fuels and are seeing their supply dwindle as the world moves away from them. This page presents a detailed investigation of the several electric vehicle (EV) models, configurations, energy sources, motors, power conversion, and charging systems that are presently on the market. We started with the most significant technologies that were discussed in each category and moved on to describing the characteristics of those technologies. The effects that electric vehicles have in a variety of industries have also been investigated, as have the vast opportunities that EVs present for the development of an energy infrastructure that is both more effective and less harmful to the environment. This is because EVs are able to work in conjunction with smart grids and make it simpler to incorporate renewable energy sources. The shortcomings of electric cars (EVs) that are now on the market have been discussed, along with some possible solutions to these problems that may be implemented. In addition to that, the most up-to-date control algorithms and optimization methodologies have been included into the design. This article is a concise overview of the current state of the electric car industry. Following the analysis of ongoing tendencies and prospective pathways for the industry's progress in the future, the results of this particular article were used to provide a concise overview of the whole piece of writing. This painted a very clear picture of the sector and highlighted the areas that need more examination.

[4] Kang: in order to relieve some of the strain that is being put on the power grid by decentralised sources of renewable energy, we need to find a solution that incorporates both of these concepts. Both the first and second chapters covered and brought attention to three areas where the research was lacking, and they are as follows: There is a need for a method that is both effective and efficient for the diagnosis of network stress for smart home appliances in order to effectively install a distributed and decentralised DSM system. This is necessary in order to ensure that the system will function as intended. The question of what the ideal size of the EHWT is when it is considered in isolation within DSM has not been thoroughly investigated to the extent that it has been thought about in great detail within the framework of combined hot water systems that make use of tanks that are heated by a variety of energy sources. This is in contrast to the level of consideration that has been given to the question when it is considered within the context of combined hot water systems that make use of tanks that are heated by a variety of energy sources This is in spite of the fact that, within the context of combined hot water systems, a significant deal of consideration has been given to the question of how large the EHWT should be. There has not been a thorough research into whether or whether a bottom-up network simulation technique is capable of being linked with an intelligent EWHT model. This is despite the fact that this question has been asked on several occasions.

[5] Ahmad: At the present, there are around 9000 electric cars operating on the roads in Hungary; however, it is anticipated that this number will significantly increase in the not too distant future. The question that has to be addressed, then, is how many electric cars can be supplied by the infrastructure that is already in existence. The widespread adoption of electric cars on the current grid might have substantial negative impacts, such as an increase in peak demand, an overloading of transformers, and increased power losses. These are only some of the potential consequences. In addition to this, there is a possibility that it may cause power quality concerns inside the grid, such as under-voltage conditions, harmonics, and voltage and current profiles. As a consequence of this, it is vital for us to study the many solutions that are available to us in order to lessen the effects of this. We modelled a small grid in the DigSilent powerfactory software and connected a few home loads and electric carloads in order to run the simulations. This was done so that we might have a better knowledge of the effects that charging electric automobiles have on the low voltage grid. We do an unbalanced load flow analysis and a time sweep analysis in order to establish the loading that is being placed on the transformer as well as the voltage and current profiles that are being produced by the loads. In anticipation of the day when there will be a substantial number of electric autos on the road, we were able to simplify the analysis of the results thanks to the scripting capabilities of the Python programming language. After conducting the research and utilising the box and whisker plot, we came to the realisation that the transformer that is utilised in our grid is overloaded. This indicates that the transformer spends the vast majority of its time functioning at a loading level that is greater than one hundred percent of its capacity. The drop in voltage along the bus bar that is farther away from the external grid is larger than the loss in voltage along the bus bar that is closest to the grid. It has been brought to our notice that the average voltage loss at each of the bus bars falls somewhere in the range of 0.96 pu to 0.99 pu. This information may be found in the following sentence: In addition, the current loading is, in the vast majority of cases, less than sixty percent of its capacity; but, there are times when it is extremely close to reaching one hundred percent of its capacity. Further simulations on a large number of electric cars are something that can be done in order to gain a more accurate image of the loads that transformers are under and the voltage problems that they face.

[6] Arsalan: in regards to the many phases that the charger goes through. An MCS has been chosen as the suitable instrument because of the probabilistic nature of EVs. This has led to the instrument's selection. Evaluating the present assets of the DN allows for the determination of the maximum amount of stress that it is able to bear in terms of the penetration of electric vehicles (EVs). As a result of the increased EV load, the DN is likely to encounter power quality issues, such as a reduction in line voltage and variable unbalance factors (VUFs), as stated by the results. From the perspective of the DSO, owners of electric vehicles are only entitled to use a 3.68 kW charger inside the confines of their own private residences. According to the conclusions of the research, forty percent of the proliferation of electric cars in the network does not result in any sort of technical issue in respect to the EN50160 standard. This information was gleaned through the examination of the situation. It is vital to first assess the breadth of the technological difficulties that are hurting the network in order to come up with any type of solution to the problem. This network is capable of supporting a 40% penetration of electric cars without requiring any further network upgrades or mitigation measures to be implemented. Distribution service organisations (DSOs) need to be proactive in defining the limits of their networks since it is inescapable that the number of electric cars and the number of charging stations for electric vehicles will continue to expand. In the framework of DN design, it is absolutely necessary to take into consideration the extreme circumstances that might possibly arise. When the conditions are as terrible as they possibly can be, the voltage level drops to 0.88 p.u. If the voltage level of 0.88 p.u. is maintained for more than a minute without changing, there is a chance that the network may become unstable. When planning the layout of the distribution grid, whomever is in charge of the network has to make sure they remember to take into consideration a number of potential catastrophes. The research does not take into consideration the possibility of a charging system that makes use of smart charging or time sequencing. The smart charging methods have a lot of potential, but it may be difficult to put them into practise because the communication protocol that is required to monitor load demand is so complicated. Although the smart charging methods have a lot of potential, it may be difficult to put them into practise. It's possible that specialised devices, such a static VAR compensator (SVC) or a static synchronous compensator, might provide other kinds of solutions instead (STATCOM). Although they are costly, it is possible to obtain a prompt response from them.

An increase in the voltage imbalance is brought on by unbalanced loading, which in turn brings about an increase in the voltage imbalance brought on by increased charging rates. The VUF of the system as a whole goes through a significant amount of change, which may lead to serious violations with respect to 7 and 11 kW chargers and may also have additional repercussions. In conclusion, the ever-increasing number of EVs throughout the system creates a significant number of significant challenges about the quality assurance of the PQ. According to the results of this probabilistic analysis, VUF is still the primary concern, although voltage level breaches provide a lesser degree of difficulty. This research has the potential to serve as a method for assessing the potential effects that would be brought about by the widespread installation of EV chargers in the real and operational network. Calculating the potential consequences of the many different EV charger ratings that are now available on the market is now possible for us thanks to the use of this technology.

The PLF method has the ability to provide results that are accurate to a certain degree. [Case in point:] [Case in point:] On the other hand, if the probability distribution of the input values and the range of mathematical modelling are not exact, one of the potential difficulties of using this strategy is that the conclusion may be meaningless, which is one of the potential drawbacks of using this approach. One of the possible drawbacks of using this approach is the presence of this one. The MCSs have the potential to take up a lot of time because of their complexity. When calculating the outcome of a scenario, the amount of time required will increase in proportion to the level of complexity of the model that is being applied. In addition, in order to maintain an acceptable level of uncertainty about the results, it may be required to explore a large number of different alternatives [9]. It is possible to utilise techniques that are known as variance reduction approaches [9] in order to reduce the amount of distinct scenarios that are used in each simulation. This is something that can be done. In the next phase of our research, we will investigate the many different ways that PLF may be included into time sequence charging.

[7] Junjie: Distribution networks are discovering that they are being put up against new hurdles as an increasing number of electric cars are linked to the electrical grid. The increasing prevalence of electric cars has directly led to the emergence of these difficulties. Congestion issues may arise at a number of various locations and points throughout distribution networks, and this may be a problem in a variety of different circumstances depending on the specifics of the situation. The thermal restrictions of the lines, as well as those in the HV/MV power transformers, are probably going to be the ones that give engineers the most trouble.

The hierarchical management structure that is presented in this study includes both the distribution system operator (DSO) and the electric cars fleet operator. (EV FO). In the context of this discussion, a market-based analysis serves as a lens through which an examination of the negotiation that takes place between EV FO and DSO in settings where congestion is present is carried out. In this section, it is explained how the negotiation architecture that was designed for the multi-agent platform JACK takes into account not only the agent for the power market operator but also the agent for the owners of electric vehicles. JACK was designed so that multiple agents can work together on a single platform.

[8] Masoud: Develop two distinct incremental voltage control algorithms, each of which should have a convergence condition that is easier to meet than the other one's. One of these methods should be based on a sub-gradient, while the other should be a pseudo-gradient that provides a lesser degree of implementation complexity. The sub-gradient-based approach should be the one to use. Both of these algorithms have to be the same in every other aspect in order to be considered equivalent. We compare and contrast these two approaches in terms of the degree of convergence that is needed of them and the pace at which they converge on a solution. In addition to this, we go through the many ways in which each of these approaches overlap with one another.

[9] Rosario: During the course of our investigation, we discovered that one of the key grounds of contention about the validity of hybrid energy systems was the cost of the ultracapacitors. This was brought to our notice when we were doing this study. Despite the fact that doing an economic analysis was not a part of the scope of the research, it was abundantly clear that this was the circumstance that had arisen. On the basis of this hypothesis, which states that the use of ultra capacitors would be restricted due to cost concerns, a number of conclusions regarding the future of this technology may be derived. One of these conclusions states that the use of ultra capacitors would be limited due to the fact that they are so expensive. However, in the end, each of these research papers concludes by arguing that the technology is unfavourable due to how expensive it is. There are currently a number of research papers that are available that speak openly about how well ultra capacitors would perform as peak power mitigation devices for electric cars. Even if the price of ultra capacitors is brought down to an incredibly low level, there will still be a significant amount of overhead in the form of metals and other passive components within the power electronics architecture that is connected with them. This is the case even if the price of ultra capacitors is brought down to an extremely low level. This is the situation regardless of whether or not the price of ultra capacitors is reduced to an unimaginably low level. The published research devotes a smaller portion of its focus to this issue in comparison to other areas. Figures should include the power electronics overhead that is fundamentally required to leverage the use of ultra capacitors in electric vehicles in order to make it easier to conduct an analysis of the costs associated with ultra capacitor applications. This will make it possible to analyse the costs more accurately (EVs). In terms of the power electronics infrastructure, an extra factor that has to be taken into account in addition to the cost per kilowatt is the weight per kilowatt. This is because the two factors are directly related to one another. According to a recent calculation of power electronics metrics (which was used with permission), these statistics are around 5 kW/kg @ £12/kW at the current time 1. It is anticipated that by the year 2020, these figures will have increased to 14.1 kW/kg at £1.8/kW. This growth is anticipated to take place. In point of fact, this demonstrates the aspects of the economic assessment that need to be addressed, and as a direct result, the arguments in favour of further PES design optimization are supported.

[10] Rui: MATLAB was used to construct a model of electric batteries that is an exact replica of the real thing. This model was then subjected to rigorous testing to determine its viability. This model has been utilised in order to analyse the natural variation that occurs in the terminal voltage as well as the power output of the battery throughout both the charging and discharging cycles. This variation was found to be significant enough to warrant analysis. In order to integrate the electric car batteries with the distribution network, the idea of a rapid charging station for electric vehicles has been deconstructed, and a full simulation model of the operation of the station has been built. This was done in order to facilitate the integration of the electric car batteries with the distribution network. The integration of the batteries for the electric vehicles was the motivation for this action. A presentation has been given on the subject of modelling a wind turbine using DFIG, which was the topic of the presentation. During the process of constructing the simulation model, crowbar protection was taken into consideration. This is due to the fact that a wind generator has to be able to continue functioning despite issues. As a direct result of the fact that the results of the simulation shown that the crowbar protection enables fault ride-through for the DFIG wind turbine, it is essential that the voltage of the DC-link capacitor be maintained within an acceptable level at all times. The crowbar's job is to dissipate the excess active power and stop the DC-link capacitor voltage from developing needlessly, both of which might lead to a greater rotor current flowing through the RSC. Its other job is to prevent the DC-link capacitor voltage from growing unnecessarily. Another aspect of its function is to ensure that the voltage across the DC link capacitor does not increase unnecessarily. This is accomplished by avoiding an increase that is not required in any way. It is generally agreed upon that the most significant contribution that has been made by this body of research is the investigation of the interactions that take place between charging stations for electric cars and the active distribution grid. This is the consensus held by the majority of those who have participated in the discussion. [Further citation is required] In this chapter, we examined the possibility that charging stations for electric vehicles could provide voltage support for the operations of distribution networks, thereby improving the fault-ride-through of wind turbines that are located nearby. These charging stations would need to be equipped with the capability to manage the flow of electricity in both directions. In addition to the fact that the control paradigm has been shown to be viable, simulations have shown that it is also effective. In addition to the fact that it is feasible, this is a benefit. As a consequence of this, the voltage support that is provided by EV charging stations has a significant potential to be developed as an additional service within the operations of smart distribution grids. This would be a result of the smart distribution grids having a greater capacity to accommodate additional services. There are a variety of approaches that may be used to achieve this goal.

[11] Jun: In order to stop electric cars from becoming a strain on distribution networks, it is necessary to have a comprehensive strategy for charging as well as an intelligent control system. This is a must. If this is done, it will make it possible to stop electric automobiles from putting a strain on the power distribution networks. It is possible that it will provide the regulators of the energy system with information that will assist them in formulating and reviewing EV policies that will stimulate the adoption of distributed PV and electric cars. This possibility exists because it is possible that it will offer such information. This is a potential outcome. There are many different market participants involved in the energy sector, and some of these market actors can have an interest in expanding the potentially profitable commercial prospects presented by pricing services. The following are examples of possible market participants: The results of this inquiry, as well as any conclusions and suggestions that may be derived from those results, are going to be reported in the next chapter. These results will also be published in full. In addition, it has been suggested that further research of a similar kind to the one that is now being carried out should be carried out concurrently with the study.

[12] Jian: It has been discovered that the transformer is the key obstacle that must be overcome in order for electric cars in the region to be charged. Even if the transformer power capacity and the base load could be able to place a limit on the penetration level of charging for electric vehicles, the ambient temperature would still be able to have an influence on it. In this scenario, the charging capacity of the dump charging pattern, also referred to as the simultaneous charging pattern, is calculated by utilising both the factor of acceleration ageing and the factor of equivalent ageing of the transformer. Both of these factors relate to the ageing of the transformer. This is done for the reason that the dump charging pattern, which is also referred to as the simultaneous charging pattern, is used. As part of a larger-scale initiative to increase the number of charging stations located in residential areas, optimum charging procedures for electric vehicles are now being development. Because it takes into consideration both the driving behaviours and the constraints of the transformer, the variable charging rate is used in the optimization process. This allows for optimal results. It is possible to greatly increase the capacity for charging if, rather than rebuilding the essential infrastructure, a charger with 6.6 kW that is designed for use with the Honda Fit is used as the representative charger. In the simulation of the feeder load, the scenario in which the charging is not balanced will result in more power losses than the situation in which the charging is balanced would produce.

3. CONCLUSION

I arrived to this conclusion after reading a few research papers on the use of D-fact in electric cars. These studies led me to the realisation that D-FACTS devices had the capability to execute comprehensive power flow control. The advantages that D-FACTS devices have in terms of line flow control, decrease in loss, and voltage regulation are as follows: The application that appears to have been the most successful is the one that controls the flow of the line, followed by the application that controls the loss, and then the application controls the voltage. It has been shown that these methods are ubiquitous, and they may be used to locate more suitable D-FACTS applications and to solve for the appropriate line impedance values. Both sensitivity analysis and optimization are included into the methodology of the solution. As suitable applications are developed, incremental D-FACTS device deployments may be carried out in locations that have been determined to be the most successful in satisfying the demands that have been identified.

REFERENCE

1. Atma Ram Gupta and Ashwani Kumar, "Deployment of Distributed Generation with D-FACTS in Distribution System: A Comprehensive Analytical" 2019, IETE JOURNAL OF RESEARCH https://doi.org/10.1080/03772063.2019.1644206

2. Paul Haley "Effect of electrical vehicles on residential distribution systems" 2012, Louisiana State University and Agricultural and Mechanical College

3. Fuad Un-Noor 1, Sanjeevikumar Padmanaban 2,*, Lucian Mihet-Popa 3, Mohammad Nurunnabi Mollah 1 and Eklas Hossain 4, "A Comprehensive Study of Key Electric Vehicle (EV) Components, Technologies, Challenges, Impacts, and Future Direction of Development" 2017, *Energies* 2017, *10*,

1217; doi:10.3390/en10081217 www.mdpi.com/journal/energies

4. Ren Kang “Appliance-level Demand Side Management for Power Network Stress Mitigation” 2016, Department of Engineering Science University of Oxford

5. Seerin Ahmad “IMPACT ASSESSMENT OF ELECTRIC CAR CHARGING ON LV GRIDS” 2019, Budapest University of Technology and Economics Faculty of Electrical Engineering and Informatics Department of Electrical Power Engineering

6. Arsalan Zaidi “Impact Assessment of High-Power Domestic EV Charging Proliferation of a Distribution Network” 2020, IET Generation, Transmission & Distribution

7. Junjie Hu “Control strategies for power distribution networks with electric vehicles integration” 2014, Kongens Lyngby.

8. Masoud Farivar “Optimization and Control of Power Flow in Distribution Networks” 2016, California Institute of Technology Pasadena, California

9. Leon C Rosario “Power and Energy Management of Multiple Energy Storage Systems in Electric Vehicles” 2007, Cranfield University, DCMT Shrivenham Swindon, Wiltshire, SN6 8LA, United Kingdom

10. RUI SHI “The Dynamic Impacts Of Electric Vehicle Integration On The Electricity Distribution Grid” 2012, Electrical and Computer Engineering The University of Birmingham

11. Jun Su “Smart Management of Electric Vehicles Charging in Distribution Networks” 2020, School of Engineering, Computer and Matehmatical Sciences, Auckland University of Technology

12. Jian Xiong, B. Eng. “Impact Assessment of Electric Vehicle Charging on Power Distribution Systems” 2014, Electrical and Computer Engineering Ottawa-Carleton Institute for Electrical and Computer Engineering Carleton University Ottawa, Ontario

13. S. L. Judd, and T. J. Overbye, "An evaluation of PHEV contributions to power system disturbances and economics," in *Proc. 2008 40th North American Power Symposium,* pp.1-8.

14. X. Yu, “Impacts assessment of PHEV charge profiles on generation expansion using national energy modeling system,” in *Proc. 2008 IEEE Power and Energy Society General Meeting - Conversion and Delivery of Electrical Energy in the 21st Century,* pp.1-5.

15. K. Schneider, C. Gerkensmeyer, M. Kintner-Meyer, and R Fletcher, “Impact assessment of plug-in hybrid vehicles on Pacific Northwest distribution systems,” in *Proc. 2008 IEEE Power and Energy Society General Meeting,* pp. 1-6.

16. S. Rahman and G.B. Shrestha, “An investigation into the impact of EV load on the electric utility distribution system,” *IEEE Trans. Power Delivery,* vol. 8, pp. 591-597, Apr. 1993.

17. J. de Hoog, T. Alpcan, M. Brazil, D. A. Thomas, and I. Mareels, “Optimal Charging of Electric Vehicles Taking Distribution Network Constraints Into Account,” *IEEE Trans. Power Systems,* vol. PP, pp. 1-11, May, 2014.

18. P. Richardson, D. Flynn, and A. Keane, “Optimal charging of electric vehicles in low-voltage distribution systems,” *IEEE Trans. Power Systems,* vol. 27, pp. 268-279. Feb. 2012.

19. J. de Hoog, D. A. Thomas, V. Muenzel, D. C. Jayasuriya, T. Alpcan, M. Brazil, and I. Mareels, “Electric vehicle charging and grid constraints: Comparing distributed and centralized approaches,” in *Proc. 2013 IEEE Power and Energy Society General Meeting,* pp. 1-5.