Decentralized Cooperative Control for Smart DC Home with DC Fault Handling Capability using ANFIS controller

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Abstract: ***Mainly it presents a decentralized cooperative control (DCC) method along with a fault phase identification (FSI) theme to realize the management and protection objectives for a smart dc home by victimization solely native measurements. The dc house is interfaced with the utility grid via a replacement standard structure convertor configuration, facilitating fault-tolerant capability in low voltage dc systems. Distributed generators are integrated into the dc home via power converters to ensure adequate energy capacity and to support ac and dc masses consumption within the off gridmode. The planned DCC methodology ensures correct current sharing, dc bus voltage regulation, and quick restoration once the fault clearance. On the opposite hand, the most objective of the proposed FSI theme is to quickly establish and isolate the faulty segment to safeguard the sensitive power electronic parts in the dc home from the high fault current. The FSI technique identifies the faulty phase by victimization solely the knowledge extracted from the native current device. Time-domain simulation studies victimization careful nonlinear models ensure the effectiveness of the planned management and protection schemes below numerous normal and faulted operative eventualities. Hardware-in-the-loop studies demonstrate the practicability of hardware implementation and verify the planned system performance.***

Keywords:-DC home, decentralized cooperative control(DCC), fault segment identification (FSI), modular multilevel converter (MMC).

I. INTRODUCTION:-

As of late, the dc appropriation framework idea has pulled in developing enthusiasm for private electrical framework applications, meaning to improve unwavering quality, control quality, and productivity. The execution of keen control systems gives structures with reasonable vitality framework. Such execution adds to strong low-vitality building plans by consolidating the ideas of effective vitality control, self-healing, furthermore, savvy stack checking. The brilliant dc home is an empowering structure for joining savvy control units, disseminated sustainable power sources (RESs), vitality stockpiling frameworks (ESSs), and dc and air conditioning loads. This sort of home has gigantic potential and favorable circumstances over its air conditioning partner in terms of effectiveness improvement, change stages lessening, also, control exchange limit change. An easier control framework and a more regular interface to RESs and ESSs are different highlights of the dc home framework within the sight of a developing number of dc electronic gadgets in structures [1]– [5]. Alongside these additions, the most unmistakable difficulties are the absence of institutionalization of the control and advancement of insurance procedures, which obstructs the execution of shrewd dc homes in present day power systems.

The fundamental control destinations in a dc home are exact power sharing among appropriated generators (DGs) and precise direction of the dc transport voltage. For the matrix tied homes, another control framework should be intended to guarantee high effectiveness also, to improve the power nature of the air conditioner/dc transformation arrange. The hang control technique is ordinarily utilized as the essential control to direct the yield voltage of individual converters by adding a virtual impedance to the voltage control circle [1]. Nonetheless, the fundamental hang strategy has a few downsides counting load-subordinate voltage deviation and the powerlessness to give composed execution of various assets.. The brought together control gathers data from all conveyed units through correspondence joins [6]– [8]. The exploration brings about [9] demonstrated that the administration in vitality what's more, ecological outline (LEED) structures outfitted with the concentrated and static control frameworks may not be vitality proficient. What's more, the fundamental inconvenience of the concentrated control is that any correspondence connect disappointment can cause the fell disappointment of different units and destabilize the whole framework. As an elective technique, the conveyed control improves the correspondence system and facilitates the adaptability of the framework by trading data as it were between units [10]. The principle disadvantage is that the handshaking technique may make the whole framework close down when a blame happens. Consequently, a proficient calculation is required so as to adapt with the previously mentioned disadvantages in the beforehand proposed insurance plans.

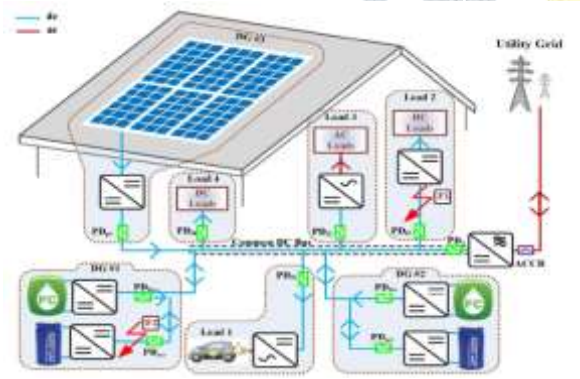
This paper shows the outline of a decentralized agreeable control (DCC) technique and a blame fragment recognizable proof (FSI) conspires for a keen dc home. The DCC technique coordinates a virtual impedance inside the decentralized control circles of the DGs and interlinking converter to ensure exact power after blame event. What's more, the FSI plot is created to rapidly recognize and separate a broken fragment to secure touchy resources from the high blame current by utilizing just neighborhood estimations. In the FSI plot, the neighborhood current gives

the expected data to distinguish the flawed fragment. At the framework level, another secluded multilevel converter (MMC) setup with dc blame tolerant ability is utilized to interface the dc home with the utility lattice. This arrangement has the innate ability to deal with the dc blame current in low-voltage dc (LVDC) frameworks by keeping the lattice from sustaining the blame. In this paper, the flexibility of the proposed control and security plans is approved by utilizing point by point nonlinear time-area reenactments in the PSCAD/EMTDC programming. Besides, the dc home is actualized in the FPGA-based constant stage to confirm the framework execution in an equipment on top of it setup. The outcomes demonstrate the specialized potential and self-maintainability benefits.

II. CONFIGURATION OF THE SMART DC HOME

The smart dc home under examination is made out of half and half energy component/supercapacitor (FC/SC) control sources, a housetop photovoltaic (PV) board, home apparatuses demonstrated as dc and air conditioning loads, and an electric vehicle charging station. The dc home structure, as a LVDC framework fundamentally conformed to the basic dc transport, is appeared in Fig. 1. The half and half FC/SC control framework incorporates the FC stacks to give the fundamental power through a unidirectional dc/dc converter and the SC modules to help the transient reaction of the primary power source through a bidirectional dc/dc converter.

A housetop PV unit with a unidirectional dc/dc converter is associated with the normal dc transport, working as a helper control source. The smart dc home is interfaced to the utility matrix by means of another blame tolerant MMC topology giving a bidirectional trade of vitality between the dc transport and the utility framework.



Fig, 1. Smart dc home configuration

A MMC furnished with quick, low-voltage, and low resistance MOSFETs gives a prevalent execution in LVDC applications. Contrasted and traditional two-or three-level inverters, the MOSFET-based MMCs offer low channel cost and size, basic acknowledgment of repetition, and low exchanging misfortunes. As per the itemized investigation of the effectiveness, the MOSFET-based MMCs exhibit an unrivaled execution in the low power extend, with the goal that they are the most appropriate choice in applications like those in savvy dc homes. Above all in case of a dc transport cut off, put away vitality in the dc capacitors of regular a few level inverters prompts a high dc blame current. Nonetheless, contingent upon the sub modules (SMs) structure, MMC topology can sidestep or square the blame current way. The half-connect converters are the most well-known sort of SMs that are serially associated with shape a MMC. In any case, the characteristic absence of dc-blame dealing with capacity is one of the significant difficulties related with the MMC utilizing half-connect SMs. Subsequently, the assurance framework vigorously depends on the air conditioning electrical switch (ACCB) to trip if there should arise an occurrence of blame event. A schematic graph of the new MOSFET-based MMC is exhibited in Fig. 2. Every leg of the MMC comprises of two arms, and each arm has N indistinguishable secluded SM circuits. The circuit of the proposed SM is intended to give the MMC with dc-adaptation to non-critical failure capacity. The fell SMs have the capacity of hindering the dc-blame current by producing a switch voltage V_{dc}. These SMs have enormous points of interest over the full-connect SMs in light of the fact that the previous deliver a similar turn around voltage with bring down exchanging misfortunes. Besides, the proposed SM offers various parallel current ways through the capacitors inside the converter.

In like manner, this component diminishes the yield impedance of the circuit, upgrades the proficiency, and guarantees a high current delivering capacity. Moreover, the proposed SM can be implanted in the MMC structure without changing the control procedure. Contingent upon the exchanging status, every SM creates up to three voltage levels. The improved unwavering quality, particular plan, and dc blame taking care of capacity of the new MMC structure add to the enhanced power nature of the dc home framework. The association purposes of each section to the basic dc transport and dc-side of the MMC are furnished with assurance gadgets (PDs), which add to the capacity of the stage to hinder the flawed portion once a dc blame happens. In like manner, picking among the topologies is application-ward and requests a money saving advantage investigation. A PD comprises of a strong state electrical switch, snubber circuit, processor for setting the limits, and current sensor to measure the current. The PDs are controlled by the FSI strategy to distinguish and confine defective portions by utilizing the data removed from the neighborhood current sensor.

III. PRINCIPLES OF CONTROL AND PROTECTION STRATEGIES

This segment clarifies how the standards of the proposed DCC and FSI techniques guarantee a steady and dependable activity of the dc home in serious power unbalance and dc blame conditions.

A.Decentralized Cooperative Control Method

The control square outline of the brilliant dc home is appeared in Fig. 3. The DCC system in light of neighborhood estimations is exhibited to accomplish a viable power adjust among the parts of the dc home without the requirement for correspondence. The dc home, furnished with the DCC technique, supplies the aggregate vitality request in the off-matrix mode, and viably deals with the vitality utilization in both the on-and off-network modes. In the half and half FC/SC unit, the FC framework controls the FC current and furthermore controls the hydrogen stream as per the

FC current. The FC converter utilizes a corresponding essential (PI) controller to give the power request at a

managed dc transport voltage. As appeared in Fig. 3(a), the present limiter is included to guarantee as far as possible and certification the safe task of the FC unit. Likewise, a present slant confinement square is coordinated into the FC control circle to evade the fuel starvation marvel. To control the hydrogen stream, the hydrogen reference is characterized as

$$q_{H_2}^{ref} = \frac{2k_c}{U_o} I_{FC} \qquad (1)$$

where IFC is the yield current of the FC stack, k_c is a displaying consistent (kmol/(sA)), and Uo is the ideal fuel usage rate, which is commonly in the vicinity of 80% and 90%. The reformer unit is coordinated to create the required hydrogen from methanol. A PI controller is utilized to control the hydrogen stream as indicated by the FC current inside the ideal fuel usage go. In transient tasks, the moderate dynamic reaction of the FC stack represents a risk to the framework execution. Subsequently, the SC unit in the mixture FC/SC setup assumes the key part of the integral power source, which is released or charged to make up for the control contrast between the free market activity. Since of the powerful thickness and quick unique reaction, the SC unit is additionally ready to supply the high-recurrence current part. A huge element of the half breed FC/SC control framework is that the controller of each power unit is outlined in view of criticism from its neighborhood flags and not from the control unit beside it. As an outcome, every framework can keep up its activity regardless of whether a blame happens in each of the FC or SC units. Furthermore, the unidirectional power stream of the FC converter brings about decoupled flow for the FC furthermore, SC units. To guarantee exact current sharing among the cross breed FC/SC frameworks and MMC as indicated by their ostensible limits, the voltage hang controller of the FC and SC units is outfitted with virtual impedances. A virtual impedance doles out the yield impedance incentive to each power unit to share a particular measure of the dc and high-recurrence current parts. The PV unit controller is intended to work in the most extreme power point following mode. The square chart of the proposed control system for the interlinking converter is appeared in Fig. 3(b). The external circle control, internal circle current, and coursing current smothering controls are the three principle control circles of the MMC controller. The external circle control produces the current reference for the inward circle current control square and can work in either the reversal or correction mode, depending on the state flag. For the external circle control in the reversal mode, the hang controller enables the MMC to share the power request of the network side by hanging its yield reference voltage extent and recurrence. The distinction between the stage voltage reference and estimated esteem is prepared by a non-ideal relative full (PR) controller to guarantee the coveted control qualities of the yield air conditioning voltage. The exchange capacity of the non-ideal PR controller with the thunderous recurrence at w is meant by

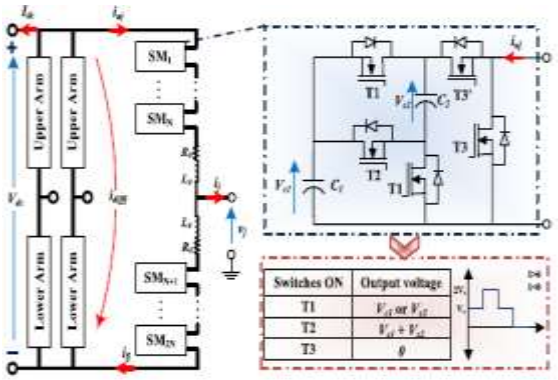


Fig. 2. Circuit diagram of the MMC and structure of fault-tolerant SM circuit.

Appropriately, this element diminishes the yield impedance of the circuit, improves the effectiveness, and guarantees a high current delivering ability. Also, the proposed SM can be inserted in the MMC structure without changing the control technique. Contingent upon the exchanging status, every SM produces up to three voltage levels. The upgraded dependability, measured outline, and dc blame taking care of ability of the new MMC structure add to the enhanced power nature of the dc home framework. The association purposes of each section to the regular dc transport and dc-side of the MMC are furnished with insurance gadgets (PDs), which add to the capacity of the stage to obstruct the broken fragment once a dc blame happens. Vast time constants and long breaker activity are a few downsides of mechanical circuit breakers and wires. An extensive time consistent for a PD draws out the blame clearing time in the security framework. Along these lines, quick acting strong state circuit breakers were intended to give critical preferences regarding the usefulness furthermore, speed of activity, normally 50-250 μs, for utilize inside dc frameworks. The practices of the different strong state electrical switch topologies have huge contrasts. In like manner, picking among the topologies is application-ward and requests a money saving advantage investigation. A PD comprises of a strong state electrical switch, snubber circuit, processor for setting the edges, and current sensor to measure the current. The PDs are controlled by the FSIsystem to recognize and disconnect flawed fragments by utilizing the data separated from the nearby current sensor.

$$G_h(s) = k_p + \frac{k_r \omega_c s}{s^2 + \omega_c s + \omega^2} \qquad (2)$$

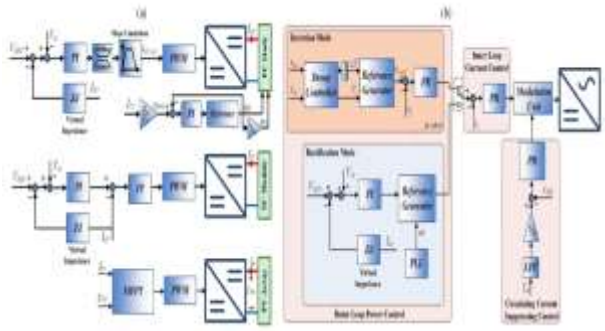


Fig. 3. Control diagram of (a) the DGs including control blocks for hybrid FC/SC and PV units, (b) the MMC including the outer loop power, inner loop current, and circulating current suppressing controls.

Where wc is the cutoff frequency. kp and kr are the proportional and resonant gains at the resonant frequency, respectively. The controller coefficients are designed to meet the performance characteristics. For the outer loop power control in the rectification mode, the dc voltage controller is equipped with a virtual impedance, in which the common dc bus voltage is given by

$$V_{dc}^{*} = V_{REF} - I_s Z_d \qquad (3)$$

where V_{REF} is the dc transport voltage reference, is the dc current of the separate power source, and Z is the virtual impedance of the hang control circle. The mix of the virtual impedance unit into the control circles of every converter ensures exact dc and high-recurrence current sharing among converters. The dc transport voltage controller gives the wanted control qualities of the dc transport voltage through a PI compensator. Next, the produced current reference is sustained to the inward circle current control square. The inward circle current control utilizes a non-ideal PR controller in the stationary abc reference outline. To outline the controller parameters, the dynamic model of the MMC plant from the internal current controller point of view is given by

$$e_j(s) - v_j(s) = \frac{L_0 s + R_0}{2} i_j(s) \qquad (4)$$

where e_j is the inward nonexistent voltage, v_j is the converter yield voltage, and ij is the line current in stage j. L0 and R0 signify the arm inductance and proportionate arm opposition, separately. In the inward circle current control hinder, the line current is controlled by an internal fanciful voltage. Moreover, the MMC control framework is furnished with another current control circle to control the flowing current. This circle incorporates a low-pass channel (LPF) and PR controller. The dc transport current is handled by the LPF to take out the twofold line-recurrence and high-arrange sounds from the deliberate flag. A non-ideal PR controller directs the circling current of each stage. From the coursing current controller point of view, the dynamic model of the MMC is communicated as

$$v_{diffj}(s) = (L_0 s + R_0) i_{diffj}(s) \qquad (5)$$

Where v_{diffj} and i_{diffj} are the inward lopsided voltage and current of the MMC in stage j, separately. In the coursing current smothering control hinder, the inward unequal current is controlled by an internal uneven voltage. At the last stage, the balance unit creates the exchanging signals for the MMC switches in light of the yields of the internal circle and flowing current stifling controls. The proposed DCC strategy works as a smart control framework to encourage control administration among various assets and the MMC with no requirement for correspondence and progresses the general execution and adaptability of the framework.

B. Fault Segment Identification Scheme

A dc cut off may bring about the most serious conditions for the dc home framework. Once a dc blame happens, the power switches of the MMC are blocked, and the charged capacitors inside the framework quickly begin bolstering the blame. The high blame current and dc transport voltage drop happen within the sight of charged capacitors and low impedance wires in the blame way. Not at all like air conditioning frameworks, have LVDC frameworks needed principles for blame assurance. The International Standard IEC 61660-1 is the most broadly utilized standard for impede current portrayal in dc frameworks. As per this standard, the rectifier connect, stationary batteries, smoothing capacitors, and dc engines are the primary dc blame sources. The add up to hamper is the total of the incomplete short out streams for every one of those sources and is determined as

$$i(t) = \begin{cases} i_p \frac{1-e^{\frac{-t}{\tau_1}}}{1-e^{\frac{-t_p}{\tau_1}}}, & 0 \le t \le t_p \\ i_p\left[\left(1-\frac{I_k}{ip}\right)e^{\frac{t_p-t}{\tau_2}} + \frac{I_k}{i_p}\right], & t_p \le t \le T_k \end{cases} \qquad (6)$$

where i_p and I_k are the peak and quasi steady-state shortcircuitcurrents, respectively. t_p is the time to peak, T_1 is the rise time constant, and T_2 is the decay time constant. Tk represents the fault duration time. The International Standard IEC

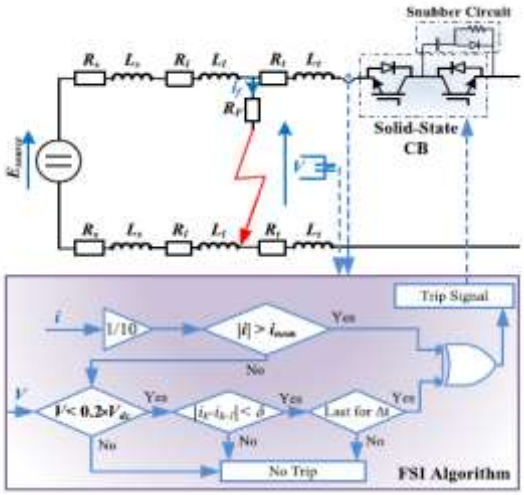


Fig. 4. Equivalent circuit of faulted network, and PD including solid-state circuit breaker, snubber circuit, and proposed FSI algorithm processing unit.

61660-1 represents an approximate dc short-circuit current inauxiliary dc systems. The fault current of the each source is multiplied by a correction factor to improve the conservative result of the total short-circuit current. The corrective factors of the Standard IEC 61660-1 need to be adapted for the LVDC configuration to ensure accurate calculation of the short-circuit current.

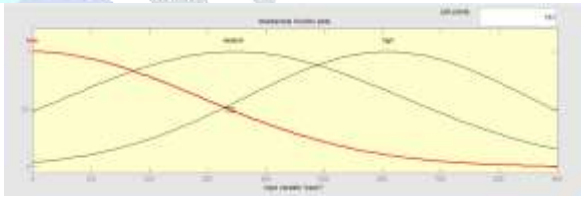
To shield the touchy power electronic parts from a high blame current, shortcomings must be quickly recognized and secluded before the dc transport voltage drops to zero and progresses toward becoming negative. The blame current contains the required data to uncover the correct area of a flawed portion. Once a dc blame happens in the framework, the examination among the current waveforms of various fragments shows that the current of a defective portion will increment quickly. The essential objective in the proposed insurance calculation is to rapidly distinguish the flawed portion by examining the deliberate current of each section. As needs be, PDs constantly screen the current of each fragment to uncover the area of the broken section. Once a dc blame happens in the dc home, a trek flag is sent to the PD in the comparing section to limit the blame. In this

way, the control stream in whatever is left of the system can be kept up. Fig. 4 demonstrates the comparable circuit of a blamed system and the PD design, where every PD is furnished with the FSI conspire to seclude the broken section without the need to organize the PDs. To have the capacity to make an opportune reaction, the FSI calculation handling unit consistently thinks about the deliberate current esteem with a limit setting. A fundamental condition to characterize a limit setting is that the FSI plot must identify the blame area and segregate it before the dc blame absolutely de-energizes the dc transport. Besides, the edge esteem ought to be sufficiently vast to stay away from superfluous excursions because of different kinds of aggravations in the dc frameworks. In the proposed calculation, the edge esteem is characterized as ten times the most extreme appraised current. In typical activity, the distinction between the estimated current esteem and the greatest evaluated current of the framework is inside a worthy range. At the point when a dc blame happens, the deliberate current will immediately surpass the edge esteem. Once the quick extent of the current in a section is more prominent than the predefined limit esteem, the FSI plot decides the blame area. As needs be, the trek flag is sent to the PD of the separate broken fragment. The proposed security calculation can promptly distinguish different and concurrent blames inside the dc home without the requirement for correspondence. The proposed FSI conspire is fundamentally powerless due to its solid dependence on the data gave by the current sensor. To upgrade the versatility of the PD against any blame in the present sensor, other contingent explanations are incorporated into the FSI calculation. The new order line helps with starting the excursion flag if a dc blame happens inside a fragment, and the current sensor of the separate PD is broken. This procedure depends on the way that the blame event influences the current waveforms of all portions associated with the dc transport. The two conceivable blame cases are (1) both sensor breakdown and dc blame event in the relating section and (2) as it were a dc blame event. In the previous case, the quick greatness of current in the broken fragment damages the first restrictive proclamation of the FSI calculation. Depending on the reality that the dc blame causes fast de-empowerment of the dc transport, the second contingent term will be met. In the wake of distinguishing serious voltage drop, the following contingent proclamation will demonstrate an abnormal settled current on the grounds that the present sensor is broken. The predefined edge setting, is set at a little incentive to inform of any adjustments in the present greatness of the comparing fragment. It can be derived that the blame event in a portion with a broken current sensor demonstrates a serious voltage drop alongside a surprising settled current. Notwithstanding, the current sensor of a non-defective portion may be broken. Subsequently, a period delay, arranged by 100 μs, is coordinated into the calculation to stay away from undesirable outings. On the off chance that serious voltage drop and bizarre settled current conditions proceed after the predetermined time interim, the FSI calculation identifies the separate section as a broken one with a broken current sensor. This piece of the proposed FSI calculation guarantees the dependable activity of the PD even at the point when there is a defective current sensor. In the last case, the FSI plot quickly decides the blame area by breaking down the section current, and summons the comparing PD to confine the defective section.

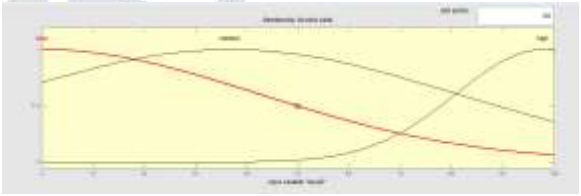
The proposed FSI conspire dispenses with the requirement for inconsistent correspondence channels between the assurance units. Its utilization of just the nearby estimations from the control unit decreases costs. Then again, the utilization of nearby estimations kills the idleness in the activity of PDs. The FSI calculation guarantees the solid task of the PD even in the nearness of a blame in the present sensor. Appropriately, the proposed security conspire enhances the administration quality by influencing the blame detachment to process fundamentally quick and dependable.

IV. SIMULATION RESULTS USING ANFIS CONTROLLER:

The adaptive network based fuzzy inference system (ANFIS) is a data driven procedure representing a neural network approach for the solution of function approximation problems. Data driven procedures for the synthesis of ANFIS networks are typically based on clustering a training set of numerical samples of the unknown function to be approximated. Since introduction, ANFIS networks have been successfully applied to classification tasks, rule-based process control, pattern recognition and similar problems. Here a fuzzy inference system comprises of the fuzzy model proposed by Takagi, Sugeno and Kang to formalize a systematic approach to generate fuzzy rules from an input output data set.



Membership function for error



Membership function for change in error

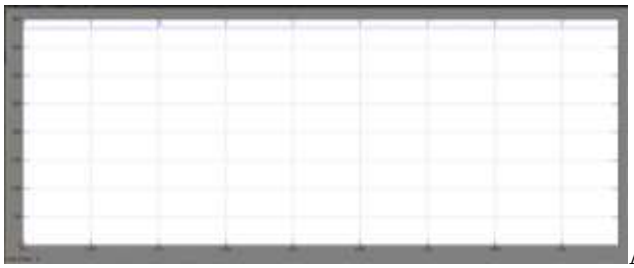
e/Δ*e*	low	Medium	high
low	low	Medium	high
medium	medium	High	high
high	high	High	high

ANFIS rule table

Case1:-

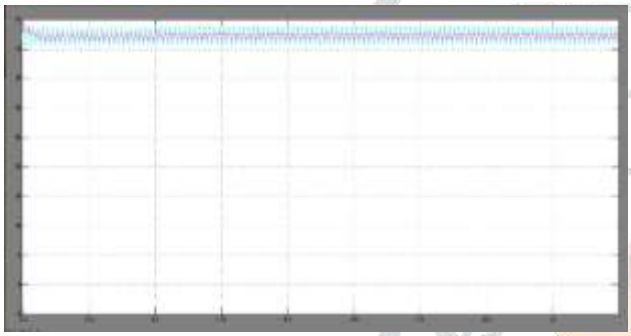
Fig. 9. Dynamic response of the dc home subsequent to sudden load changes

A)Dc bus voltage

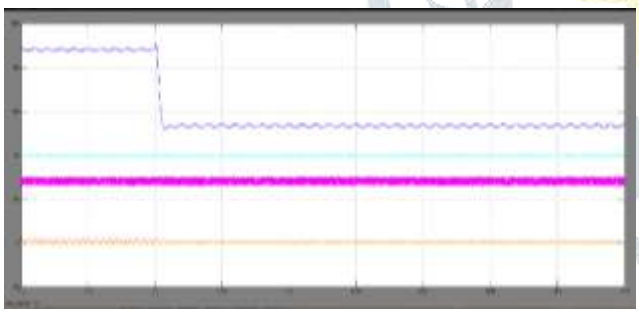


A)Dc bus voltage

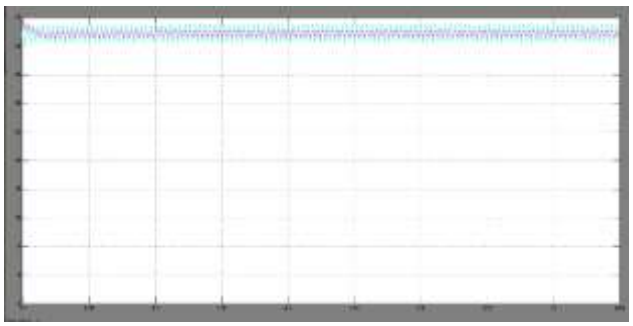
B) Current of dc and ac loads



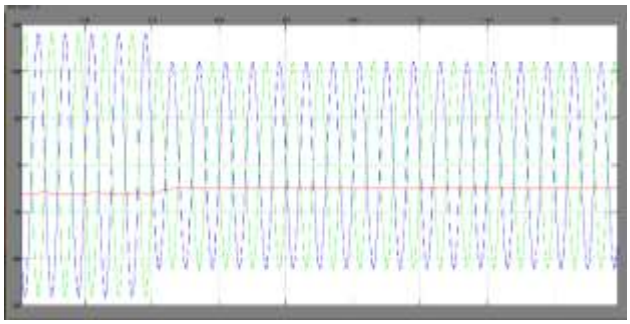
C) Submodule capacitor voltages of the upper arm of phase b;



D)Output current of the MMC and DGs



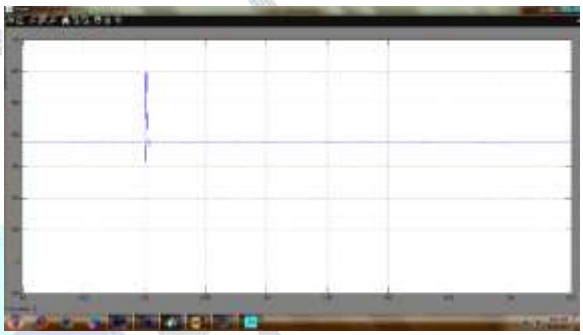
E) Submodule capacitor voltages of the lower arm of phase b; and



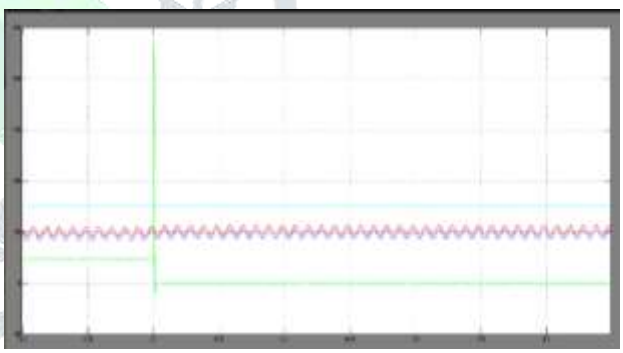
F)Waveforms of upper arm, lower arm, and circulating currents

Case2:-Fig. 10. Dynamic response of the dc home in case of dc fault in load2 segment

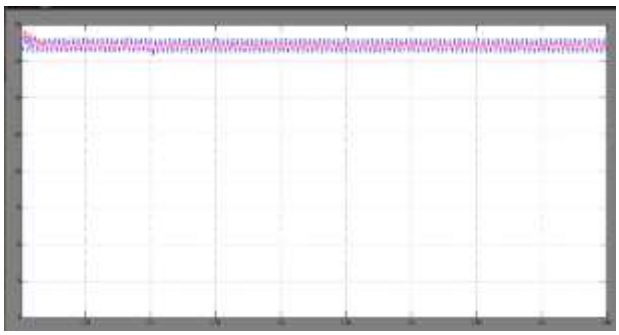
DC bus voltage



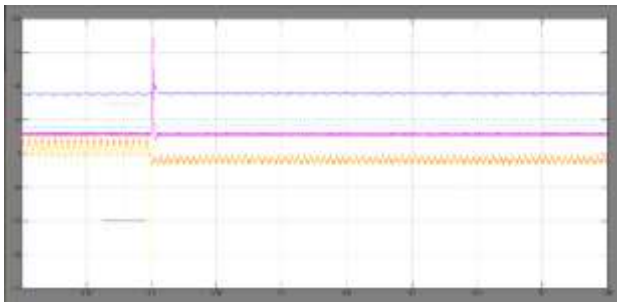
A)DC bus voltage



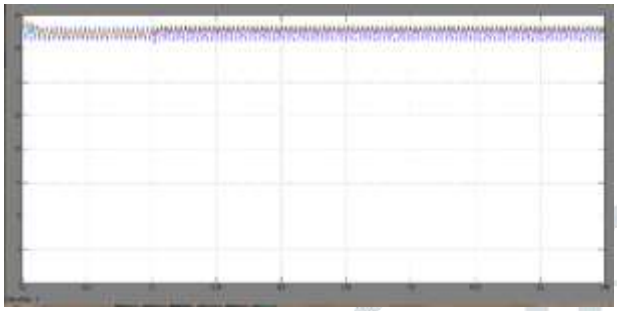
b) Current of dc and ac loads;



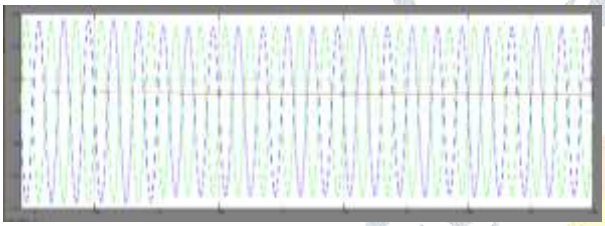
C)Submodule capacitor voltages of the upper arm of phase b;



D)Output current of the MMC and DGs

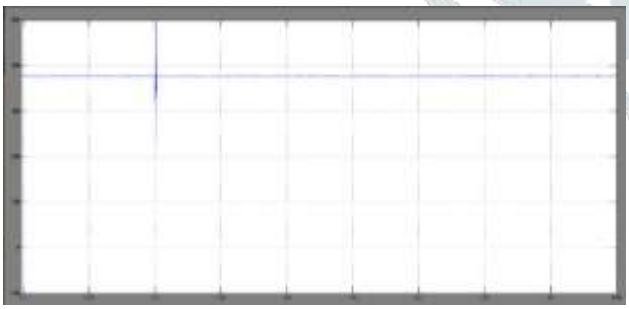


E)Submodule capacitor voltages of the lower arm of phase b;

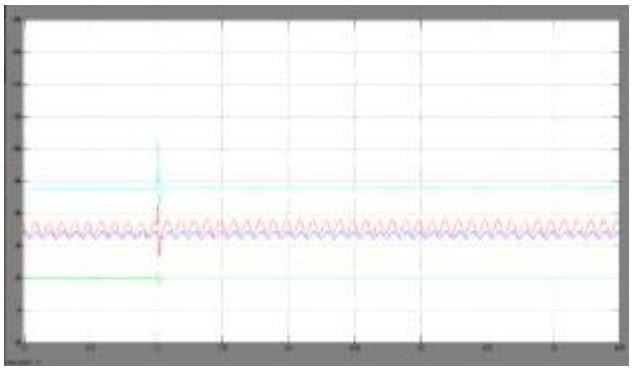


F)Waveforms of upper arm, lower arm, and circulating currents.

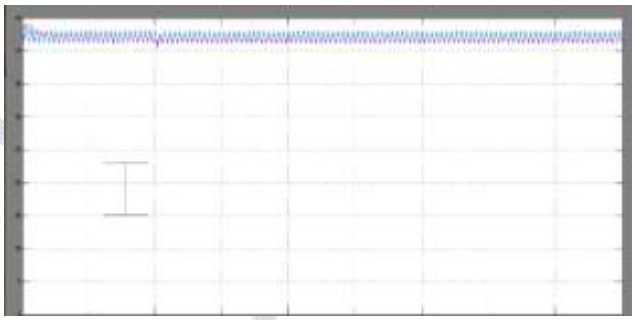
Case3: Fig. 11. Dynamic response of the dc home in case of dc fault in DG1 segment



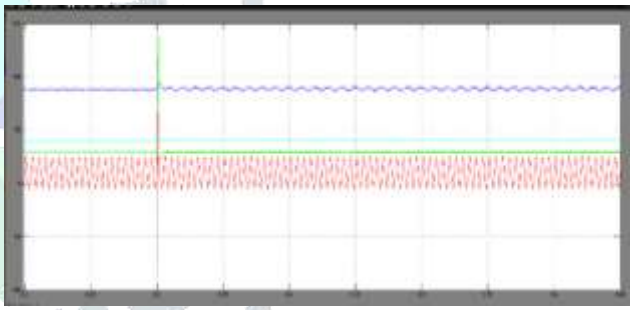
A)DC bus voltage



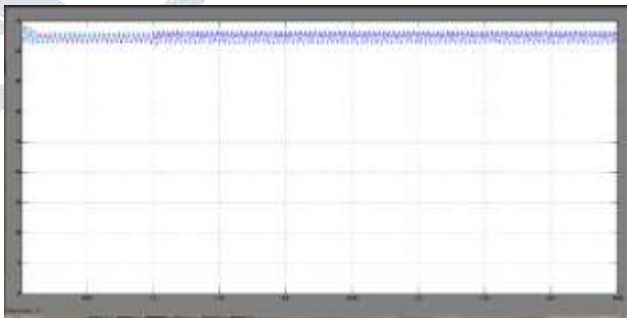
(b) Current of dc and ac loads



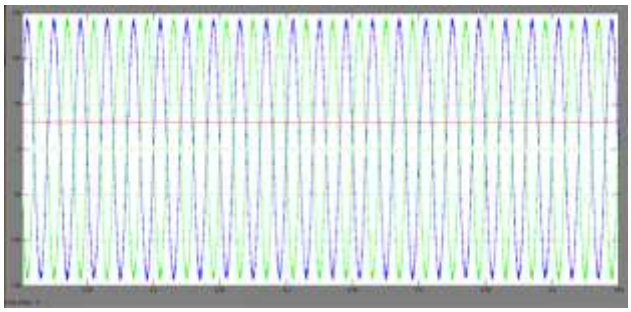
(c) Submodule capacitor voltages of the upper arm of phase



(d) Output current of the MMC and DGs

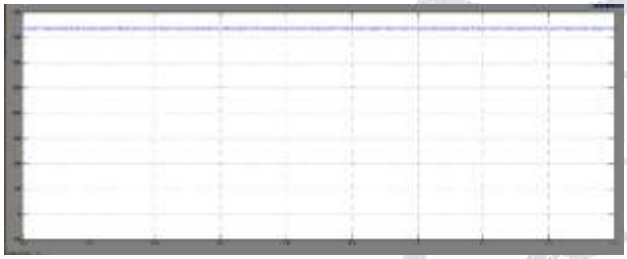


(e) Submodule capacitor voltages of the lower arm of phase b;

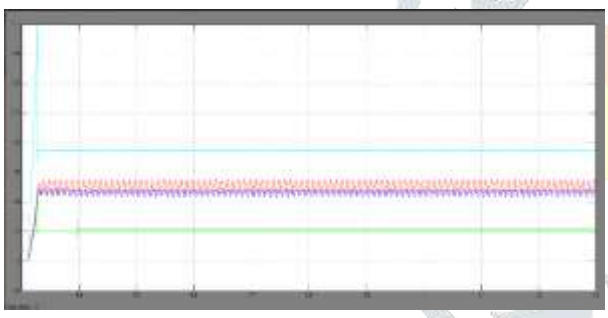


F)Waveforms of upper arm, lower arm, and circulating currents

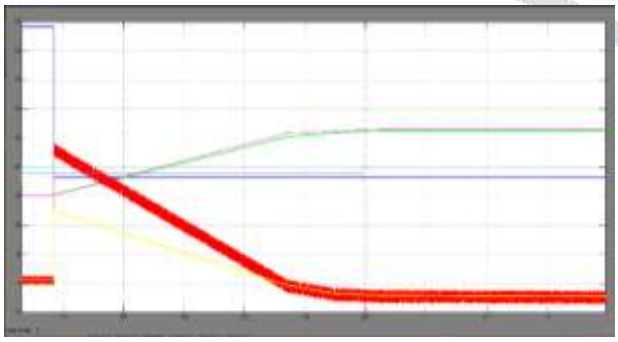
Case4: Fig. 12. Dynamic response of the dc home during transition from the grid-tied To off-grid mode.



A) DC bus voltage



A) Current of dc and ac loads; and



C)Output current of the MMC and DGs

Conclusion

This paper conferred the DCC and FSI ways to satisfy the control and protection objectives during a dc home by victimization only native measurements. The dc home was interfaced with the utility grid via a replacement MMC configuration with a dc fault-handling capability. The DGs and MMC were equipped with the DCC methodology to hand in glove guarantee the system performance with none want for communication. The projected FSI theme quickly known the faulted phase by analyzing the native currents. Simulation studies were carried out to verify the effectiveness of the schemes. Moreover, the hardware-in-the-loop studies incontestable the feasibleness of hardware implementation. The projected schemes had the following advantages for the dc home.

1) The improved dependableness, high resiliency, and simple management of the projected ways contributed to the service quality and dependableness within the dc home.
2) The DCC and FSI ways increased the system's ability to reconfigure the dc home once a fault occurred.
3) The DCC methodology ensured quick system restoration once fault clearance, effective dc bus voltage regulation, and accurate current sharing among the DGs and MMC.
4) The projected low-tension MMC precluded damages to the device and dc home throughout dc faults by preventing the grid from feeding the fault.
5) The FSI theme known the faulted segments in less than one ms before the fault current might utterly de-energize the entire system.
6) The FSI theme used solely the native measurements from the management unit, eliminating the latency within the operation of the PDs.

References:

[1] T. Dragicevic, X. Lu, J. C. Vasquez, and J. M. Guerrero, "DCmicrogrids-Part I: A review of control strategies and stabilization techniques,"IEEE Trans. Power Electron., vol. 31, no. 7, pp. 4876–4891, Jul. 2016.
[2] R. S. Balog and P. T. Krein, "Bus selection in multibus dc microgrids,"IEEE Trans. Power Electron., vol. 26, no. 3, pp. 860–867, Mar. 2011.
[3] T. Dragicevic, X. Lu, J. C. Vasquez, and J. M. Guerrero, "DC microgrids-Part II: A review of power architectures, applications and standardization issues," IEEE Trans. Power Electron., vol. 31, no. 5, pp. 3528–3549, May 2016.
[4] G.AlLee and W. Tschudi, "Edison Redux: 380 Vdc brings reliability
and efficiency to sustainable data centers," IEEE Power and Energy Magazine, vol. 10, no. 6, pp. 50–59, Nov 2012.
[5] A. Ghazanfari, M. Hamzeh, and Y. A.-R. I. Mohamed, "A resilient plugand- play decentralized control for DC parking lots," IEEE Trans. SmartGrid, DOI. 10.1109/TSG.2016.2602759.
[6]B.Wang, M.Sechilariu, and F. Locment, "Intelligent DC microgrid with smart grid communications: Control strategy consideration and design,"IEEE Trans. Smart Grid, vol. 3, no. 4, pp. 2148–2156, Dec. 2012.
[7] T. Dragicevic, J. M. Guerrero, J. C. Vasquez, and D. Skrlec, "Supervisory control of an adaptive-droop regulated DC microgrid with battery management capability," IEEE Trans. Power Electron., vol. 29, no. 2, pp. 695–706, Feb. 2014.
[8] T. Zhou and B. Francois, "Energy management and power control of a hybrid active wind generator for distributed power generation and grid integration," IEEE Trans. Ind. Electron., vol. 58, no. 1, pp. 95–104, Jan. 2011.
[9] J. Pan, R. Jain, S. Paul, T. Vu, A. Saifullah, and M. Sha, "An internet of things framework for smart energy in buildings: Designs, Prototype, and Experiments," IEEE

Internet of Things Journal, vol. 2, no. 6, pp. 527–537, Dec 2015.
[10] S. Anand, B. G. Fernandes, and J. M. Guerrero, "Distributed control to ensure proportional load sharing and improve voltage regulation in low voltage DC microgrids," IEEE Trans. Power Electron., vol. 28, no. 4, pp. 1900–1913, Apr. 2013.

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