



V2G CONTROL OF MULTI AREA POWER SYSTEM IN DEREGULATED ENVIRONMENT

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ABSTRACT

The primary LFC loop is not much effective to control the frequency. The secondary frequency control loop via LFC controller is necessary for frequency stabilization. The design of load frequency controller is not complex for integrated conventional power system. In a Deregulated Power System (DPS) there are multiple power distributors for the consumers. The entire system is monitored by Independent system operator (ISO) this will ensure the contacted powers and their regulation to the particular power distributors (DISCOS). Using the approximation approach, it is possible to approximate the fractional-order structure as the extremely high integer-order system, which is advantageous.

KEYWORDS: Loop, Power, Deregulated, Fractional, Order.

I. INTRODUCTION

Load Frequency Control (LFC) has been one of the main controls in electric power framework plan and activity. Presently it is turning out to be considerably more confounded as per the expanding size and the changing design and intricacy of interconnected power frameworks. By and by, power frameworks utilize straightforward Proportional-Integral (PI) regulators for recurrence control and guideline. Notwithstanding, since the PI regulator boundaries are normally tuned dependent on traditional or experimentation draws near, they are unequipped for getting great dynamical execution for a wide scope of working conditions and different burden changing conditions in a rebuilt power framework. In a liberated climate, the essential power exchange might be through pool exchanges or potentially reciprocal/multilateral exchanges to fulfill the dynamic power necessities of the purchasers. These exchanges must be checked and cleared by a fair-minded element called Independent System Operator

(ISO). Aside from this capacity, the ISO needs to give/control various auxiliary administrations. Among different auxiliary administrations, recurrence guideline and burden adhering to are the two recurrence related administrations in the liberated framework. These two administrations are consolidated together and distinguished as Load Frequency Control (LFC) in the liberated power framework. In a liberated climate, LFC as a subordinate assistance assumes an indispensable part to keep up with the electrical framework dependability. Thus, there has been expanding interest during ongoing years for planning load recurrence regulators with better execution. A few ideal and hearty control procedures have likewise been created for LFC blend as indicated by the changing climate of force framework activity under liberation.

II. SYSTEM MODELING FOR LFC

There are two DISCOMs in each CA, therefore there are four in total. Bilateral transactions are transactions between GENCOs and DISCOMs that take place between two parties. The DPM matrix is used to

$$DPM = \begin{bmatrix} cpf11 & cpf12 & cpf13 & cpf14 \\ cpf21 & cpf22 & cpf23 & cpf24 \\ cpf31 & cpf32 & cpf33 & cpf34 \\ cpf41 & cpf42 & cpf43 & cpf44 \end{bmatrix}$$

III. V2G CONTROL SCHEME

Differences in power generation and demand are to blame for frequency variations. This causes the electricity grid's speed to fluctuate. All of these cars will need a meaningful

$$P_{V2G} = \begin{cases} K_{V2G} \Delta f & (|K_{V2G} \Delta f| \leq P_{max}) \\ P_{max} & (P_{max} < |K_{V2G} \Delta f|) \end{cases}$$

The amount of power that can be transferred from a car battery to the grid is governed by the V2G gain and the frequency variations that exist in the system. The V2G gain of K_{V2G} is set by taking into account the V2G effect and the state of charge of the battery. The State of Charge (SOC) of a car battery is denoted by the letters SOC (State of charge). When a car is hooked into a charging station for an extended period of time, the recharging of the vehicle occurs in a smart fashion, with the vehicle being charged initially while taking the vehicle's state of charge into consideration. The majority of cars are charged to a higher state of charge (SOC), after which the battery begins to send energy to the grid until it reaches a low state of charge (SOC). When the battery's state of charge (SOC) falls below a

$$K_{V2G} = K_{max} \left[- \left(\frac{SOC - SOC_{low(high)}}{SOC_{max(min)} - SOC_{low(high)}} \right)^n \right]$$

In is the design parameter and SOC_{low} , SOC_{min} , SOC_{high} , SOC_{max} is the low battery SOC, minimum battery SOC, high batter SOC, maximum battery SOC, and SOC_{max} is the maximum battery SOC, and SOC_{min} is the

depict this. As a consequence, the total number of items in the column that belongs to DPM's DISCOs is. As an example, let's take a power system that has three regions, that all have two DISCOs and two GENCOs. The following is the appropriate DPM for the mentioned power system.

parameter that determines how much power is delivered to the power system in order to send battery power to the grid, and this may be done by controlling the V2G output by the droop features against frequency variations (Δf) as

certain threshold, the charging station begins to charge the vehicle. It is possible to create a cycle of discharging and charging in this manner. During the fluctuation period, the battery included within these cars also adjusts for the inductive load that is present on the system. When the greatest amount of power that may be pulled from a car battery is considered, the value of P_{max} is established. It may be calculated by taking into consideration that the plug-in station's specifications are 200V and 25 Amperes. As a result of the following In light of these considerations by the stations, a total of 5000W or 5KW of electricity may be extracted from a car battery in a single charge. Then the K_{V2G} may be calculated using the formula

minimum cell SOC. K_{max} , on the other hand, represents the greatest V2G gain. As seen in Fig. 1, the battery is maintained at around 50% capacity

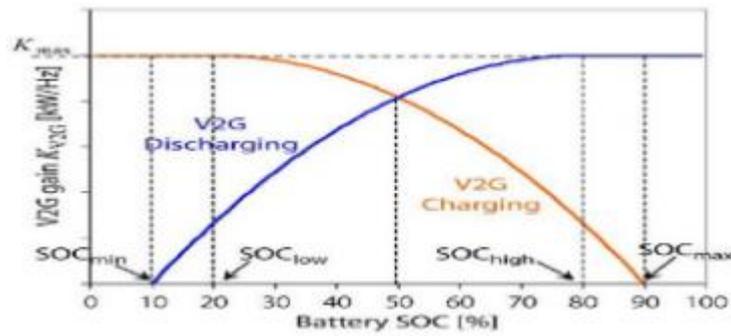


Figure 1 State Of Charge control of Battery

In Fig 2, you can see a computational formula of an electric vehicle (EV).

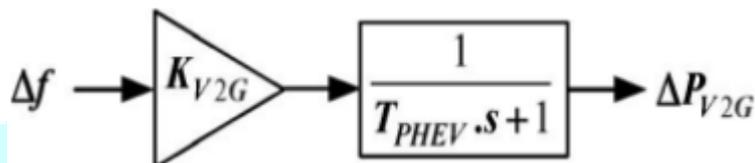


Figure 2 Block model of V2G

Using the synthesis approximation and conformation by experimentation and theoretical analysis, the favourable result when $b = 10$ and $d = 9$, for example, may be obtained by the use of conformation by experiment and theoretical analysis. Using the approximation approach, it is possible to

approximate the fractional-order structure as the extremely high integer-order system, which is advantageous. Figure 3 depicts a block schematic of a two-area deregulated hydrothermal system with plug-in electric vehicles (EVs).

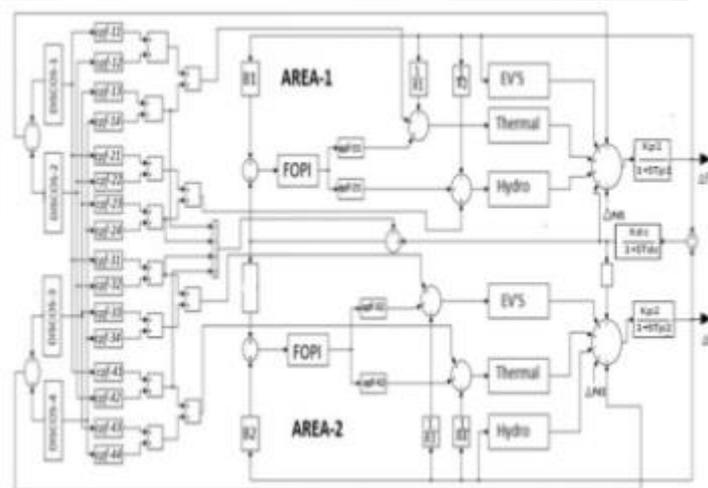


Figure 3 Two-area hydro-thermal power system with HVDC link with EV's

IV. SIMULATION RESULTS:

A battery-powered vehicle can reduce the frequency variations that are produced by power imbalances by adding fresh power into the system and thereby increasing the system's overall power. This power will be obtained from electric vehicles using the V2G control mechanism, which will take into account the state of charge (SOC) of the battery of the electrical

vehicle. The quantity of electricity drawn from electric vehicles (EVs) through a charging station is entirely dependent on the current state of charge (SOC) of the battery. When the power demand is decreased by the EV's remaining LFC, the FOPI controller is in charge of reducing the power demand. For example, if N numbers of automobiles are employed to supply power and K_p , K_i and λ are respectively the proportional, integrator, and

lambda parameters of the FOPI (Factional order PI) controller, the simulation results are presented. The

contract situation for the deregulated system is represented by the matrix shown below.

$$\begin{bmatrix} 0.5 & 0.3 & 0.1 & 0.3 \\ 0.1 & 0.2 & 0.6 & 0.2 \\ 0.4 & 0 & 0.2 & 0.1 \\ 0 & 0.5 & 0.1 & 0.4 \end{bmatrix}$$

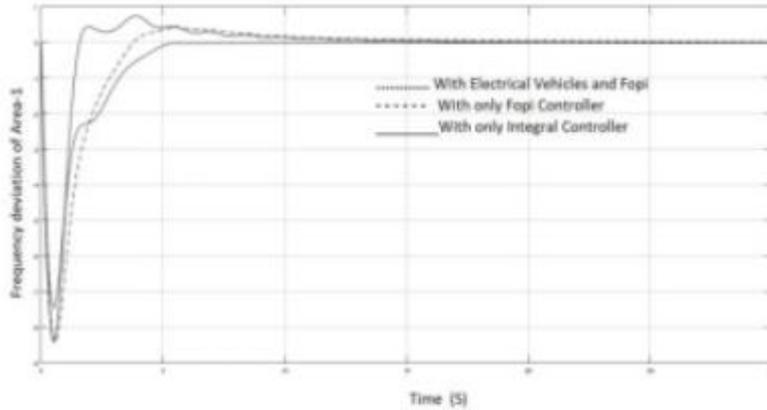


Figure 4 displays Frequency response of CA-1 with FOPI and EVs compared to FOPI and I controller without EVs

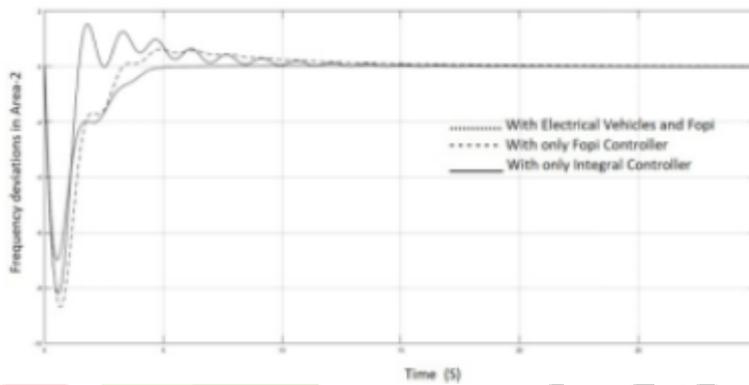


Figure 6 Shows Frequency response of CA-2 with FOPI and EVs compared to FOPI and I controller without EVs

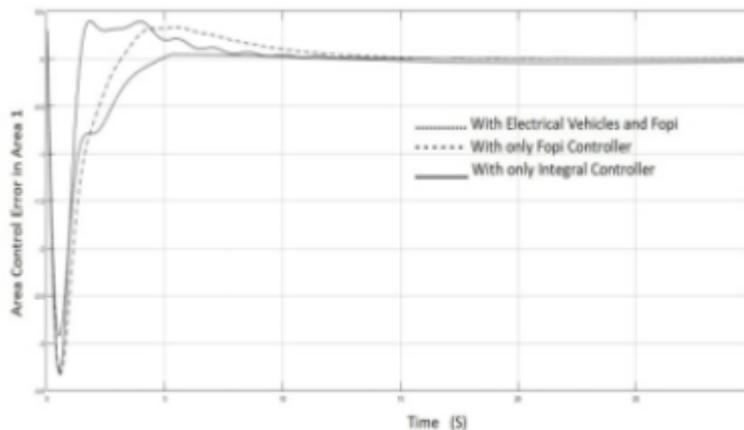


Figure 7 displays Area Control Error (ACE) of CA-1 with FOPI and EVs compared to FOPI and I controller without EVs

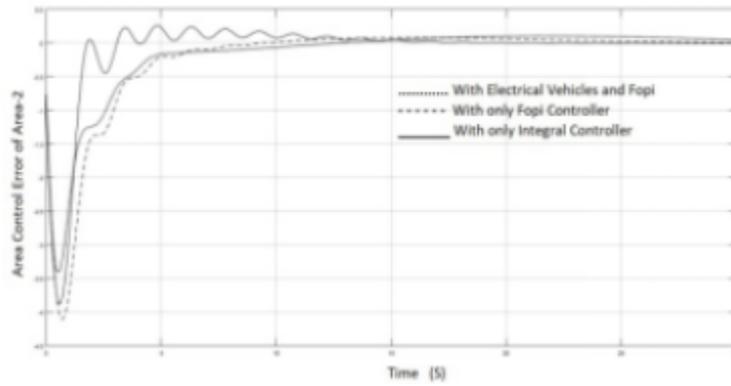


Figure 8 Shows Area Control Error (ACE) of CA-2 with FOPI and EVs compared to FOPI and I controller without EVs

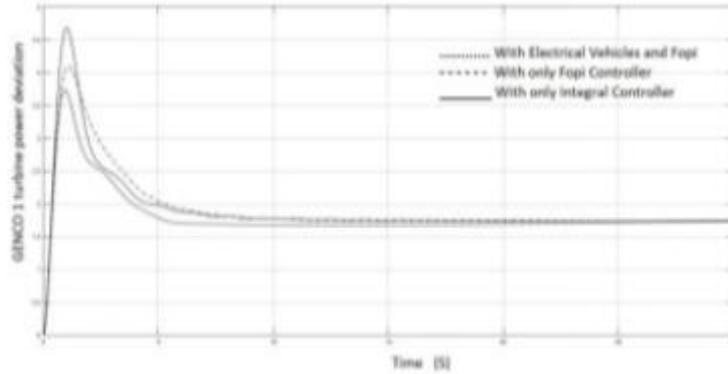


Figure 9 displays Power Output of GENCO-1 of CA-1 with FOPI and EVs compared to FOPI and I controller without EVs

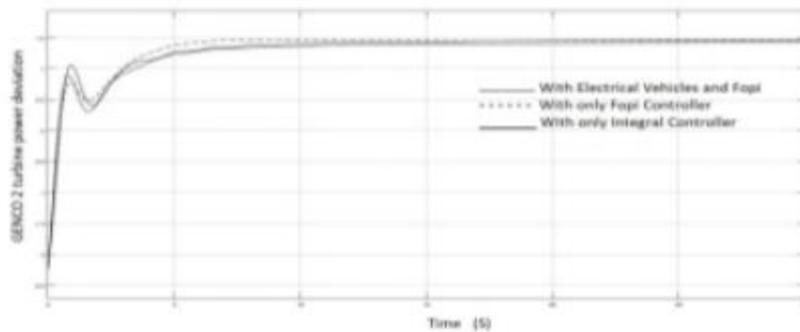


Figure 10 displays Power Output of GENCO-2 of CA-1 with FOPI and EVs compared to FOPI and I controller without EVs

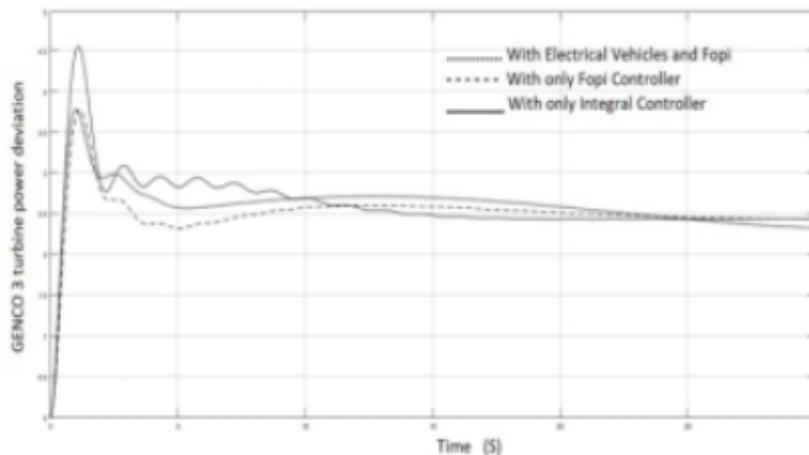


Figure 11 displays Power Output of GENCO-3 of CA-2 with FOPI, EVs compared to FOPI and I controller without EVs

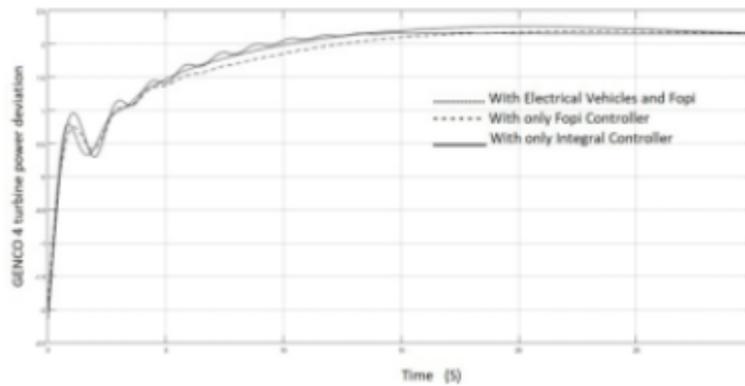


Figure 12 displays Power Output of GENCO-4 of CA-2 with FOPI, EVs compared to FOPI and I controller without EVs

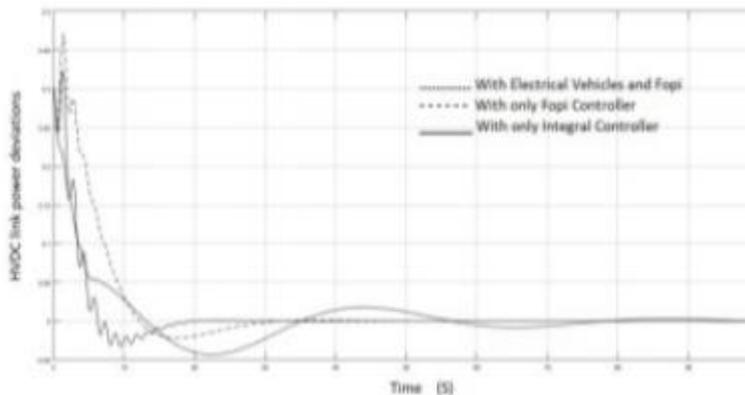


Figure 13 displays Power Output of GENCO-4 of CA-2 with FOPI, EVs compared to FOPI and I controller without EVs

V. CONCLUSION

In this proposed work two CAs modeled in deregulated environment and connected with HVDC link, integrated with EVs (V2G control) in each control area (CA) to reduce frequency deviations. A new coordinated control strategy proposed to address LFC by considering bilateral transactions. This scenario simulated and tested using MATLAB simulink for one possible contract scenario. The coordinated control strategy of EVs ((V2G control) with FOPI reduces frequency deviation of each control area effectively compared to FOPI and conventional integral controller

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