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Enhancement in dynamic performance of three area interconnected system with SMES device

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***ABSTRACT*: Automatic generation control is balance between power generation and load demand. In load frequency control is implementing in the system to maintain the system frequency within the limits. SMES used to reduce the deviation occur in area frequency and tie line power. In this paper the frequency and tie line power firstly controlled by the fuzzy controller then combination of fuzzy controller with SMES device.To damp out the transient the SMES device is used.**

***Keywords*: Automatic generation control(AGC), load frequency control(LFC), Tie line power control, PID Controller, Fuzzy controller, SMES (superconducting magnetic energy storage), Multi area power system.**

INTRODUCTION

In automatic generation control, load frequency control is controlling the output system frequency within limits by adjusting the active power demand and tie line power control. Automatic generation control is balance between generation and load power demand. Nowadays bulk power system consist of multiple interconnected controlled area, load frequency control in multiple area is very necessary in power system which is mechanism that balance between generation and load demand without considering fluctuation to maintain the frequency in acceptable limits.[1] the operating point of power system change with to respect time. To control the p, ower grid frequency and controlling area error are implement of automatic generation control. As real or active power of system is depend upon the frequency and reactive power of system mainly depend upon the voltage of system. Therefore it is necessary to maintain the frequency within limits.[2] Now a days in large power system number of areas interconnected with each other through tie line.

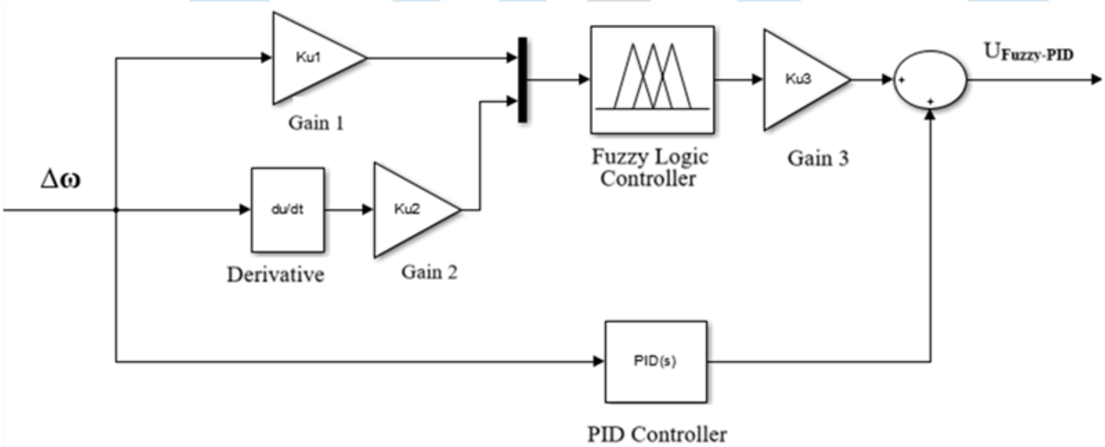

Fig 1:PID – FUZZY CONTROLLER STRUCTURE

In interconnected system, sudden load change in any area cause deviation of frequencies of every areas and also deviation in tie line power. This is corrected to ensure the generation and distribution of power with good quality. This is achieved by load frequency control known as automatic generation control. LFC is used to regulate the power flow in different area while holding the system frequency constant.[3]

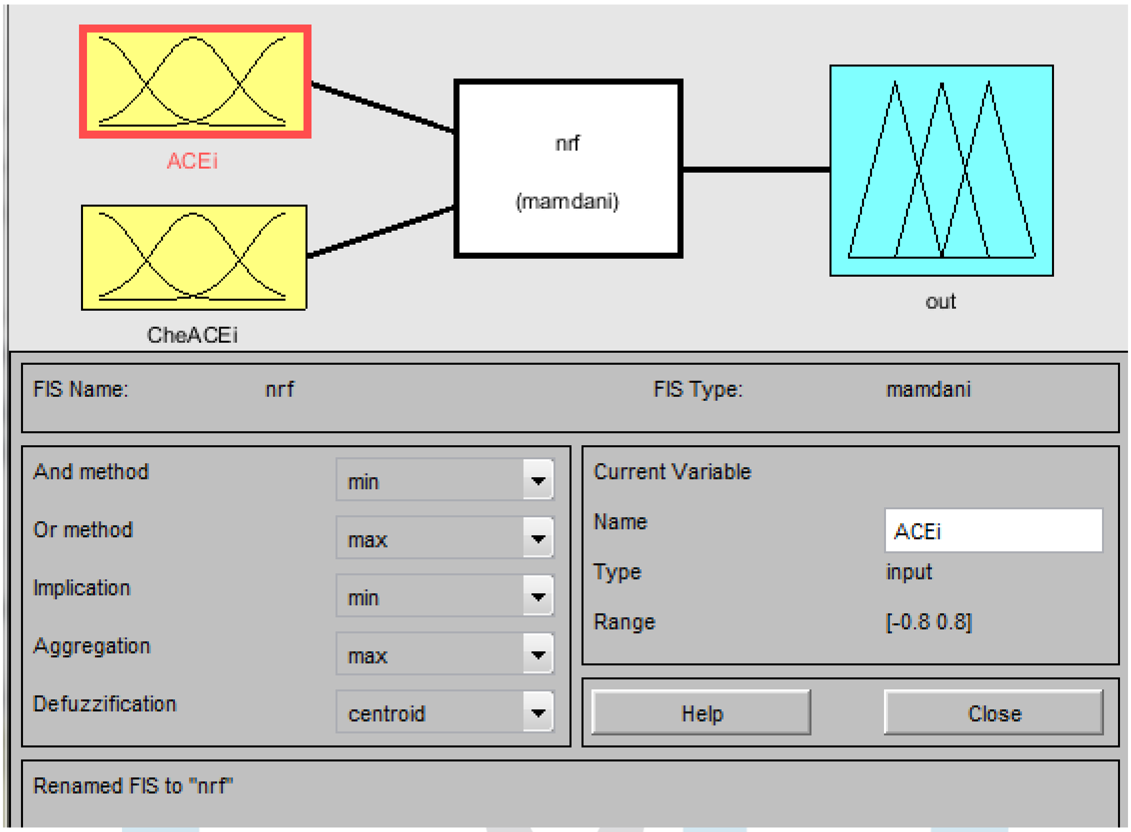

FIG2: Fuzzy logic controller input –output

Interconnected system is when two or more area of power system is interconnected with each other through tie line. Each control area consist of linear combination of tie line power and frequency. In order to nominal frequency and tie line power to set value, the area control error of area is minimized to zero.

SUPERCONDUCTING MAGNETIC ENERGY STORAGE (SMES)

The SMES unit is basically consist of two components i.e. a converter and superconducting coil converter which is connect to grid through transformer. The superconducting coil can be charged to a specific value from power grid during working of power system. DC magnetic coil connected to grid through inverter or rectifier arrangement. The energy exchange between coil and power system is controlled by line commutated converter. Sudden rise in load demand energy, the stored energy is release through converter to power system as alternating current and decrease in load demand superconducting coil not release energy.[9]

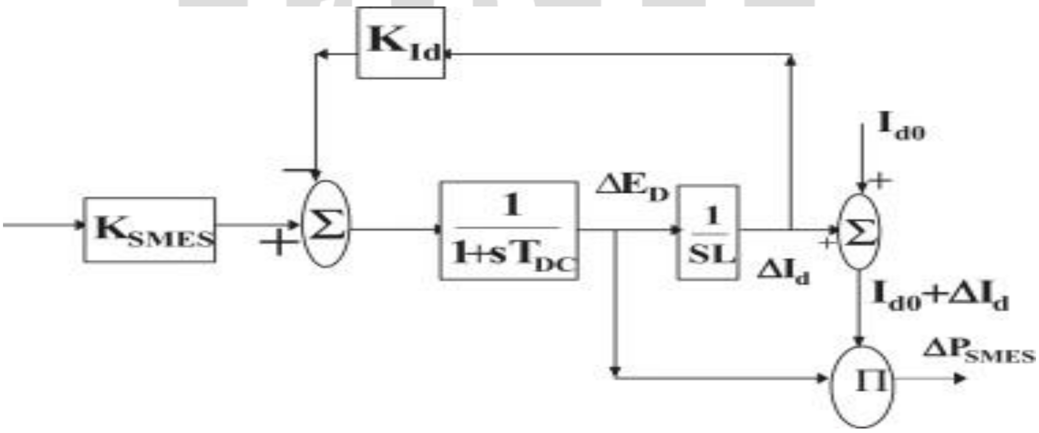

FIG3:- Block diagram of SMES device

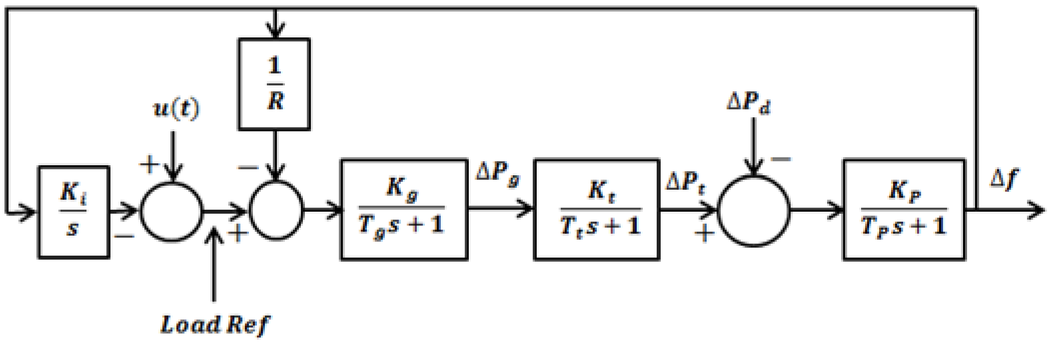

FIG 4:- Block diagram model of load frequency control

$\Delta f= -(\frac{Kp}{1+ KgKtKp/_R})\Delta P$

Kt= Gain fixed for turbine

Kp= Gain fixed for power system

Kg= speed governor gain

KgKt=1

$\Delta f= -(\frac{1}{B+ 1/_R})\Delta P$

$B= \frac{\frac{\delta P}{\delta f}}{P}$

B= 0.01 pu MW/Hz

Literature review

This paper present the simulation of multi area multi source restructured power system for load frequency control.IN this PID controller with derivative filter is evaluated to solve load frequency problem. Each generation source of each area is provided with different controllers for better performance of system[3] .In mutiarea interconnected power system the load demand varies randomly as small change in load demand the tie line power and frequency change . the main goal of LFC is maintain the system frequency and tie line power within limits. The purpose of this paper is present application of fuzzy logic controller based load frequency control using PID controller in multi area interconnected system. The primary goal of load frequency control is suppress all fluctuation of system[4]. Due to simple structure and better performance of PID controller are mostly common used controller in industrial process control. The success of PID controller is depend on the choice of PID Gain and tuning of PID gain. In this study set the tuning ranges of PID gain after this fuzzy is implement. This is two level fuzzy PID Controller.[5]

SIMULATION MODEL:-

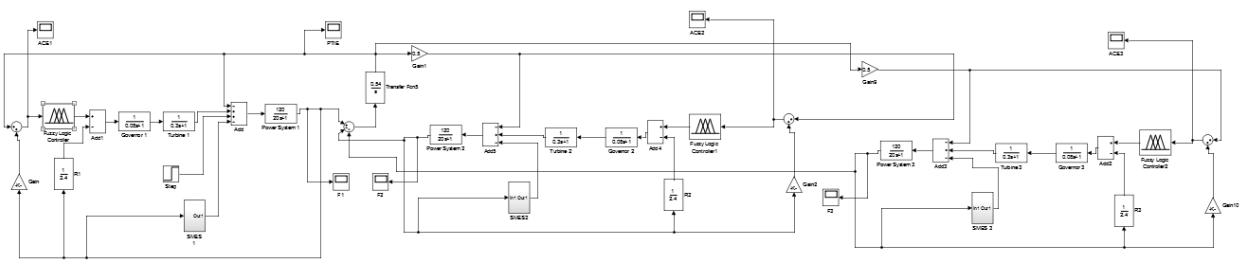

FIG5:- Simulink model of load frequency control with fuzzy and SMES devices

RESULTS:-

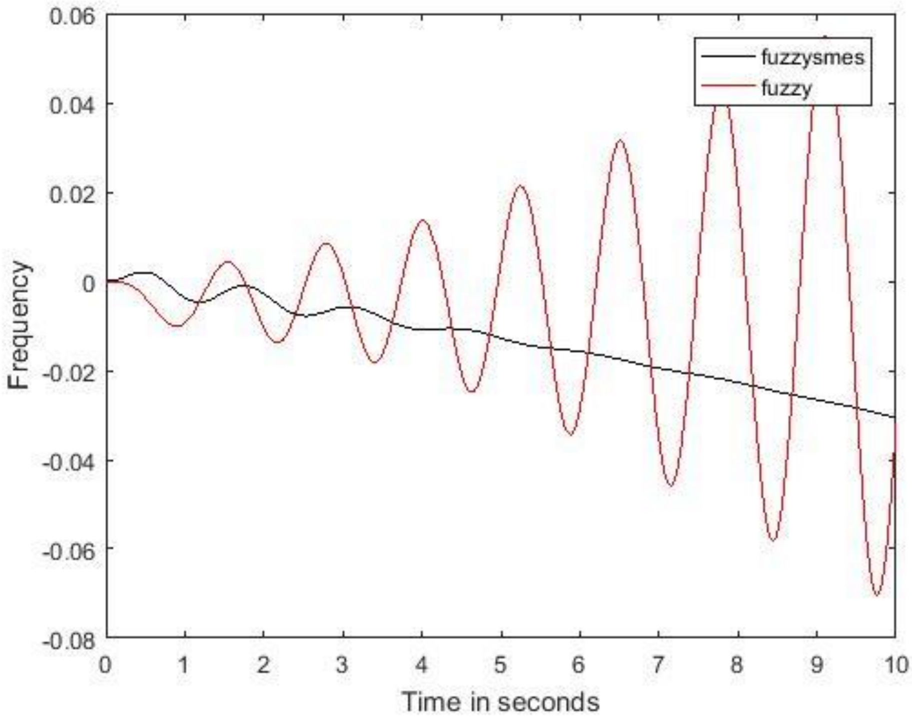

FIG6:-Frequency deviation curve of area 1

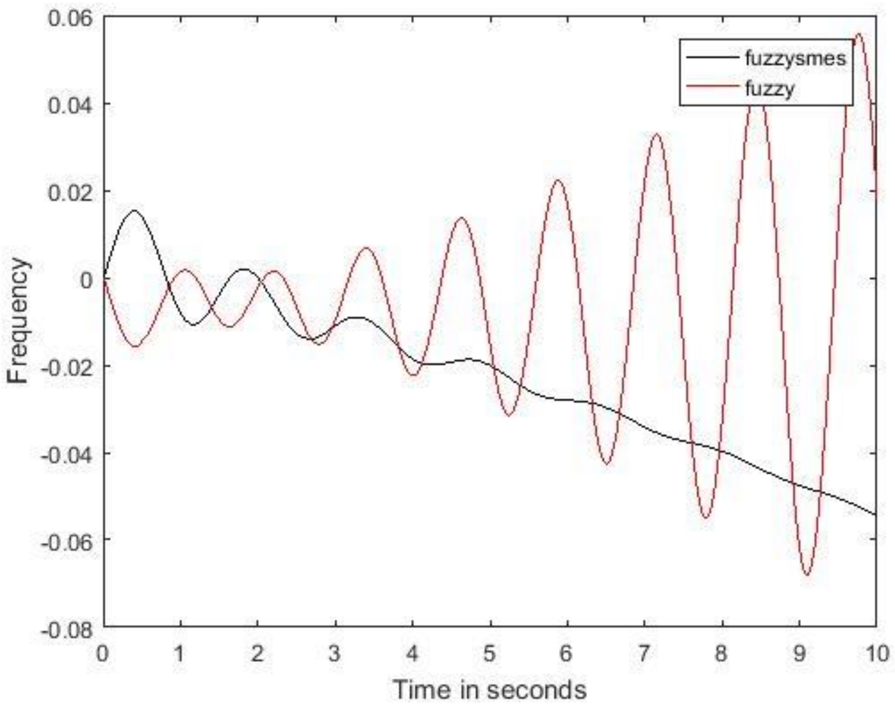

FIG7:-Frequency deviation curve of area 2

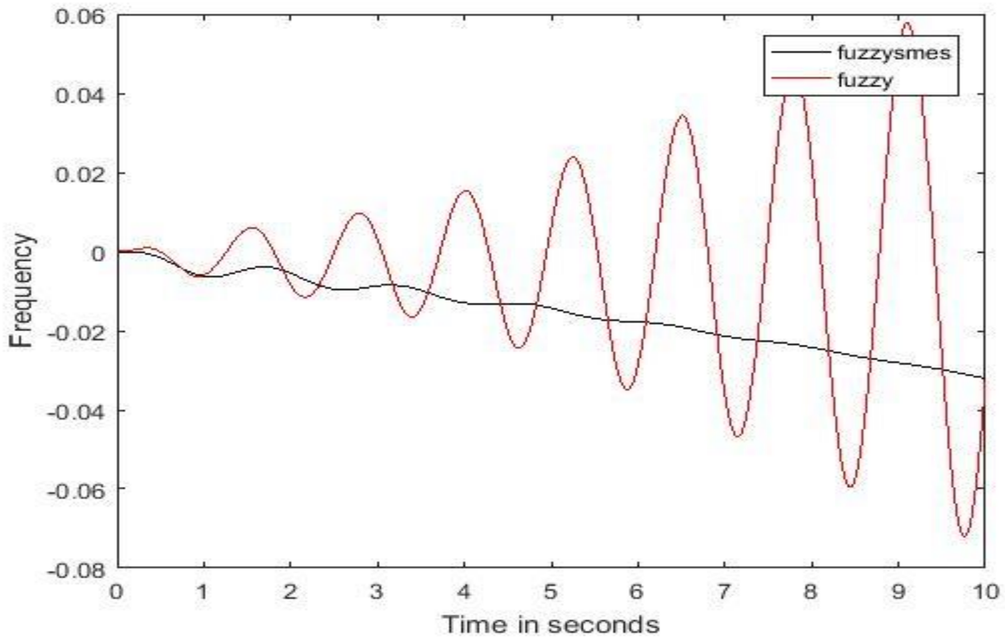

FIG8:- Frequency deviation curve of area 3

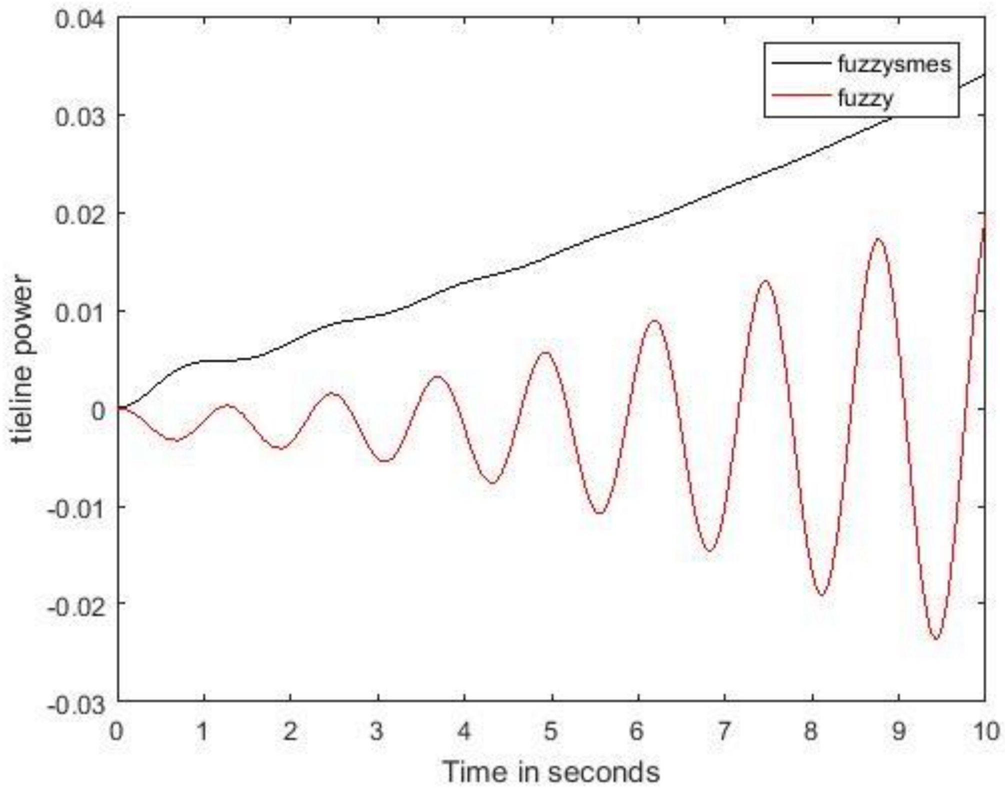

FIG9:- Tie line power deviation curve

Conclusion:-To damp out the deviation in tie line power and frequency of power system, SMES device is used. Dynamic performance of system is improved with use of SMES device. with comparison of fuzzy controller and fuzzy with SMES ,the result of fuzzy with SMES is better.The deviation in frequency and tie line power of system with use of SMES is reduce.

References

[1] Parvaneh, H., Dizgah, S. M., Sedighizadeh, M., & Ardeshir, S. T. (2016). Load frequency control of a multi-area power system by optimum designing of frequency-based PID controller using seeker optimization algorithm. *6th Conference on Thermal Power Plants, CTPP 2016*, 52–57. https://doi.org/10.1109/CTPP.2016.7483053

[2] Pati, T. K. (2015). Load Frequency Control of an Interconnected Three-Area Thermal Power System Using Conventional PID & Fuzzy-Logic Controller, 0–5.

[3] Sekhar, G. T. C., Sahu, R. K., & Panda, S. (2014). Load frequency control with fuzzy-PID controller under restructured environment. *2014 International Conference on Control, Instrumentation, Communication and Computational Technologies, ICCICCT 2014*, 112–117. https://doi.org/10.1109/ICCICCT.2014.6992940

[4] Kouba, N. E. Y., Menaa, M., Hasni, M., & Boudour, M. (2015). Load Frequency Control in multi-area power system based on Fuzzy Logic-PID Controller. *International Conference on Smart Energy Grid Engineering, SEGE 2015*. doi:10.1109/SEGE.2015.7324614

[5] Oysal, Y., Koklukaya, E., & Yilmax, A. (1999). Fuzzy PID controller design for load frequency control using gain scaling technique. *Electric Power Engineering, …*, (5), 1997. doi:10.1109/PTC.1999.826610

[6] Hassan, L. H., Mohamed, H. a F., Moghavvemi, M., & Yang, S. S. (2009). Load Frequency Control of Power Systems with Sugeno Fuzzy Gain Scheduling PID Controller, 614–618.

[7] Rana, K., & Kakran, S. (2016). Improvement in dynamic performance of an interconnected power system in Load Frequency Control using SMES. *2016 IEEE Students' Conference on Electrical, Electronics and Computer Science (SCEECS)*, 1–6. https://doi.org/10.1109/SCEECS.2016.7509338

[8] Hassen, S. Z. S., & Jahmeerbacus, M. I. (n.d.). Optimal Frequency Regulation of a Two-area Power System, 140–145.

[9] Deepak, M. (2014). Improving the dynamic performance in load frequency control of an interconnected power system with multi source power generation using Superconducting Magnetic Energy Storage (SMES). *International Conference on Advances in Green Energy (ICAGE)*, (December), 106–111.

[10] Singla, H., & Kumar, A. (2012). LQR based load frequency control with SMES in deregulated environment. *2012 Annual IEEE India Conference, INDICON 2012*, 286–292. https://doi.org/10.1109/INDCON.2012.6420630

[11] Mufti, M.-D., Zargar, M. Y., & Lone, S. A. (2017). Predictive controlled SMES for frequency control of hybrid wind-diesel standalone system. *2017 International Conference on Computing, Communication and Automation (ICCCA)*, 1395–1400. https://doi.org/10.1109/CCAA.2017.8230059

[12] Rafi, F. H., Ansary, Z., Rahman, H., Mollah, A. S., & Rahman, A. (2013). Load Frequency Control Analysis Using AGC , TCPS and SMES.

[13] K.P Singh Parmar, S. Majhi, D.P.Kothari. "Load frequency control of a realistic power system with multi-source power generation", *Electrical Power and Energy Systems*, vol.42, pp-426-433, 2012.

[14] Mir, A. S., & Senroy, N. (2017). Adaptive Model Predictive Control Scheme for Application of SMES for Load Frequency Control. *IEEE Transactions on Power Systems*, *8950*(c), 1–9. https://doi.org/10.1109/TPWRS.2017.2720751