Chapter 5: Conclusion

This project work has presented a comprehensive study on the effect of integrating EV aggregator with communication time delay to conventional LFC system. For a given time delay and load sharing scheme, a set of all stabilizing PI controller gains that constitute a stability region in the parameter space of the controller have been determined using a graphical ex‐act method. The impact of both time delay and EV aggregator participation factor on the stability regions has been evaluated. It is observed that the size of stability regions decreases as the time delay and EV participation factor increase.

To complement stability region results, stability delay margins have been determined for a large number of PI controller gains using a frequency domain exact method. It has been observed that stability delay margin becomes smaller with an increase in the integral gain. Moreover, for any given PI controller gains, an increase in EV aggregator participation factor results in a decrease in stability delay margin. If the PI controller gains and participation factor of EVs are not properly selected, the participation of EV aggregator with a communication time delay may cause instability and degrade the dynamic response against an expectation that EVs can improve the LFC dynamic performance.

It is expected that the results will allow us to determine the communication delay requirements and the design of PI controller for EV aggregators participating in frequency regulation service. In the future, the gain and phase margins will be taken into account for obtaining stability regions of load frequency control systems with multiple EVs aggregators and time delays. Also, the stability regions will be computed for multi-area load frequency control system.

Chapter 6: References and Base Paper

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