

Study Committee SC-A1

Generation Mix of the Future PS 1

10431_2022

CASE STUDY FOR SYNCHRONOUS CONDENSER IMPLEMENTATION A NOVEL SOLUTION FOR GRID STABILITY IN ERA OF RENEWABLES

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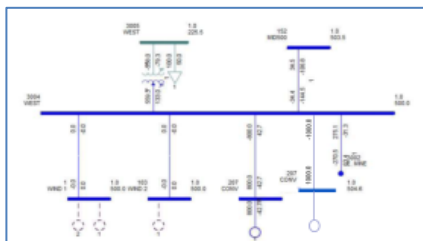
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Motivation

- Grid Stability/Reliability issues with huge RE integration planned in future
- Solution to the challenging aspects of Short Circuit Power (SCP), Inertia and Dynamic Reactive Power
- Analysis of available solutions/technologies for these challenges and finding the most suitable techno-economic solution

Method/Approach

- Study of changing Generation Mix with increasing renewable penetration
- Analysis of problems of Inertia, SC Power and Dynamic Reactive Power through load flow and dynamic simulation studies
- Simulation on sample network (with 1800 MW conventional generation and 800 MW RE)



- Study of available solutions and their responses

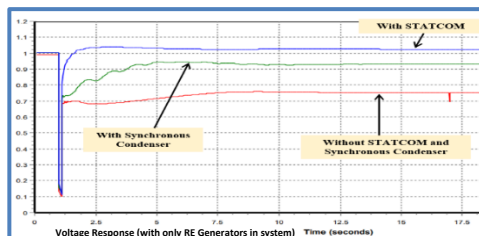
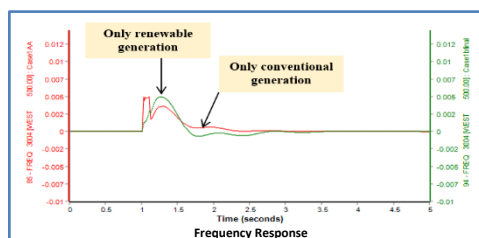
Objects of Investigation

- Sample Network
- Available ancillary service technologies such as SVC, STATCOM and Synchronous Condenser

Support	Syn. Con	STATCOM	SVC
Inertia	YES	NO	NO
Dynamic Reactive Power	YES	YES	YES
SCP	Very High	Very Limited	NO
Overload Capacity	Very High 200% for 12 sec	NO/expensive (overrated components)	NO

Test results

	Case Description	Short Circuit Ratio (SCR)
Case-I	1800 MW Conventional and no RE generator	SCR = 5.09
Case-II	1800 MW Conventional + 800 MW RE Generator	SCR = 3.63
Case-III	800 MW RE and no conventional generator	SCR = 2.45
Case-IV	1000 MW Conventional + 800 MW RE + Syn Con (400MVAR)	SCR = 5.24



Discussion

- SCR decreases with increase in renewables and withdrawal of conventional energy. It is due to limitation of power electronics in RE generators
- Frequency response with only RE generators in system is slow due to no inertia in the system
- STATCOMs can provide a very fast dynamic reactive power response

Conclusion

- Increased requirement of Inertia, SCP and Dynamic Reactive Power with increasing RE penetration
- Synchronous condensers come out as the strongest techno-economic solution
- System studies are required for deciding location and type of ancillary service required at a particular node
- Well planned regulatory policies and cost recovery mechanism are necessary for promoting investment in these ancillary services