Applications of Synchronous Condensers in Conventional Diesel Generators

Background

Synchronous condensers (SCs) are gaining importance in modern electricity systems. They help integrate distributed energy resources (DERs) and improve microgrid stability. SCs operate without mechanical loads, offering flexibility in reactive power control, short circuit support, and system inertia. Retrofitting SCs in diesel generators (DGs) with Synchro-Self-Shifting (SSS) clutches could enhance performance and promote decarbonisation of isolated microgrids.

Methodology

This research tackles grid stability, fault current, DER reactive power, and the impact of adding SC functions to existing diesel generators. Using MATLAB Simulink, two models were tested under different operational scenarios to evaluate SC retrofitted DGs' viability and their effects on grid performance.

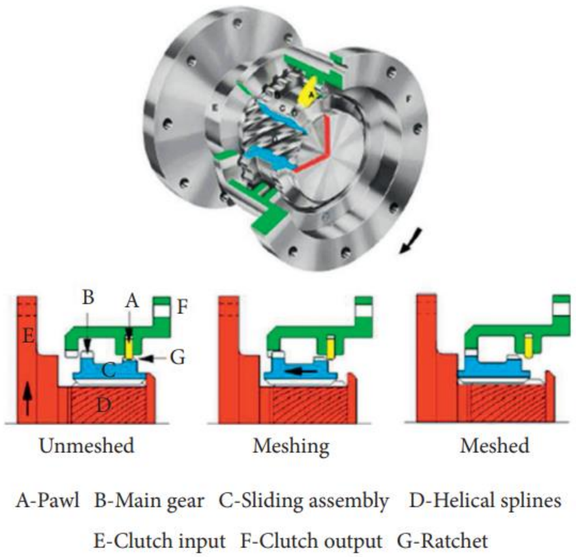

*Figure 1: Synchro-Self-Shifting (*SSS) Clutch

The research suggests that Synchronous Condenser (SC) retrofitted Diesel Generators (DGs) could serve as **robust** and **environmentally friendly** alternatives to current DG integration in isolated microgrids.

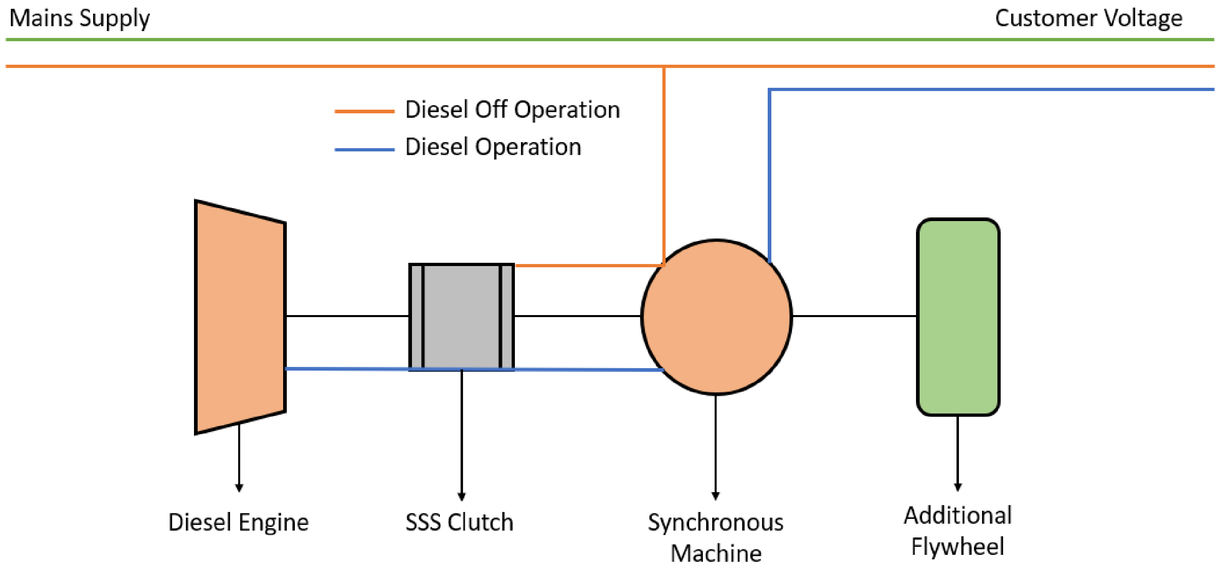

Figure 2: Synchronous Condenser (SC) retrofitted Diesel Generator (DG) with the use of SSS Clutch

Results & Conclusion

This study highlights the intricacies and trade-offs in integrating SSS clutches into diesel generators for synchronous condensing, particularly in high DER penetration power systems. It underscores synchronous condensers as promising alternatives to traditional generators, excelling in load-switching scenarios, but emphasizes the need for careful technology choice and further research on control mechanisms.

The investigation into engine engagement suggests potential grid impacts, and there's room for research on deloading DGs and refining clutch engagement. Limitations in simulations are noted, including the need for a more precise mechanical model for clutch transitions. Overall, this study provides valuable insights for power system engineers, stressing the importance of tailored solutions and careful DER implementation for grid resilience and sustainability.

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