National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Performance Enhancement of Grid-Tied Virtual Synchronous Generators for Renewable PV Systems.
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Venue	: Electrical Engineering Seminar Hall-401
Date and Time	: 11 Aug 2025 (11:00 AM)
Abstract	: The transition from centralized to distributed generation, driven by renewable energy integration, particularly Photovoltaic Generators (PVGs), poses challenges due to their lack of rotational inertia. This affects system stability and grid synchronism. PVGs interfaced via power electronic converters introduce power quality issues like voltage/frequency fluctuations and harmonics. To address this, a Virtual Synchronous Generator (VSG)-based control is proposed, incorporating adaptive control of Active and Reactive Power Loops (APL/RPL) for power tracking, oscillation damping, and improved power factor. An Elevated Adaptive Integrated Control Strategy (EAICS) is developed, combining a Modified Proportional Resonant Controller and Phase-Corrected Reference Current (PCRC) generator to manage harmonics and frequency oscillations under distorted grid conditions without requiring a PLL. Small-signal analysis ensures optimal dynamic performance. A single-stage Photovoltaic Energy Conversion System (PECS) integrated with Community Residences (CR) as generators introduces the CRVSG concept. CRVSG enhances grid interactivity, delivering distortion-free, balanced currents and maintaining power quality under irradiance fluctuations. The system adaptively adjusts DC-link voltage and supplements power from the grid as needed. Grid-side and PECS-side uncertainties are analyzed. The proposed Three-Phase Grid-Tied VSG (TPGTVSG) system is modeled and experimentally validated using MATLAB/Simulink and a laboratory prototype, demonstrating robustness under dynamic conditions.