Abstract

Power quality (PQ) measures system reliability, equipment security, and power availability in electrical power systems. Common PQ problems include voltage sags, swells, overvoltages, undervoltages, harmonics, transients, and grounding issues, with harmonics and sags having the most significant impact. PQ events are variations in voltage magnitudes and waveform distortions affecting low-frequency to high-frequency spectral content deviations and other phenomena. Power quality is a growing concern due to the restructuring of the electric utility industry and the proliferation of small- and medium-scale distribution generations. This study investigates the predictive monitoring and analysis of power quality (PQ) events in a three-phase microgrid using digital signal processing (DSP) and machine learning (ML) approaches. The results show that harmonics and voltage sags are prevalent issues in AC microgrids, affecting system stability and equipment performance. This study also compares the microgrid's performance with the utility grid, showing that converter-interfaced systems are more susceptible to harmonics combined with RMS voltage variations. The microgrid showed lower Total Harmonic Distortion (THD) but increased sensitivity to voltage sags, highlighting the need for careful consideration when operating high-power devices. This research emphasizes the importance of PQ monitoring in power systems and the significance of both long-term and short-term monitoring for effective power system operation and equipment safety.