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Harmonics in Power Systems and Mitigating Techniques

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Abstract

The increasing emphasis on overall power system efficiency has resulted in continued growth in the application of devices such as high-efficiency, adjustable-speed motor drives and shunt capacitors for power factor correction to reduce losses. This is resulting in increasing harmonic levels on power systems and has many people concerned about the future impact on system capabilities.

Newer-generation load equipment, with microprocessor-based controls and power electronic devices, is more sensitive to power quality variations than was equipment used in the past. Both electric utilities and end users of electric power are becoming increasingly concerned about the quality of electric power. End users have an increased awareness of power quality issues. Utility customers are becoming better informed about such issues as interruptions, sags, and switching transients and are challenging the utilities to improve the quality of power delivered.

The modern electric power systems that include non-linear loads may experience power quality problem such as harmonic distortion. Non-linear loads draw current that passes through all the impedances between the loads and the system sources. The current causes power quality problems.
The harmonic problems are mainly due to substantial increase of non-linear loads such as the SMPS, UPS, VSD using power electronic devices or microprocessor and power electronic controllers in AC/DC Transmission links.

Simulation studies and tests will be carried out on rectifiers and inverters in VSD applications and results analyzed to study their impact on the system and suggest methods to improve power quality by reducing harmonic levels.The harmonic analysis would be performed and their effects on the motors and transformers studied. The variable speed

drives performance analysis will be carried out using inverters in 180-degree mode and in PWM mode by conducting tests on three-phase squirrel cage induction motors. The effects of harmonics and performance of these inverters will be analyzed and mitigating techniques suggested to improve power quality issues.

The filters are applied to keep the total harmonic distortion (THD) of the current and the voltage within the limits set by the IEEE Recommended Practices and Requirements for Harmonic Control in electrical power systems. For best result, filters are installed close to the non-linear loads. The application of the filters at the non-linear load locations reduces the total harmonic distortions of the voltage below 5 percent and the total harmonic distortions of the current below 15 percent. These limits meet the IEEE-519, 1992 limit.

Keywords
Harmonics, IEEE-519, 1992 limit, Non-linear loads.

Biographies

Abdalrhman Safar, Yasseen Ali, Turki Alharbi, Maher Aljohani and Abdulhameed Salim are final year undergraduate students. They are studying electrical engineering. They are expected to graduate in 2020. They are working in Biogas power generation for their final year project.

Mustajab Khan is a lecturer at Electrical and Electronics department, Yanbu Industrial College. He has taught courses in machinery, motor control and power electronics for engineers. Mr. Khan is the main supervisor for this project.

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