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***Harmonics Requirements for Products in
North American Public Networks***

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Introduction

This document explains the common position shared by CEMEP and NEMA regarding harmonics requirements for products, in particular for variable speed drives, in public supply networks. In contrast to Europe, for example, North America follows the philosophy to limit harmonic emissions for installations rather than for individual equipment. This approach, which promotes an optimized, efficient, and cost-effective solution for all installations, is unfortunately sometimes misinterpreted by drives customers or consultants due to inappropriate simplifications or limited understanding, resulting in overly strict harmonic emission requirements for power electronic products. Consequently, an optimized solution is not achieved, and the cost for harmonics mitigation in the final installation is unnecessarily high, potentially requires more facility space, increases system complexity and reduces energy efficiency.

Harmonic Emission Limitation In IEC

The standards IEC 61000-3-2 and 61000-3-12 define harmonic current emission limits for all products in public networks. These limits are derived from compatibility voltage levels defined in IEC 61000-2-2 for the point of common coupling (PCC). This derivation is based on the assumption that the superposition of the harmonic current emissions to be found at a typical location in a public network causes a harmonic voltage drop lower than the compatibility level at the PCC. The superposition takes into account that the vector addition of harmonic currents from different types of equipment is considerably smaller than the scalar addition. This allows relatively high harmonic emission of equipment, e.g., for variable speed drives, while still ensuring a low disturbance level in the network. However, according to this concept, each type of equipment has to be certified for its harmonic emissions, which is a considerable test effort.

Harmonic Emission Limitation in North America

In North America, no current emission limits for individual equipment exist. Instead, IEEE 519 defines harmonic emission limits for complete installations at their PCC. This concept removes the burden of EMC certification for each individual type of equipment, and also allows the connection of equipment with relatively high harmonic emissions if other equipment in the installation is without harmonic emission or even compensating these emissions. In this way, optimum installation performance can be achieved at minimum cost. As IEEE 519 limits the resulting vector addition of all harmonic emission currents of all pieces of equipment at the PCC, the relative limits are considerably lower than the relative emission limits for individual equipment in the IEC standards.

Misinterpretation of IEEE 519

In some cases, misinterpretations of IEEE 519 have occurred in North America. Due to limited knowledge of the final installation in the planning phase, some customers of drives ask for individual power electronic equipment to meet the low installation limits of IEEE 519 at their inputs, not taking into account the diverse phase angles and the existence of equipment without harmonic emissions on the system that tend to mitigate individual contributions. While the resulting harmonic emissions are low, the increased harmonic current emission mitigation effort in each piece of equipment is not justified from an economic viewpoint in comparison to mitigation for the installation. In addition to the increased equipment cost, when viewed collectively individual equipment solutions often require more space in the installation which must be factored into the cost of the initial investment. Individual equipment solutions also tend to

increase the overall complexity of the installation, which may result in increased cost of long term operation and maintenance due to increased energy consumption and repair cost.

Conclusion

CEMEP and NEMA are both concerned about the economic impact of misinterpretation of the harmonic current emission requirements in IEEE 519. A project is underway to update IEEE 519 for clarification that the limits defined in that document are only applicable to installations and not to individual equipment. Only when properly utilized can an optimized, efficient and cost-effective solution be achieved for all installations.

The National Electrical Manufacturers Association (NEMA)

The National Electrical Manufacturers Association (NEMA) represents nearly 325 electrical equipment and medical imaging manufacturers that make safe, reliable, and efficient products and systems. Our combined industries account for 370,000 American jobs in more than 6,100 facilities covering every state. These industries produce \$124 billion in shipments and \$42 billion in exports of electrical equipment and medical imaging technologies per year.

About CEMEP

CEMEP is the European Committee of Manufacturers of Electrical Machines and Power Electronics, representing an industry with a market value of € 6.3 billion and 130,000 employees. The members of CEMEP are the National Associations in Europe, representing manufacturers of electric motors, variable speed drives, and uninterruptible power supplies.

This organization allows industry to co-ordinate actions at the European and International level, with the main topics being: market evolution, standardization, regulation, promotion, and connection with other products & professional groups.

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