

ENGINEERING NOTE

SUBJECT: IEEE-519 Harmonic Specifications

APPLICABLE MODELS: ALL

What Is Meant by Meeting the Requirements of IEEE-519-1992?

Howard G. Murphy P.E.

First and foremost, IEEE-519-1992 describes the **RECOMMENDED** Practices and Requirements for Harmonic Control in Electrical Power Systems. The scope of IEEE-519-1992 is clearly stated as the intention of establishing goals for the design of electrical systems that include both linear and non-linear loads. The document describes the voltage and current waveforms that may exist throughout the system and establish waveform distortion goals. It defines the interface between sources and loads as the point of common coupling with observances of the design goals to minimize interference between electrical equipment.

Secondly, it is the responsibility of any reputable equipment supplier to provide their customers with equipment, at the best possible cost per performance ratio, that will meet the known operating requirements of the

customer. Included with the purchase of that equipment are the less tangible but equally important application experience that the supplier can share with the customer.

Lastly, the equipment supplier should be able to supply any necessary service and application support directly associated with the performance of that equipment and its impact on other electrical equipment utilizing the same point of common coupling.

Specifically addressing the objective of meeting the requirements of IEEE-519-1992, it can be stated that all variable speed drives (both AC and DC) meet the requirements in most installations. With some types of variable speed drives (DC and Current Source Inverters), it may be necessary to add an isolation transformer or ac line reactors between the source and the drive to prevent interference with other electrical equipment. The requirement for isolation transformers or ac line reactors stems from the fact that those types of power converters produce voltage distortion in the form of line notching. Those types of converters also may generate higher levels of reactive currents which may place additional stress on the components of the distribution system when they are injected back into the system.

Typically, if the system capacity is greater than twice the demand, voltage distortion is minimal and no interference with other electrical equipment is experienced. Often the recommended goals established within IEEE-519 are exceeded without creating any interference problems. Because of the diversity of the individual loads, the recommended goals defined within IEEE-519 can not identify the demarcation line between an electrical system that is problem free and a system that is subject to problems.

The principal goals established within IEEE-519-1992 are for voltage distortion.. The document clearly dedicates its volume to describing power converter types where phase controlled rectifiers are used. The main applications for that type of converter are in power control for arc furnaces, dc motor controllers and current source drives. The converter used in PWM ac drives is mentioned briefly in a few paragraphs of the 100+ page document. That fact should not go unnoticed.

It is generally accepted that PWM ac drives which contain internal bus reactors or input ac line reactors do not create electrical interference with other electrical equipment. Although some rare occurrences may exist, more than 500,000 installations where PWM ac drives are installed have not experienced any interference problems. In the majority of these installations, the voltage distortion goals defined within IEEE-519-1992 have not been exceeded.

In many or even most of the installations, the current distortion goals have been exceeded (if current is measured at the input of the drive and not at the utility). These facts clearly show that the description for current distortion defined within IEEE-519-1992 is correctly stated as an aid in determining voltage distortion.

In section 10.3 (**Development of Current Distortion Limits**), *"..... The objectives of the current limits are to limit the maximum individual frequency voltage harmonic to 3% of the fundamental and the voltage THD to 5% for systems without a major parallel resonance at one of the injected frequencies."* It further goes on to state that; *"..If individual customers meet the current distortion limits, and there is not sufficient diversity between individual customer harmonic injections, then it may be necessary to implement some form of filtering on the utility system to limit voltage distortion levels."* It can be clearly noted that achieving low voltage distortion is the principle goal. Measurements for current distortion are to help identify potential voltage distortion problems.

Meeting the requirements defined within IEEE-519 does not mean crossing every t and dotting every i without applying common sense. It is a system evaluation which requires going beyond the easy approach of putting in bigger and more expensive equipment that is not required. It is the responsibility of the equipment supplier to take their best technical experience and share that experience with their customers to provide the lowest cost, most efficient solution to the application. If we are to efficiently use the limited energy that is available to us at this time we must not implement the bigger, less efficient, and more expensive solutions when it is obvious that they are not required for the proper performance and most efficient use of electrical energy.

Finally, we must understand that we are dealing with electrical systems which are dynamic. It may be required, in the future, that different solutions are necessary. As the demands on the electrical system change, it is likely that other solutions, that are more expensive today, may be required in the future. There is every reason to believe that, when those solutions are needed, the cost and reliability will be more favorable. IEEE-519 is also a dynamic document. As technology changes, that document will change. As suppliers offer new products, those products will help the customer meet their electrical needs when those needs are required and they will likely be achieved at favorable costs without an atmosphere of fear. If no interference between electrical equipment exist in an installation, then the scope of IEEE-519 has been met. The harmonic distortion percentage limits are guides to achieving that result. Those who utilize IEEE-519 with that in mind clearly have met their responsibility of designing and specifying on the basis of intelligence not fear.

As a final note, It is recommended practice to consider the effect on power factor correction capacitors that were applied to the system to improve or counteract the lagging power factor of any motor operating across the line. When applying drives, any capacitors on the system may have to be relocated or electrically buffered to prevent an increased demand caused by forcing the capacitors to provide kVA power instead of the kVAR power that they were designed to handle. Discussions with the equipment supplier can obtain a more appropriate solution to a potential system problem.

For further information email Hitachi at: inverterinfo@hal.hitachi.com