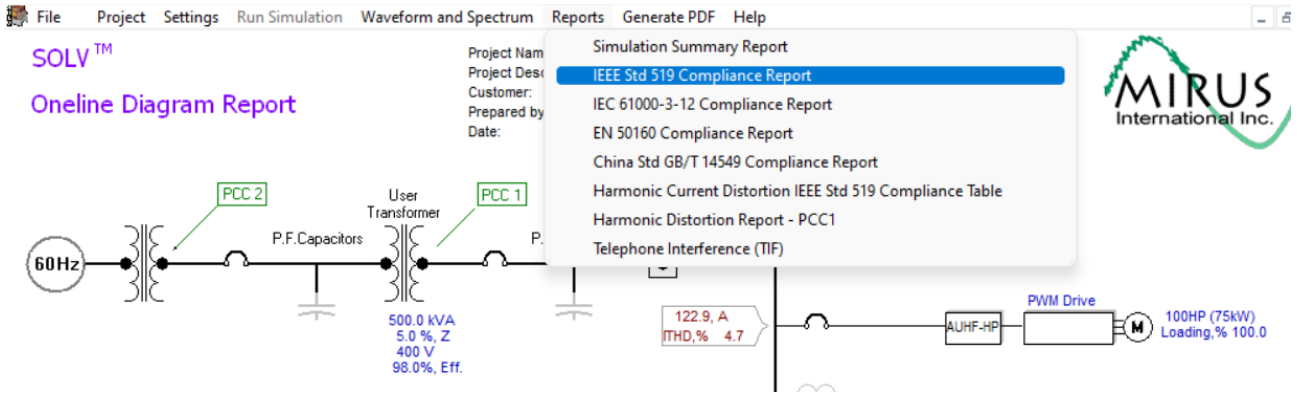
IEEE Standard 519-2022 Update and Changes From Prior Version (-2014)



*Mirus' SOLV™ simulation software[1]

IEEE Standard for Harmonic Control in Electric Power Systems (IEEE Std 519-2022), is a highly recognized and referenced standard, and has been updated in 2022 from its prior 2014 version. The purpose of the standard is to establish goals for the design of electrical systems that include both linear and nonlinear loads[2].

Please note that Mirus is not responsible for any misinterpretation of the standard, and the following notes are Mirus' interpretation only. The more significant changes are shown in **bold**:

• Title Change: 'Recommended Practice and Requirements' changed to 'Standard'. Although the title has removed the word 'recommended', the fact is that the use of IEEE Std 519 still remains wholly voluntary. Several other verbage simplifications have been made throughout the document as effort to simplify and help avoid misinterpretation of the standard.

• The introduction mentions that users should not add equipment that affects the impedance characteristic in such a way that voltage distortions are increased. The word 'passive' has now been removed from this description, so now we can interpret that ALL equipment should be considered to meet this criteria.

• **Scope added to include Inverter-Based Resource (IBR) and/or Distributed Energy Resource (DER) installations which direct the User to IEEE Std 1547[3] or IEEE Std 2800[4] for current distortion limits if the combined site rated generation is >=10% of the annual average load demand. A Decision Tree has been provided as Figure 1 in the standard to determine whether IEEE Std 519 current limits apply at the PCC.**

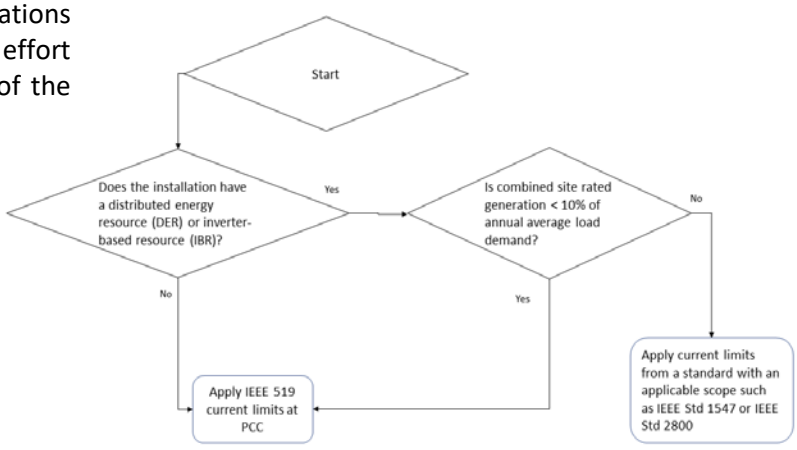


Figure 1: Decision tree for applying current distortion limits at PCC[2]

• Additional note in the scope that the limits given in this document are justifiable only at the PCC, and not intended to be used for the evaluation of equipment. This was always the intent of the standard, but some additional clarification has been included. Although IEEE Std 519 does not specify limits on individual equipment, Mirus accepts that some engineers/specifications may choose to apply specify limits on certain non-linear loads. This strategy can be used to ensure compliance at the PCC provided there is no system resonance conditions at the residual harmonics and/or all nonlinear loads contributing to the distortion at the PCC have been considered.

• Additional clarity provided for the 'maximum demand load current' to clarify how it is calculated by the max 15 or 30min demand, and what to do if 12 months of data is not available. If not available, then it shall be based on the projected 15- or 30-min demand. Previously it was not clear what should be done for new installations or when 12 months of data was not available.

• Harmonic measurements for IEEE 519 evaluation are required to be made up to the 50th using Class A instruments. Class S would only require measurement up to the 40th harmonic. This clarification may help those looking to use or purchase a power analyzer.

• **Even-order harmonic current limits have been relaxed. Previously all even-order harmonics were limited to 25% of the individual harmonic limits as provided in the current limit tables. Now the current harmonic limits have been increased for even harmonics.**

For h<=6 -> Limits have increased from 25% to 50% of the individual limits shown in the tables.
For h>6 -> Limits have increased from 25% to 100% of the individual limits shown in the tables.

Even-order harmonics are not desirable on power systems, and their appearance can indicate asymmetry between the positive and negative halves of the waveform. Perhaps it was felt that these increases were required due to the larger numbers of IBR, AFE drive and active filters, which may result in some levels of even order harmonics that may not have always been meeting the more stringent even-order harmonic limits in the previous 2014 standard.

• **Annex A. Significant changes to the Interharmonic Voltage Limits and Rationale. The standard mentions that more detail can be provided by referencing a paper by Drapela, et al [B3] "Issues and Challenges Related to Interharmonic Distortion Limits", 2020.** [5]
Interharmonics can be difficult to address when dealing with active devices such as IBR, AFE Drives and active filters because they can often generate interharmonics. Passive filters typically treat harmonics over a frequency range so both harmonic and interharmonic frequencies are usually addressed.
The recommended limits (not prescriptive) are based on analysis of the sensitivity of lighting equipment (LEDs) to prevent flicker, and also more strict limits required on sensitive non-lighting equipment. Appropriate limits should be based on specific needs (local, country, conditions, etc.).

References:

1. SOLV™ Software Registration and Download, https://www.mirusinternational.com/register.php
2. IEEE Std 519-2022, IEEE Standard for Harmonic Control in Electric Power Systems.
3. IEEE Std 1547-2018, IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces.
4. IEEE Std 2800-2022, IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBR) Interconnecting with Associated Transmission Electric Power Systems.
5. Drapela, J., M. Halpin, R. Langella, J. Meyer, D. Mueller, H. Sharma, A. Testa, N. Watson and D. Zech, "Issues and Challenges Related to Interharmonic Distortion Limits," 2020 19th International Conference on Harmonics and Quality of Power (ICHQP), Dubai, United Arab Emirates, 2020, pp. 1–6, doi: 10.1109/ICHQP46026.2020.9177933.