Foretec Electric India Pvt Ltd

IEEE 519 - 2022 : WHAT IS CHANGED FROM IEEE-519-2014

Application note on Harmonic Standard

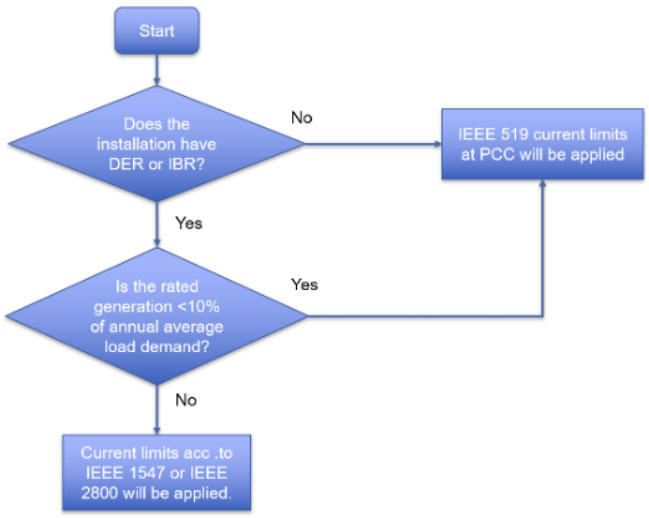
IEEE STANDARD 519-2022: UPDATE AND CHANGES FROM ITS PREDECESSOR 2014

INTRODUCTION: IEEE-519 is an often-referenced standard that prescribes recommendations for Harmonic Control in Electrical Power Systems. The 2014 version of this recommendation has been adopted internationally for harmonics mitigation by the Regulatory Authorities, including the Central Electricity Authority of India, for framing rules so that the Regulatory Commission issues directions to the Electricity Supply Companies for implementation. This Standard has been revised, and IEEE 519-2022 has come into existence. The changes in the new standards address the important issues relating to the areas like measurement, treating equipment like grid-interactive inverters, etc., as current producing ones for harmonic compliance, besides salient other issues for improving power quality in the power system. Various changes made in the new standards are discussed in this paper to enable the stakeholders to understand the true nature of the equipment for harmonic compliance during selection so that the challenges in providing harmonics filters later are minimised.

CURRENT DISTORTION SOURCES

In clause 1.2- "Purpose" of this standard, the word "passive" has been removed to imply that any equipment addition by the user results in altering the impedance characteristic that increases voltage distortions, shall come under the purview of this standard. IEE519-2014 does not prescribe specific guidelines for installations involving distributed energy generation or Invertor based grid interactive equipments or any other form of such equipment that becomes a current producing source.

As per changes made in the new standards under clause 5.2, when an installation like solar power is connected to inverter-based sources to the grid with generation exceeding 10% of the annual average demand, the current harmonics limits specified in IEEE1547 or IEEE2800 need to be followed. The decision tree below explains the compliance with the harmonics limits in the case of Inverter-based Resources.



EVEN ORDER HARMONICS

In the new standards, the limits for the even order current harmonics are enhanced. The relaxation offered by such enhanced limits is twice the limits prescribed in the earlier standards for the harmonics order of <=6 and the relaxation offered by such enhanced limits is four times the limits prescribed in the earlier standards for the harmonics order of >6.

On power systems, even-order harmonics are undesirable, and their occurrence could signify an imbalance between the waveform's positive and negative sides. The more IBR, AFE drive, and active filters there are, the more likely it is that some levels of even-order harmonics may not always comply with the stricter individual and, especially, even-order harmonic limitations in the earlier 2014 standard, leading to the perception that these enhanced limits are necessary. Table 2 and 3 of IEEE-510-2022 is furnished below for reference:

Table 2—Current distortion limits for systems rated 120 V through 69 kV

Maximum harmonic current distortion in percent of I_L						
Individual harmonic order[b]						
I_{SC}/I_L	$2 \le h < 11$[a]	$11 \le h < 17$	$17 \le h < 23$	$23 \le h < 35$	$35 \le h \le 50$	TDD
<20[c]	4.0	2.0	1.5	0.6	0.3	5.0
20 < 50	7.0	3.5	2.5	1.0	0.5	8.0
50 < 100	10.0	4.5	4.0	1.5	0.7	12.0
100 < 1000	12.0	5.5	5.0	2.0	1.0	15.0
> 1000	15.0	7.0	6.0	2.5	1.4	20.0

[a] For $h \le 6$, even harmonics are limited to 50% of the harmonic limits shown in the table.

Table 3—Current distortion limits for systems rated above 69 kV through 161 kV

Maximum harmonic current distortion in percent of I_L						
Individual harmonic order[b]						
I_{SC}/I_L	$2 \le h < 11$[a]	$11 \le h < 17$	$17 \le h < 23$	$23 \le h < 35$	$35 \le h \le 50$	TDD
<20[c]	2.0	1.0	0.75	0.3	0.15	2.5
20 < 50	3.5	1.75	1.25	0.5	0.25	4.0
50 < 100	5.0	2.25	2.0	0.75	0.35	6.0
100 < 1000	6.0	2.75	2.5	1.0	0.5	7.5
> 1000	7.5	3.5	3.0	1.25	0.7	10.0

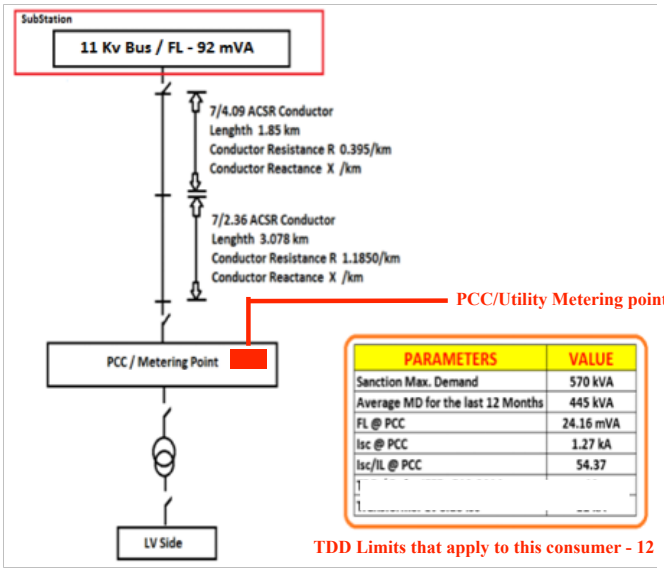
[a] For $h \le 6$, even harmonics are limited to 50% of the harmonic limits shown in the table.

CALCULATION OF IL (Average Demand Load current)

In the 2014 edition, one of the points of contention is the calculation of IL when the installation does not have the previous 12 months' demand current. The ambiguity in calculating IL is eliminated in the IEEE519-2022 as per clause 3.1, which is reproduced below:

This current value is established at the point of common coupling and shall be taken as the sum of the RMS currents corresponding to the 15 min or 30 min maximum demand during each of the twelve previous months divided by 12. If 12 months of data is not available due to the length of time in service, then the maximum 15 min or 30 min apparent power demand for each month should be summed over the total number of months available, and then divided by the number of months. For situations where the installation is a proposed new installation, the maximum demand load current shall be based on the projected 15 min or 30 min maximum monthly apparent power demand over the course of the year following operation of the proposed harmonic producing loads listed on the service application.

TYPICAL CALCULATION FOR ARRIVING AT THE PERMISSIBLE CURRENT HARMONICS LIMITS



TIPS FOR COMPLIANCE AND ACTION POINTS

It is the TDD that determines the limit of harmonic injection and not the iTHD as per standards and regulations. But the TDD variation is based on the IL and the load current during the measurement. The consumer must therefore anticipate a scenario where the load current during the measurement period could be very low compared to the sanctioned demand and plan accordingly to avoid exceeding the limits of harmonics injection into the grid.

a. The consumer should note that when the load current during the measurement period exceeds the IL, no harmonic filter will support in limiting the TDD.

b. Artificially increasing the IL to ensure that the load current during the measurement period falls below the IL to fix the problem will be a temporary solution only.

c. Installing filters without a proper design considering various technical and practical situations will not help, and it will become oversized. Uncertainty in sizing the filters will increase the impedance of the grid, which in turn could increase the voltage harmonic distortion.

Ref : PQWC's white paper - 'Realities in Harmonic Mitigation

CONCLUSION

It is, therefore, necessary to observe the following points irrespective of the fact that the new standards are made mandatory by the Regulatory authorities to avoid any embarrassment in the future when statutory implementation comes into effect:

1. Consumers should understand the true nature of the equipment for harmonic compliance during selection so that the challenges in providing harmonics filters later are minimised.
2. Monitor Power quality compliance continuously to ensure that the power quality parameters are well within limits.
3. Ensure to get the automated results/reports without doing any calculations or manual intervention so that the measurements are not disputed.
4. Deploying CLASS A Ed3 Power Quality Analyser offers a correct approach on the above points by
   - ensuring continuous monitoring
   - an easy way of monitoring compliance through the device home page
   - Monitoring all the power quality issues like Sags, Swells, and Transients as per IEC61000-4-30.

About Authors

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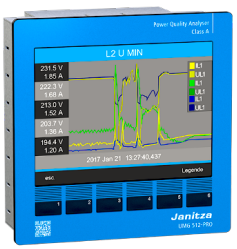

Foretec electric — Passion in Power Quality

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