

Choose right capacitor and detuned reactor for detuned filter wisely

IEC and IEEE standard have been used in Most electric utilities' standard. In this article, we will use IEC standard for calculation and use IEC standard no. 61000-2 about Compatibility levels for individual harmonic voltages in low voltage networks < 415 volts (Harmonic Limit)

This section of IEC 61000-2 is concerned with harmonic distortion in the voltage range up to 415 volts. This section gives numerical compatibility levels for low voltage a.c. distribution system with voltage up to 240V single phase and 415V three phase to avoid disturbances of systems and its elements or network devices. The amplitude of each harmonic should not exceed the levels as follows:

- Harmonic voltage order 1st not more than 10% ($U_1 < 10\%$)
- Harmonic voltage order 3rd not more than 5% ($U_3 < 5\%$)
- Harmonic voltage order 5th not more than 6% ($U_5 < 6\%$)
- Harmonic voltage order 7th not more than 5% ($U_7 < 5\%$)
- Harmonic voltage order 11st not more than 3.5% ($U_{11} < 3.5\%$)
- Harmonic voltage order 13rd not more than 3% ($U_{13} < 3\%$)

With our consideration, we will choose harmonic order 1,3,5,7 because electronic equipments in Thailand have been consisted of DC power supply, six-pulse type. These equipments will generate the said harmonic order. However, we will revise some values of each harmonic order as below:

- Harmonic voltage order 1st not more than 6% ($U_1 = 6\%$)

Harmonic voltage order 1st not more than 6% ($U_1 = 6\%$) because most distribution transformers of buildings or factories in Thailand are 22000 / 400V or 22000/415V. The voltage over 400V is hard to occur at main bus bar of Main Distribution Board.

- Harmonic voltage order 3rd not more than 0.5% ($U_3 = 0.5\%$)

because current of harmonic order 3rd or other orders which is divisible by three are flowing to neutral point. But element connection inside capacitor is delta and no neutral, thus harmonic order 3rd is not flowing to capacitor unit.

- Harmonic voltage order 5th not more than 5% ($U_5 = 5\%$)
- Harmonic voltage order 7th not more than 5% ($U_7 = 5\%$)

The voltage across the capacitor is system voltage plus other voltages as follows:

1. Induced voltage occurred by reactor when electric current is flowing it.
2. Voltage occurred by harmonic current flowing to capacitor unit

Much value of reactive power or kVAR is, much the voltage across the capacitor is.