TRINITY ENERGY SYSTEMS PVT. LTD.
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De-Tuned Reactors

When we use capacitors in the system for Power Factor improvement, the transformer inductance along with with capacitors form a resonant circuit. This circuit could get coupled with a harmonic current generated by the load. This circuit is now a resonant circuit, and it has a resonance frequency; if harmonic current of this frequency (or close to it) exists in the system, a resonance condition will develop in the system, and high current will flow through all the branches, including the transformer (inductive), and the capacitor bank (capacitive). This will lead to overloading, and raise the voltage across the transformer and capacitor(s), and finally across the entire electrical system that is connected in parallel.

Detuned filtering is a reliable and time-tested method to improve the power factor and also mitigating the risk of resonance; this is achieved by shifting the resonance frequency to lower levels, thereby ensuring that no harmonic currents are present.

The method is simple; by changing the basic LC circuit formed by the transformer and the capacitor banks, by way of introducing a filter reactor in series with the capacitor; this makes the circuit a more complex resonant circuit but with a resonance frequency below the first existing harmonic. In this way a real resonance condition cannot arise.

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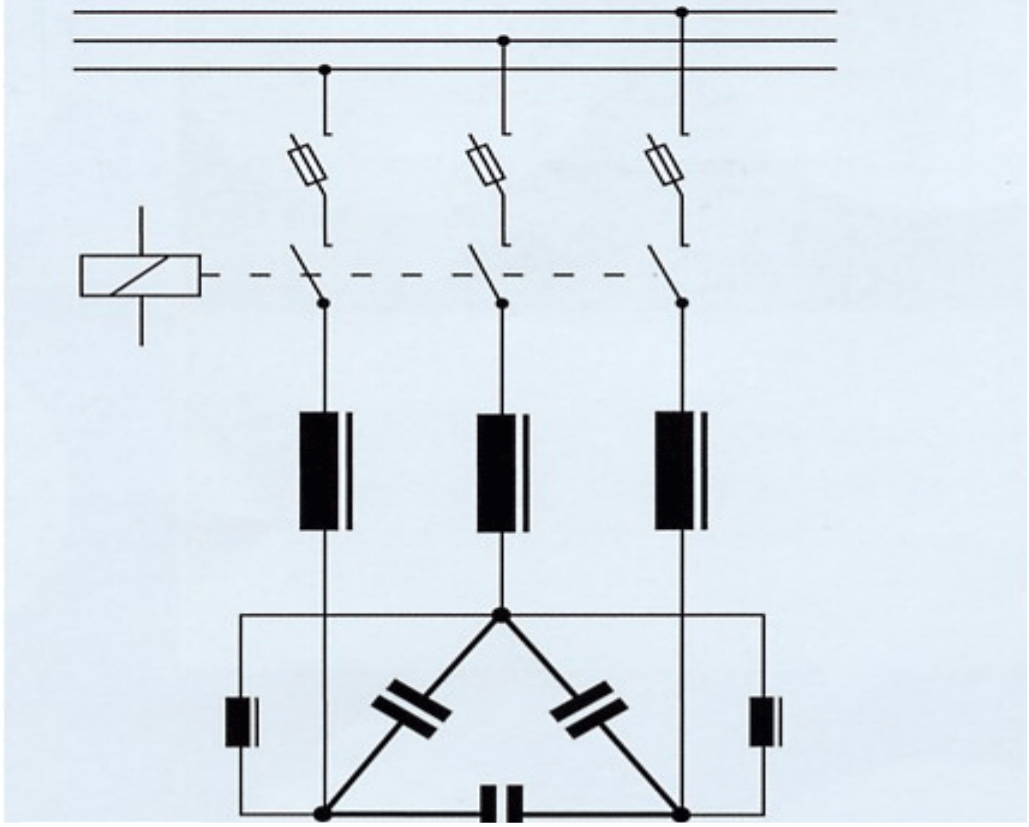
Installation of Detuned (reactor-connected) Capacitors



An additional and very valuable benefit of introducing de-tuned reactors is that when connected in series to the capacitors, this forms a series resonant circuit with some tuning frequency. At this frequency, the branch offers a low impedance path, helping in filtering the system harmonic current and cleansing the grid of harmonic pollution.

The components for the detuned filter need to be selected very carefully, after a proper harmonic study is conducted.

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Particular care is required as the voltage across the capacitors will be higher than the normal grid voltage when reactors are connected in series.

The reactors must be calculated in line with the inductance values. Only then the desired tuning frequency and harmonic current absorption will result. Tuning frequency is usually indicated by an indirect factor like P, and is generally expressed as a percentage of capacitance say 5.67%, 6% ,7% or 14%.

If a detuned reactor is defined as 7%, it means that the reactance is 7% of the capacitor reactance at the fundamental frequency.

Guidelines for manufacturing De-tuned Reactors

Voltage harmonics :

U3 = 0.5% UR
U5 = 6% UR
U7 = 5% UR
U11 = 3.5%UR
U13 = 3% UR

Effective current: √ I12 + I32 + …….. I132
Fundamental Current = 1.06 X IR (50Hz Current of capacitor)
Voltage: 400, 415, 440, 480V
Capacity: 5…….. 120KVAR
De-Tuning Factor: 5.67,6%, 7% and 14%.
Cooling: Natural , or Forced using Fans, or a combination of both.
Over temp. 120degree NC switch is provided on demand.
Harmonic Linearity: 135%, 150%, 175%, 200%
Material of Winding : Al or Cu.

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Insulation : Class F (Class H on Demand)

Our Available Range :

5.67% , 7% , 14% Detuned reactors available in the range from 5 Kvar to 100 Kvar single bank.

Calculation of Required Capacitor Power

The reactive power which is necessary to achieve a desired power factor is calculated by the following formula:

$Q_C = P \cdot F$

Q_C - reactive power of the required correcting capacitor

P - active power of the load to be corrected

F - conversion factor acc. to chart 1

Original Power Factor	Conversion Factor for a Target Power Factor									
COSf1	COSf 2									
	0.70	0.75	0.80	0.85	0.90	0.92	0.94	0.96	0.98	1.00
0.20	3.879	4.017	4.149	4.279	4.415	4.473	4.536	4.607	4.696	4.899
0.25	2.853	2.991	3.123	3.253	3.389	3.447	3.510	3.581	3.670	3.873
0.30	2.160	2.298	2.430	2.560	2.695	2.754	2.817	2.888	2.977	3.180
0.35	1.656	1.795	1.926	2.057	2.192	2.250	2.313	2.385	2.473	2.676
0.40	1.271	1.409	1.541	1.672	1.807	1.865	1.928	2.000	2.088	2.291
0.45	0.964	1.103	1.235	1.365	1.500	1.559	1.622	1.693	1.781	1.985
0.50	0.712	0.85	0.982	1.112	1.248	1.306	1.369	1.440	1.529	1.732
0.55	0.498	0.637	0.768	0.899	1.034	1.092	1.156	1.227	1.315	1.518
0.60	0.313	0.451	0.583	0.714	0.849	0.907	0.97	1.042	1.130	1.333
0.65	0.149	0.287	0.419	0.549	0.685	0.743	0.806	0.877	0.966	1.169
0.70		0.138	0.27	0.4	0.536	0.594	0.657	0.729	0.817	1.020
0.75			0.132	0.262	0.398	0.456	0.519	0.59	0.679	0.882
0.80				0.13	0.266	0.324	0.387	0.458	0.547	0.75
0.85					0.135	0.194	0.257	0.328	0.417	0.62
0.90						0.058	0.121	0.193	0.281	0.484
0.95								0.037	0.126	0.329