Basic Power

More Power to You

An Introduction.

Corporate Headquarters
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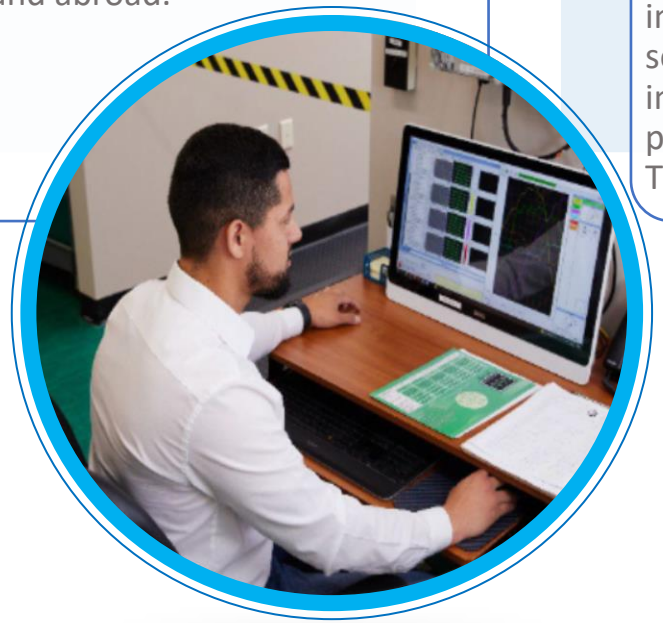
About Us

We are committed to a more sustainable future

Basic Power Inc. is a Baltimore-based power quality and energy efficiency technology company, with customers in the U.S. and abroad.



Our primary focus is on providing technical expertise for comprehensive power quality surveys to assess the potential for improvements to facility electrical services and the manufacture and installation of our patented passive filter technology, TruWatts®.

We believe that by optimizing the efficiency of electrical systems we can help reduce energy consumption, mitigate issues and assist companies in meeting their energy and sustainability goals.

Power Quality Solutions

Water & Waste-Water Plants

For many municipal governments, drinking water and wastewater plants typically are the largest energy consumers, often accounting for 30 to 40 percent of total energy consumed [1]. In this sector, energy represents the largest controllable cost.

[1] United States Environmental Protection Agency

OTHER APPLICATIONS

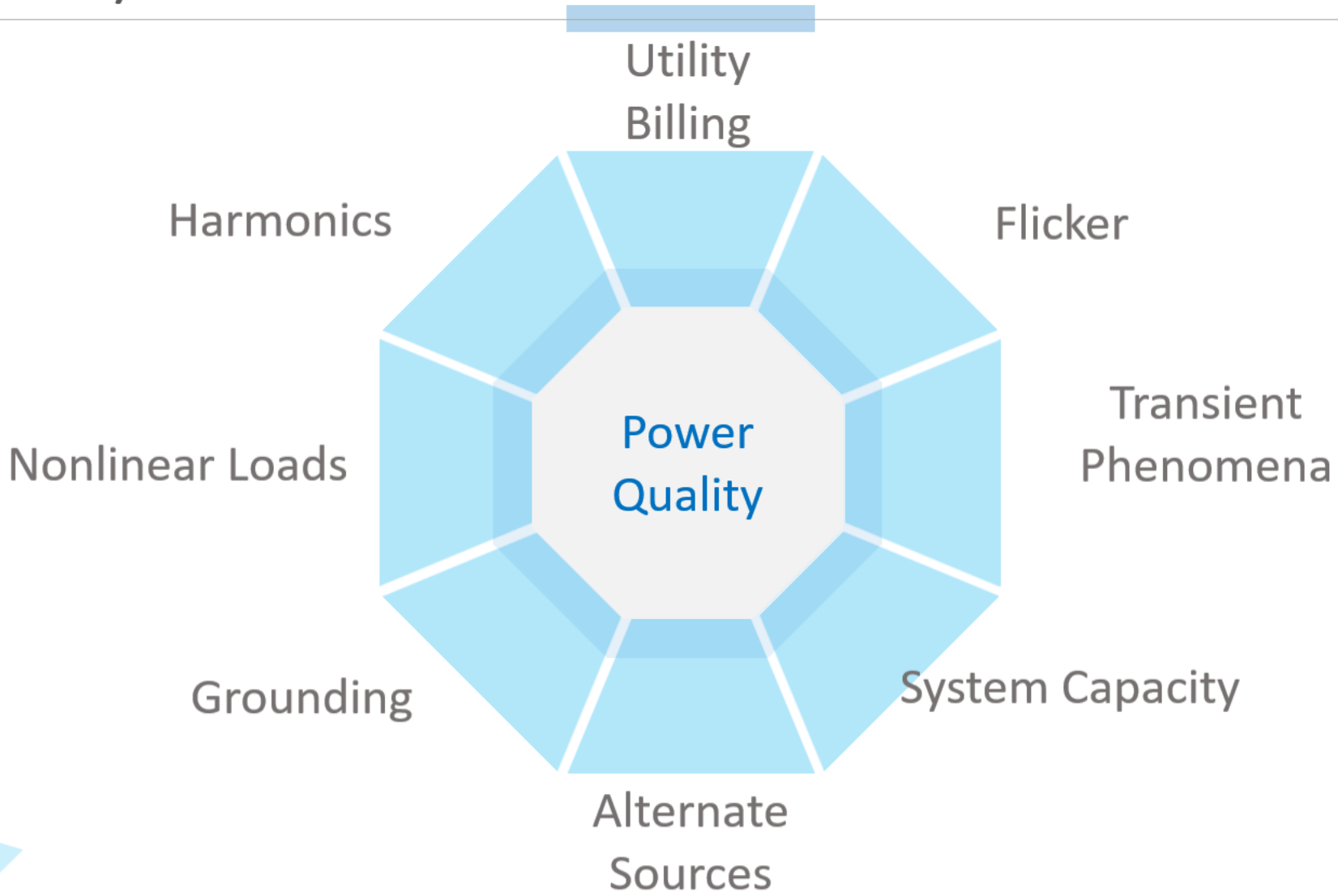
- Industrial processes
- HVAC & Chillers
- Heavy manufacturing
- Renewable Energy
- Pulp & Paper
- Oil & Gas

Cold Food Storage

Cold Storage Facilities represent some of the highest electric energy usage. Compressor, fan and pump motors, conveyor belt motors and the Variable Frequency Drives, installed to control all these electrical loads, produce undesirable power quality issues throughout a facility.

"Poor Power Factor and harmonic currents reduce the efficiency of the electric system and cost facilities money in higher electric bills, additional maintenance, unplanned equipment replacement and system downtime."

Power Quality Assessment

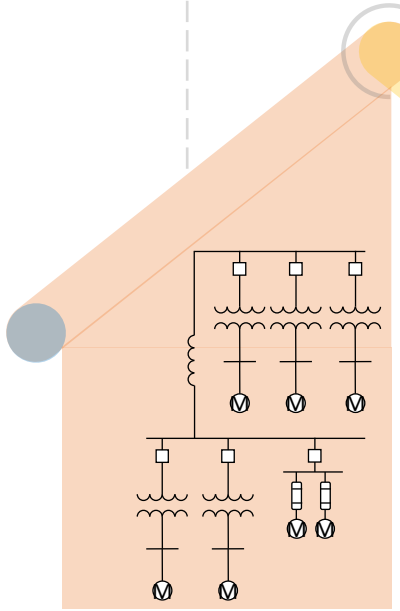


Source: Fundamentals of Electric Power Quality
S. Santoso, The University of Texas at Austin 2021

Power Quality Assessment

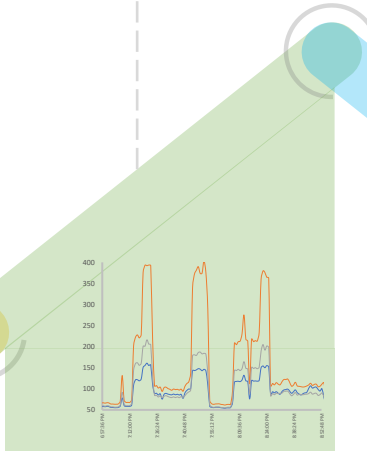
Diagnostic

To first solve a problem, we first need to **identify the problem**. Our team of engineers will analyze the schematics of the system to determine any issues.



Survey

After the initial planning phase, we will send an engineer to conduct a Site PQ Survey. Data collected will allow our engineers to analyze the system accurately to identify any power quality issues.

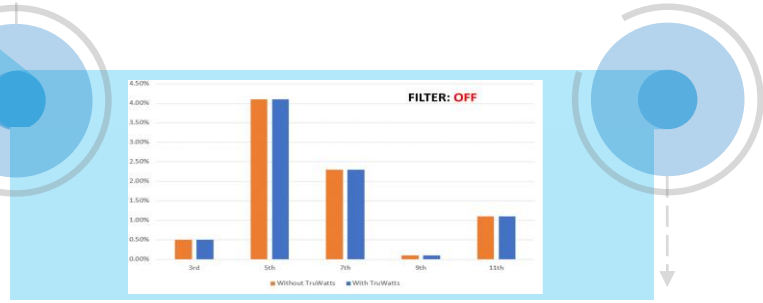


Analysis

Our engineers will analyze the data collected from the survey to determine any PQ deficiencies within the system.

Report

A report is generated with the findings of the inspection, recommending actions to reduce energy consumption and effectively improve power quality.



Compare

After implementation of any corrective measures, we will perform another power quality test to ensure that the desired optimization is achieved.

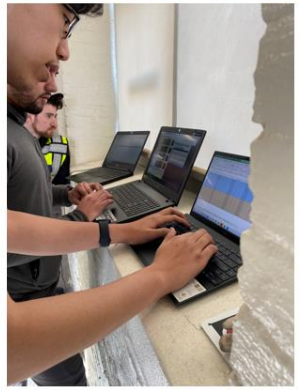
White Papers by Basic Power

Basic Power conducted their own independent research regarding the effects of power quality on equipment life – with several white papers in their catalogs.

Images below were taken during their research.





The Effects of Power Factor on Fuel Consumption of Diesel Generators

D. Andrade-Torres, C. Z. Wang, S. Washington, G. Ostendorf

Abstract – This research paper addresses the issue of power quality in diesel generators, specifically focusing on the impact of poor power factor on fuel consumption. The study highlights the relationship between power factor and fuel usage, demonstrating that as power factor decreases, the current demanded by the load increases exponentially, leading to higher fuel consumption. The estimated increase in fuel consumption for 480V three-phase systems at 90 kW is approximately 6.22%, when power factor is at 80% instead of 100%. The generator efficiency also improved by 2.32%, nearing the ideal 40% efficiency of generators. Poor power factor also increases fuel consumption over time, resulting in a 8.50% consumption rate increase after 10 hours.

I. INTRODUCTION

In numerous nations, generators serve as the predominant energy source for both industrial and residential sectors. These devices utilize fuel to mechanically produce the electricity required by consumers. Consequently, the generator's fuel consumption is directly proportional to the level of consumer demand; the higher the demand, the greater the fuel requirement. However, an additional factor must be considered in this context – power quality. Inefficient systems draw excess power, leading to the generator supplying unnecessary energy, which, in turn, necessitates the consumption of additional fuel to cater to this inefficient demand.

The primary objective of Basic Power Inc. is to address the concept of fuel conservation through the utilization of TruWatts technology. This document aims to explain the intricacies of this assertion and propose an experimental methodology to verify its efficacy. We suspect that by reducing electrical consumptions, it would result in significant reduction in fuel consumption by generators.

First let's cover the basics of power quality analysis. Engineers use power factor to determine the quality of the facility, but what does it mean? Power factor is a ratio of real power demanded by the facility out of the actual total energy demanded by the facility. This ratio is often represented in a

have an inductive power factor, while a site with large capacitive loads would have a capacitive power factor. Consider **Figure 1** as the spectrum mentioned above. However, for many cases, the power demanded changes over the time, so maintaining 100% all the time is too unrealistic. There's also a risk to this balancing act. An inductive power factor implicates inductive power, meaning if it goes into capacitive or *leading* power factor, the inductive loads will shut down. For critical infrastructure, having a leading power factor is dangerous, which is why most buildings are expected to have around 80% power factor. Without a *power factor control* (PFC) unit, optimizing power consumption while preventing a leading power factor is very challenging.

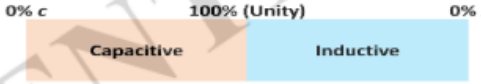


Figure 1. Centered down the middle is power factor unity – where power is ideally utilized at 100% efficiency. For inductive loads, if it becomes too capacitive, the system is deemed leading. Leading power factor can cause equipment damage due to voltage exceeding the capacity of the equipment.

II. MATHEMATICS

For those who are allergic to mathematics, skip to page 3. The following explanation is catered to those who have some basic understanding of power and electronics. Most power around the world uses alternating current (AC) due to its efficiency and flexibility. Direct current (DC) is a constant flow of charge carriers, making it challenging to manipulate through transmission lines. Consider the following equation:

$$R = \frac{V}{I} \quad (1)$$

where resistance is R, voltage is V and current is I. **Equation (1)** is Ohm's Law rearranged to portray the relationship between voltage and current. Resistance is a value assigned to describe a material's ability to conduct electricity under certain conditions. The higher the resistance, the more difficult it is for charge carriers to flow through the material. Current, on the other hand, describes the speed at which these charge carriers are traveling through the material. The electromotive force that induces an

VARIVAR

VARIVAR-480 V – Optimized Capacitor Bank

Basic Power, Inc. designs and manufacturers passive filters that are installed on the main distribution panel, or a subpanel. TruWatts® acts as a guardian against variability of power supply from the utility company and protects against internal power disruptions from load switching and non-linear, harmonic generating loads.

TruWatts® conditions the electrical system to optimize the voltage and current so that power is used efficiently and cost-effectively. TruWatts® helps to prevent component failure, prolongs operational life and increases motor efficiency by removing nuisance heat from the line.

VARIVAR Features & Benefits

Benefits

1. **Energy Efficiency**
   Removing losses within the system will result in loads demanding less energy to perform the same task
2. **Maintenance Reliability**
   Protection from damaging harmonics and transient events will maintain the lifespan of existing equipment
3. **Down-time Mitigation**
   Protection devices in the unit will prevent down-time during surges, sags, and transient events
4. **Carbon Footprint**
   Fixing power factor will directly lead to less fuel burned by the utility to supply energy, hence reducing CO_2 emissions

Financial Savings – Utility Billing
PQ Savings – Equipment Longevity
– Capacity Expansion
– Operational Continuity

Features

- Surge Protection Device
- Power Factor Control
- Harmonic Filters
- Phase Balancing Capacitors
- Improve Voltage Profile
- Sag Mitigation
- kW Reduction
- kVAr/kVA Reduction

Conventional Capacitor Banks

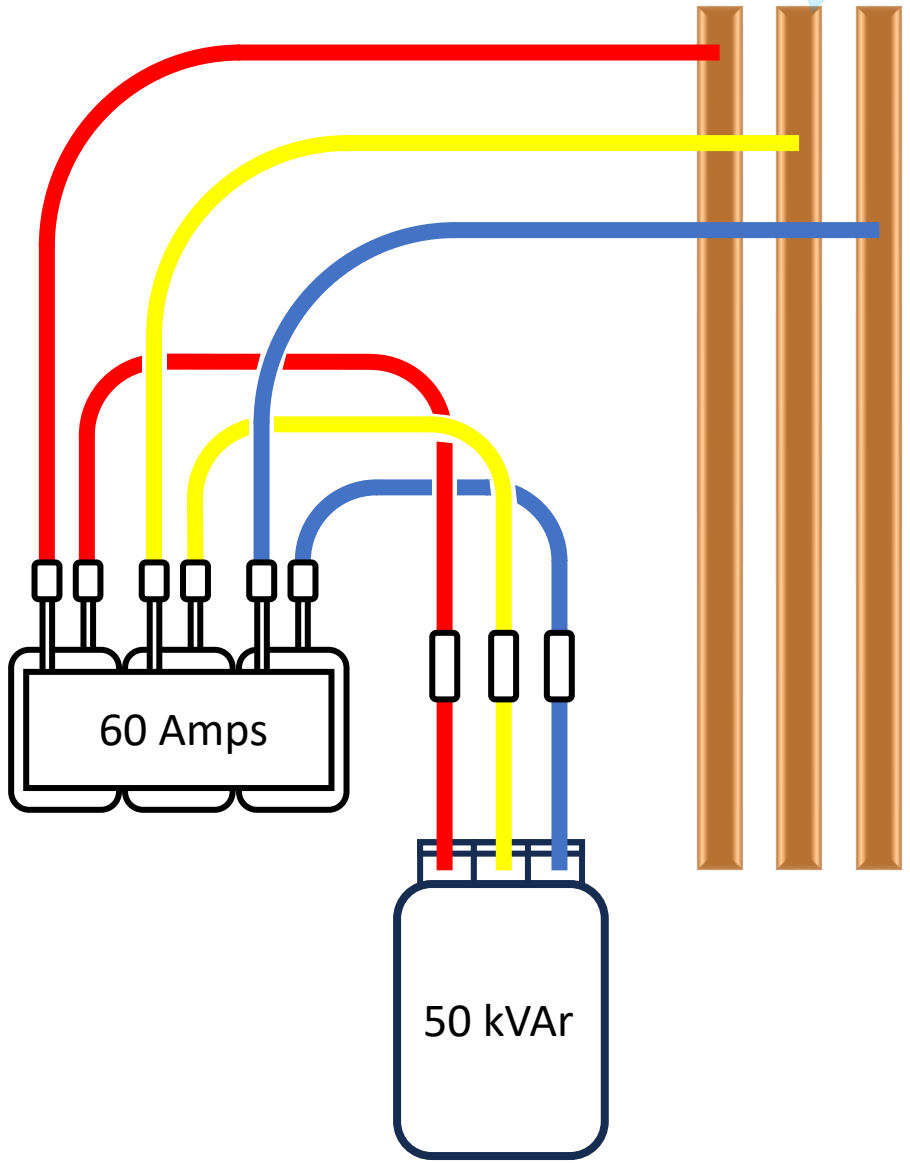
The capacitor banks currently on the market are heavy and bulky.

As the capacitor gets larger, the safety features required also increases.

Line fuses are recommended to further protect the system.

Generally, the weight of these types of capacitor banks are roughly 800lbs to 1,000lbs.

The reason for this weight is due to the large inductor sized to prevent the large switching capacitor from impacting the rest of the system.



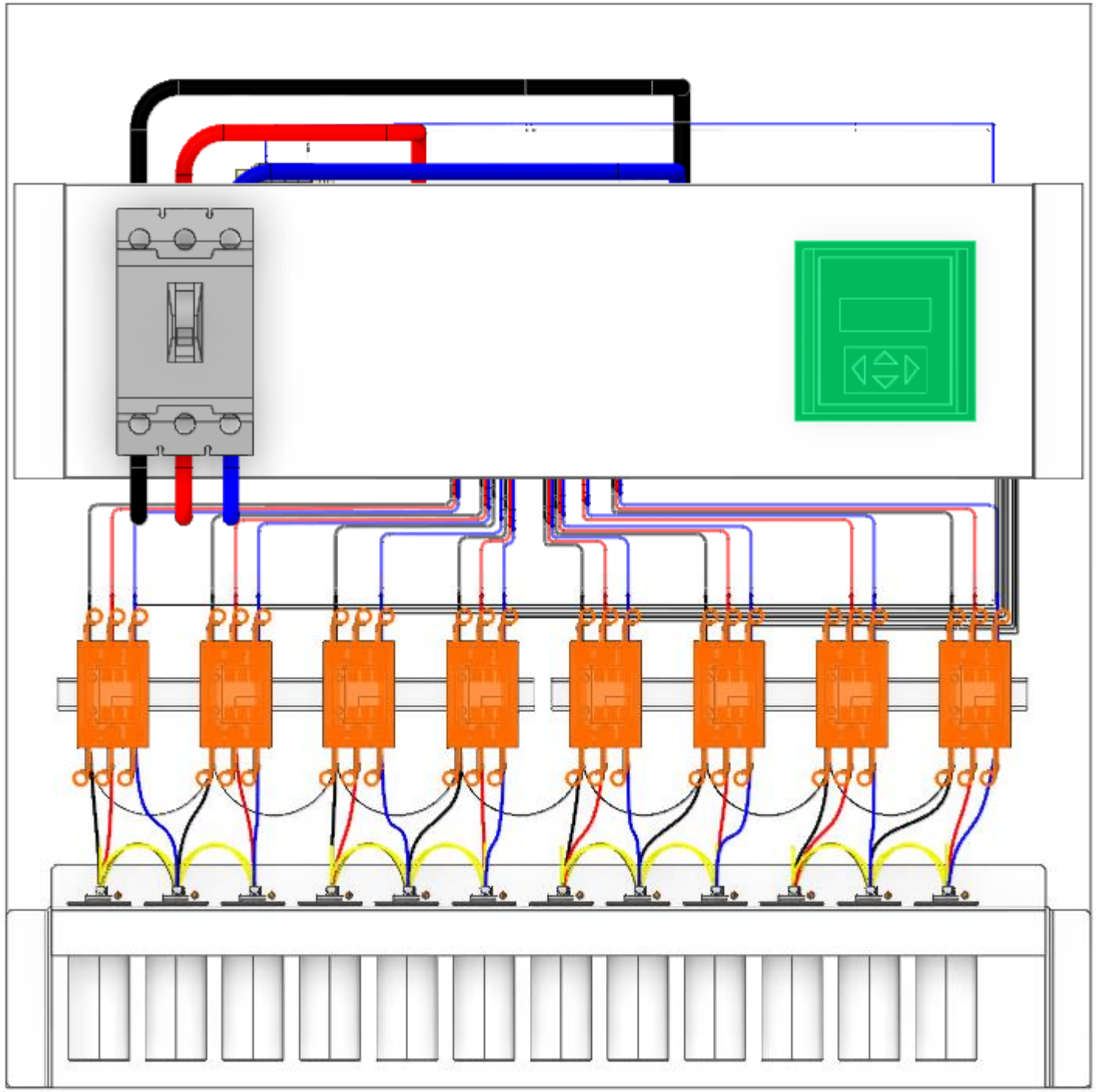
VARIVAR Capacitor Bank

To the right is our new capacitor bank design, the VARIVAR.

The VARIVAR has 8-steps of smaller capacitors.

Each individual step is roughly 20 kVAr, equivalent to 25 amps each step.

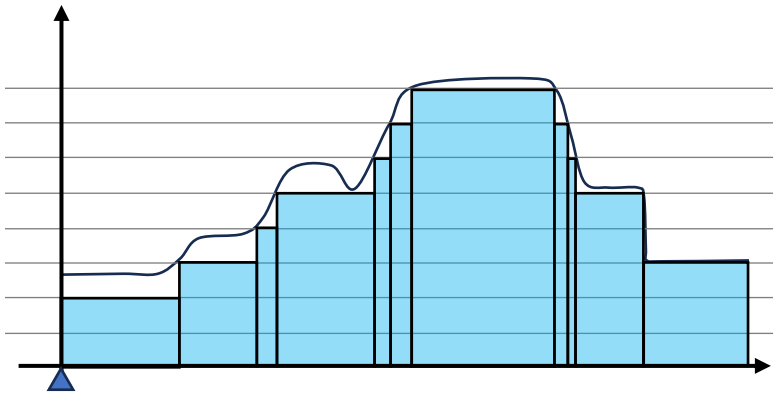
The reason for smaller steps and greater number of steps is to reduce the need for bulky inductors and provide a finer resolution in power factor correction.

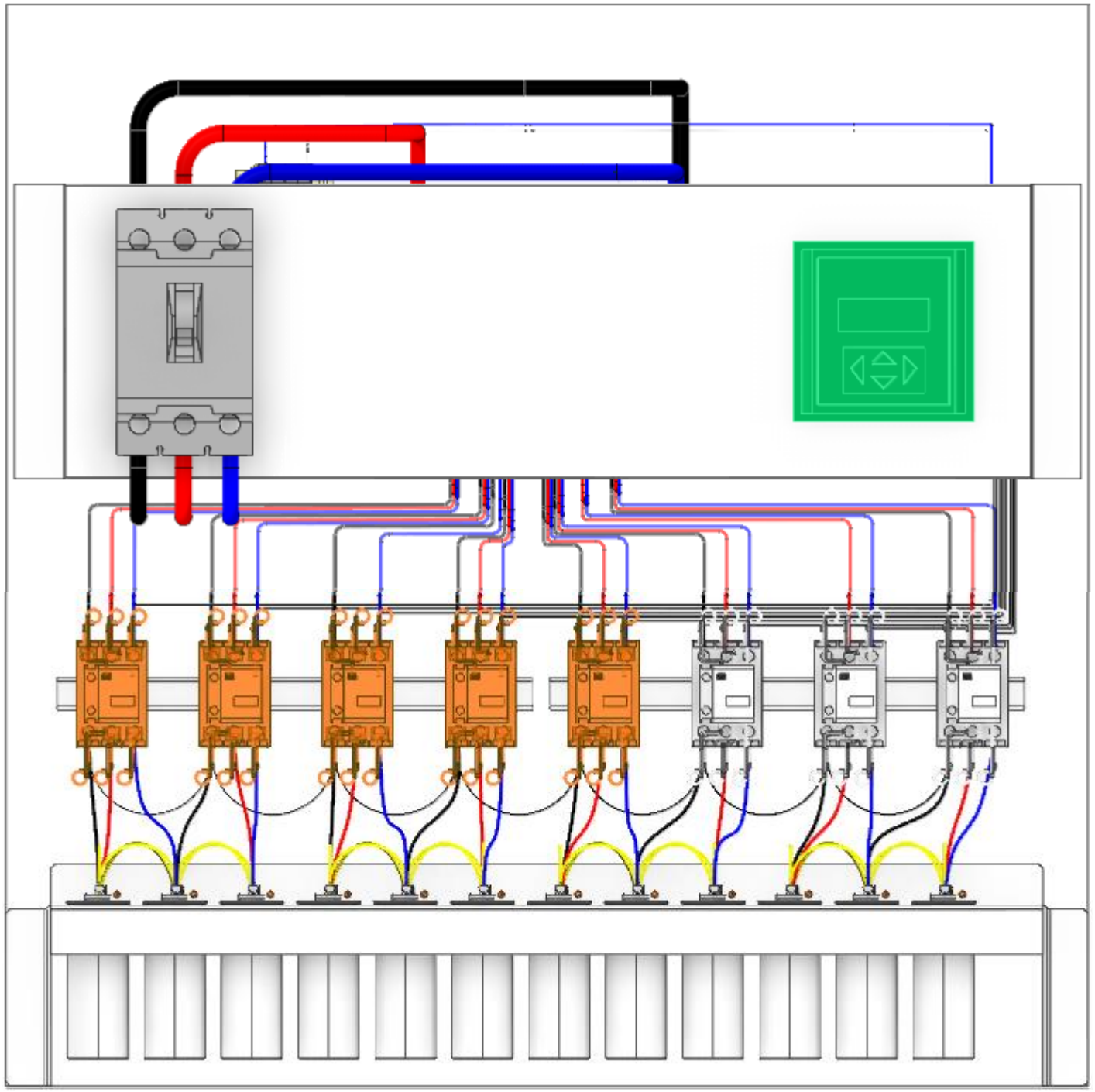


VARIVAR Example

A building's load profile is dynamic over the course the day, the week, month or even years.

As the load changes, VARIVAR needs to efficiently adapt to the demand.

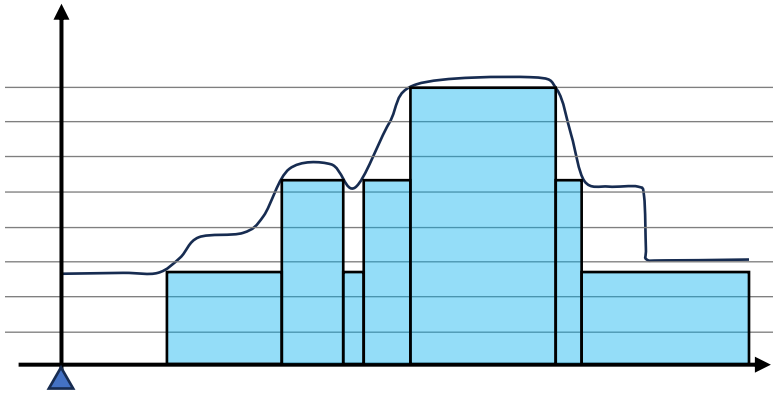


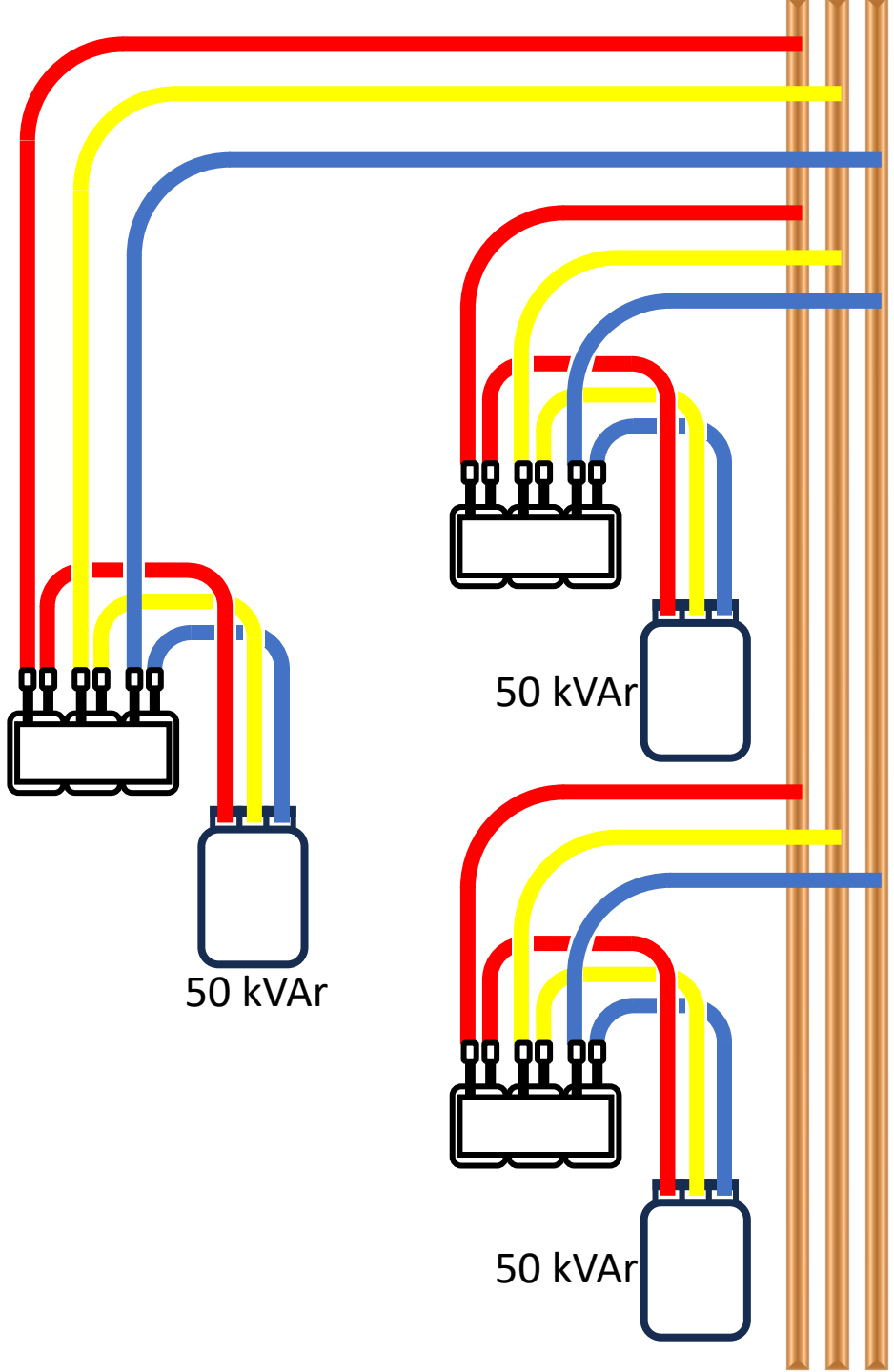


Conventional Cap Bank Example

For a rigid compensation of 50 kVAr per step, there are noticeable gaps where the step is too large to efficiently compensate the system.

As a result, the system would be inefficiently drawing current more often.



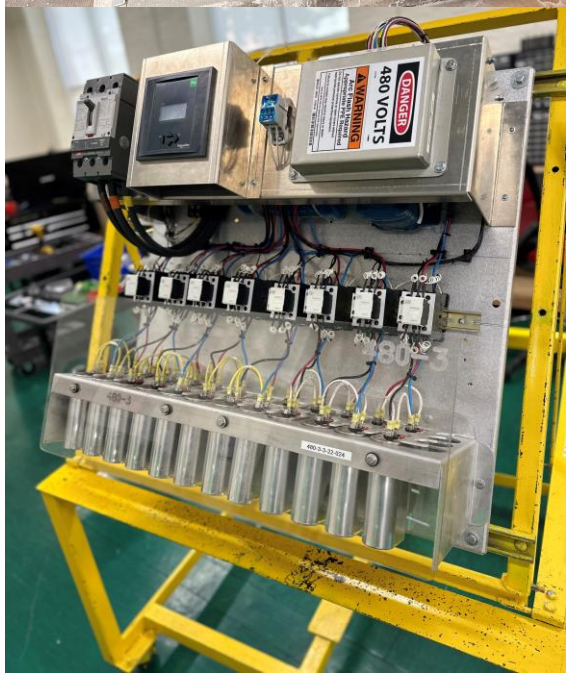


Comparing Capacitor Banks

This is a 150 kVAr capacitor bank we identified in one of our client's substations. It is roughly 1,000lbs and a little over 6 ½ feet tall.

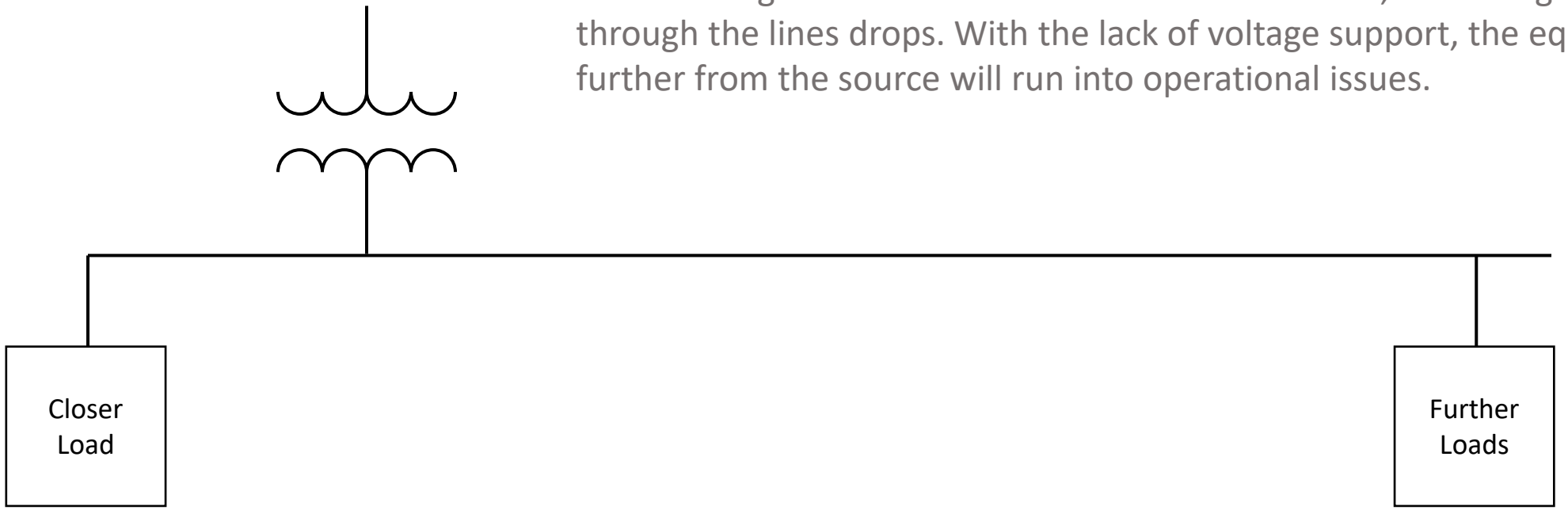
VARIVAR, on the other hand, weighs roughly 250lbs and has the same kVAr output. It is enclosed within a 3ft by 3ft cabinet. Additionally, it comes with a surge protection device to protect the equipment.

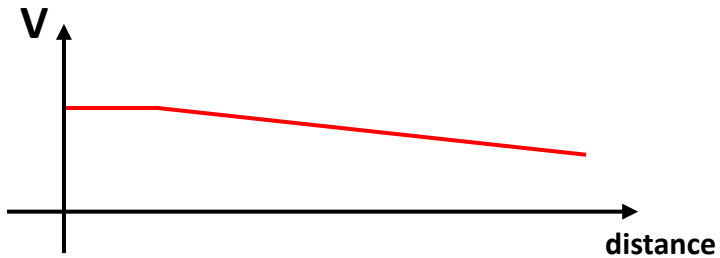
VARIVAR is also capable of being a passive harmonic filter, but a power quality study is required to size/tune the filter appropriately.



Voltage Sag

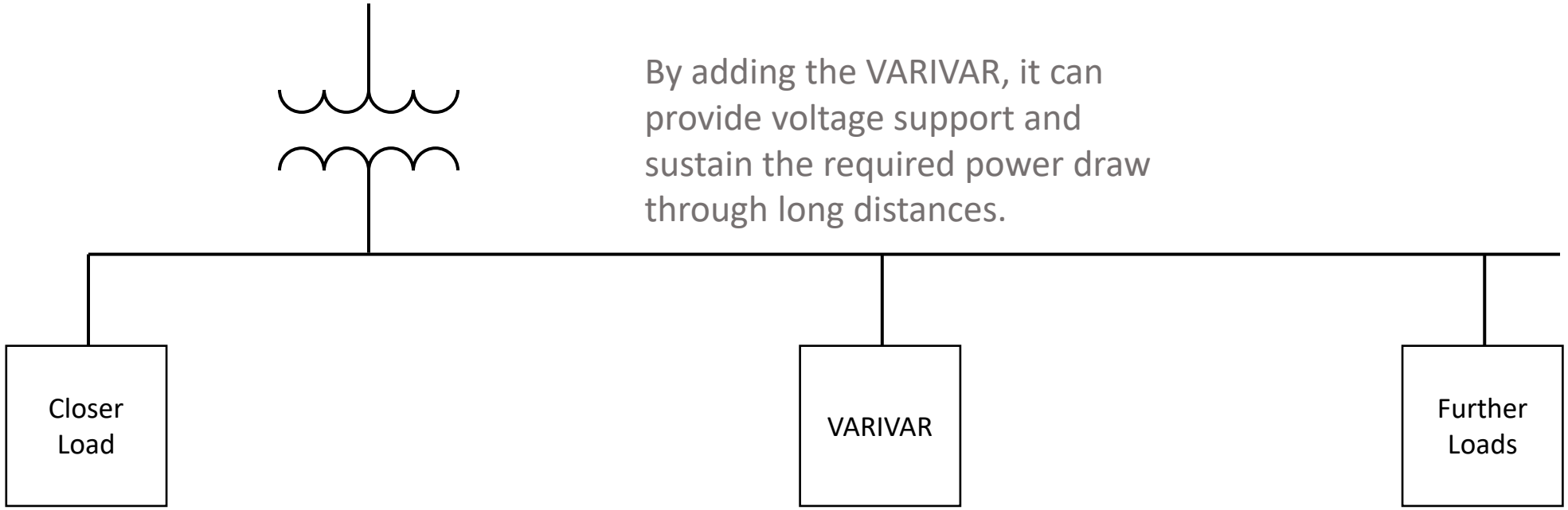
As the load gets further and further from the source, the voltage level through the lines drops. With the lack of voltage support, the equipment further from the source will run into operational issues.



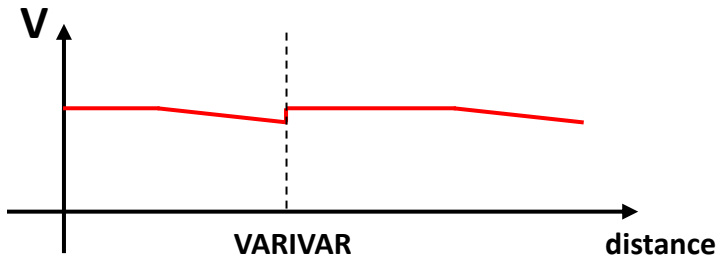


For motors, the voltage drop can impact the power draw, weakening its torque and potentially causing additional heat from increased current draw.

Voltage Sag



By adding the VARIVAR, it can provide voltage support and sustain the required power draw through long distances.



Harmonic
Distortion

BASICPOWER

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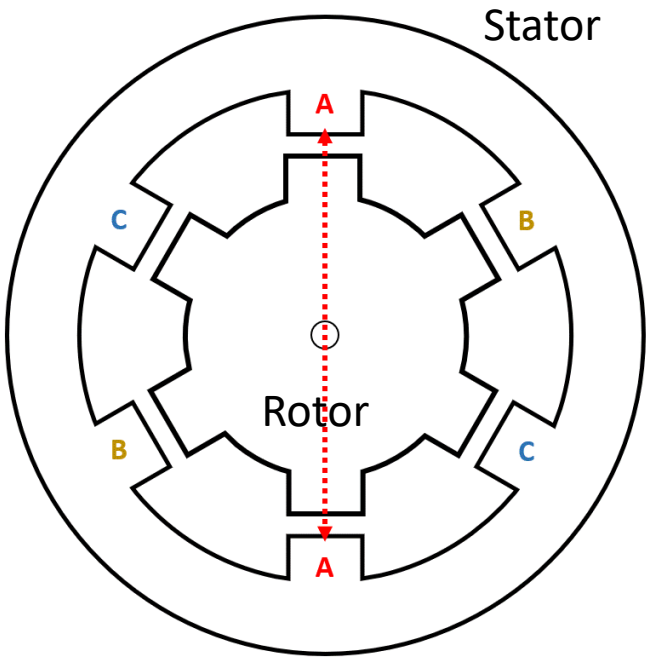
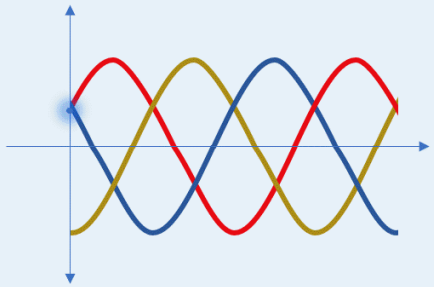
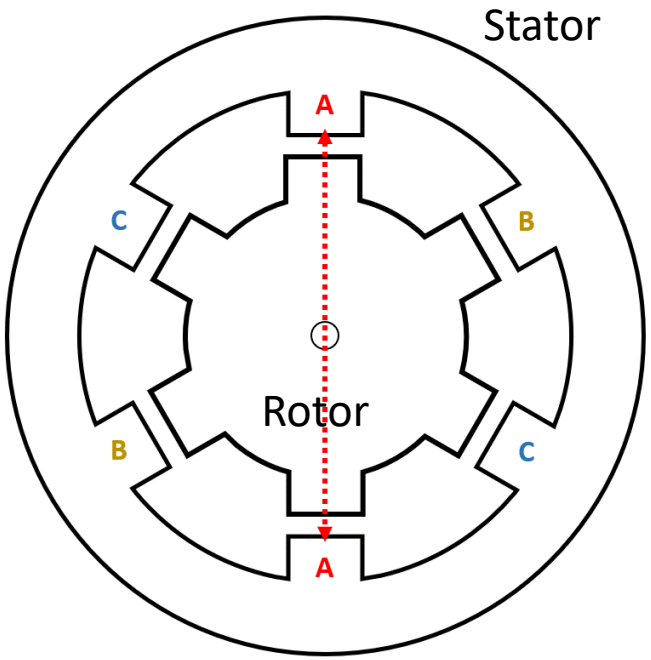
Harmonics in Motors

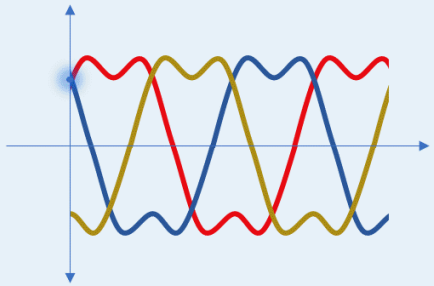




Three-phase AC motors are powered by the alternating magnetic field created of the stator – influencing the rotor to spin. The speed is based on the frequency of the wave, and a pure sine wave allows for a smooth motor turn.

Harmonics in Motors

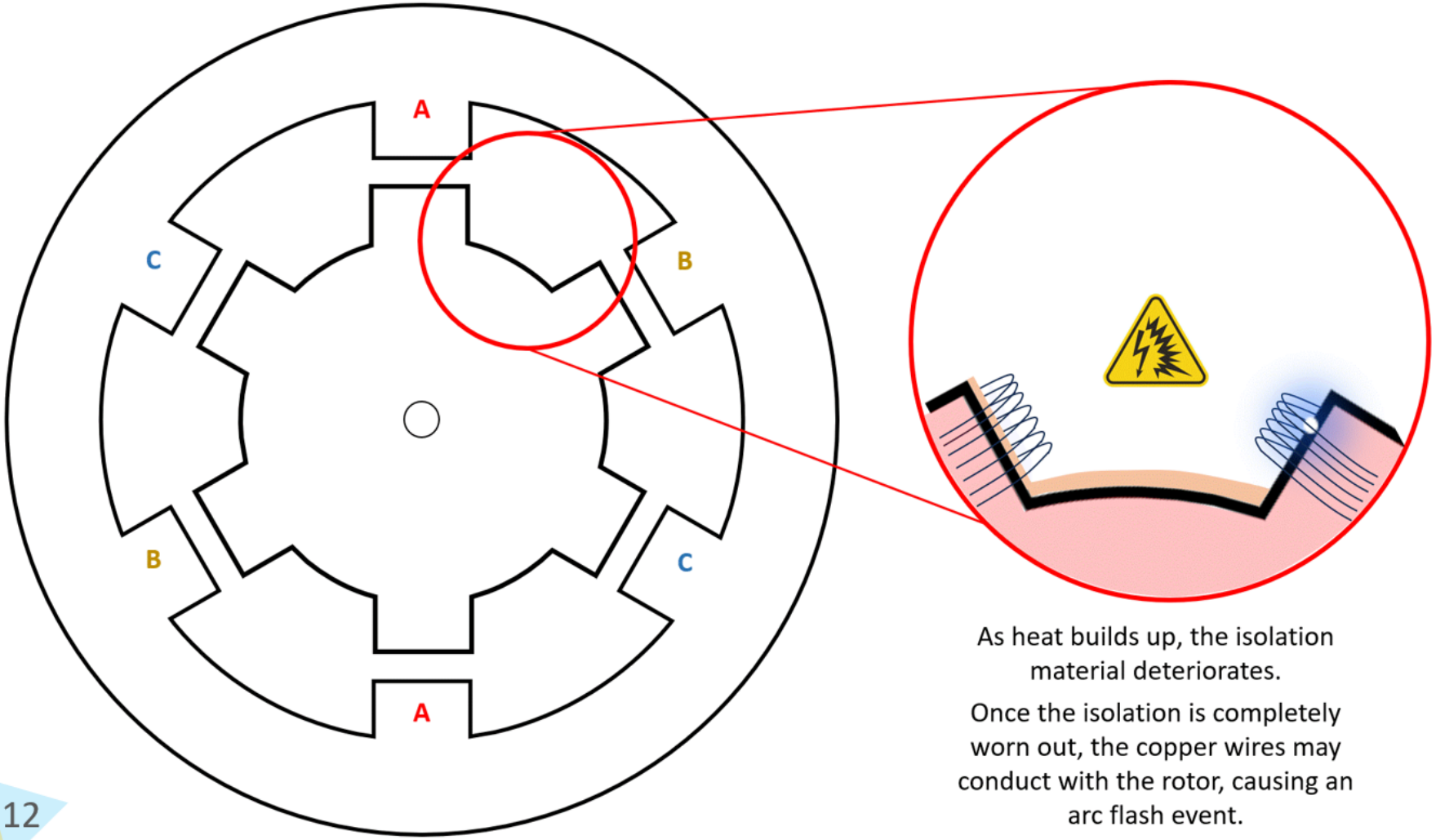




When the motor experiences harmonic distortion, it will cause the motor to stutter. The reason for this is due to the nature of harmonic distortion.
A typical, six-pulse VFD or ECM experience high 5th and 7th harmonic distortion.

+	1st	7th	13th	19th	← Rotates with fundamental
0	3rd	9th	15th	21st	← Does not rotate
-	5th	11th	17th	23rd	← Rotates against fundamental

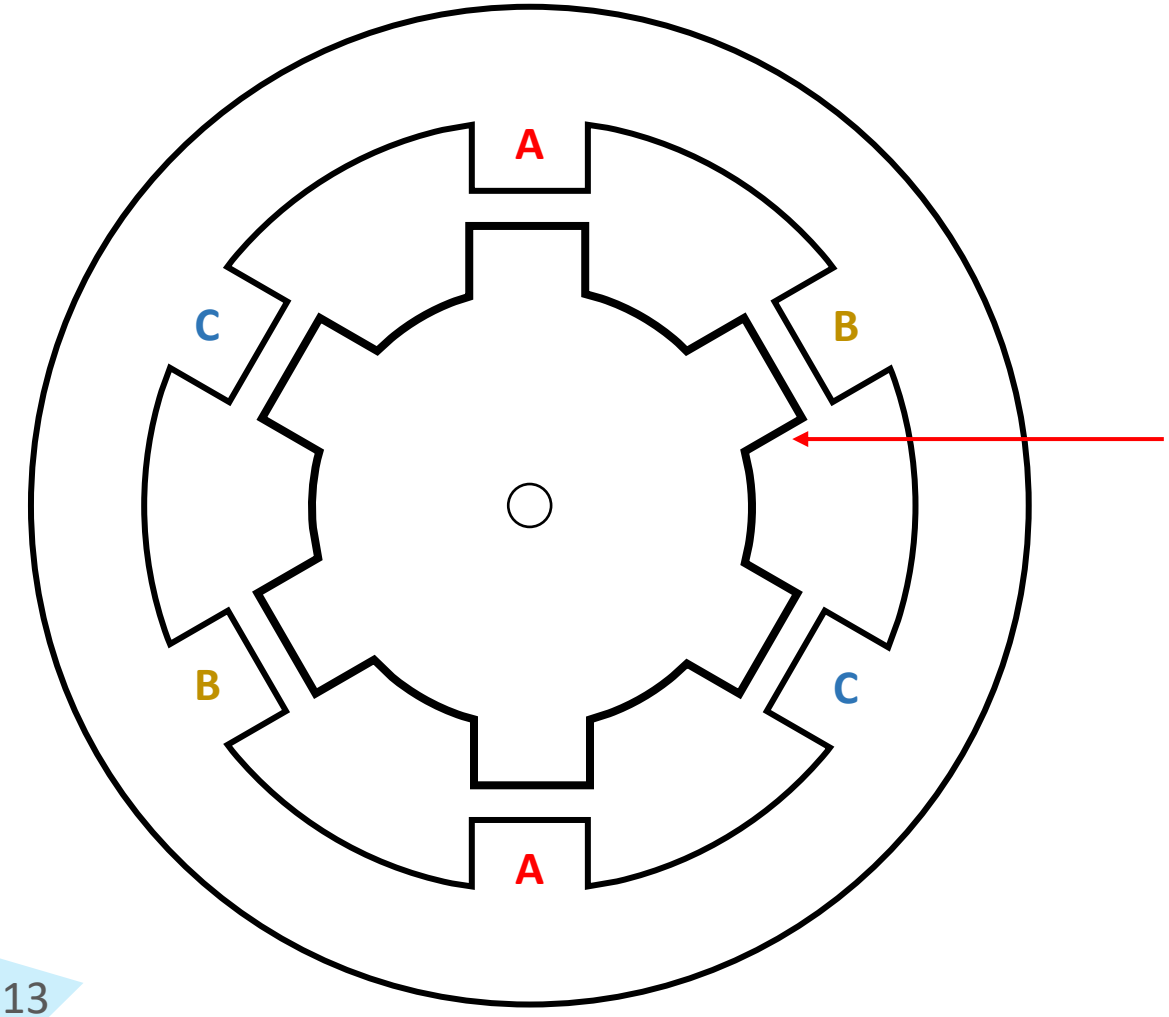
Harmonics in Motors



As heat builds up, the isolation material deteriorates.

Once the isolation is completely worn out, the copper wires may conduct with the rotor, causing an arc flash event.

Harmonics in Motors

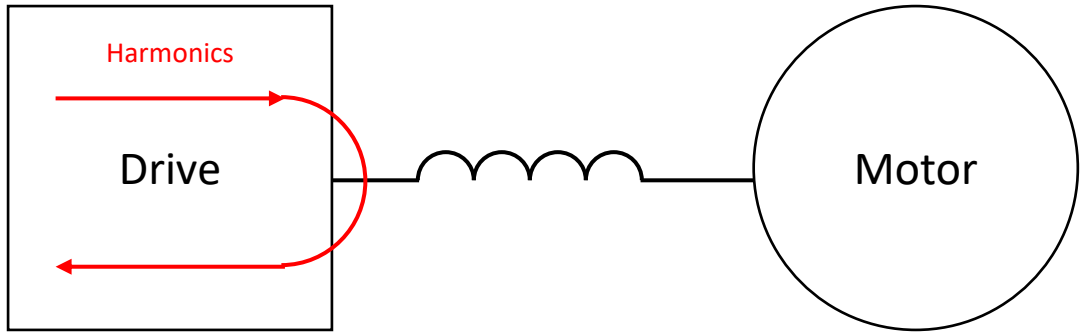


The core that the copper wires wrap around can also saturate due to heating. This will result in a less efficient motor performance over time.

Harmonics from VFD Motors

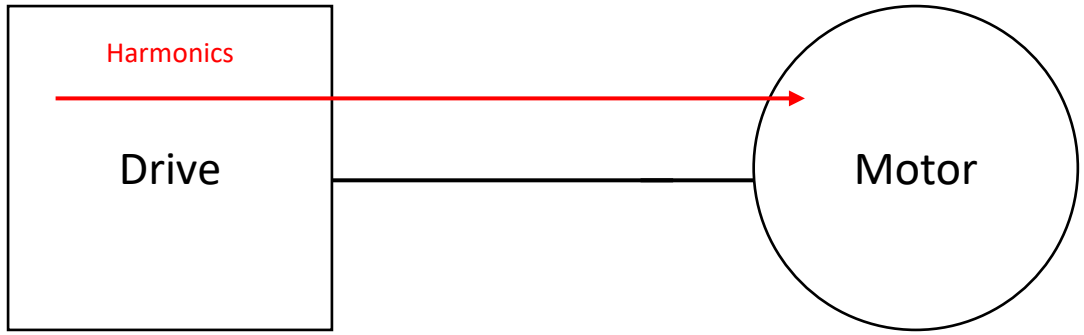
Typically, VFDs have a built in DC-link choke, an inductor that adds a bit of “resistance” between the drive and the motor.

This “resistance” can help prevent harmonics from migrating towards the motor as it is not an efficient path for the harmonics to travel towards.



Harmonics on VFD Motors

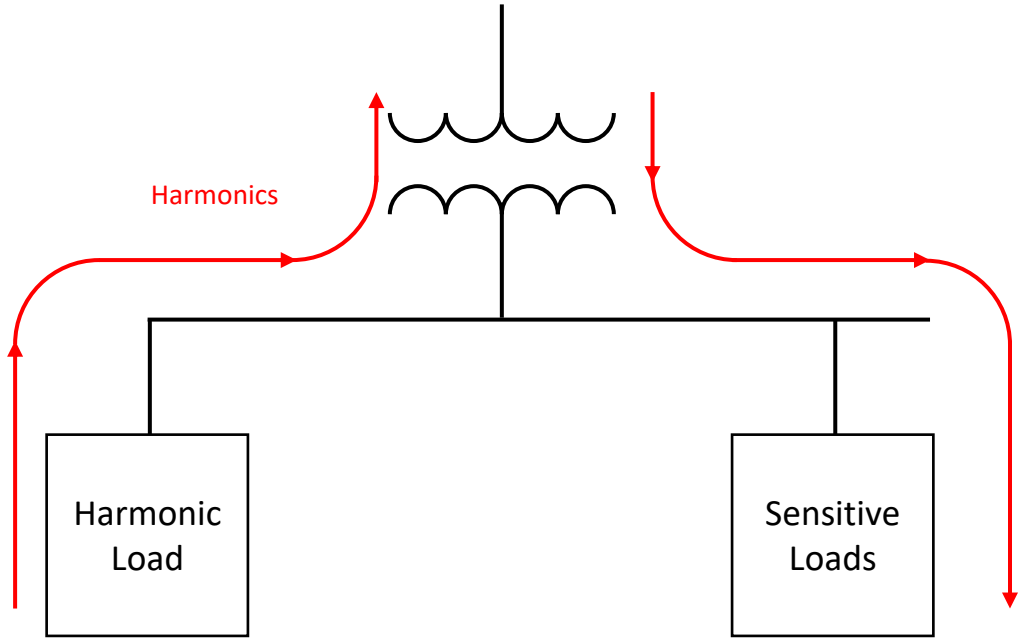
Motor-drive setups that do not have any line reactor between the VFD and the motor risk harmonic damages.



Harmonics In General

With drives creating more harmonic distortion in the system, not only will it affect the motors negatively, but these harmonics could also affect other electrical equipment in the system.

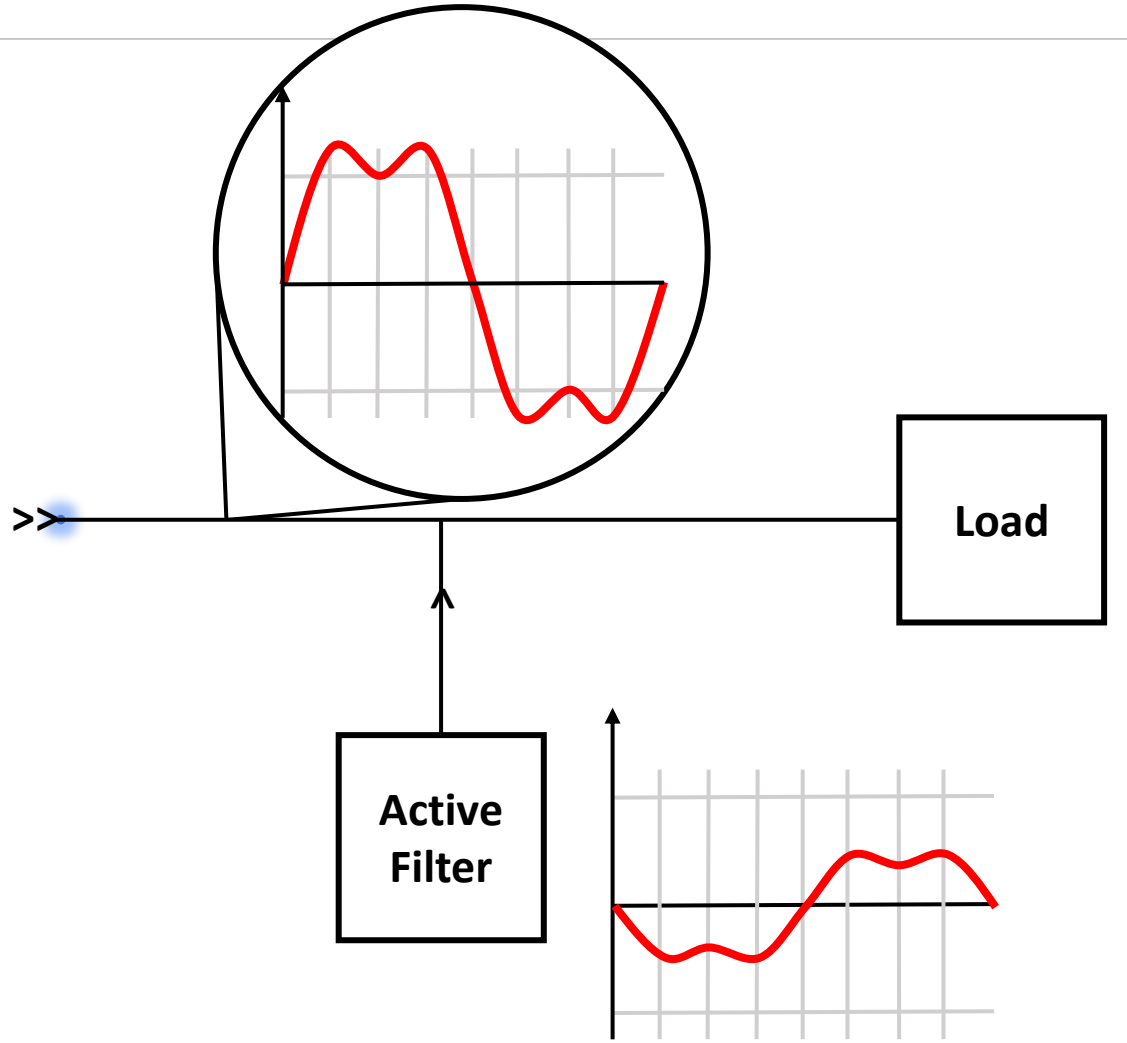
Harmonic current can affect the local transformer's efficiency from increased heating. This will impact the voltage harmonic of the low voltage side of the transformer, and it may negatively impact other sensitive loads in the system.



Harmonics Filtration

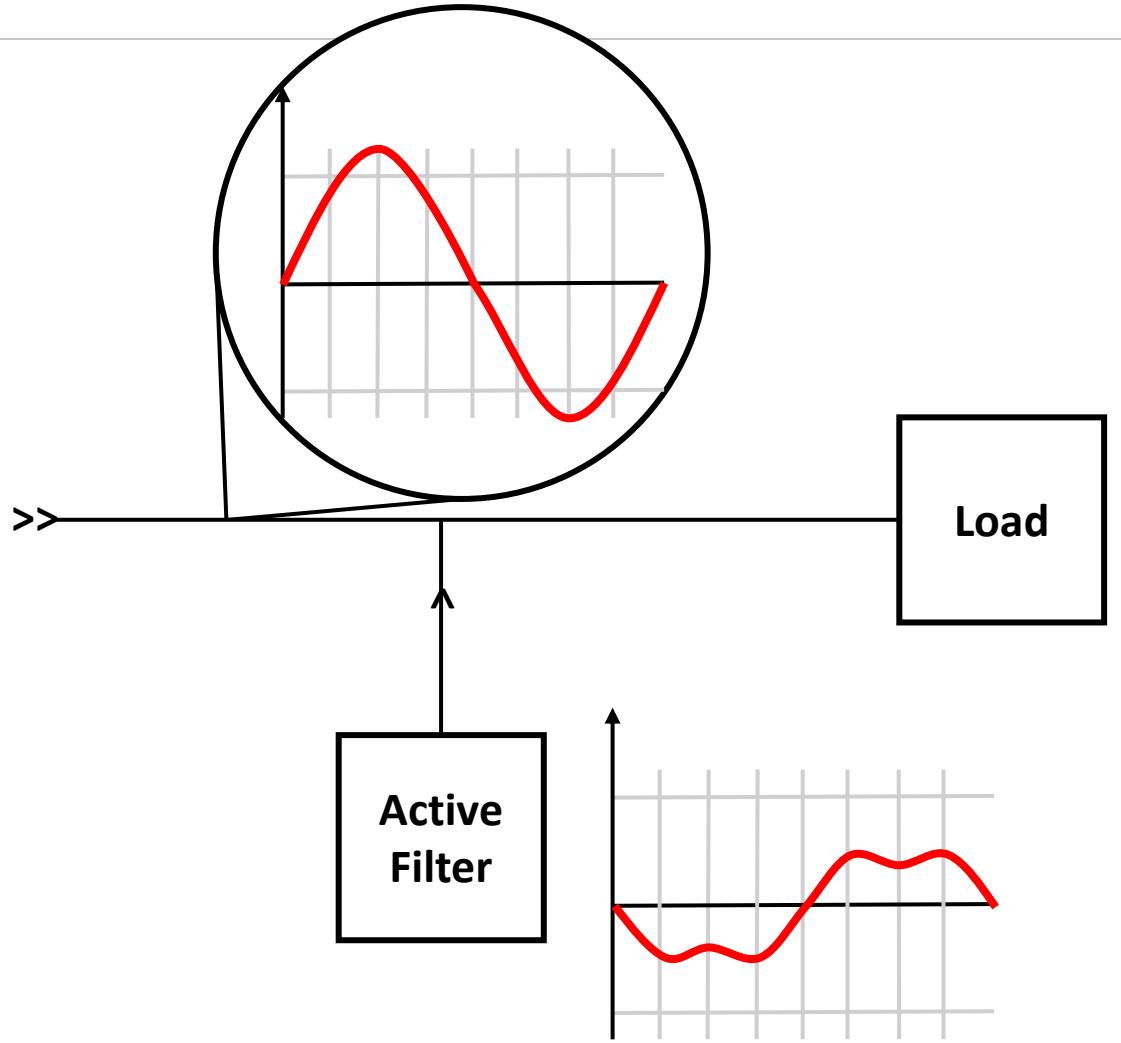
When a nonlinear load demands a noisy energy waveform, it does not look like a clean sine wave.

An active filter is designed to inject a waveform that cancels out the noise, similar to noise cancellation technology for audio systems.



Harmonics Filtration

As a result, the waveform should appear like a clean and pure sine wave after the harmonic distortion is negated by the active filter.

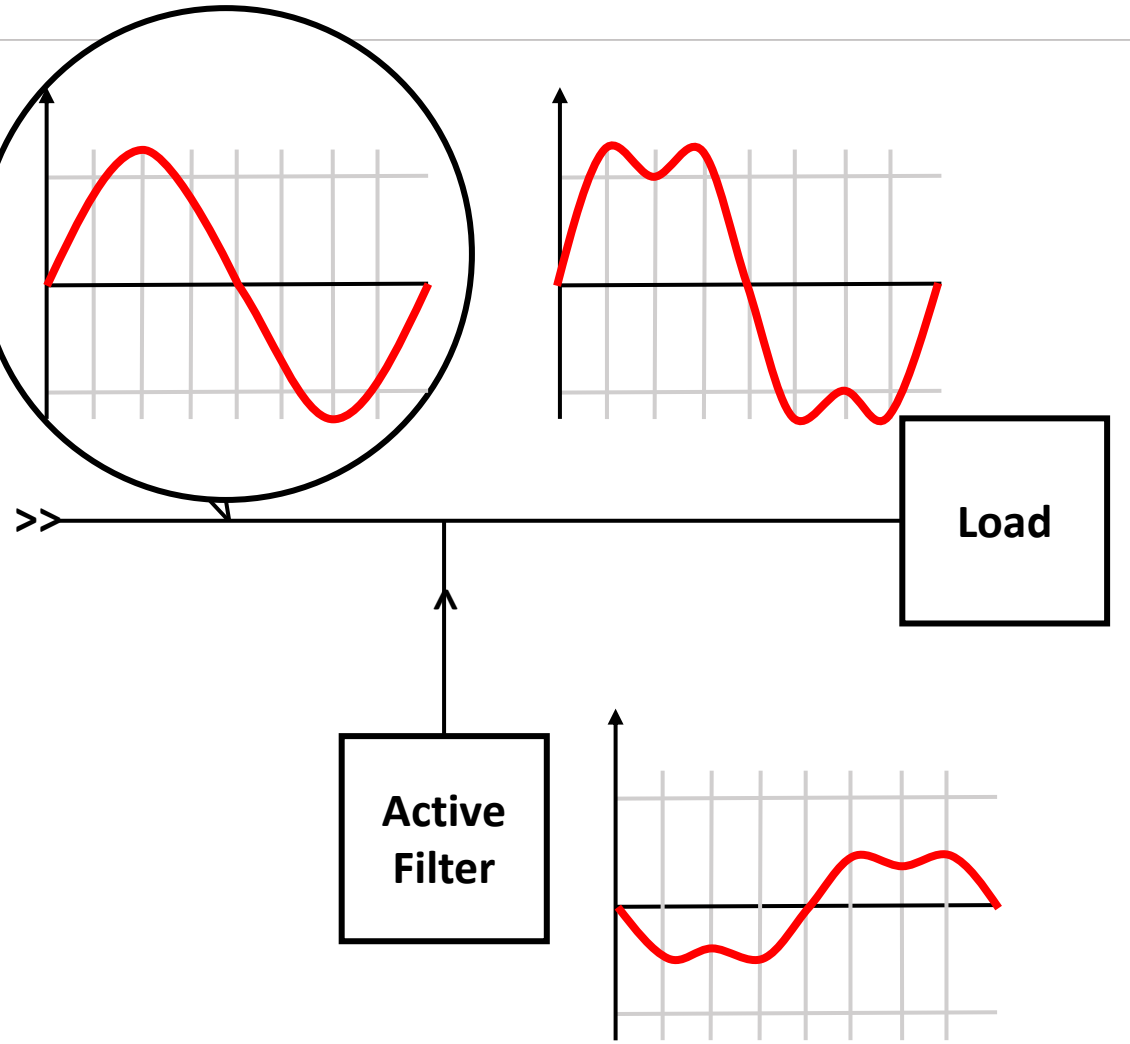


Harmonics Filtration

It does not affect the actual operation of the equipment since the waveform it desires remain the same.

However, this technology will prevent the harmonic distortion from migrating outwards towards other loads.

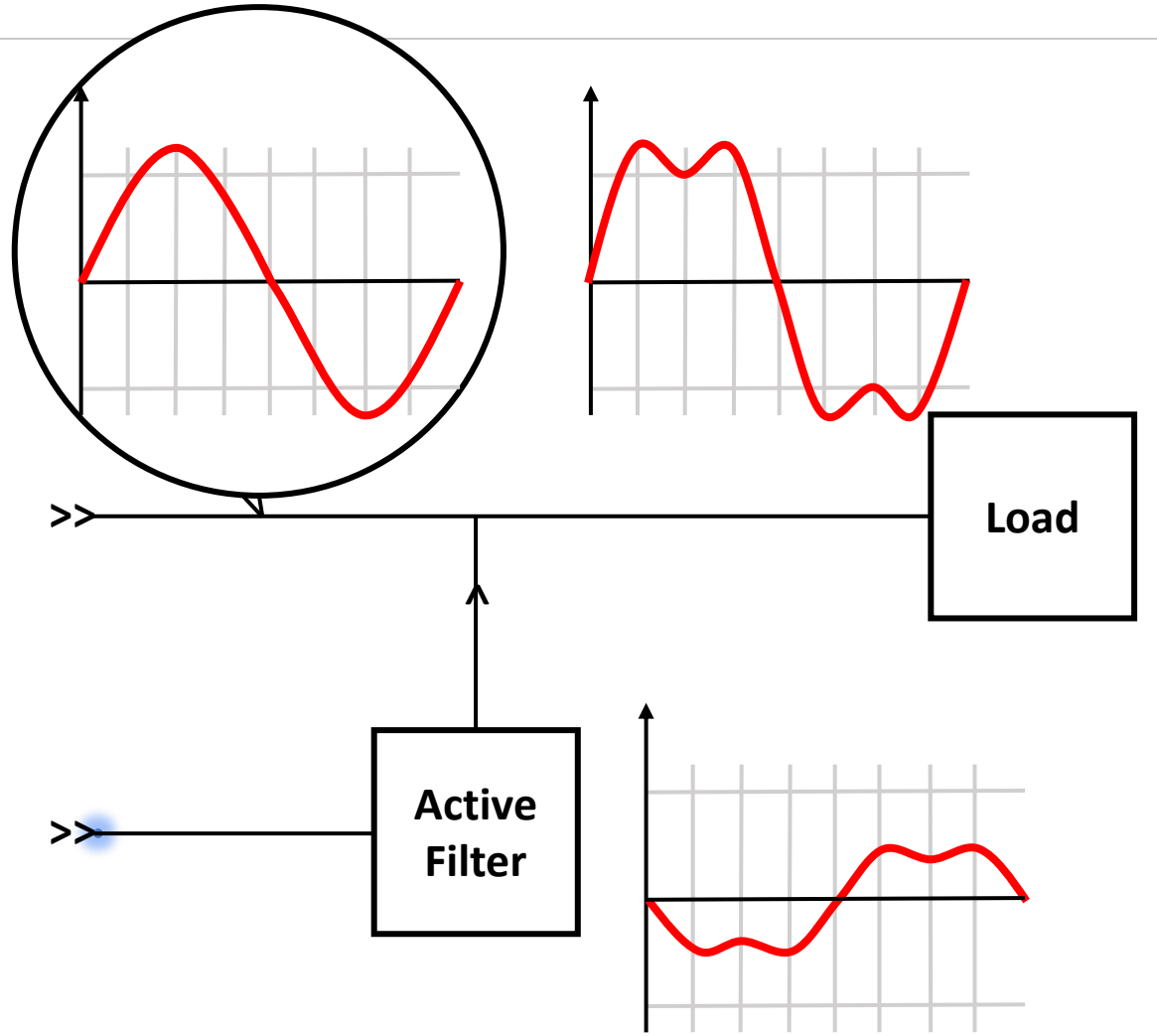
Meaning the load will contribute next to nothing in terms of additional harmonics to other loads.



Harmonics Filtration

The active filter requires a source feed to generate the necessary waveform to cancel out the dangerous harmonics within the system.

The idea is that one VFD and Motor pair may not see any issues, but a set of VFD and Motors will affect each other with their harmonics migrating and resonating.



Any Questions?

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