HIGRID POWER CORP.

Power Quality Solutions for Commercial and Industrial Applications

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6/11/2018

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1. INTRODUCTION

HIGRID Power Corp. is an Electrical Systems and Testing provider based in Edmonton, Alberta, with over 40 years of experience in the electrical field on a wide variety of low and medium voltage equipment.

We provide all levels of customer services including power analysis that result in maximizing a company's energy efficiency that identifies potential problematic issues that can cause increase in power bills and damage to machinery and equipment.

HIGRID Power Corp. service personnel are equipped with the latest testing devices to test, analyze, and troubleshoot electrical equipment to provide clients with options to reduce the company's overhead costs.

2. POWER QUALITY IN ELECTRICAL SYSTEMS - TECHNICAL OWERVIEW

Harmonic Distortion:

All solid state equipment such as computers, LED lighting, VFDs (Variable Frequency Drives used in HVAC systems etc.) will create a distorted current waveform when a pure sinewave voltage is provided. The IEEE 519 Harmonic Guidelines is the accepted standard for current and voltage distortion limits by most North American Utilities. The Voltage Distortion maximum limit is 5% based on Utility Incoming Voltage less than 69kV. The Current Distortion is based on a 15 minute average load compared to the short circuit capacity of the Utility supply to the Building and in most cases is either 12% or 15% for buildings located within the City of Edmonton power grid.

A distorted line voltage is seen by all equipment in the building providing additional heat and stress which shortens the products life significantly.

Theoretically any waveform that repeats itself on a continuous basis can be represented by a series of pure sinewaves called harmonics that have different frequencies and different magnitudes and they are flowing in the same conductors.

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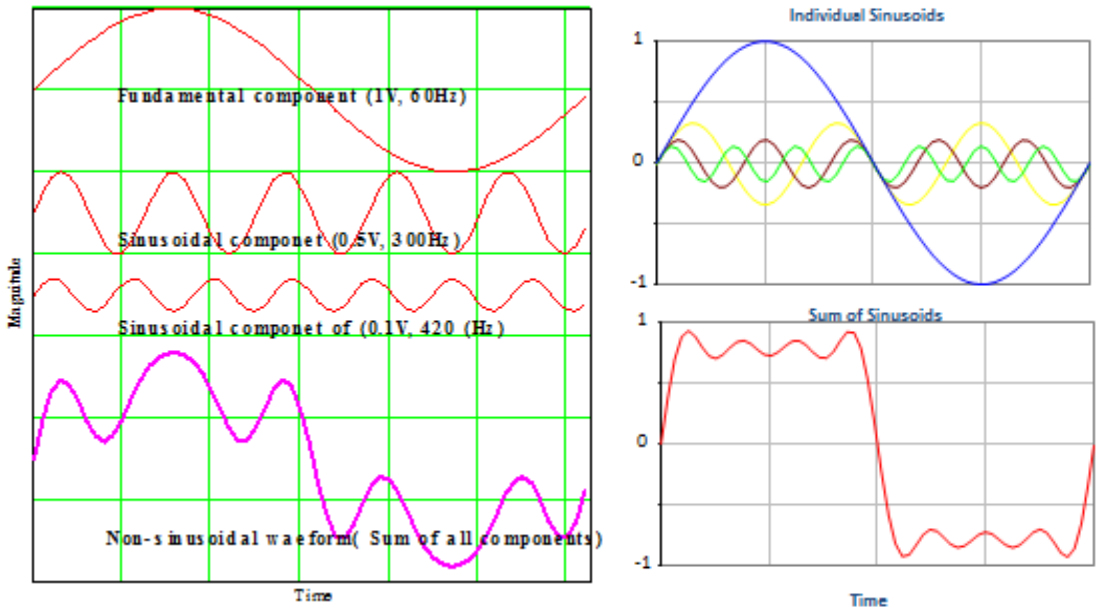
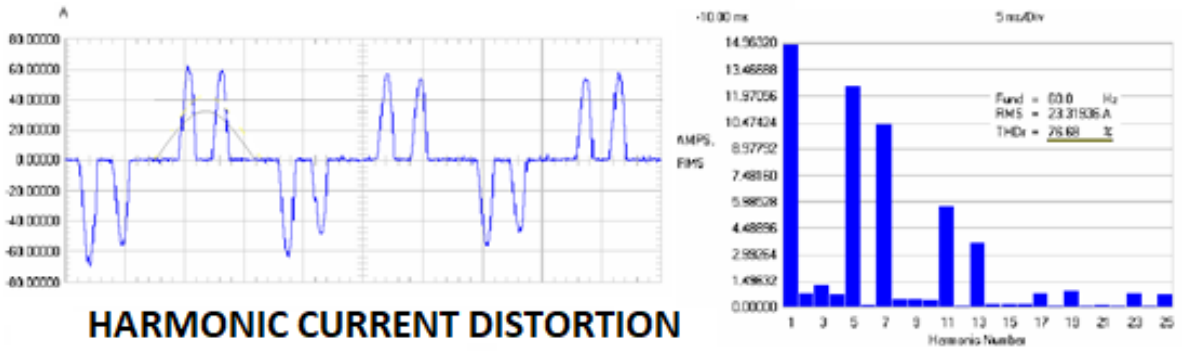


The above are two non-sinusoidal waveforms are comprised of multiple pure sinewave of different frequencies and magnitudes.



The addition of a series of voltage and or current waveforms of different frequencies produces additional loading to each device, increases power losses and reduces the network and devices capacity.

A good rule to follow for harmonics distortion is as follows: If the total percent of the complete building load comprises of less than 20% solid state equipment, harmonics are normally not a concern. If the building load is more than 50% solid state equipment, then you have a harmonic problem and somewhere between 20 and 50% you may have a harmonic problem.

IEEE 519 Harmonic Guideline 2014 is considered the specification most Utilities use in North America for Voltage and Current Distortion. The attached two tables cover the acceptable limits for each size system.

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Bus voltage V at PCC	Individual harmonic (%)	Total harmonic distortion THD (%)
$V \leq 1.0$ kV	5.0	8.0
1 kV $< V \leq 69$ kV	3.0	5.0
69 kV $< V \leq 161$ kV	1.5	2.5
161 kV $< V$	1.0	1.5[a]

The Voltage Distortion THD limit for 69kV and below utility supply is 5%.

Current Distortion Limits for General Distribution Systems (120 V Through 69000 V)

Maximum Harmonic Current Distortion in Percent of I_L						
Individual Harmonic Order (Odd Harmonics)						
I_{SC}/I_L	<11	11≤h<17	17≤h<23	23≤h<35	35≤h	TDD
<20*	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
Even harmonics are limited to 25% of the odd harmonic limits above.						
Current distortions that result in a dc offset, e.g. half-wave converters, are not allowed.						
* All power generation equipment is limited to these values of current distortion, regardless of actual I_{SC}/I_L.						
Where I_{SC} = maximum short-circuit current at PCC. I_L = maximum demand load current (fundamental frequency component) at PCC. TDD = Total demand distortion (RSS), harmonic current distortion in % of maximum demand load current (15 or 30 min demand). PCC = Point of common coupling.						

Whereas the Current Distortion THD limit for an I_{SC} / I_L between 100 and 1000 is 15%.

These limits are considered acceptable distortion limits, however equipment life expectancy of all equipment will be shortened as a result of 2 or more percent voltage distortion.

Noise Interference:

The non-sinusoidal voltage forms causes communication issues and erratic behavior of controls and can interfere with communication systems (Wi-Fi) and computers, television monitors and radio making them become not reliable.

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3. HIGRID POWER QUALITY MEASUREMENT AND SOLUTION:

Measurement of power quality may apply to the main power distribution, sub- distribution circuit or circuit specific device. With the possibility of subsequent analysis of the recorded values of selected parameters, we can evaluate:

- Disturbances (surges and dips) in voltage on phases of the power supply
- Uniformity of load phases
- Harmonic voltages and currents
- Power factor
- Unbalanced Voltages

HIGRID Power Corp. offers building owners and property managers a free inspection walk through of their building where we will determine if a power quality filtering equipment is going to offer significant benefits such as:

- Reduction in monthly power bill as a result of increasing the average power factor
- Reduction in monthly power bill by increasing the efficiency of major power consumption components
- Reduction in carbon tax by reducing the carbon footprint
- Reduction in voltage disturbance issues
- Reduction in Electromagnetic Interference.

This visit nominally takes about 1 to 2 hours depending on the number of electrical rooms that exist in the facility.

Many operators do not know that they have power quality problems and they live with the ongoing consequences such as:

- Power outages
- Random equipment tripping or not starting
- Communications and Wi-Fi errors and signal loss
- Higher electrical power bills and possible additional penalty charges
- Higher carbon tax bills
- Premature failure of the building's electrical components
- Nuisance customer complaints of failure of their tenant owned equipment

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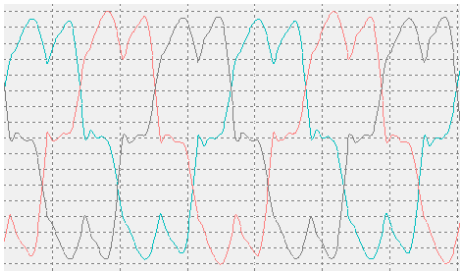
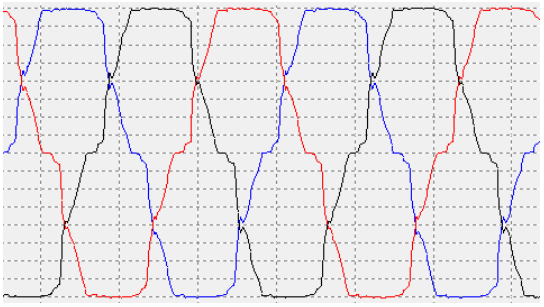
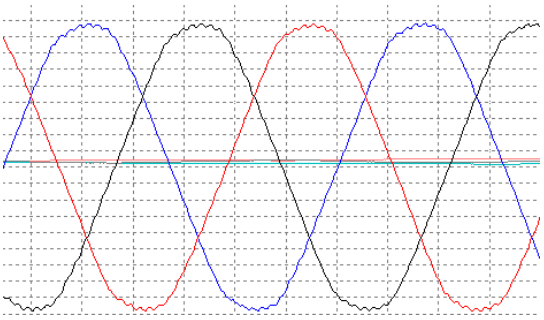
The following are examples of typical waveforms measured in some buildings where the owner or property and maintenance management did not know they had power quality issues.



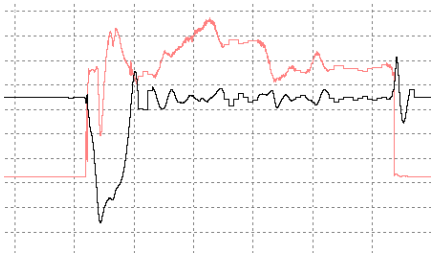
Three phase Current waveform with high harmonic current content.



Three Phase Voltage waveform showing distortion at the peaks due to 5th and 7th Harmonics.



Three Phase Voltage or Current waveforms should look similar to these waveforms.



Line Voltage disturbance when starting a large load.

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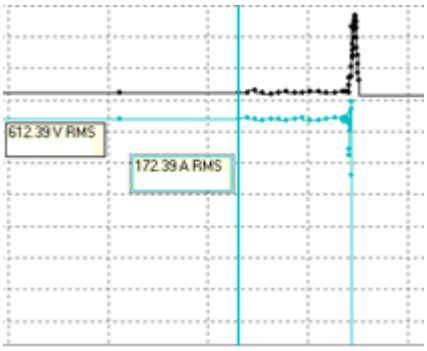
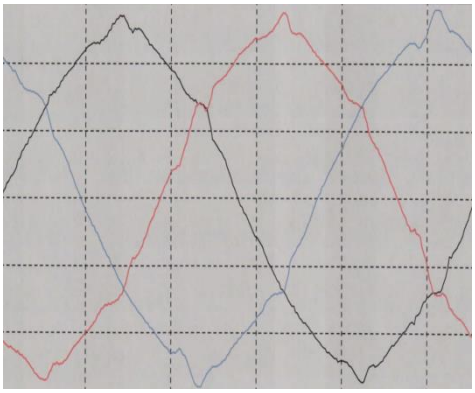


Over Voltage Instantaneous Trip causing power loss shutdown



Distorted Line Current due to VFD and other non-linear Loads

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4. THE HIGRID PROPOSAL

The **HIGRID** power quality specialists can test and verify the impact of commercial and industrial equipment on the client's facility electrical system and offer solutions to reduce or eliminate these issues.

Upon completion of the initial building inspection, **HIGRID** Power Corp. will provide a report free of charge as to the application of different power quality filtering options, in terms of energy and cost savings. If the inspection finds a potential for significant cost savings by installing power filtering and the possibility of recovering the costs of equipment in a reasonable period of time, then **HIGRID** Power Corp. will offer the filtering equipment to the client as a loan for a trial period of two months.

The client might perform the filter installation on its own or alternately, **HIGRID** installation services might be used as well. The **HIGRID** report will suggest the most convenient place for installation and with the least disruption to service. After the equipment installation **HIGRID** will take new readings to indicate the improvements and to set a reference base. The equipment will remain in the trial until there are two consecutive monthly utility bills for comparison. Following that, **HIGRID** and the owner will review the power bills to verify savings.

If the installed filtering proves reasonable cost savings and operational benefits and the client decides to proceed, **HIGRID** will procure the equipment designed and tuned for installation into this specific facility. Typically the installed trial equipment already offers an optimal benefit and thus avoids the additional installation efforts. In both cases, a direct purchase contract or rent to own contract will be offered to the client.

It is estimated that the monthly dollar savings will be in the range of several thousands of dollars. The cost benefits of the installed equipment are estimated to pay for itself within 16 to 24 month period.

In case the equipment is still not purchased after the trial period, a nominal fee equal to the amount of power savings during the trial period will be charged. Please note that our minimum charge is $2,000.00, however we expect the savings to be greater, so in most cases the building owner will effectively bare no cost for this trial. **HIGRID** will then remove the trial filter from the facility within a short period of time.

If you have any further questions regarding our proposal or to arrange a more in depth presentation and discussion, please feel free to contact us by email or phone:

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or

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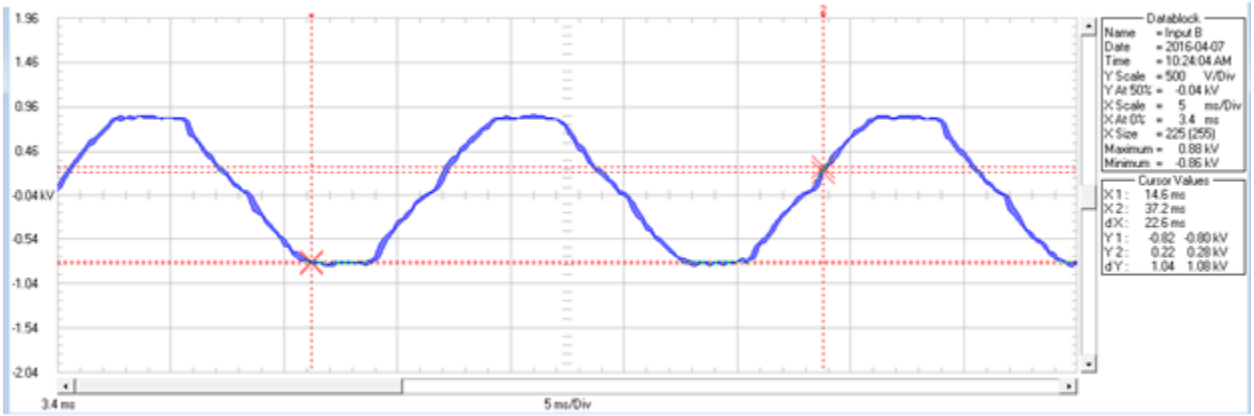
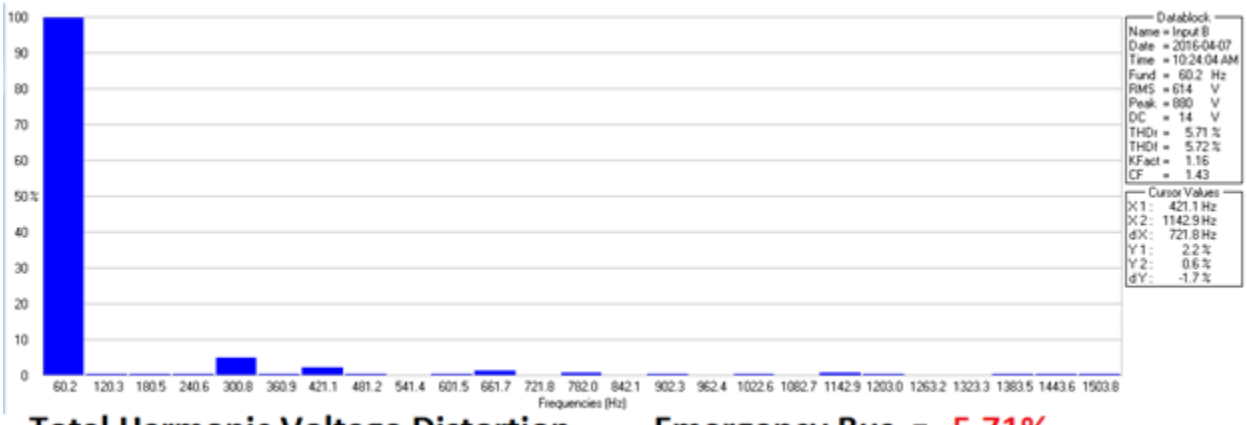
5. TYPICAL POWER QUALITY CASE STUDIES APPLIED IN BUILDINGS

BUILDING: 1



Mechanical Room 600 volt emergency bus

Note: The flat topping of the voltage peaks is a result of the high peak discontinuous current from several VFDs.



Total Harmonic Voltage Distortion Emergency Bus = 5.71%

THD – Total Harmonic Distortion

The distortion exceeds the IEEE519 harmonic limits. A harmonic distortion filter is required immediately to increase the expected life of all the electrical gear in the building. Premature loss of equipment life is reduced significantly at this distortion level.

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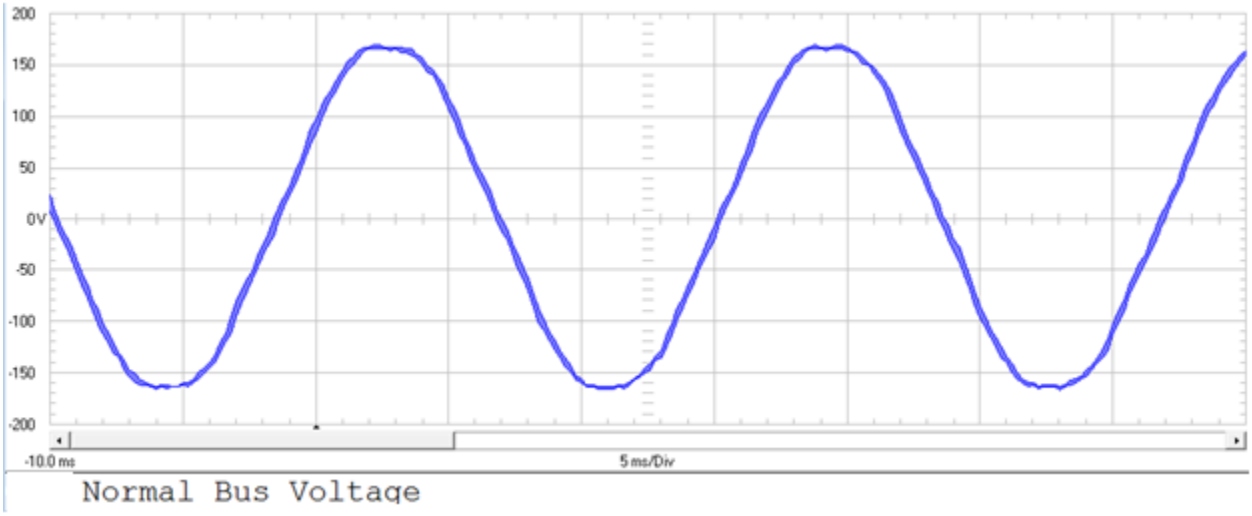
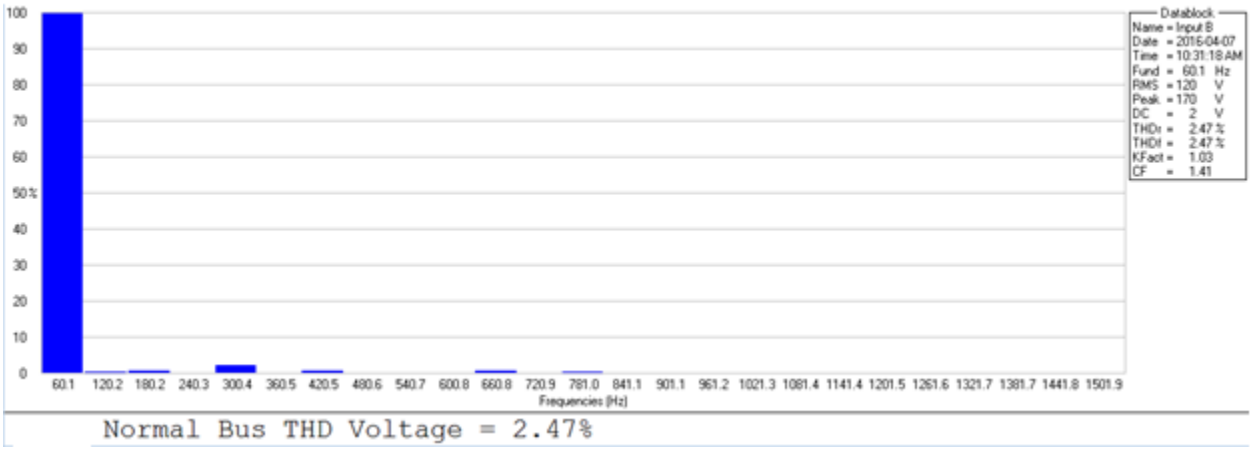
NORMAL BUS VOLTAGE DISTORTION



Voltage waveform is considered acceptable with slight flat topping occurring in the top 30 degrees of the peak.



THD – Total Harmonic Distortion

The distortion is within the conditions of acquiring utility power, however the distortion will cause a reduction in the life of all equipment.

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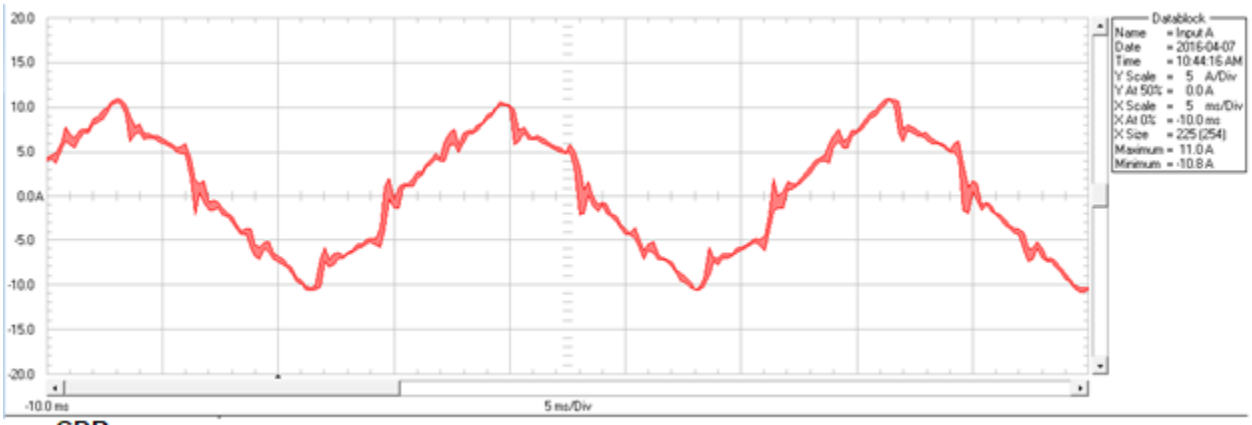
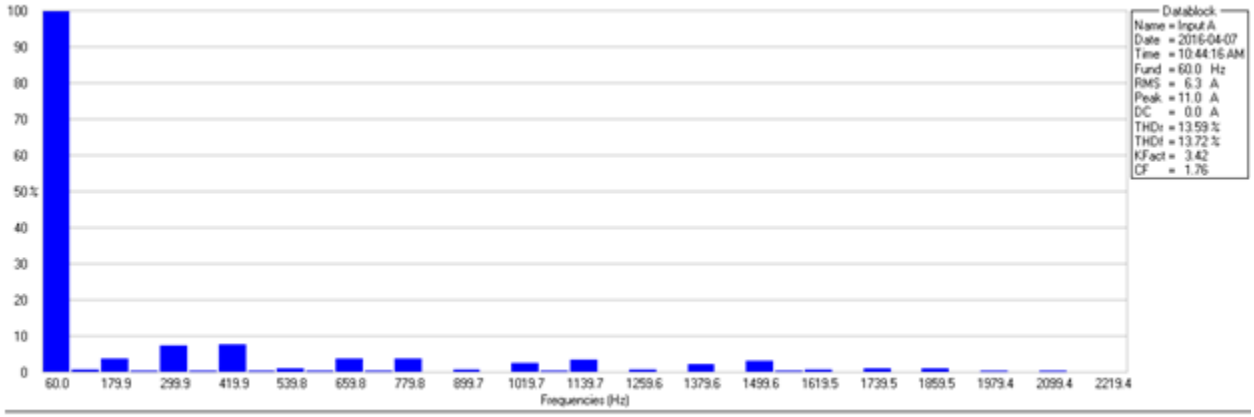


CDP

CDP-Current Distortion Spectrum



CDP CURRENT DISTORTION SPECTRUM

13.59% increases the power consumption and therefore a higher utility bill charge.

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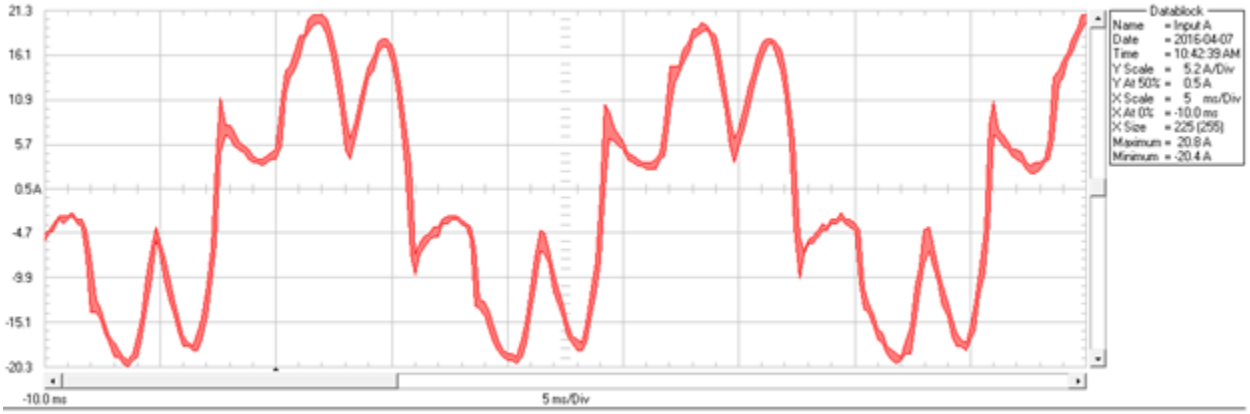
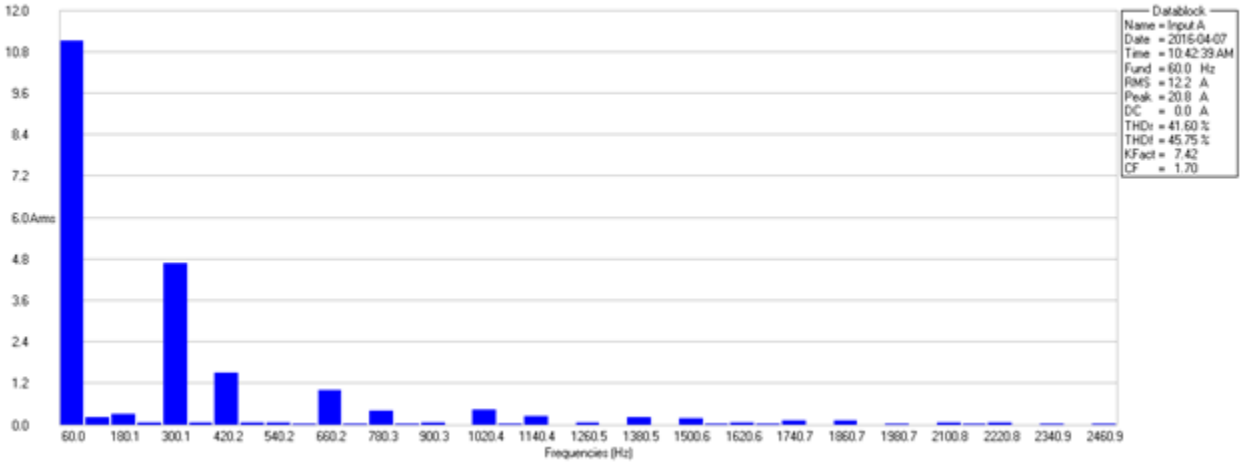


SUPPLY FAN 1A ABB 75HP VFD LOAD

SUPPLY FAN 1A CURRENT DISTORTION = 41.6%



45.75% current distortion is excessive and a harmonic filter should be installed at the VFD if possible.

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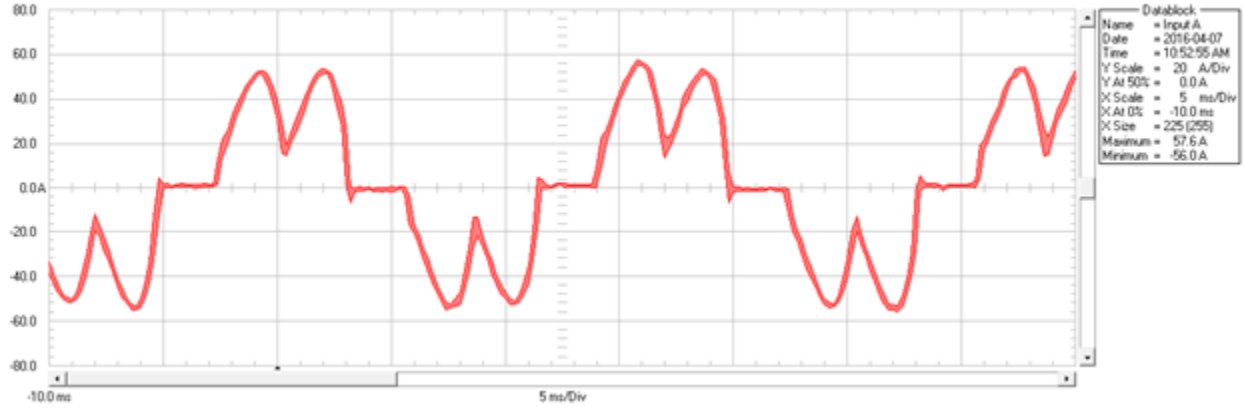
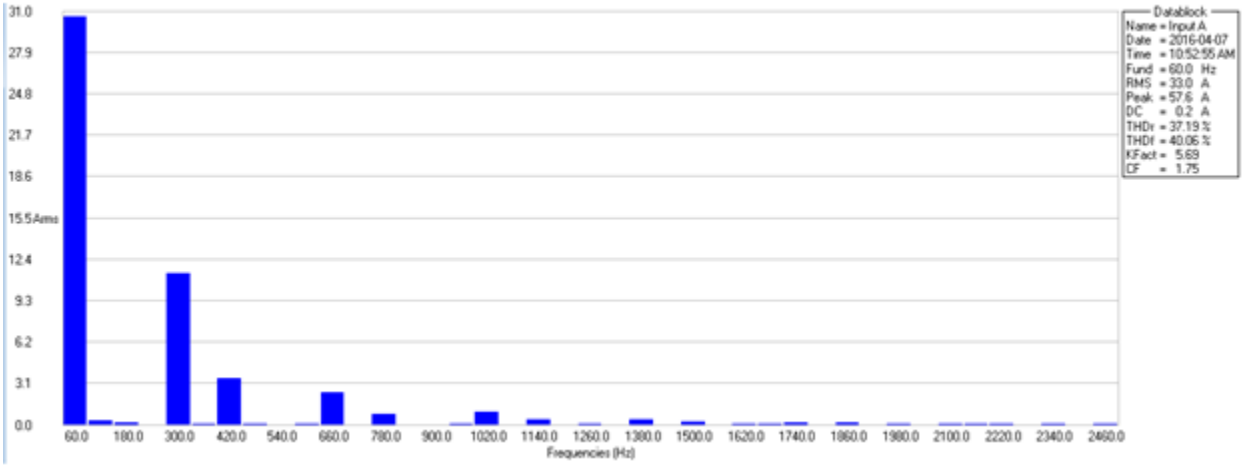
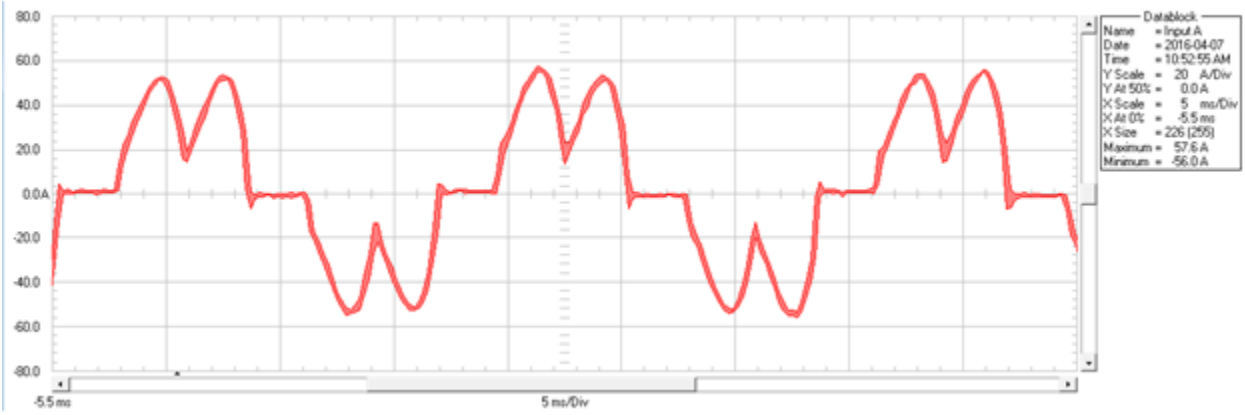
SF-2A



SUPPLY FAN 2A CURRENT DISTORTION 37.19%



SUPPLY FAN 1B 33AMPS RMS



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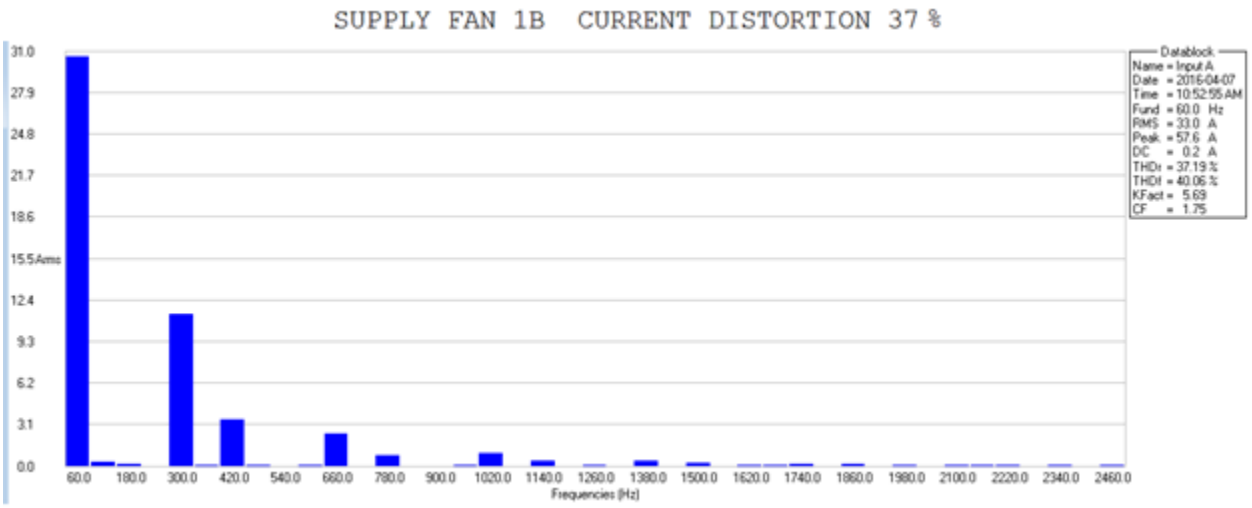

An active filter is recommended to reduce the current distortion by 90 amperes. This filter will also improve power factor and the voltage distortion. An estimated cost $44-49K will be required depending on the available time to have a maximum of a four hour shutdown for the filter connection into the power system.

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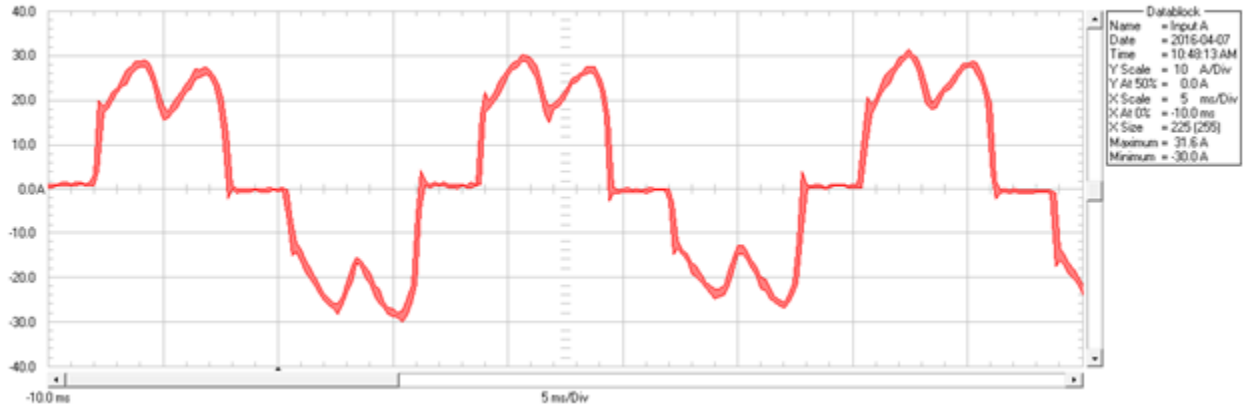
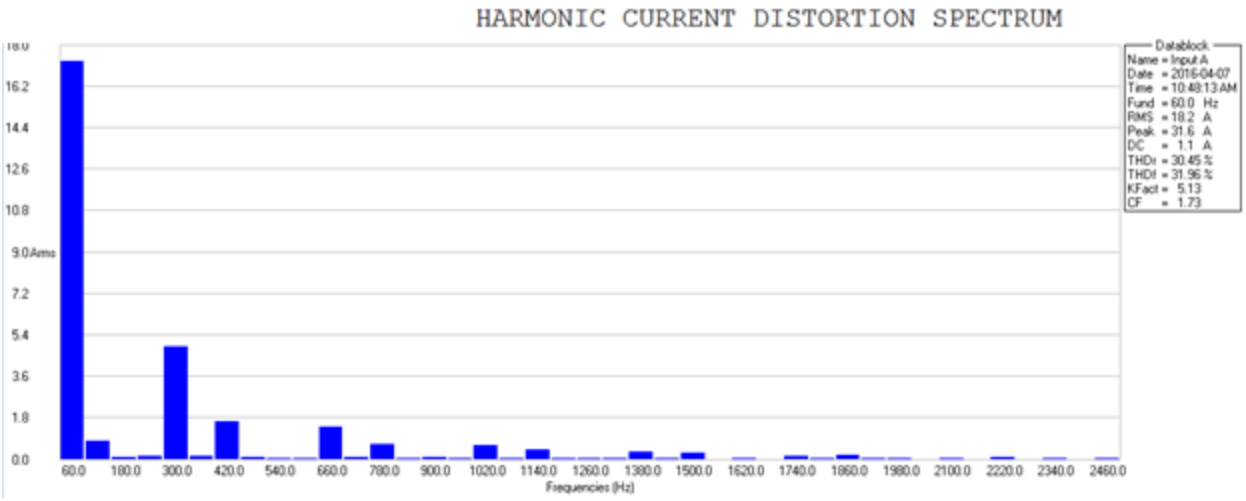
BUILDING: 2





The 31.96 % current distortion is requiring the utility to supply and additional current of 108 amperes more that is required. This relates to a utility cost of $42, 350.00 higher than it needs to be. A harmonic filter costing $42,550.00 lot will reduce the power bill by approximately $38,000.00 per year.

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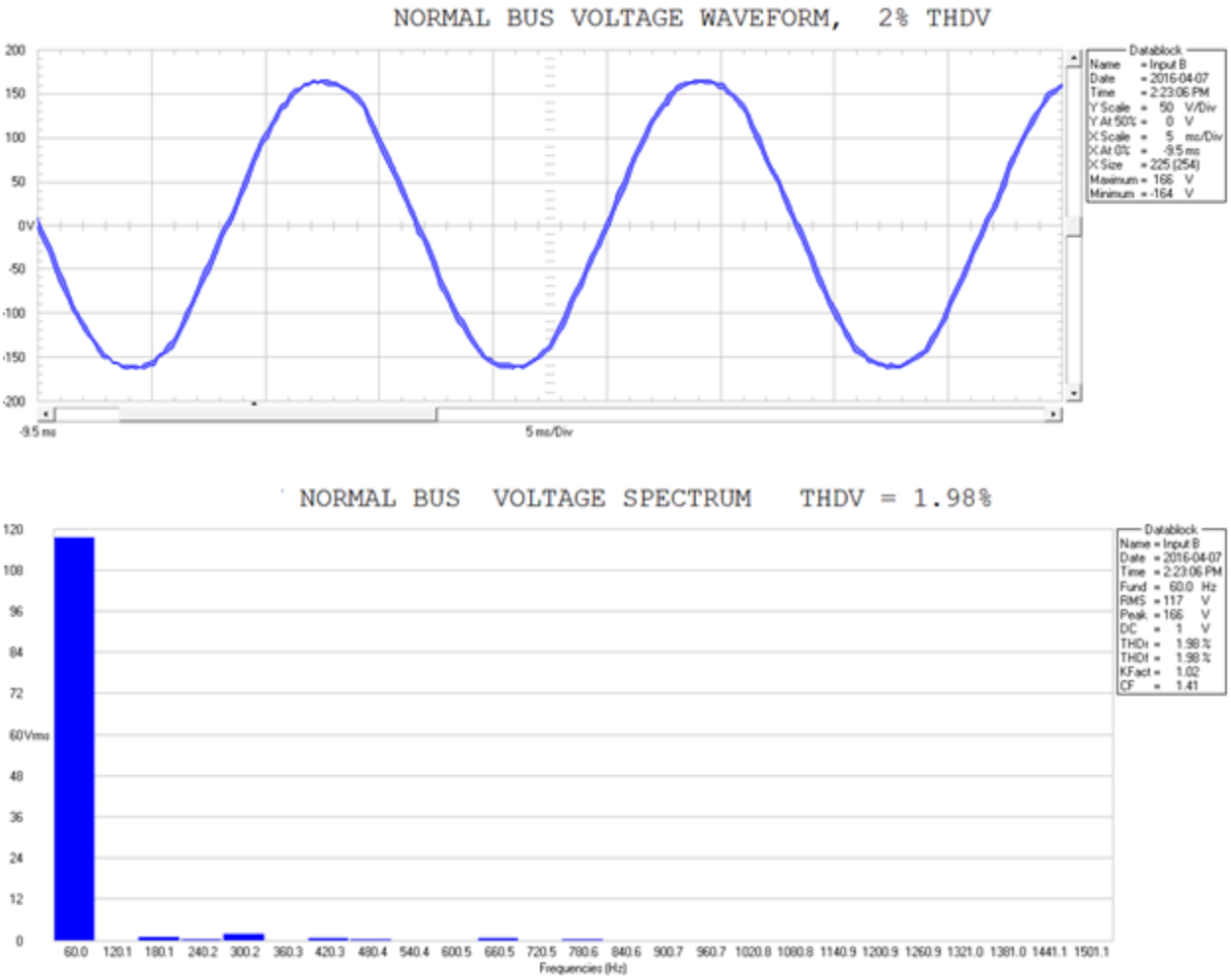
BUILDING: 3



Voltage Distortion less than 2 % is acceptable although equipment life is reduced.

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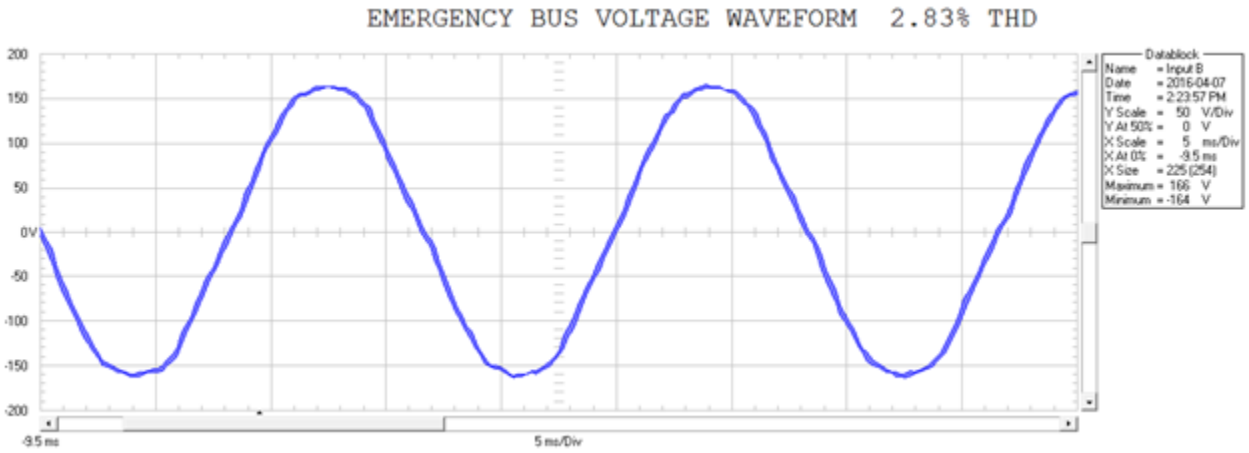

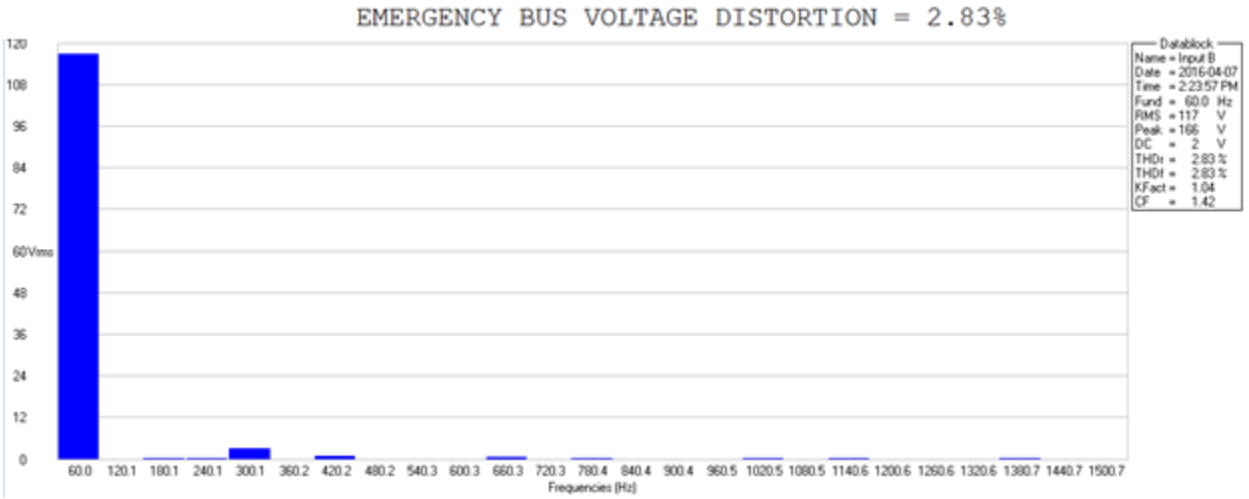

The voltage distortion is minimal on the Normal and Emergency Bus. At this time we do not recommend any corrective action to be done.

Since electrical equipment will fail sooner with this level of voltage distortion, monitor you equipment to verify the shorter life is acceptable.

Adding a $65,000.00 harmonic filter will not significantly reduce the capital operating cost so the payback on energy reductions will be several years. If the repair cost of repairing or replacing electrical equipment justifies this investment, then the filter should be purchased.

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BUILDING: 4

MAIN 1:

TDD (Total Demand Distortion) = 46.6% of 927 Amperes

THDI (Total Harmonic Distortion Current) = 33-34% Based on 370 average phase loading

THDV (Total Harmonic Distortion Voltage) = 4.7 – 5.1% based on 611Volts phase to phase voltage

MAIN 2:

TDD = 47.5 % of 853 Amperes

THDI = 38- 40% Based on 350 average phase loading

THDV = 4.9 – 5.2% based on 610Volts phase to phase voltage

Conclusion:

Both supplies have significant Voltage and Current Distortion readings indicating the need for power quality improvement filtering to be added to each of the two BUS systems. A budget cost for the harmonic equipment required on each Bus system is;

Harmonic Filter for Main #1: $68,500.00 lot

Harmonic Filter for Main #2: $65, 350.00 lot

Prior to proceeding, we recommend that further investigation be done to determine the root cause of this distortion to determine if an alternate solution can achieve the required results at a lower cost.