

Power Analysis Summary

Introduction

This is a summary of the power conditions at-----, Illinois 60475, as recorded at location main switchgear. Data at this location was collected from 01/03/05 14:11:18 through 01/10/05 14:11:18.

This summary is composed of:

- The events section. This is a summary of the voltage events that occurred at this location during the monitor interval. Events are defined as changes in the monitored voltage. These changes may be subtle or severe. The power tolerance curve provides a graphical representation of the likelihood of an event to disrupt equipment operations.
- The voltage current and frequency, (vif), section. This section contains summaries for each of these parameters during the monitor interval.
- The harmonics section. This contains the voltage and current harmonic, and harmonic distortion summaries acquired during the monitor interval.
- The power section. This contains the va, vars, watts, and power factor acquired during the monitor interval. For multiphase locations, voltage and current imbalance are also included.

Site and Location Information

Site Information

Name	XYZ School
Date and Time	01/03/05 14:05:18
Problem Description	Energy consumption
Date First noticed	01/03/05
Problem Frequency	Excessive Energy Costs

Location Information

Name	Main Switchgear
Power Type	Split single phase
Date and Time	01/11/05 18:48:03
Nominal Voltage	240 Volts
Nominal Frequency	60 Hz

Report Parameters

This report was prepared on 1/18/2005 by Midwest Electrical Consultants (MEC)
18055 Upland Drive Tinley Park, Illinois 60477 (708) 444-0001 fax: 444-0003.
The following limits were used in analyzing the results.

Maximum Phase Voltage.	254 V
Minimum Phase Voltage.	208 V
Maximum Neutral Voltage.	3 V
Maximum Impulse Voltage.	500 V
Maximum. Waveshape Voltage.	10 V
Maximum Frequency Deviation.	.02 Hz
Minimum Power Factor.	.85
Maximum Voltage T.H.D.	5 %
Maximum Current T.H.D	20 %
Maximum Voltage Imbalance.	2 %
Maximum Current Imbalance.	5 %

Any values outside these limits are noted in the report. Values within the limits are considered to be within a safe operating range. These limits have been programmed by MEC engineering services.

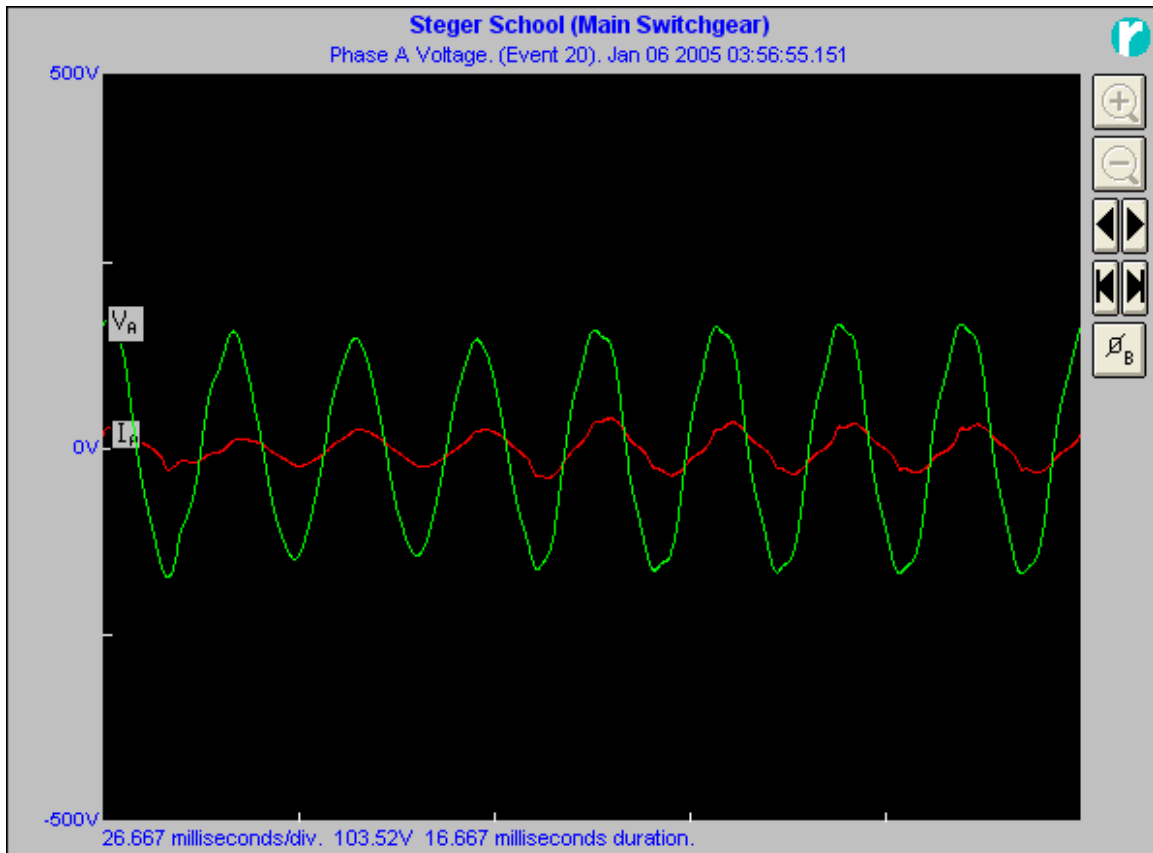
Voltage Events

The following summarizes the results of the Power Quality monitoring survey from 01/03/05 14:11:18 through 01/10/05 14:11:18. It is intended to present an overview of the power quality at Parkview Elementary School:Main Switchgear. The table below is a listing of the most significant events.

Event Description	No.	Amp.	Duration	Date and Time
Phase A Largest RMS. Event	120	121.7V	23.283 sec	Jan 06 2005 05:41:31
Phase A Largest Waveshape Event	20	103.5V	16.667 ms	Jan 06 2005 03:56:55
Phase A Longest Waveshape Event	260	113.0V	83.333 ms	Jan 06 2005 14:48:03
Phase A Largest Impulse Event	N/A			
Phase A Longest Impulse Event	N/A			
Phase B Largest RMS. Event	121	121.5V	23.283 sec	Jan 06 2005 05:41:31
Phase B Largest Waveshape Event	21	103.5V	16.667 ms	Jan 06 2005 03:56:55
Phase B Longest Waveshape Event	261	112.7V	83.333 ms	Jan 06 2005 14:48:03
Phase B Largest Impulse Event	N/A			
Phase B Longest Impulse Event	N/A			
Neutral Largest RMS. Event	443	49.68V	3.927 day	Jan 01 2005 15:56:43
Neutral Largest Waveshape Event	233	6.470V	16.667 ms	Jan 06 2005 01:23:03
Neutral Longest Waveshape Event	173	5.127V	16.667 ms	Jan 05 2005 02:48:42
Neutral Largest Impulse Event	N/A			
Neutral Longest Impulse Event	N/A			

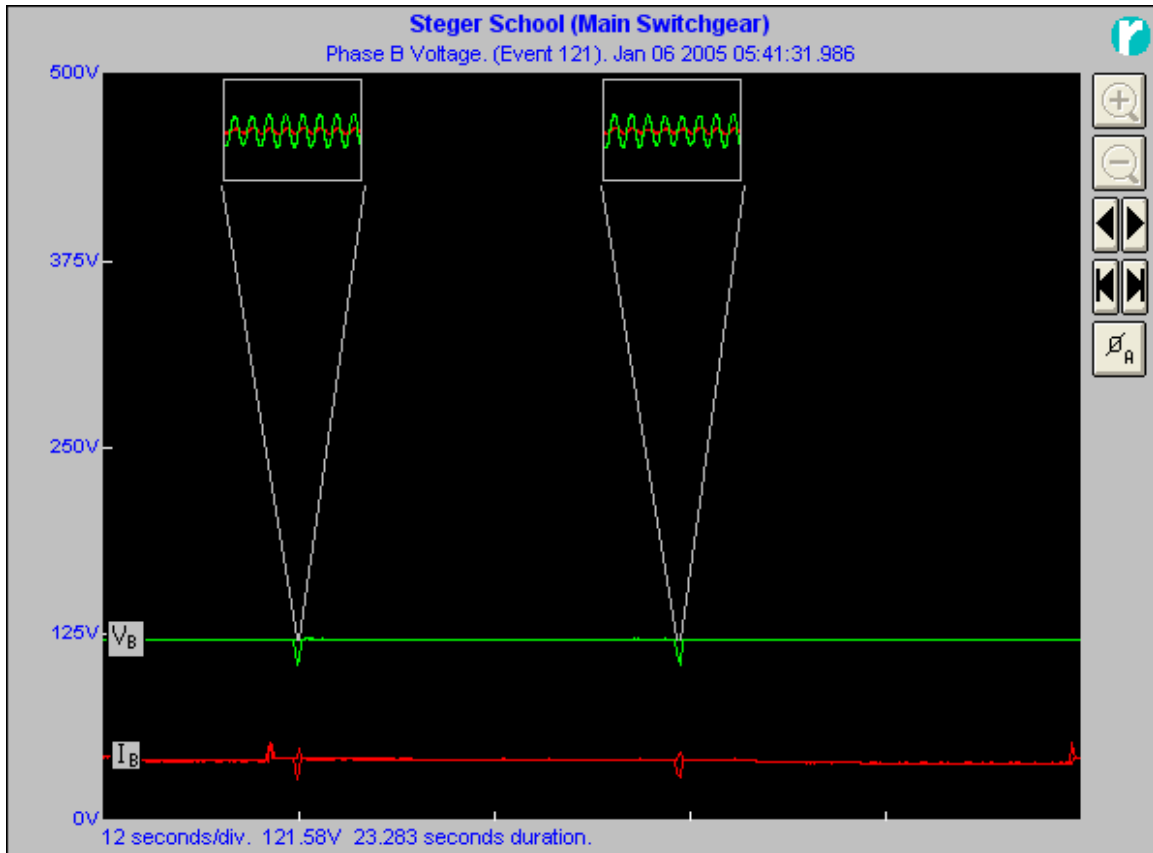
Waveshape Faults:

Waveshape faults are longer in duration than impulses and are shown in the middle of the Power Tolerance Envelope. They are often sub-cycle distortions of the AC sinusoid. However these distortions can last for a fraction of the single cycle period or they can continue for hundreds of milliseconds, hours or even days. All equipment which is not supplied by an Uninterruptible Power Supply, or whose power supply doesn't inherently have sufficient "ride through" to withstand the disturbance will be disrupted. Frequently these disturbances are associated with impulses. **12 Waveshape faults occurred during the monitoring period.** Event 20, a typical Waveshape fault is shown below.



Voltage Surges and Sags:

The utility strives to keep RMS. levels within a +5%, -10% range of the nominal voltage. Surges are those RMS. levels which go above the +5% range. Sags are those RMS. levels which go below the -10% range. The duration is generally from a few cycles to a few seconds. **18 RMS. events occurred during the monitoring period.** Event 121, a typical RMS. event is shown below.



Solutions Table:

The following table provides a general overview of the types of mitigation devices available for specific power quality phenomena. Often times the need for choosing the right mitigation device depends upon existing system parameters. This information in correlation with monitoring data allows for the implementation of the most economical and feasible electrical solutions.

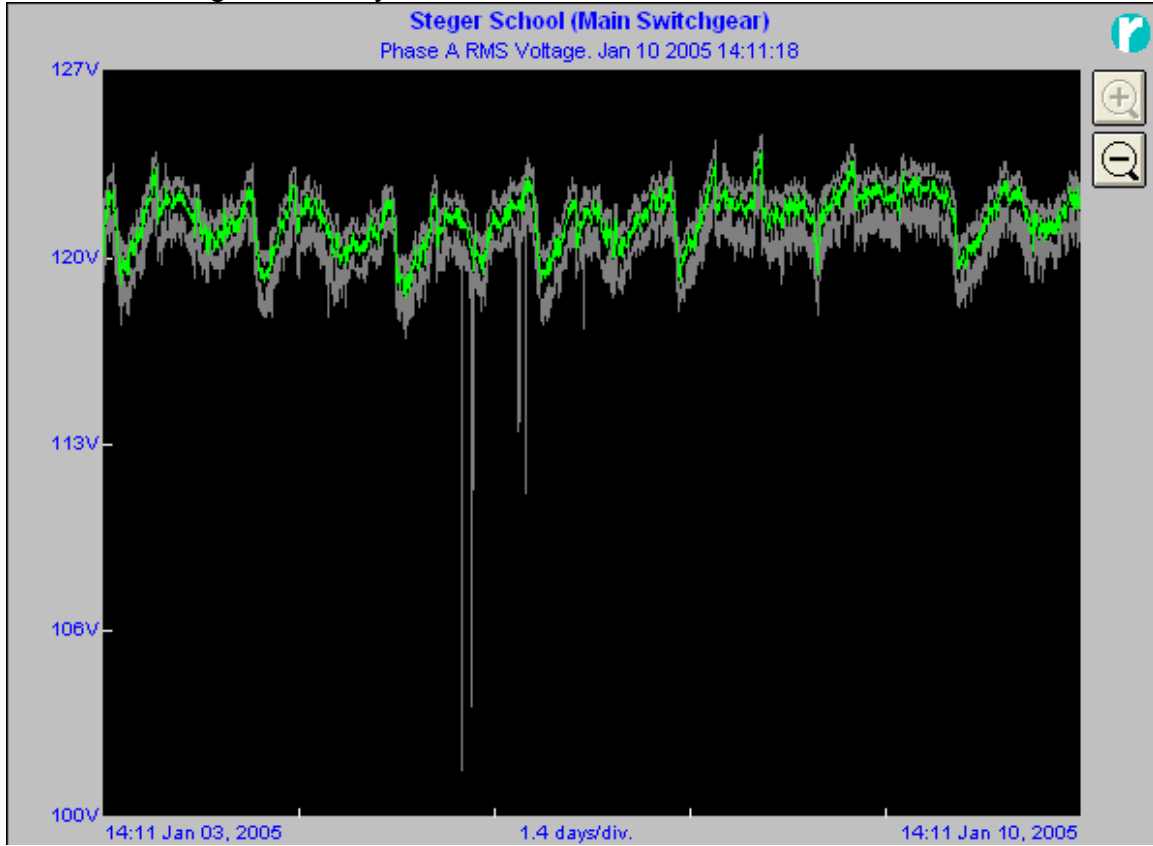
Disturbance Type	P1159 Category	Specific Phenomena	Solution
Type I – Transients	Impulsive	Lightning, Electro-static Discharge	Filters Isolation Transformers
	Oscillatory	Line/Load switching, power electronic device operation	Low-impedance Power Conditioners (LIPCs) On-Line UPS
		Capacitor switching	Surge Protective Devices (SPDs)
		Ferroresonance Transformer energization	Line Reactor Constant Voltage Transformers (high frequency)
Type II – (0.5 cycles to 2 s)	Instantaneous and Momentary Short Duration Variations	System faults	Constant Voltage Transformers Energy Storage Technologies Magnetic Synthesizers Motor Generator Standby Power Supply Static Transfer Switch Static Voltage Regulator UPS System
Type III – (> 2 s)	Temporary Short Duration Variations (3s to 1 min)	System Protection, Maintenance	Energy Storage Technologies Motor Generator UPS System
	Sustained Interruption Undervoltage Overvoltage	Motor Starting, Load Variations, Load Dropping	Backup Generator Constant Voltage Transformers Energy Storage Technologies Voltage Regulators

Voltage, Current and Frequency Summaries

Voltage, Current and Frequency measurements for XYZ School:Main Switchgear from 01/03/05 14:11:18 through 01/10/05 14:11:18.

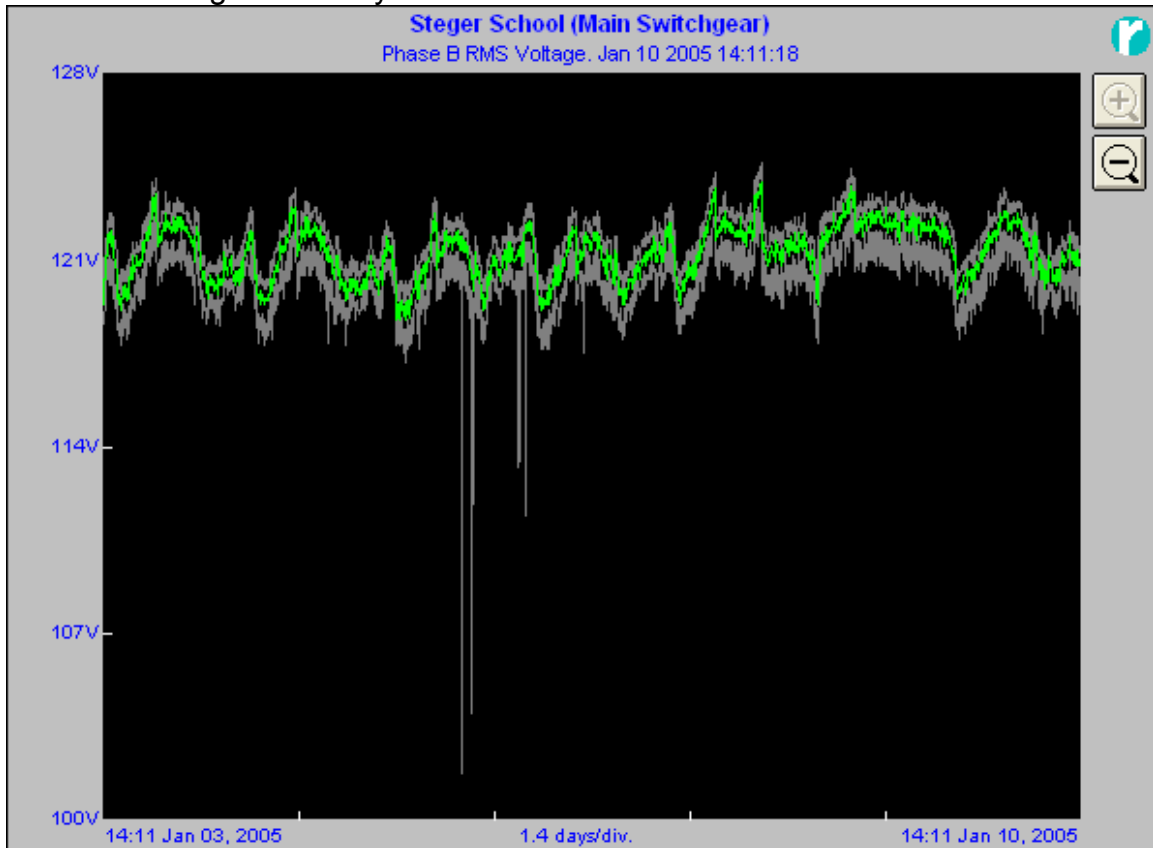
RMS. Voltages	Value	Date and Time
Phase A minimum	101.8V	Jan 06 2005 03:56:18
Phase A average	121.9V	
Phase A maximum	125.1V	Jan 08 2005 07:16:18
Phase B minimum	101.8V	Jan 06 2005 03:56:18
Phase B average	121.5V	
Phase B maximum	125.0V	Jan 08 2005 07:21:18
Neutral minimum	366.2mV	Jan 04 2005 10:26:18
Neutral average	29.43V	
Neutral maximum	52.85V	Jan 06 2005 15:56:18
RMS. Currents	Value	Date and Time
Phase A minimum	48.15A	Jan 08 2005 08:21:18
Phase A average	112.7A	
Phase A maximum	305.4A	Jan 05 2005 07:56:18
Phase B minimum	46.69A	Jan 06 2005 03:56:18
Phase B average	125.5A	
Phase B maximum	361.1A	Jan 10 2005 13:36:18
Neutral minimum	8.240mA	Jan 04 2005 10:46:18
Neutral average	10.90mA	
Neutral maximum	22.88mA	Jan 03 2005 14:11:18
Ground minimum	46.69mA	Jan 04 2005 10:51:18
Ground average	51.58mA	
Ground maximum	70.49mA	Jan 03 2005 14:11:18
Frequency	Value	Date and Time
Phase A minimum	59.92Hz	Jan 07 2005 23:01:18
Phase A average	60.00Hz	
Phase A maximum	60.07Hz	Jan 09 2005 21:46:18
Phase B minimum	59.92Hz	Jan 07 2005 23:01:18
Phase B average	60.00Hz	
Phase B maximum	60.07Hz	Jan 09 2005 21:46:18

RMS. Voltage Summaries for XYZ School:Main Switchgear.
Phase A Voltage Summary.



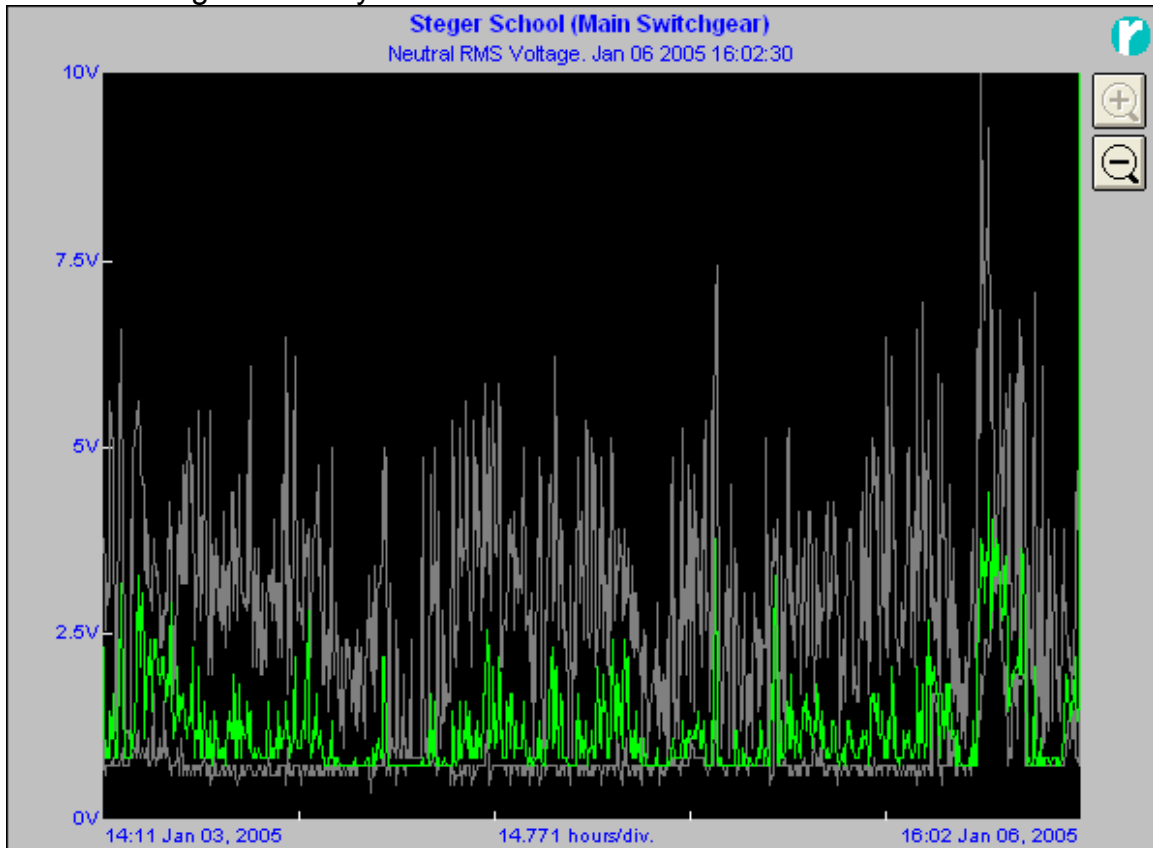
Min.	101.8V	Jan 06 2005 03:56:18
Avg.	121.9V	
Max.	125.1V	Jan 08 2005 07:16:18

Phase B Voltage Summary.



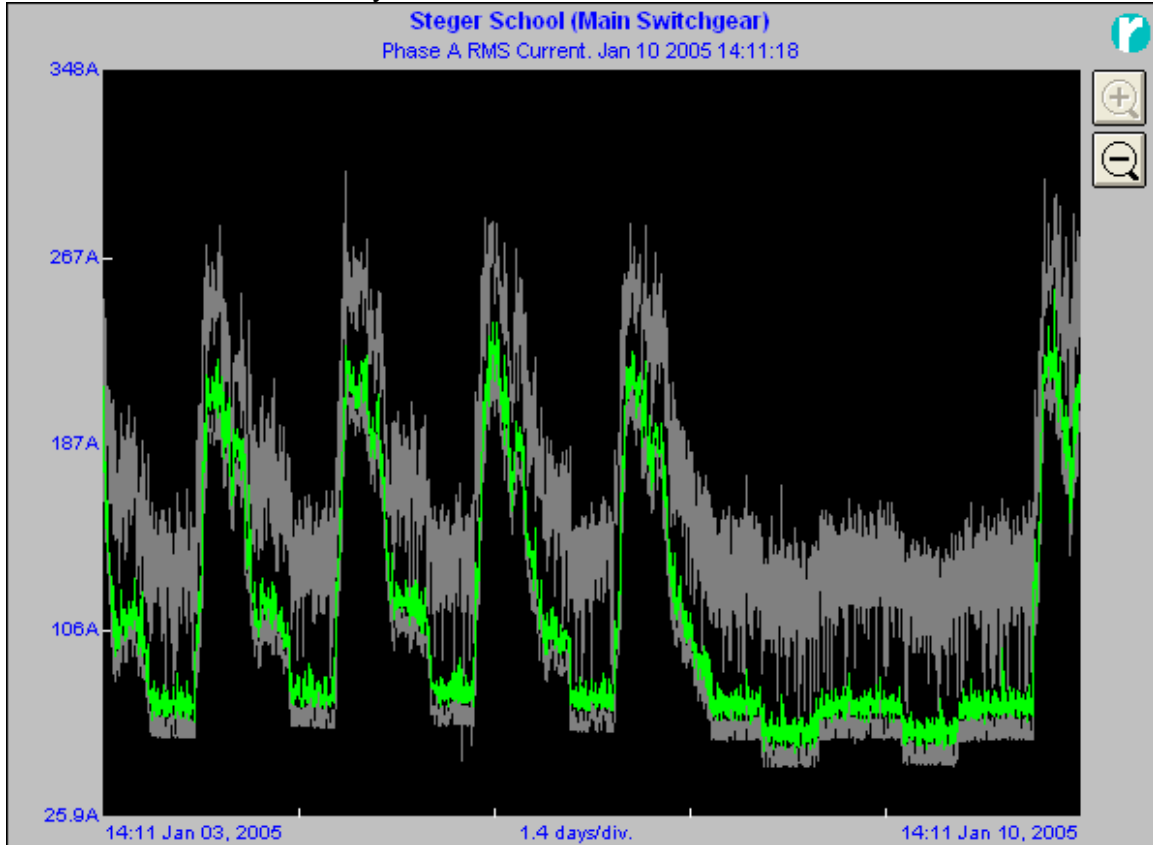
Min. 101.8V Jan 06 2005 03:56:18
Avg. **121.5V**
Max. 125.0V Jan 08 2005 07:21:18

Neutral Voltage Summary.



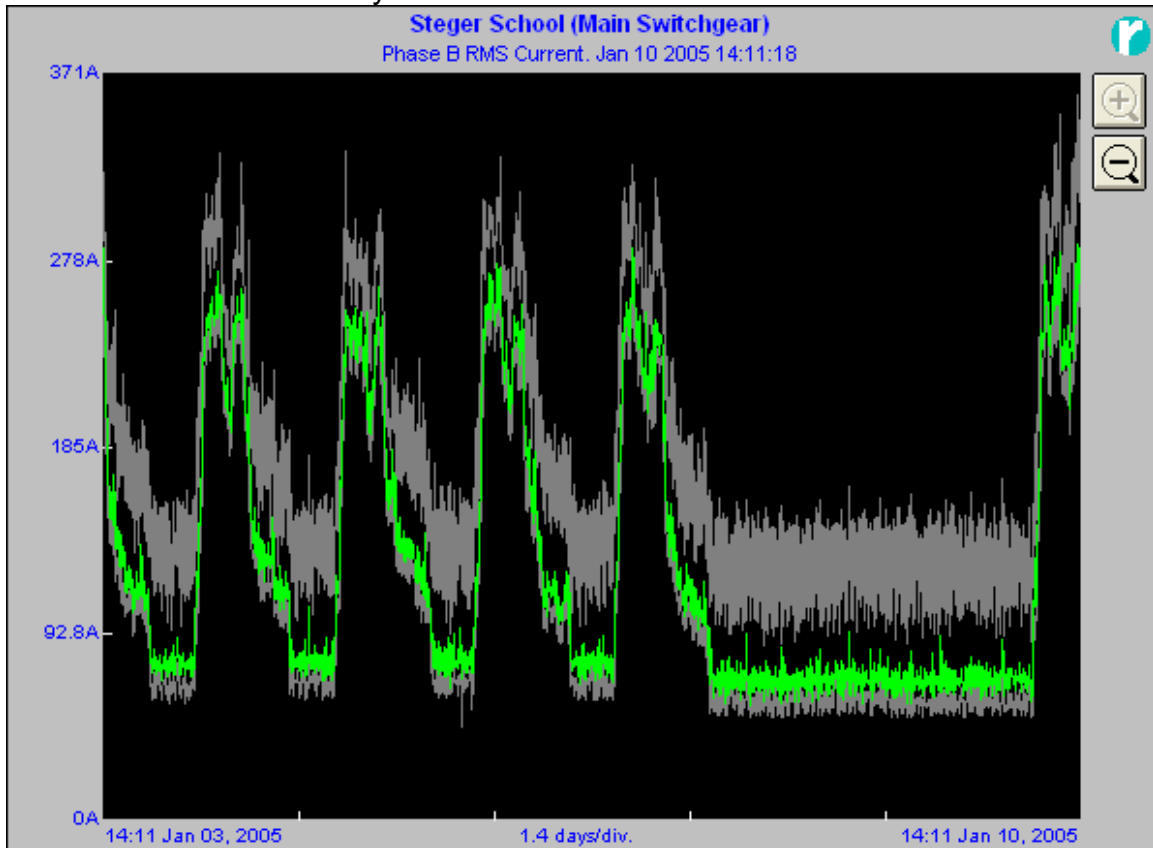
Min. 366.2mV Jan 04 2005 10:26:18
Avg. **29.43V**
Max. 52.85V Jan 06 2005 15:56:18

RMS. Current Summaries for Parkview Elementary School:Main Switchgear. Phase A Current Summary.



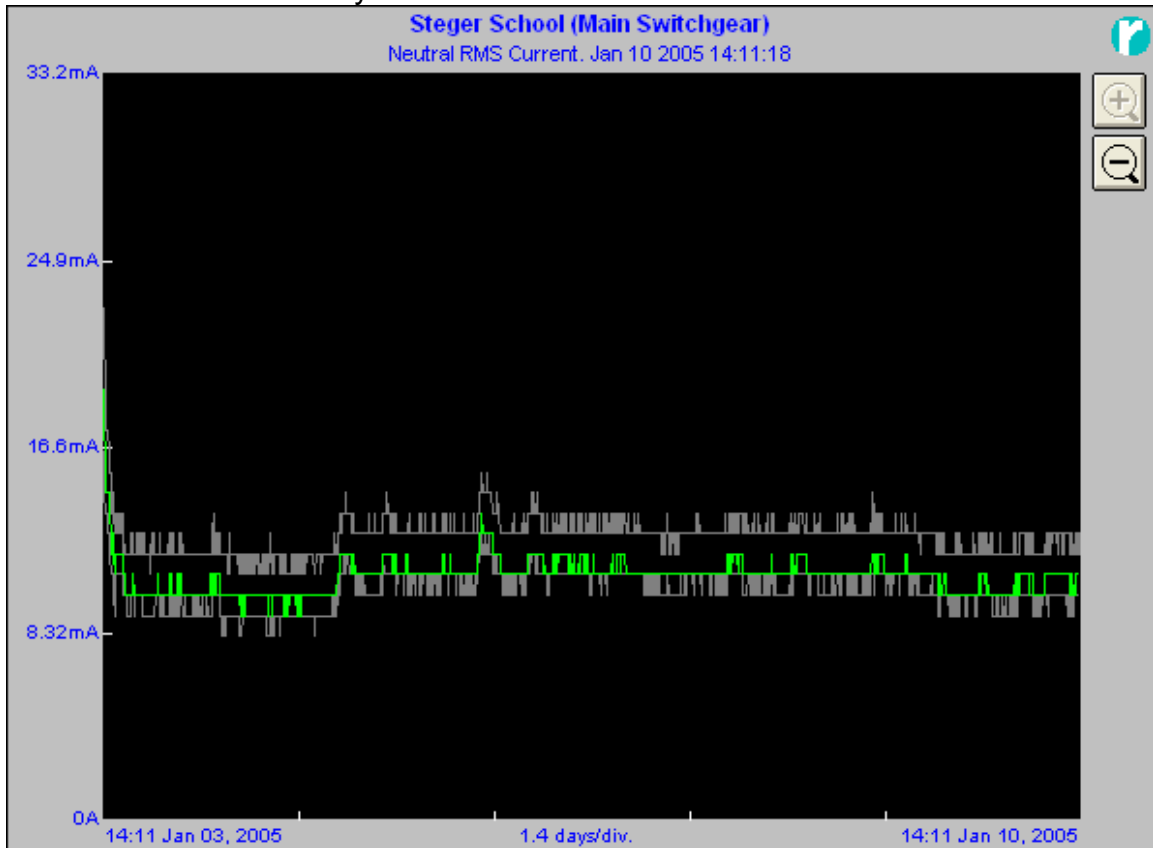
Min. 48.15A Jan 08 2005 08:21:18
Avg. **112.7A**
Max. 305.4A Jan 05 2005 07:56:18

Phase B Current Summary.



Min. 46.69A Jan 06 2005 03:56:18
Avg. **125.5A**
Max. 361.1A Jan 10 2005 13:36:18

Neutral Current Summary.



Min. 8.240mA Jan 04 2005 10:46:18
Avg. **10.90mA**
Max. 22.88mA Jan 03 2005 14:11:18

Ground Current Summary.



Min. 46.69mA Jan 04 2005 10:51:18
Avg. **51.58mA**
Max. 70.49mA Jan 03 2005 14:11:18

Voltage and Current Distortion Summaries

Voltage and Current harmonic distortion measurements for Parkview Elementary School:Main Switchgear from 01/03/05 14:11:18 through 01/10/05 14:11:18.

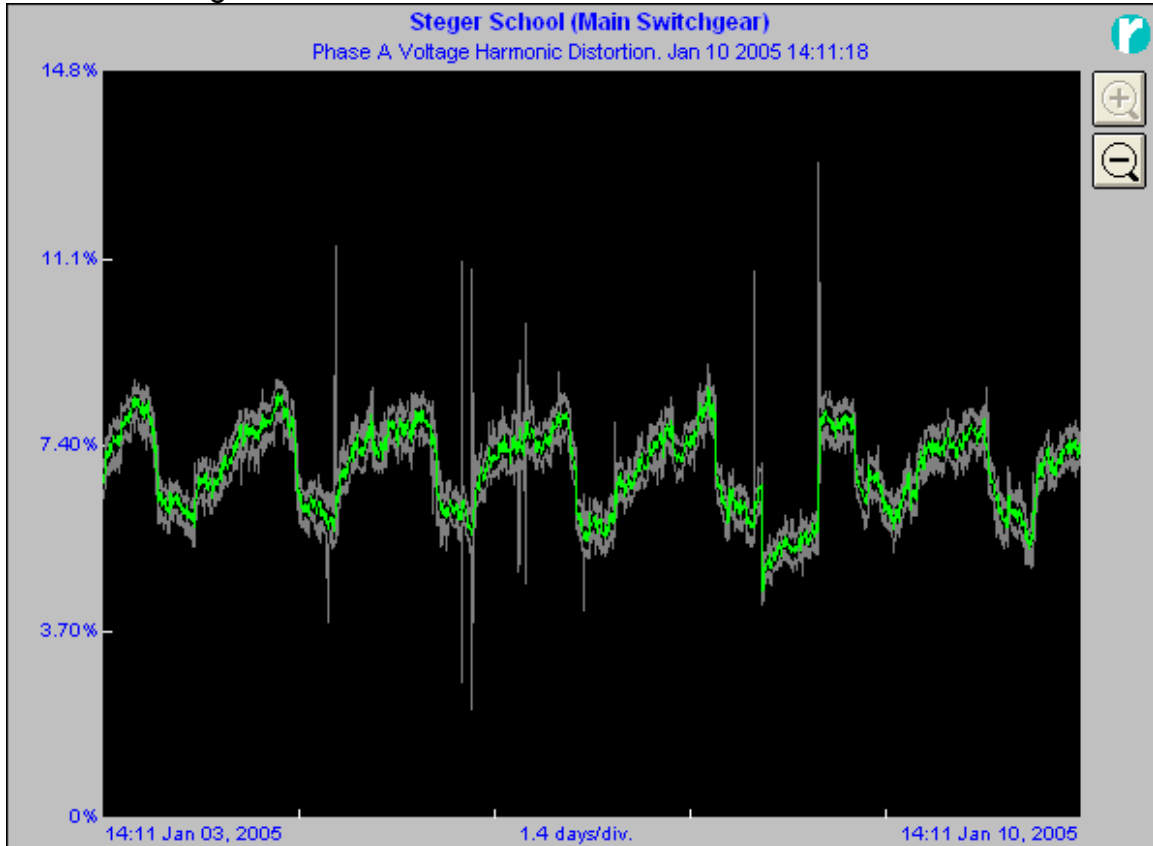
Voltage Distortion	Value	Date and Time
Phase A minimum	4.52%	Jan 08 2005 07:31:18
Phase A average	6.925%	
Phase A maximum	8.57%	Jan 07 2005 22:11:18
Phase B minimum	4.53%	Jan 08 2005 07:31:18
Phase B average	6.889%	
Phase B maximum	8.41%	Jan 07 2005 22:11:18

Current Distortion	Value	Date and Time
Phase A minimum	7.66%	Jan 06 2005 11:16:18
Phase A average	10.59%	
Phase A maximum	15.37%	Jan 05 2005 03:31:18
Phase B minimum	7.25%	Jan 08 2005 16:51:18
Phase B average	11.40%	
Phase B maximum	16.16%	Jan 05 2005 04:01:18

Voltage Flicker	Value	Date and Time
Phase A minimum	0.177	Jan 05 2005 11:21:18
Phase A average	0.257	
Phase A maximum	3.158	Jan 06 2005 03:51:18
Phase B minimum	0.174	Jan 04 2005 22:01:18
Phase B average	0.257	
Phase B maximum	3.179	Jan 06 2005 03:51:18

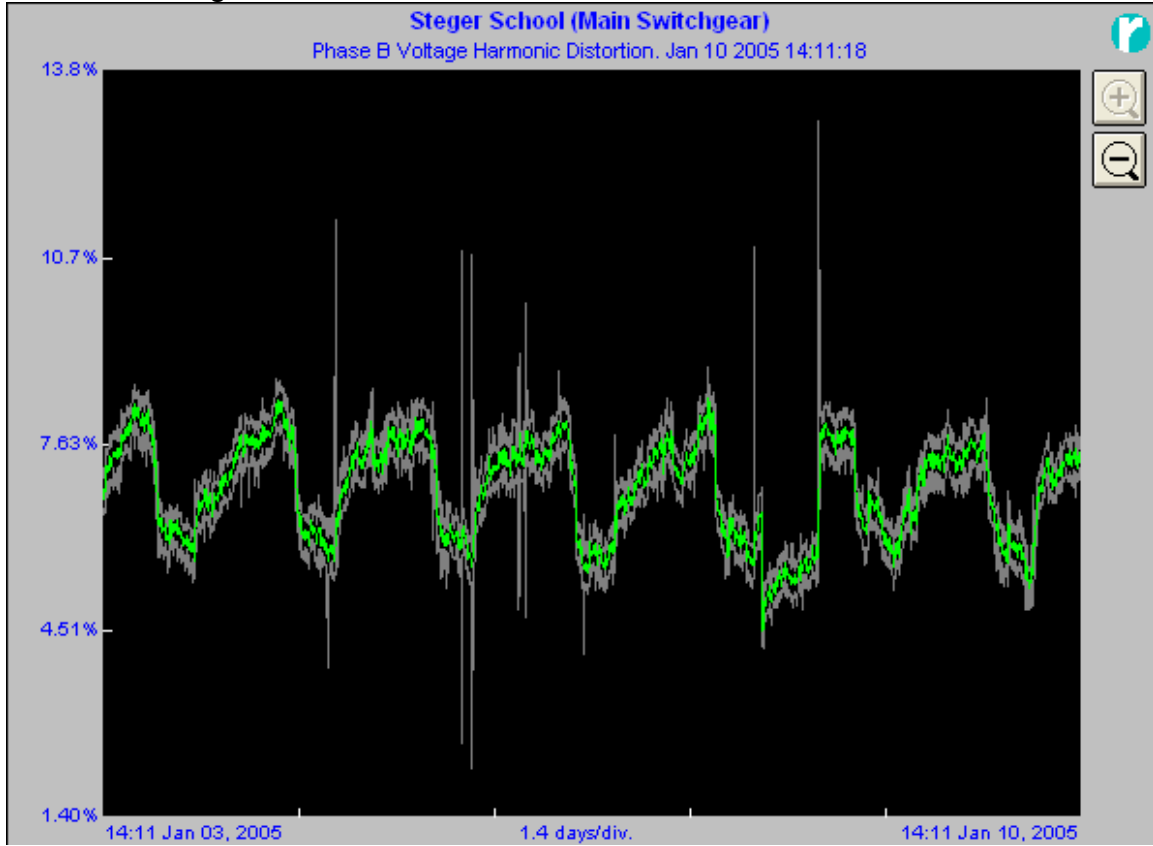
Voltage T.H.D. Summaries for Parkview Elementary School:Main Switchgear.

Phase A Voltage Distortion.



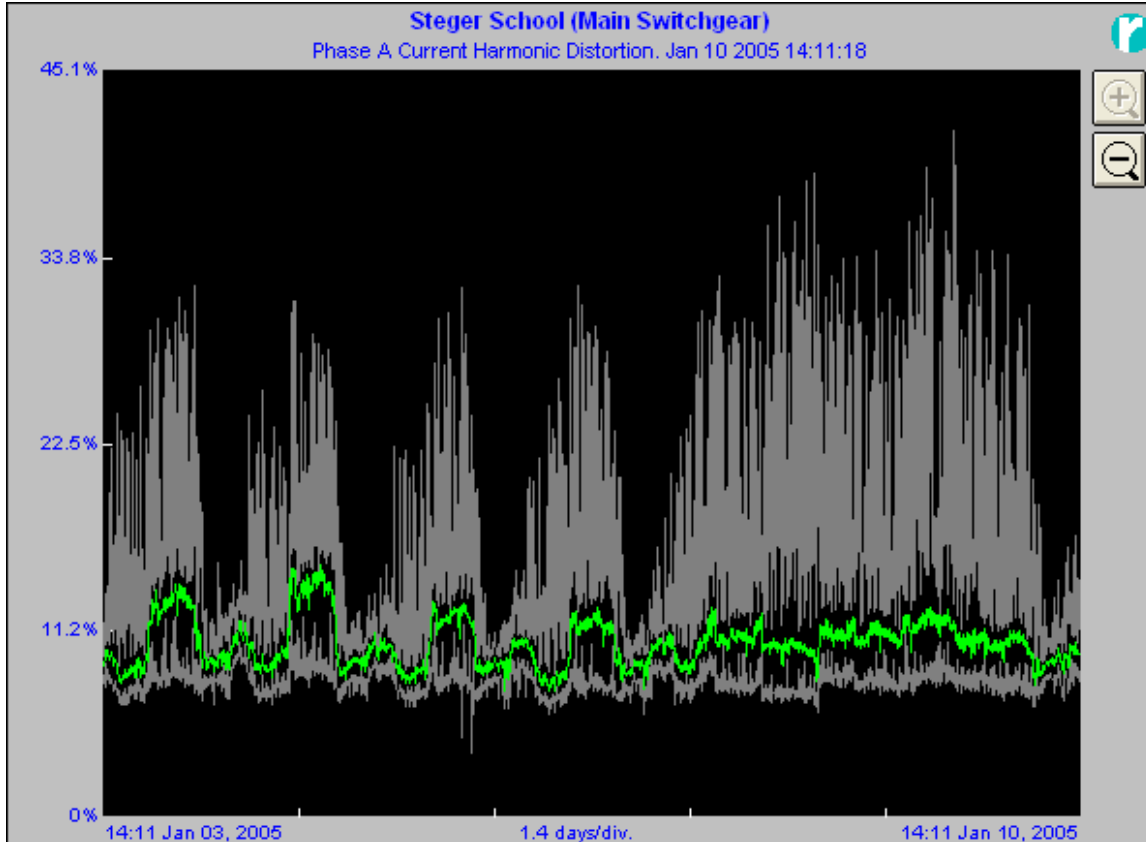
Min. 4.52% Jan 08 2005 07:31:18
Avg. **6.925%**
Max. 8.57% Jan 07 2005 22:11:18

Phase B Voltage Distortion.



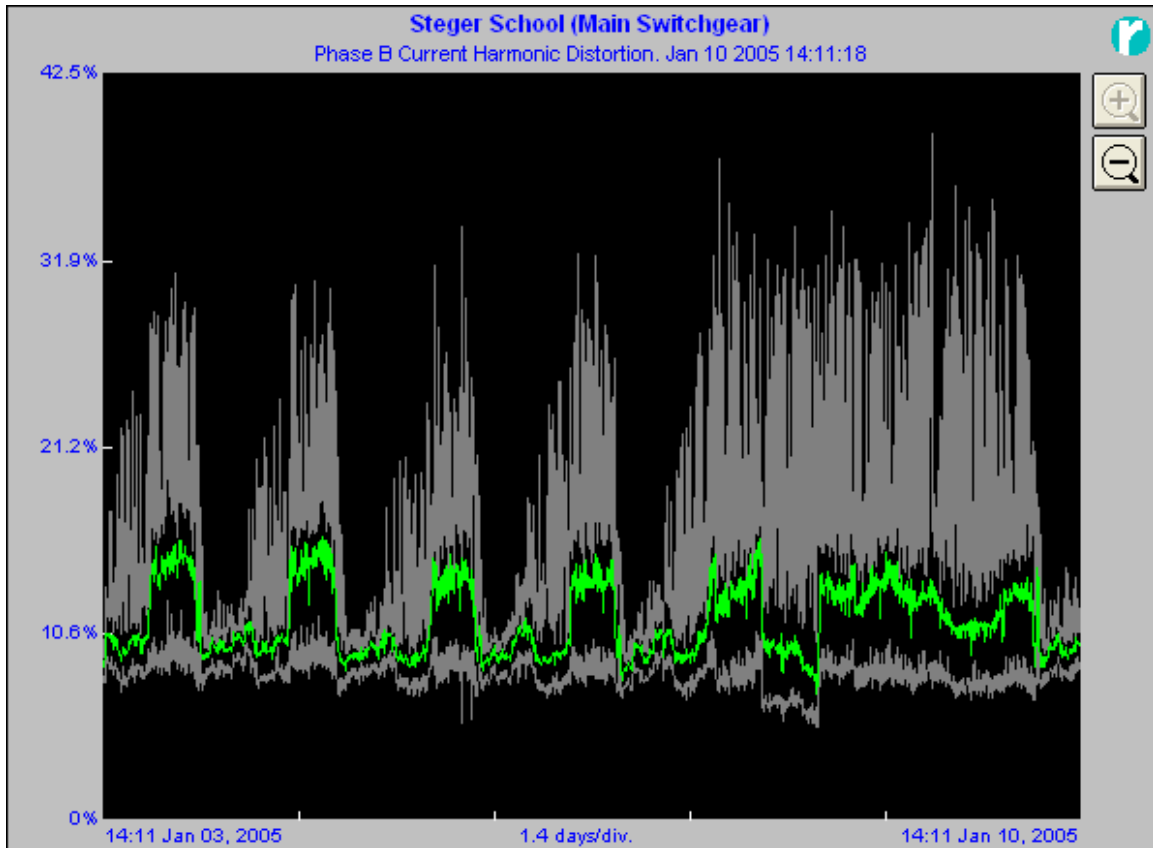
Min. 4.53% Jan 08 2005 07:31:18
Avg. **6.889%**
Max. 8.41% Jan 07 2005 22:11:18

Current T.H.D. Summaries for XYZ School:Main Switchgear.
Phase A Current Distortion.



Min.	7.66%	Jan 06 2005 11:16:18
Avg.	10.59%	
Max.	15.37%	Jan 05 2005 03:31:18

Phase B Current Distortion.



Min. 7.25% Jan 08 2005 16:51:18
Avg. **11.40%**
Max. 16.16% Jan 05 2005 04:01:18

Power Summaries

Power measurements for XYZ School:Main Switchgear from 01/03/05 14:11:18 through 01/10/05 14:11:18.

Imbalance	Value	Date and Time
Minimum Voltage Imbalance	0%	Jan 03 2005 18:36:18
Average Voltage Imbalance	0.169%	
Maximum Voltage Imbalance	0.6%	Jan 04 2005 14:06:18
Minimum Current Imbalance	0%	Jan 04 2005 01:41:18
Average Current Imbalance	5.673%	
Maximum Current Imbalance	22.97%	Jan 03 2005 16:16:18

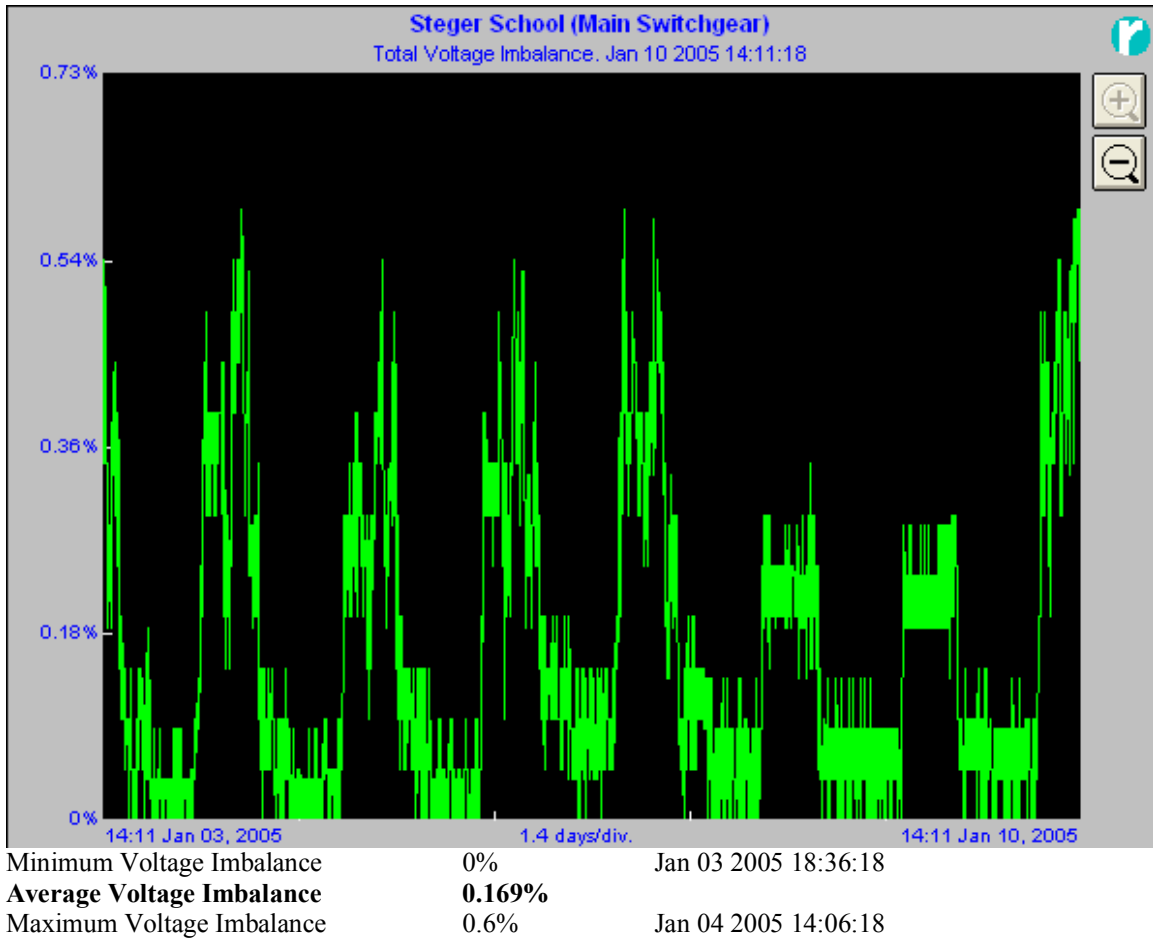
VA Power	Value	Date and Time
Phase A minimum	5.244kVA	Jan 06 2005 03:56:18
Phase A average	13.75kVA	
Phase A maximum	36.27kVA	Jan 05 2005 07:56:18
Phase B minimum	4.840kVA	Jan 06 2005 03:56:18
Phase B average	15.24kVA	
Phase B maximum	43.10kVA	Jan 10 2005 13:36:18
Total minimum	14.03kVA	Jan 08 2005 12:56:18
Total average	29.00kVA	
Total maximum	64.66kVA	Jan 10 2005 09:41:18

VARS Power	Value	Date and Time
Phase A minimum	2.074kVAR	Jan 06 2005 05:41:18
Phase A average	6.127kVAR	
Phase A maximum	13.48kVAR	Jan 10 2005 11:31:18
Phase B minimum	1.643kVAR	Jan 06 2005 03:56:18
Phase B average	5.989kVAR	
Phase B maximum	13.03kVAR	Jan 04 2005 10:21:18
Total minimum	8.652kVAR	Jan 08 2005 07:46:18
Total average	12.11kVAR	
Total maximum	18.46kVAR	Jan 10 2005 09:41:18

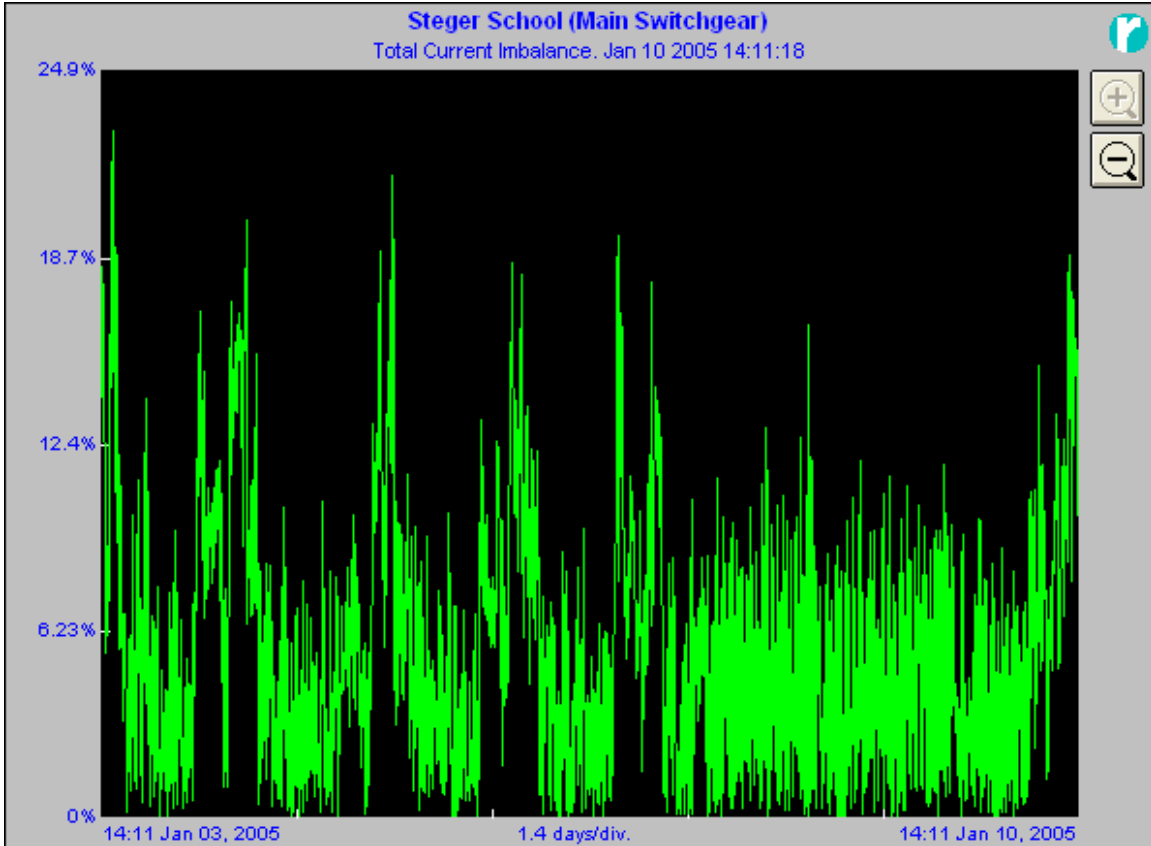
Watts Power	Value	Date and Time
Phase A minimum	3.828kW	Jan 08 2005 08:26:18
Phase A average	12.12kW	
Phase A maximum	34.07kW	Jan 05 2005 07:56:18
Phase B minimum	4.553kW	Jan 06 2005 03:56:18
Phase B average	13.83kW	
Phase B maximum	41.18kW	Jan 10 2005 13:36:18
Total minimum	10.53kW	Jan 08 2005 12:56:18
Total average	25.95kW	
Total maximum	61.94kW	Jan 10 2005 09:41:18

Demand Power	Value	Date and Time
Phase A minimum	5.052kW	Jan 08 2005 16:36:18
Phase A average	12.12kW	
Phase A maximum	27.67kW	Jan 10 2005 09:41:18
Phase B minimum	6.406kW	Jan 10 2005 05:36:18
Phase B average	13.83kW	
Phase B maximum	33.31kW	Jan 10 2005 13:46:18
Total minimum	11.57kW	Jan 08 2005 09:26:18
Total average	25.96kW	
Total maximum	59.69kW	Jan 10 2005 09:46:18
Power Factor	Value	Date and Time
Phase A minimum	0.981 Lag	Jan 03 2005 14:11:18
Phase A average	0.850 Lag	
Phase A maximum	0.571 Lag	Jan 09 2005 10:26:18
Phase B minimum	0.982 Lag	Jan 03 2005 14:16:18
Phase B average	0.874 Lag	
Phase B maximum	0.674 Lag	Jan 09 2005 23:21:18
Total minimum	0.972	Jan 03 2005 14:11:18
Total average	0.863	
Total maximum	0.730	Jan 09 2005 09:21:18

Voltage and Current Imbalance Summaries for XYZ School:Main Switchgear.



Current Imbalance



Minimum Current Imbalance	0%	Jan 04 2005 01:41:18
Average Current Imbalance	5.673%	
Maximum Current Imbalance	22.97%	Jan 03 2005 16:16:18