

March 13, 2006

Keith Beecham
American Independent Insurance Company
PO Box 3000
Plymouth Meeting, PA 19462-3000

Dear Keith:

Please find attached the detailed power analysis for your computer room. I summarized the results below.

The power was monitored from the October 12, 2005 through November 09, 2005 using Fluke RPM meter. Data was collected for all three phases including neutral and ground at your 3rd Floor computer room electrical panel. The computer room panel is rated for 150 Amps, 208 volts three phase (4 wire), 60 Hertz and is fed from a 45 kVA, 480 to 208 volt transformer located in the 3rd floor electrical closet. The computer room panel has a built in transient voltage surge suppressor design to protect the connected load from voltage spikes and transients.

The report details the Voltage, Current, kVA, KW, Frequency, Power Factor, and Harmonics over a 29 day period. The average values are listed in the Table below.

Phase	Amps	Volt-Amps	Watts
A	32.68	3955	3776
B	29.29	3531	3354
C	54.68	6593	5999
Total		14.08 kVA	13.12 kW

Please note that C phase is running 76% higher than Phase A and B creating 40.7% current imbalance on average. If the load was greater, the imbalance may result in tripped circuit breakers and transformer overheating. However, C phase is running at 46% of its maximum continuous rating of 120 Amps and does not warrant concern. The maximum continuous rating is based on 80% of the breaker rating. Attention should be given in the future to adding load to A and B phases or redistributing the load on C phase. During the 29 day period, the maximum load was 18.79 kVA / 17.92 kW.

The total current harmonic distortion is running high and averaging 28% on all three phases. The high current distortion is not unusual for computer room loads. Modern day servers and computers use switch mode power supplies that cause notching of the current waveform. Harmonic current distortion will result in overheating of conductors, breakers, and transformers thereby reducing your overall energy efficiency. There are transformers available that cancel or block harmonic currents. However, these solutions are typically expensive to implement and take long time for the energy savings to pay for the investment. The most common practice today is to use a K13 or K20 rated transformer that can tolerate high harmonics and not overheat. If your load continues to grow, I recommend replacing the transformer feeding the computer room with a K20 rated transformer.

Manufacturer's Representative for

During the 29 day period, the power meter recorded multiple events or power anomalies. The events are broken down into three categories. Type I events are transients or spikes typically caused by lightning and last less than 8.3 ms in duration. Type II events are momentary short duration variations typically caused by system faults and last 8.3 ms to 2 seconds in duration. Type III events last longer than 2 seconds and are typically caused by utility voltage fluctuations or outages.

The meter measured 19 Type II events and 3 Type III events. No Type I events were measured during the 29 day period. This is not unusual considering the panel measured has build in transient surge protection. Out of the 22 events recorded, only one Type II event was significant falling outside the power envelope acceptable by most equipment manufacturers. The meter recorded a fault condition on October 26th at 11:36 AM lasting 367 ms causing the voltage to dip to 65.2 Volts on B phase.

Although only one event fell outside the power envelope, some computer manufactures power supplies do not inherently have sufficient ride through time to withstand the Type II disturbances and could be disrupted. Your current APC SmartUPS use line interactive topology that will not protect against many of the power disturbance captured. Line interactive topology protected against only Type III disturbances. I recommend that all critical equipment be protected by an "on-line" type Uninterruptible Power System. An on-line UPS always provides clean conditioned power regardless of the input fluctuations and protects against Type I, Type II and Type III disturbances.

If you have any questions regarding the report or recommendations, please feel free to call.

Sincerely,

A handwritten signature in black ink, appearing to read "Jim Davis", with a stylized flourish at the end.

Jim Davis
President

Power Analysis Summary

Introduction

This is a summary of the power conditions at the AIIC site, as recorded at location 3rd Floor Computer Room. Data at this location was collected from 10/12/05 07:44:24 through 11/09/05 06:44:24.

This summary is composed of:

- The initial conditions section. This Section defines the power conditions at the above location.
- 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	American Independent Insurance Company
Phone Number	610-832-4940 x8347
Contact	Keith Beecham

Location Information

Name	3rd Floor Computer Room
Power Type	Three phase wye
Feed Phase	Unknown
Date and Time	10/12/05 07:32:49
Nominal Voltage	120 Volts
Nominal Frequency	60 Hz

Report Parameters

This report was prepared on 3/13/2006 by Jim Davis of Core Power, Inc.. The following limits were used in analyzing the results.

Maximum Phase Voltage.	127 V
Minimum Phase Voltage.	104 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 Jim Davis.

Initial Conditions

A summary of all the electrical parameters at this location is presented in the tables and graphs below. Parameters marked with an ‘*’ lie outside the limits defined above.

Initial Power measurements for AHC:3rd Floor Computer Room , 10/12/05 at 07:32:49

Measurement	Phase A	Phase B	Phase C	Neutral	Ground
True RMS. Voltage	121.0V	120.5V	120.7V	853.4mV	
Max. Peak to Peak Voltage	339.4V	338.0V	336.4V		
True RMS. Current	30.48A	30.88A	54.24A	33.88A	204.5mA
Max. Peak to Peak Current	122.1A	125.6A	211.1A		
Fundamental RMS. Voltage	120.9V	120.5V	120.6V		
Voltage Angle	0°	240.3°	119.8°		
Fundamental RMS. Current	29.45A	29.62A	51.68A		
Current Angle	185.1°	71.45°	315.6°		
Fundamental Impedance	4.107 Ohms	4.067 Ohms	2.334 Ohms		
Impedance Angle	174.8°	168.8°	164.1°		
Voltage Imbalance	0.21%				
Current Imbalance	39.9%*				
Total Voltage Harmonics	1.936%	1.930%	2.181%	195.0%	
Total Current Harmonics	25.89%*	29.36%*	32.71%*	135.5%	207.2%
True VA	3.677k	3.706k	6.588k	29.10	
True VARS.	988.6	1.263k	2.800k	28.96	
True Watts	-3.542k	-3.484k	-5.963k	2.855	
Distortion	7.905	18.82	37.26	1.773	
True Power Factor	0.963	0.940	0.905	0.098	
Fundamental VA	3.564k	3.570k	6.238k	1.099	
Fundamental VARS.	321.5	688.2	1.704k	-0.190	
Fundamental Watts	-3.55k	-3.503k	-6.000k	1.082	
Fundamental Power Factor	0.995	0.981	0.961	-0.984	

One or more of the Initial Conditions exceed the limits defined above. It is recommended that corrective action be implemented to reduce or eliminate these conditions.

Nominal Voltages

Phase Voltages:

Phase voltages that exceed the nominal voltage may damage sensitive electronic equipment or cause overheating. Low phase voltages may result in intermittent equipment operation and overheating.

Neutral and Neutral to Ground Voltages:

Excessive neutral voltages may indicate wiring problems exist or that the loads on the supply exceed the wiring rating.

Voltage and Current Imbalance

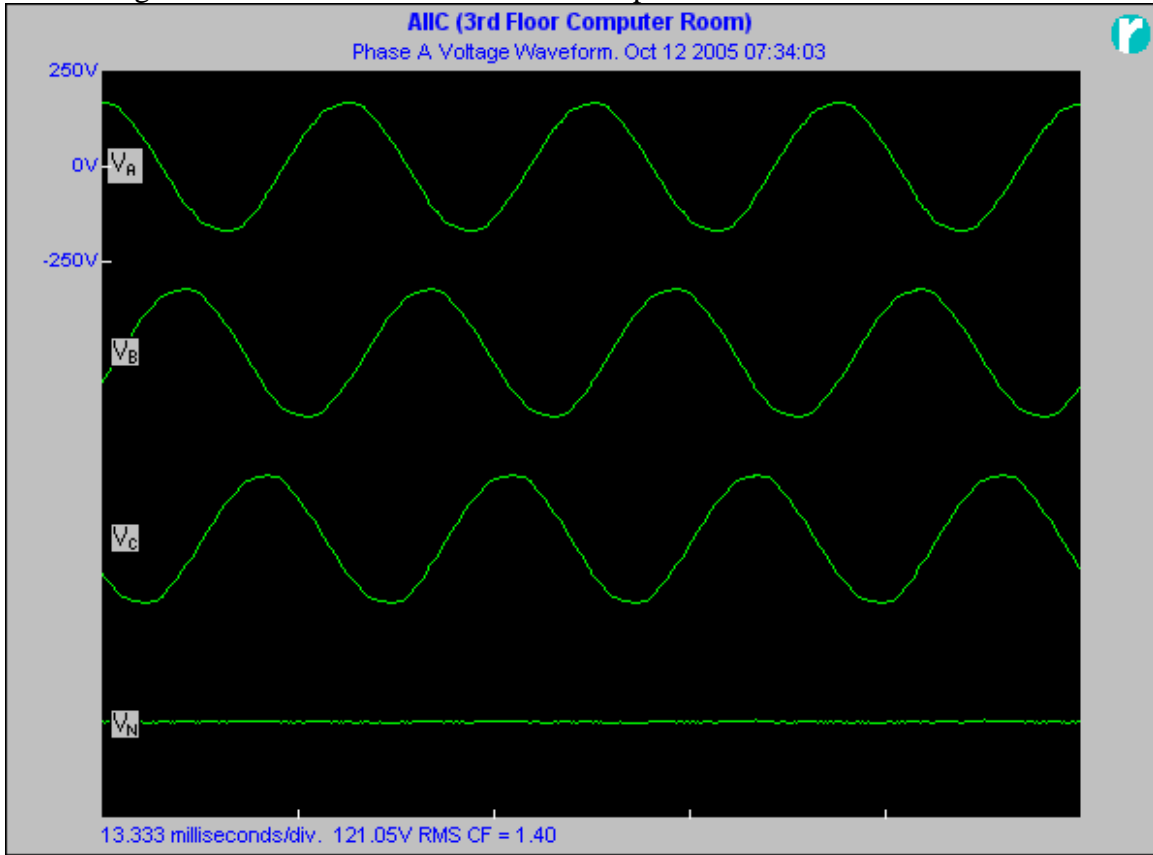
Voltage Imbalance:

Excessive Voltage Imbalance is an indication that one or two phases may be overloaded. A redistribution of the loads on one or more of the phases may be in order.

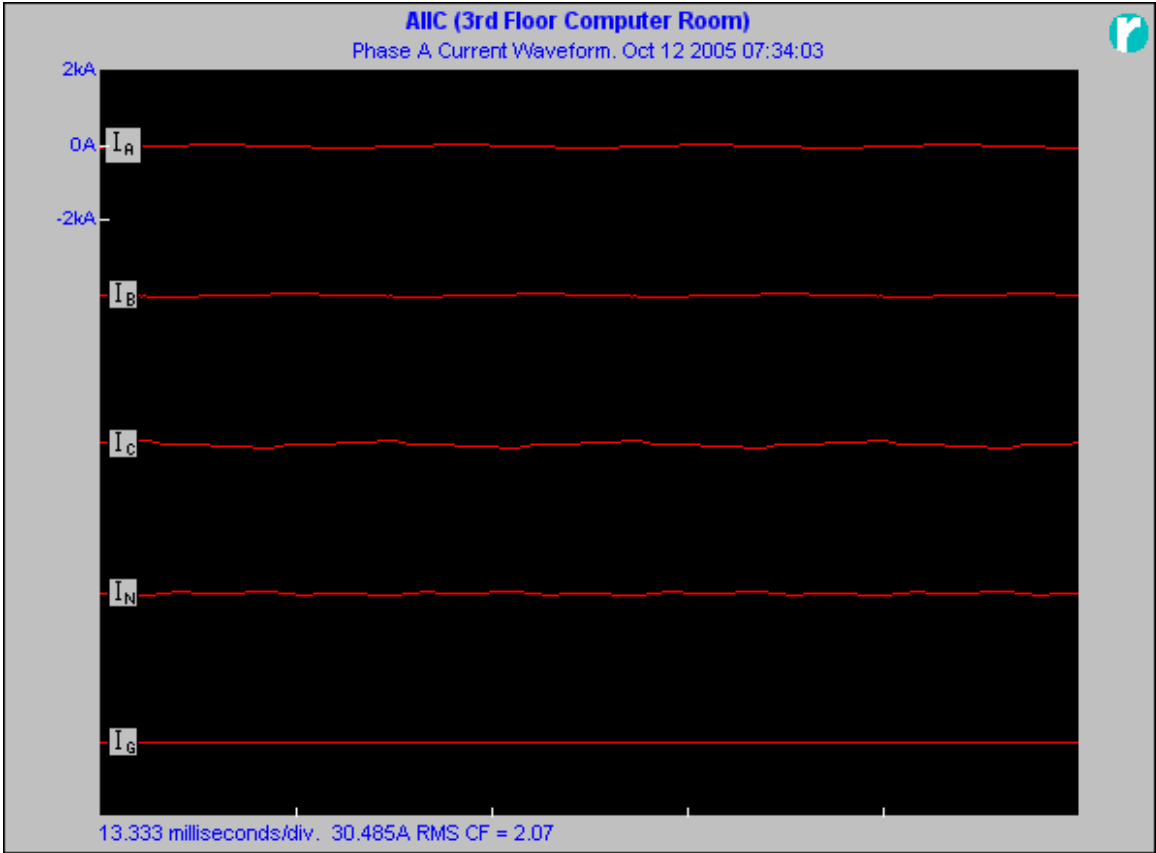
Current Imbalance:

Excessive Current Imbalance also indicates a poor distribution of loads. Although there may be no corresponding voltage imbalance, excessive current imbalance may result in tripped circuit breakers or transformer overheating.

The Voltage waveforms for AIIC:3rd Floor Computer Room are shown below:

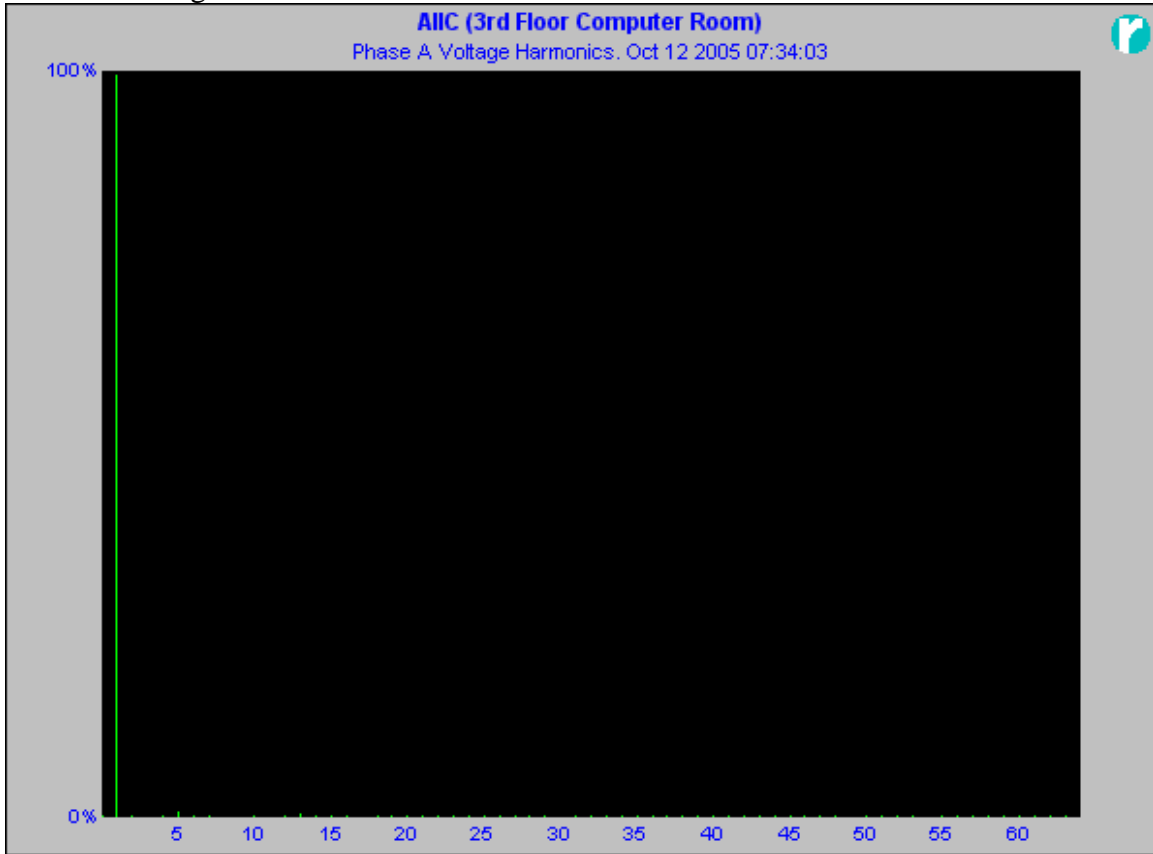


The Current waveforms for AIIC:3rd Floor Computer Room are shown below:

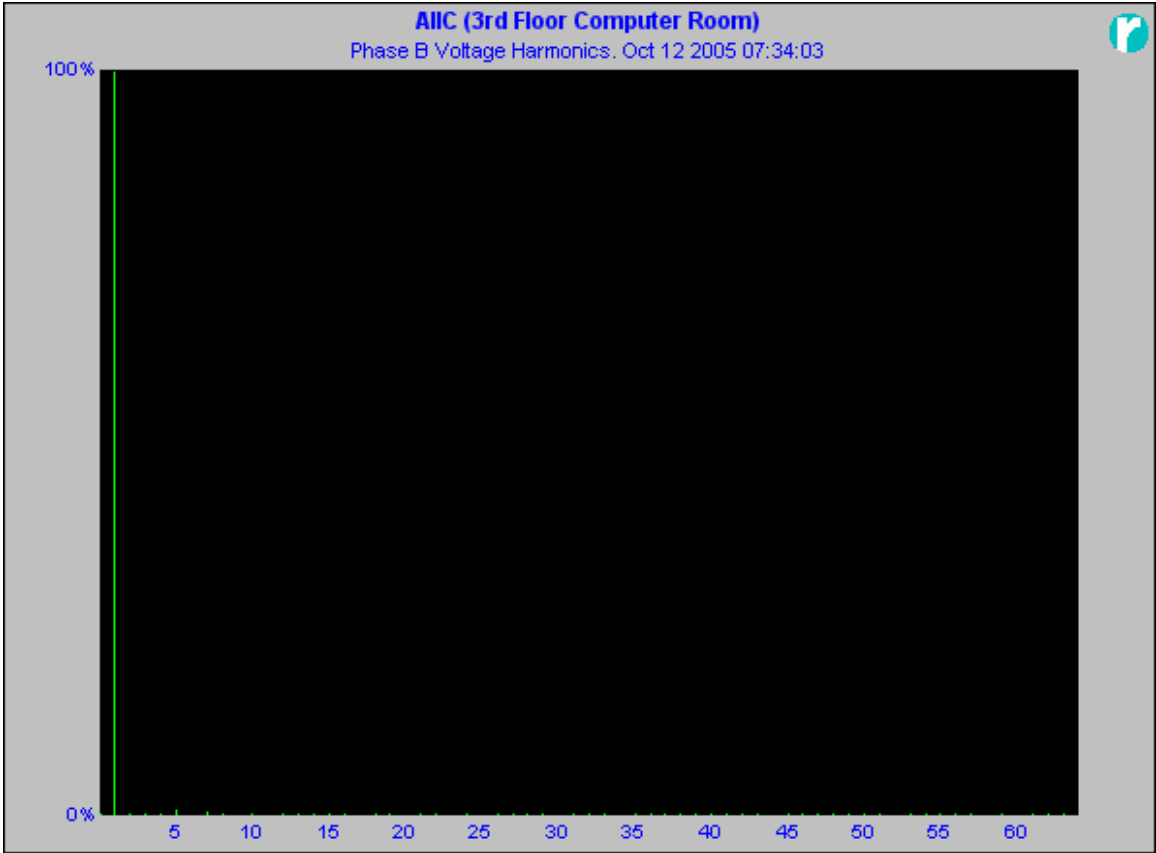


Voltage harmonics for AHC:3rd Floor Computer Room.

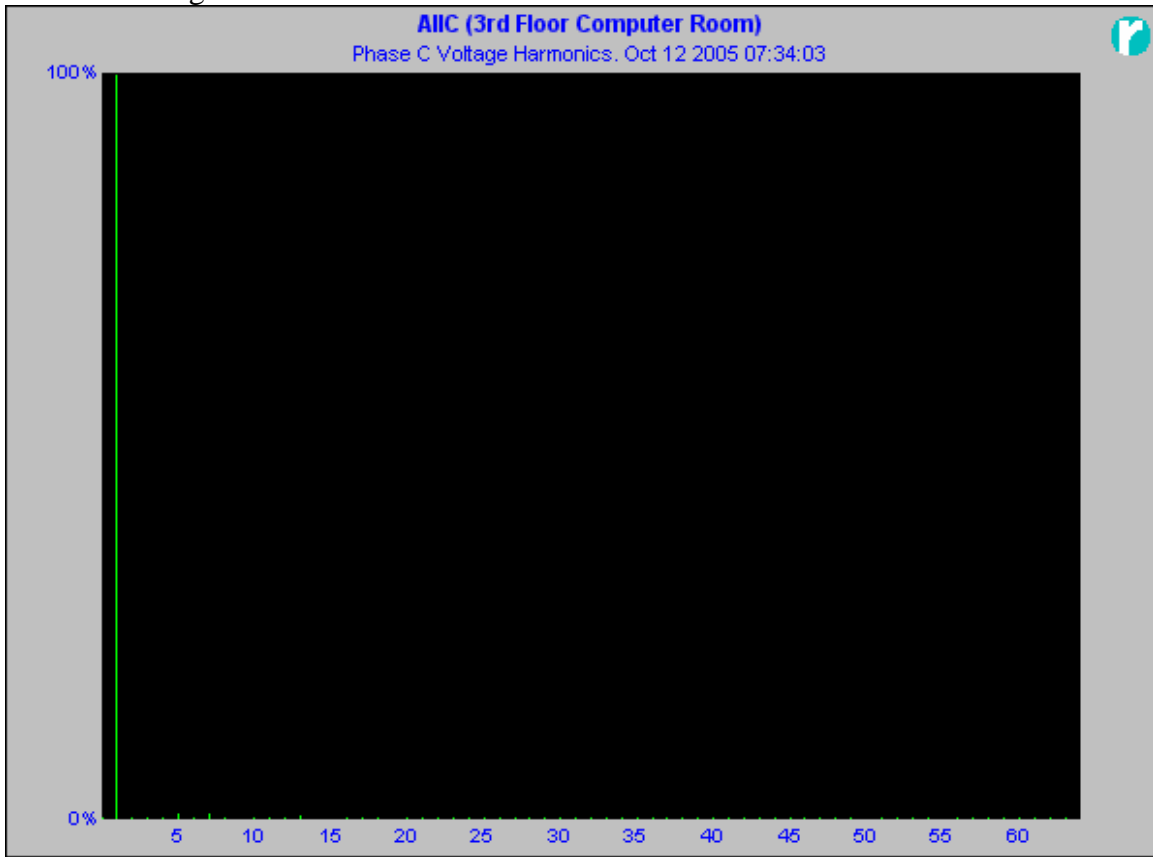
Phase A Voltage Harmonics.



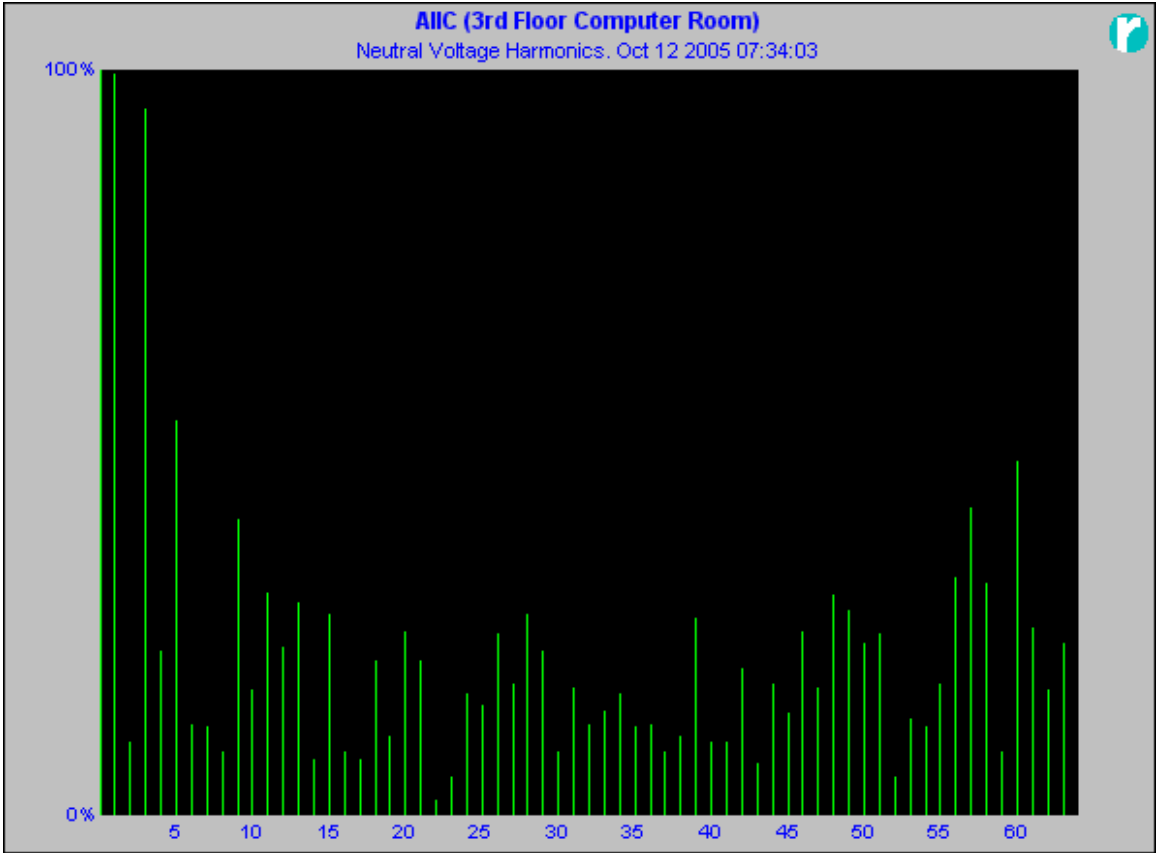
Phase B Voltage Harmonics.



Phase C Voltage Harmonics.

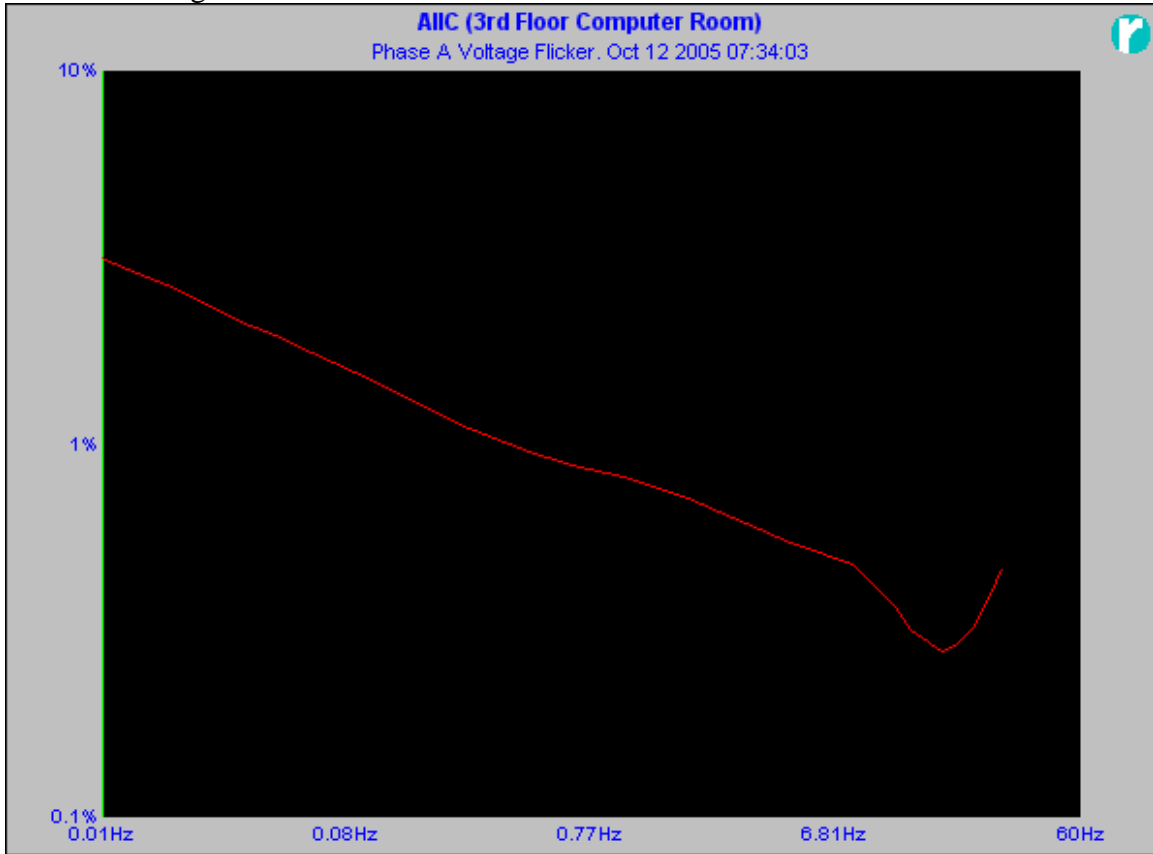


Neutral Voltage Harmonics.

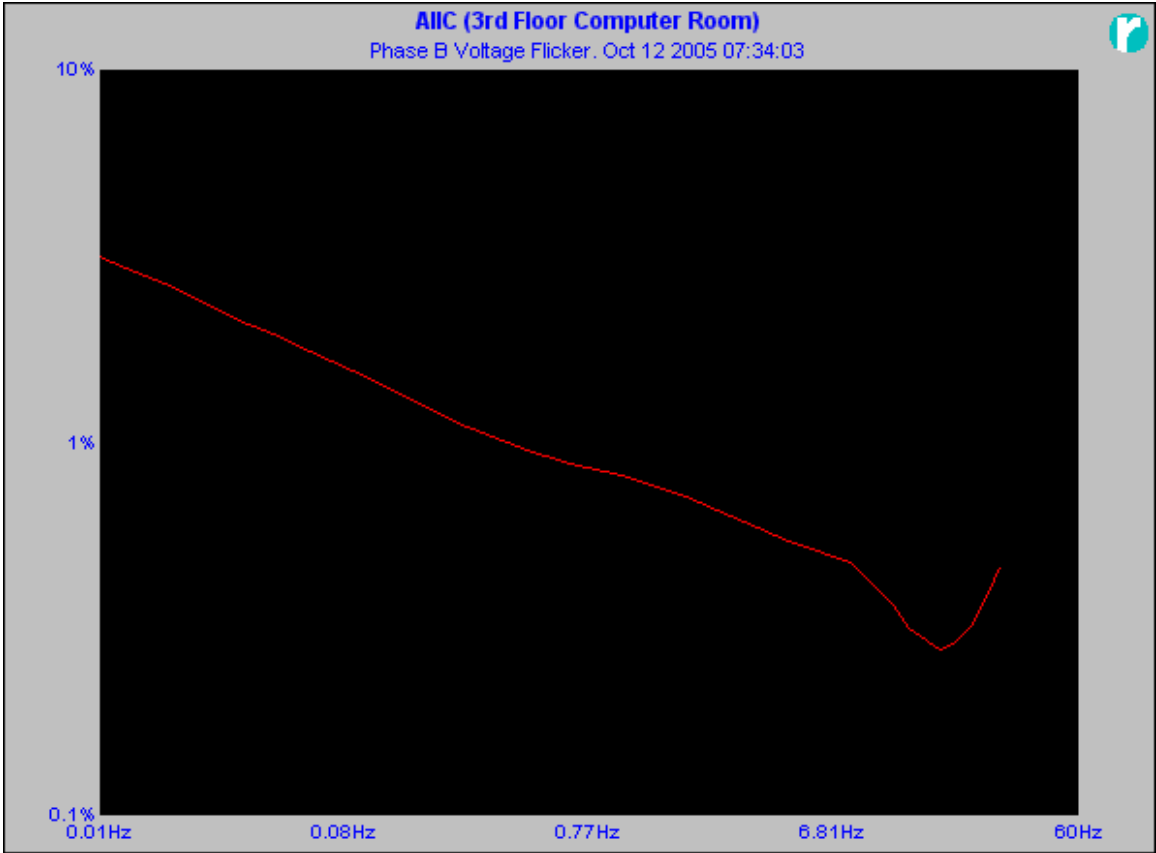


Voltage Flicker for AHC:3rd Floor Computer Room.

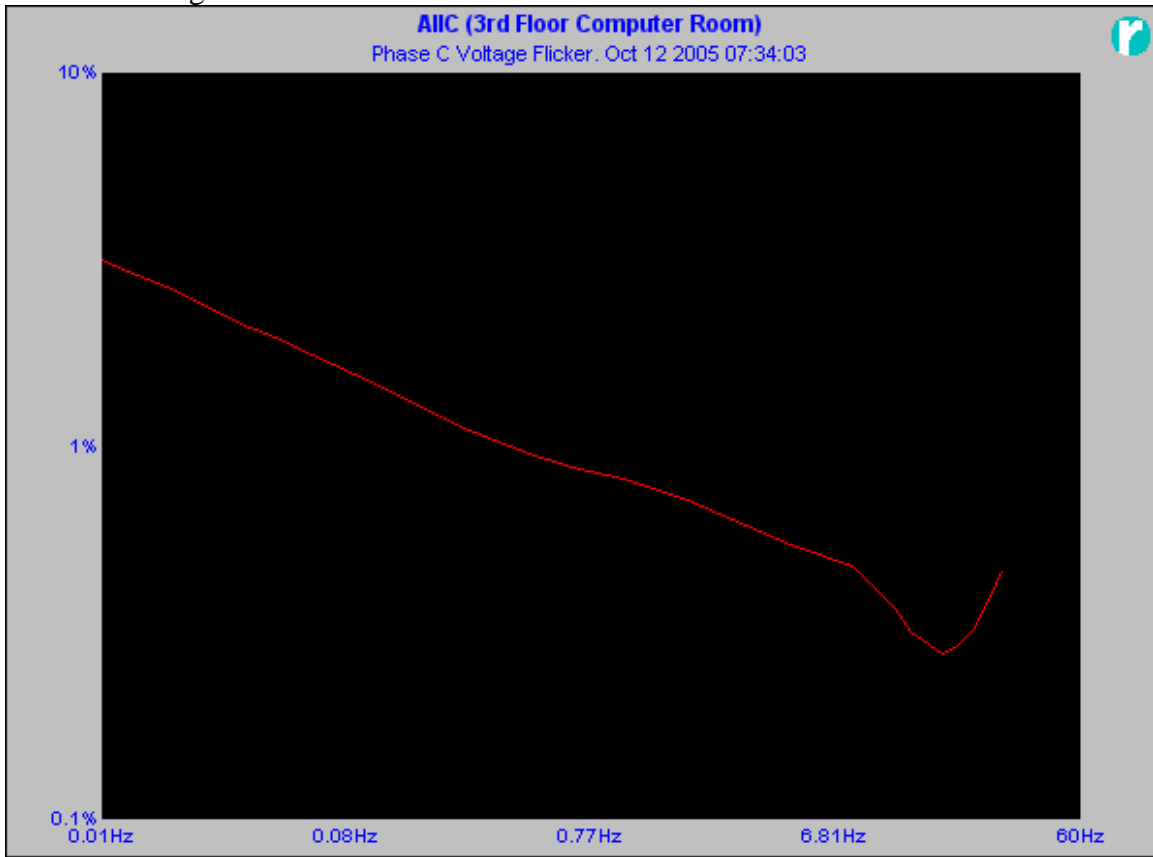
Phase A Voltage Flicker.



Phase B Voltage Flicker.



Phase C Voltage Flicker.



The first 16 harmonics for Phase A voltage are shown below:

Harmonic	Amplitude	Phase	Percent
0	335.7mV	180°	0.196%
1	171.1V 2.099°	100%	
2	119.1mV	227.8°	0.069%
3	739.5mV	246.6°	0.432%
4	92.82mV	79.34°	0.054%
5	1.886V 287.9°	1.102%	
6	34.12mV	332.6°	0.019%
7	1.264V 249.5°	0.739%	
8	0V 359.4°	0%	
9	507.3mV	248.3°	0.296%
10	68.26mV	116.0°	0.039%
11	841.0mV	2.688°	0.491%
12	21.58mV	224.6°	0.012%
13	1.777V 154.1°	1.039%	
14	55.01mV	213.3°	0.032%
15	137.0mV	206.2°	0.080%
16	48.25mV	198.1°	0.028%
Odd Harmonics		1.931%	
Even Harmonics		0.147%	
Total Harmonics		1.936%	

The first 16 harmonics for Phase B voltage are shown below:

Harmonic	Amplitude	Phase	Percent
0	305.1mV	180°	0.179%
1	170.4V 242.4°	100%	
2	68.24mV	61.04°	0.04%
3	1.145V 226.6°	0.672%	
4	61.03mV	268.8°	0.035%
5	1.928V 58.62°	1.131%	
6	0V 359.2°	0%	
7	1.480V 137.2°	0.868%	
8	30.51mV	179.4°	0.017%
9	444.9mV	247.3°	0.261%
10	55.01mV	303.2°	0.032%
11	643.6mV	111.8°	0.377%
12	68.31mV	243.0°	0.040%
13	1.279V 24.36°	0.750%	
14	63.08mV	13.69°	0.037%
15	108.3mV	134.6°	0.063%
16	34.12mV	26.26°	0.02%
Odd Harmonics		1.926%	
Even Harmonics		0.131%	
Total Harmonics		1.930%	

The first 16 harmonics for Phase C voltage are shown below:

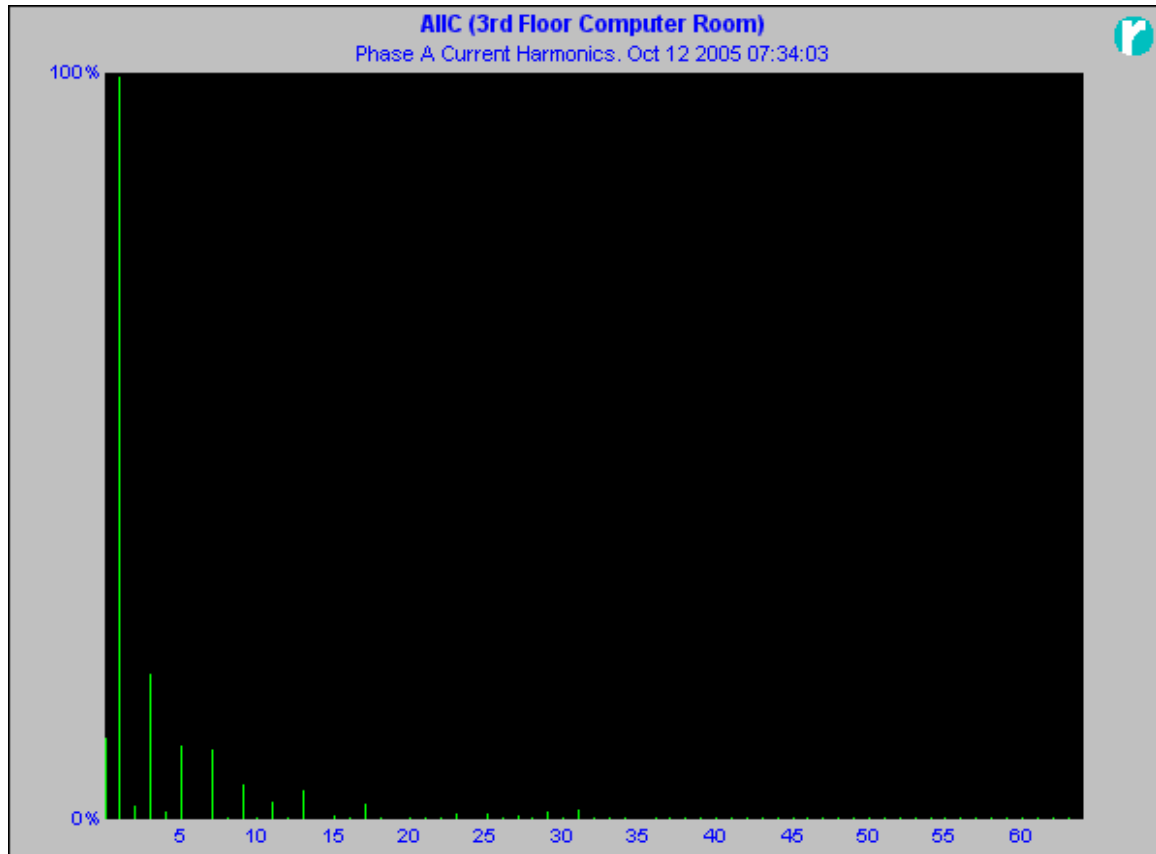
Harmonic	Amplitude	Phase	Percent
0	76.29mV	180°	0.044%
1	170.6V	121.9°	100%
2	92.82mV	7.076°	0.054%
3	1.084V	282.2°	0.635%
4	30.51mV	178.8°	0.017%
5	1.879V	144.9°	1.101%
6	62.91mV	165.1°	0.036%
7	1.957V	351.2°	1.146%
8	21.58mV	134.4°	0.012%
9	637.3mV	196.1°	0.373%
10	21.58mV	44.52°	0.012%
11	887.7mV	243.0°	0.520%
12	62.98mV	345.5°	0.036%
13	1.526V	262.1°	0.894%
14	0V	359.6°	0%
15	459.9mV	29.66°	0.269%
16	55.01mV	123.3°	0.032%
Odd Harmonics			2.177%
Even Harmonics			0.136%
Total Harmonics			2.181%

The first 16 harmonics for the neutral voltage are shown below:

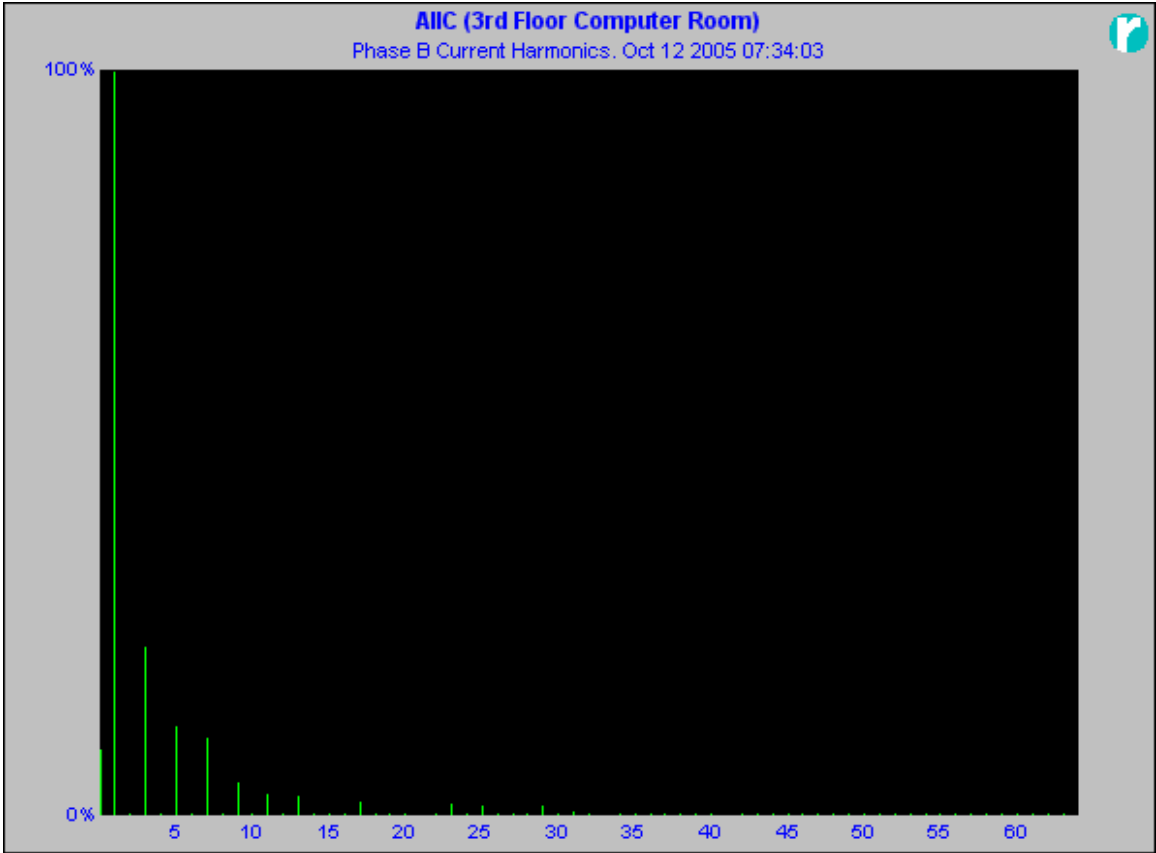
Harmonic	Amplitude	Phase	Percent
0	1.697V	0°	2.212k%
1	76.72mV	140.3°	100%
2	7.864mV	73.57°	10.25%
3	73.03mV	47.64°	95.18%
4	17.27mV	262.4°	22.51%
5	40.95mV	241.2°	53.37%
6	9.726mV	77.89°	12.67%
7	9.537mV	36.18°	12.43%
8	6.877mV	145.7°	8.963%
9	30.75mV	59.72°	40.08%
10	13.35mV	359.5°	17.40%
11	23.28mV	124.5°	30.34%
12	17.58mV	49.00°	22.92%
13	22.24mV	328.6°	28.99%
14	6.031mV	71.22°	7.861%
15	20.98mV	269.6°	27.34%
16	6.877mV	56.01°	8.963%
Odd Harmonics			158.0%
Even Harmonics			114.4%
Total Harmonics			195.0%

Current harmonics for AHC:3rd Floor Computer Room.

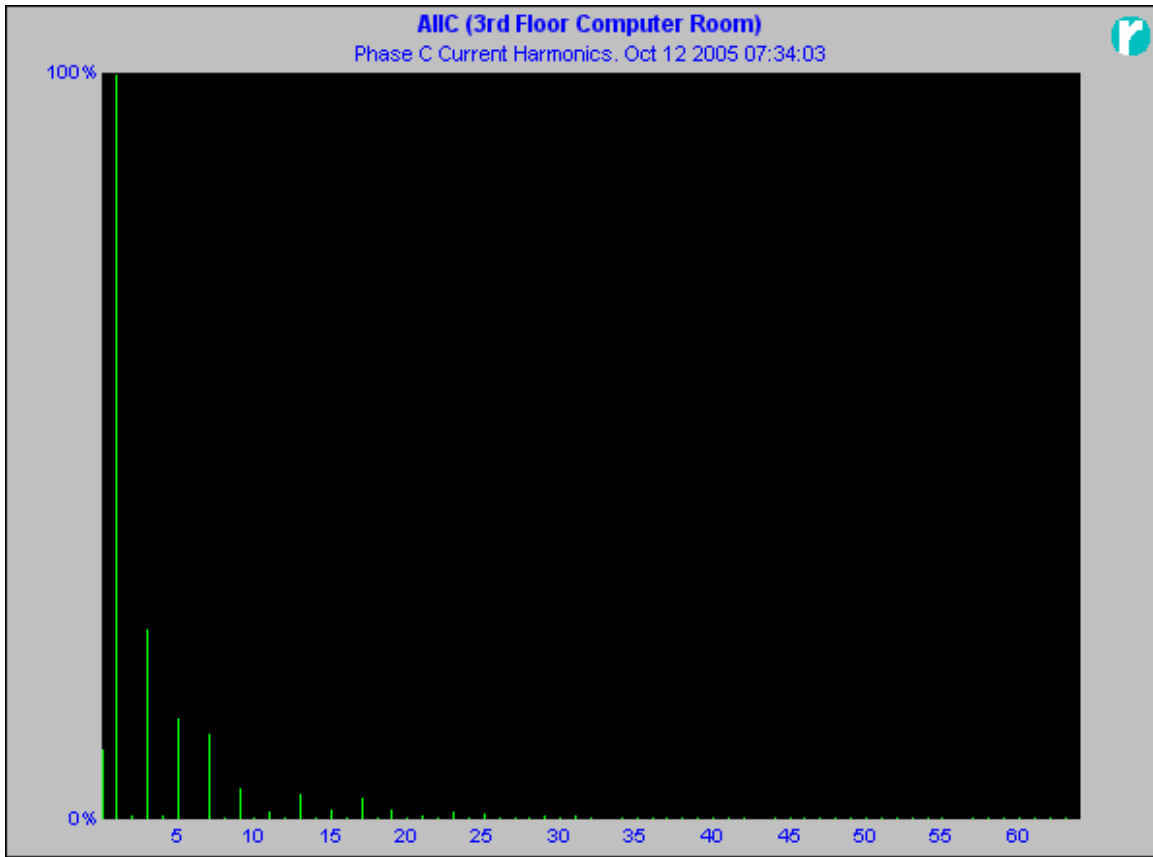
Phase A Current Harmonics.



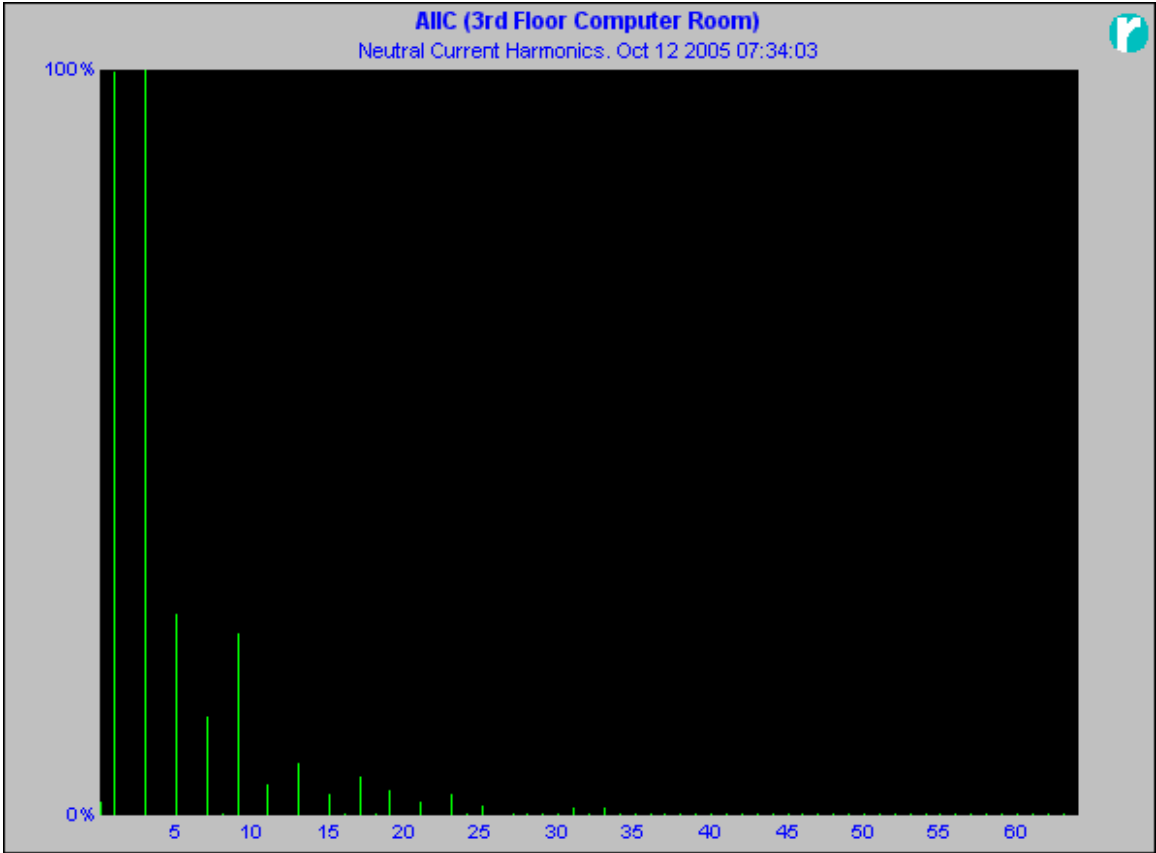
Phase B Current Harmonics.



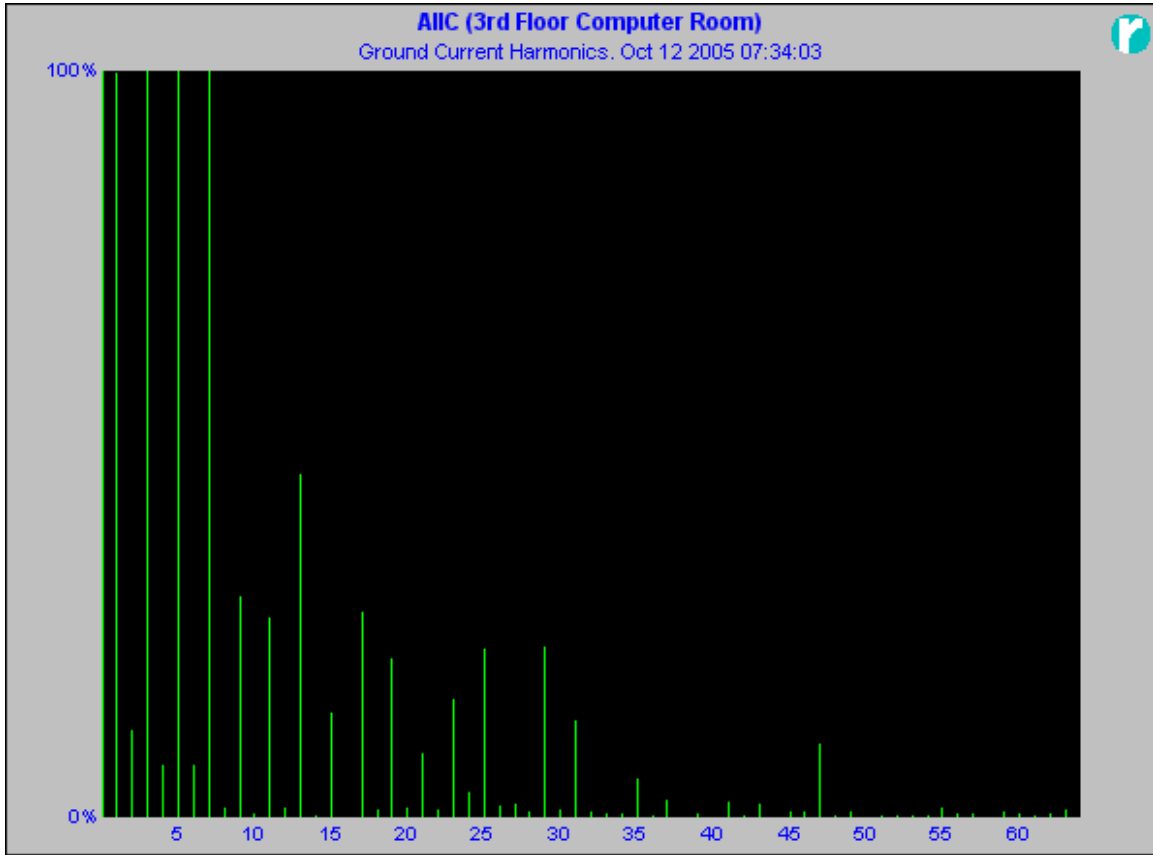
Phase C Current Harmonics



Neutral Current Harmonics.



Ground Current Harmonics



The first 16 harmonics for Phase A current are shown below:

Harmonic	Amplitude	Phase	Percent
0	4.658A 180°	11.18%	
1	41.66A 187.2°	100%	
2	878.3mA	121.4°	2.108%
3	8.306A 163.8°	19.93%	
4	559.5mA	69.34°	1.343%
5	4.246A 138.5°	10.19%	
6	197.5mA	358.3°	0.474%
7	4.028A 151.9°	9.668%	
8	82.57mA	345.9°	0.198%
9	2.152A 166.3°	5.166%	
10	97.98mA	6.709°	0.235%
11	1.084A 207.5°	2.603%	
12	53.75mA	295.2°	0.129%
13	1.812A 54.07°	4.349%	
14	115.5mA	104.3°	0.277%
15	373.5mA	90.88°	0.896%
16	65.86mA	92.48°	0.158%
Odd Harmonics		25.76%	
Even Harmonics		2.632%	
Total Harmonics		25.89%	

The first 16 harmonics for Phase B current are shown below:

Harmonic	Amplitude	Phase	Percent
0	3.842A 180°	9.170%	
1	41.90A 73.55°	100%	
2	291.5mA	317.3°	0.695%
3	9.650A 189.4°	23.03%	
4	76.34mA	77.00°	0.182%
5	5.200A 285.5°	12.41%	
6	78.09mA	188.4°	0.186%
7	4.510A 50.25°	10.76%	
8	24.61mA	54.46°	0.058%
9	1.998A 160.4°	4.769%	
10	20.02mA	90°	0.047%
11	1.408A 308.3°	3.361%	
12	44.78mA	63.43°	0.106%
13	1.271A 278.1°	3.033%	
14	69.14mA	204.4°	0.165%
15	296.8mA	42.64°	0.708%
16	68.90mA	265.2°	0.164%
Odd Harmonics		29.34%	
Even Harmonics		0.898%	
Total Harmonics		29.36%	

The first 16 harmonics for Phase C current are shown below:

Harmonic	Amplitude	Phase	Percent
0	7.055A 180°	9.652%	
1	73.09A 317.7°	100%	
2	695.8mA	301.2°	0.951%
3	18.97A 190.1°	25.95%	
4	606.2mA	250.7°	0.829%
5	10.19A 25.61°	13.94%	
6	212.4mA	184.6°	0.290%
7	8.701A 259.5°	11.90%	
8	115.0mA	174.2°	0.157%
9	3.346A 120.6°	4.577%	
10	114.4mA	233.1°	0.156%
11	1.008A 137.0°	1.380%	
12	139.5mA	250.8°	0.190%
13	2.696A 139.5°	3.688%	
14	52.75mA	12.52°	0.072%
15	1.221A 294.1°	1.671%	
16	63.20mA	5.194°	0.086%
Odd Harmonics		32.68%	
Even Harmonics		1.368%	
Total Harmonics		32.71%	

The first 16 harmonics for the Neutral current are shown below:

Harmonic	Amplitude	Phase	Percent
0	643.7mA	0°	2.247%
1	28.64A 150.3°	100%	
2	129.2mA	152.3°	0.451%
3	36.98A 4.156°	129.1%	
4	123.1mA	300.7°	0.429%
5	7.832A 196.7°	27.34%	
6	108.9mA	29.93°	0.380%
7	3.892A 53.87°	13.58%	
8	48.89mA	159.4°	0.170%
9	7.083A 324.5°	24.72%	
10	79.70mA	111.0°	0.278%
11	1.283A 48.16°	4.480%	
12	88.14mA	54.24°	0.307%
13	2.143A 292.6°	7.480%	
14	106.7mA	276.1°	0.372%
15	946.8mA	140.4°	3.305%
16	45.23mA	161.5°	0.157%
Odd Harmonics		135.5%	
Even Harmonics		1.280%	
Total Harmonics		135.5%	

The first 16 harmonics for the Ground current are shown below:

Harmonic	Amplitude	Phase	Percent
0	163.4mA	180°	139.8%
1	116.8mA	26.59°	100%
2	14.16mA	173.5°	12.12%
3	118.0mA	235.1°	101.0%
4	8.651mA	117.5°	7.403%
5	131.8mA	135.5°	112.8%
6	8.507mA	213.4°	7.280%
7	131.8mA	283.1°	112.8%
8	1.918mA	342.6°	1.641%
9	35.00mA	166.1°	29.96%
10	1.144mA	323.1°	0.979%
11	31.61mA	197.7°	27.05%
12	1.998mA	283.2°	1.710%
13	54.12mA	146.5°	46.31%
14	871.6uA	113.1°	0.745%
15	16.76mA	335.7°	14.35%
16	471.8uA	104.0°	0.403%
Odd Harmonics			206.5%
Even Harmonics			17.25%
Total Harmonics			207.2%

Voltage Events

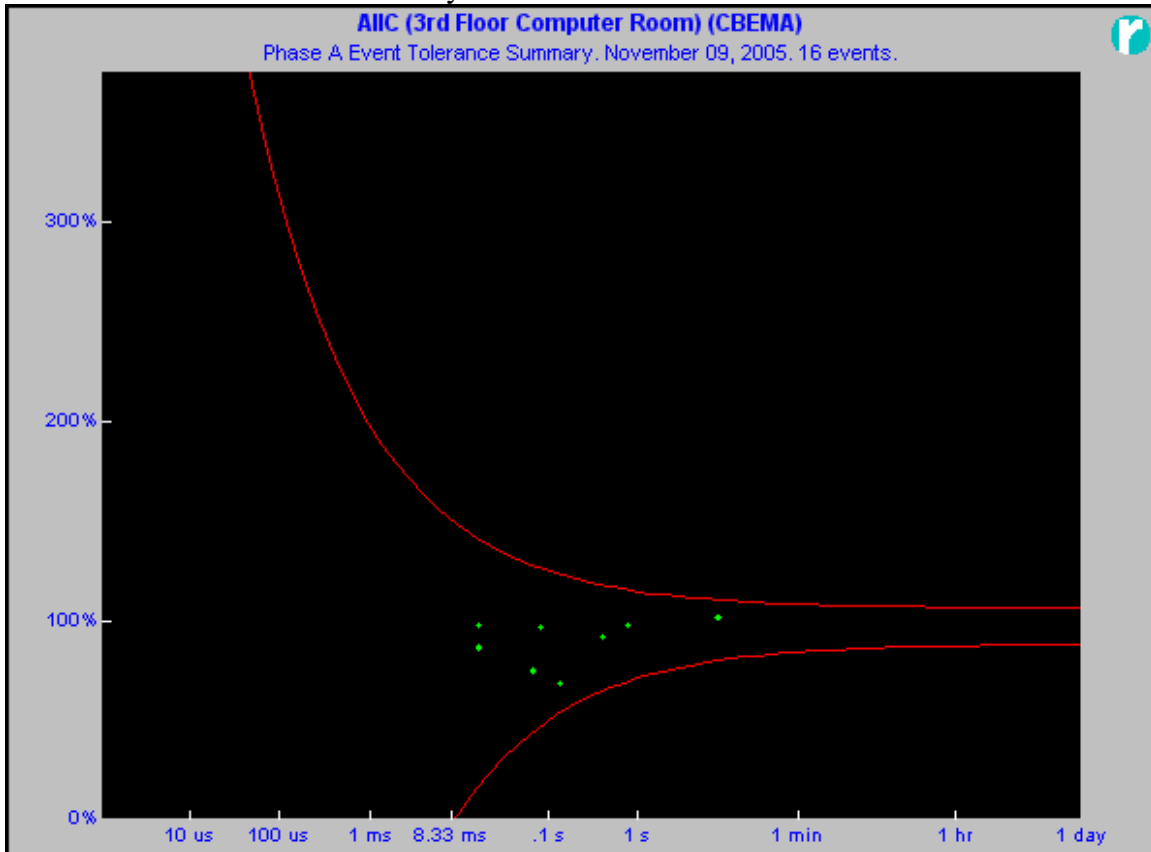
The following summarizes the results of the Power Quality monitoring survey from 10/12/05 07:44:24 through 11/09/05 06:44:24. It is intended to present an overview of the power quality at AICC:3rd Floor Computer Room. The table below is a listing of the most significant events.

Event Description	No.	Amp.	Duration	Date and Time
Phase A Largest RMS. Event	260	114.8V	9.936 day	Oct 04 2005 11:36:56
Phase A Largest Waveshape Event	140	82.76V	133.333 ms	Oct 26 2005 11:36:55
Phase A Longest Waveshape Event	20	117.6V	750 ms	Oct 22 2005 02:29:30
Phase A Largest Impulse Event	N/A			
Phase A Longest Impulse Event	N/A			
Phase B Largest RMS. Event	101	115.7V	5.39 day	Oct 05 2005 17:08:29
Phase B Largest Waveshape Event	201	65.18V	366.667 ms	Oct 26 2005 11:36:55
Phase B Longest Waveshape Event	121	121.1V	733.333 ms	Oct 22 2005 02:29:30
Phase B Largest Impulse Event	N/A			
Phase B Longest Impulse Event	N/A			
Phase C Largest RMS. Event	62	114.6V	17.272 day	Sep 30 2005 02:29:31
Phase C Largest Waveshape Event	42	110.6V	550 ms	Oct 22 2005 02:29:31
Phase C Longest Waveshape Event	22	118.5V	783.333 ms	Oct 22 2005 02:29:30
Phase C Largest Impulse Event	N/A			
Phase C Longest Impulse Event	N/A			
Neutral Largest RMS. Event	3	1.953V	27.054 day	Sep 20 2005 07:44:25
Neutral Largest Waveshape Event	N/A			
Neutral Longest Waveshape Event	N/A			
Neutral Largest Impulse Event	13	2.958kV	512 us	Oct 12 2005 07:44:55
Neutral Longest Impulse Event	13	2.958kV	512 us	Oct 12 2005 07:44:55

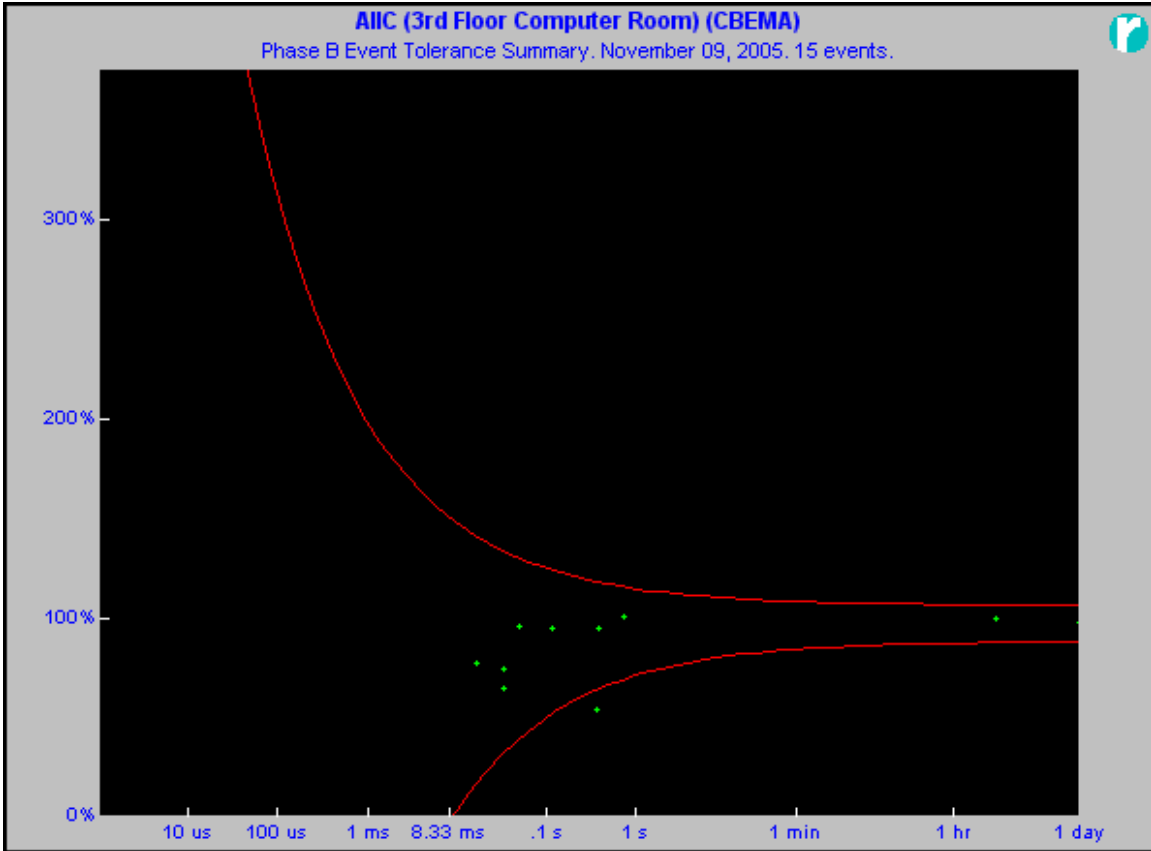
Power Tolerance Envelope:

The power quality parameters are summarized in the Power Tolerance Envelope shown below. Each dot on these graphs represents an event. The area outside of these lines depict events which are often associated with equipment malfunction..

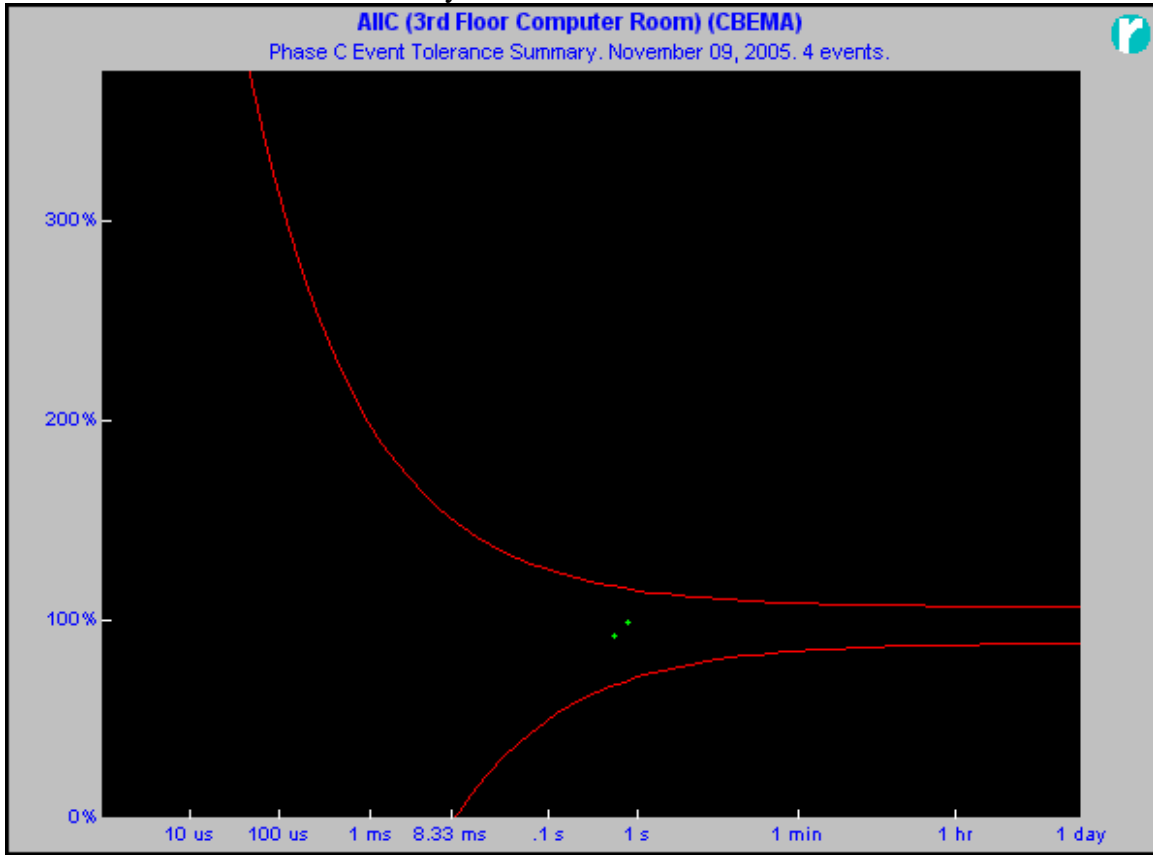
Phase A Event Tolerance Summary.



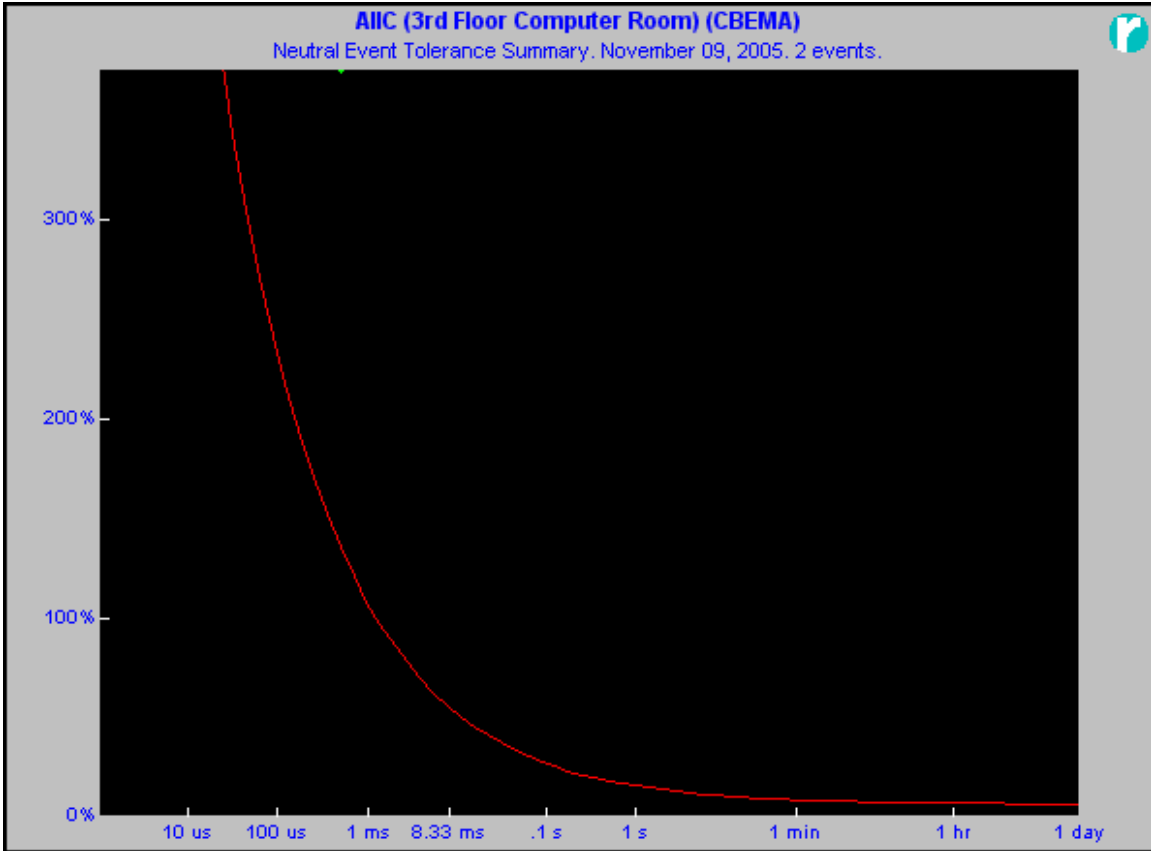
Phase B Event Tolerance Summary.



Phase C Event Tolerance Summary.



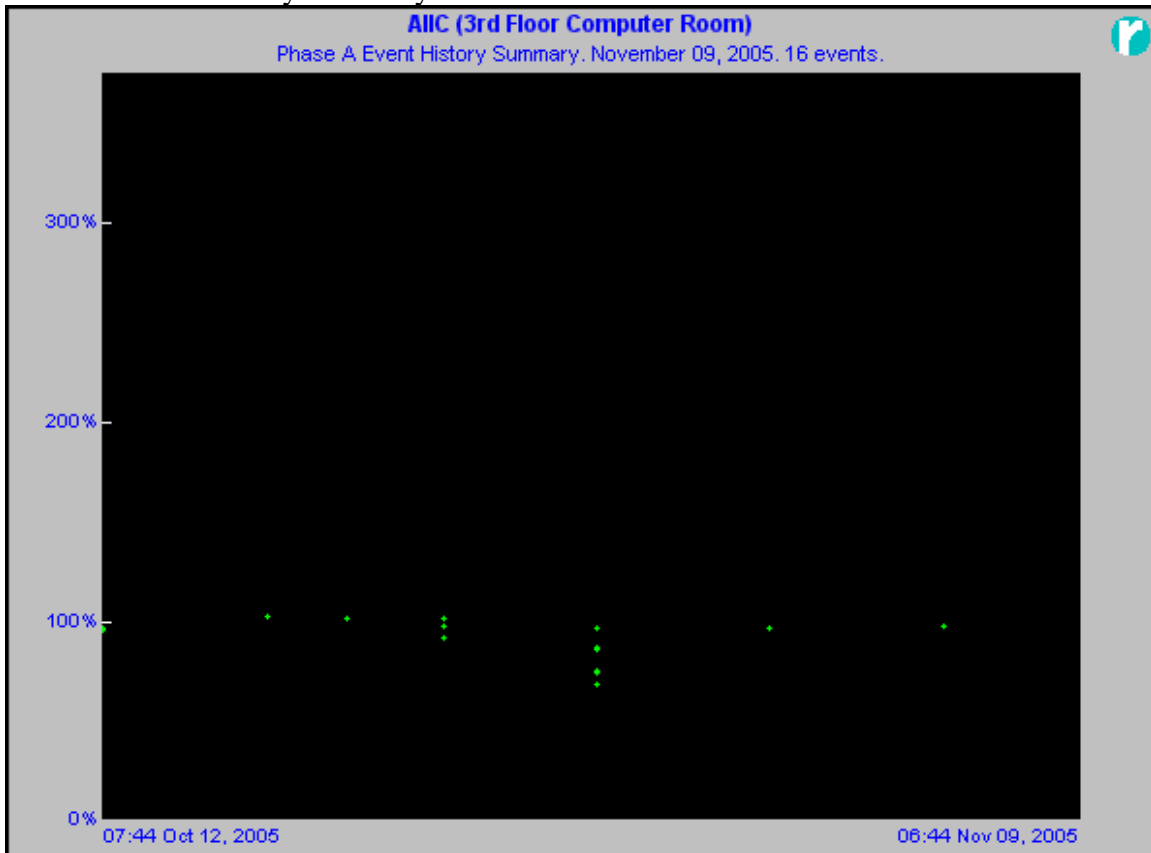
Neutral Event Tolerance Summary.



Event History Graphs:

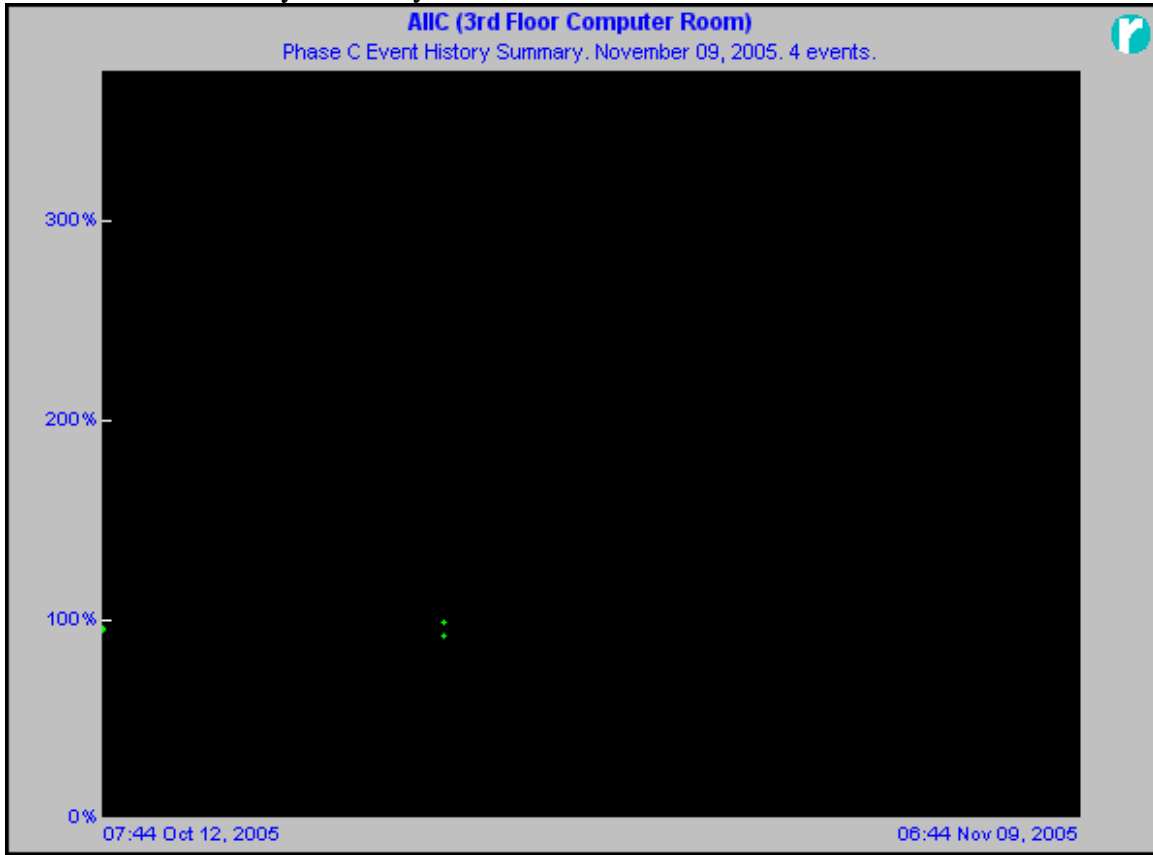
A summary of events that occurred during the monitoring interval is shown in the event history graphs below. These events are graphed by amplitude versus time of occurrence.

Phase A Event History Summary.



Phase B Event History Summary.

Phase C Event History Summary.



Neutral Event History Summary.



Event Domain Analyzer

This section contains the Event Tolerance Summaries, the Event Characterization, and the Solutions Table.

Event Tolerance Summaries:

The tables below show the Event Tolerance Summary, listing the events in the categories of Type I (Impulses), Type II (Waveshape Events), and Type III (RMS Events), for each phase. An asterisk by the event number indicates a Fault.

Phase A Event Tolerance Summary.

AIIC (3rd Floor Computer Room) (CBEMA)			
Phase A Event Tolerance Summary, November 09, 2005, 16 events.			
	Type I	Type II	Type III
Start Duration	1 us	8.333 ms	2 sec
End Duration	8.333 ms	2 sec	1 day
Total Events	0	9	2
Total Faults	0	0	0
	Event No.	Amplitude	Duration
Longest Type I Event	N/A		
Largest Type I Event	N/A		
Longest Type II Event	20	117.6V	750 ms
Largest Type II Event	140	82.76V	133.333 ms
Longest Type III Event	80	122.1V	7.783 sec
Largest Type III Event	60	122.1V	7.383 sec

Phase B Event Tolerance Summary.

AIC (3rd Floor Computer Room) (CBEMA)			
Phase B Event Tolerance Summary: November 09, 2005. 15 events.			
	Type I	Type II	Type III
Start Duration	1 us	8.333 ms	2 sec
End Duration	8.333 ms	2 sec	1 day
Total Events	0	8	1
Total Faults	0	1	0
	Event No.	Amplitude	Duration
Longest Type I Event	N/A		
Largest Type I Event	N/A		
Longest Type II Event	121	121.1V	733.333 ms
Largest Type II Event	201*	65.18V	366.667 ms
Longest Type III Event	21	120.0V	2.953 hr
Largest Type III Event	21	120.0V	2.953 hr

Phase C Event Tolerance Summary.

AiIC (3rd Floor Computer Room) (CBEMA)

Phase C Event Tolerance Summary. November 09, 2005. 4 events.



	Type I	Type II	Type III
Start Duration	1 us	8.333 ms	2 sec
End Duration	8.333 ms	2 sec	1 day
Total Events	0	2	0
Total Faults	0	0	0

	Event No.	Amplitude	Duration
Longest Type I Event	N/A		
Largest Type I Event	N/A		
Longest Type II Event	22	118.5V	783.333 ms
Largest Type II Event	42	110.6V	550 ms
Longest Type III Event	N/A		
Largest Type III Event	N/A		

Neutral Event Tolerance Summary.

AIC (3rd Floor Computer Room) (CBEMA)			
Neutral Event Tolerance Summary: November 09, 2005. 2 events.			
	Type I	Type II	Type III
Start Duration	1 us	8.333 ms	2 sec
End Duration	8.333 ms	2 sec	1 day
Total Events	1	0	0
Total Faults	1	0	0
	Event No.	Amplitude	Duration
Longest Type I Event	13*	2.958kV	512 us
Largest Type I Event	13*	2.958kV	512 us
Longest Type II Event	N/A		
Largest Type II Event	N/A		
Longest Type III Event	N/A		
Largest Type III Event	N/A		

Event Characterization:

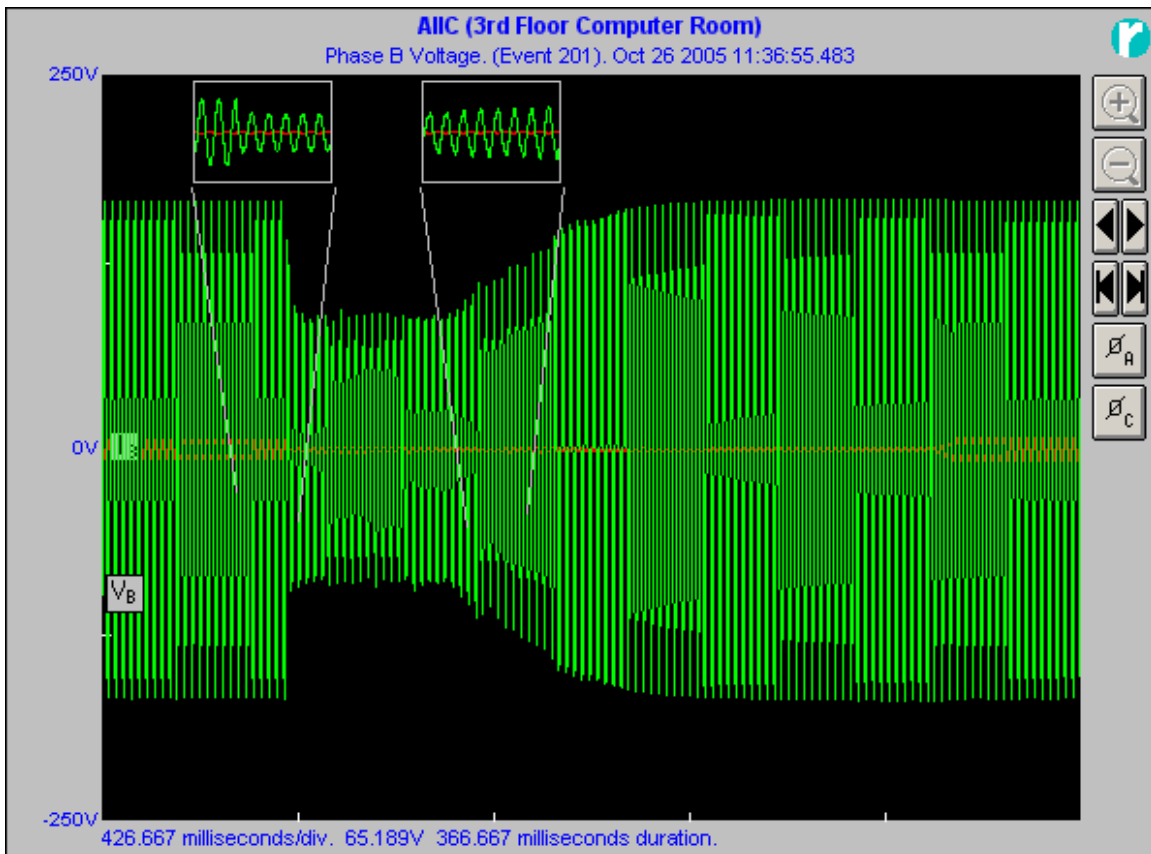
If Impulses, Waveshape Events, and/or RMS Events were chosen to be in this report, they are shown in this section. They are summarized over all of the phases together. The largest of the events in each category are also shown.

Impulses:

Impulses are shown on the left side of the Power Tolerance Envelope. They are relatively high frequency voltage excursions of short duration. When of significant magnitude and duration, these disturbances can cause malfunction of sensitive electronic equipment and damage both components and insulation. **No impulses occurred during the monitoring period.**

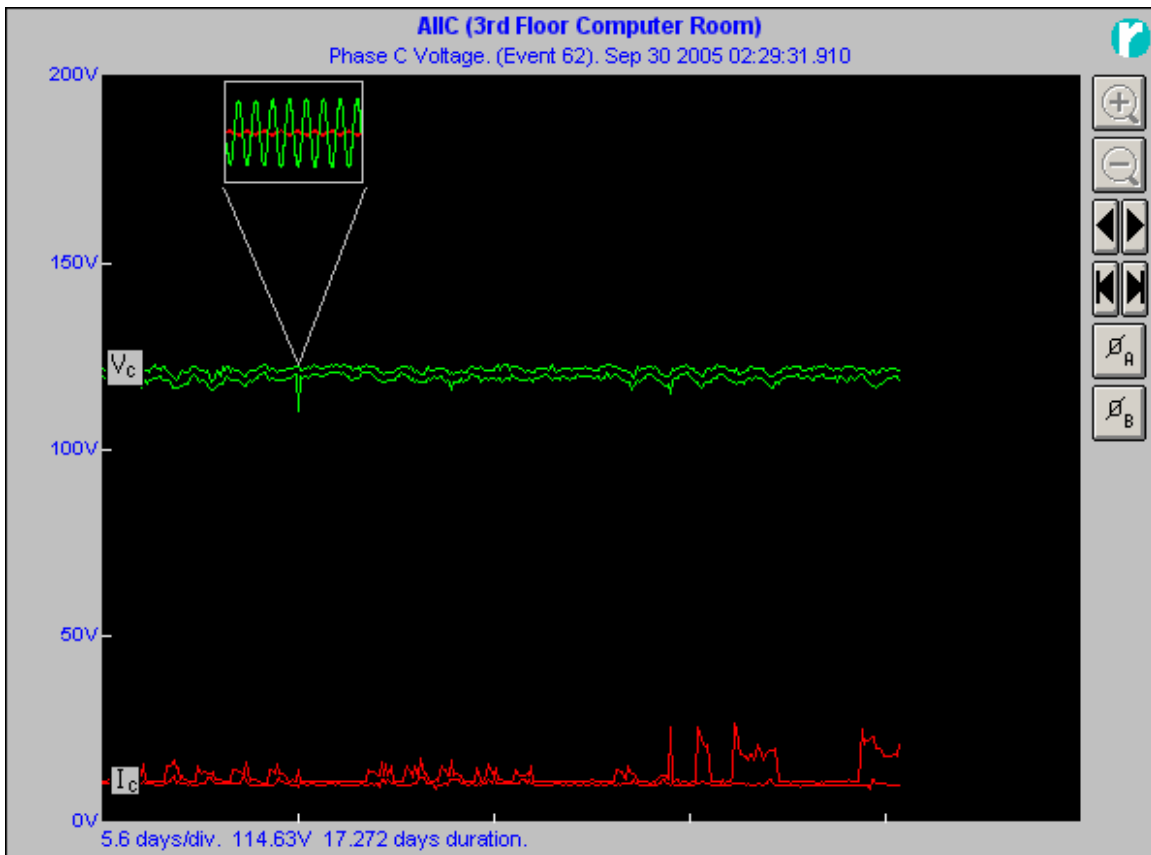
Waveshape Faults:

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. **19 Waveshape faults occurred during the monitoring period.** Event 201, 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. **16 RMS. events occurred during the monitoring period.** Event 62, 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, Electrostatic 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

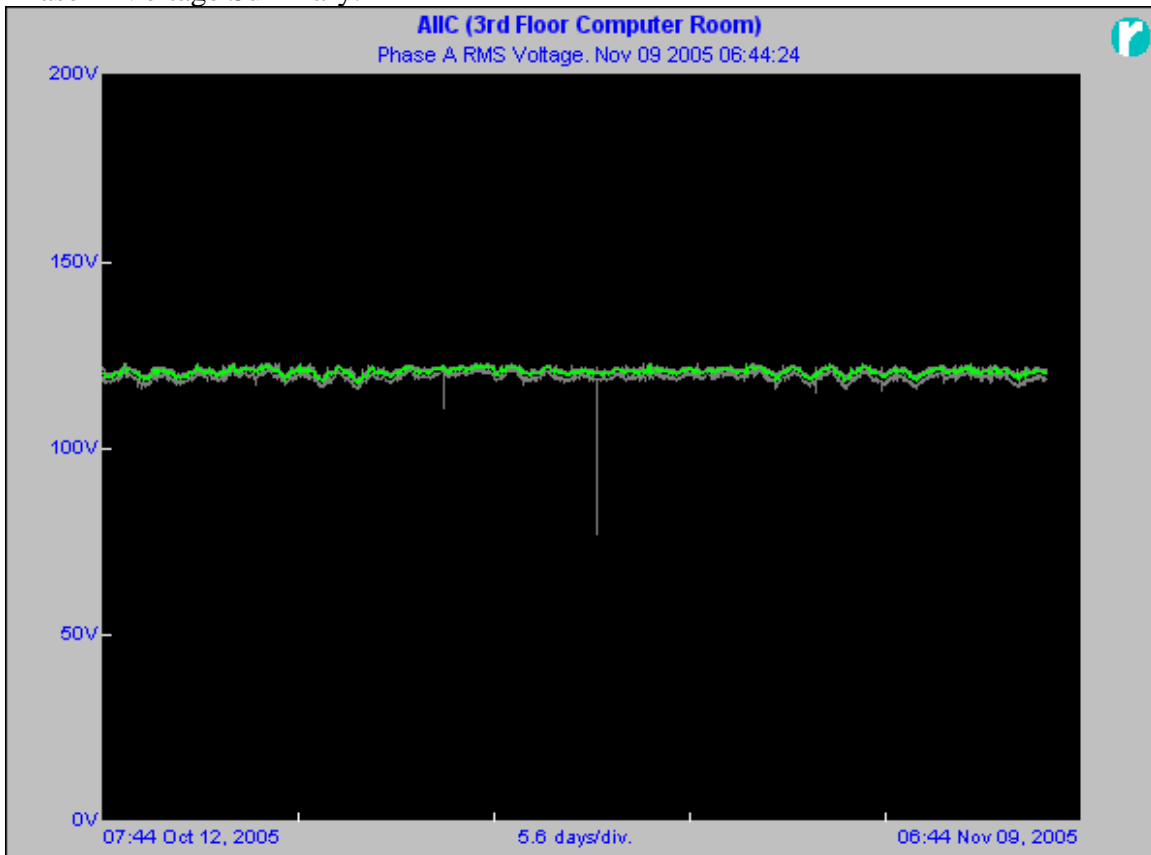
Voltage, Current and Frequency Summaries

Voltage, Current and Frequency measurements for AIC:3rd Floor Computer Room from 10/12/05 07:44:24 through 11/09/05 06:44:24.

RMS. Voltages	Value	Date and Time
Phase A minimum	77.39V	Oct 26 2005 11:29:24
Phase A average	120.6V	
Phase A maximum	123.0V	Oct 12 2005 23:29:24
Phase B minimum	65.18V	Oct 26 2005 11:29:24
Phase B average	120.1V	
Phase B maximum	122.6V	Oct 27 2005 18:59:24
Phase C minimum	110.2V	Oct 22 2005 02:29:24
Phase C average	120.3V	
Phase C maximum	122.8V	Oct 27 2005 18:59:24
Neutral minimum	610.3mV	Oct 12 2005 07:44:24
Neutral average	744.1mV	
Neutral maximum	1.953V	Oct 12 2005 07:59:24
RMS. Currents	Value	Date and Time
Phase A minimum	17.57A	Oct 26 2005 11:29:24
Phase A average	32.68A	
Phase A maximum	159.6A	Oct 12 2005 07:44:24
Phase B minimum	5.859A	Oct 26 2005 11:29:24
Phase B average	29.29A	
Phase B maximum	71.23A	Oct 13 2005 03:44:24
Phase C minimum	43.39A	Oct 25 2005 23:59:24
Phase C average	54.68A	
Phase C maximum	132.0A	Nov 03 2005 11:59:24
Neutral minimum	23.43A	Oct 22 2005 02:29:24
Neutral average	32.90A	
Neutral maximum	52.55A	Oct 26 2005 11:29:24
Ground minimum	153.8mA	Oct 26 2005 11:29:24
Ground average	202.6mA	
Ground maximum	25.19A	Oct 14 2005 09:44:24
Frequency	Value	Date and Time
Phase A minimum	59.91Hz	Oct 23 2005 07:59:24
Phase A average	60.00Hz	
Phase A maximum	60.06Hz	Oct 13 2005 23:44:24
Phase B minimum	59.91Hz	Oct 23 2005 07:59:24
Phase B average	60.00Hz	
Phase B maximum	60.06Hz	Oct 13 2005 23:44:24
Phase C minimum	59.91Hz	Oct 23 2005 07:59:24
Phase C average	60.00Hz	
Phase C maximum	60.06Hz	Oct 13 2005 23:44:24

RMS. Voltage Summaries for AHC:3rd Floor Computer Room.

Phase A Voltage Summary.

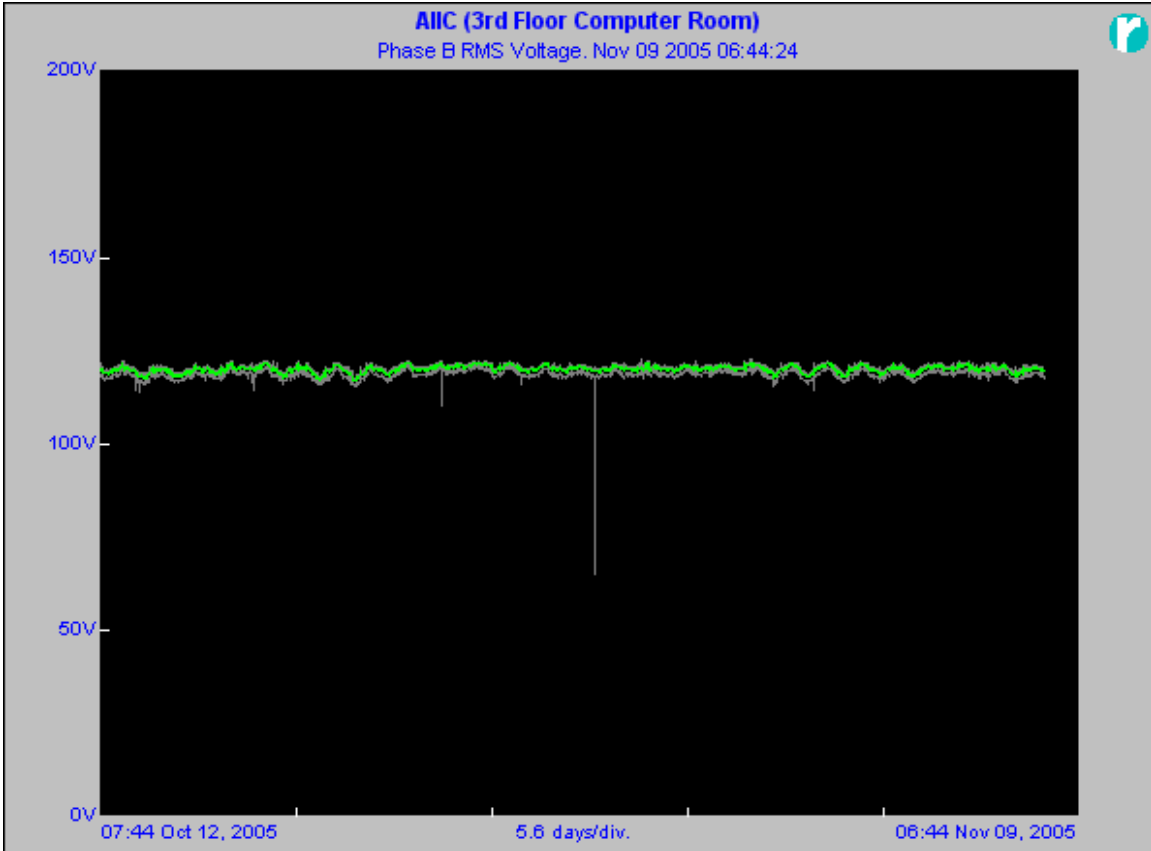


Min. 77.39V Oct 26 2005 11:29:24

Avg. 120.6V

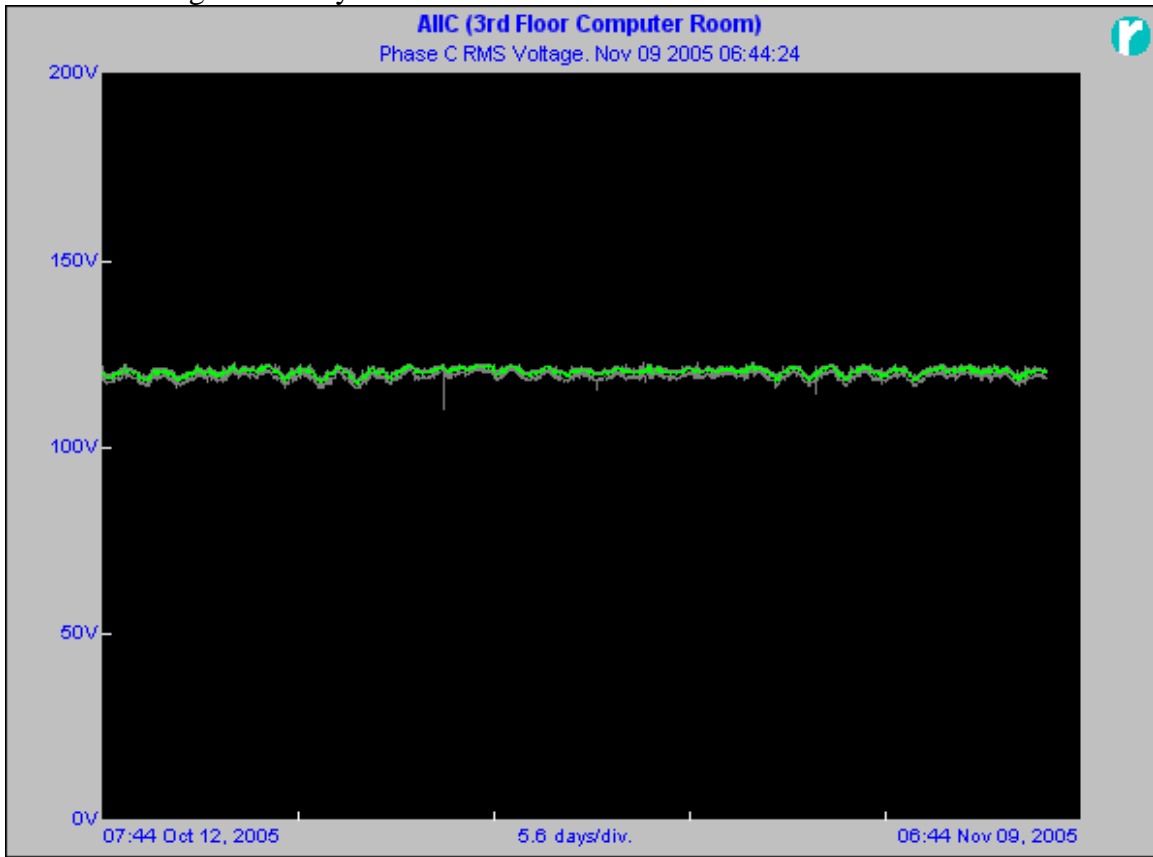
Max. 123.0V Oct 12 2005 23:29:24

Phase B Voltage Summary.



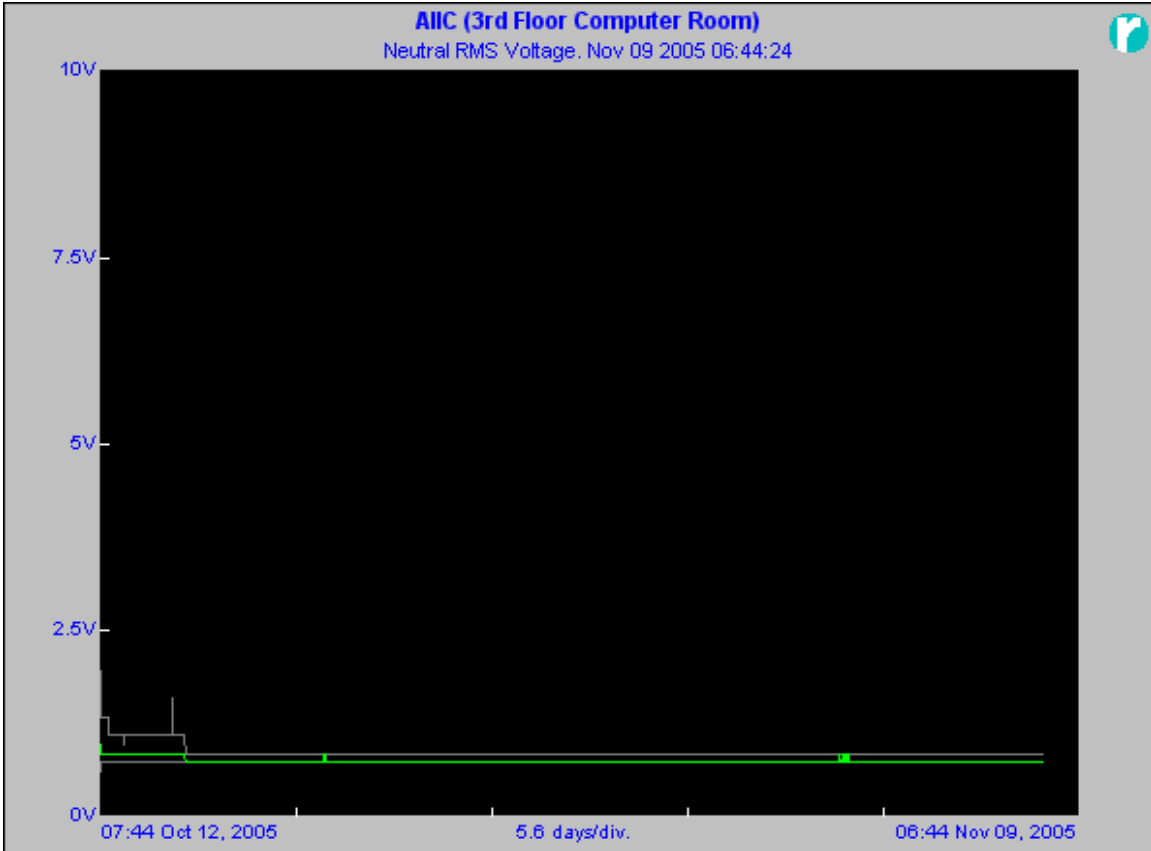
Min.	65.18V	Oct 26 2005 11:29:24
Avg.	120.1V	
Max.	122.6V	Oct 27 2005 18:59:24

Phase C Voltage Summary.



Min. 110.2V Oct 22 2005 02:29:24
Avg. **120.3V**
Max. 122.8V Oct 27 2005 18:59:24

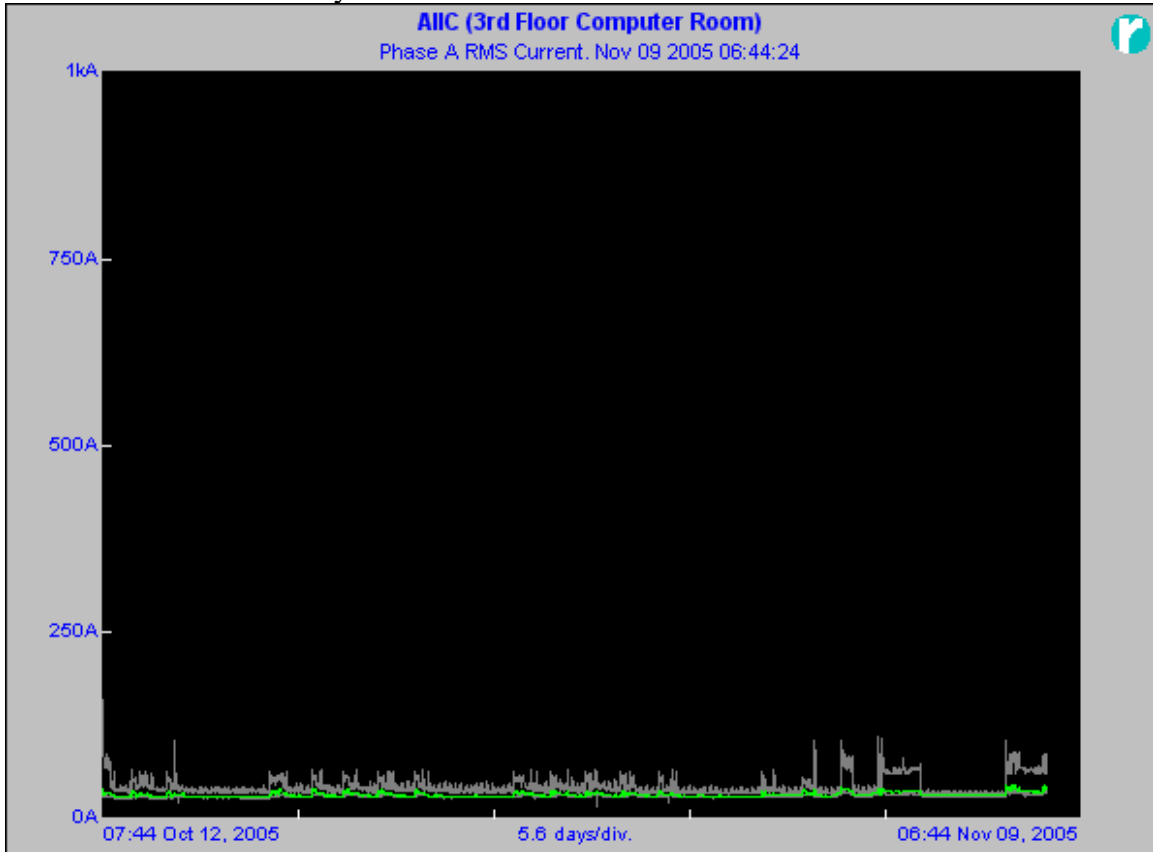
Neutral Voltage Summary.



Min. 610.3mV Oct 12 2005 07:44:24
Avg. **744.1mV**
Max. 1.953V Oct 12 2005 07:59:24

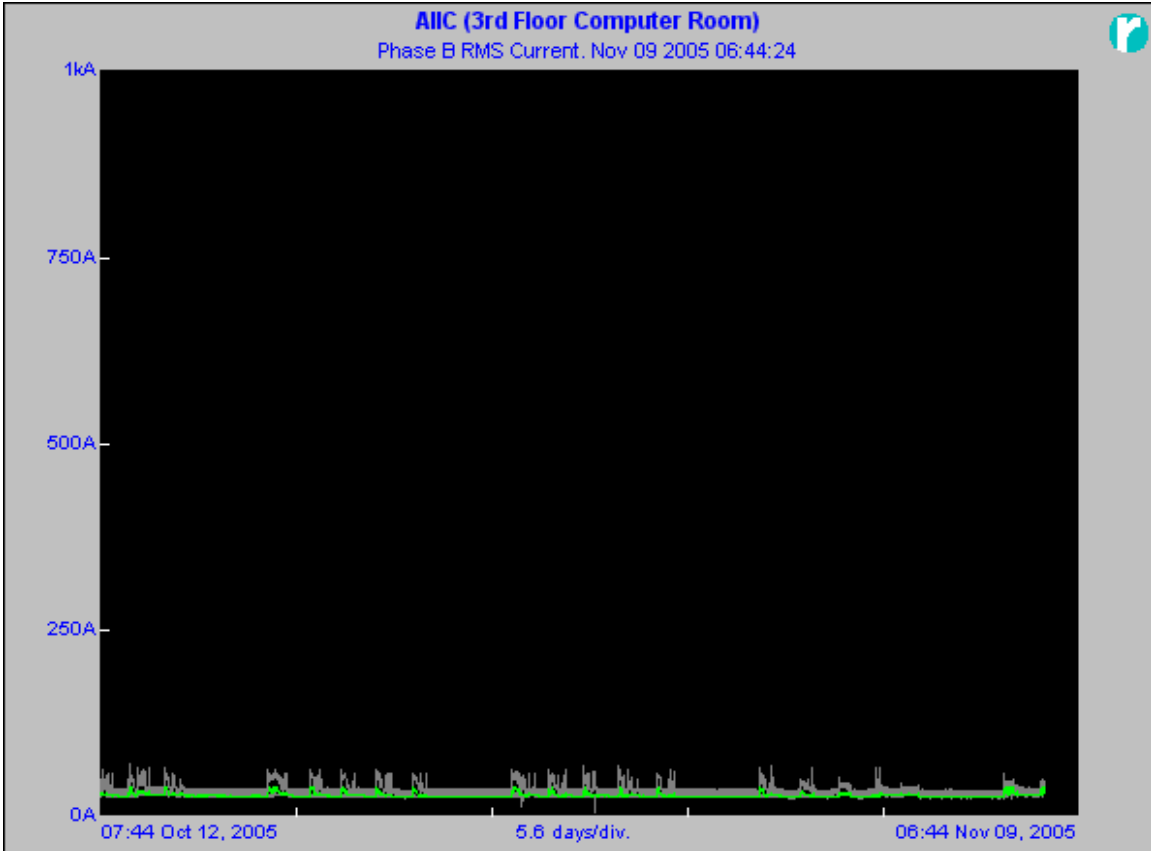
RMS. Current Summaries for AHC:3rd Floor Computer Room.

Phase A Current Summary.



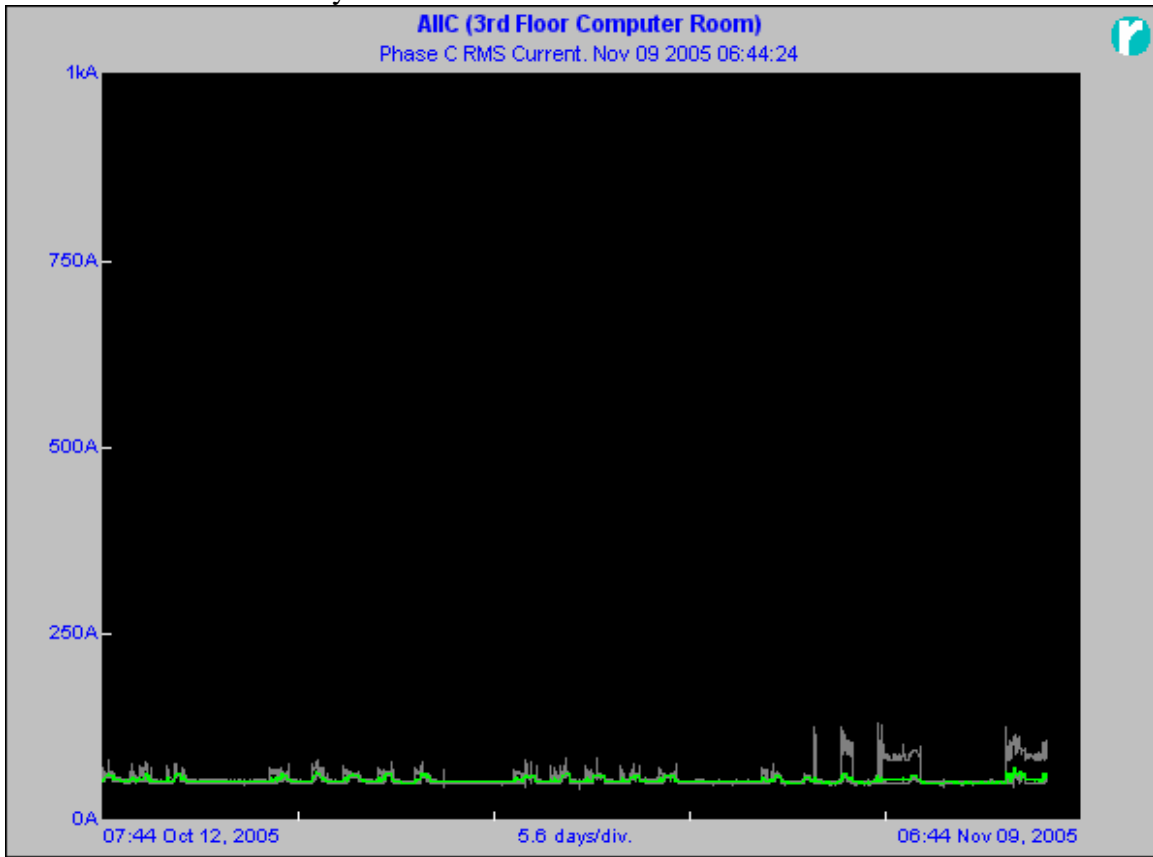
Min. 17.57A Oct 26 2005 11:29:24
Avg. **32.68A**
Max. 159.6A Oct 12 2005 07:44:24

Phase B Current Summary.



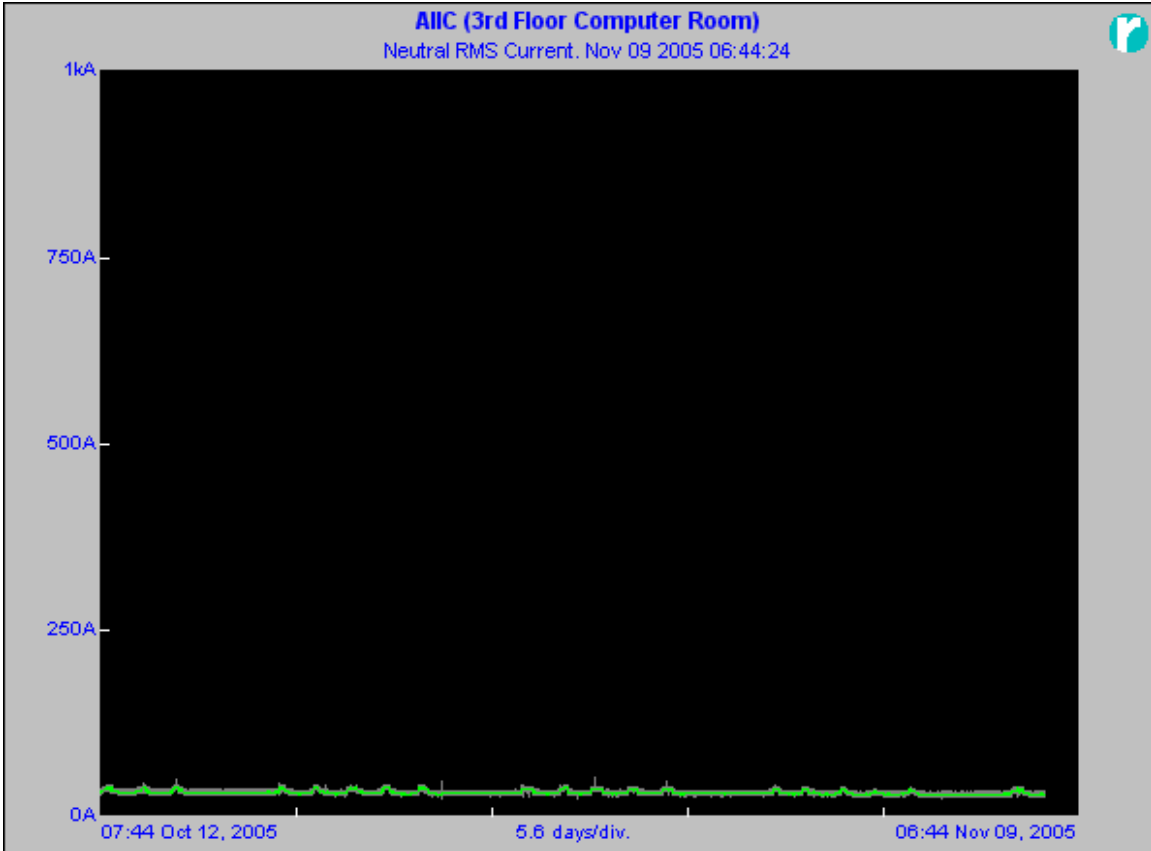
Min. 5.859A Oct 26 2005 11:29:24
Avg. 29.29A
 Max. 71.23A Oct 13 2005 03:44:24

Phase C Current Summary.



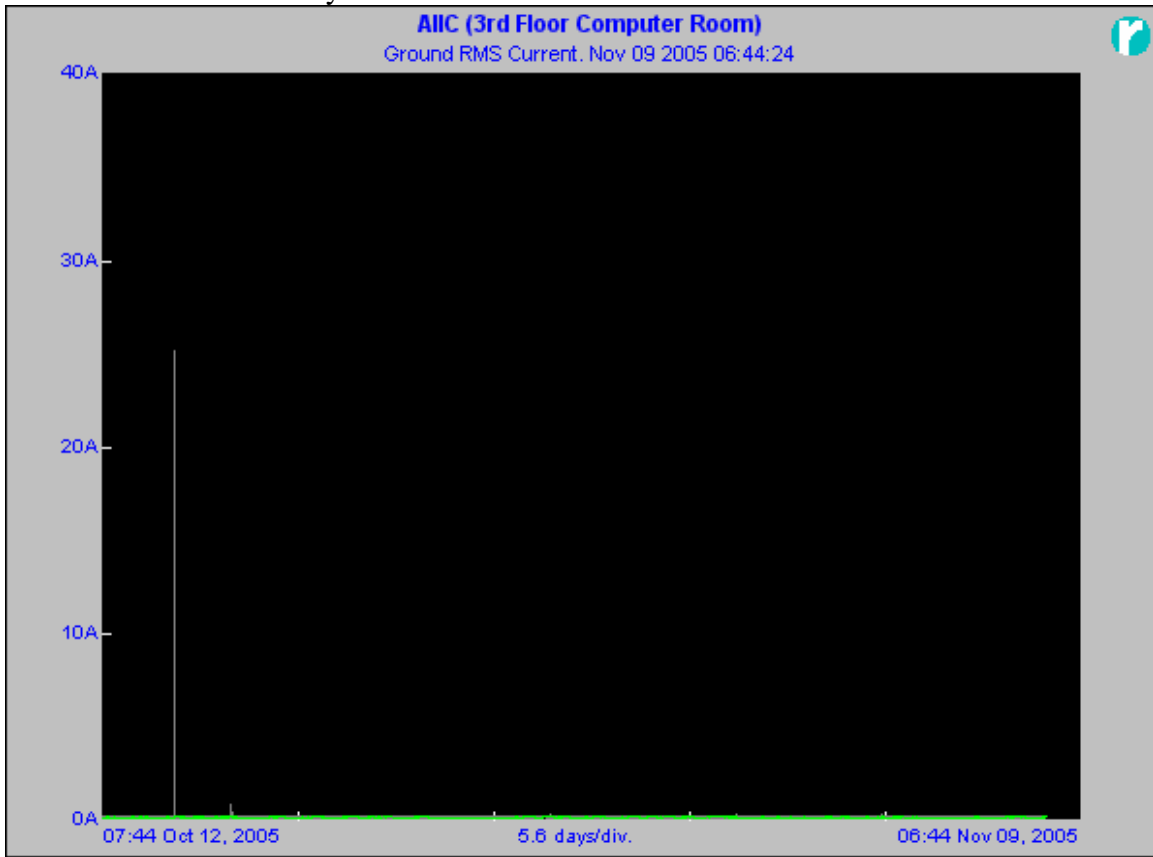
Min. 43.39A Oct 25 2005 23:59:24
Avg. **54.68A**
Max. 132.0A Nov 03 2005 11:59:24

Neutral Current Summary.



Min. 23.43A Oct 22 2005 02:29:24
Avg. 32.90A
 Max. 52.55A Oct 26 2005 11:29:24

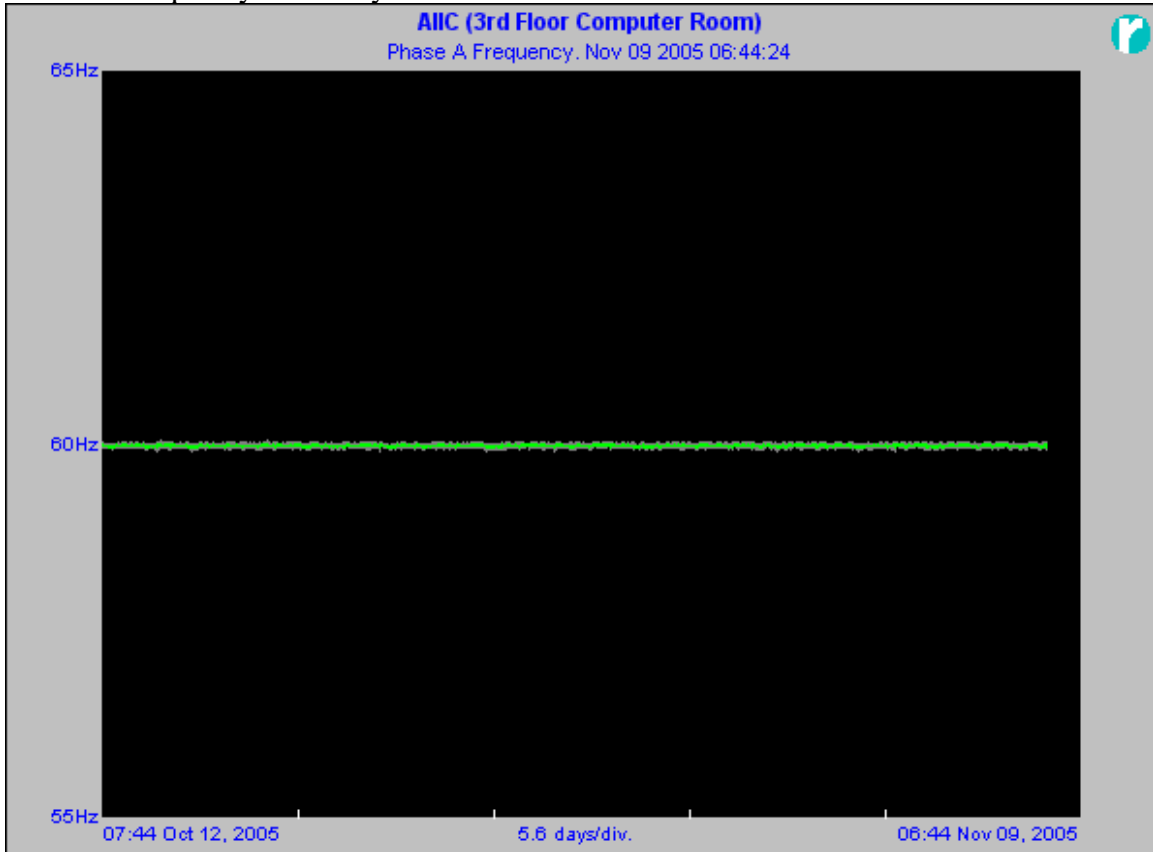
Ground Current Summary.



Min. 153.8mA Oct 26 2005 11:29:24
Avg. **202.6mA**
Max. 25.19A Oct 14 2005 09:44:24

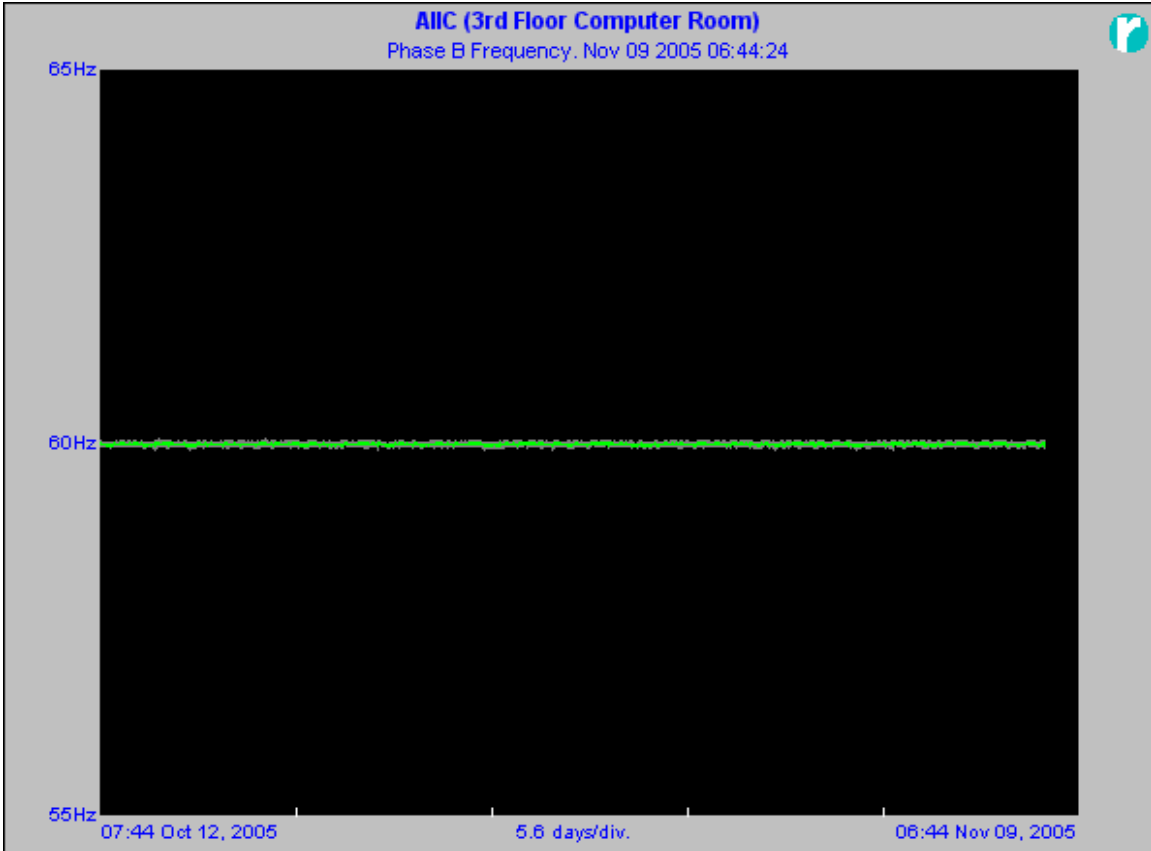
Frequency Summaries for AHC:3rd Floor Computer Room.

Phase A Frequency Summary.



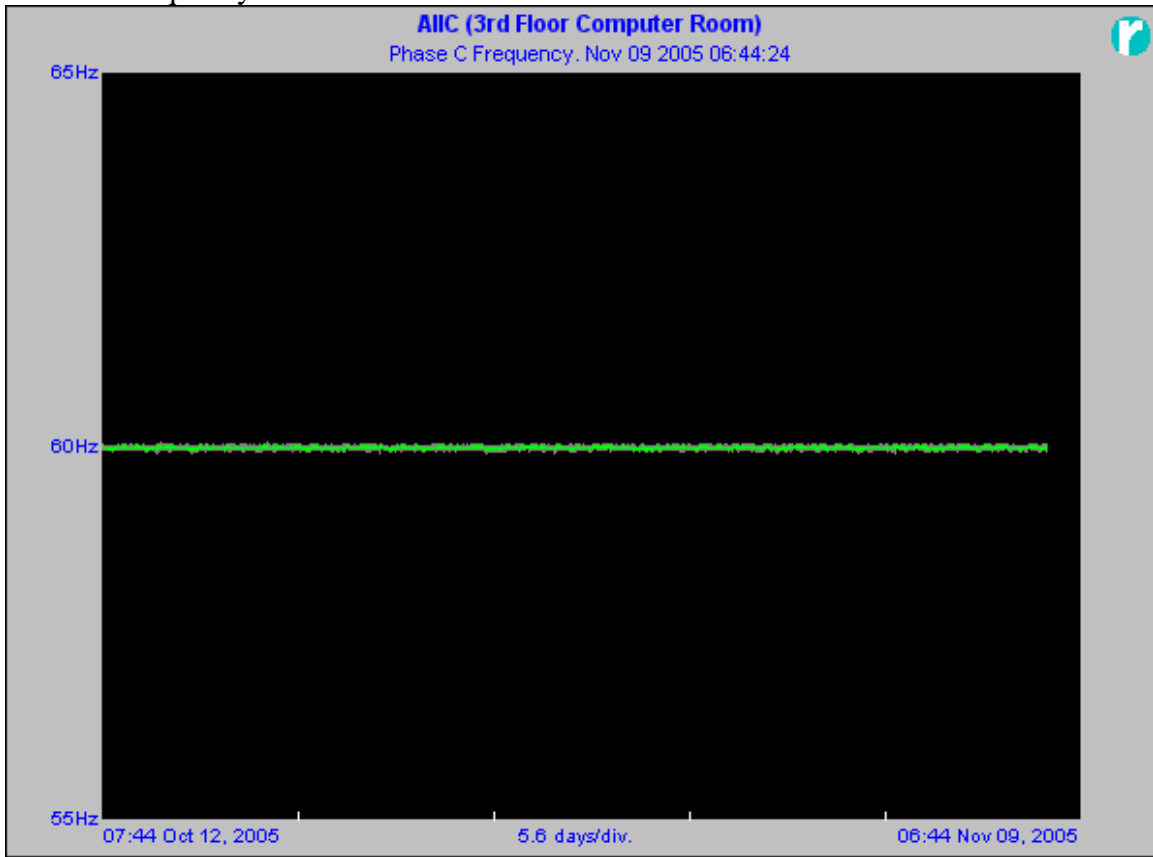
Min. 59.91Hz Oct 23 2005 07:59:24
Avg. **60.00Hz**
Max. 60.06Hz Oct 13 2005 23:44:24

Phase B Frequency.



Min. 59.91Hz Oct 23 2005 07:59:24
Avg. 60.00Hz
 Max. 60.06Hz Oct 13 2005 23:44:24

Phase C Frequency.



Min. 59.91Hz Oct 23 2005 07:59:24
Avg. **60.00Hz**
Max. 60.06Hz Oct 13 2005 23:44:24

Voltage and Current Distortion Summaries

Voltage and Current harmonic distortion measurements for AHC:3rd Floor Computer Room from 10/12/05 07:44:24 through 11/09/05 06:44:24.

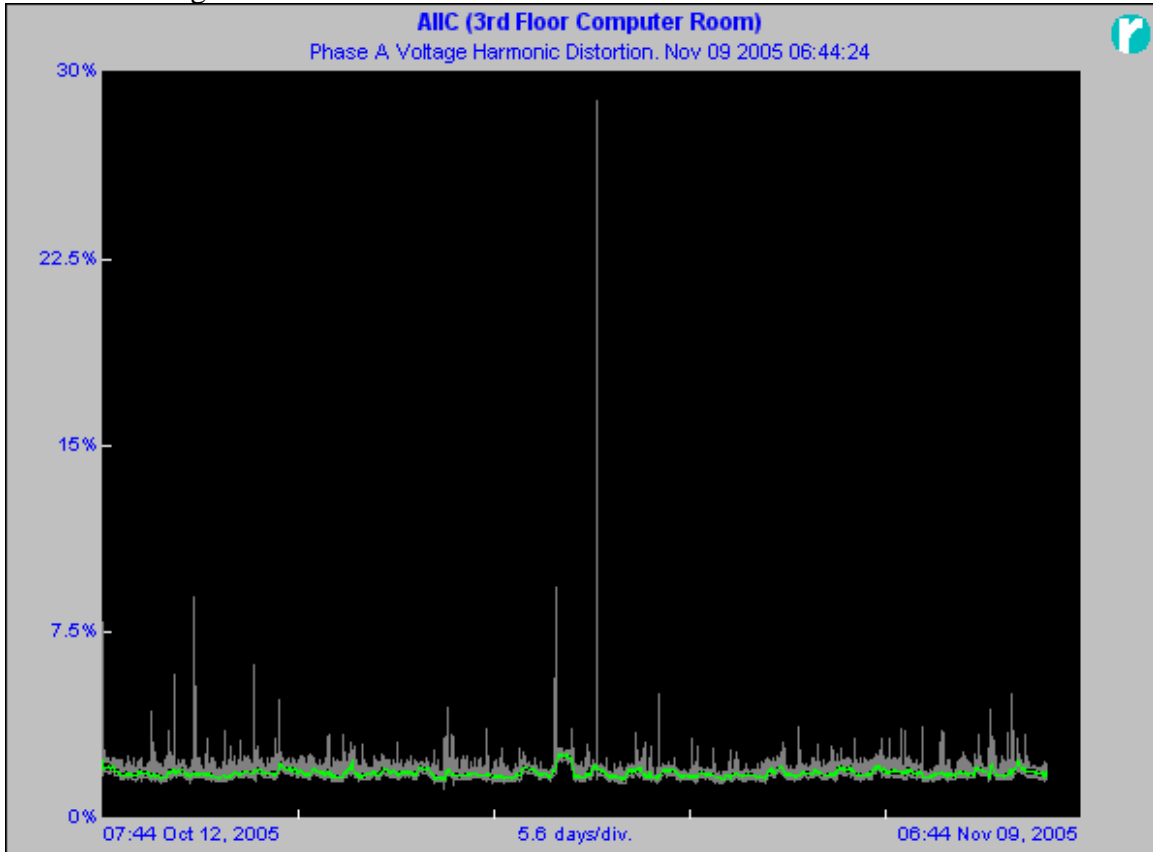
Voltage Distortion	Value	Date and Time
Phase A minimum	1.58%	Oct 27 2005 05:44:24
Phase A average	1.851%	
Phase A maximum	2.59%	Oct 25 2005 10:44:24
Phase B minimum	1.27%	Nov 08 2005 05:59:24
Phase B average	1.588%	
Phase B maximum	2.38%	Oct 25 2005 15:59:24
Phase C minimum	1.67%	Nov 07 2005 03:14:24
Phase C average	2.021%	
Phase C maximum	2.54%	Oct 25 2005 15:44:24

Current Distortion	Value	Date and Time
Phase A minimum	18.61%	Nov 08 2005 06:29:24
Phase A average	26.12%	
Phase A maximum	31.94%	Oct 25 2005 10:44:24
Phase B minimum	17.58%	Oct 24 2005 03:59:24
Phase B average	25.99%	
Phase B maximum	31.08%	Oct 31 2005 18:14:24
Phase C minimum	27.31%	Nov 07 2005 09:44:24
Phase C average	31.88%	
Phase C maximum	35.35%	Oct 20 2005 16:29:24

Voltage Flicker	Value	Date and Time
Phase A minimum	1.482	Oct 28 2005 04:24:24
Phase A average	1.938	
Phase A maximum	5.560	Oct 26 2005 11:34:24
Phase B minimum	0.536	Oct 22 2005 01:14:24
Phase B average	1.544	
Phase B maximum	6.861	Oct 26 2005 11:34:24
Phase C minimum	1.298	Nov 07 2005 04:34:24
Phase C average	2.074	
Phase C maximum	2.708	Oct 25 2005 14:34:24

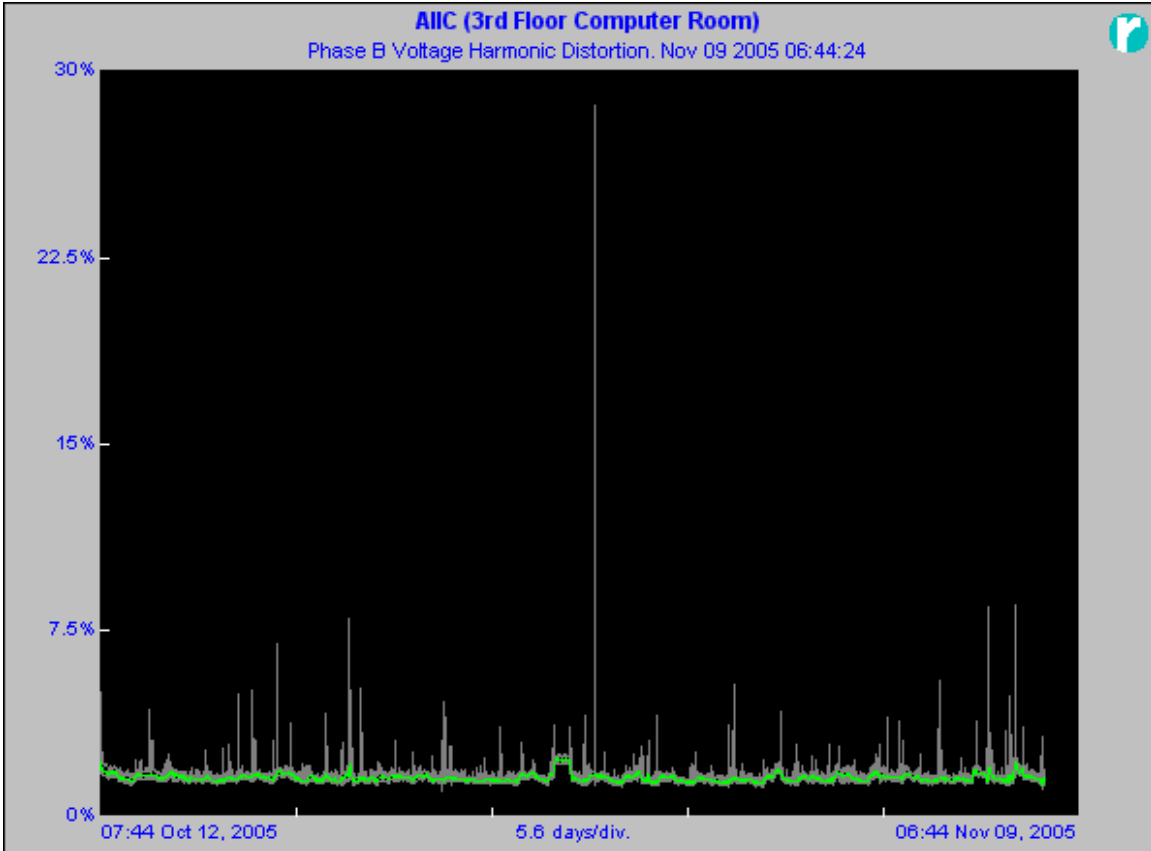
Voltage T.H.D. Summaries for AHC:3rd Floor Computer Room .

Phase A Voltage Distortion.



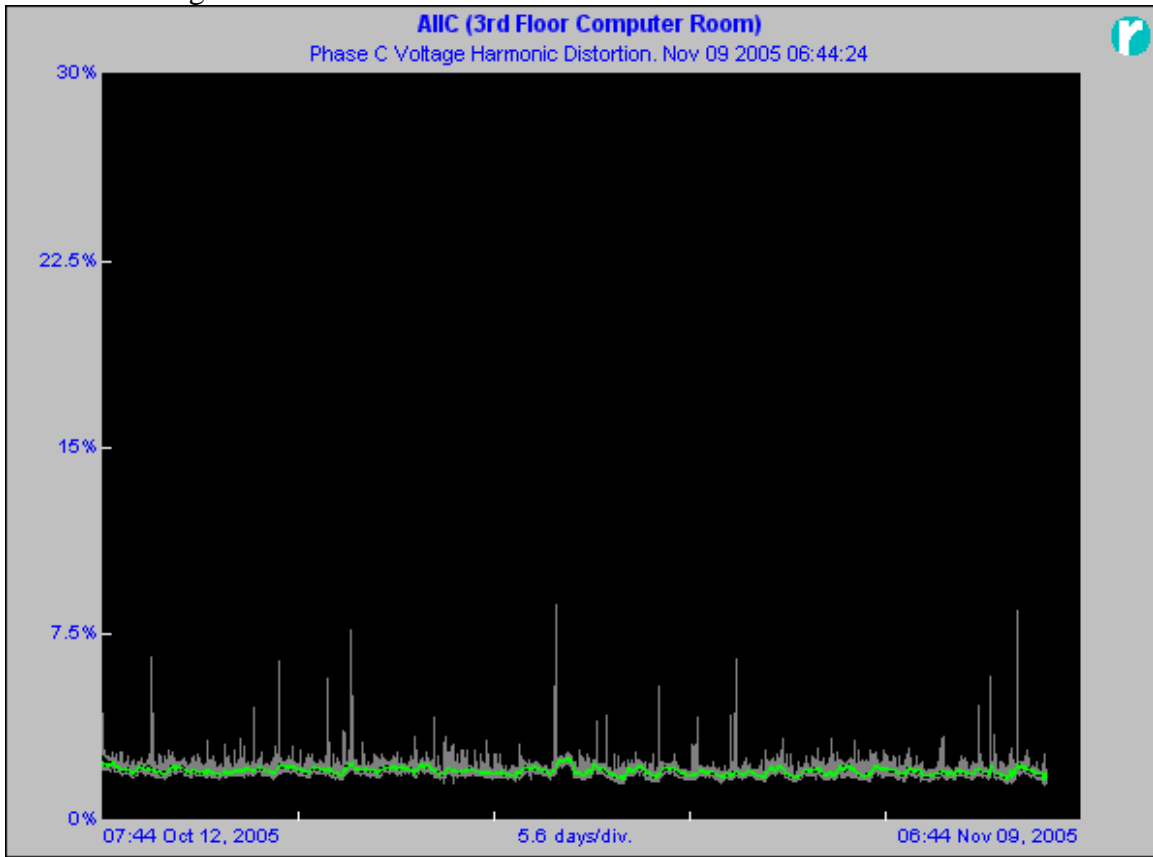
Min. 1.58% Oct 27 2005 05:44:24
Avg. 1.851%
Max. 2.59% Oct 25 2005 10:44:24

Phase B Voltage Distortion.



Min. 1.27% Nov 08 2005 05:59:24
Avg. 1.588%
 Max. 2.38% Oct 25 2005 15:59:24

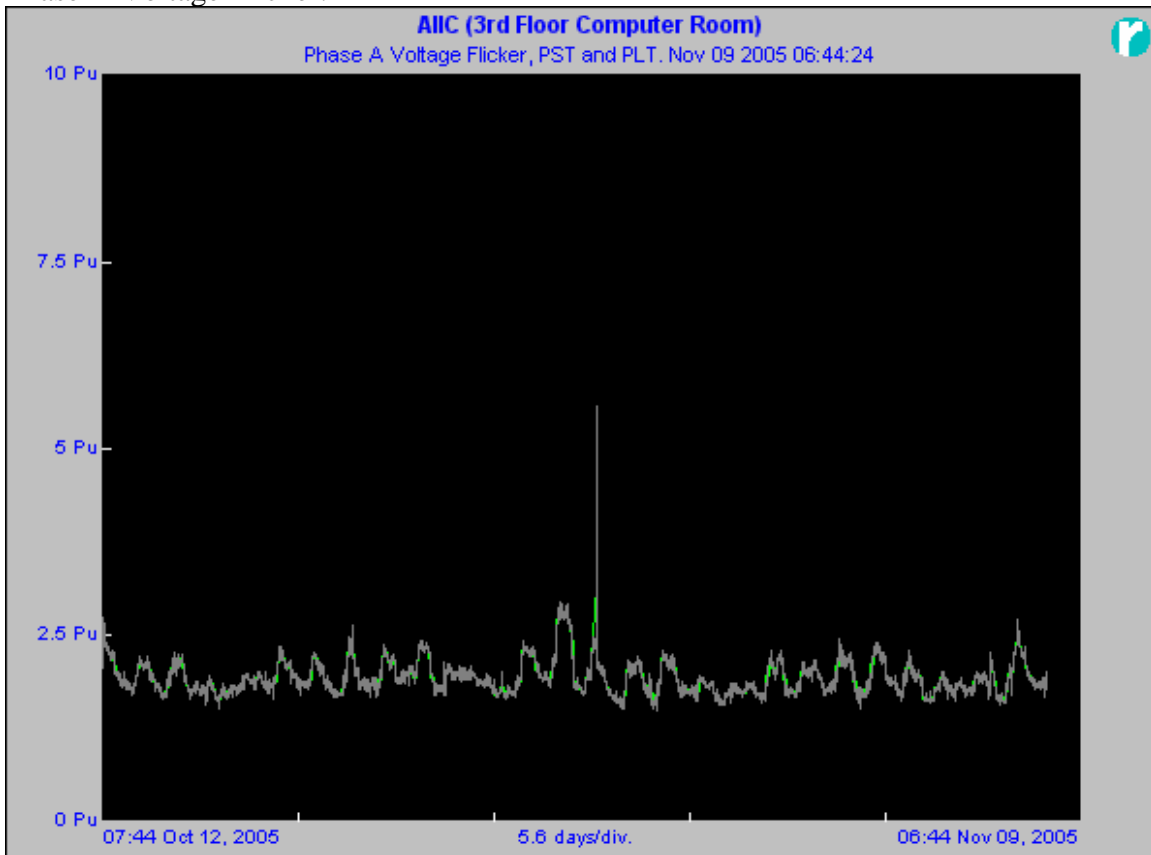
Phase C Voltage Distortion.



Min.	1.67%	Nov 07 2005 03:14:24
Avg.	2.021%	
Max.	2.54%	Oct 25 2005 15:44:24

Voltage Flicker Summaries for AHC:3rd Floor Computer Room.

Phase A Voltage Flicker.

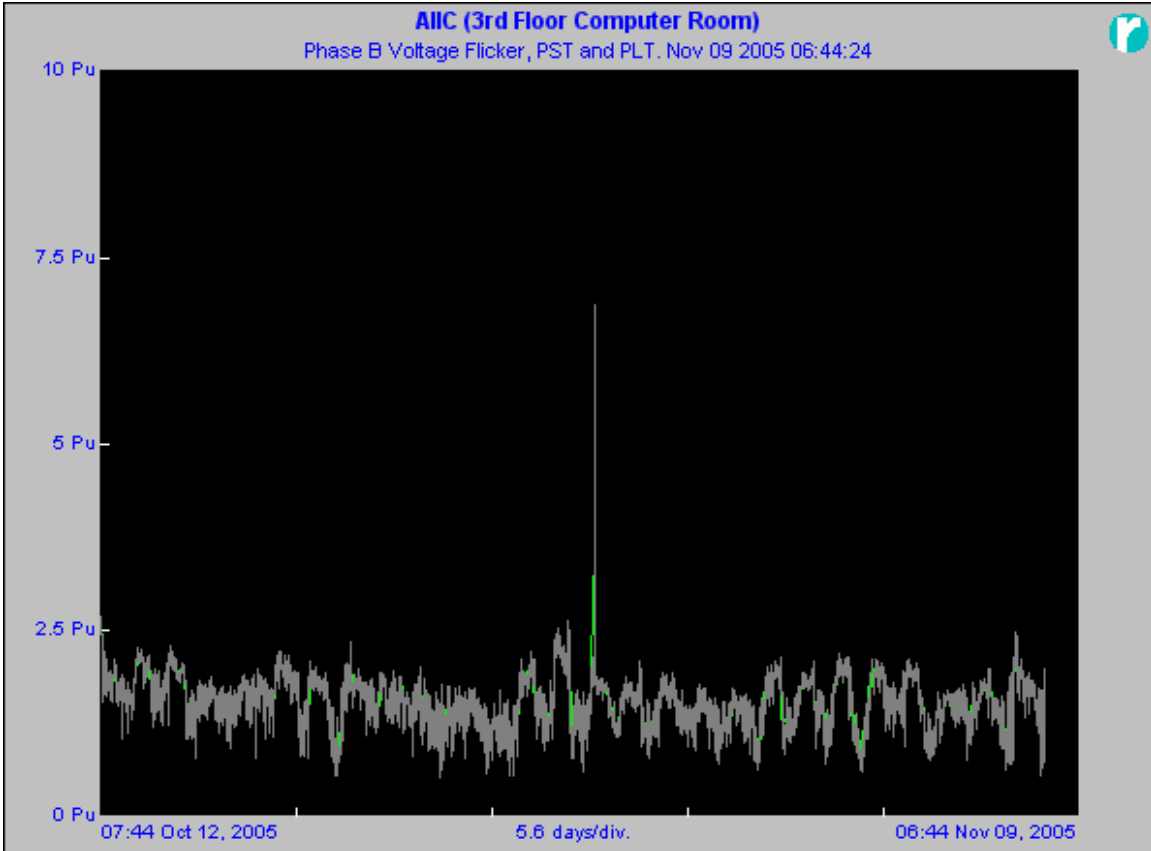


Min. 1.482 Oct 28 2005 04:24:24

Avg. 1.938

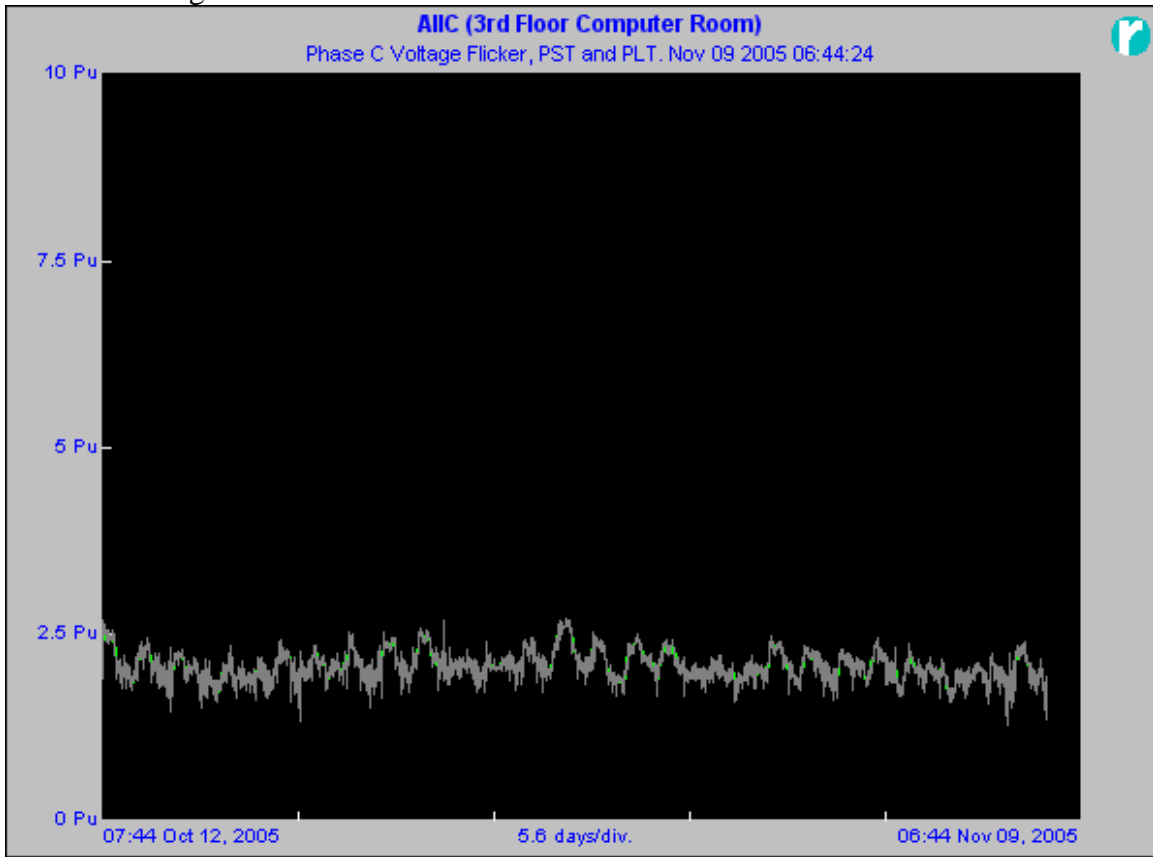
Max. 5.560 Oct 26 2005 11:34:24

Phase B Voltage Flicker.



Min.	0.536	Oct 22 2005 01:14:24
Avg.	1.544	
Max.	6.861	Oct 26 2005 11:34:24

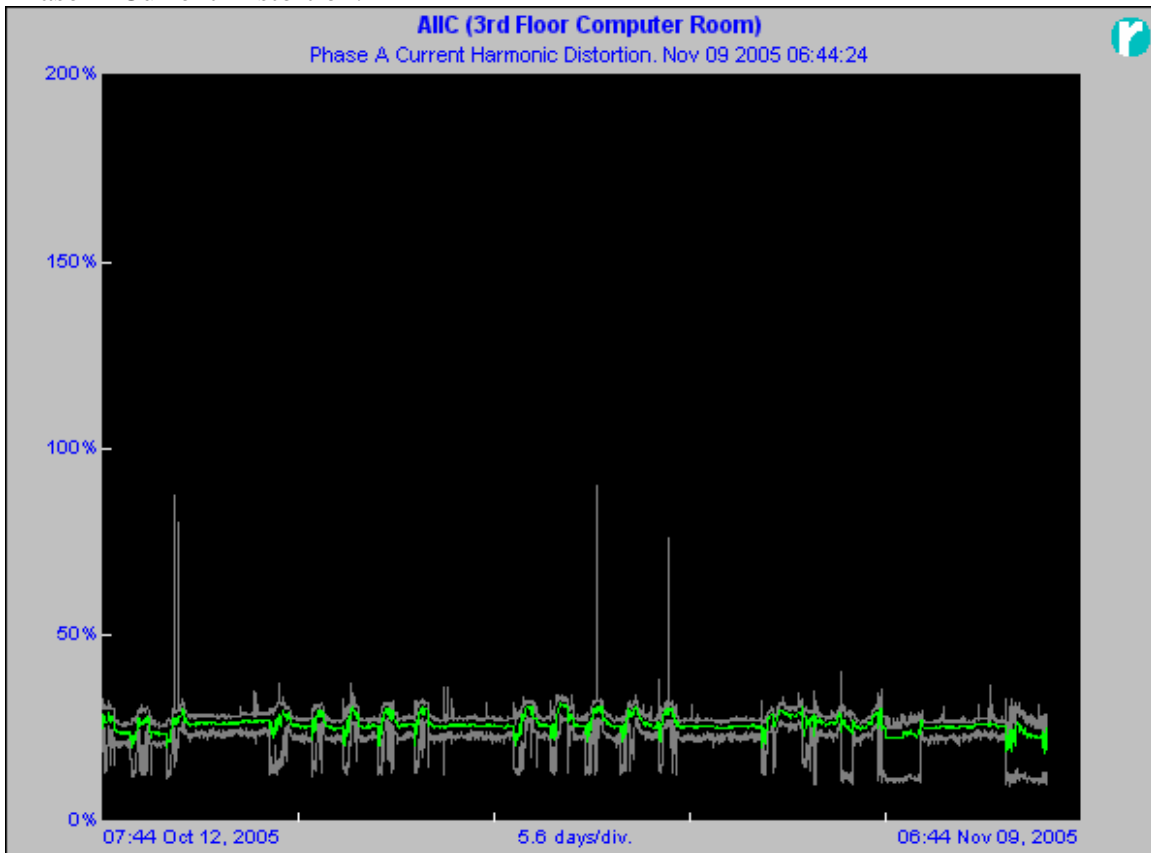
Phase C Voltage Flicker.



Min.	1.298	Nov 07 2005 04:34:24
Avg.	2.074	
Max.	2.708	Oct 25 2005 14:34:24

Current T.H.D. Summaries for AHC:3rd Floor Computer Room.

Phase A Current Distortion.

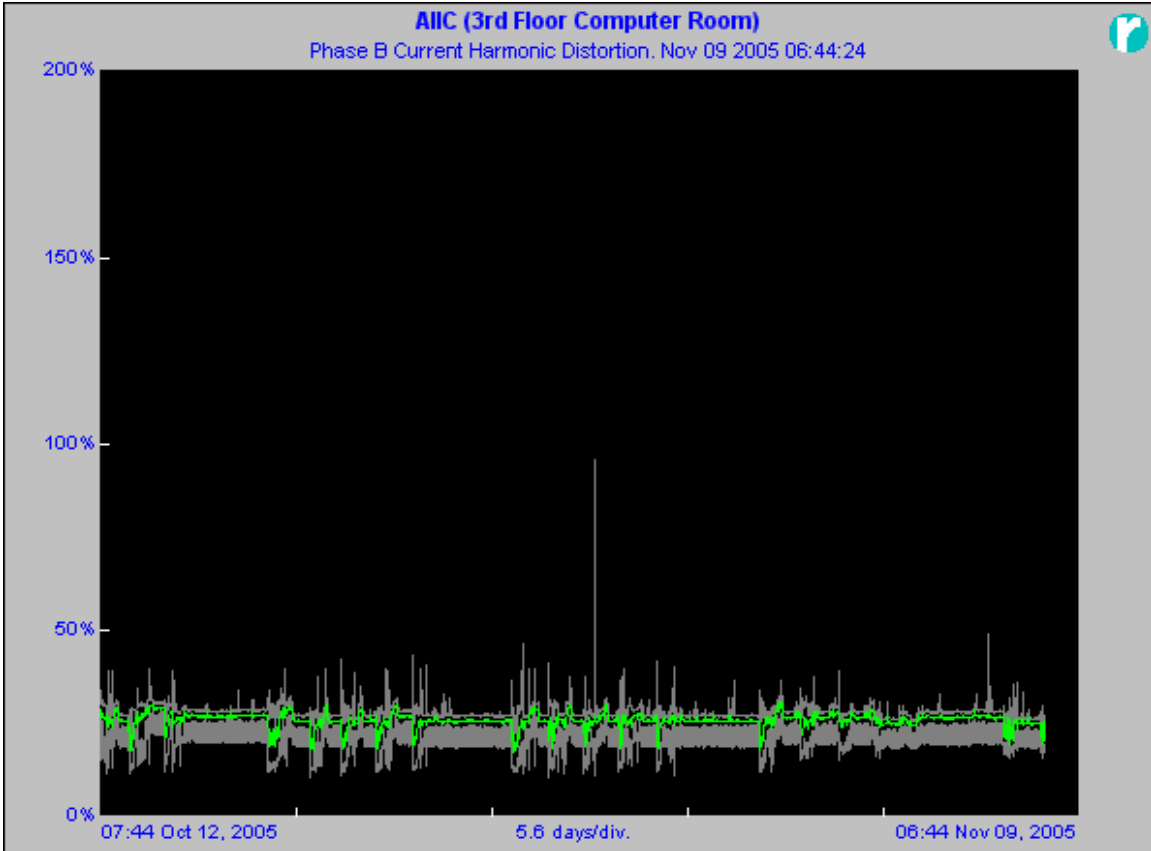


Min. 18.61% Nov 08 2005 06:29:24

Avg. 26.12%

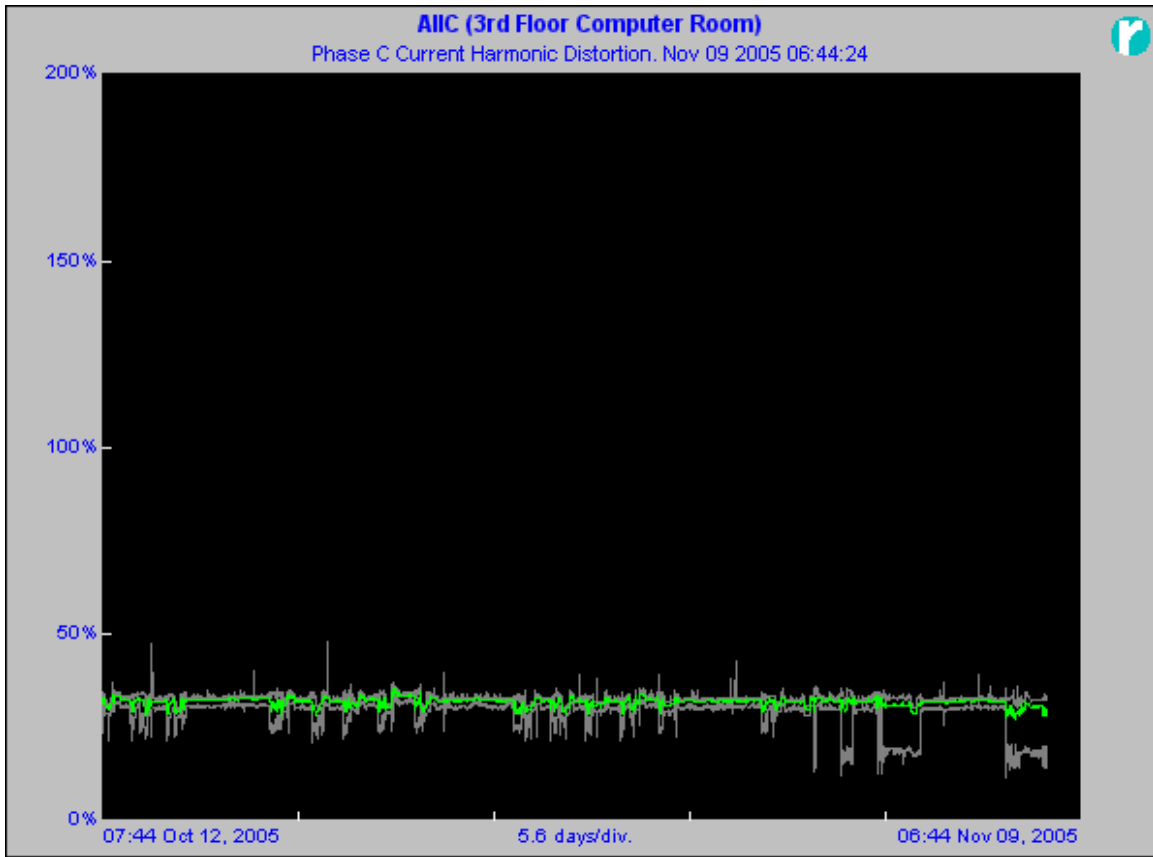
Max. 31.94% Oct 25 2005 10:44:24

Phase B Current Distortion.



Min.	17.58%	Oct 24 2005 03:59:24
Avg.	25.99%	
Max.	31.08%	Oct 31 2005 18:14:24

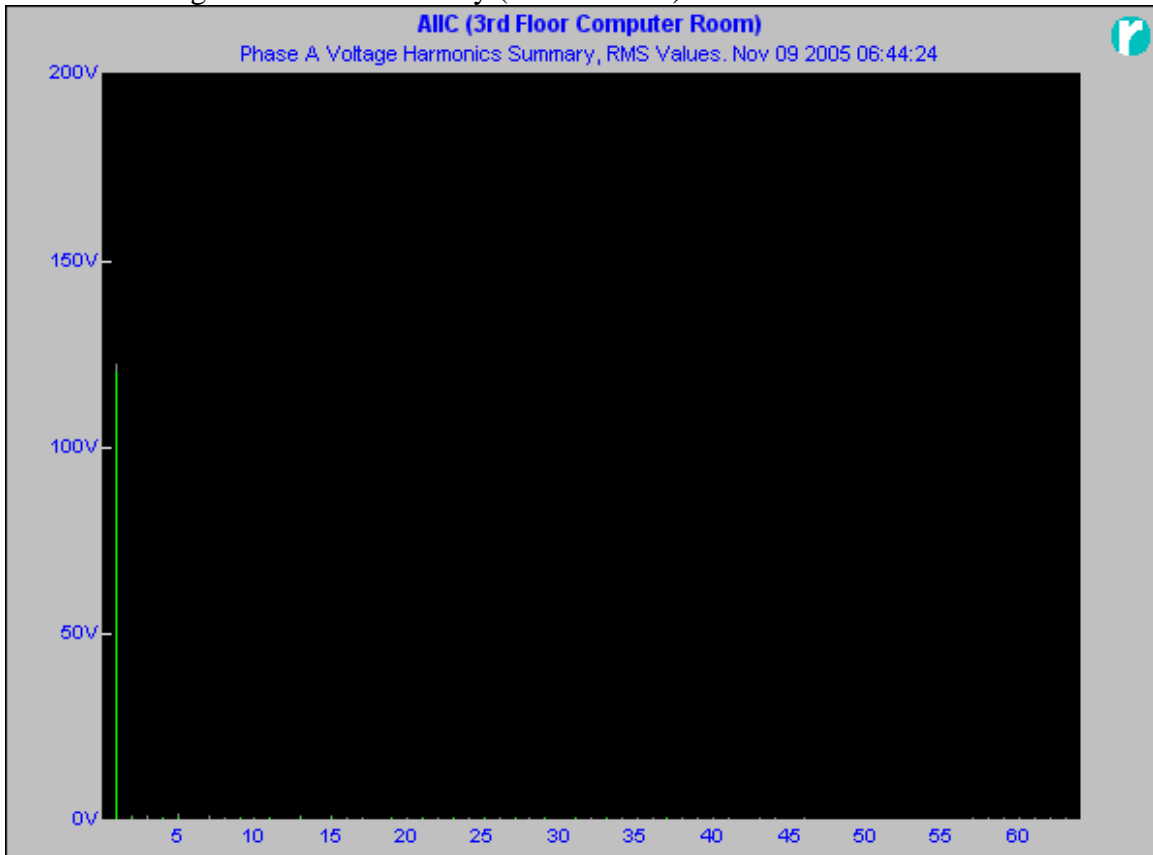
Phase C Current Distortion.



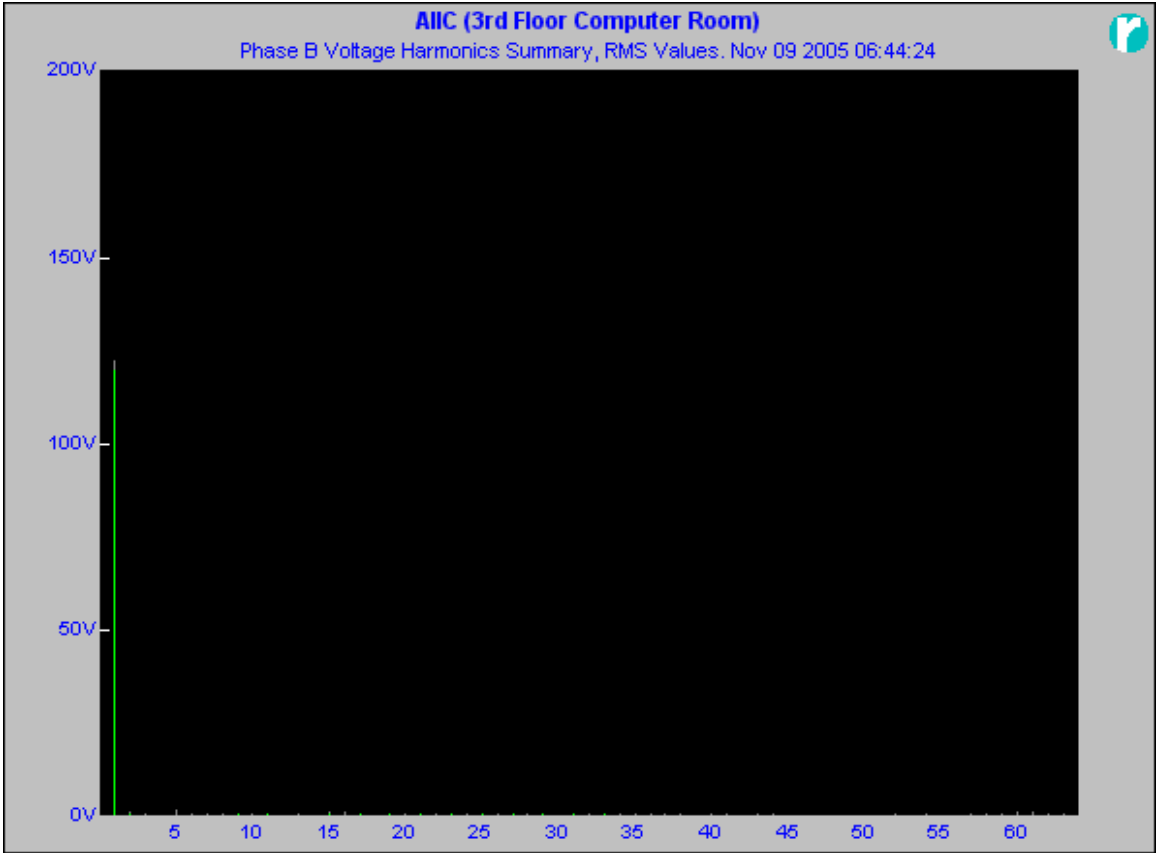
Min.	27.31%	Nov 07 2005 09:44:24
Avg.	31.88%	
Max.	35.35%	Oct 20 2005 16:29:24

Voltage harmonic Summary for AHC:3rd Floor Computer Room.

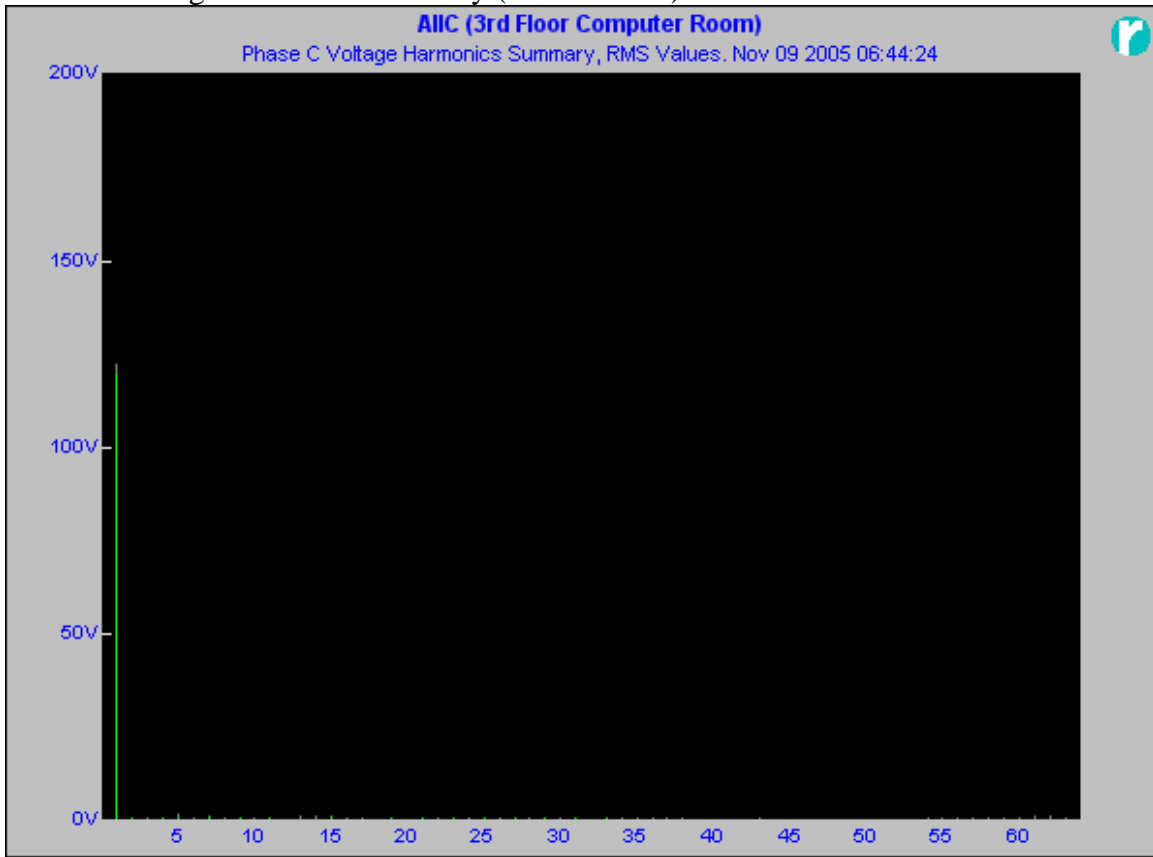
Phase A Voltage Harmonic Summary (RMS Values).



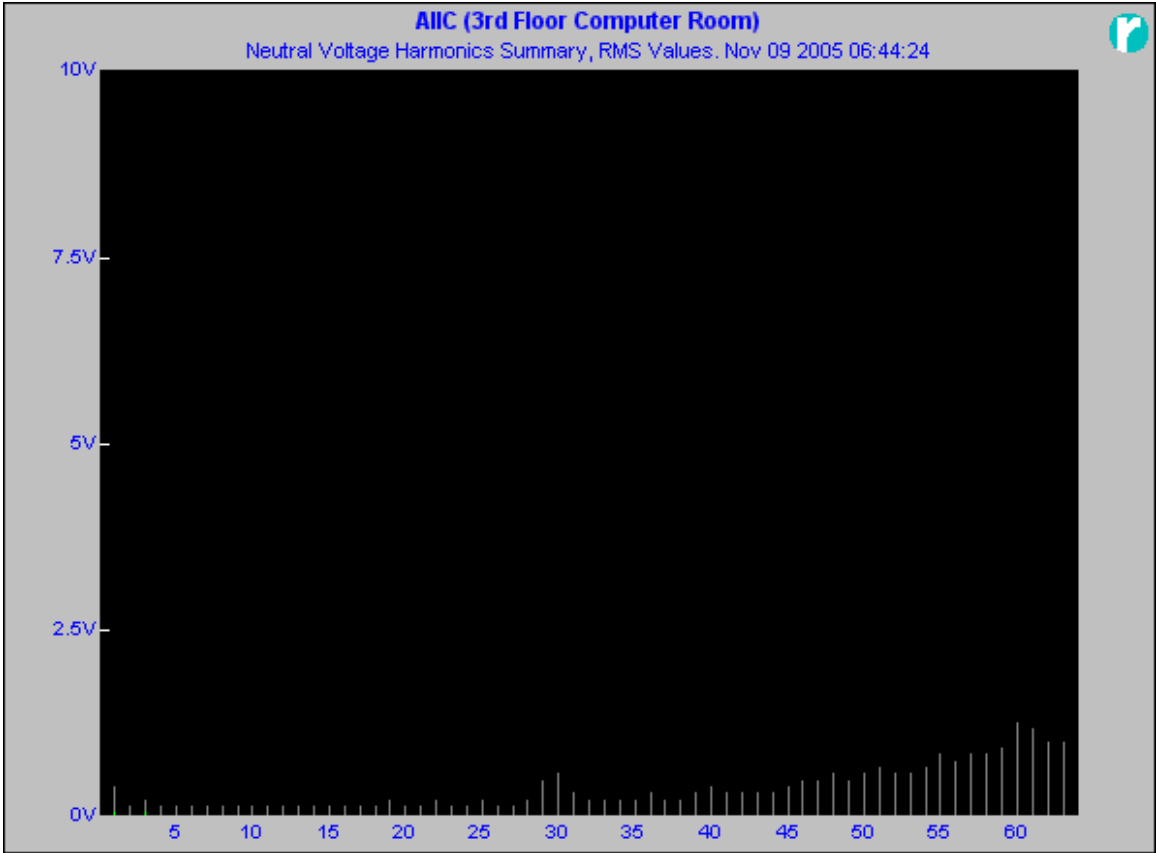
Phase B Voltage Harmonic Summary (RMS Values).



Phase C Voltage Harmonic Summary (RMS Values).



Neutral Voltage Harmonics (RMS Values).



The first 16 harmonics for the Phase A voltage are shown below (RMS Values):

Harmonic	Max Amplitude	Avg Amplitude
1	123.009	120.678
2	1.813	0.086
3	1.985	0.777
4	0.950	0.086
5	2.590	1.122
6	0.691	0.000
7	1.813	0.950
8	0.345	0.000
9	0.777	0.345
10	0.518	0.000
11	0.950	0.432
12	0.950	0.000
13	1.726	1.122
14	0.863	0.000
15	1.640	0.086
16	1.554	0.000

The first 16 harmonics for the Phase B voltage are shown below (RMS Values):

Harmonic	Max Amplitude	Avg Amplitude
1	122.664	120.160
2	1.813	0.086
3	1.122	0.691
4	0.950	0.000
5	2.503	0.950
6	0.518	0.000
7	1.467	0.950
8	0.259	0.000
9	0.691	0.259
10	0.345	0.000
11	1.036	0.432
12	0.604	0.000
13	1.381	0.777
14	1.036	0.000
15	1.813	0.086
16	1.813	0.000

The first 16 harmonics for the Phase C voltage are shown below (RMS Values):

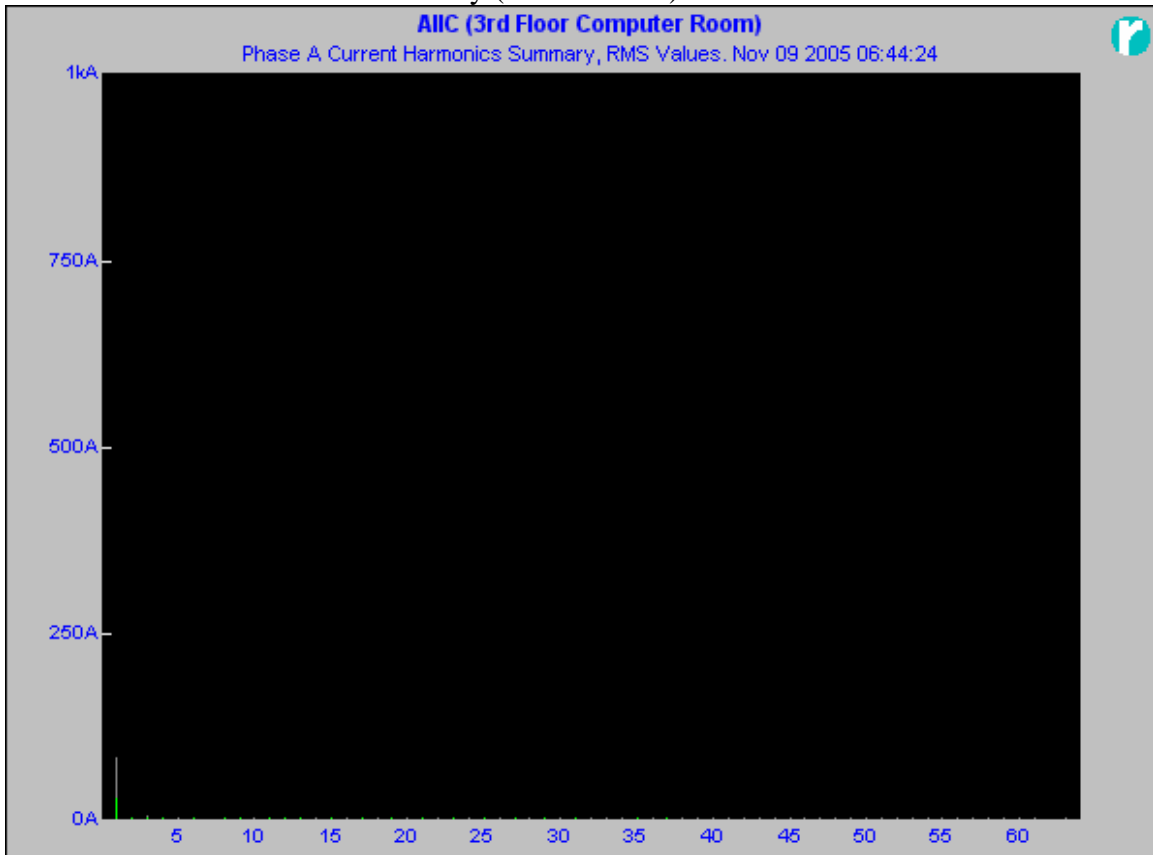
Harmonic	Max Amplitude	Avg Amplitude
1	122.750	120.419
2	0.691	0.086
3	1.295	0.777
4	0.604	0.086
5	2.244	1.122
6	0.345	0.000
7	2.072	1.295
8	0.345	0.000
9	0.691	0.432
10	0.432	0.000
11	1.122	0.518
12	0.863	0.000
13	1.640	0.950
14	1.726	0.000
15	1.640	0.432
16	1.209	0.000

The first 16 harmonics for the neutral voltage are shown below (RMS Values):

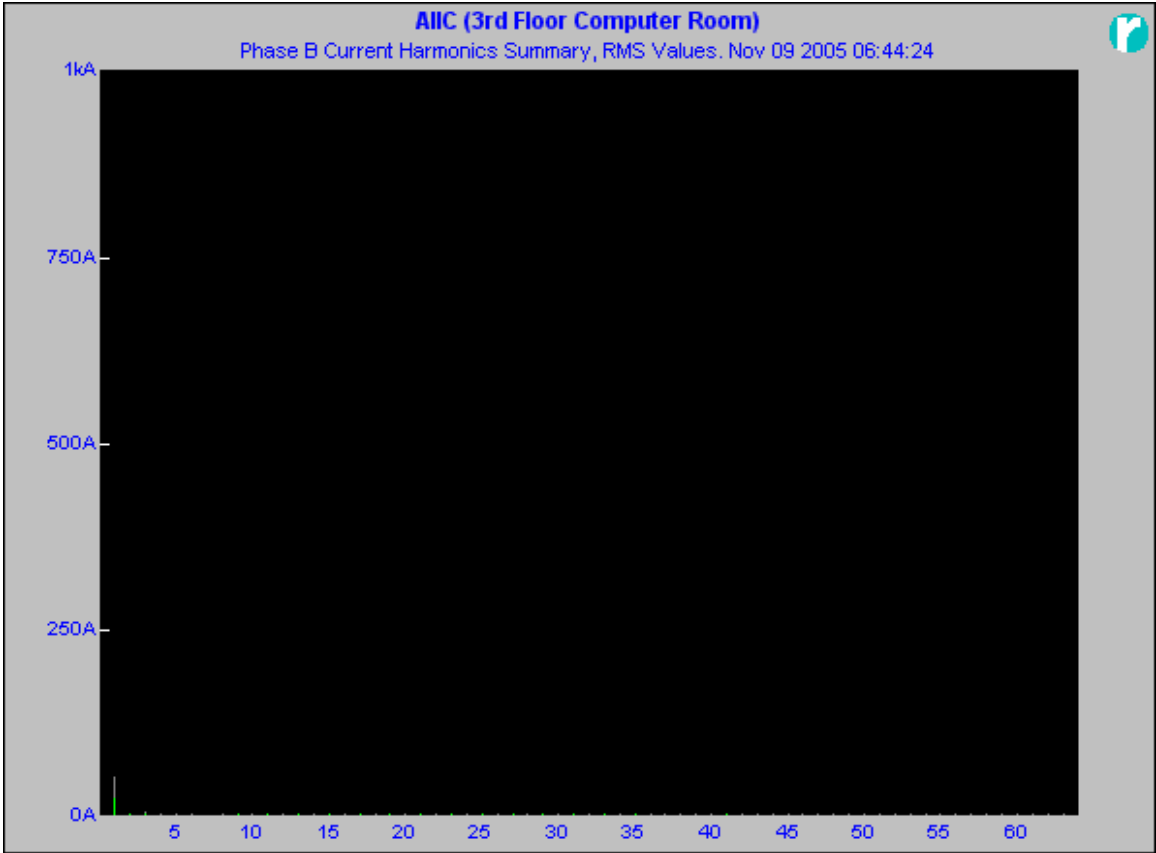
Harmonic	Max Amplitude	Avg Amplitude
1	0.432	0.086
2	0.173	0.000
3	0.259	0.086
4	0.173	0.000
5	0.173	0.000
6	0.173	0.000
7	0.173	0.000
8	0.173	0.000
9	0.173	0.000
10	0.173	0.000
11	0.173	0.000
12	0.173	0.000
13	0.173	0.000
14	0.173	0.000
15	0.173	0.000
16	0.173	0.000

Current harmonic Summary for AIIC:3rd Floor Computer Room.

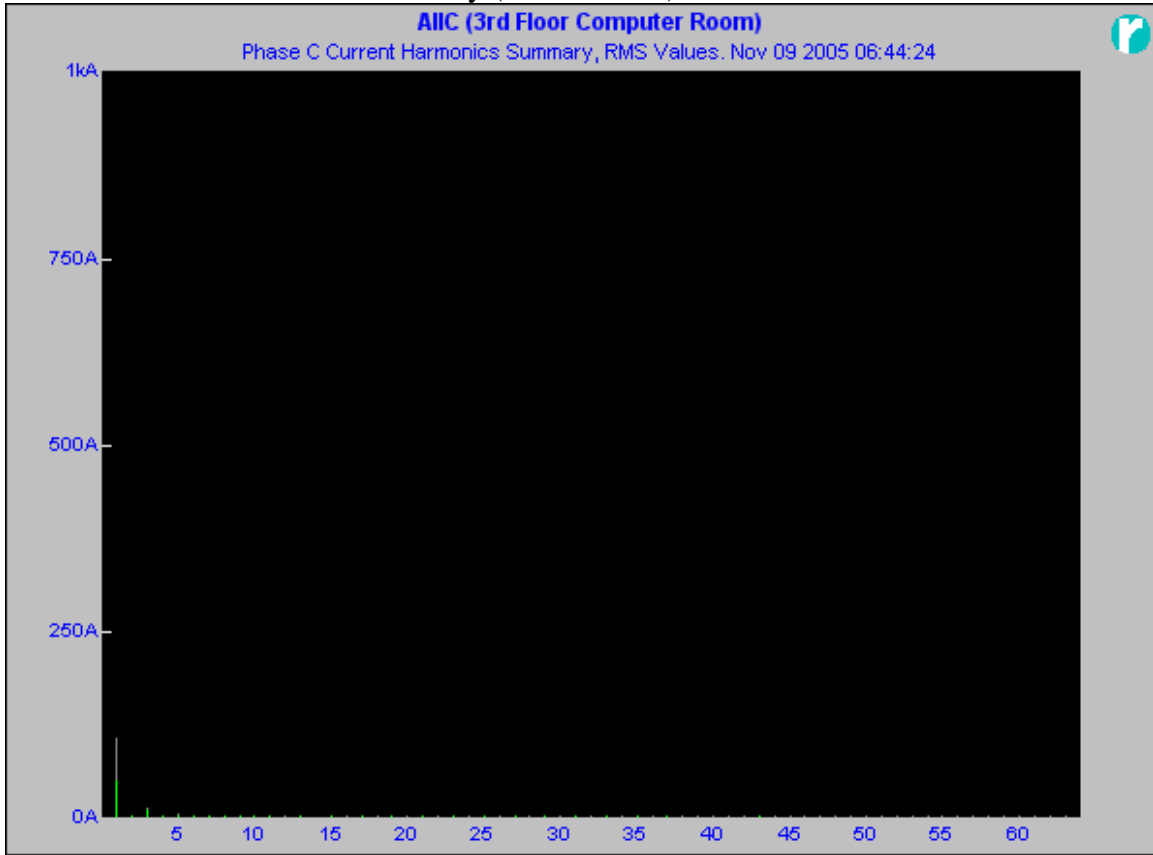
Phase A Current Harmonic Summary (RMS Values).



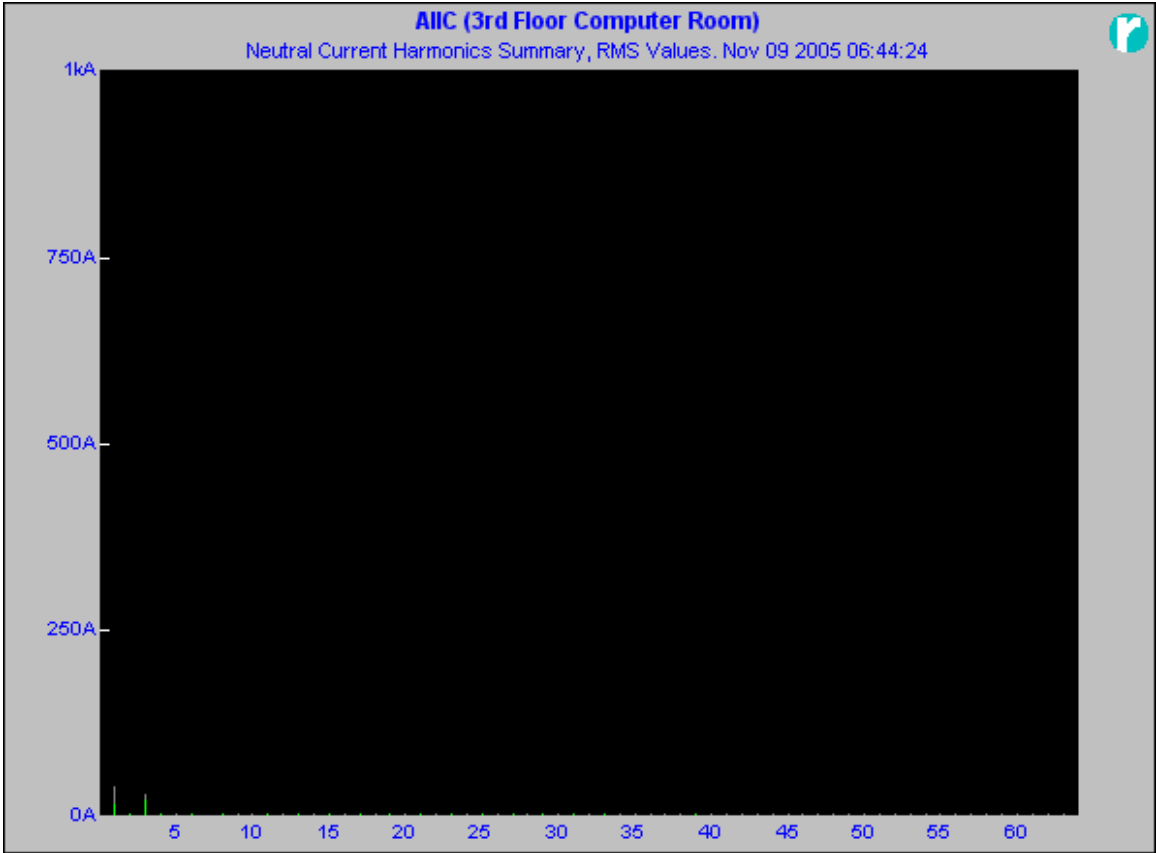
Phase B Current Harmonic Summary (RMS Values).



Phase C Current Harmonic Summary (RMS Values).



Neutral Current Harmonics (RMS Values).



The first 16 harmonics for the Phase A current are shown below (RMS Values):

Harmonic	Max Amplitude	Avg Amplitude
1	85.977	31.464
2	6.345	0.518
3	9.582	6.345
4	2.331	0.388
5	5.697	3.237
6	1.942	0.129
7	4.402	3.237
8	1.424	0.129
9	2.849	1.683
10	1.036	0.000
11	1.813	0.647
12	1.554	0.129
13	2.201	1.295
14	1.683	0.000
15	1.813	0.129
16	1.942	0.000

The first 16 harmonics for the Phase B current are shown below (RMS Values):

Harmonic	Max Amplitude	Avg Amplitude
1	55.937	28.486
2	5.827	0.129
3	9.323	5.827
4	1.813	0.000
5	5.438	2.849
6	1.554	0.000
7	4.920	2.719
8	0.777	0.000
9	3.108	1.295
10	0.777	0.000
11	2.590	1.036
12	0.518	0.000
13	1.295	0.647
14	0.777	0.000
15	1.424	0.259
16	1.942	0.000

The first 16 harmonics for the Phase C current are shown below (RMS Values):

Harmonic	Max Amplitude	Avg Amplitude
1	109.413	52.052
2	6.215	0.388
3	17.869	13.466
4	2.719	0.388
5	9.970	6.863
6	1.942	0.129
7	7.122	5.827
8	1.554	0.129
9	3.237	2.331
10	1.295	0.129
11	2.460	0.647
12	1.683	0.000
13	3.367	1.683
14	3.237	0.000
15	2.978	1.036
16	1.813	0.000

The first 16 harmonics for the neutral current are shown below (RMS Values):

Harmonic	Max Amplitude	Avg Amplitude
1	44.024	19.552
2	5.697	0.129
3	31.205	25.508
4	1.942	0.129
5	6.992	4.661
6	1.424	0.129
7	5.050	2.978
8	0.777	0.129
9	5.956	5.050
10	1.036	0.000
11	1.683	0.777
12	0.906	0.000
13	2.331	1.424
14	1.424	0.000
15	2.201	0.906
16	1.424	0.000

Power Summaries

Power measurements for AHC:3rd Floor Computer Room from 10/12/05 07:44:24 through 11/09/05 06:44:24.

Imbalance	Value	Date and Time
Minimum Voltage Imbalance	0%	Oct 25 2005 18:29:24
Average Voltage Imbalance	0.228%	
Maximum Voltage Imbalance	0.61%	Oct 18 2005 10:29:24
Minimum Current Imbalance	25.47%	Oct 18 2005 07:59:24
Average Current Imbalance	40.69%	
Maximum Current Imbalance	54.1%	Oct 12 2005 16:14:24

VA Power	Value	Date and Time
Phase A minimum	1.360kVA	Oct 26 2005 11:29:24
Phase A average	3.955kVA	
Phase A maximum	19.23kVA	Oct 12 2005 07:44:24
Phase B minimum	407.7VA	Oct 26 2005 11:29:24
Phase B average	3.531kVA	
Phase B maximum	8.461kVA	Oct 13 2005 03:44:24
Phase C minimum	5.204kVA	Oct 22 2005 02:29:24
Phase C average	6.593kVA	
Phase C maximum	15.74kVA	Nov 03 2005 11:59:24
Total minimum	13.27kVA	Oct 21 2005 05:29:24
Total average	14.08kVA	
Total maximum	18.79kVA	Nov 07 2005 09:29:24

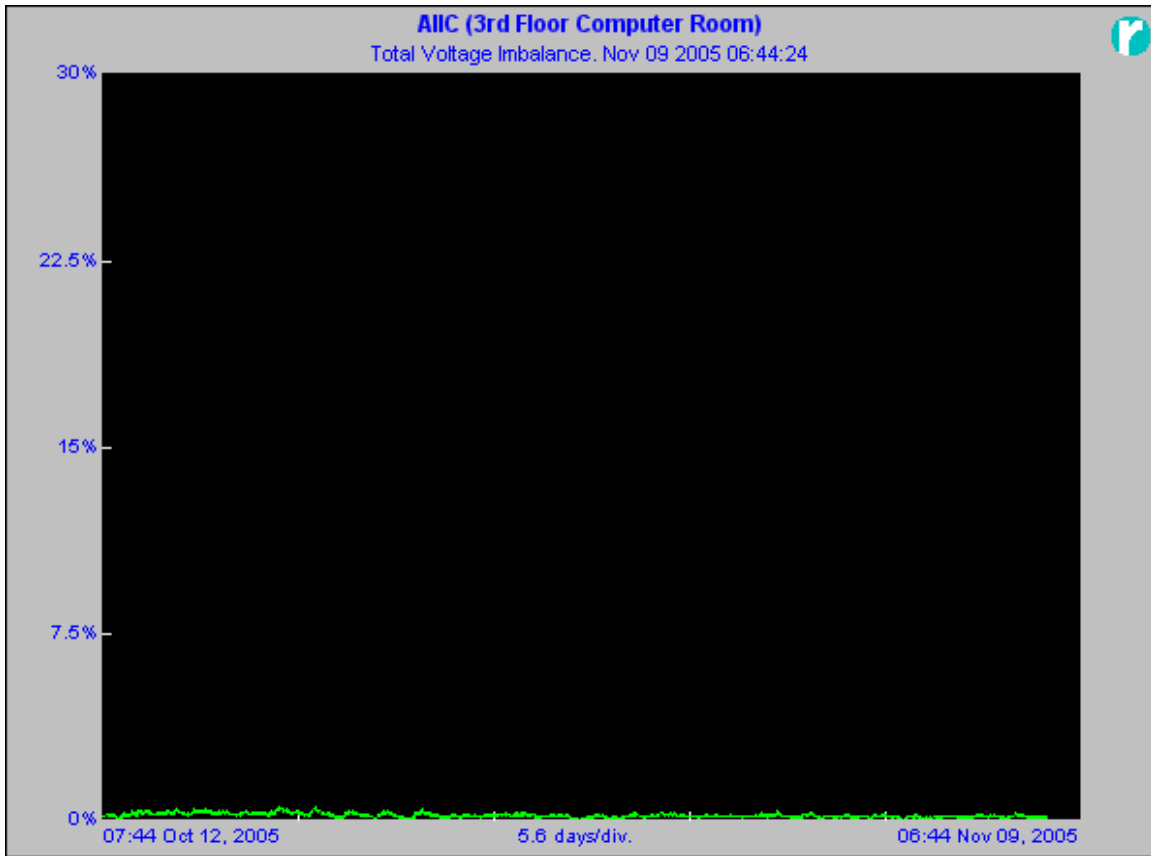
VARs Power	Value	Date and Time
Phase A minimum	-18.90kVAR	Oct 12 2005 07:44:24
Phase A average	-171.7VAR	
Phase A maximum	4.355kVAR	Oct 24 2005 04:29:24
Phase B minimum	-2.895kVAR	Oct 31 2005 03:29:24
Phase B average	-845.2VAR	
Phase B maximum	2.809kVAR	Oct 26 2005 03:59:24
Phase C minimum	-3.303kVAR	Oct 20 2005 14:44:24
Phase C average	2.514kVAR	
Phase C maximum	7.318kVAR	Nov 07 2005 02:59:24
Total minimum	-3.030kVAR	Oct 18 2005 09:29:24
Total average	1.497kVAR	
Total maximum	3.844kVAR	Nov 08 2005 05:59:24

Watts Power	Value	Date and Time
Phase A minimum	-12.13kW	Nov 03 2005 11:59:24
Phase A average	-3.776kW	
Phase A maximum	-925.0W	Oct 26 2005 11:29:24
Phase B minimum	-8.158kW	Oct 13 2005 03:44:24
Phase B average	-3.354kW	
Phase B maximum	-406.8W	Oct 26 2005 11:29:24
Phase C minimum	-14.19kW	Nov 03 2005 11:59:24
Phase C average	-5.999kW	
Phase C maximum	-4.643kW	Oct 25 2005 23:59:24
Total minimum	-17.92kW	Nov 07 2005 09:29:24
Total average	-13.12kW	
Total maximum	-12.27kW	Oct 21 2005 02:29:24

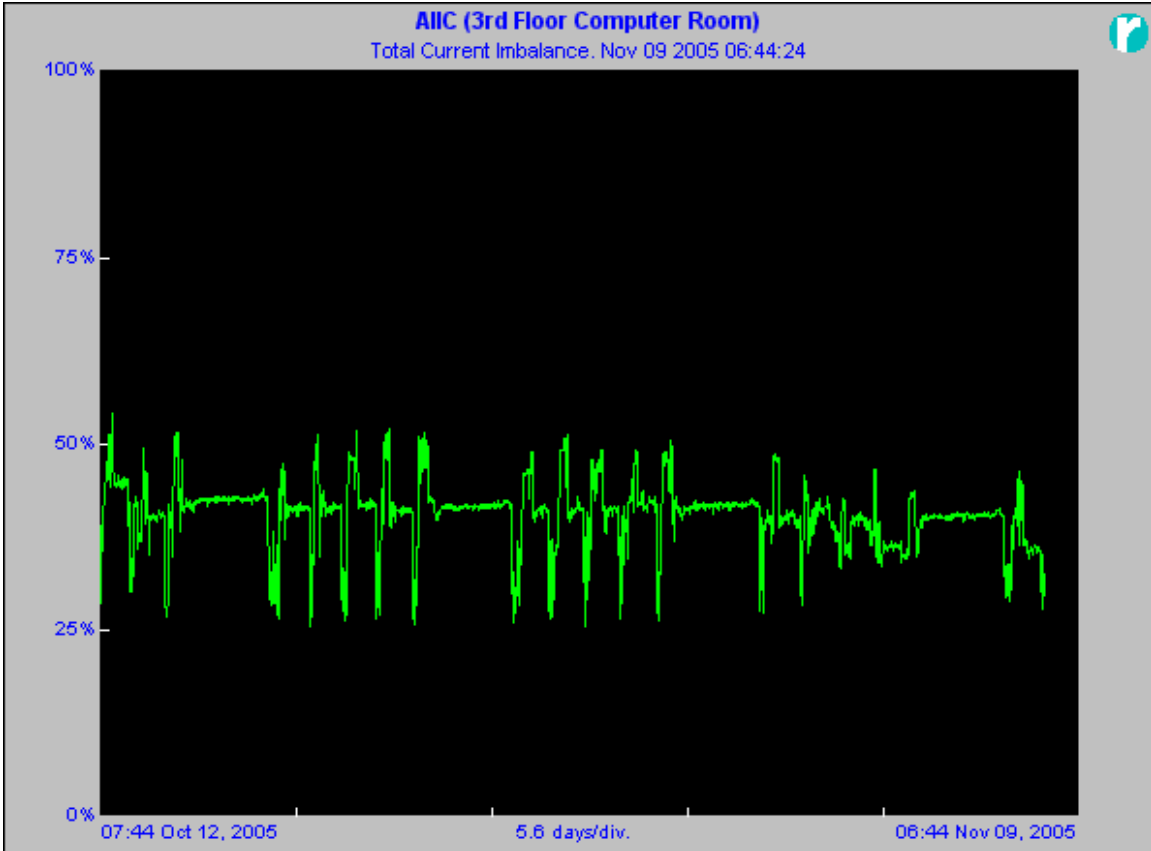
Demand Power	Value	Date and Time
Phase A minimum	3.358kW	Oct 13 2005 16:39:24
Phase A average	3.776kW	
Phase A maximum	5.412kW	Nov 07 2005 03:19:24
Phase B minimum	3.030kW	Nov 07 2005 00:04:24
Phase B average	3.354kW	
Phase B maximum	5.001kW	Oct 14 2005 04:09:24
Phase C minimum	5.609kW	Oct 21 2005 03:19:24
Phase C average	5.999kW	
Phase C maximum	7.990kW	Nov 07 2005 09:14:24
Total minimum	12.26kW	Oct 21 2005 02:54:24
Total average	13.12kW	
Total maximum	17.92kW	Nov 07 2005 09:34:24

Power Factor	Value	Date and Time
Phase A minimum	0.184 Lead	Oct 12 2005 07:44:24
Phase A average	0.989 Lead	
Phase A maximum	0.739 Lag	Oct 24 2005 04:29:24
Phase B minimum	0.686 Lead	Oct 26 2005 11:29:24
Phase B average	0.957 Lead	
Phase B maximum	0.873 Lag	Oct 24 2005 02:59:24
Phase C minimum	0.910 Lead	Oct 21 2005 09:59:24
Phase C average	0.915 Lag	
Phase C maximum	0.805 Lag	Nov 03 2005 11:59:24
Total minimum	0.955	Oct 24 2005 03:14:24
Total average	0.932	
Total maximum	0.866	Oct 12 2005 07:44:24

Voltage and Current Imbalance Summaries for AHC:3rd Floor Computer Room.



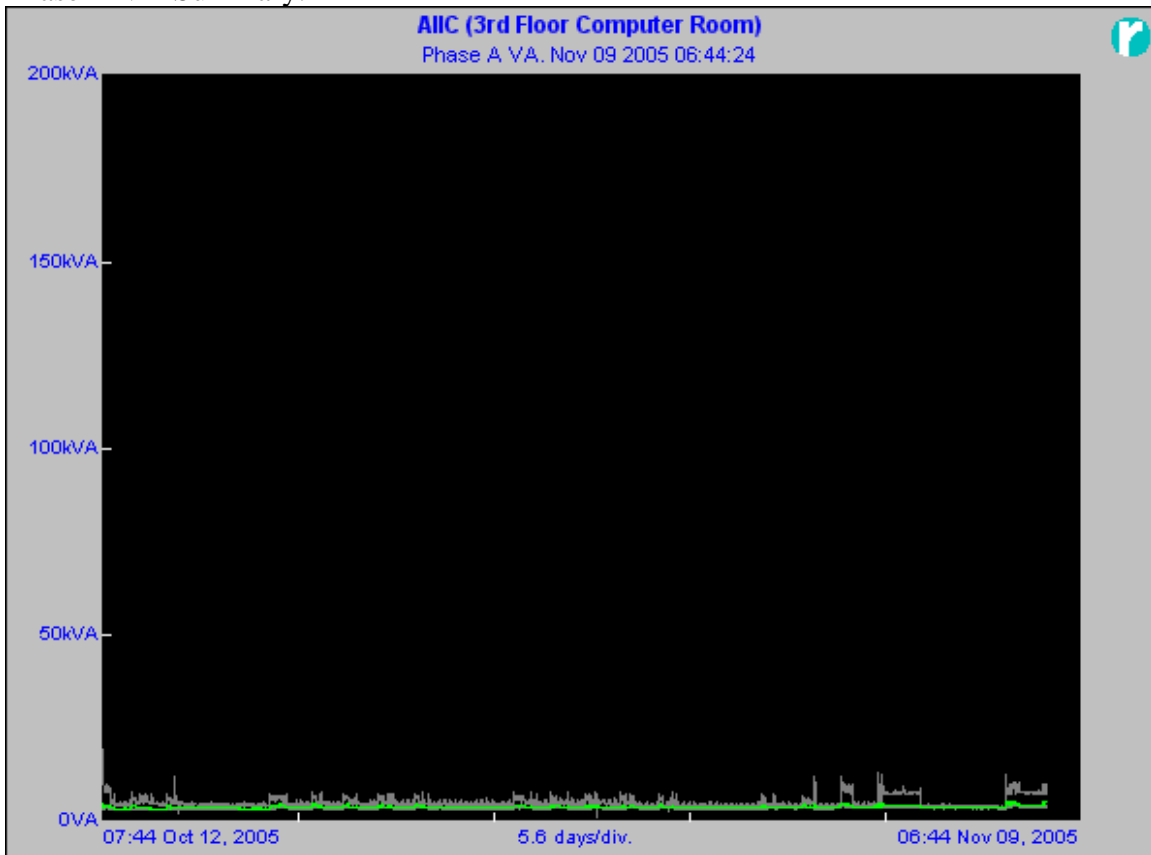
Minimum Voltage Imbalance	0%	Oct 25 2005 18:29:24
Average Voltage Imbalance	0.228%	
Maximum Voltage Imbalance	0.61%	Oct 18 2005 10:29:24



Minimum Current Imbalance	25.47%	Oct 18 2005 07:59:24
Average Current Imbalance	40.69%	
Maximum Current Imbalance	54.1%	Oct 12 2005 16:14:24

VA Power Summaries for AIIC:3rd Floor Computer Room.

Phase A VA Summary.

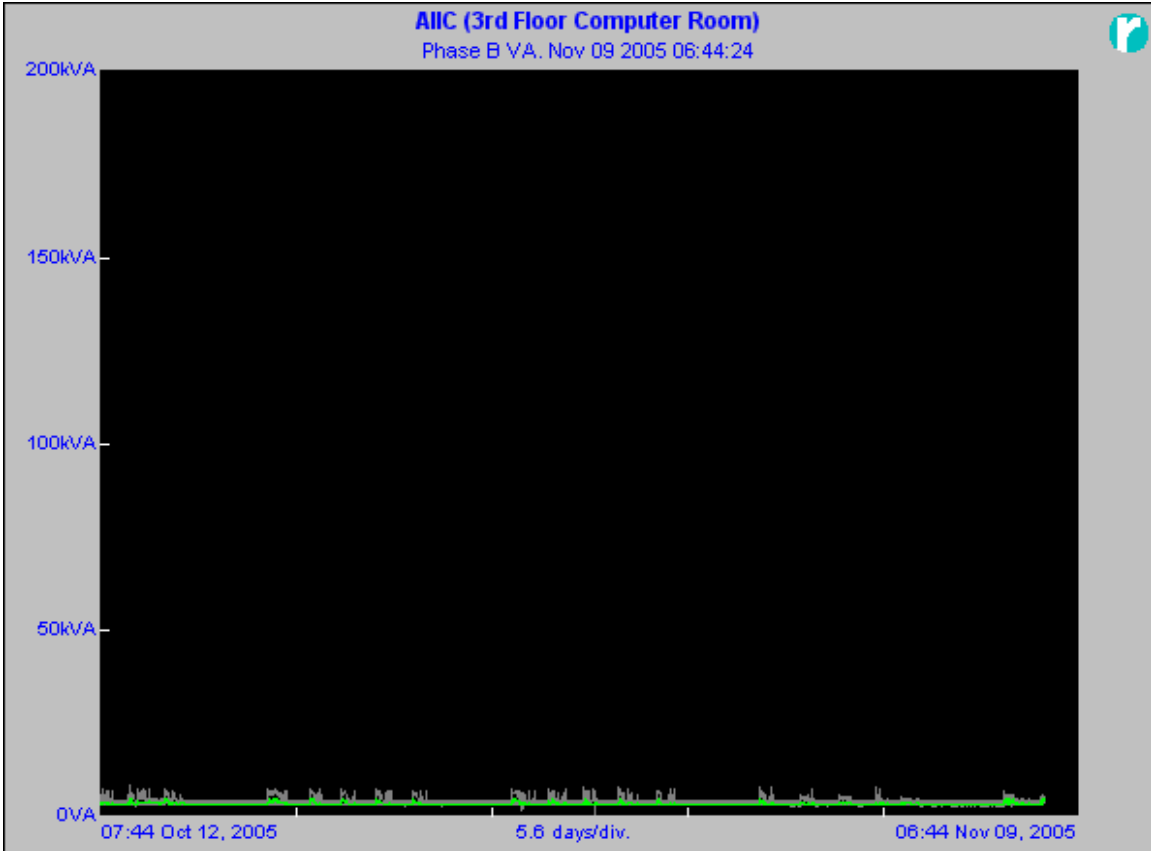


Min. 1.360kVA Oct 26 2005 11:29:24

Avg. 3.955kVA

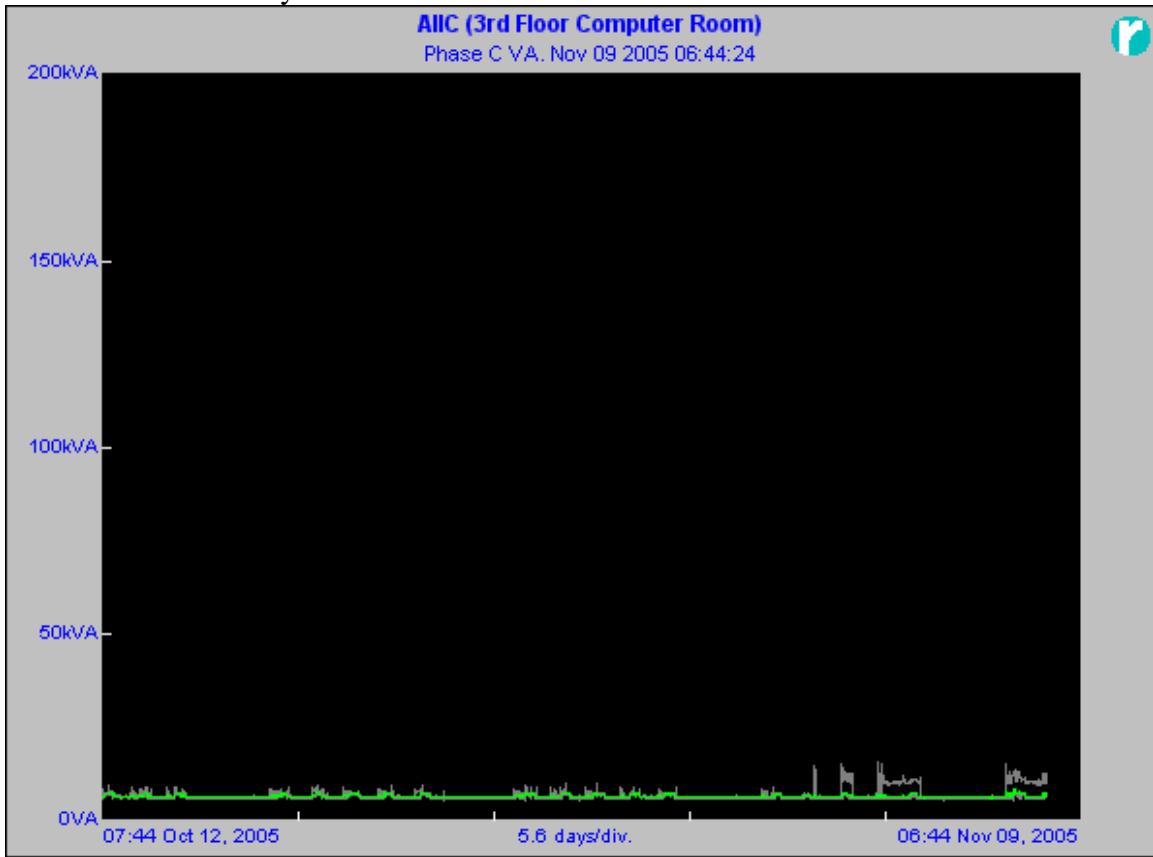
Max. 19.23kVA Oct 12 2005 07:44:24

Phase B VA Summary.



Min. 407.7VA Oct 26 2005 11:29:24
Avg. 3.531kVA
 Max. 8.461kVA Oct 13 2005 03:44:24

Phase C VA Summary.



Min. 5.204kVA Oct 22 2005 02:29:24
Avg. **6.593kVA**
Max. 15.74kVA Nov 03 2005 11:59:24

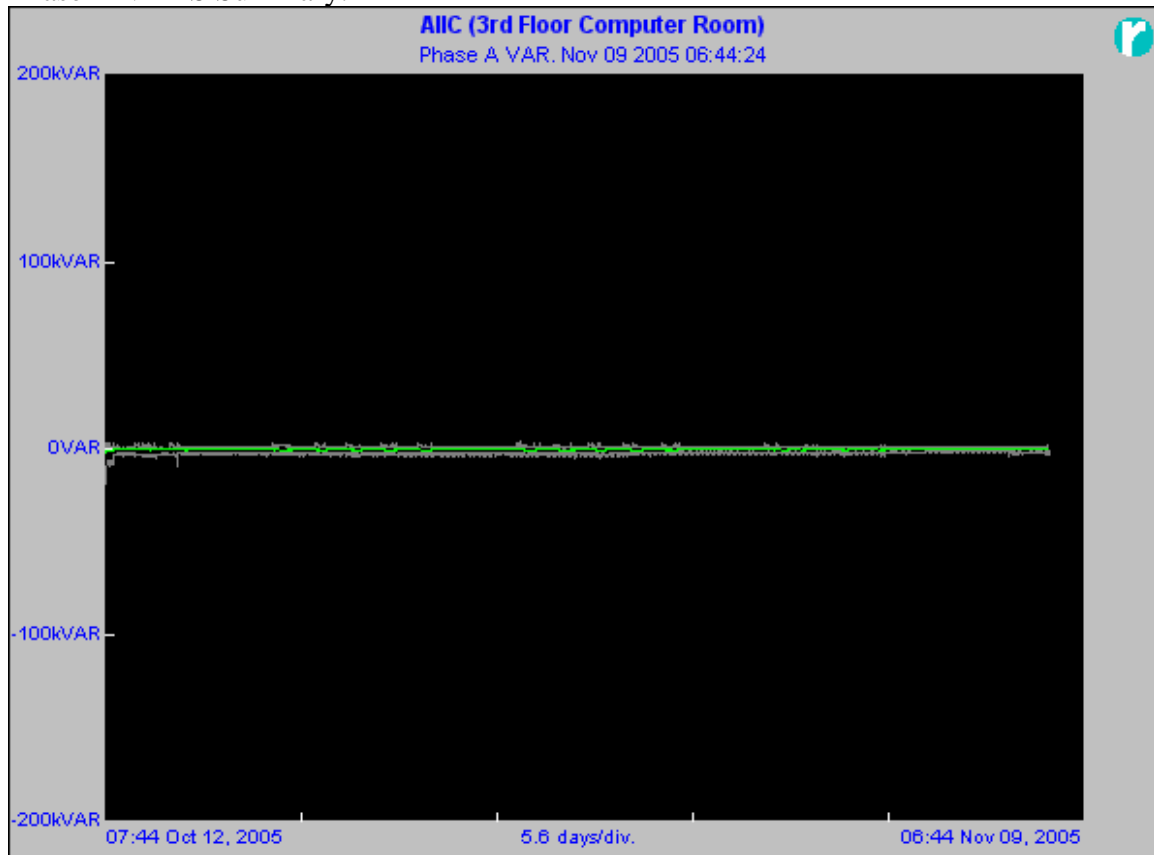
Total VA Summary.



Min. 13.27kVA Oct 21 2005 05:29:24
Avg. 14.08kVA
 Max. 18.79kVA Nov 07 2005 09:29:24

VARs Power Summaries for AIIC:3rd Floor Computer Room.

Phase A VARs Summary.

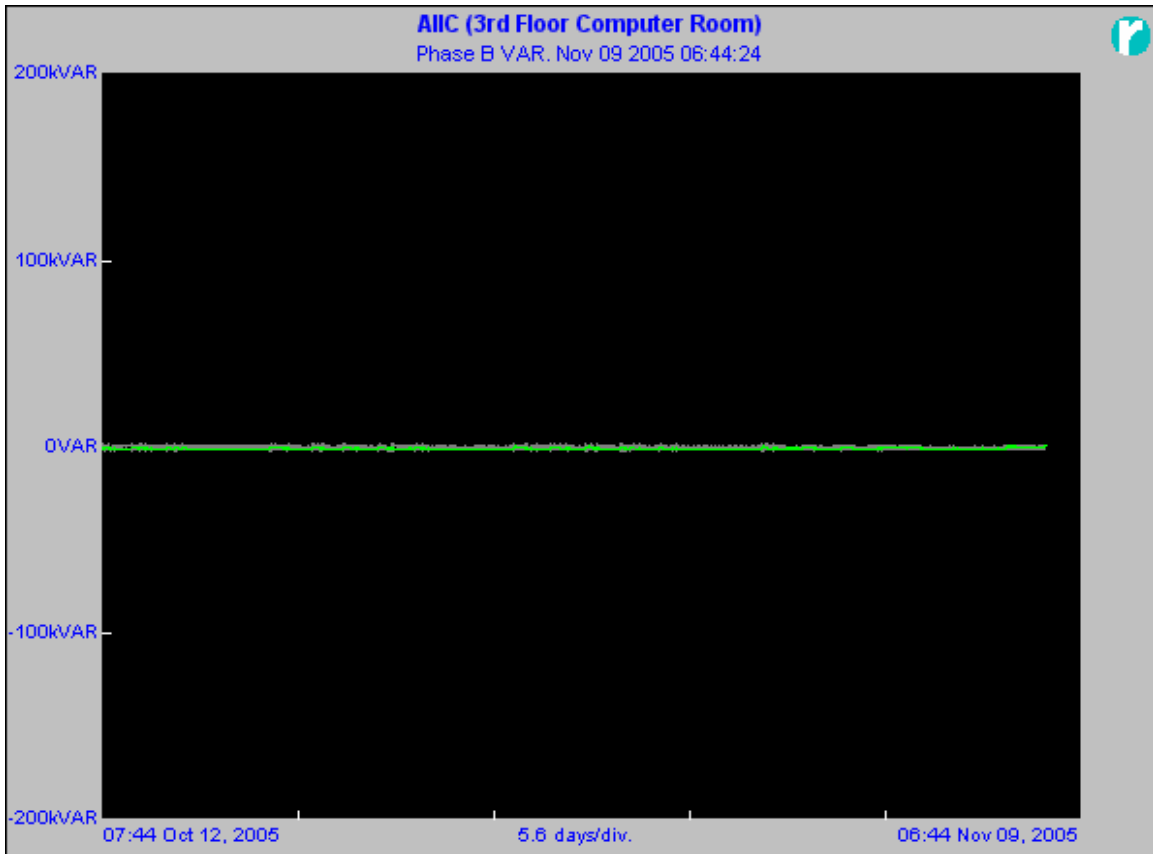


Min. -18.90kVAR Oct 12 2005 07:44:24

Avg. -171.7VAR

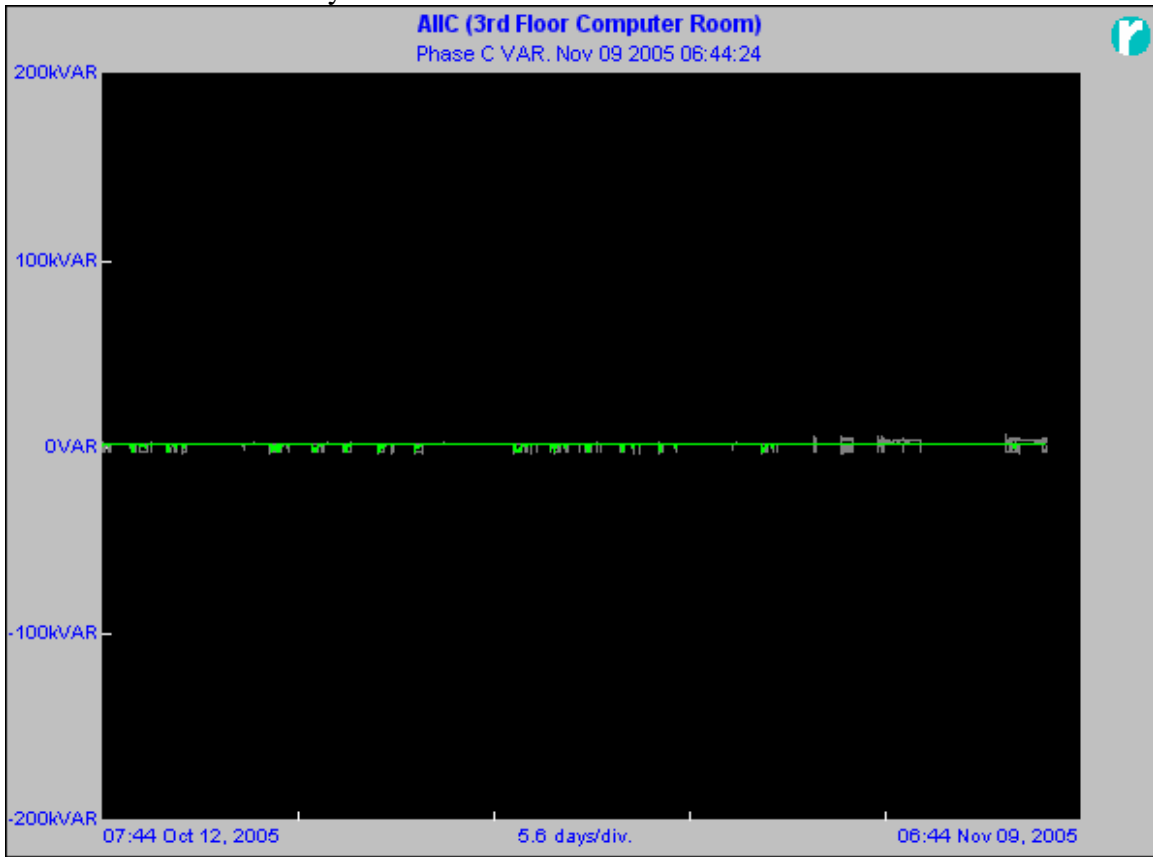
Max. 4.355kVAR Oct 24 2005 04:29:24

Phase B VARs. Summary.



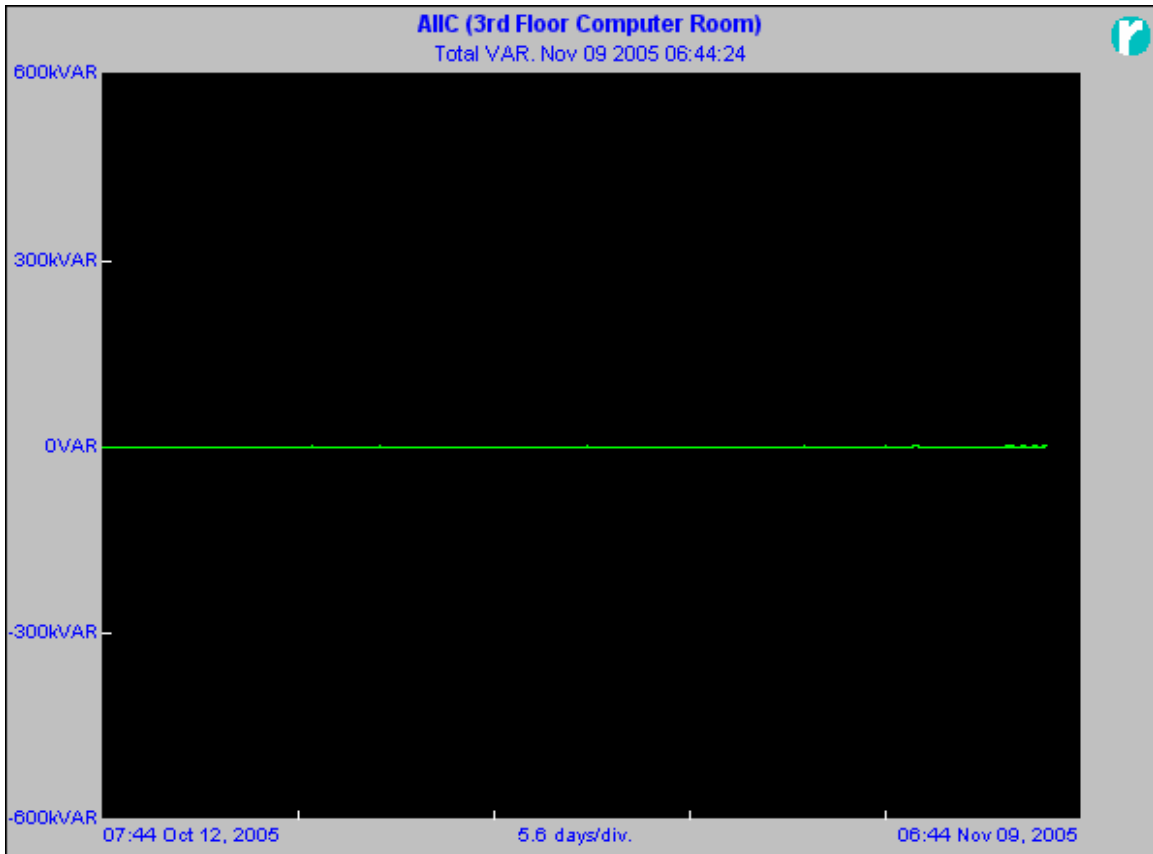
Min. -2.895kVAR Oct 31 2005 03:29:24
Avg. -845.2VAR
 Max. 2.809kVAR Oct 26 2005 03:59:24

Phase C VARS. Summary.



Min. -3.303kVAR Oct 20 2005 14:44:24
Avg. **2.514kVAR**
Max. 7.318kVAR Nov 07 2005 02:59:24

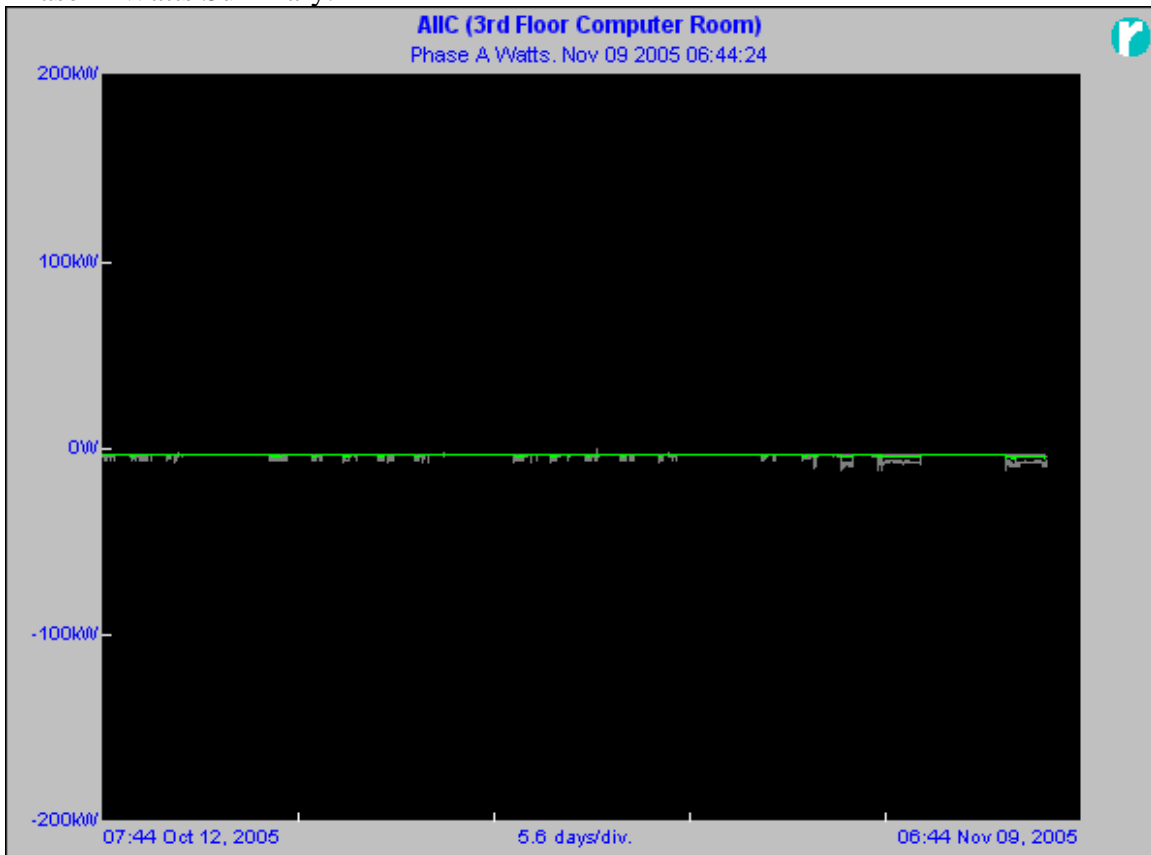
Total VARS Summary.



Min. -3.030kVAR Oct 18 2005 09:29:24
Avg. 1.497kVAR
 Max. 3.844kVAR Nov 08 2005 05:59:24

WATTS Power Summaries for AHC:3rd Floor Computer Room.

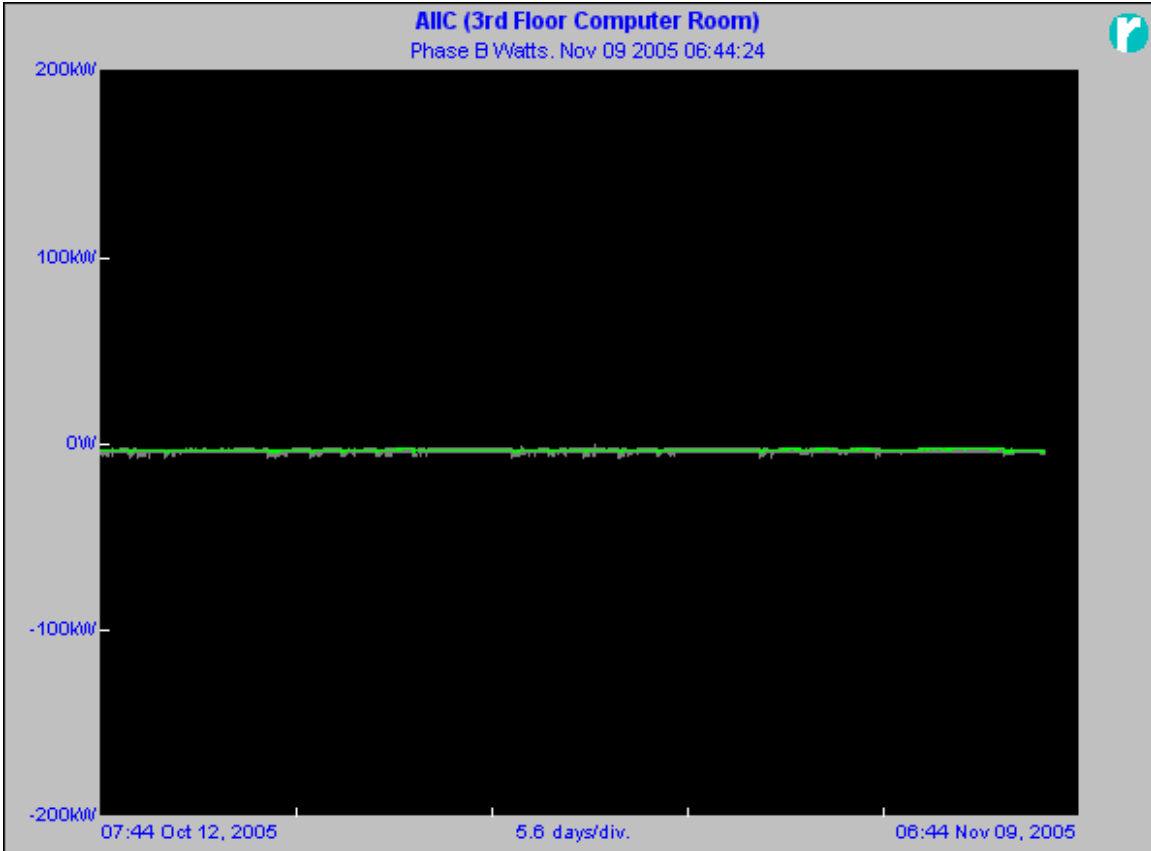
Phase A Watts Summary.



Min. -12.13kW Nov 03 2005 11:59:24 Avg. -3.776kW

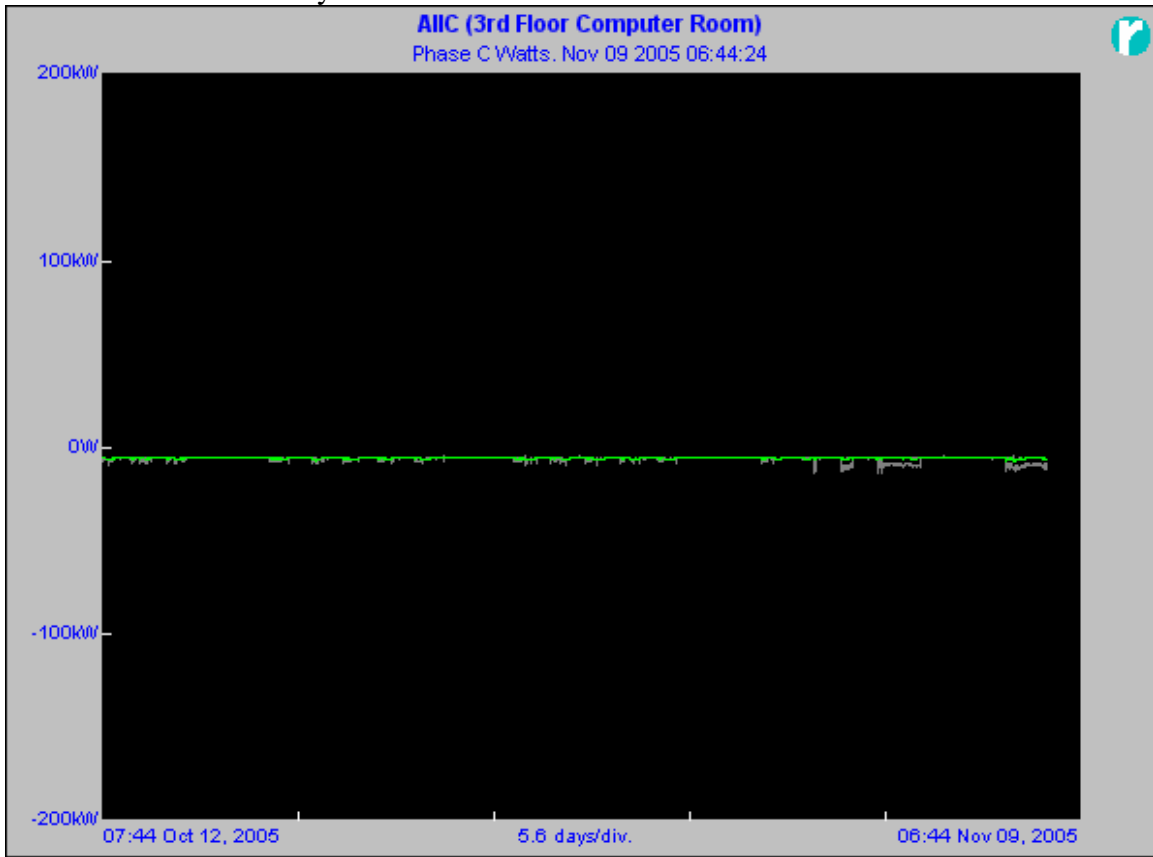
Max. -925.0W Oct 26 2005 11:29:24

Phase B Watts. Summary.



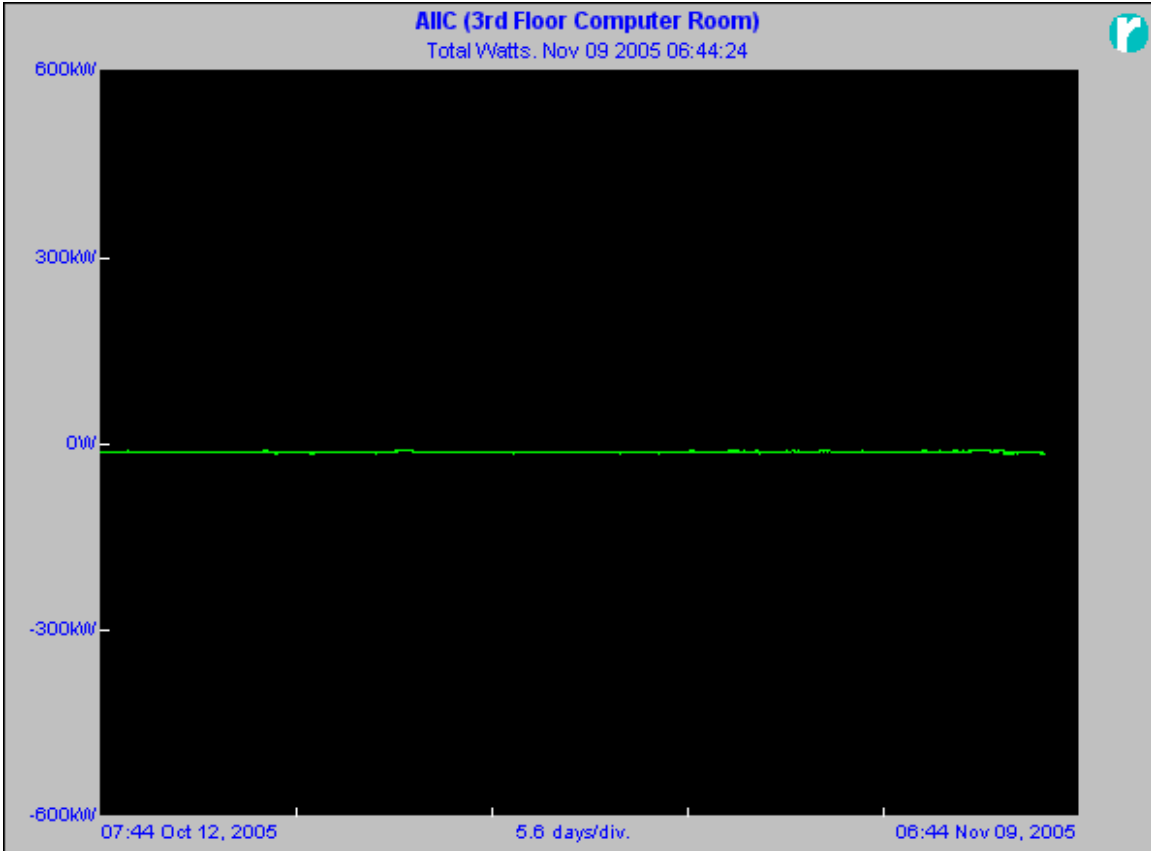
Min. -8.158kW Oct 13 2005 03:44:24
Avg. -3.354kW
 Max. -406.8W Oct 26 2005 11:29:24

Phase C Watts. Summary.



Min. -14.19kW Nov 03 2005 11:59:24
Avg. **-5.999kW**
Max. -4.643kW Oct 25 2005 23:59:24

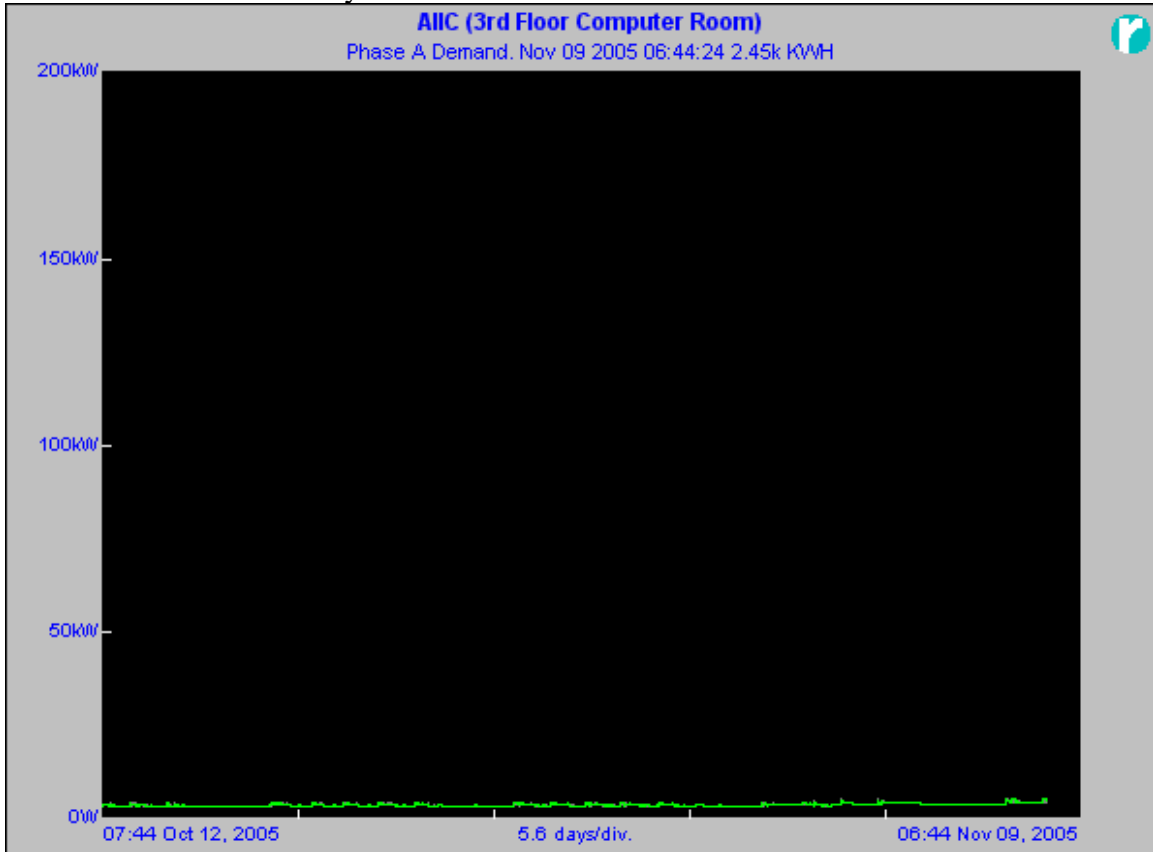
Total Watts Summary.



Min. -17.92kW Nov 07 2005 09:29:24
Avg. -13.12kW
 Max. -12.27kW Oct 21 2005 02:29:24

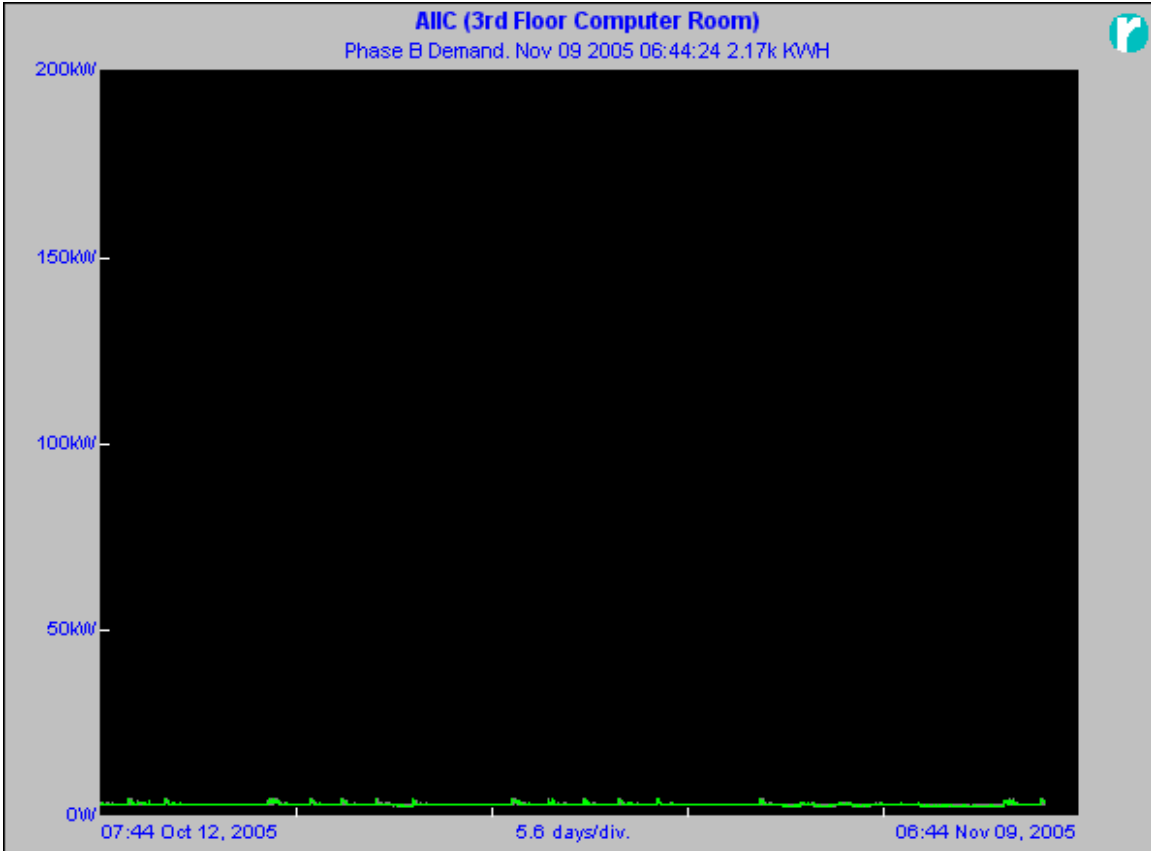
Demand Power Summaries for AHC:3rd Floor Computer Room.

Phase A Demand Summary.



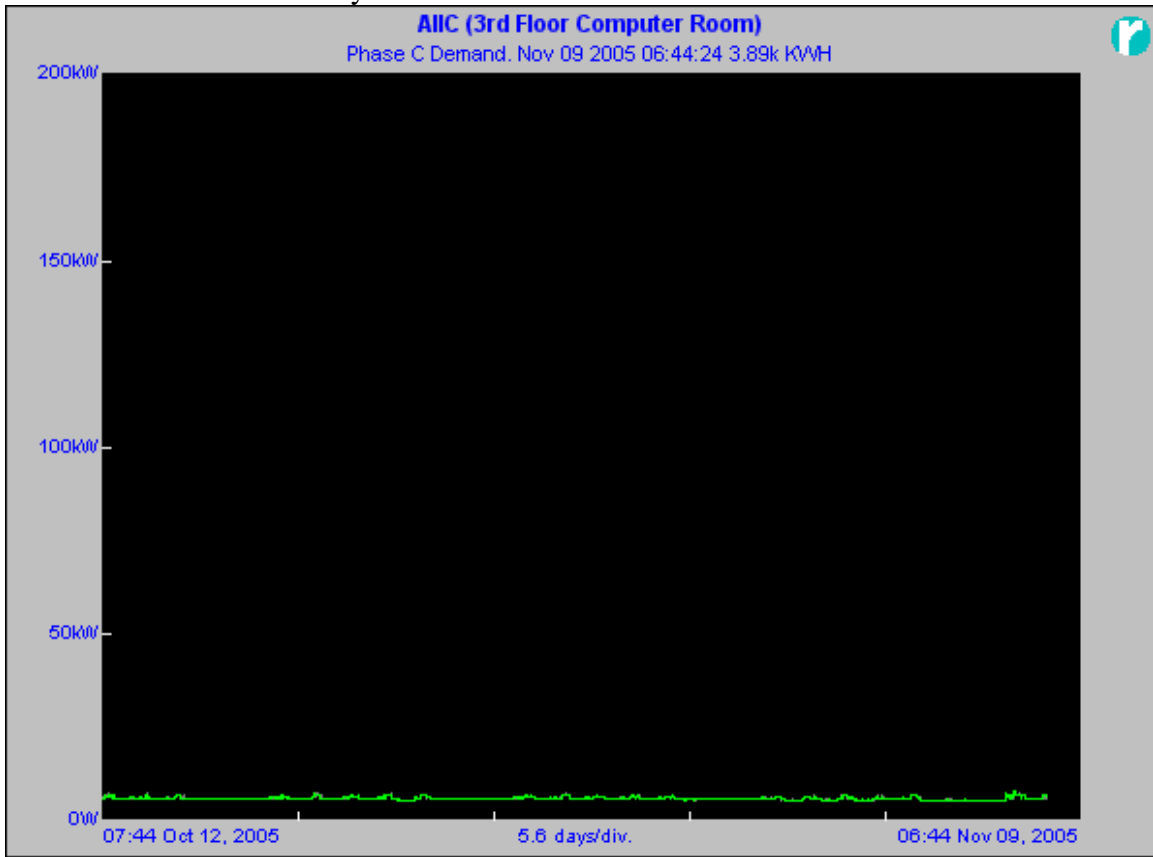
Min. 3.358kW Oct 13 2005 16:39:24
Avg. **3.776kW**
Max. 5.412kW Nov 07 2005 03:19:24

Phase B Demand Summary.



Min. 3.030kW Nov 07 2005 00:04:24
Avg. 3.354kW
 Max. 5.001kW Oct 14 2005 04:09:24

Phase C Demand. Summary.



Min. 5.609kW Oct 21 2005 03:19:24
Avg. **5.999kW**
Max. 7.990kW Nov 07 2005 09:14:24

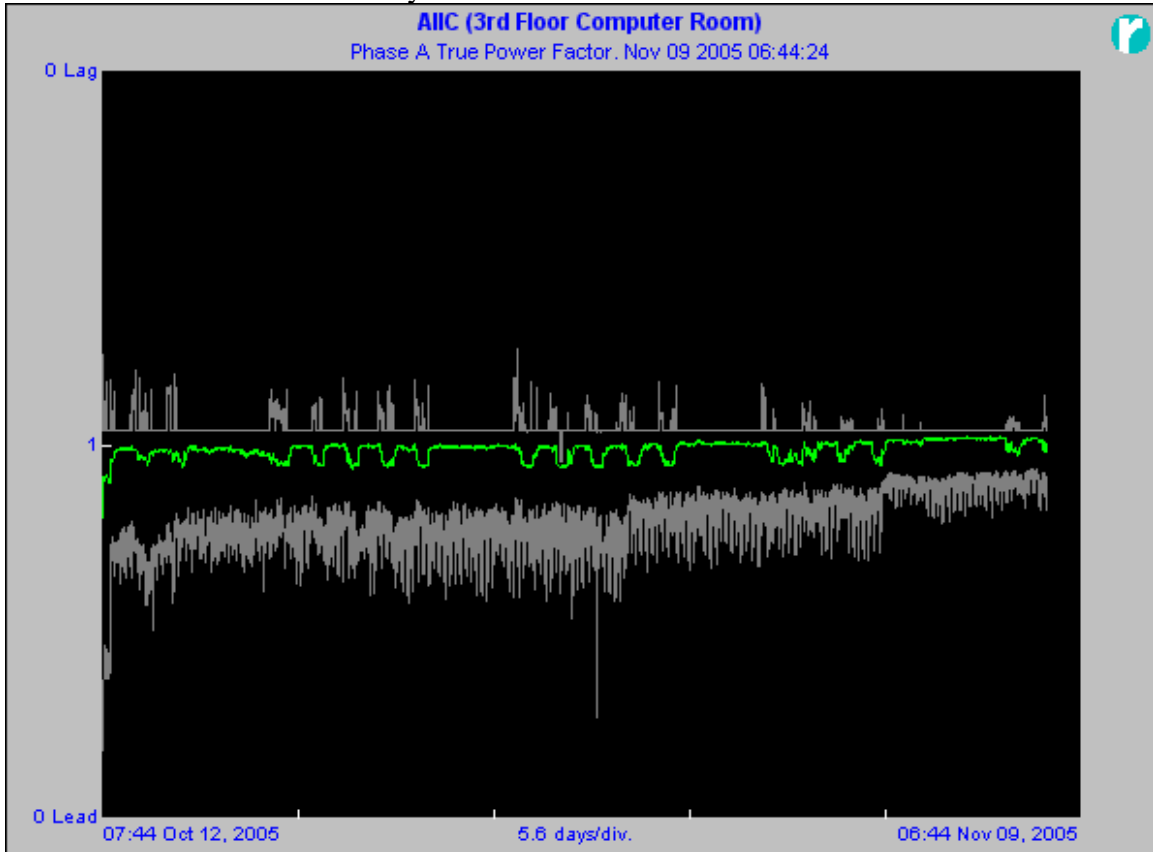
Total Demand Summary.



Min. 12.26kW Oct 21 2005 02:54:24
Avg. 13.12kW
 Max. 17.92kW Nov 07 2005 09:34:24

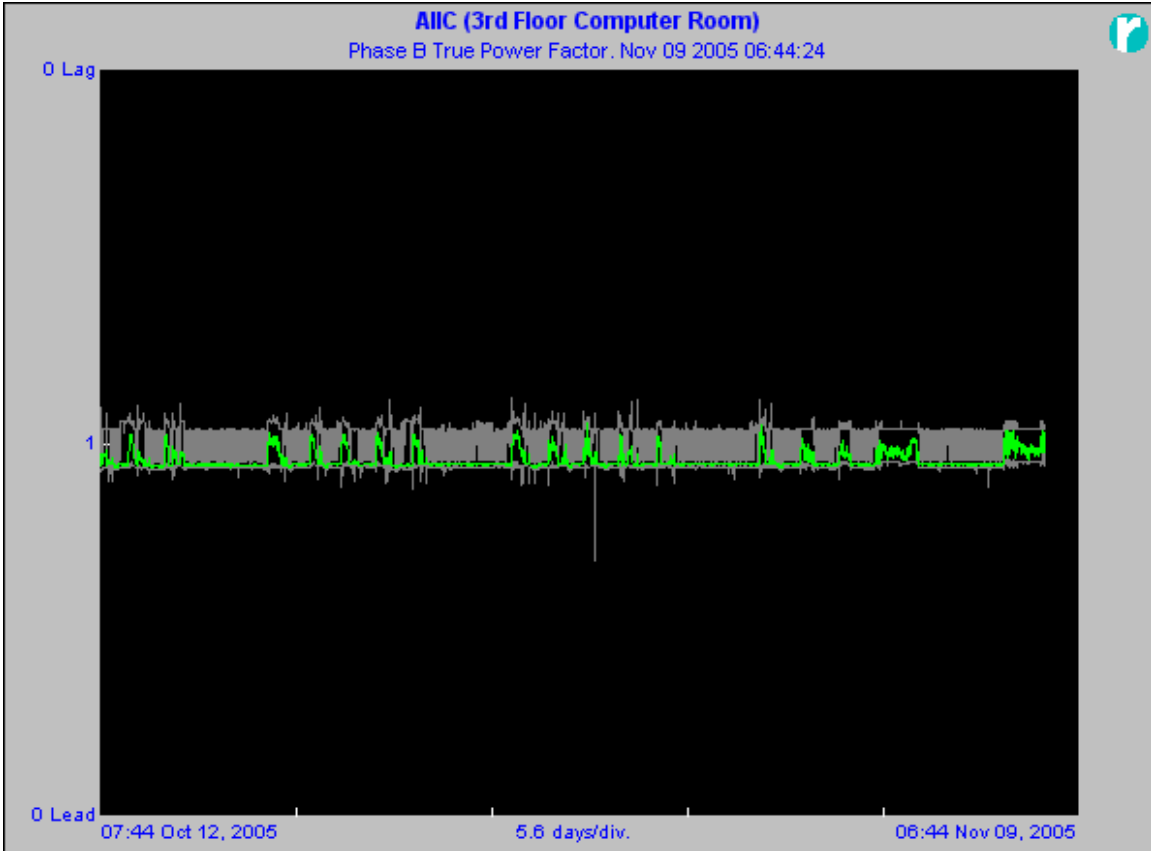
Power Factor Summaries for AIIC:3rd Floor Computer Room.

Phase A Power Factor Summary.



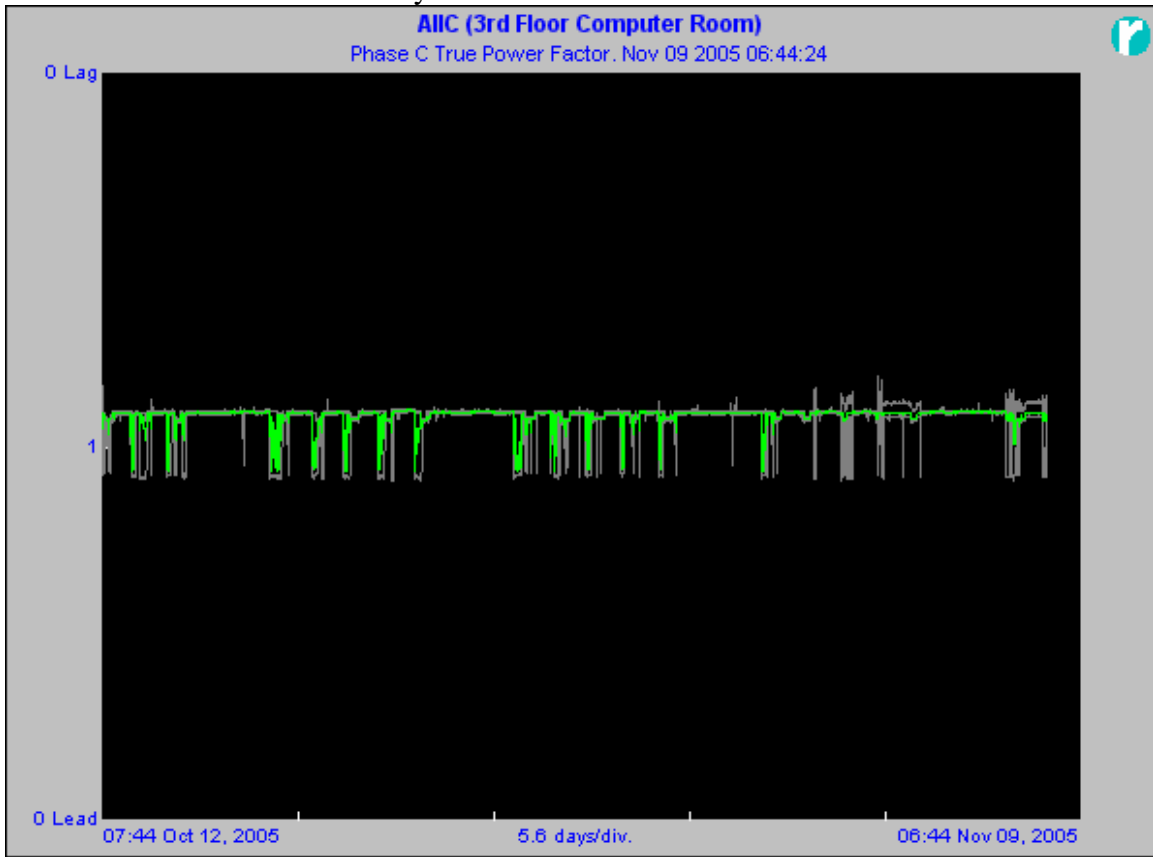
Min. 0.184 Lead Oct 12 2005 07:44:24
Avg. **0.989 Lead**
Max. 0.739 Lag Oct 24 2005 04:29:24

Phase B Power Factor. Summary.

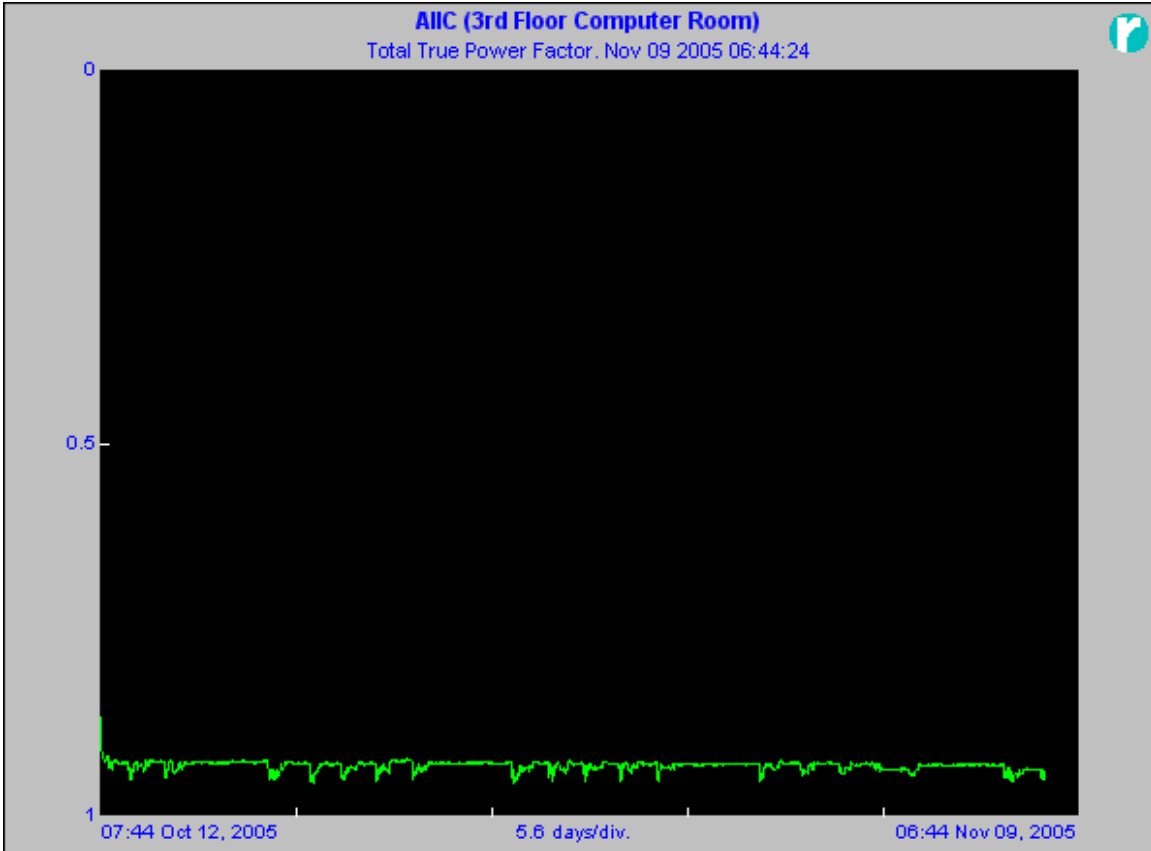


Min. 0.686 Lead Oct 26 2005 11:29:24
Avg. **0.957 Lead**
Max. 0.873 Lag Oct 24 2005 02:59:24

Phase C Power Factor. Summary.



Min. 0.910 Lead Oct 21 2005 09:59:24
Avg. 0.915 Lag
Max. 0.805 Lag Nov 03 2005 11:59:24
Total Power Factor Summary.



Min.	0.955	Oct 24 2005 03:14:24
Avg.	0.932	
Max.	0.866	Oct 12 2005 07:44:24