



# Energy Management Diagnostics

## ENERGY STAR Monthly Partner Web Conference

**March 21, 2007**

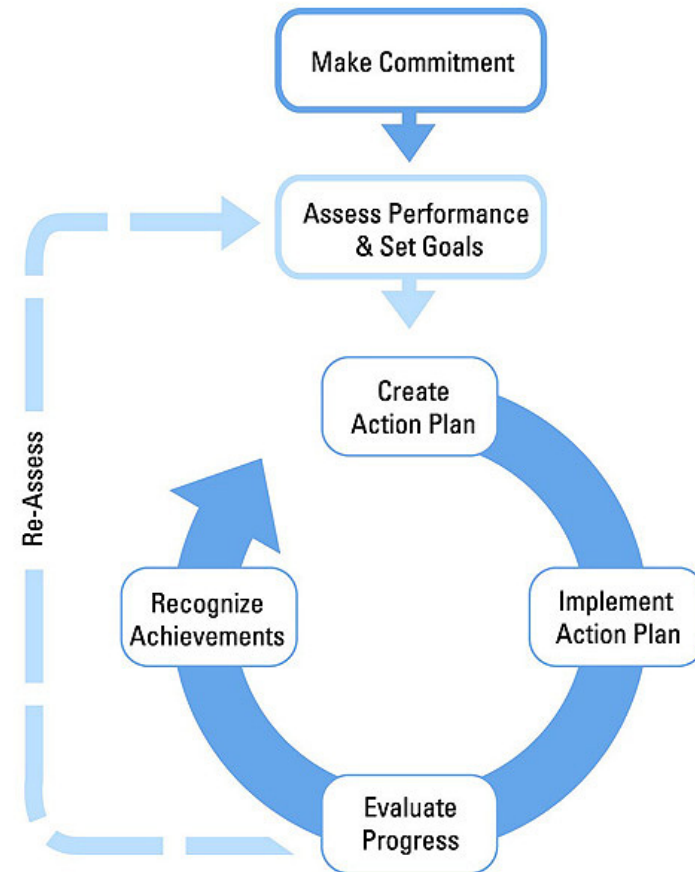
Call-in Number: 1-866-299-3188

Conference Code: 202 343 9965

# About The Web Conferences



- Monthly
- Topics are structured on a strategic approach to energy management
- Opportunity to share ideas with others
- Slides are a starting point for discussion
- Open & Interactive
- Supports the **ENERGY STAR Challenge** to build a better world, 10% at time



# Web Conference Tips



- Mute phone when listening! Improves sound quality for everyone.  
Use \* 6 – to mute and # 6 to un-mute
- Hold & Music – If your phone system has music-on-hold, please don't put the web conference on hold!
- Presentation slides will be sent by email to all participants following the web conference.

# Today's Web Conference



Energy Management Diagnostics –  
Using metering information to identify and solve  
energy use problems

Presenters:

- Carlos Montanez – Philips Academy
- Gary Smith – Honda of America

# Phillips Andover Academy Energy Star Web Conference



(Photo by John Hurley)

Carlos Montanez  
Jonathan McDonnell  
3/21/07



# Background

Phillips Andover Academy is a private co-educational boarding school.

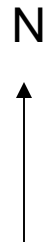
- Founded in 1778
- Grades 9-12 w/ post graduate year
- International students from 36 countries
- Located just north of Boston
- Tuition cost for Fall 2007 \$38,000

# Phillips Academy Campus

Power Plant



500 Acres



# Facts

- 150+ Buildings w/ over 1.85 million ft<sup>2</sup>
- Annual Campus growth for the past five yrs = 4.6 %
- 1012 students, approx. 800 Boarders
- 258 faculty, 338 staff
- Annual Elect. usage @ approx. 13.5 million KW
- Annual Natural Gas usage @ approx. 90,000 mmBTU
- Annual Diesel fuel usage @ approx. 420,000 gals.
- Estimated energy costs for FY07 approx. \$4.8 million dollars



# What lead to the decision to install extensive sub-meters?

- Old Maxim “You can’t manage what you don’t measure”
- Education is a business, we must compete with other schools for students
- Rising costs in energy have made a huge impact in adequately funding facilities improvements
- As a Facilities Professional, it is my responsibility to effectively manage the rising costs of energy at Phillips Academy

**What do you track and monitor?  
Explain how this information is used to  
manage energy use.**

- One of the biggest challenges was capturing energy usage throughout campus from those buildings that receive their heat and electricity from the Central Heating and Power Plant.
- The data can then be entered into a spreadsheet to establish a BTU/ft<sup>2</sup> index for comparison purposes.

# What do you track and monitor?

We track and monitor:

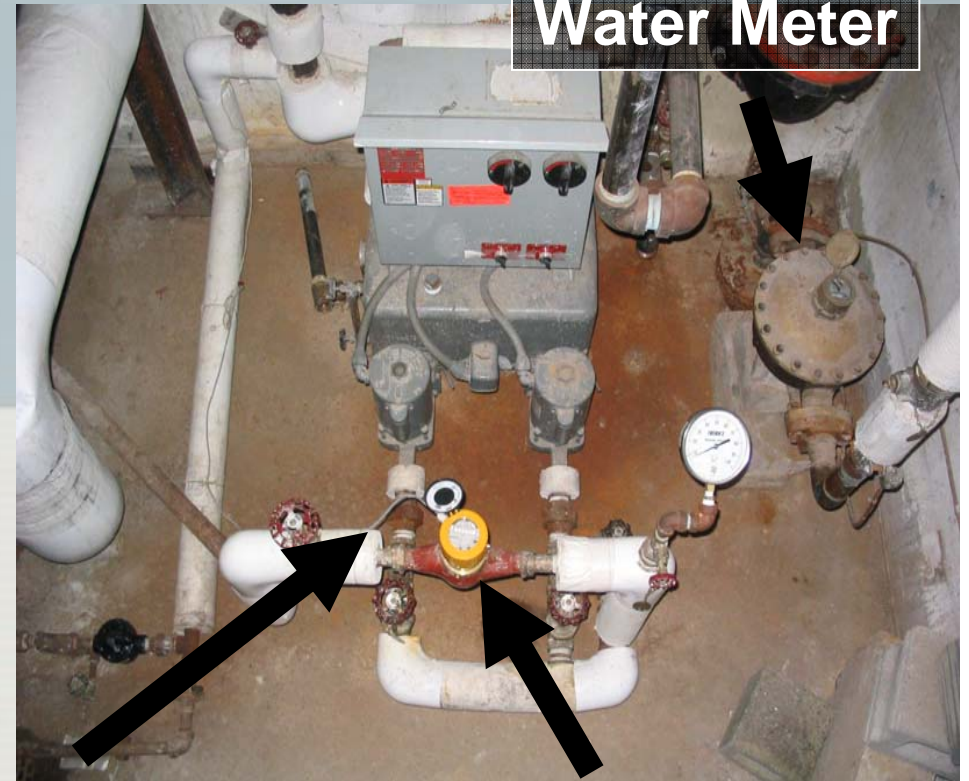
- Steam flow and condensate returns from the Power Plant to all areas of the Campus.
- Steam usage in every building served by the Power Plant.
- All of the Electricity that leaves the Power Plant to the campus buildings
- All the Electric usage in the buildings served by the Power Plant.

# **How is this information used to manage energy consumption?**

We collect all of this information to trend building energy usage, campus distribution losses, and compare against historical averages to identify areas to improve upon.

# Condensate Sub-meters

- 10 Dorms
- 5 Administration Buildings
- 14 Academic Buildings



**Water Meter**

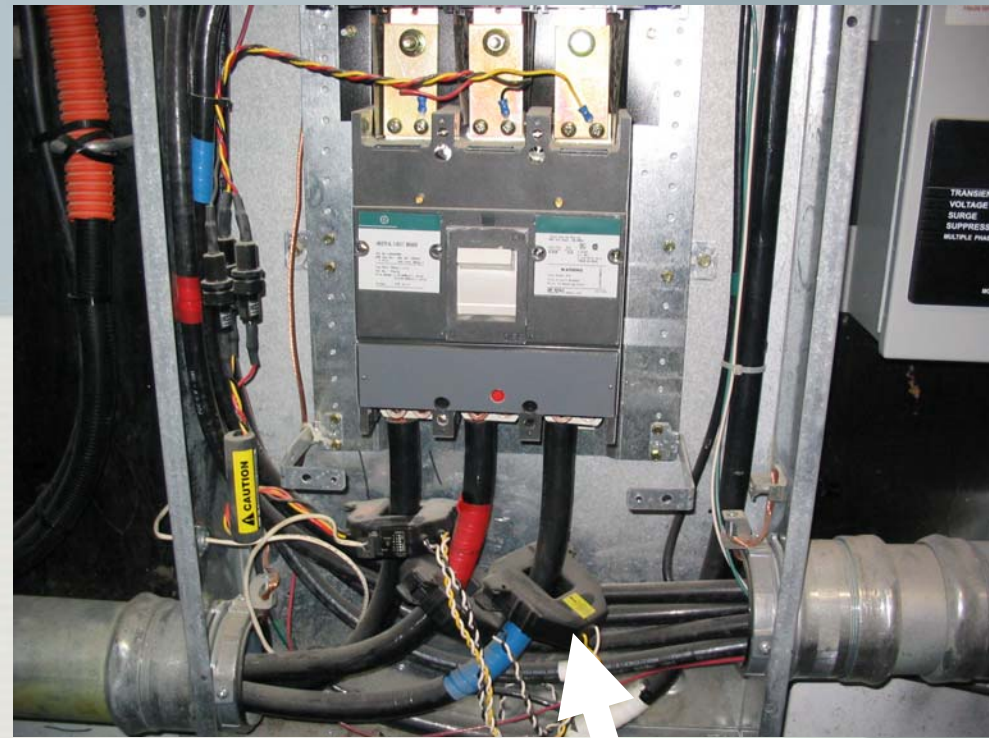
**Energy Management System Connection**

**Condensate Meter**



# Digital Energy Sub-meters

- 14 Dorms
- 5 Administration Buildings
- 5 Academic Buildings
- 2 Chiller Plants



**Digital Energy Meter  
Current Transformer(s)**



# Diagnostic Story

What first alerted you that there was an issue/problem?

- In 1994 the Central Heating and Power Plant was exporting about 1 million lbs/stm/day to the campus when the Outside Air temperature was in the single digits.
- The amount of condensate return was approx. 55%. The school was losing 45% due to leaks in direct burial steam lines and within the buildings.

## **What steps did you take to determine where the problem was coming from?**

- Installed sub-meters on all steam lines leaving the Power Plant and condensate coming back from the campus.
- Monitored and tracked distribution percentage differences and conducted steam vault in-service audits
- Made Capital requests to the administration to invest in steam line improvements, building mechanical system upgrades, and sub-metering installations
- Isolated piping sections from vault to vault to determine leak locations

# How did you fix it?

- We began by performing a comprehensive capital replacement program of areas identified with pipeline failures.
- Received annual funding for steam line replacement. To date the school has invested over \$9 million dollars in improvements and renewal.
- Today, the steam condensate losses are approx. 9%-11%
- In today's dollars, these improvements would have saved over \$7,800 in one day based upon our initial conditions in 1994.

# Power Plant Monthly Steam Usage

DATE	DAY	TEMP	D.D. <sup>1</sup>	FUEL CONSUMPT.		STEAM OUTPUT (EFF.)			BTU D. D. <sup>2</sup>	MWD	MARKUP		FUEL DAY (cents \$)			Gas Day (\$/CF)
				OIL(gal)	Gas(\$/CF)	OIL	Gas	TOTAL			WATER	% Markup	OIL	Gas	TOTAL	
1	MON	37	20		443		375	375	165		50629	14%			428	
2	TUE	37	20		445		360	360	158		48075	15%			474	
3	WED	38	27		468		379	379	173		44681	12%			450	
4	THU	44	21		428		345	345	200		49051	14%			379	
5	FRI	55	10		363		245	245	200		44375	18%			259	
6	SAT	61	4		290		203	203	189		41289	20%			309	
7	SUN	44	21		385		315	315	185		44644	14%			400	
8	MON	42	23		432		350	350	180		55580	18%			489	
9	TUE	35	30		509		412	412	170		44438	11%			529	
10	WED	29	36		593		480	480	165		41412	9%			644	
11	THU	25	40		657		532	532	164		41231	8%			812	
12	FRI	29	36		504		400	400	194		32419	8%			444	
13	SAT	43	22		442		350	350	201		26750	8%			473	
14	SUN	33	32		545		441	441	170		29451	7%			572	
15	MON	32	33		593		480	480	180		32680	7%			594	
16	TUE	28	39		691		535	535	169		32288	6%			759	
17	WED	18	55		811		657	657	147		48919	7%			810	
18	THU	21	44		727		589	589	165		50438	6%			859	
19	FRI	32	33		597		484	484	161		35220	7%			801	
20	SAT	23	42		697		565	565	166		36031	7%			762	
21	SUN	18	49		798		614	614	155		40631	7%			731	
22	MON	22	43		727		589	589	169		37187	6%			731	
23	TUE	25	40		695		563	563	174		35488	6%			675	
24	WED	29	36		638		517	517	177		44380	6%			641	
25	THU	19	49		741		600	600	161		32488	6%			831	
26	FRI	3	62		813		740	740	147		55378	7%			910	
27	SAT	13	52		849		698	698	163		45432	7%			762	
28	SUN	27	39		678		548	548	176		34238	6%			899	
29	MON	21	44		752		609	609	171		44689	7%			770	
30	TUE	28	45		754		611	611	166		44183	7%			745	
31	WED	21	44		729		590	590	166		46288	6%			709	
AVERAGE		29.7			#DIV/0!	625	#DIV/0!	490	490	178	42280	8%	#DIV/0!	\$ 11.3	\$ 11.3	
TOTAL					0	18244	3	15109	15109					\$ 2658		11430

**NOTES:**

<sup>1</sup> Default value of 1 Degree Day is used if Temperature is > or = 65 degree F., or null (no value). Default value is not included in Cumulative Total or average.

<sup>2</sup> BTU/D. D. reflect values for normal operating range only and are not calculated when figure exceeds 360.

January 2007





**Power Plant Condensate  
Sub-meter**



# Some Lessons

- Identify the low hanging fruit (Energy Hogs). They are the easiest pickings and then put a program together.
- Convince management that the investment into sub-metering is worth every penny. (Lighting retrofits, dehumidification, fume hoods, boiler burner technology, capacitor banks and co-generation)
- Document and demonstrate that savings in energy are being realized by collecting accurate data.
- Success breeds success, especially when the administration sees energy usage reductions and resultant savings being effectively managed.



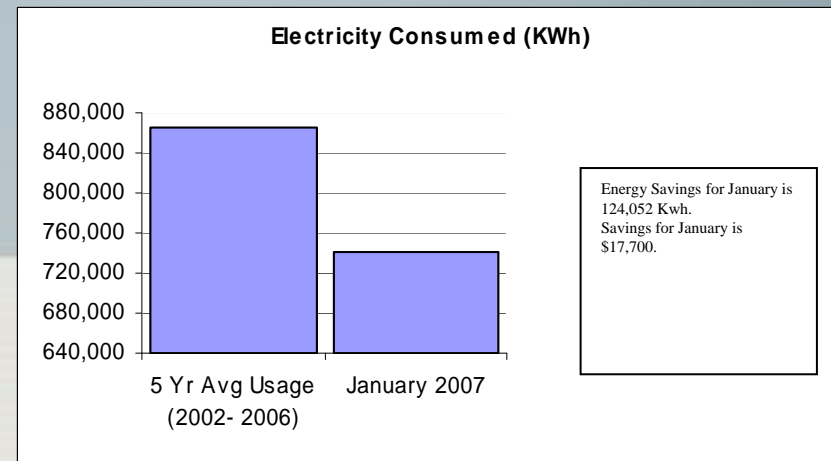
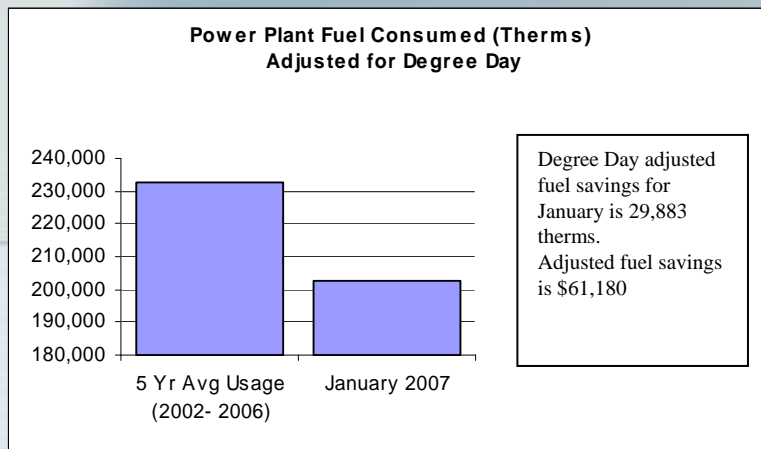
# Cogeneration Plant

- Installed in 1996
- Produces 1 million KWH/yr
- Saves approx. \$130K/yr in avoided costs
- Cost to install approx. \$360K
- Payback less than 3 years
- Maintenance cost to date approx. \$38K



# Monthly Gazette Feature

## Campus Conservation Efforts



**These charts appear monthly in the campus Newsletter to help the community recognize the financial impact of their conservation efforts**

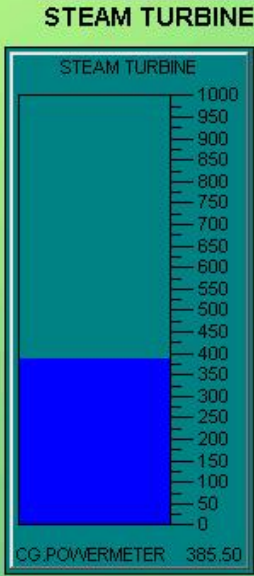
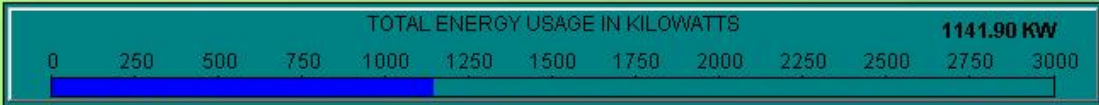
SBTT

Graphics - [Green Cup Challenge]

File Edit View Insert Dynamic Tools Window Help

# Phillips Academy Green Cup Challenge

## CAMPUS ELECTRIC USAGE

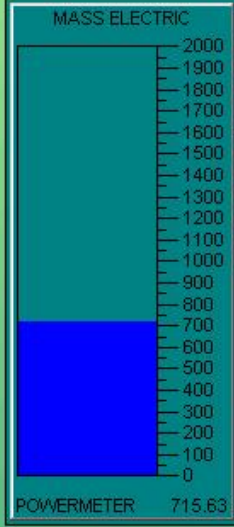


DAY TOTAL  
8369.62 KWH

WEEK TOTAL  
8369.62 KWH

CG.BASELINE  
Descriptor

4 WEEK TOTAL  
132718.81 KWH

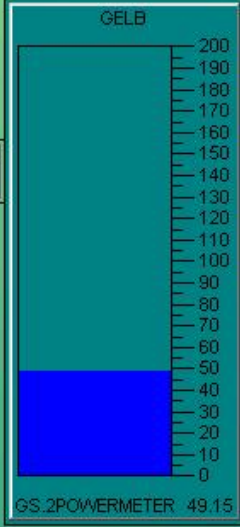


DAY TOTAL  
7099.90 KWH

WEEK TOTAL  
7099.90 KWH

PR PLANT BASELINE  
168068 KWH AVG

4 WEEK TOTAL  
206321.72 KWH



DAY TOTAL  
804.32 KWH

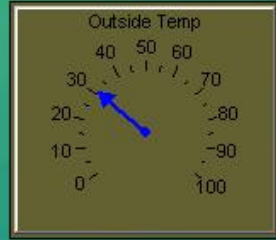
WEEK TOTAL  
804.32 KWH

GELB BASELINE  
11667 KWH AVG

4 WEEK TOTAL  
21226.68 KWH

DORMS

ACADEMIC



**Note: During the one month competition, energy reduction of 3.7% could be attributed to personal habit**

Questions?

*Thank You*



# *Energy Diagnostics through Metering*

*in an Auto Manufacturing Facility*

***Measuring Energy Use to Improve Energy  
Performance, Power Quality and Reliability***

*Presented by: Gary C Smith, Honda of America Mfg., Inc.  
March 2007*



# *Energy Diagnostics through Metering*

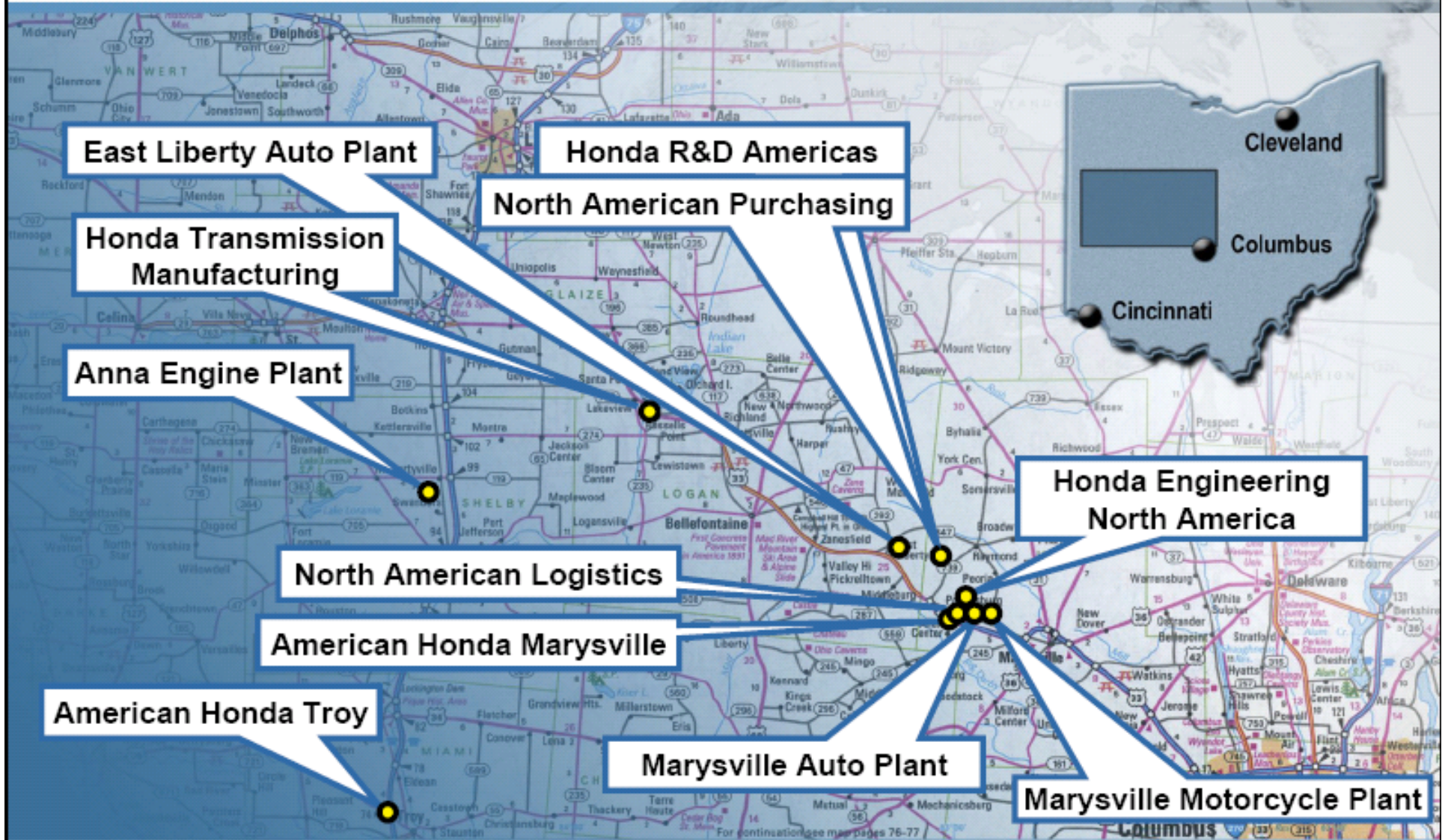
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## OVERVIEW

- Who is Honda
- Know your Energy
- Efficiency Up
- New Technology



# Operations in Ohio



Marysville and East Liberty = 8,100 acres

**HONDA**

## *Energy Diagnostics through Metering*

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### Know Your Energy

- *You cannot manage that which you cannot measure*
- Know your demand and your consumption
- Metering is essential
  
- Primary Metering
  - Electricity
  - Natural Gas
  - Steam
  - Compressed Air

*The very least metering you have is the Utility metering serving you. The best is a meter on every process. Reality is somewhere in between.*

*Energy Diagnostics through Metering*

# **Your Meter is your Cash Register!**



## *Energy Diagnostics through Metering*

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### Know your Energy

- Sub Metering (Metering for departments)
  - Electricity
  - Natural Gas
  - Compressed Air
  - Steam
  
- Our goal is to have each department metered separately

*In order for a person or department to take accountability and ownership, you have to give them a yardstick!*

# *Energy Diagnostics through Metering*

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## Know your Energy

- What if you do not have the metering?
  - Calculate
  - Estimate
  - Review your history

*You can use a portable meter to measure before and after scenarios. Calculations will work nicely for achieving approval for a project but management may want to see the result.*

## *Energy Diagnostics through Metering*

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The first step(s)

- Metering
  - Installing metering on all substations
  - Installing the mechanical metering
  - Gathering data (computers)
  - What to do with the data
  - Who should receive the data

*You can have the best, most expensive metering in the world. If it isn't used, it's worthless.*







RESET KW

Plant History 60 Minutes

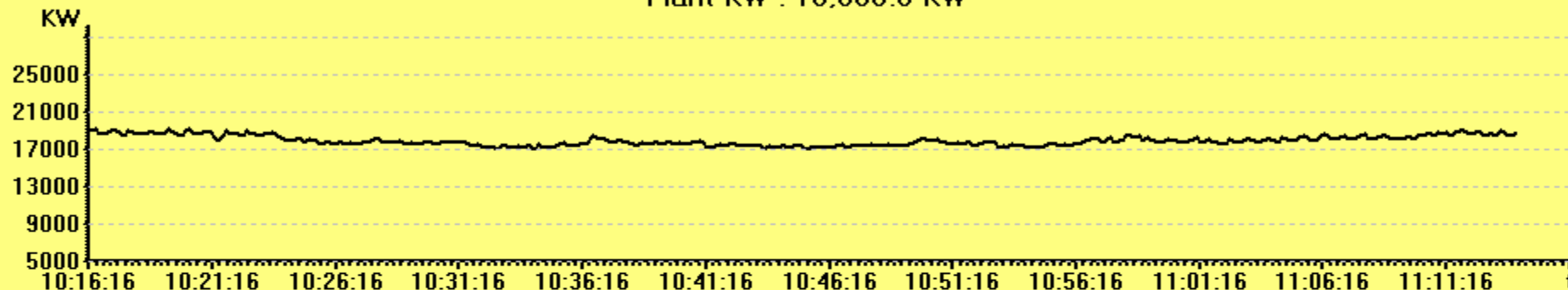
78ki SWD 27,637.6 07/23/01 @ 8:28pm

79ki SWD 27,203 08/01/02 @ 2:41pm

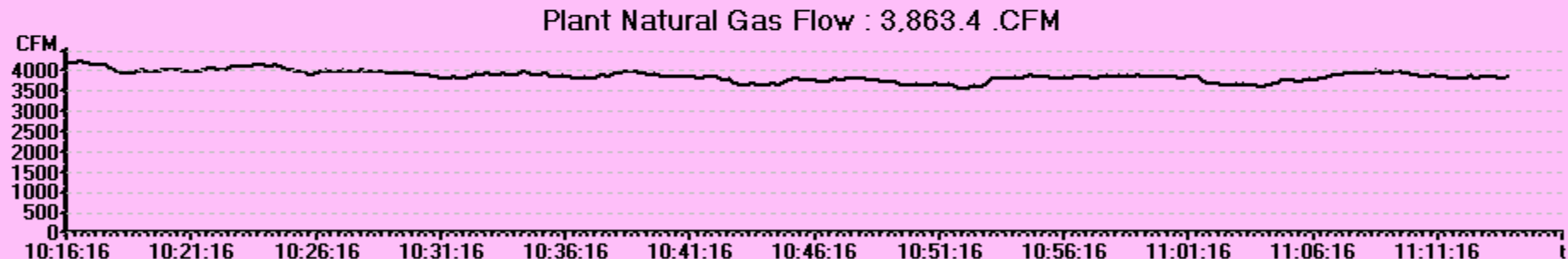
Plant KW Maximum : 28,021.7 @ 7/22/2002 11:51:25.000 AM

Plant KW swd max : 18,860.5 @ 1/2/2003 10:30:20.000 PM

Plant KW : 18,658.8 KW

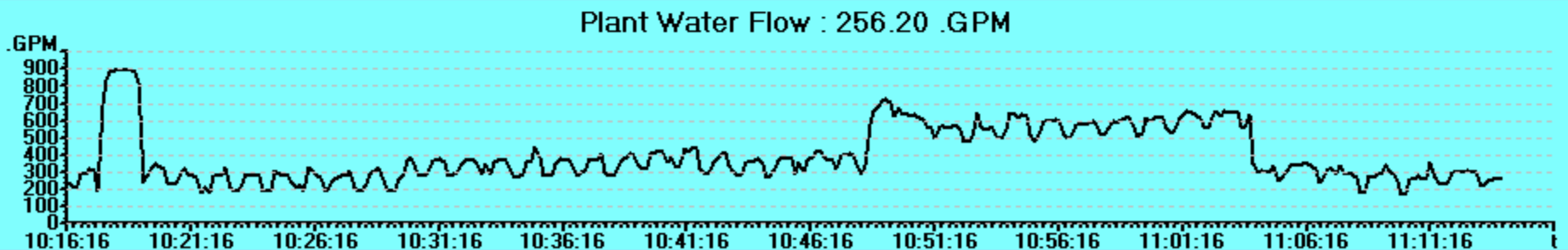


Plant KWHr Total : 2,753,468 KWHr



Plant Natural Gas Flow : 3,863.4 .CFM

Natural Gas Total Usage : 491,563 .MCF



Plant Water Flow : 256.20 .GPM

Water Total Usage : 0.000 701 .KGM



Plant History 60 Minutes

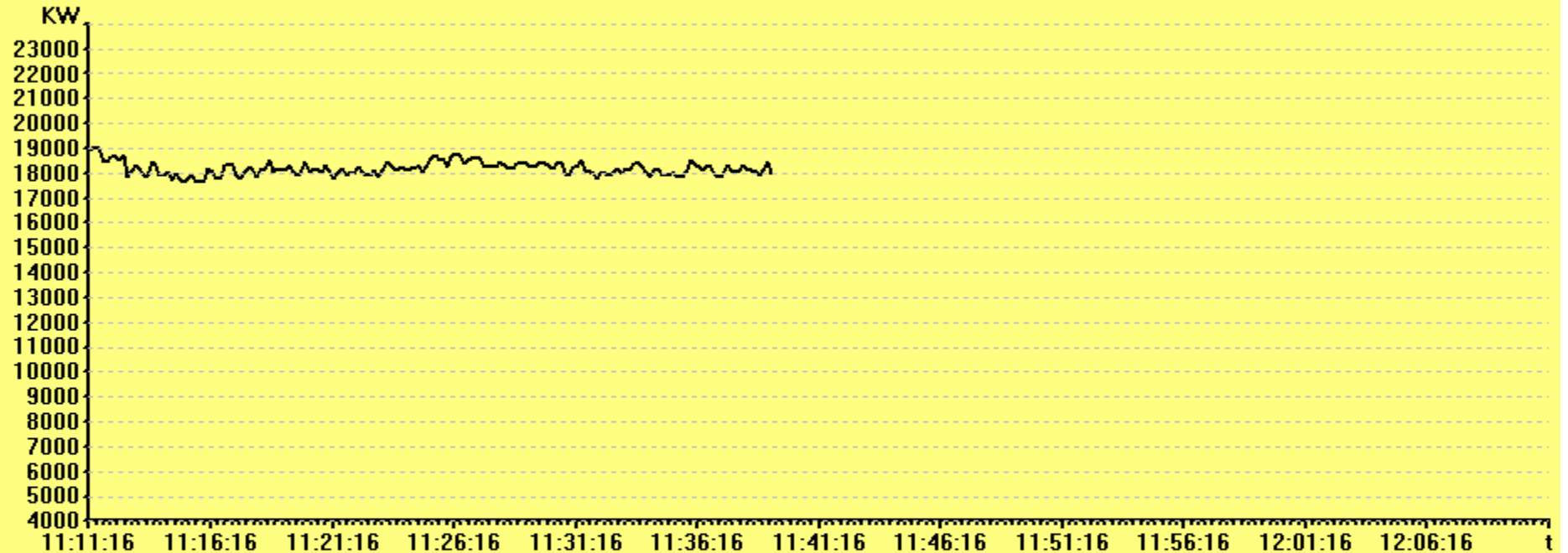
RESET KW

78Ki swd 27,637.6 7/23/01/ 8:28:35 pm  
79Ki swd 27,203. 8/01/02/ 2:41:55 pm

Plant KW Maximum : 28,021.7 @ 7/22/2002 11:51:25.000 AM

Plant KW swd max : 18,860.5 @ 1/2/2003 10:30:20.000 PM

Plant KW : 17,997.8 KW

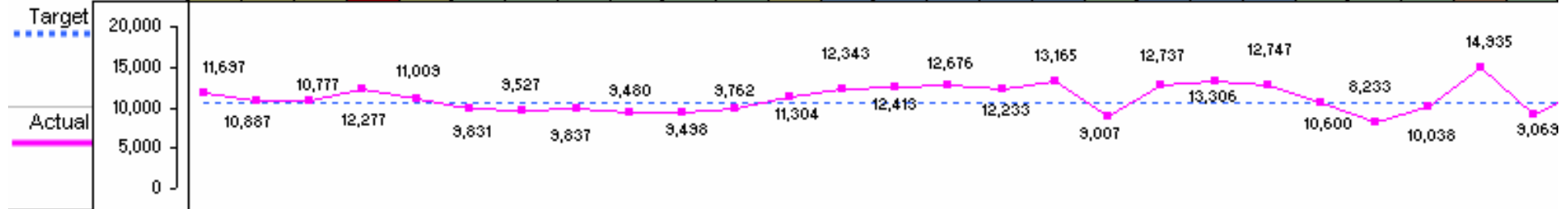


Plant KWhr Total : 2,763,856 KWhr

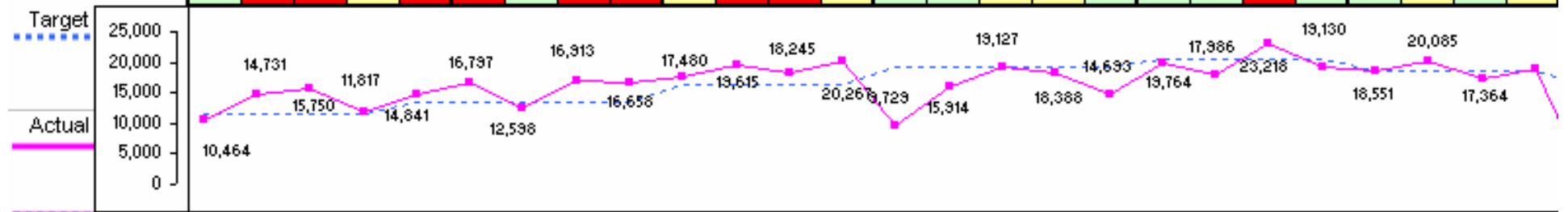
**17,997.8 KW**

# Weekend Electric (kWh) Reduction Scorecard 82 Ki

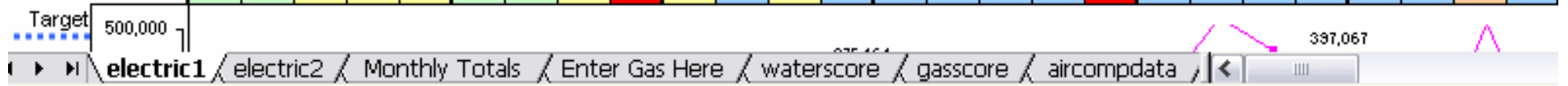
Audit Dates in Red	April					May				June				July					Aug				Sep			
	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24
ADM	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658	10,658



AQG	11,429	11,429	11,429	11,429	11,429	13,605	13,605	13,605	13,605	16,317	16,317	16,317	16,317	19,078	19,078	19,078	19,078	19,078	20,443	20,443	20,443	20,443	18,596	18,596	18,596	18,596
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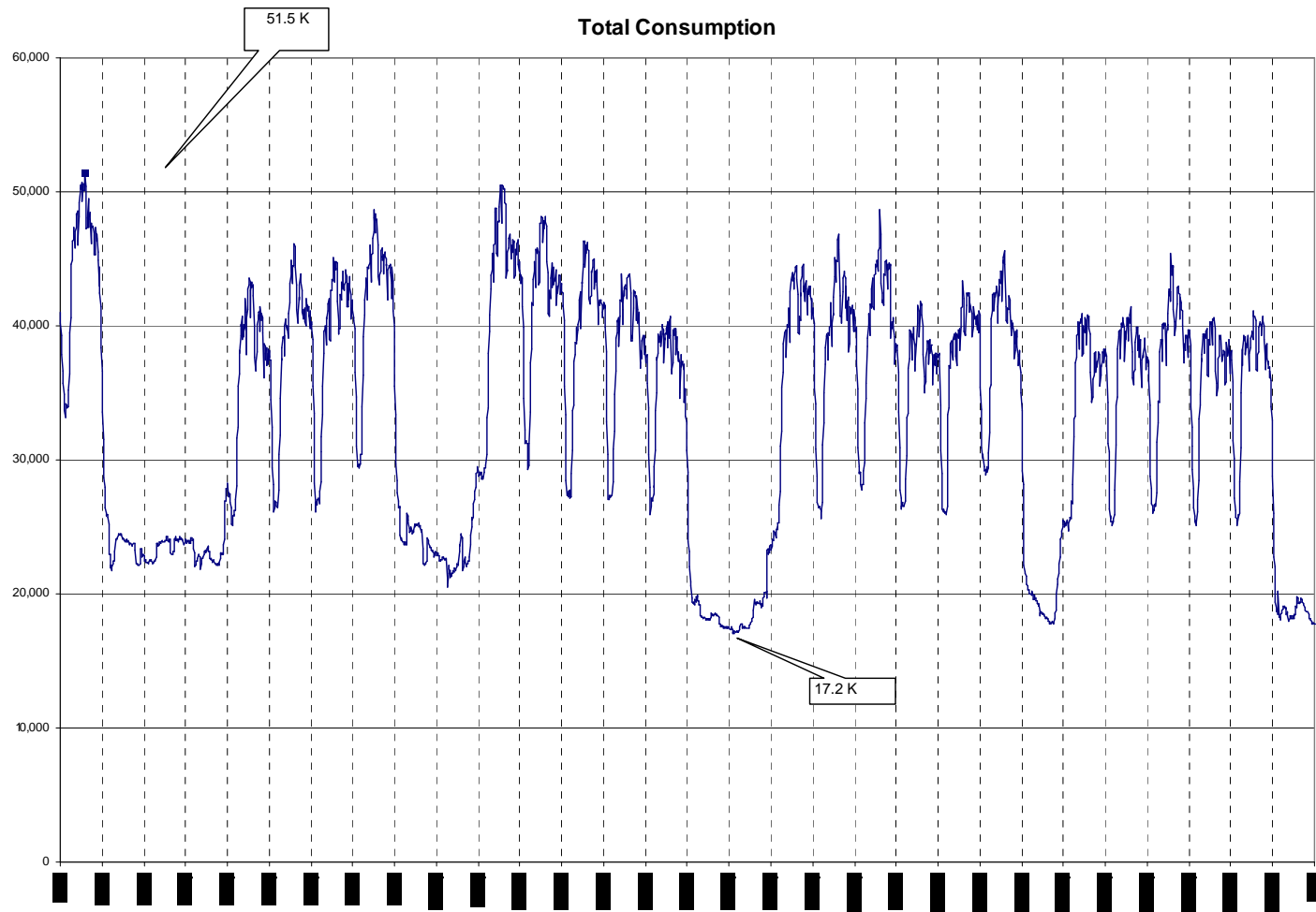


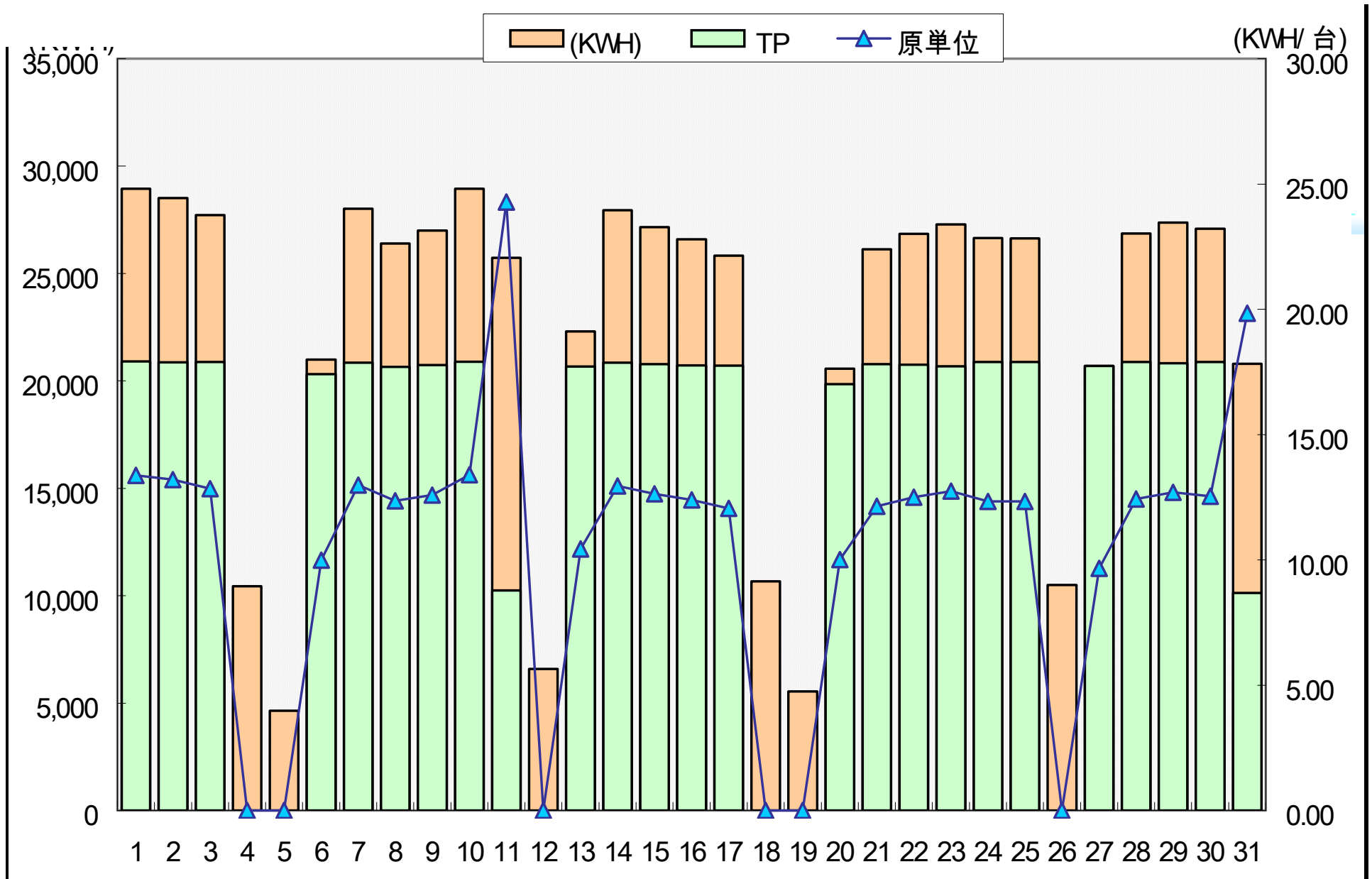
Plant Total	212,529	212,529	212,529	212,529	212,529	214,705	214,705	214,705	214,705	217,417	217,417	217,417	217,417	220,178	220,178	220,178	220,178	220,178	221,543	221,543	221,543	221,543	219,696	219,696	219,696	219,696
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- + 10 % ABOVE TARGET - EXPLAIN
- 0 - 10% ABOVE TARGET  
4 WEEKS OF YELLOW - EXPLAIN
- OVER DUE TO WEATHER
- OVER DUE TO PRODUCTION SATURDAY
- BELOW TARGET

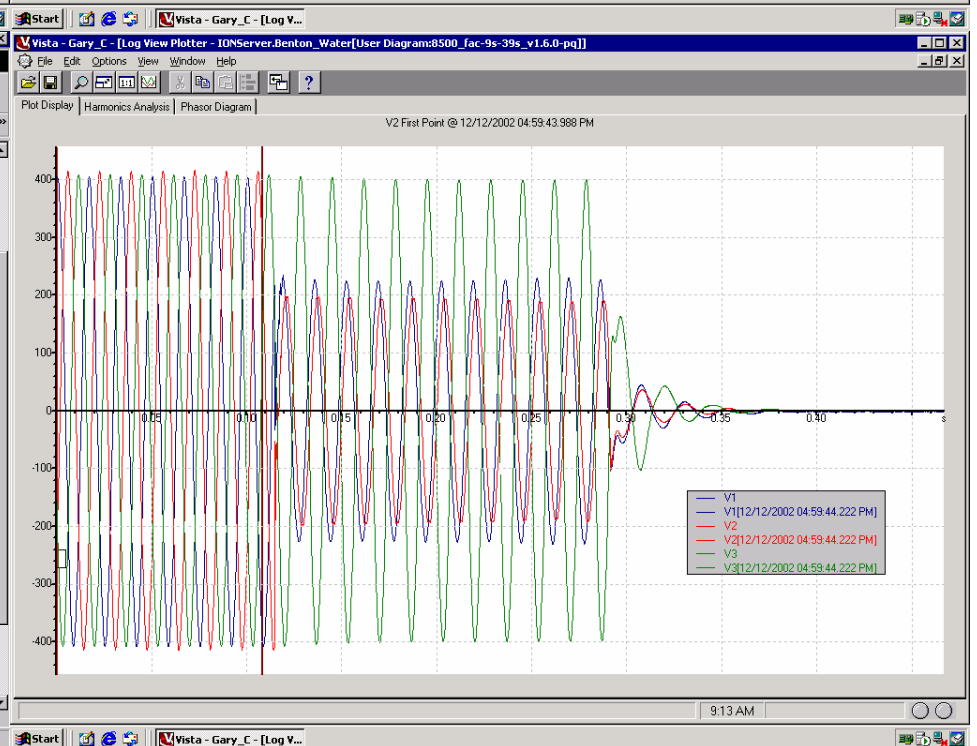
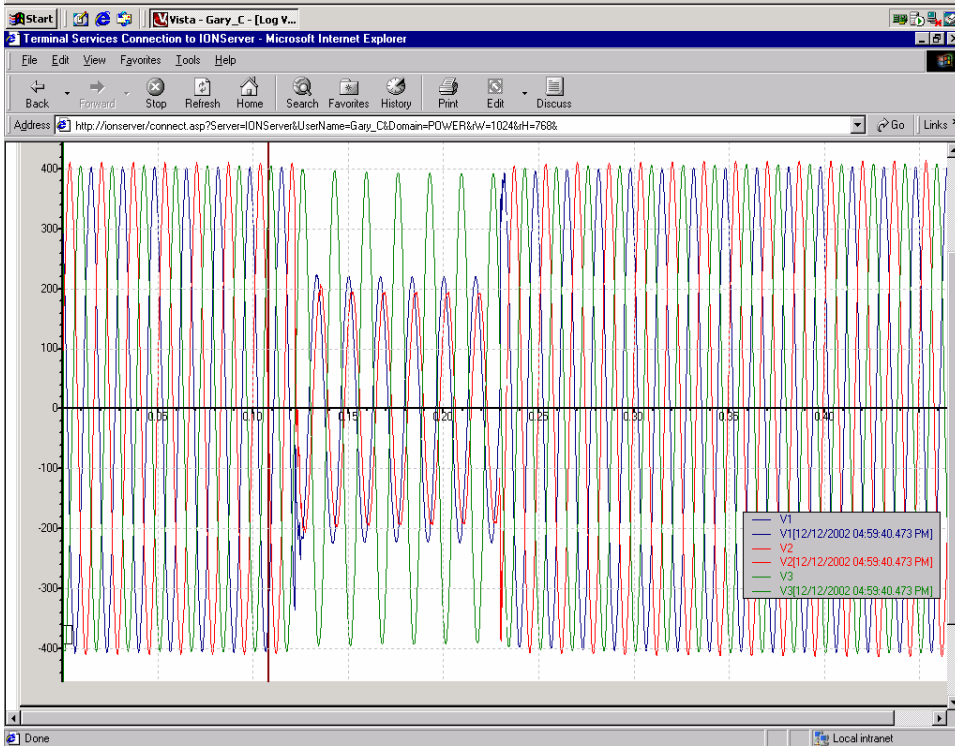
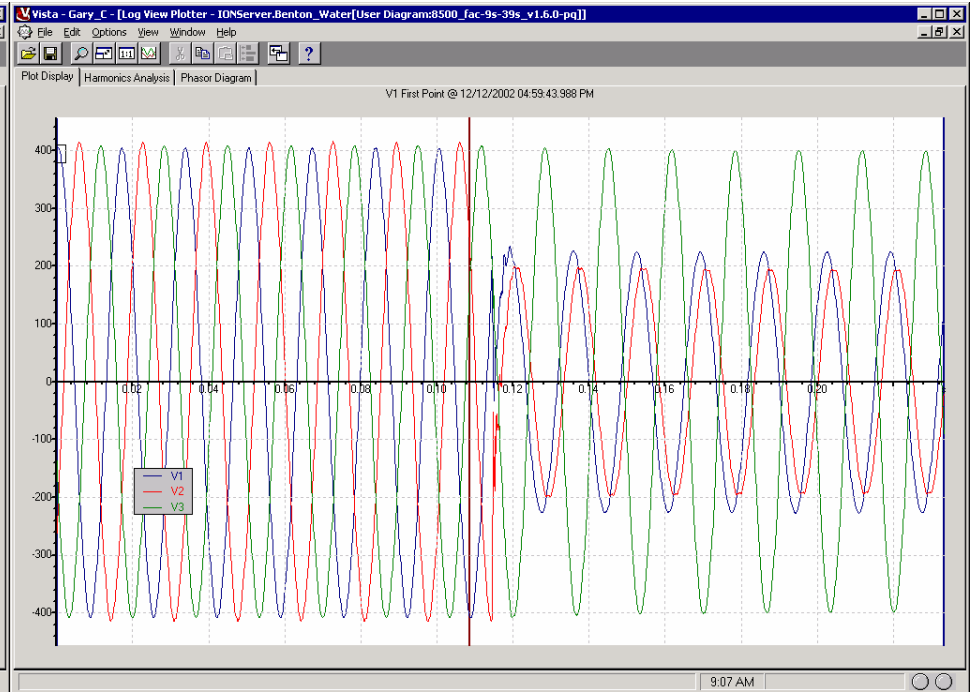
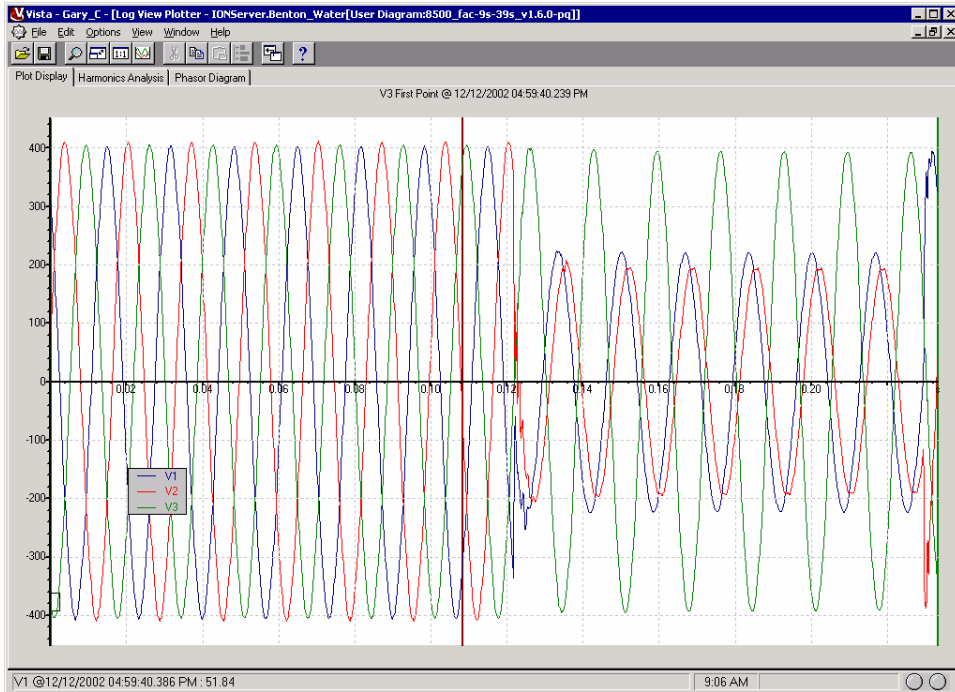
# Energy Diagnostics through Metering





Consumption of weekend is about 16% of workday.



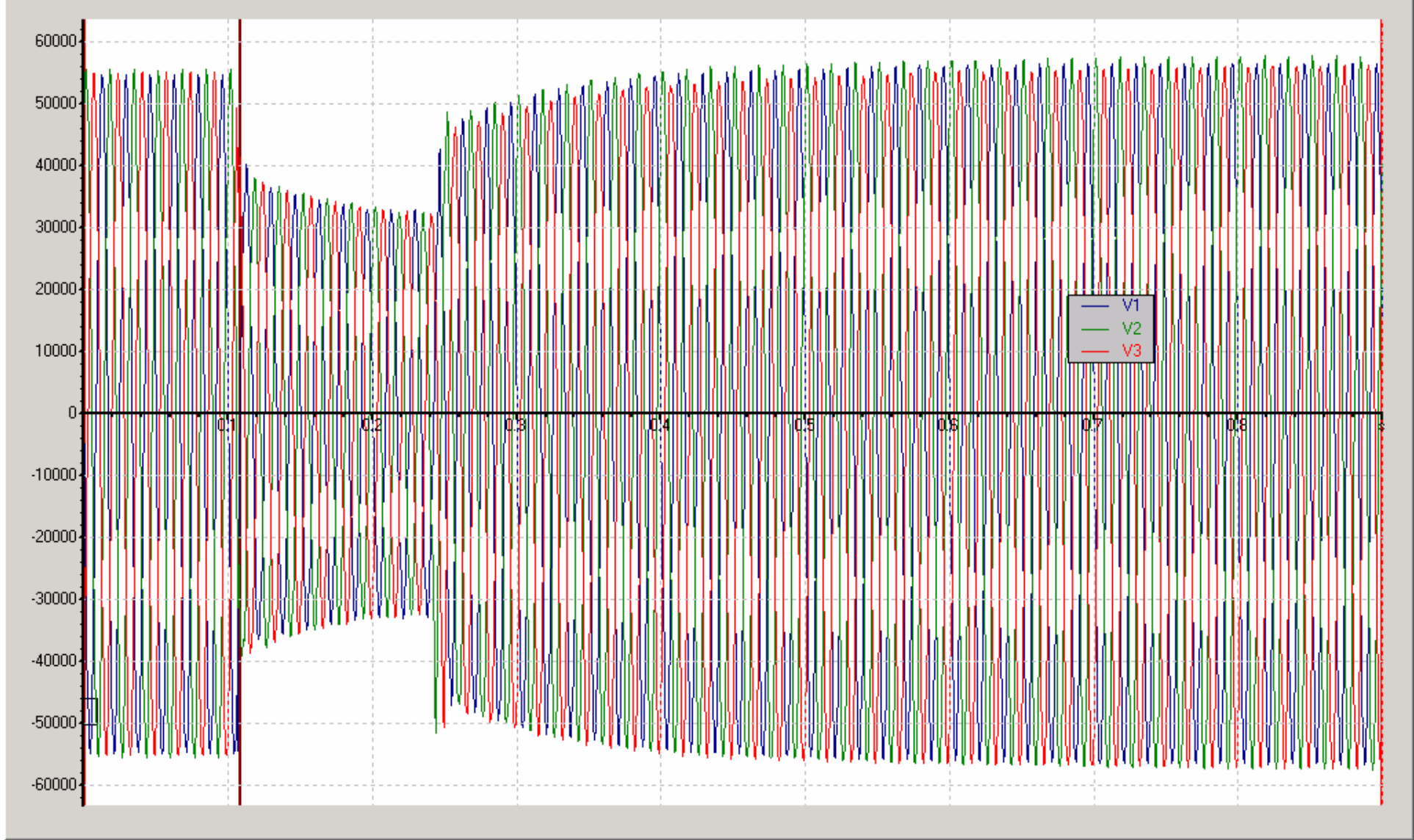


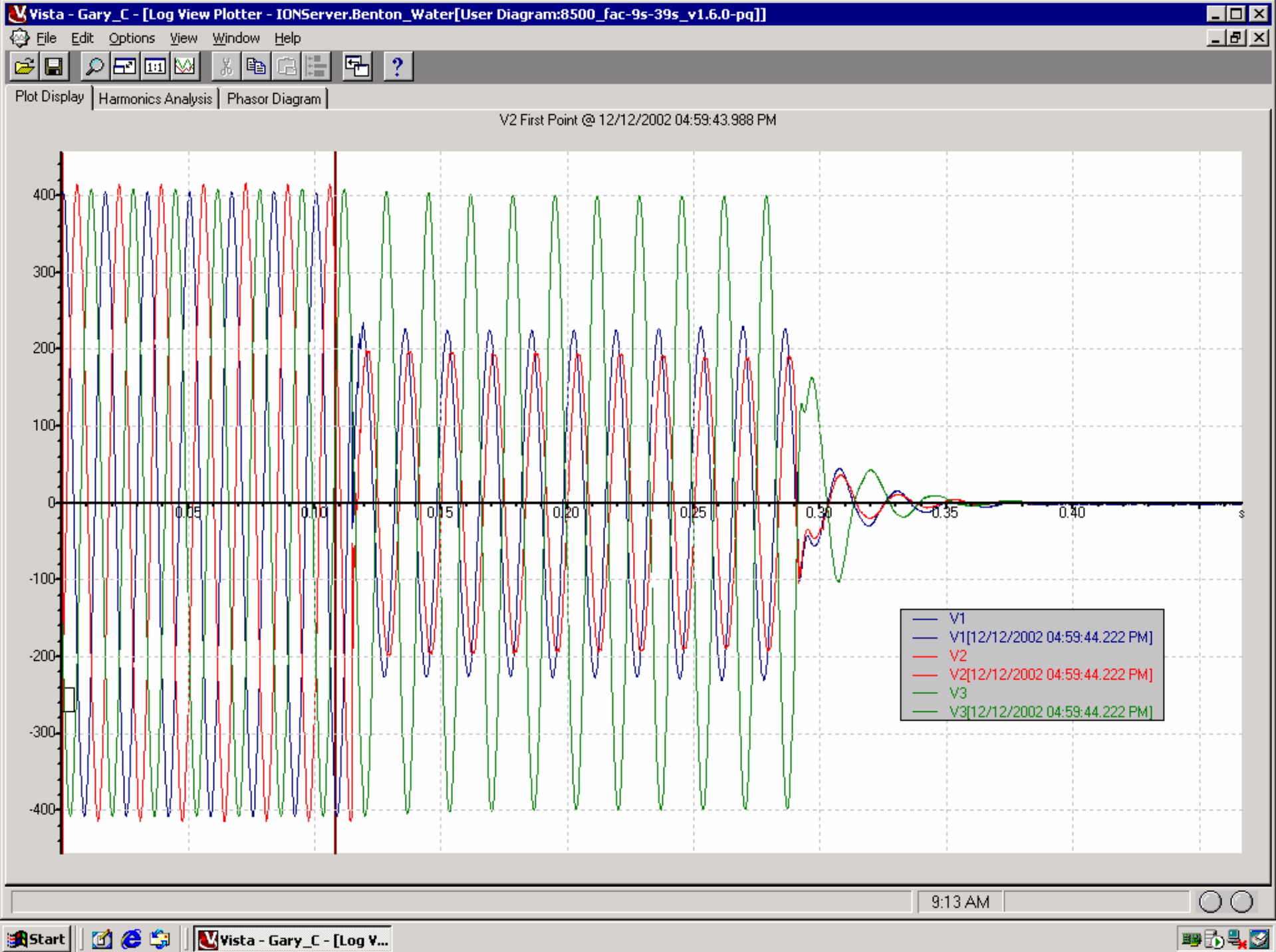


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90	0.008	105	106	105	SagSwell	08/03/2006 03:17:40.846 PM
91	0.892	105	106	105	SagSwell	08/03/2006 03:17:40.805 PM
92	0.025	105	106	105	SagSwell	08/03/2006 03:17:39.905 PM
93	0.024	105	106	105	SagSwell	08/03/2006 03:17:39.863 PM
94	0.016	105	106	105	SagSwell	08/03/2006 03:17:39.821 PM
95	0.016	105	106	105	SagSwell	08/03/2006 03:17:39.088 PM
96	0.008	105	106	105	SagSwell	08/03/2006 03:17:38.963 PM
97	0.008	105	106	105	SagSwell	08/03/2006 03:17:38.596 PM
98	0.241	105	106	105	SagSwell	08/03/2006 03:17:38.546 PM
99	0.033	105	106	105	SagSwell	08/03/2006 03:17:38.288 PM
100	0.033	105	106	105	SagSwell	08/03/2006 03:17:38.247 PM
101	1.65	105	106	105	SagSwell	08/03/2006 03:17:38.197 PM
102	0.058	105	106	105	SagSwell	08/03/2006 03:17:36.538 PM
103	2.033	105	107	106	SagSwell	08/03/2006 03:17:27.165 PM
104	0.167	58	58	58	SagSwell	08/03/2006 03:17:22.132 PM
105	0.000048			157	Transient Phase3	08/03/2006 03:16:12.131 PM
106	0.000065	167			Transient Phase1	08/03/2006 03:16:12.131 PM
107	0.000097		161		Transient Phase2	08/03/2006 03:16:12.131 PM
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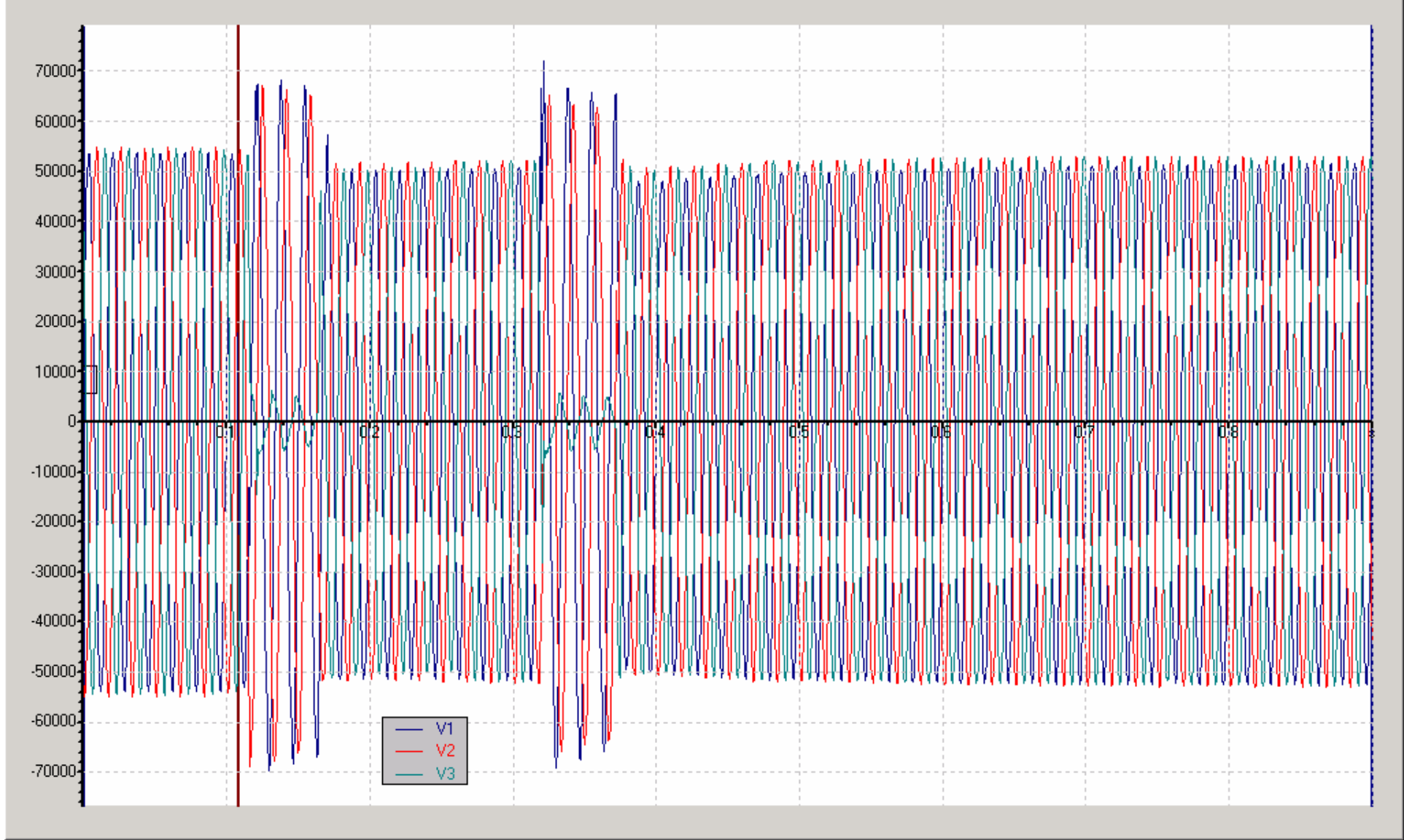
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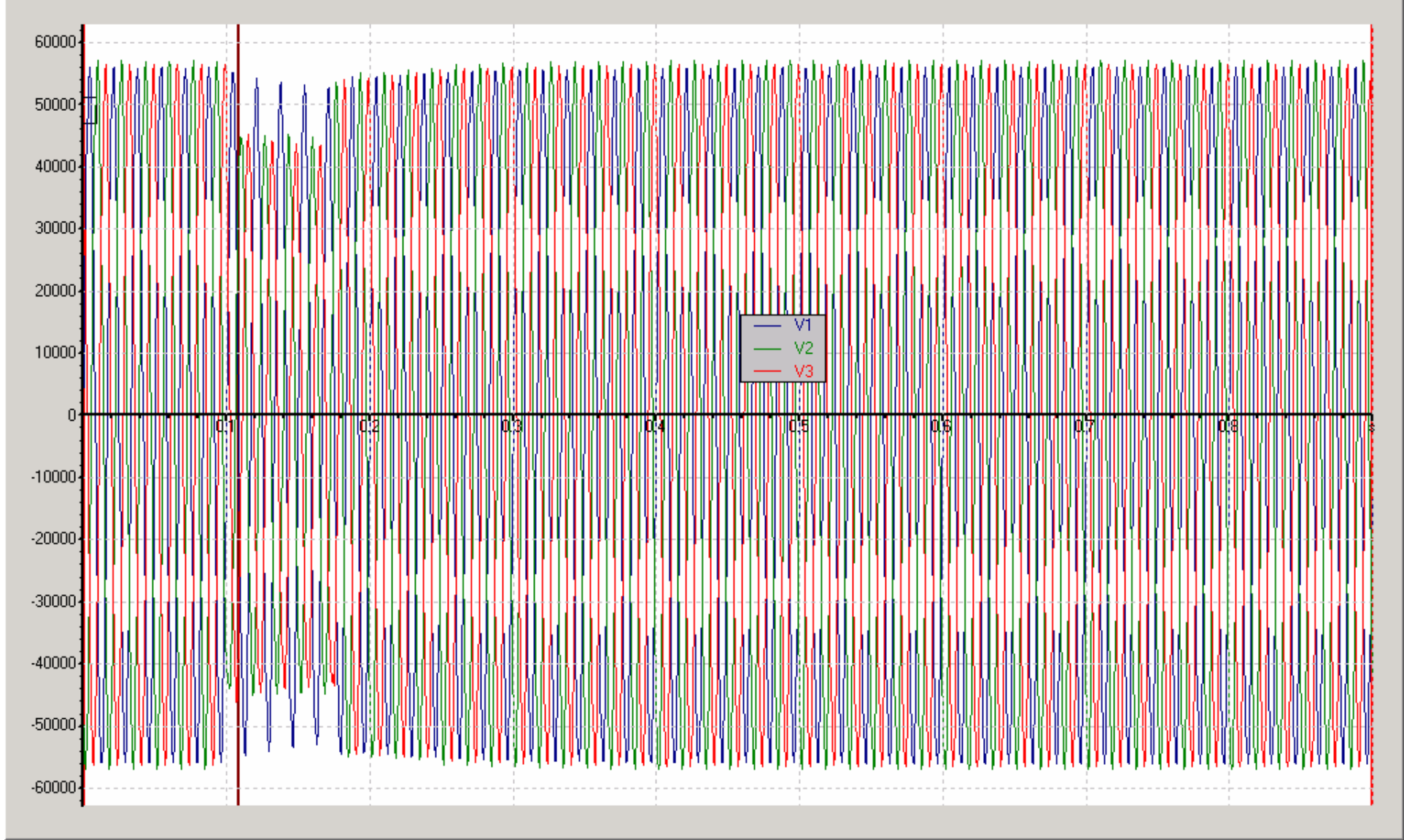




V1 First Point @ 08/20/2002 03:04:21.958 PM



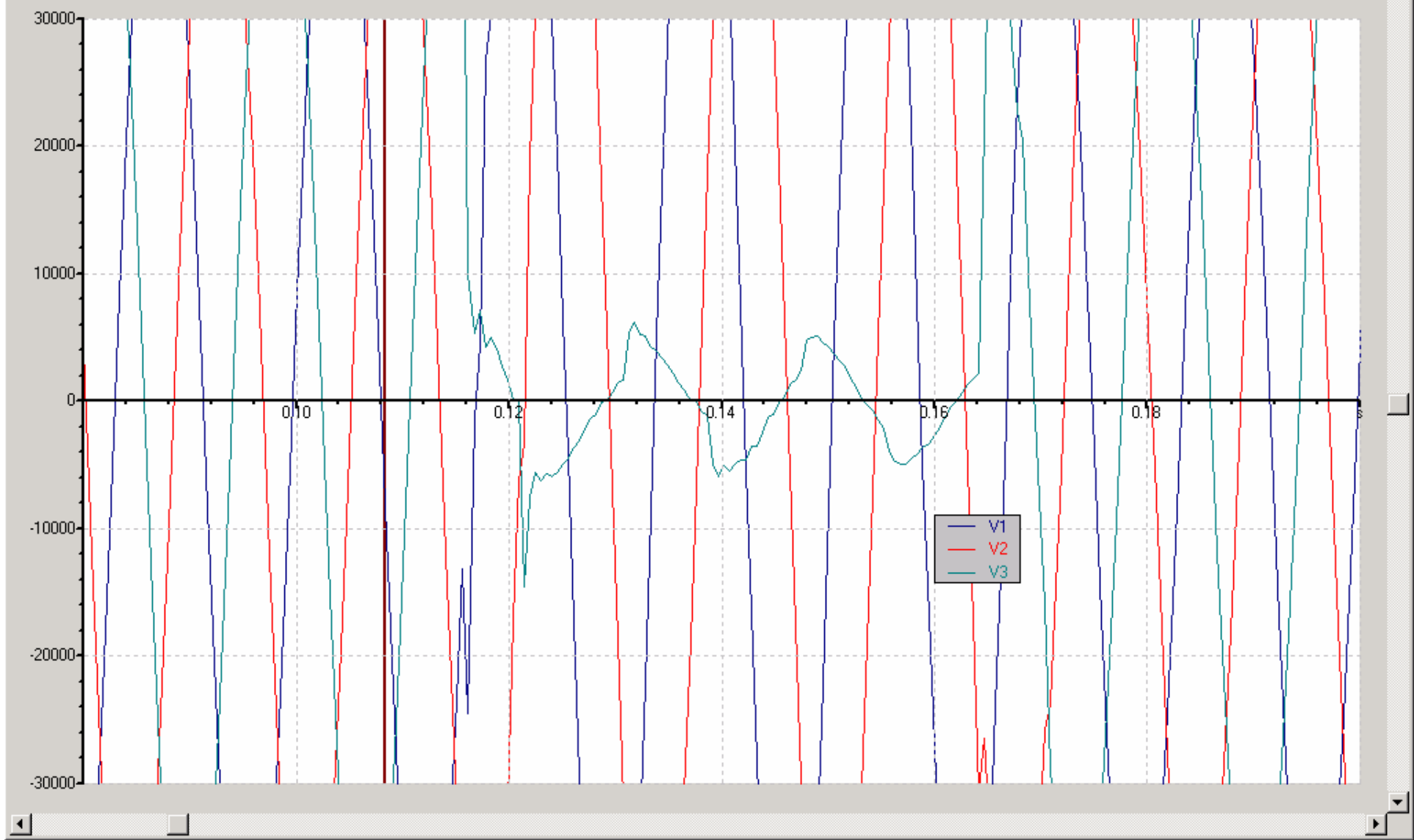
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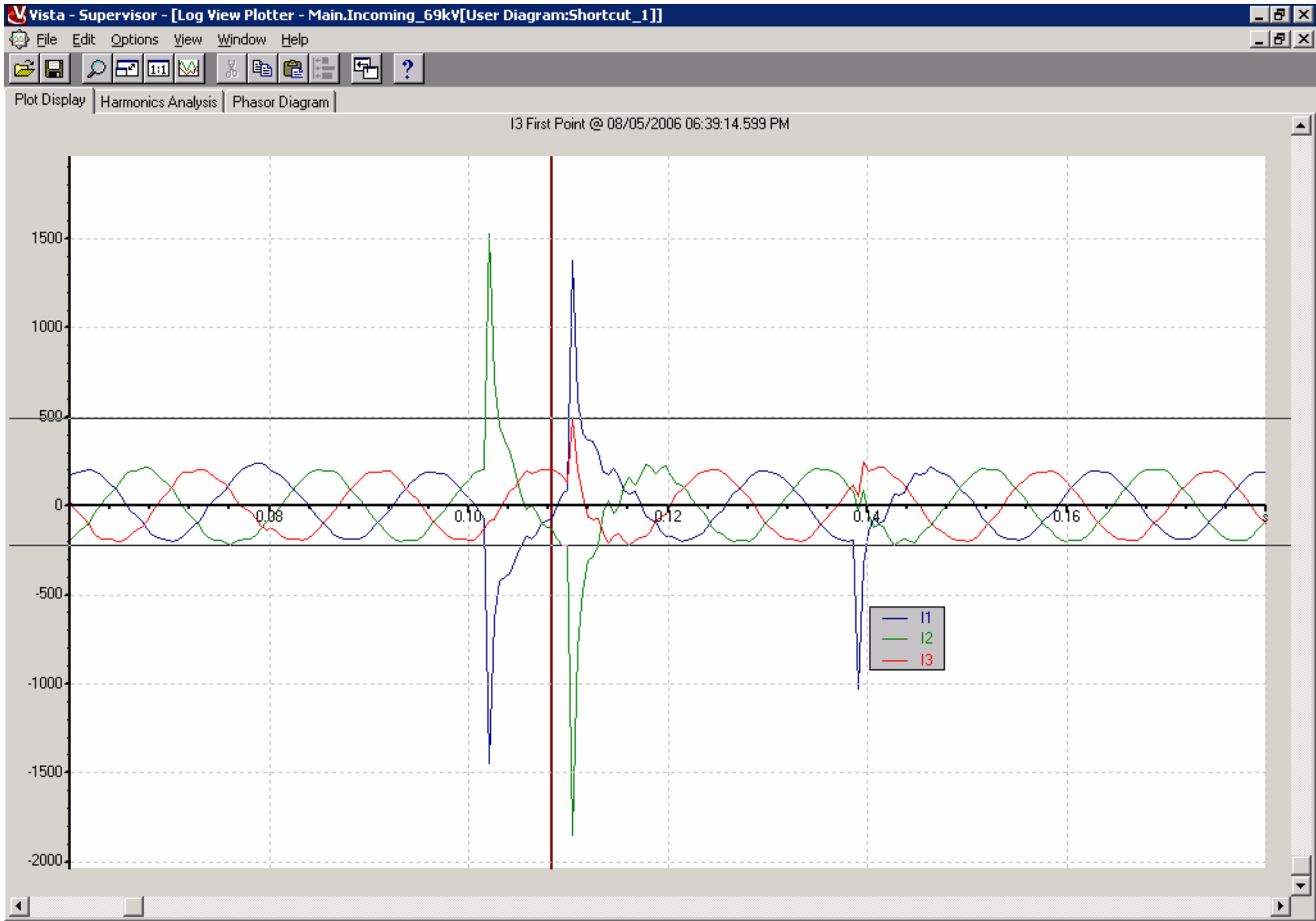






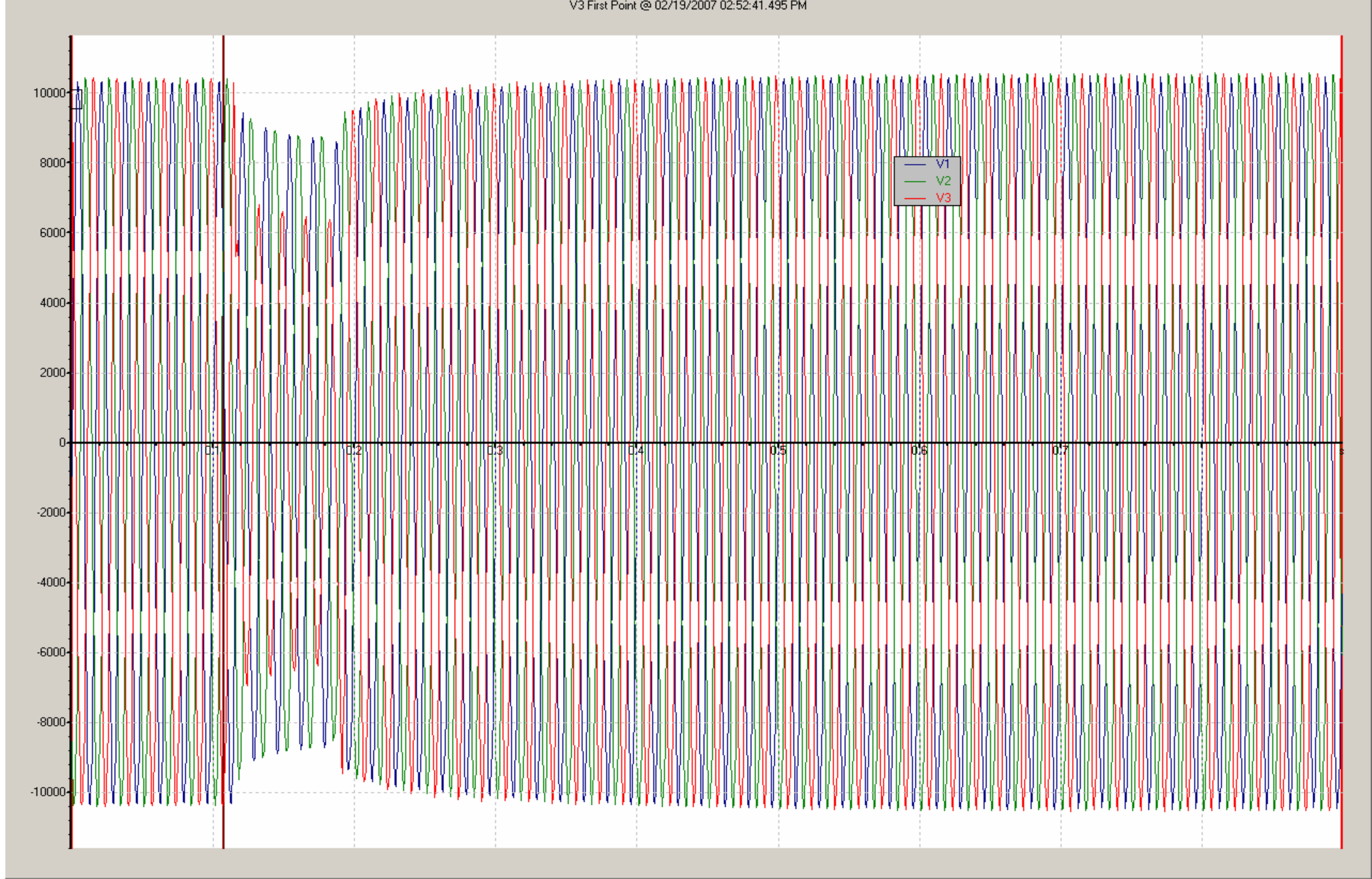
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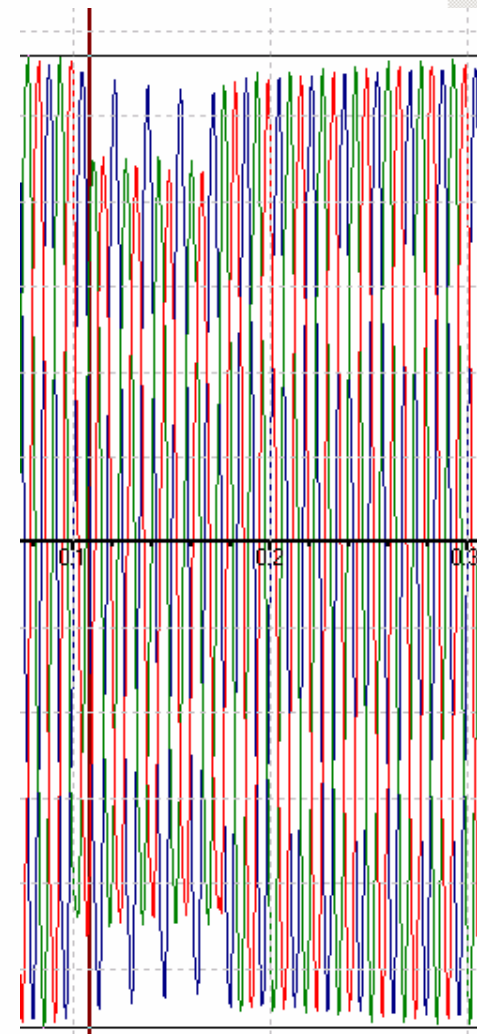


3:51 PM

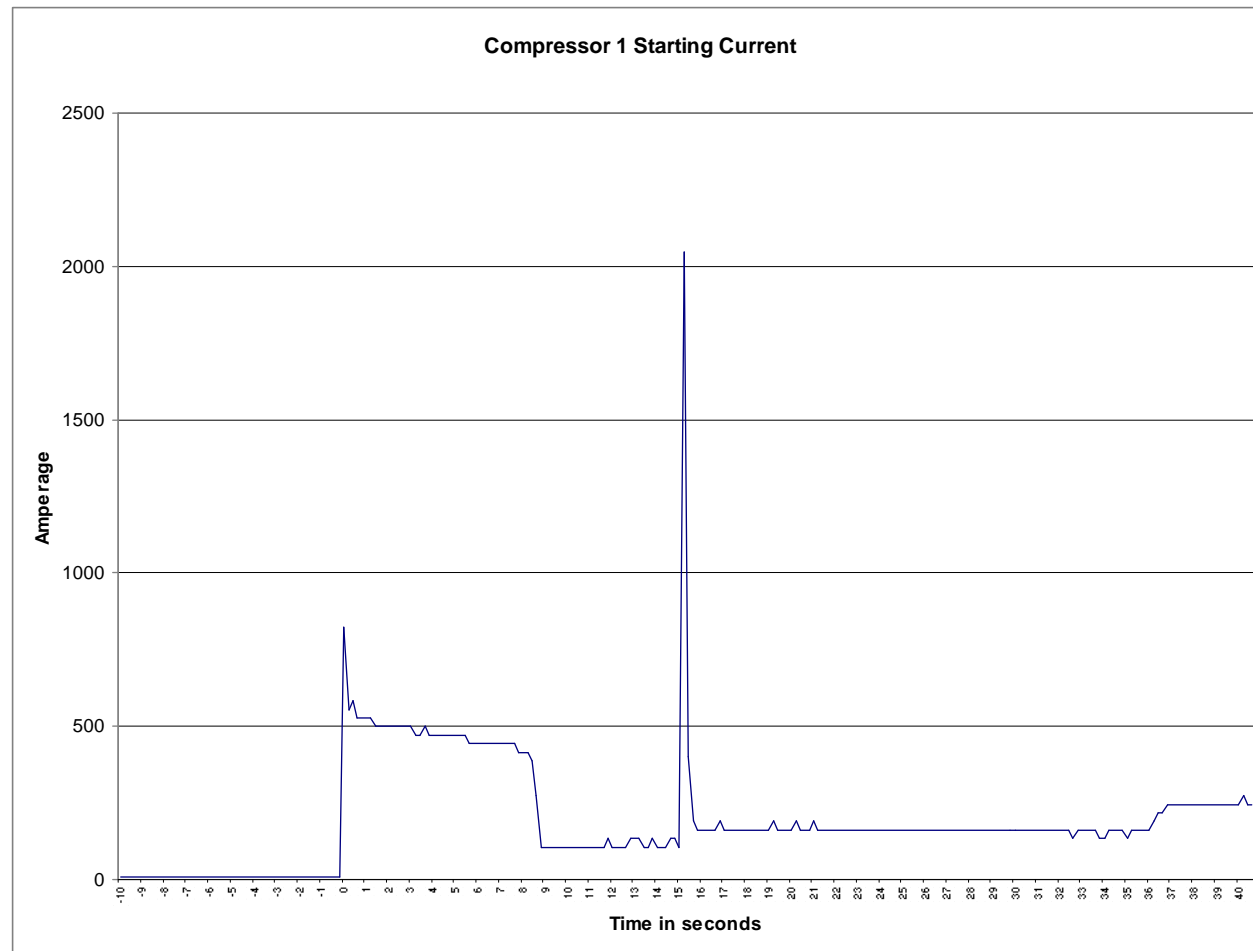
V3 First Point @ 02/19/2007 02:52:41.495 PM



	Duration	Magnitude Phase1	Magnitude Phase2	Magnitude Phase3	Cause	timestamp
1	0.074	95	79	76	SagSwell	02/24/2007 09:54:32.045 PM
2	0.075	95	78	76	SagSwell	02/24/2007 09:54:19.729 PM
3	0.075	95	79	77	SagSwell	02/24/2007 09:54:13.972 PM
4	0.000016			128	Transient Phase3	02/24/2007 06:59:09.026 AM
5	0.000048	131			Transient Phase1	02/24/2007 06:59:09.026 AM
6	0.000113		138		Transient Phase2	02/24/2007 06:59:09.026 AM
7	0.000048		135		Transient Phase2	02/24/2007 06:07:24.874 AM
8	0.000081			132	Transient Phase3	02/24/2007 06:07:24.874 AM
9	0.000016			145	Transient Phase3	02/24/2007 06:07:14.876 AM
10	0.000016		134		Transient Phase2	02/24/2007 06:07:14.876 AM
11	0.000016	128			Transient Phase1	02/23/2007 06:55:02.039 PM
12	0.000048			133	Transient Phase3	02/22/2007 10:32:51.092 AM
13	0.000097	140			Transient Phase1	02/22/2007 10:32:51.092 AM
14	0.000488		158		Transient Phase2	02/22/2007 10:32:51.092 AM
15	0.000032			129	Transient Phase3	02/22/2007 05:48:08.746 AM
16	0.000016	126			Transient Phase1	02/21/2007 06:22:45.431 PM
17	0.000016	126			Transient Phase1	02/21/2007 05:48:37.438 PM
18	0.000016	129			Transient Phase1	02/21/2007 05:51:37.254 AM
19	0.000032	127			Transient Phase1	02/21/2007 05:47:59.763 AM
20	0.000585			167	Transient Phase3	02/20/2007 05:28:58.313 PM
21	0.000699	176			Transient Phase1	02/20/2007 05:28:58.313 PM
22	0.000065	128			Transient Phase1	02/20/2007 05:32:18.227 AM
23	0.083	91	68	65	SagSwell	02/19/2007 02:52:42.056 PM
24	0.000016			132	Transient Phase3	02/19/2007 09:30:22.790 AM
25	0.000667	168			Transient Phase1	02/16/2007 06:12:41.361 AM
26	0.000765			165	Transient Phase3	02/16/2007 06:12:41.361 AM
27	0.000813		175		Transient Phase2	02/16/2007 06:12:41.361 AM
28	0.000065	149			Transient Phase1	02/16/2007 06:07:03.934 AM
29	0.000032		131		Transient Phase2	02/16/2007 06:06:21.136 AM
30	0.000032	136			Transient Phase1	02/16/2007 06:06:21.136 AM
31	0.000423		152		Transient Phase2	02/16/2007 04:27:08.488 AM
32	0.000959			215	Transient Phase3	02/16/2007 04:27:08.488 AM
33	0.001106	256			Transient Phase1	02/16/2007 04:27:08.488 AM
34	0.000032	129			Transient Phase1	02/16/2007 04:19:18.684 AM



## Measuring Energy Use to Improve Energy Performance





# *Energy Diagnostics through Metering*

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## New Technology

- Fuel Cells
- Co-Generation
- VFD's
- Micro Turbines
- Solar technology
- Wind power
- Increases and improvements in existing technology

*In our monthly energy meeting, we, at times, bring in a guest speaker, (vendor), to speak on some type of new technology.*







# Questions & Discussion

# Upcoming Web Conferences



April – Award Wining Energy Programs: The ENERGY STAR Partners of Year

- JC Penney's
- Davenport IA School District

May – Assessing Facility Energy Management Practices

June – Our Top Three Energy Projects

Download past web conference presentations at:  
[www.energystar.gov/index.cfm?c=networking.bus\\_networking](http://www.energystar.gov/index.cfm?c=networking.bus_networking)

Questions or comments? Contact: [tunnessen.walt@epa.gov](mailto:tunnessen.walt@epa.gov)





Thank You!