Power for the future

POWERSMITHS

Transformer Measurement & Verification Report

Harvard Science Center

Prepared for:

TNT Energy

Powersmiths International Corp.

September 9, 2014

Performance Measurement & Verification Methodology

ECM Technology Category	Parameter Type	Parameter	Project Phase	
			Baseline Transformers	New Replacement Transformers
Transformer Retrofits	Performance	Transformer Losses and load profile	Measurement of representative transformer(s) selected by customer	ISO 17025 Certified Efficiency Test Lab Validation of loading vs. losses of each new transformer replacing baseline units, measured under corresponding load profile on unit by unit basis.

Measurement & Verification Protocol for Determining Performance of Baseline Transformers

1. Develop the baseline transformer inventory based upon on-site audit.
2. For each transformer selected for the baseline, measure comprehensive power and power quality data including losses, efficiency and associated load profile (loading and current THD).
3. Summarize existing measurements and as well as proposed performance of replacement units in chart and table format for all baseline units. Include relevant pictures of each existing unit.

Measurement & Verification Protocol for Determining Performance of New Replacement Transformers

1. Perform testing in an ISO 17025 Certified Efficiency Test Lab
2. Establish a test plan based for each new transformer that replaces a transformer measured as part of the baseline that considers each unit's corresponding measured load profile (% loading & current THD). Use multiple load point measurements when appropriate.
3. Measure each new unit per its test plan, and record the results. Test reports shall be signed by the test technician and the supervising engineer.
4. Prepare a report documenting that the losses at measured load points demonstrate compliance with the specified loss curve for each transformer.

Transformer Measurements & Findings

During January 5 to August 18, 2014 baseline measurements were taken on four (4) existing transformers at Harvard Science Center. These measurements were taken using the Cyberhawk EP-300 portable meter; see Appendix 1 for information regarding the Cyberhawk meter capabilities and setup. The measured loading, efficiency and losses of the replacement Powersmiths E-Saver-C3L transformers were measured on June 16, 2014. These measurements were performed in the ISO 17025 Certified Efficiency Test Lab and compared to the old transformers (see tables below for each transformer).

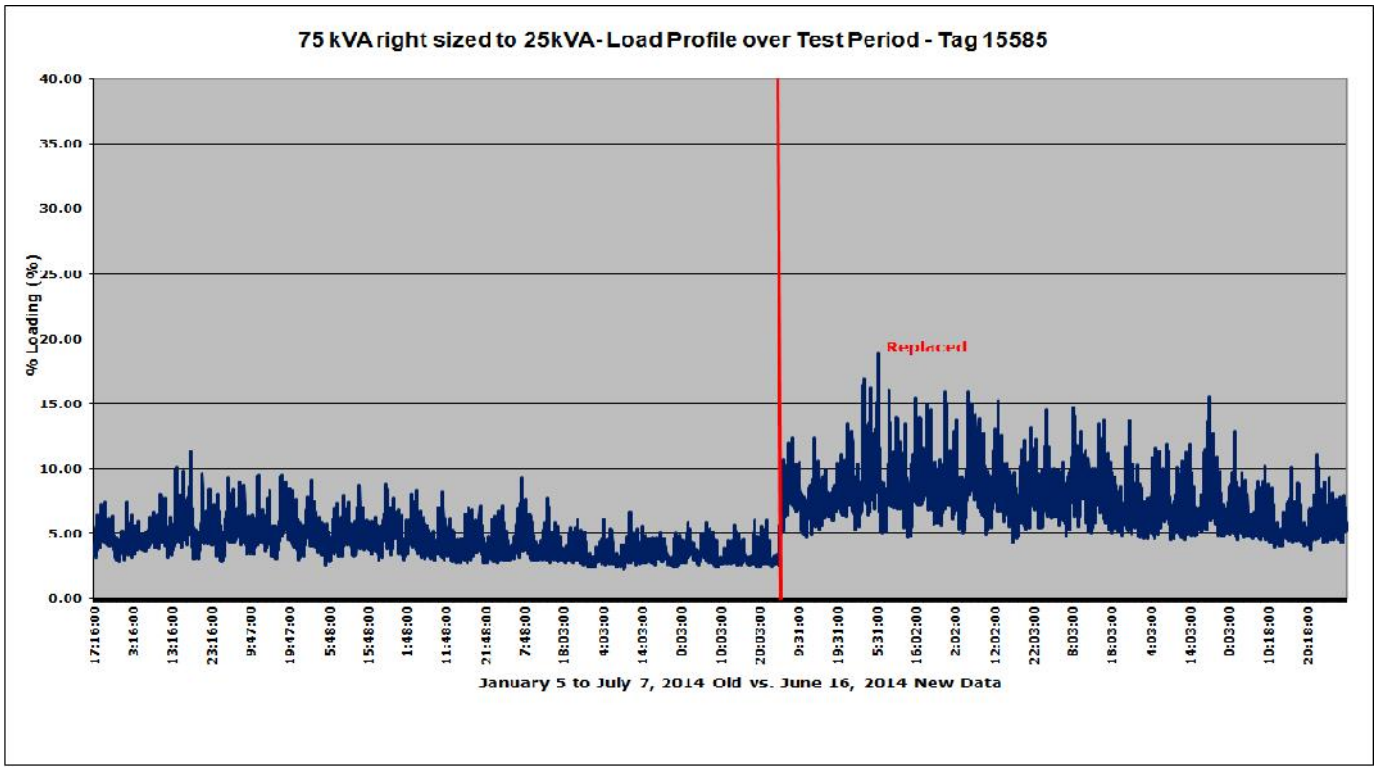
Figure 1: 22153_ 75T3HFISCUNLP

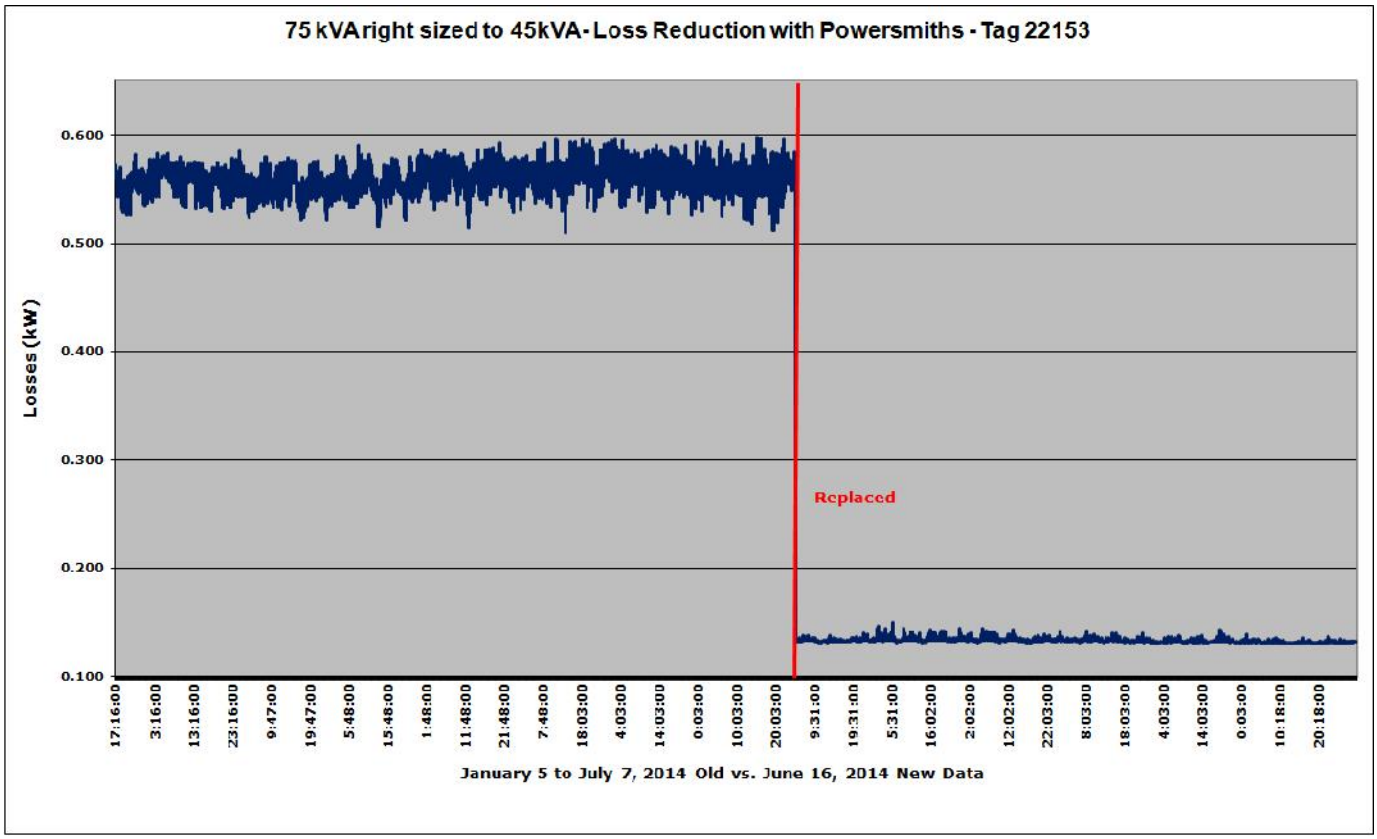
Figure 2: 22153_C3L-45-480-208

Building	Harvard Science Center			
Location	Room 717			
Tag Number	22153			
Measurement Period (HH:MM)	4387 hrs 32 min		Powersmiths	
Sampling Interval	15 Minute			
Manufacturer	Square D			
Model	75T3HFISCUNLP		E-Saver-C3L	
Nominal kVA	75		45	
Loading Period	On Load	Off Load	On Load	Off Load
% Loading (kVA) - Average	7.1%	3.1%	11.8%	5.2%
% Efficiency - Average	90.8%	80.3%	95.7%	90.7%
Losses (kW) - Average	0.542	0.562	0.137	0.131
Reduction in Average Losses			74.7%	76.7%

Representative Output Current THD (%)	0.3%	27.0%

Note: The existing transformer kVA has been down-sized; therefore, the average % loading has been adjusted to correspond with the existing load profile.


75 kVA right sized to 25kVA - Load Profile over Test Period - Tag 15585
% Loading (%)
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Replaced
17:16:00
3:16:00
13:16:00
23:16:00
9:47:00
19:47:00
5:48:00
15:48:00
1:48:00
11:48:00
21:48:00
7:48:00
18:03:00
4:03:00
14:03:00
0:03:00
10:03:00
20:03:00
9:31:00
19:31:00
5:31:00
16:02:00
2:02:00
12:02:00
22:03:00
8:03:00
18:03:00
4:03:00
14:03:00
0:03:00
10:18:00
20:18:00
January 5 to July 7, 2014 Old vs. June 16, 2014 New Data


75 kVA right sized to 45kVA - Loss Reduction with Powersmiths - Tag 22153
Losses (kW)
0.600
0.500
0.400
0.300
0.200
0.100
Replaced
17:16:00
3:16:00
13:16:00
23:16:00
9:47:00
19:47:00
5:48:00
15:48:00
1:48:00
11:48:00
21:48:00
7:48:00
18:03:00
4:03:00
14:03:00
0:03:00
10:03:00
20:03:00
9:31:00
19:31:00
5:31:00
16:02:00
2:02:00
12:02:00
22:03:00
8:03:00
18:03:00
4:03:00
14:03:00
0:03:00
10:18:00
20:18:00
January 5 to July 7, 2014 Old vs. June 16, 2014 New Data

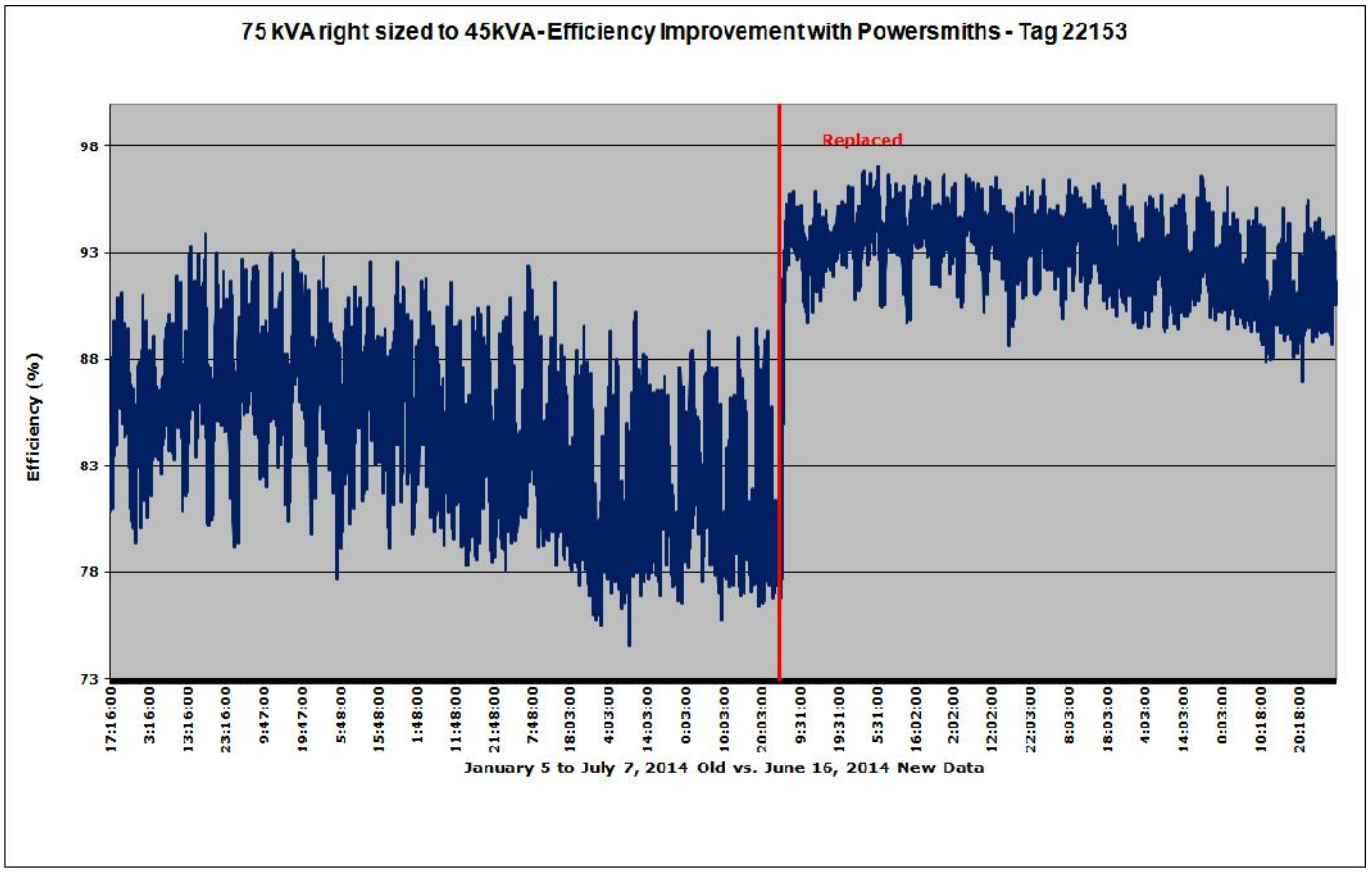
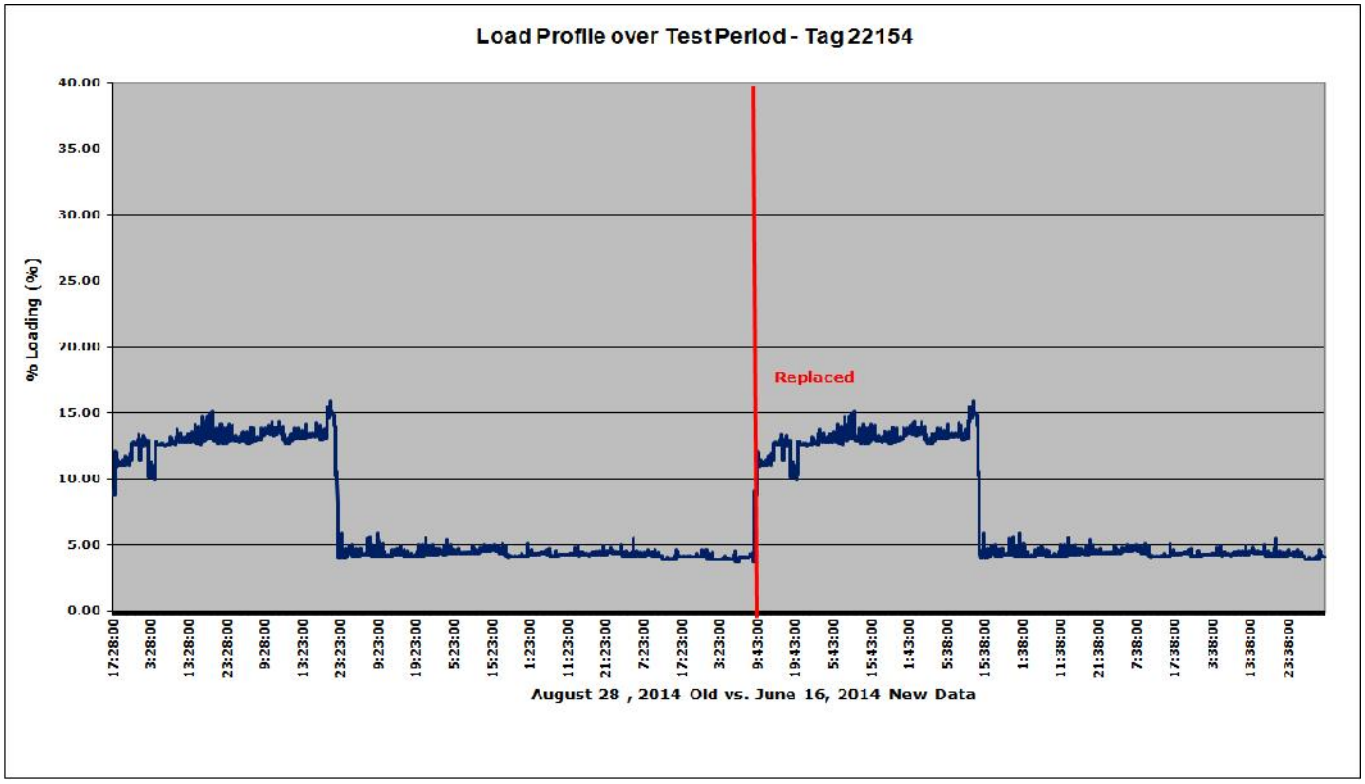

75 kVA right sized to 45kVA-Efficiency Improvement with Powersmiths - Tag 22153
Replaced
Efficiency (%)
98
93
88
83
78
73
17:16:00
3:16:00
13:16:00
23:16:00
9:47:00
19:47:00
5:48:00
15:48:00
1:48:00
11:48:00
21:48:00
7:48:00
18:03:00
4:03:00
14:03:00
0:03:00
10:03:00
20:03:00
9:31:00
19:31:00
5:31:00
16:02:00
2:02:00
12:02:00
22:03:00
8:03:00
18:03:00
4:03:00
14:03:00
0:03:00
10:18:00
20:18:00
January 5 to July 7, 2014 Old vs. June 16, 2014 New Data

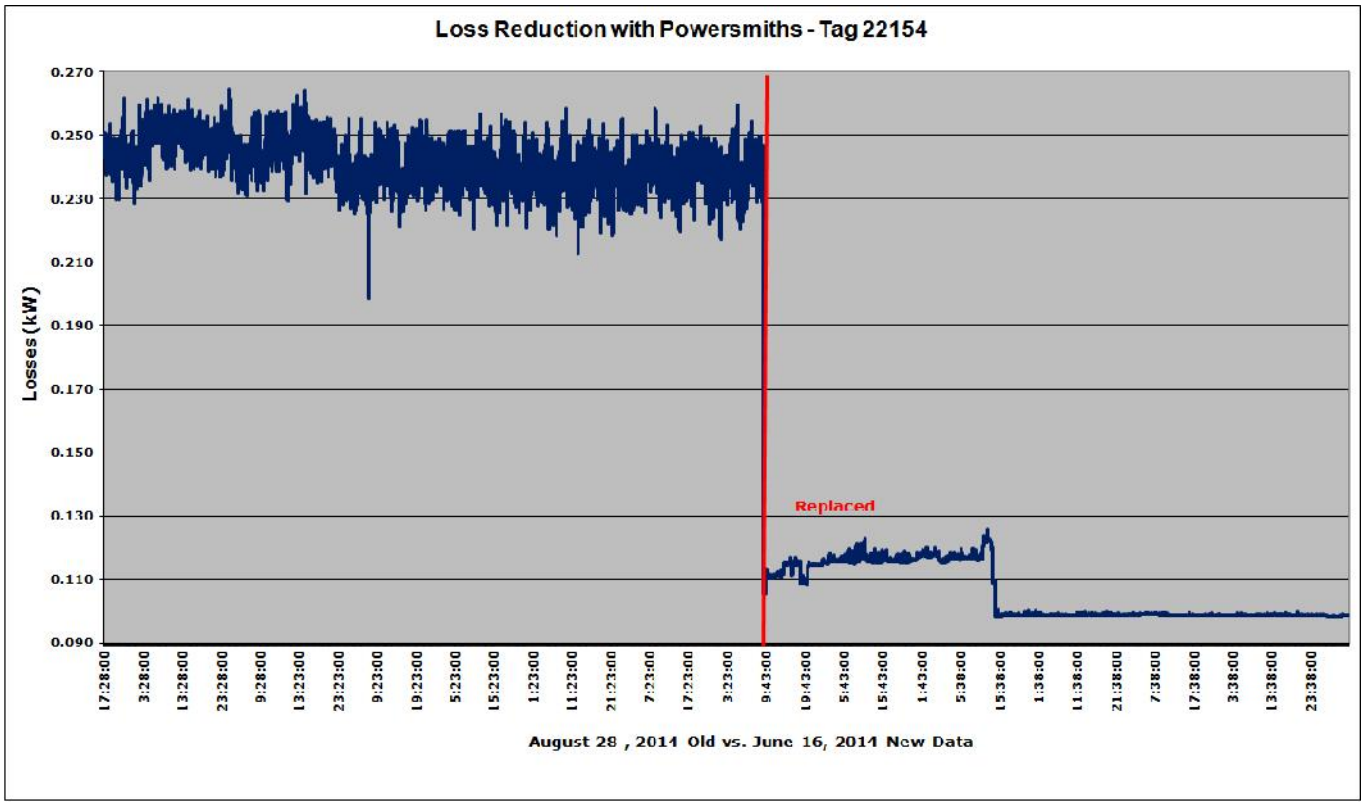
Figure 3: 22154_3B3Y030-ES

Figure 4: 22154_C3L-30-480-208

Building	Harvard Science Center			
Location	Room 528			
Tag Number	22154			
Measurement Period (HH:MM)	5427 hrs 40 min		Powersmiths	
Sampling Interval	15 Minute			
Manufacturer	ITE			
Model	3B3Y030-ES		E-Saver-C3L	
Nominal kVA	30		30	
Time Period	January to May			
Loading Period	On Load	Off Load	On Load	Off Load
% Loading (kVA) - Average	14.3%	12.7%	14.3%	12.7%
% Efficiency - Average	94.6%	94.1%	97.2%	97.0%
Losses (kW) - Average	0.245	0.237	0.120	0.115
Reduction in Average Losses			50.9%	51.5%
Time Period	May to August			
Loading Period	On Load	Off Load	On Load	Off Load
% Loading (kVA) - Average	5.03%	4.15%	5.03%	4.15%
% Efficiency - Average	85.8%	84.5%	93.4%	92.1%
Losses (kW) - Average	0.249	0.228	0.100	0.099
Reduction in Average Losses			60.0%	56.8%

Representative Output Current THD (%)	25.3%	64.0%


Load Profile over Test Period - Tag 22154
% Loading (%)
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Replaced
17:28:00
3:28:00
13:28:00
23:28:00
9:28:00
19:23:00
5:23:00
15:23:00
1:23:00
11:23:00
21:23:00
7:23:00
17:23:00
3:23:00
9:43:00
19:43:00
5:43:00
15:43:00
1:43:00
11:38:00
21:38:00
7:38:00
17:38:00
3:38:00
13:38:00
23:38:00
August 28 , 2014 Old vs. June 16, 2014 New Data


Loss Reduction with Powersmiths - Tag 22154
Losses (kW)
0.270
0.250
0.230
0.210
0.190
0.170
0.150
0.130
0.110
0.090
Replaced
17:28:00
3:28:00
13:28:00
23:28:00
9:28:00
19:23:00
5:23:00
15:23:00
1:23:00
11:23:00
21:23:00
7:23:00
17:23:00
3:23:00
9:43:00
19:43:00
5:43:00
15:43:00
1:43:00
11:38:00
21:38:00
7:38:00
17:38:00
3:38:00
13:38:00
23:38:00
August 28 , 2014 Old vs. June 16, 2014 New Data

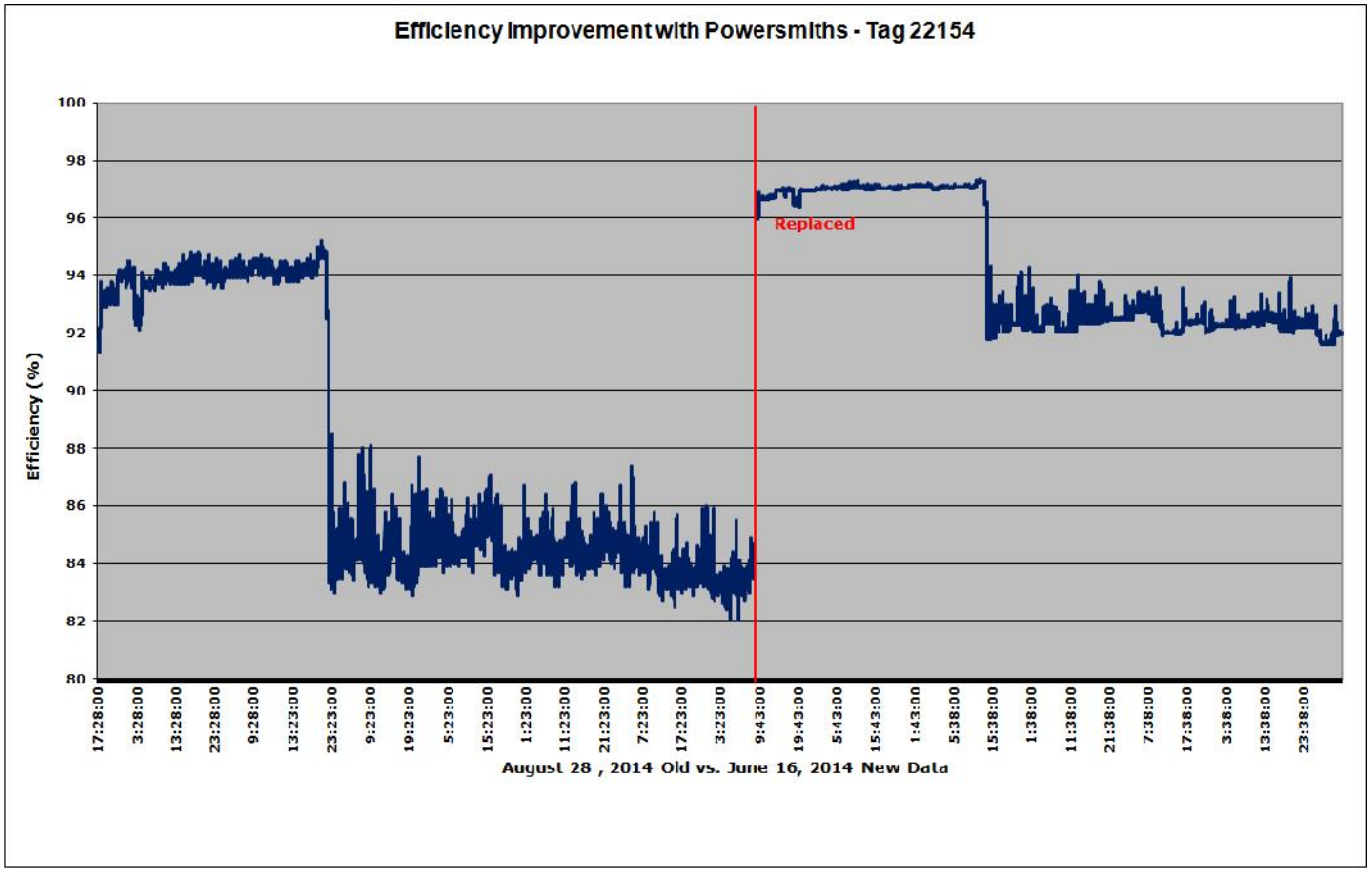

Efficiency Improvement with Powersmiths - Tag 22154
Efficiency (%)
100
98
96
94
92
90
88
86
84
82
80
Replaced
17:28:00
3:28:00
13:28:00
23:28:00
9:28:00
13:23:00
23:23:00
9:23:00
19:23:00
5:23:00
15:23:00
1:23:00
11:23:00
21:23:00
7:23:00
17:23:00
3:23:00
9:43:00
19:43:00
5:43:00
15:43:00
1:43:00
5:38:00
15:38:00
1:38:00
11:38:00
21:38:00
7:38:00
17:38:00
3:38:00
13:38:00
23:38:00
August 28 , 2014 Old vs. June 16, 2014 New Data

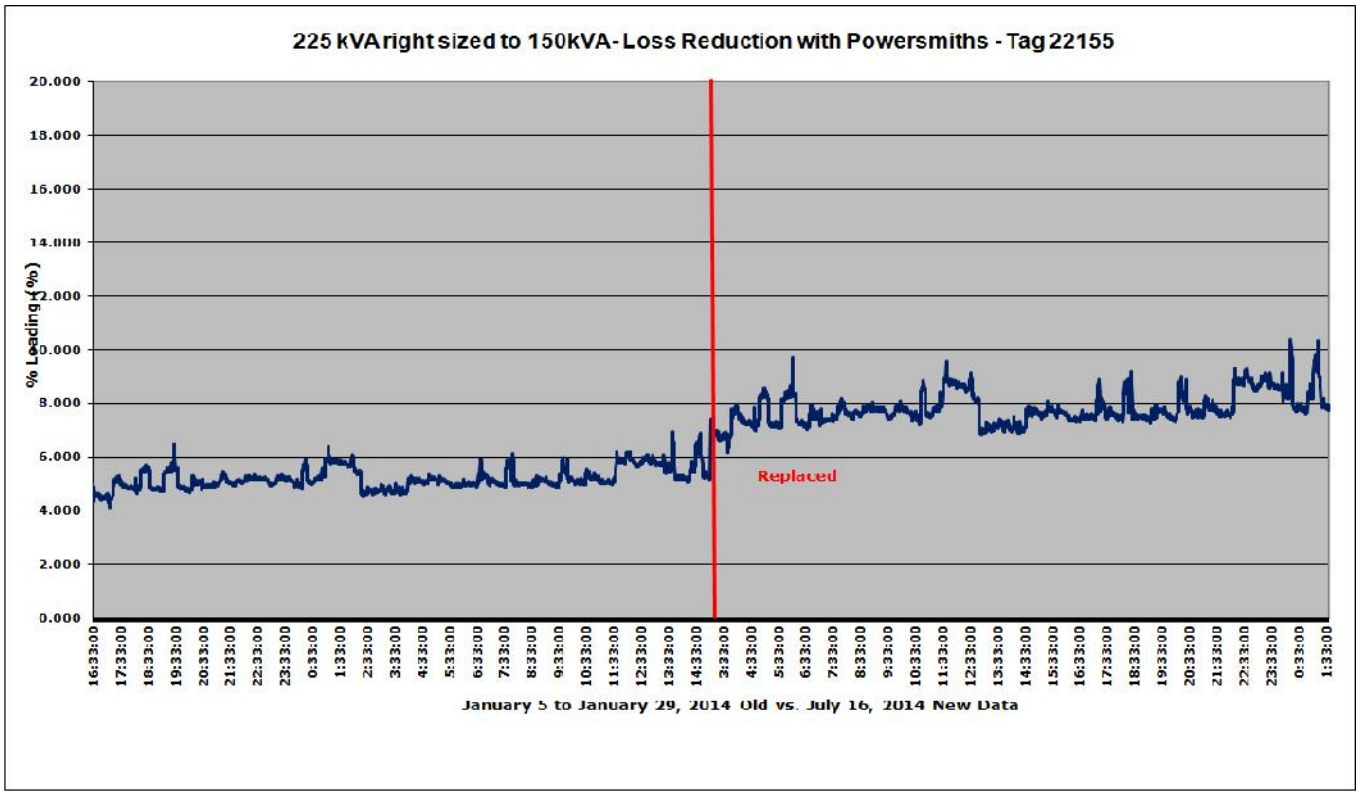
Figure 5: 22155_TD3225H4-216

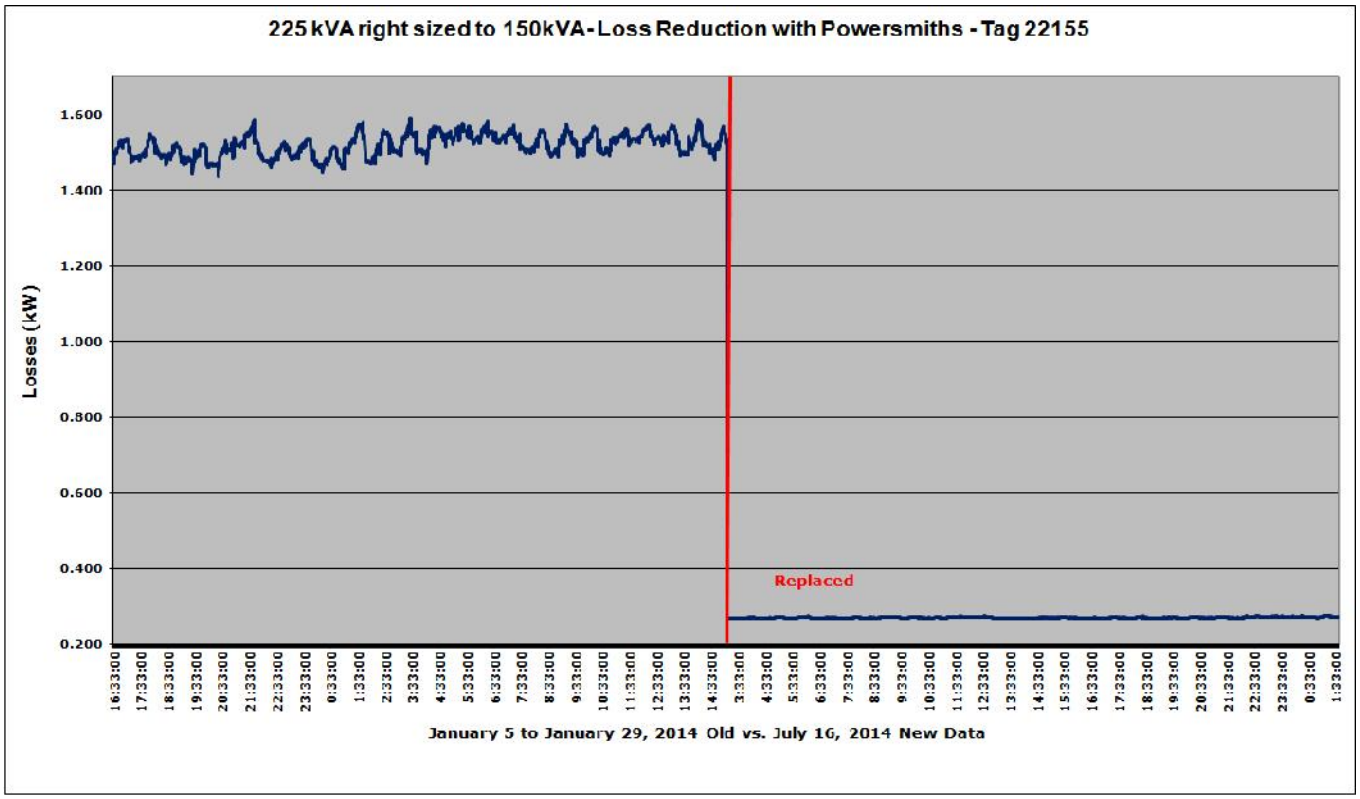
Figure 6: 22155_C3L-150-480-208

Building	Harvard Science Center			
Location	5th Floor Mech Room			
Tag Number	22155			
Measurement Period (HH:MM)	563 hrs 45 min		Powersmiths	
Sampling Interval	15 Minute			
Manufacturer	Square D			
Model	TD3225H4-216		E-Saver-C3L	
Nominal kVA	225		150	
Loading Period	On Load	Off Load	On Load	Off Load
% Loading (kVA) - Average	5.9%	5.0%	8.9%	7.5%
% Efficiency - Average	90.0%	88.4%	96.9%	96.4%
Losses (kW) - Average	1.478	1.484	0.272	0.269
Reduction in Average Losses			81.6%	81.9%

Representative Output Current THD (%)	0.8%	25.0%

Note: The existing transformer kVA has been down-sized; therefore, the average % loading has been adjusted to correspond with the existing load profile.


225 kVA right sized to 150kVA - Loss Reduction with Powersmiths - Tag 22155
% Loading (%)
Replaced
January 5 to January 29, 2014 Old vs. July 16, 2014 New Data


225 kVA right sized to 150kVA - Loss Reduction with Powersmiths - Tag 22155
Losses (kW)
Replaced
January 5 to January 29, 2014 Old vs. July 16, 2014 New Data

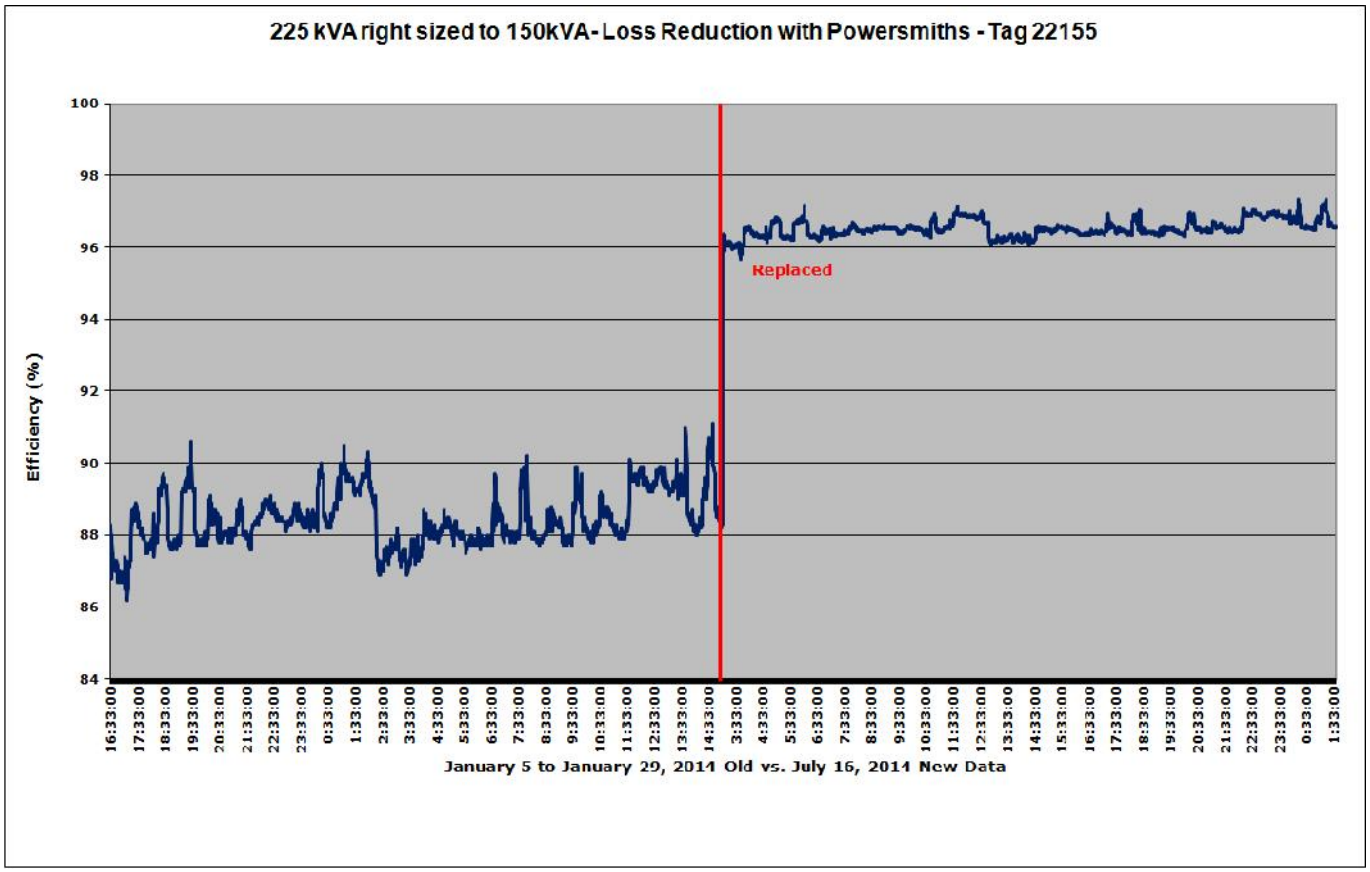
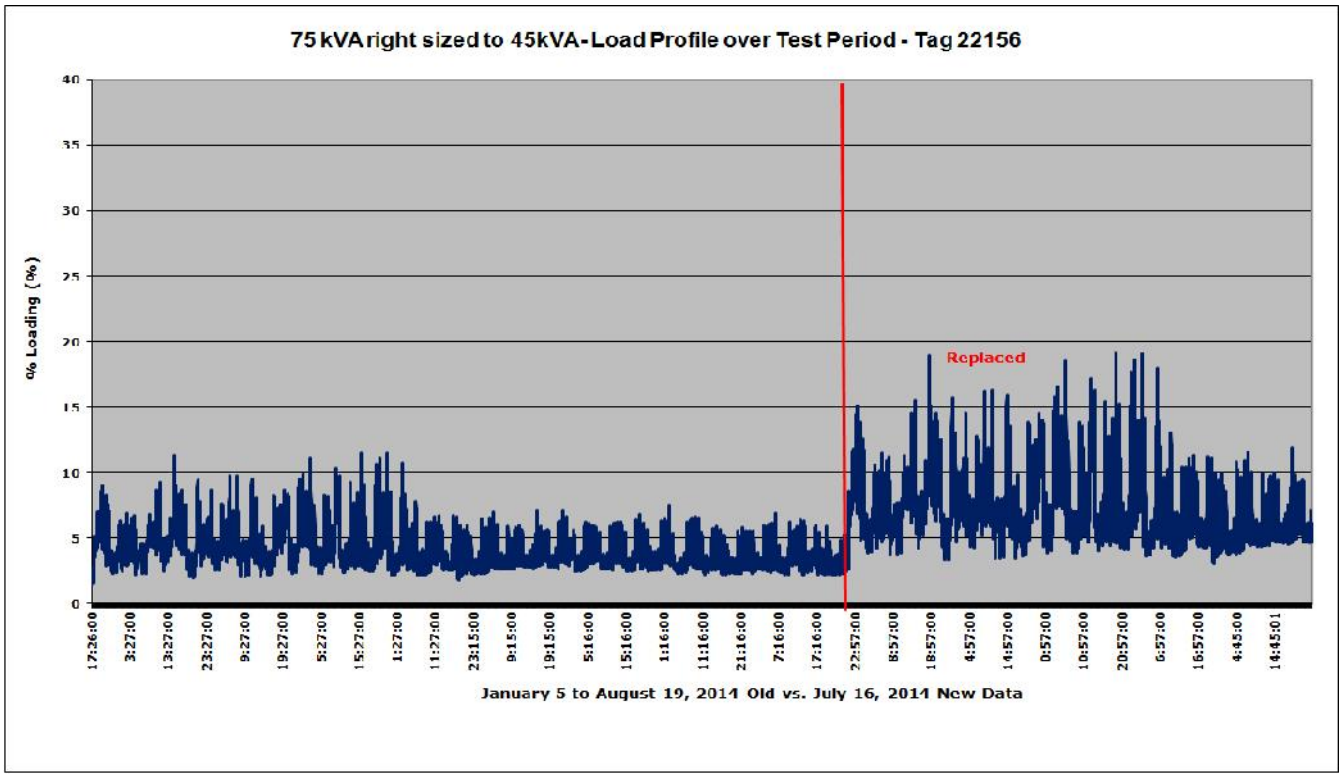

225 kVA right sized to 150kVA - Loss Reduction with Powersmiths - Tag 22155
Efficiency (%)
100
98
96
94
92
90
88
86
84
Replaced
16:33:00
17:33:00
18:33:00
19:33:00
20:33:00
21:33:00
22:33:00
23:33:00
0:33:00
1:33:00
2:33:00
3:33:00
4:33:00
5:33:00
6:33:00
7:33:00
8:33:00
9:33:00
10:33:00
11:33:00
12:33:00
13:33:00
14:33:00
15:33:00
16:33:00
17:33:00
18:33:00
19:33:00
20:33:00
21:33:00
22:33:00
23:33:00
0:33:00
1:33:00
January 5 to January 29, 2014 Old vs. July 16, 2014 New Data

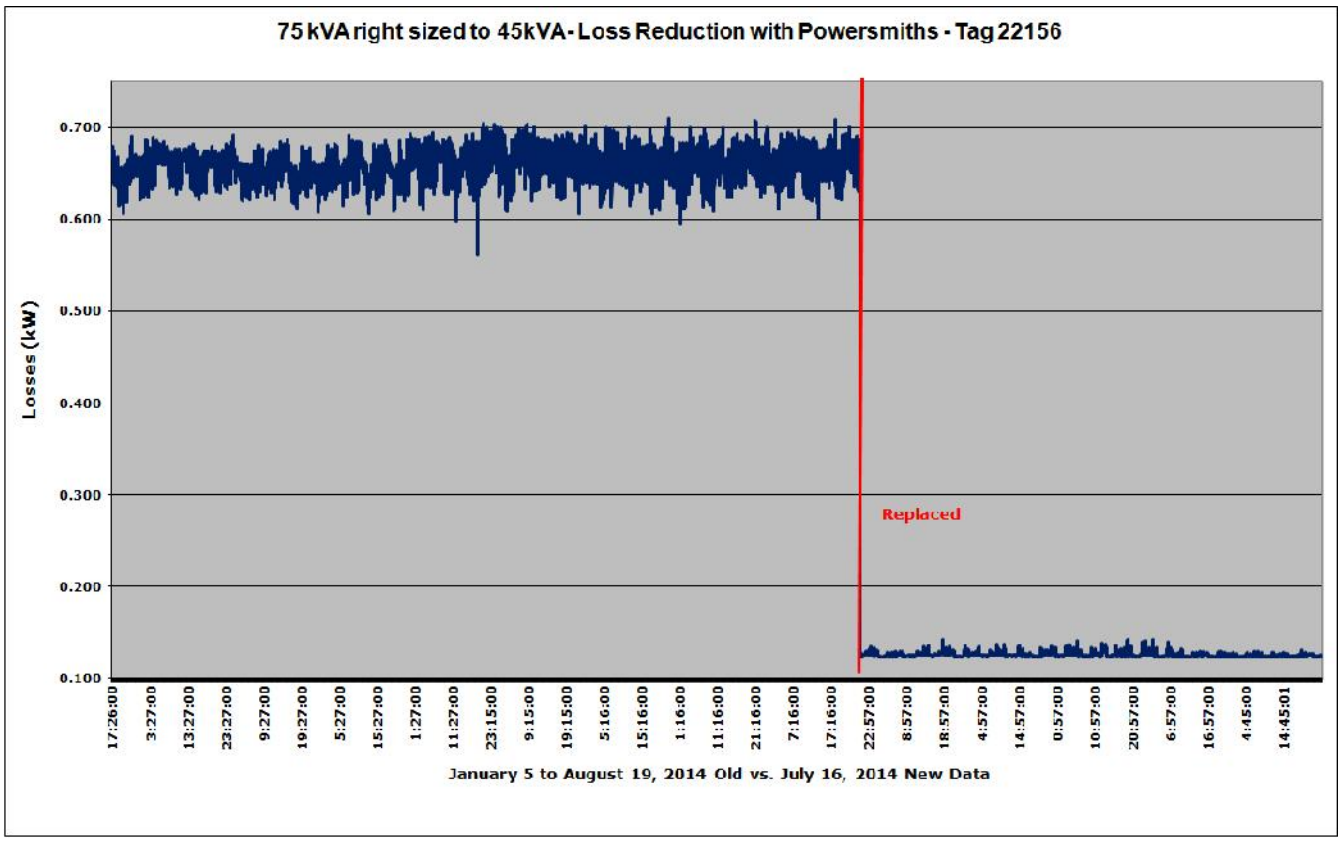
Figure 7: 22156_75T3HFISCUNLP

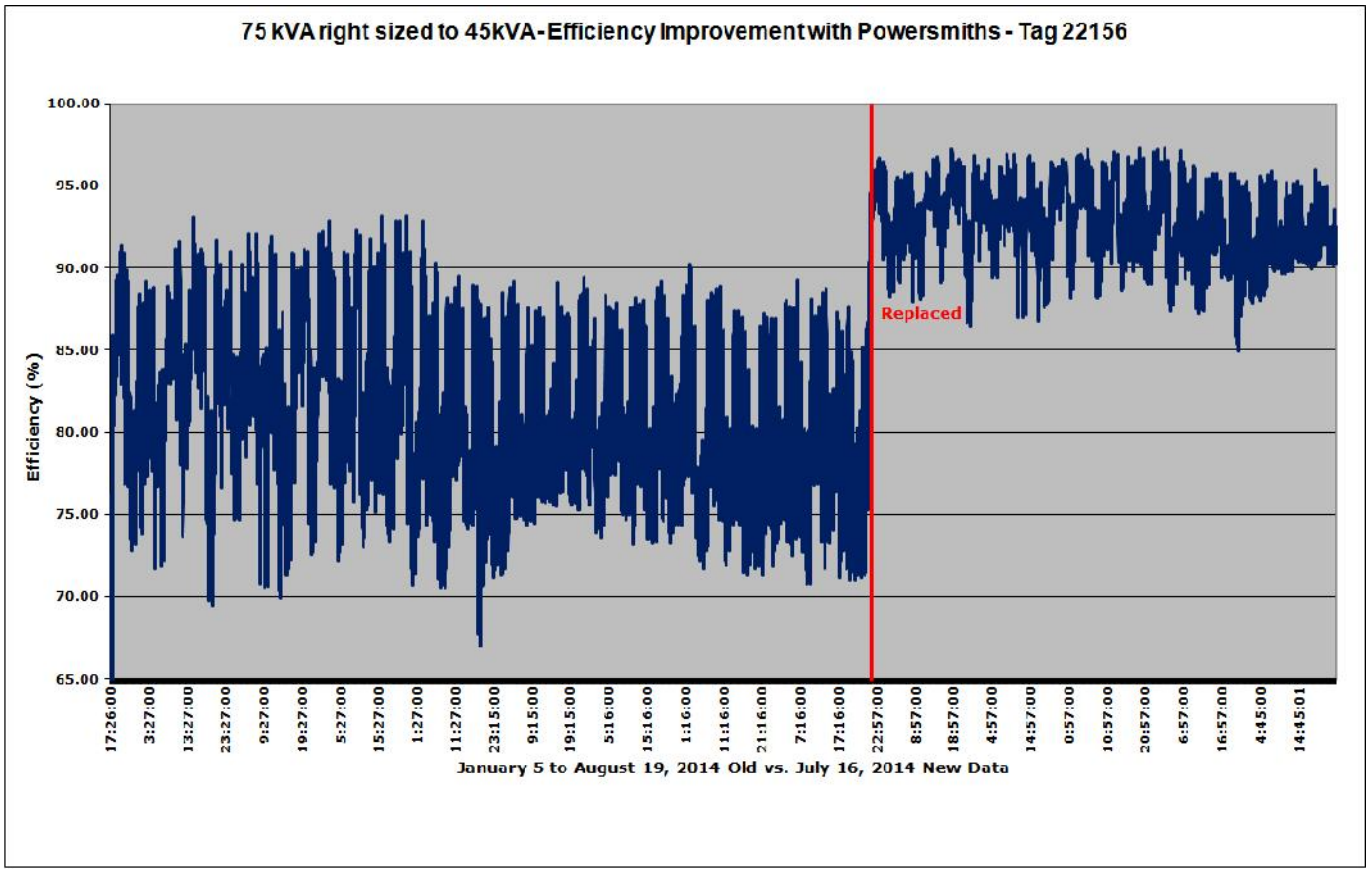
Figure 8: 22156_C3L-45-480-208

Building	Harvard Science Center			
Location	4th Floor Electrical Room			
Tag Number	22156			
Measurement Period (HH:MM)	5428 hrs 5 min		Powersmiths	
Sampling Interval	15 Minute			
Manufacturer	Square D			
Model	75T3HFISCUNLP		E-Saver-C3L	
Nominal kVA	75		45	
Loading Period	On Load	Off Load	On Load	Off Load
% Loading (kVA) - Average	5.9%	5.0%	9.8%	8.3%
% Efficiency - Average	90.0%	88.4%	95.2%	94.4%
Losses (kW) - Average	1.478	1.484	0.128	0.126
Reduction in Average Losses			91.4%	91.5%
Representative Output Current THD (%)	0.2%		48.0%	

Note: The existing transformer kVA has been down-sized; therefore, the average % loading has been adjusted to correspond with the existing load profile.


75 kVA right sized to 45kVA - Load Profile over Test Period - Tag 22156
% Loading (%)
Replaced
January 5 to August 19, 2014 Old vs. July 16, 2014 New Data


75 kVA right sized to 45kVA - Loss Reduction with Powersmiths - Tag 22156
Losses (kW)
Replaced
January 5 to August 19, 2014 Old vs. July 16, 2014 New Data


75 kVA right sized to 45kVA-Efficiency Improvement with Powersmiths - Tag 22156
Efficiency (%)
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
Replaced
17:26:00
3:27:00
13:27:00
23:27:00
9:27:00
19:27:00
5:27:00
15:27:00
1:27:00
11:27:00
23:15:00
9:15:00
19:15:00
5:16:00
15:16:00
1:16:00
11:16:00
21:16:00
7:16:00
17:16:00
22:57:00
8:57:00
18:57:00
4:57:00
14:57:00
0:57:00
10:57:00
20:57:00
6:57:00
16:57:00
4:45:00
14:45:01
January 5 to August 19, 2014 Old vs. July 16, 2014 New Data

Conclusions

- Reduction in Average Losses with Powersmiths E-Saver-C3 Transformers: **71.7% on average.**
- Replacement of the existing transformers with Powersmiths E-Saver-C3 transformers will pay for themselves many times over during the decades of expected service life.
- Current THD levels are greater than 5% and therefore general purpose transformers would not have been UL listed for this application. Powersmiths E-Saver Transformers carry the required K rating to supply the measured load profile.
- Upgrading to Powersmiths transformers provides significant ongoing environmental benefits. Reduced transformer losses result in reductions in greenhouse gas emissions and carbon footprint due to reductions in fossil-fuel consumption at the power-generating station feeding transformer losses.
- See the complete description of Powersmiths E-Saver-C3 transformer benefits in Appendix 2

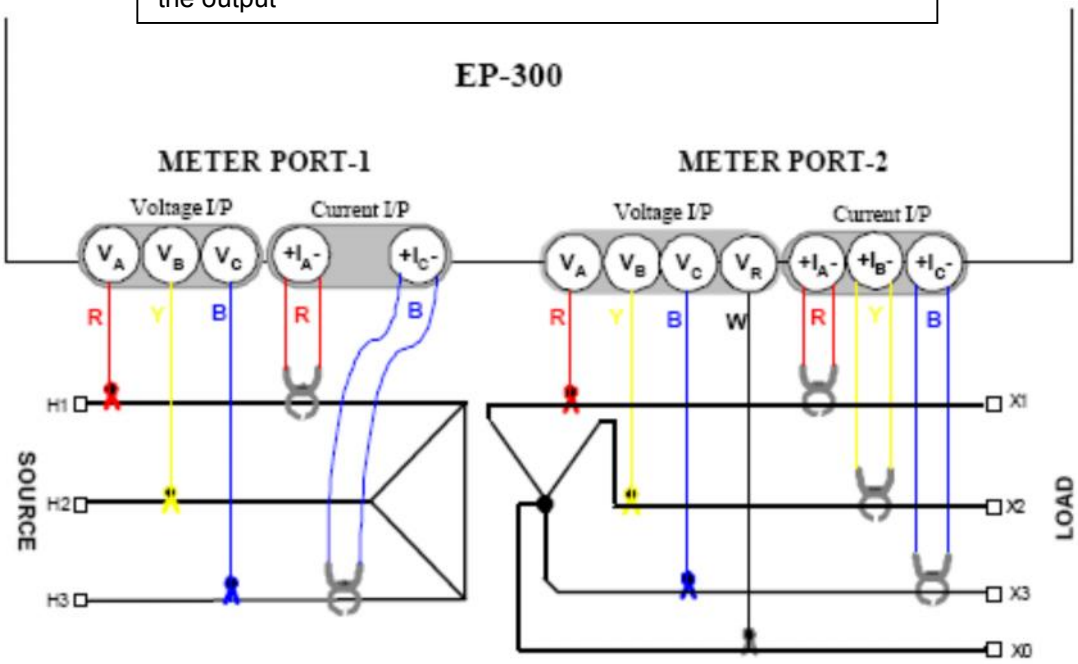
Appendix 1

Cyberhawk Portable Meter

Cyberhawk® Portable is a practical instrument for the field measurement of energy efficiency and power quality. With the unique capability of SIMULTANEOUSLY measuring up to three 3-phase ports, Cyberhawk® Portable can be used to quantify losses and efficiency of transformers, UPS's and other multi-port devices with near revenue class accuracy.

TYPICAL TRANSFORMER SET-UP

A Typical hookup configuration to the input and output of the transformer is illustrated in the figure below, which uses the 2-Wattmeter method on the input and the 3-Wattmeter method on the output



Appendix 2

Powersmiths E-Saver-C3 Transformer Benefits

The E-Saver transformer is the ideal transformer for all environments where energy efficiency is a priority. The E-Saver is a practical and affordable solution for buildings where lowest life-cycle cost and energy savings are a priority.

Characteristics
The E-Saver-C3 delivers a higher level of environmental protection, energy efficiency and reliability. Designed to provide the lowest life cycle cost per the US DOE's 2004 assessment, the E-Saver goes beyond US DOE Candidate Level 3 efficiency ensuring lower operating losses than standard off-the-shelf transformers. To provide superior performance and reduce environmental impact, the E-Saver also comes with a superior Nomex based insulation system impregnated with an organic epoxy adhesive.

Customize
E-Saver transformers are designed and manufactured to fit within the existing footprint or constraints and are provided with custom lug termination configurations. Custom design and manufacturing allows for faster installation and lower installation costs.

Quiet Operation
Working or Learning environments can be degraded or disrupted when noisy transformers are located close to people. To meet this challenge, the E-Saver has embedded structural and acoustic treatments that combine to reduce ambient noise generated by the transformer. To ensure quiet operation, noise tests are part of our ISO 9001 procedures for every transformer.

Environmental
The E-Saver is built in an ISO 9001 (quality management) and ISO 14001 (environmental management) certified facility. Throughout the manufacturing process, Powersmiths takes steps to ensure that waste is eliminated and hazardous materials are avoided. Because Powersmiths transformers generate lower losses, they reduce power drawn from generating stations resulting in less smog and lower greenhouse gas emissions.

Testing
E-Saver transformers are subjected to rigorous testing to ensure efficiency under various load profiles and loading conditions, quiet operation, and insulation integrity and production tests with actual computer power loading. Powersmiths' test facility has been certified to ISO 17025 for efficiency testing by Canadian Standards Association International (CSA).

Warranty
The E-Saver's long life and dependable performance is backed up by Powersmiths' industry leading 25 year pro-rated warranty.