POWER QUALITY ANALYSIS REPORT

FOR

CHEMICAL MANUFACTURING PLANT

Industrial Area MIDC,
Roha, Raigad.

By

SAS Powertech Pvt Ltd.

101, Gera's Regent Manor, Survey No. 33, Area No. 39/570,
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SITE DETAILS

Site Name	**Chemical Manufacturing Plant** MIDC Roha, Raigad
Contact Person	**Mr. Sanjay Jagdale** **Contact: 08879913631**
Analysis Period	14th and 15th January 2015
Audit Conducted By	**Mr. Amit Jadhav**
Equipment Used For Analysis	 **KRYKARD ALM35 Power Quality Analyzer** **Chauvin Arnoux,**

LIST OF ABBREVIATION

MLTP	Main LT panel
PQA	Power quality analysis
Vrms	Phase to neutral voltage
Urms	Phase to phase voltage
Arms	Current
Avg.	Average
Min.	Minimum
Max.	Maximum
Ith	Total harmonics distortion in current
Vthd	Total harmonics distortion in voltage
PF	Power factor
PCC	Power control circuit/point of common coupling
TDD	Total demand distortion
THD	Total harmonics distortion
MERC	Maharashtra electricity regulatory commission
DB	Distribution board
DG	Diesel generator
LT	Low tension
IEEE	Institute of electrical and electronics engineers
NEC	National electric code
SLD	Single line diagram
UPS	Uninterrupted power supply

COLOUR CODE

Red	R-Phase / Line-1 / Phase-1 / R-Y
Yellow	Y-Phase / Line-2 / Phase-2 / Y-B
Blue	B-Phase / Line-3 / Phase-3 / B-R
Black	Neutral
Green	Total Value

ACKNOWLEDGEMENT

We are thankful to the management of **Chemical Manufacturing Plant, MIDC Area Roha, Raigad** for giving us an opportunity to conduct power quality analysis at their premises.

We are also thankful to **Mr. Sanjay Jagdale** for making available documentation and information of electrical system.

We are also thankful to **Mr. Dalvi Sir** from Maintenance department for the help and co-operation during Power Quality Analysis.

We do hope you will find our recommendations useful in helping you to improve the power quality of your electrical system

We wish the management success in their Endeavour to improve power quality.

For **SAS Powertech, Pune**

Abhijit Katre

Authorized Signatory

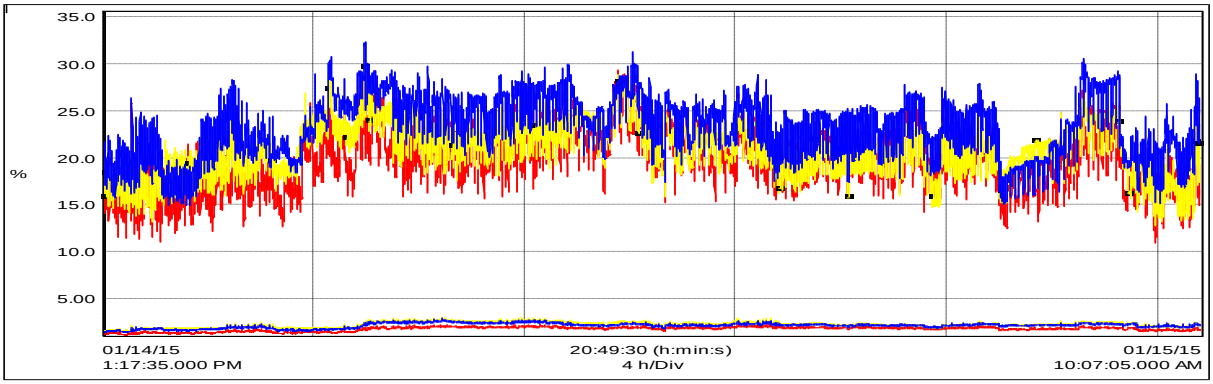
Description of Electrical Infrastructure

The company receives electrical input through 22KV / 433V, 2MVA transformer which is installed in a different company premise which is another user of this transformer. The contract demand of the client is 250 KVA. 100KVAR fixed capacitors are used for reactive power compensation. On a typical working day KWh consumption is around 2800 to 3000 units. Main load is Motors and VFD's.

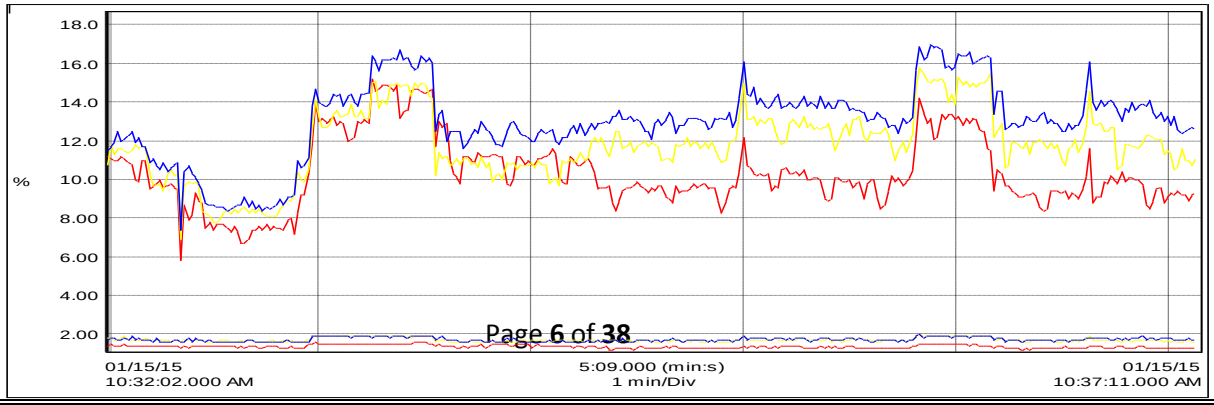
Executive summary of findings:-

1) Phase to Neutral voltage appears to be on higher side (260 Volts) throughout the period. Normal single phase loads work with rated voltage of 215V or 230V. This results into 15% excess energy consumption by loads like lighting. This consistent high voltage also reduces life of such loads due to voltage stress.
2) Excess single phase voltage is slow poisoning for split air conditions used in isolated AC areas.
3) The load current varies between 110 to 230Amps. Max current harmonic distortion is 32.4% and associated voltage distortion is about 3.0%. This current distortion reduces to less than 17.0% and voltage distortion reduces to 2.0% when capacitors are off.

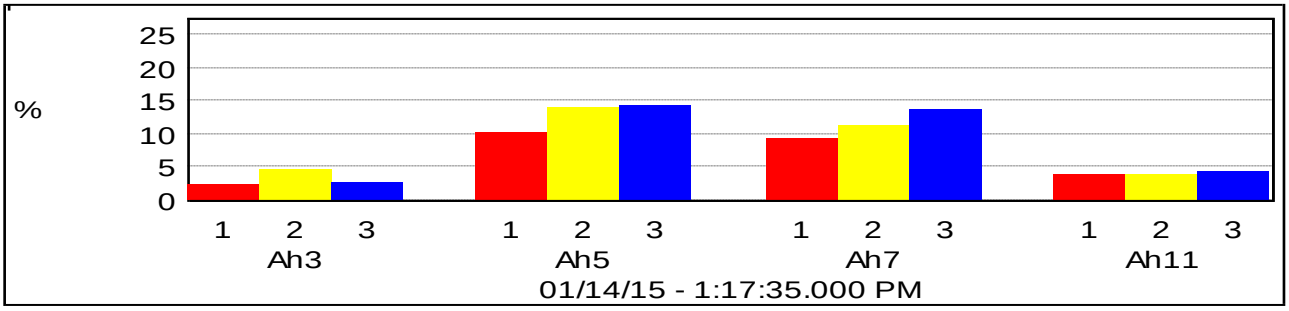
Current distortion at Archoma Main incomer with capacitor



Current distortion at Archoma Main incomer without capacitor



4) Predominant harmonic currents are as given bellow**.**



As measured during audit in your case the current taken by your load includes 5th and 7th harmonic currents approximately 25Amps each.

The table bellow shows power quality parameters at all RAW POWER feeders at a glance.

Sr No	Name	I rms			I thd %			V thd %			kVA			kW			pf		
1)	Main Incomer with Capacitor	228	220	206	29	30	32	2.3	2.9	3.0	59	56	54	57	54	53	.99	.99	.98
2)	Main Incomer without Capacitor	208	213	206	15	15	17	1.2	1.6	1.6	52	53	52	39	40	38	.89	.89	.86
3)	Feeder 1	101	79	90	21	24	22	1.9	2.5	2.4	25	20	23	23	17	17	.90	.87	.85
4)	Feeder 2	17	12	11	30	61	58	2.7	2.4	2.5	4	3	2	3	2	2	.81	.83	.80
5)	Cooling Tower	124	126	126	7	7	9	1.9	2.4	2.3	31	32	32	22	23	23	.87	.87	.87

Transformer Details (MSEDCL)	
Make	Bharat Bijli
Rating	2MVA
Primary Voltage/Secondary	22KV/433V
Impedance	6.02%

Isc / IL calculations for the setup as per IEEE519 – 1992

Client : Chemical Manufacturing PlantLtd	
Parameter	Value
MSEDCL Transformer Capacity MVA	2
MSEDCL Transformer % Impedense	6.02
Contract Demand KVA	250
Max current as per contract demand on LT Side AMPS	333.75
Max Load Current IL Amps on LT Side AMPS	230
HT System Voltage K Volts	22
LT System Voltage	433
Full Load current of MSEDCL Transformer Amps	2670
Short Circuit current of MSEDCL Transformer IscAmps	44352
Plant current as per contract demand on HT side	6.56
Plant Average load current on HT side	4.52
Isc / IL Ratio as per contract demand	132
Isc / IL Ratio as per Average Plant Current	192

Table showing Current distortion limits for general distribution system (120V through 69,000V) as per IEEE 519 – 1992

Maximum harmonic current distortion in percentage of IL for voltages less than 22KV.						
Individual harmonic order (odd harmonics)						
Isc/IL	**<11h**	**11≤h<17**	**17≤h<23**	**23≤h<35**	**35≤h<49**	**TDD**
<20	4.00	2.0	1.5	0.6	0.3	5.00
20<50	7.00	3.5	2.5	1.0	0.5	8.00
50<100	10.00	4.5	4.0	1.5	0.7	12.00
100<1000	12.00	5.5	5.00	2.0	1.0	15.00
>1000	15.00	7.00	6.00	3.5	1.4	20.00
Even harmonics are limited to 25% of odd harmonic limits above.						

As per above current harmonics compliance limit is 15% as the ratio is 132

MSEDCL compliance requirements on current harmonics.

Nonlinear loads like UPS systems, variable frequency drives, etc demand non linear currents from source, i.e. MSEDCL. Non linear currents comprise of 50Hz currents and currents of higher frequency. As measured during audit in your case the current taken by your load includes 5^{th} and 7^{th} harmonic currents approximately 25Amps each. These currents have 250Hz and 350Hz frequencies. Such high frequency currents can result into overheating of MSEDCL infrastructure which brings power to your premises. To safe guard commercial interests of MSEDCL against this overheating, government rules and regulations have given them powers of deciding current harmonics compliance limits. These are mentioned in MSEDCL code – Supply code 2005, which in turn asks consumers to follow an international standard IEEE 519 1992.

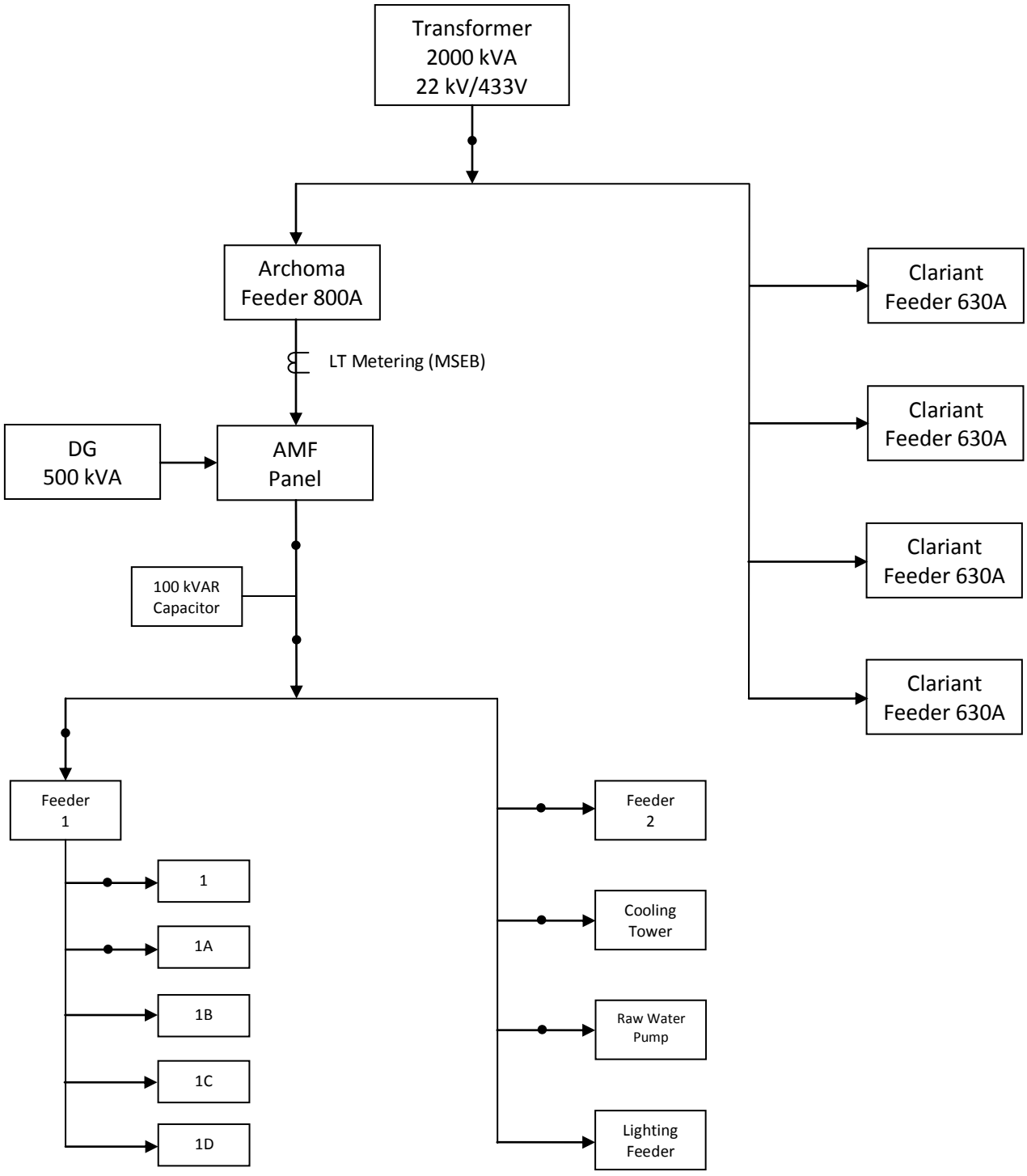
This report calculates compliance requirements as per provisions in above standard and as required by Supply code 2005, compares the measured current harmonics as per this and recommends the methods to achieve this compliance.

Recommendations & Suggestions :-

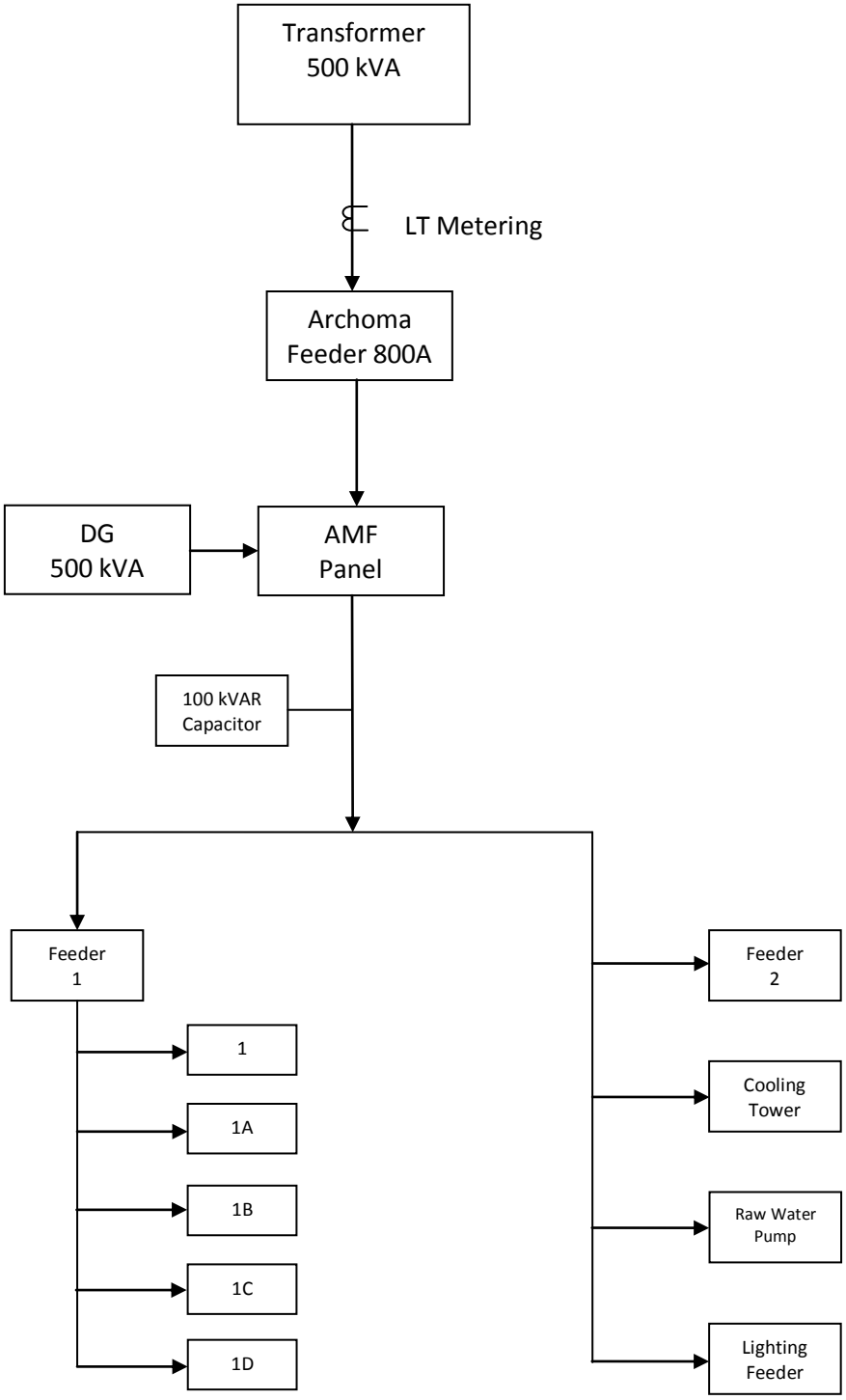
- We recommend **225KVAR / 525Volts detuned filters** with APFC and thyristor switching. The total load being comparatively less, we do not recommend distributed correction as the same will not provide noticeable effects.

- We also recommend **60Amps active harmonic filter** at main incomer to control load harmonics at a low value and reduce currents harmonics handled by transformer further. This will also result into reduction in voltage harmonics and improve quality of raw power in the premises.

Single Line Diagram of Electrical Distribution System

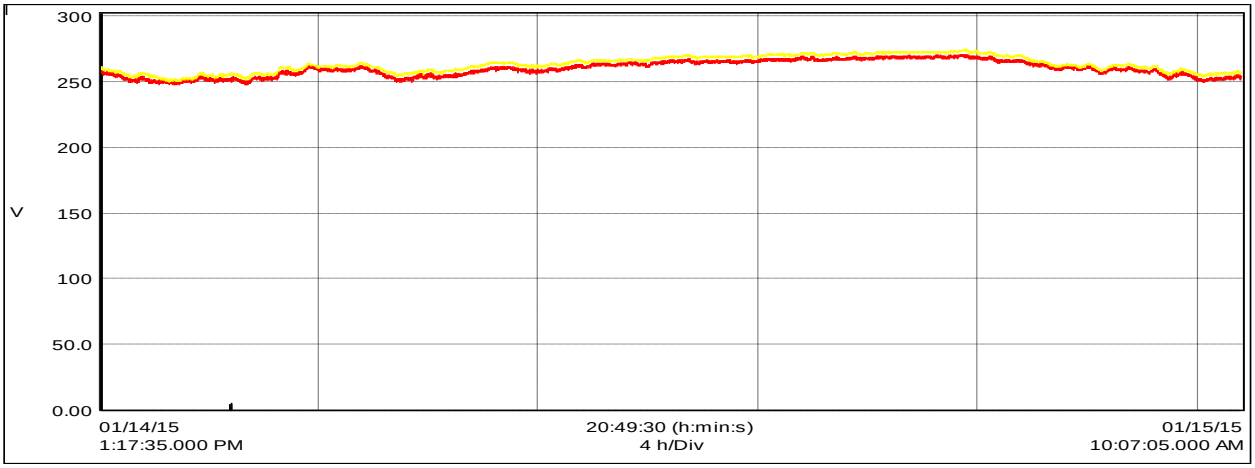


(SLD) should be in future



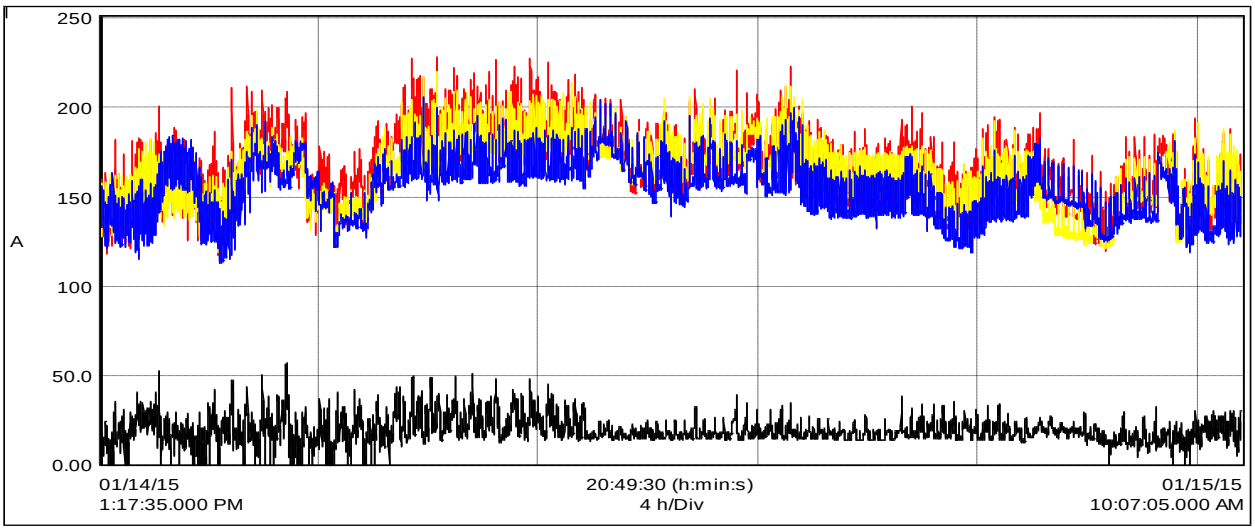
(Archoma) Main Incomer with capacitors

Phase to Neutral Voltage (VRMS)



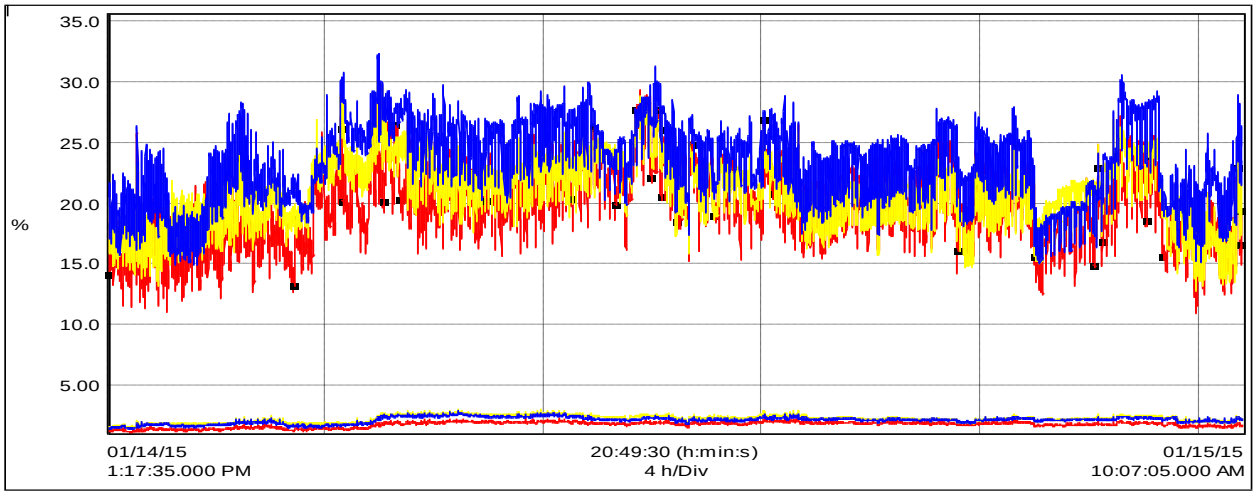
PARAMETERS (Phase to Neutral V)	AVG (V)	MIN (V)	MAX (V)
R Phase Voltage (V_{rms})	260.339	247.800	271.000
Y Phase Voltage (V_{rms})	260.312	248.100	270.700
B Phase Voltage (V_{rms})	263.724	250.300	275.300
Neutral to Earth Voltage	0.001	0.000	5.100

Current (ARMS)



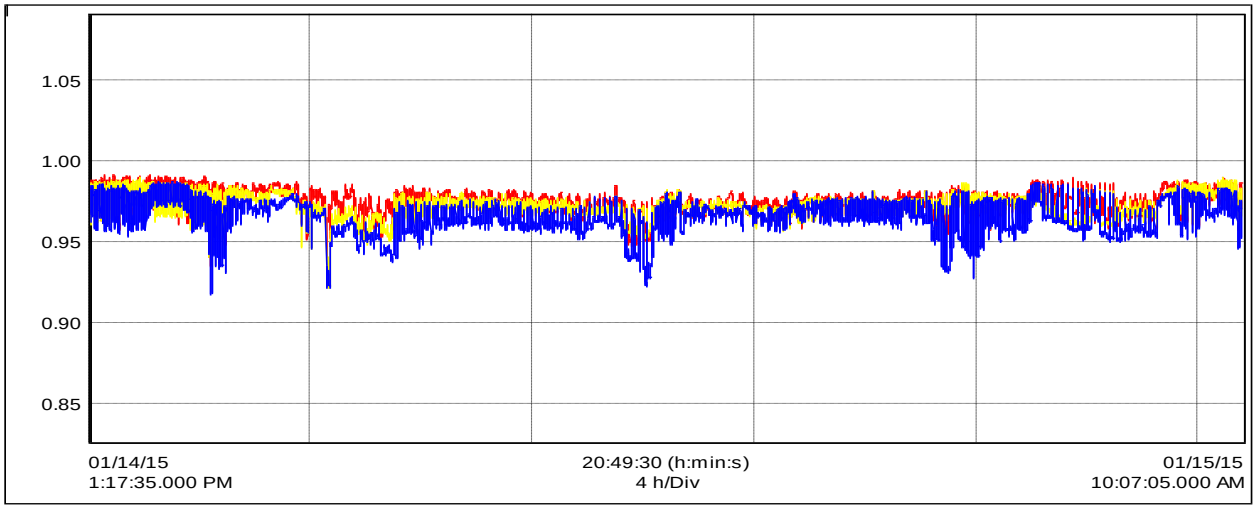
PARAMETERS	AVG (A)	MIN (A)	MAX (A)
R-Phase Load Current (A_{rms})	166.619	114.500	228.800
Y-Phase Load Current (A_{rms})	162.401	118.900	220.700
B-Phase Load Current (A_{rms})	154.342	113.100	206.000
Neutral Current (A_{rms})	**19.273**	**0.000**	**57.700**
Current Unbalance (%)	3.990	0.100	10.800

Total Current & Voltage Harmonics Distortion



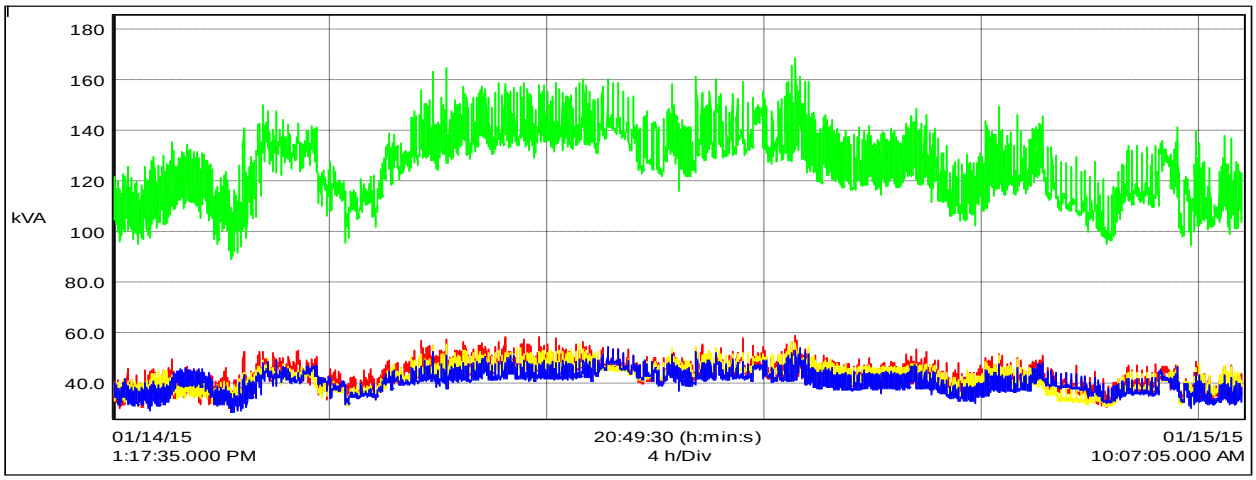
PARAMETERS	AVG (%)	MIN (%)	MAX (%)
R-Phase THD in Current (I_{thd})	19.729	10.900	29.400
Y- Phase THD in Current (I_{thd})	20.925	12.800	30.100
B- Phase THD in Current (I_{thd})	23.253	14.900	32.400
R-Phase THD in Voltage (V_{thd})	1.761	1.100	2.300
Y-Phase THD in Voltage (V_{thd})	2.227	1.500	3.000
B-Phase THD in Voltage (V_{thd})	2.115	1.400	2.900

Power Factor (pf)



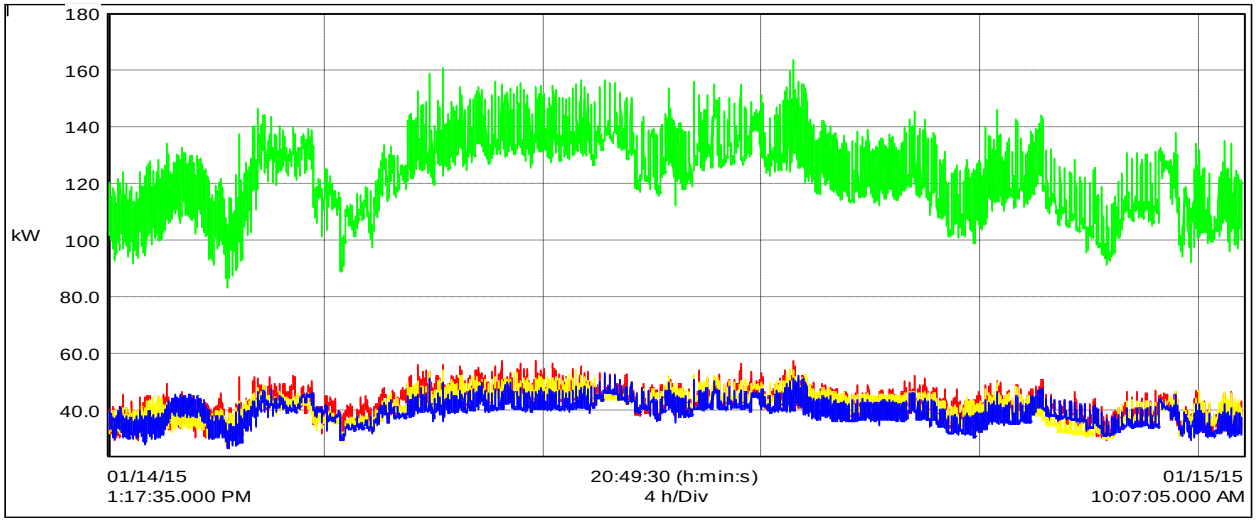
PARAMETERS	AVG (pf)	MIN (pf)	MAX (pf)
R- Phase Power Factor	0.976	0.935	0.992
Y- Phase Power Factor	0.973	0.922	0.990
B- Phase Power Factor	0.966	0.918	0.988

Load Power (kVA)



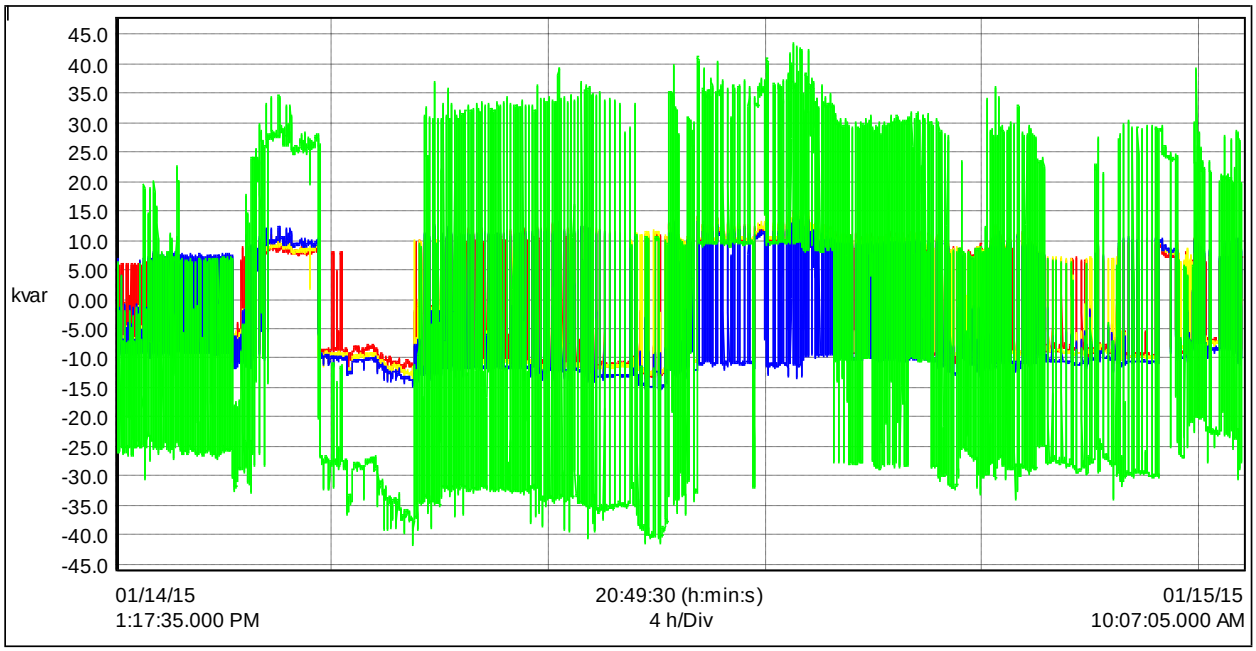
PARAMETERS	AVG (kVA)	MIN (kVA)	MAX (kVA)
R- Phase kVA	43.363	28.973	59.229
Y- Phase kVA	42.274	30.123	56.754
B- Phase kVA	40.698	28.947	54.568
Total kVA	126.335	89.580	169.028

Load Pwer (kW)



PARAMETERS	AVG (kW)	MIN (kW)	MAX (kW)
R- Phase kW	42.328	27.094	57.616
Y- Phase kW	41.139	28.355	54.802
B- Phase kW	39.330	26.599	53.395
Total kW	126.335	89.580	169.028

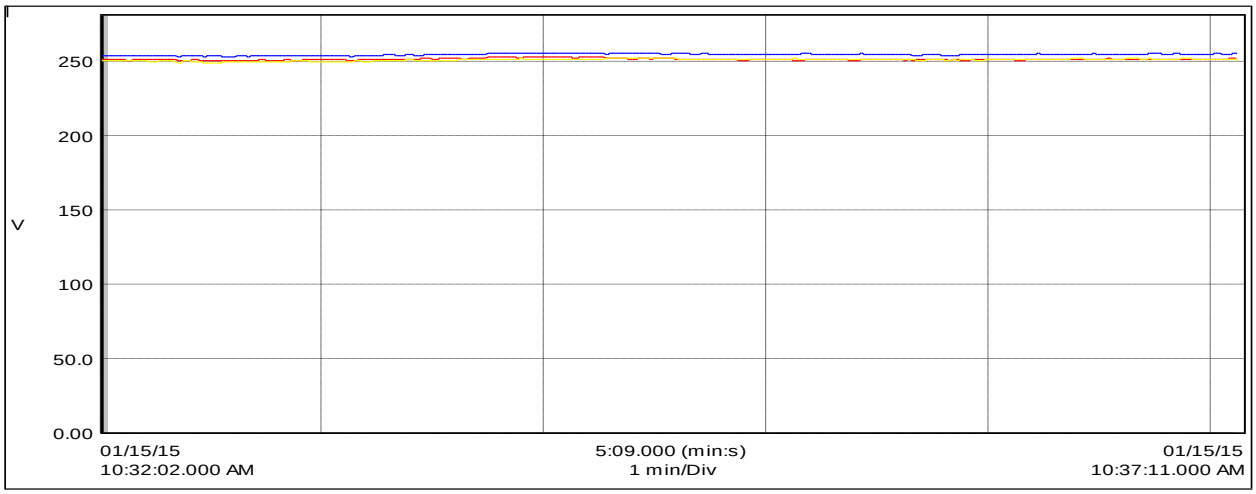
Load Power (kvar)



PARAMETERS	AVG (kvar)	MIN (kvar)	MAX (kvar)
R- Phase kvar	-0.510	-13.663	14.891
Y- Phase kvar	-1.436	-13.410	14.979
B- Phase kvar	-4.365	-15.367	14.224
Total kvar	-6.311	-41.776	43.601

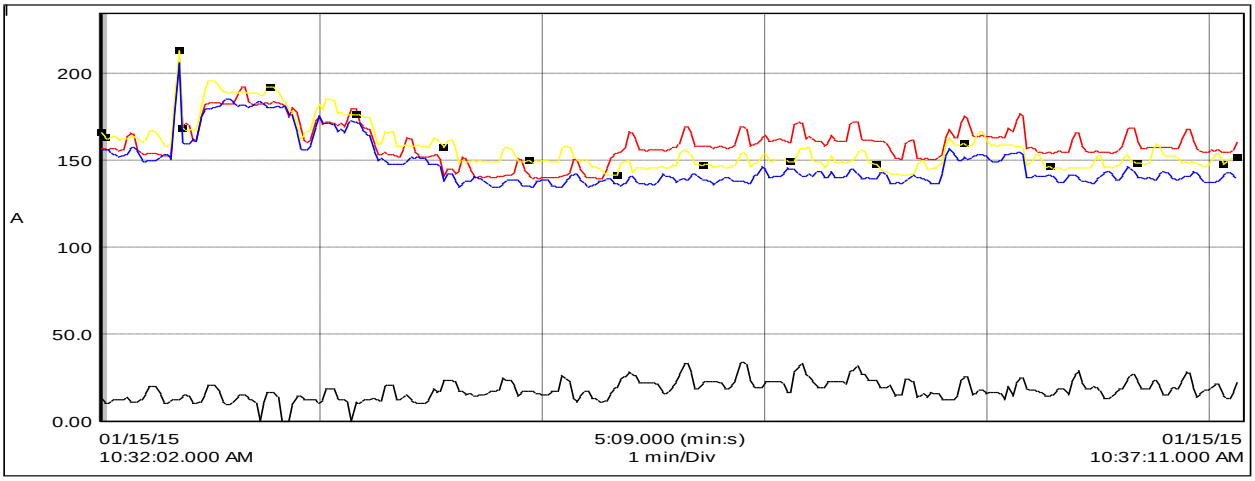
(Archoma) Main Incomer without Capacitors

Phase to Neutral Voltage (VRMS)



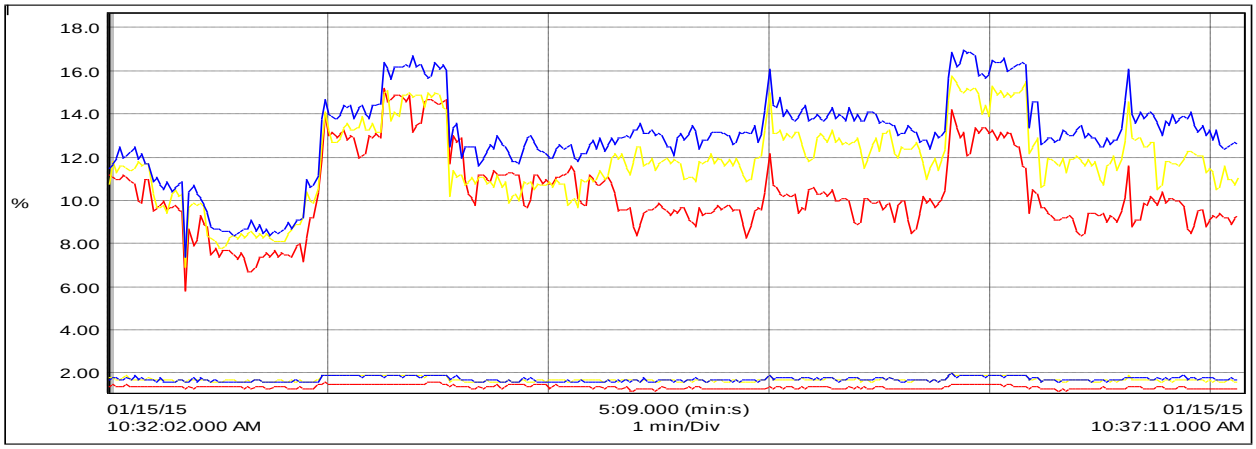
PARAMETERS (Phase to Neutral V)	AVG (V)	MIN (V)	MAX (V)
R Phase Voltage (V_{rms})	251.612	250.300	253.100
Y Phase Voltage (V_{rms})	251.193	249.100	252.600
B Phase Voltage (V_{rms})	254.751	253.300	255.900
Neutral to Earth Voltage	0.000	0.000	0.000

Current (ARMS)



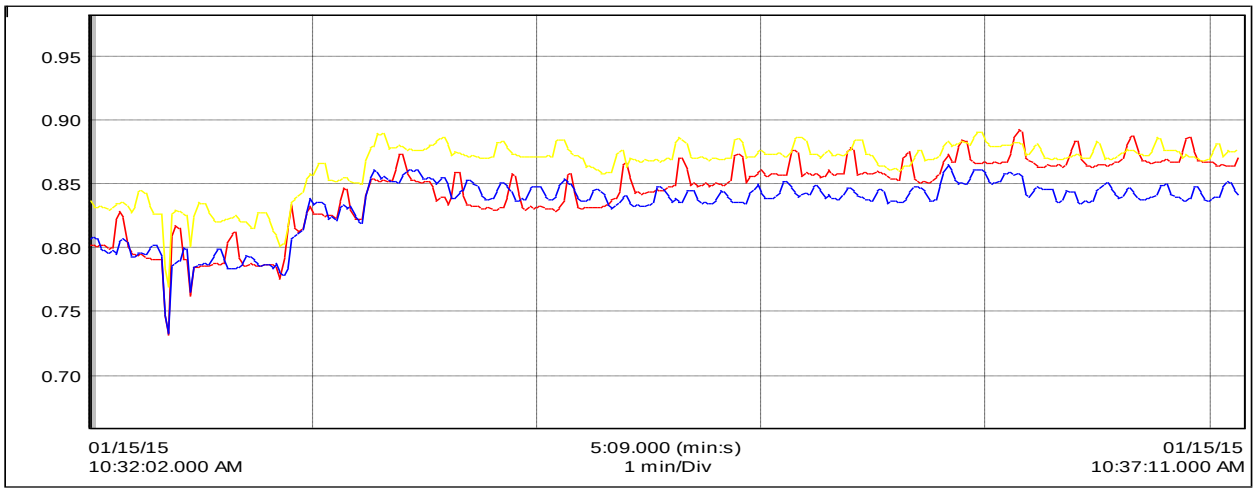
PARAMETERS	AVG (A)	MIN (A)	MAX (A)
R-Phase Load Current (A_{rms})	160.190	139.500	208.800
Y-Phase Load Current (A_{rms})	157.537	141.600	213.600
B-Phase Load Current (A_{rms})	148.214	134.600	206.700
Neutral Current (A_{rms})	17.955	0.000	33.800
Current Unbalance (%)	2.547	0.700	5.100

Total Current & Voltage Harmonics Distortion



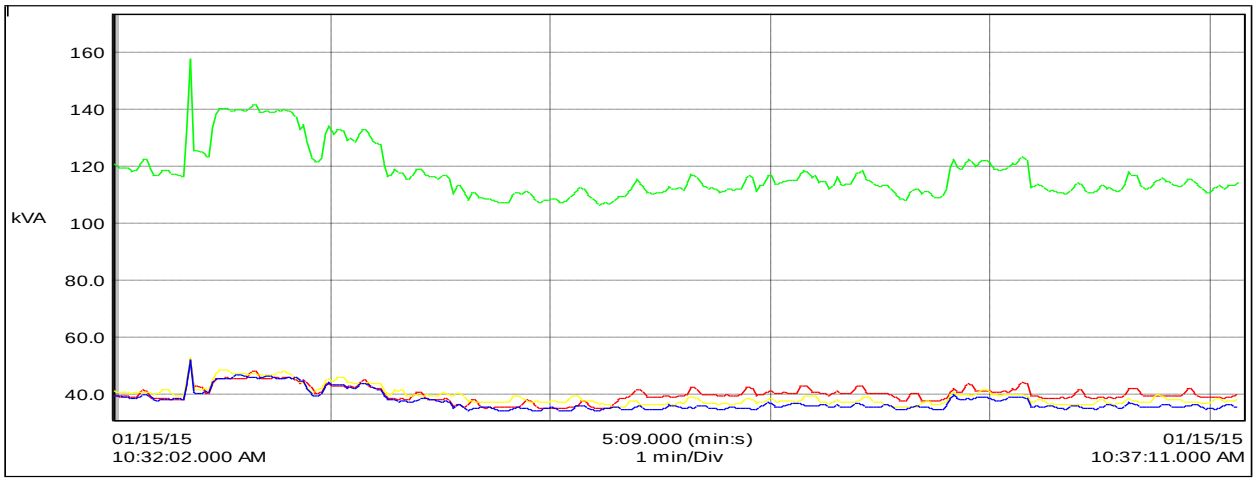
PARAMETERS	AVG (%)	MIN (%)	MAX (%)
R-Phase THD in Current (I_{thd})	10.343	5.800	15.200
Y- Phase THD in Current (I_{thd})	11.806	6.900	15.800
B- Phase THD in Current (I_{thd})	13.013	7.400	17.000
R-Phase THD in Voltage (V_{thd})	1.378	1.200	1.600
Y-Phase THD in Voltage (V_{thd})	1.716	1.600	2.000
B-Phase THD in Voltage (V_{thd})	1.728	1.600	2.000

Power Factor (pf)



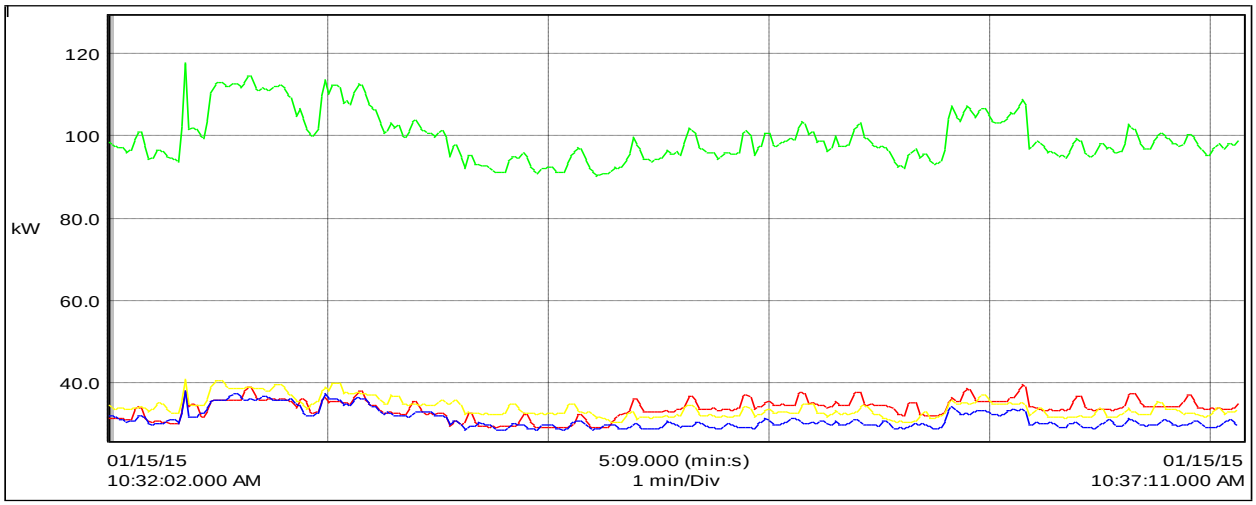
PARAMETERS	AVG (pf)	MIN (pf)	MAX (pf)
R- Phase Power Factor	0.844	0.732	0.893
Y- Phase Power Factor	0.864	0.770	0.891
B- Phase Power Factor	0.834	0.733	0.865

Load Power (kVA)



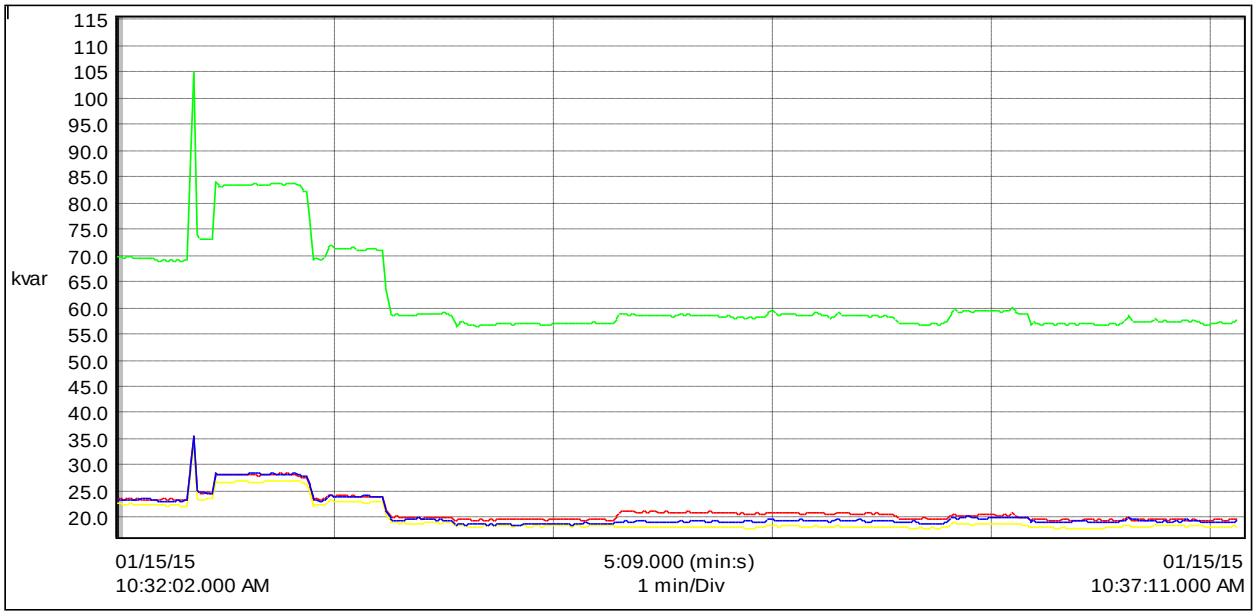
PARAMETERS	AVG (kVA)	MIN (kVA)	MAX (kVA)
R- Phase kVA	40.300	35.320	52.264
Y- Phase kVA	39.563	35.650	53.222
B- Phase kVA	37.752	34.413	52.366
Total kVA	117.614	106.775	157.853

Load Pwer (kW)



PARAMETERS	AVG (kW)	MIN (kW)	MAX (kW)
R- Phase kW	33.988	29.363	39.698
Y- Phase kW	34.150	30.674	40.955
B- Phase kW	31.425	28.841	38.382
Total kW	99.563	90.140	117.587

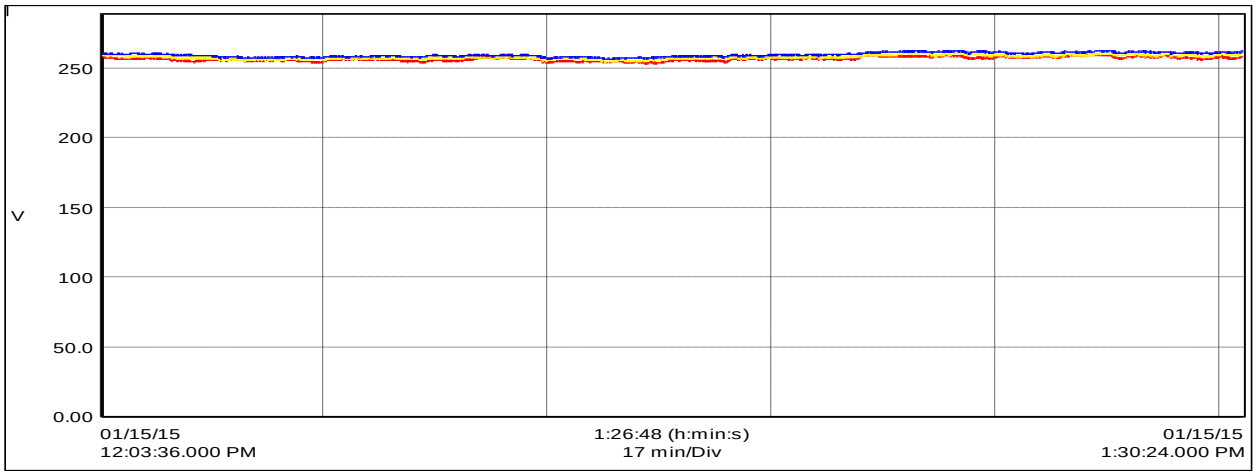
Load Power (kvar)



PARAMETERS	AVG (kvar)	MIN (kvar)	MAX (kvar)
R- Phase kvar	21.549	19.449	35.616
Y- Phase kvar	19.906	17.953	33.990
B- Phase kvar	20.863	18.593	35.623
Total kvar	62.318	56.604	105.229

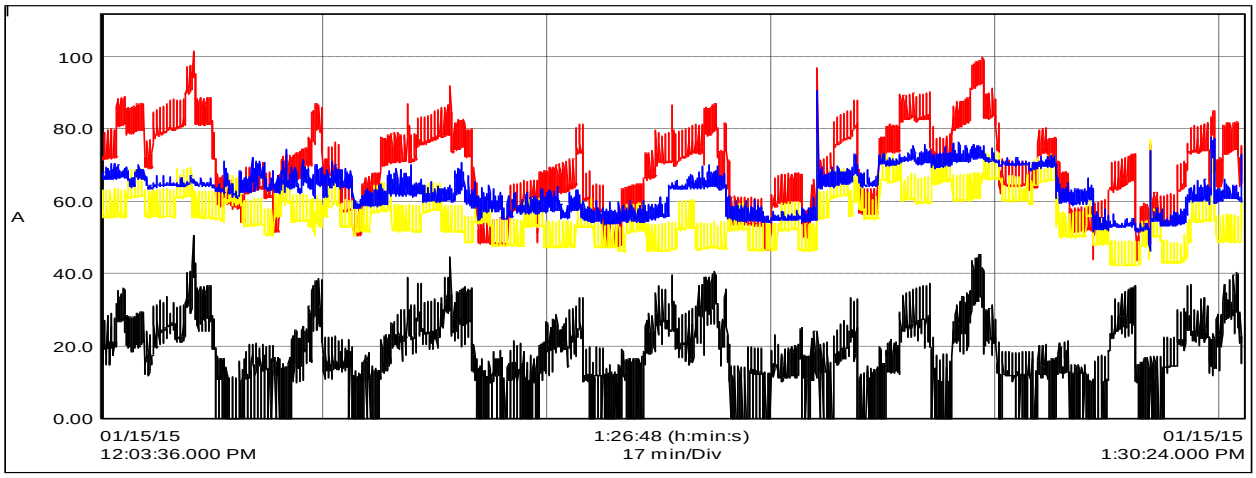
Feeder 1

Phase to Neutral Voltage (VRMS)



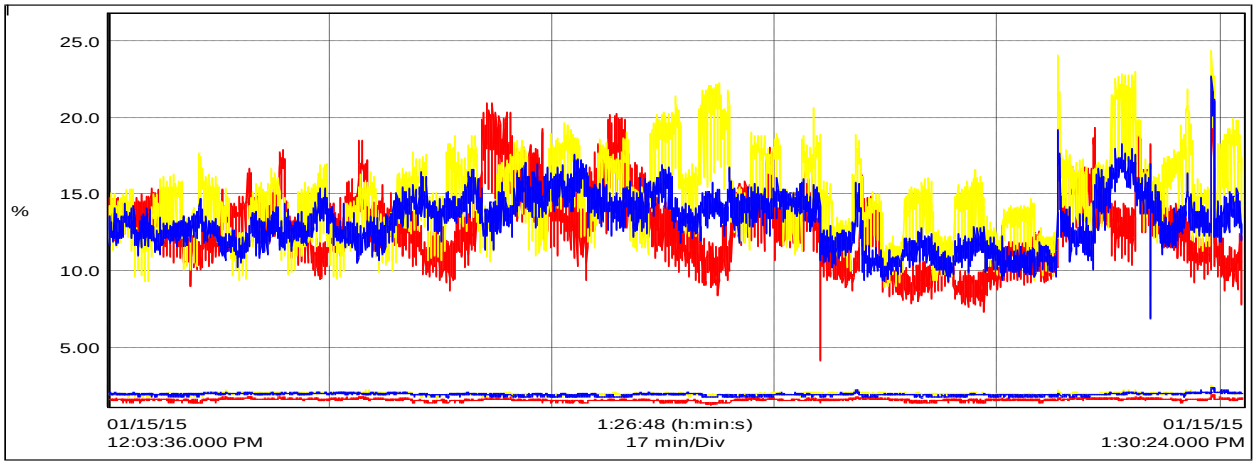
PARAMETERS (Phase to Neutral V)	AVG (V)	MIN (V)	MAX (V)
R Phase Voltage (V_{rms})	256.656	253.000	260.000
Y Phase Voltage (V_{rms})	257.933	254.300	261.200
B Phase Voltage (V_{rms})	259.603	256.200	262.700
Neutral to Earth Voltage	0.000	0.000	0.000

Current (ARMS)



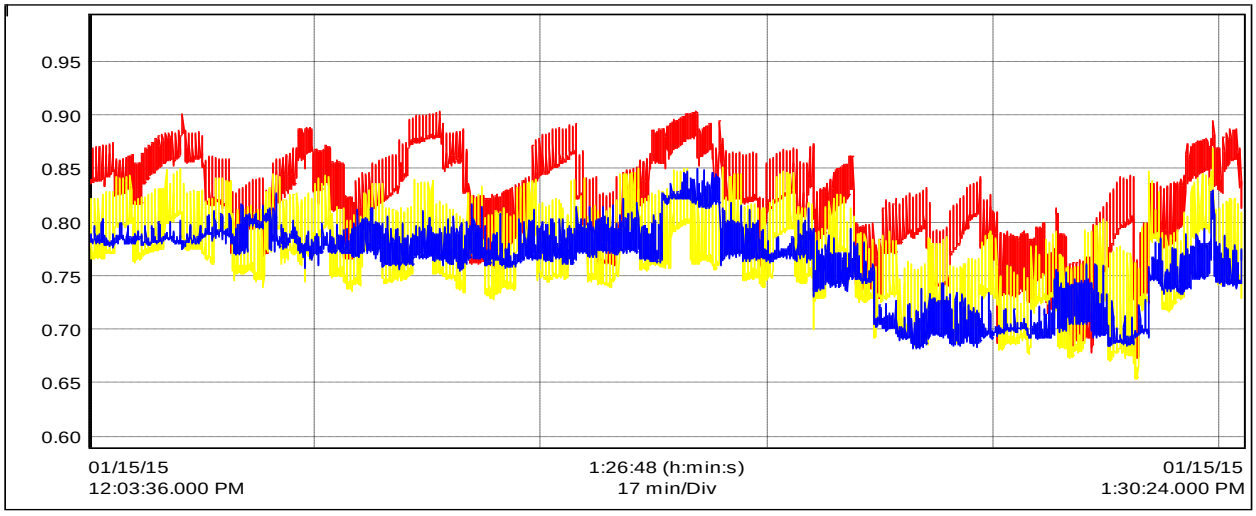
PARAMETERS	AVG (A)	MIN (A)	MAX (A)
R-Phase Load Current (A_{rms})	68.291	43.600	101.700
Y-Phase Load Current (A_{rms})	54.972	42.200	79.000
B-Phase Load Current (A_{rms})	62.626	46.400	90.700
Neutral Current (A_{rms})	**17.338**	**0.000**	**50.800**
Current Unbalance (%)	6.306	0.200	18.100

Total Current & Voltag Harmonics Distortion



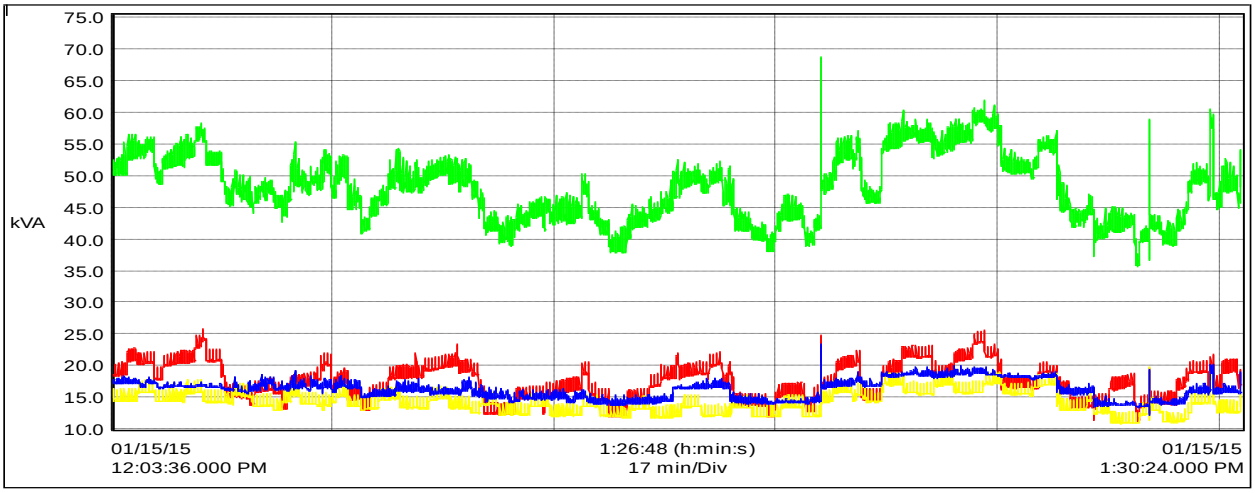
PARAMETERS	AVG (%)	MIN (%)	MAX (%)
R-Phase THD in Current (I_{thd})	12.803	4.100	21.200
Y- Phase THD in Current (I_{thd})	14.952	8.400	24.400
B- Phase THD in Current (I_{thd})	13.243	6.900	22.700
R-Phase THD in Voltage (V_{thd})	1.561	1.200	1.900
Y-Phase THD in Voltage (V_{thd})	1.975	1.700	2.500
B-Phase THD in Voltage (V_{thd})	1.927	1.700	2.400

Power Factor (pf)



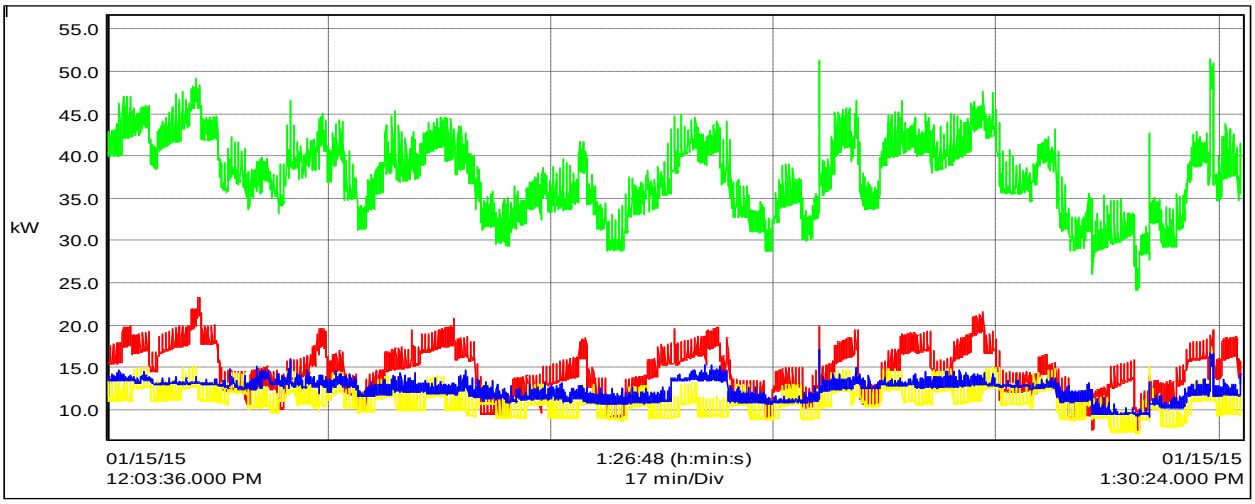
PARAMETERS	AVG (pf)	MIN (pf)	MAX (pf)
R- Phase Power Factor	0.817	0.673	0.904
Y- Phase Power Factor	0.762	0.655	0.870
B- Phase Power Factor	0.761	0.682	0.851

Load Power (kVA)



PARAMETERS	AVG (kVA)	MIN (kVA)	MAX (kVA)
R- Phase kVA	17.525	11.310	25.844
Y- Phase kVA	14.181	10.924	20.388
B- Phase kVA	16.260	12.150	23.516
Total kVA	47.966	35.775	68.757

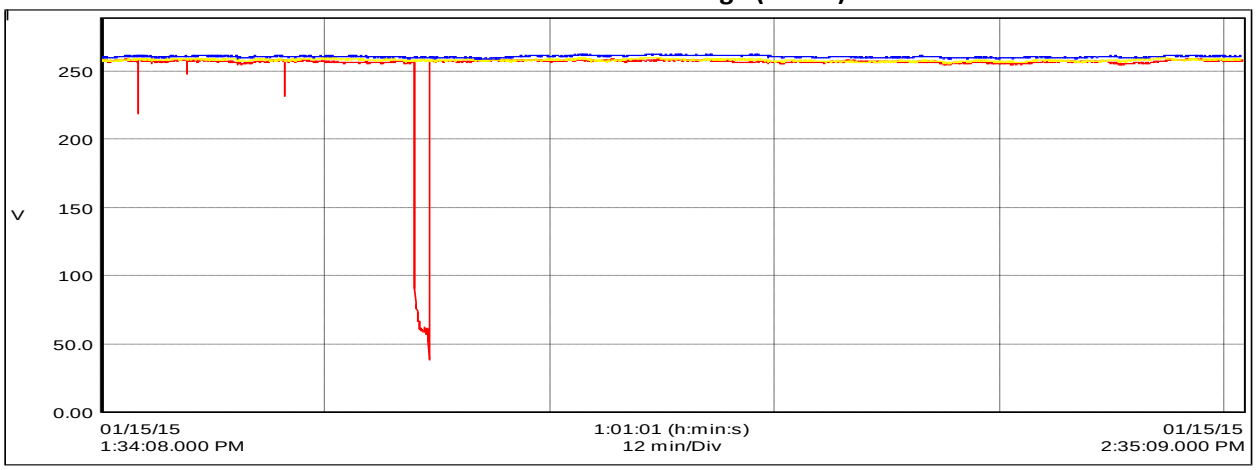
Load Power (kW)



PARAMETERS	AVG (kW)	MIN (kW)	MAX (kW)
R- Phase kW	14.377	7.616	23.308
Y- Phase kW	10.813	7.181	17.153
B- Phase kW	12.357	9.217	17.192
Total kW	37.548	24.218	51.595

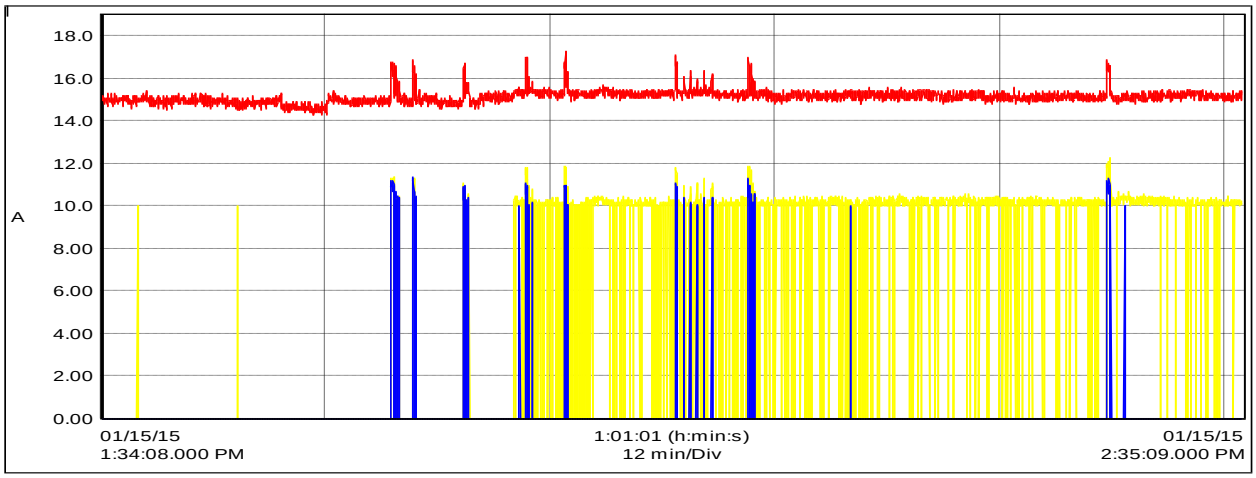
Feeder 2

Phase to Neutral Voltage (VRMS)



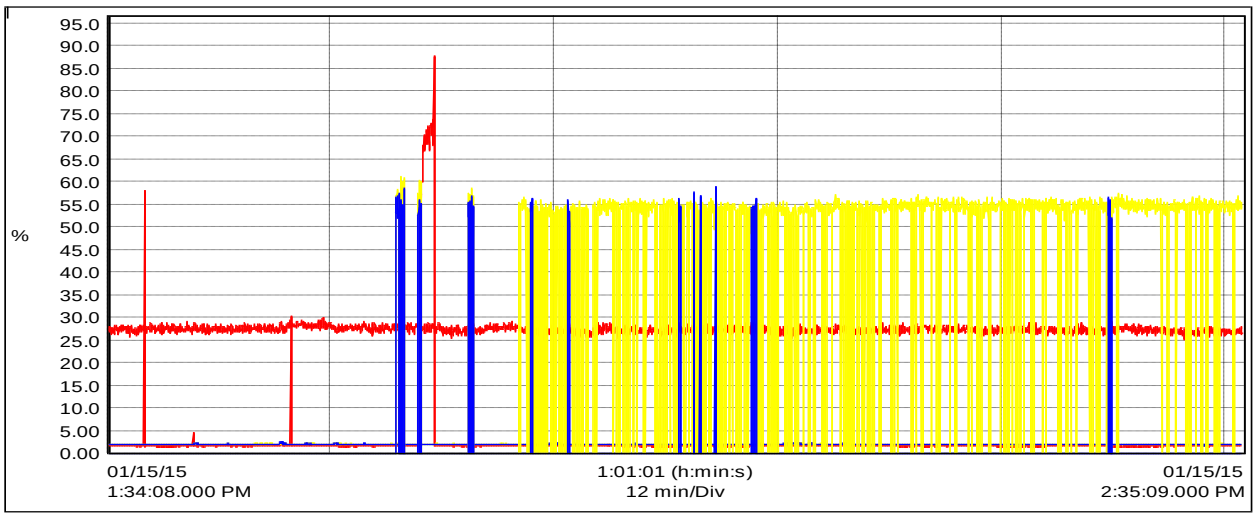
PARAMETERS (Phase to Neutral V)	AVG (V)	MIN (V)	MAX (V)
R Phase Voltage (V_{rms})	254.832	38.600	259.400
Y Phase Voltage (V_{rms})	258.233	255.900	260.400
B Phase Voltage (V_{rms})	260.839	259.100	262.800
Neutral to Earth Voltage	0.000	0.000	0.000

Current (ARMS)



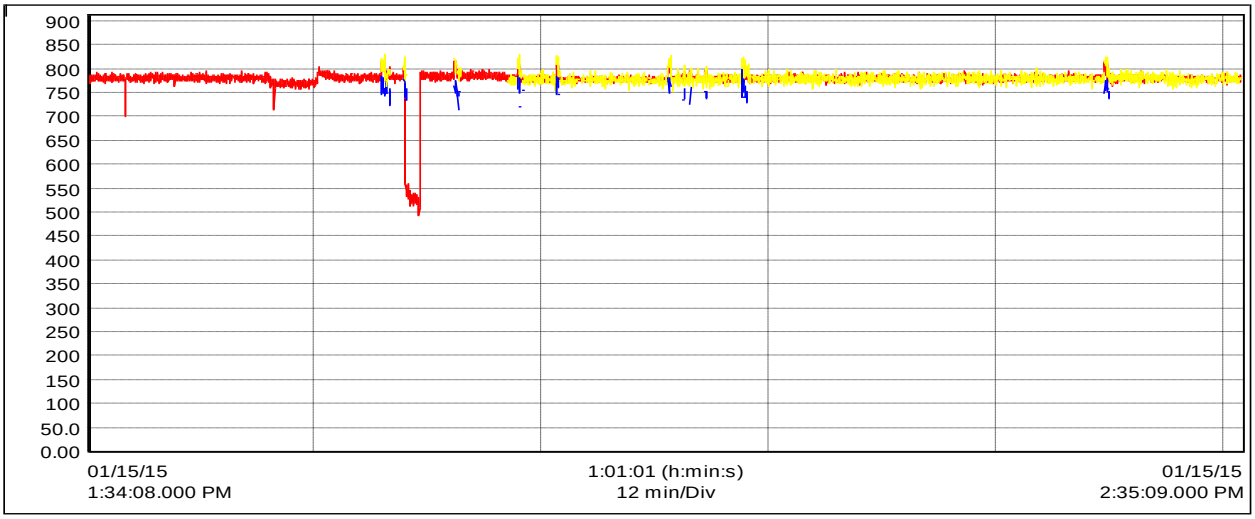
PARAMETERS	AVG (A)	MIN (A)	MAX (A)
R-Phase Load Current (A_{rms})	15.148	14.300	17.300
Y-Phase Load Current (A_{rms})	5.982	0.000	12.300
B-Phase Load Current (A_{rms})	0.292	0.000	11.400
Neutral Current (A_{rms})	0.000	0.000	0.000
Current Unbalance (%)	20.622	14.900	25.500

Total Current & Voltage Harmonics Distortion



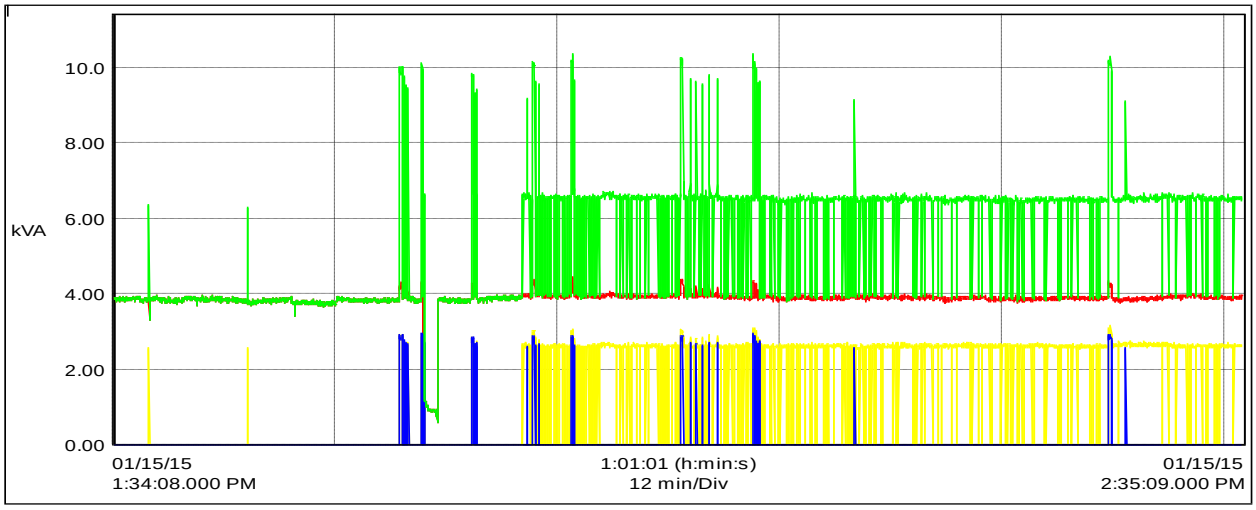
PARAMETERS	AVG (%)	MIN (%)	MAX (%)
R-Phase THD in Current (I_{thd})	27.350	25.200	30.000
Y- Phase THD in Current (I_{thd})	28.369	0.000	61.100
B- Phase THD in Current (I_{thd})	1.067	0.000	58.900
R-Phase THD in Voltage (V_{thd})	2.515	1.400	87.800
Y-Phase THD in Voltage (V_{thd})	2.017	1.800	2.400
B-Phase THD in Voltage (V_{thd})	2.036	1.800	2.500

Power Factor (pf)



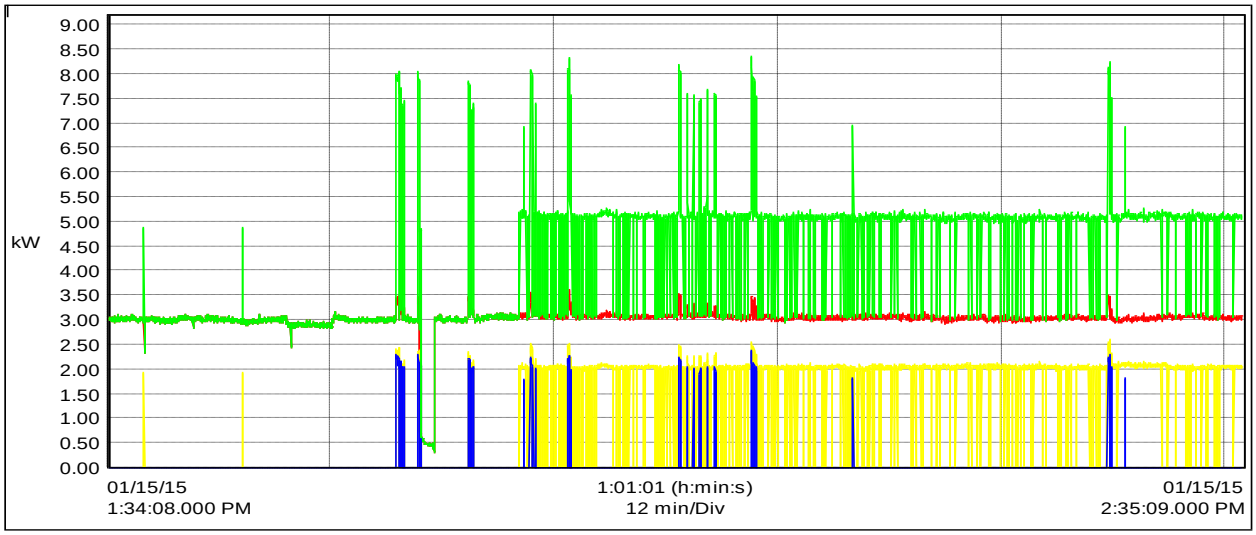
PARAMETERS	AVG (pf)	MIN (pf)	MAX (pf)
R- Phase Power Factor	0.778	0.494	0.816
Y- Phase Power Factor	0.781	0.744	0.831
B- Phase Power Factor	0.756	0.693	0.800

Load Power (kVA)



PARAMETERS	AVG (kVA)	MIN (kVA)	MAX (kVA)
R- Phase kVA	3.862	0.579	4.460
Y- Phase kVA	1.543	0.000	3.180
B- Phase kVA	0.076	0.000	2.970
Total kVA	5.482	0.579	10.394

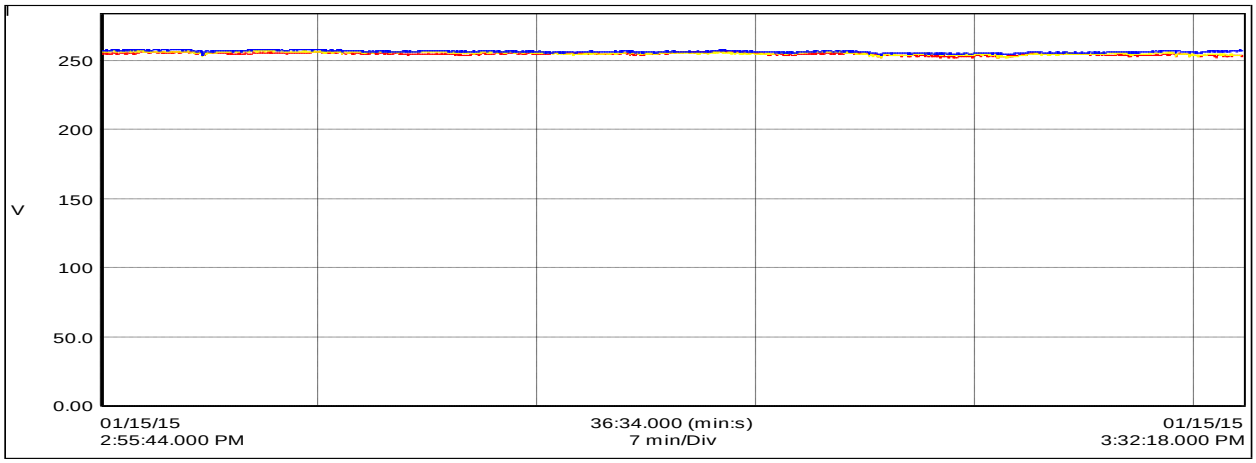
Load Power (kW)



PARAMETERS	AVG (kW)	MIN (kW)	MAX (kW)
R- Phase kW	3.015	0.297	3.607
Y- Phase kW	1.205	0.000	2.618
B- Phase kW	0.058	0.000	2.377
Total kW	4.278	0.297	8.369

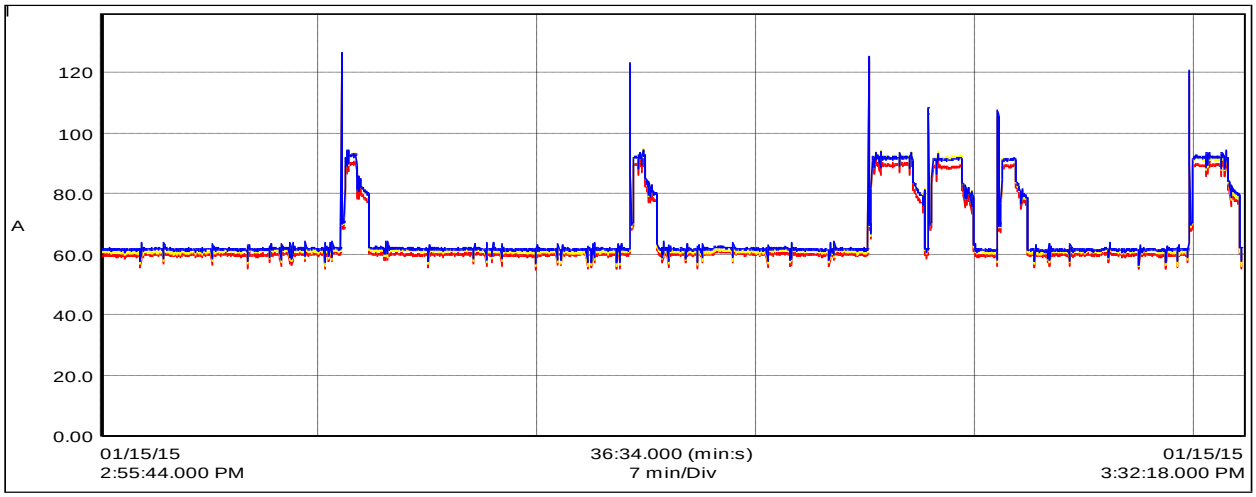
Cooling Tower Feeder

Phase to Neutral Voltage (VRMS)



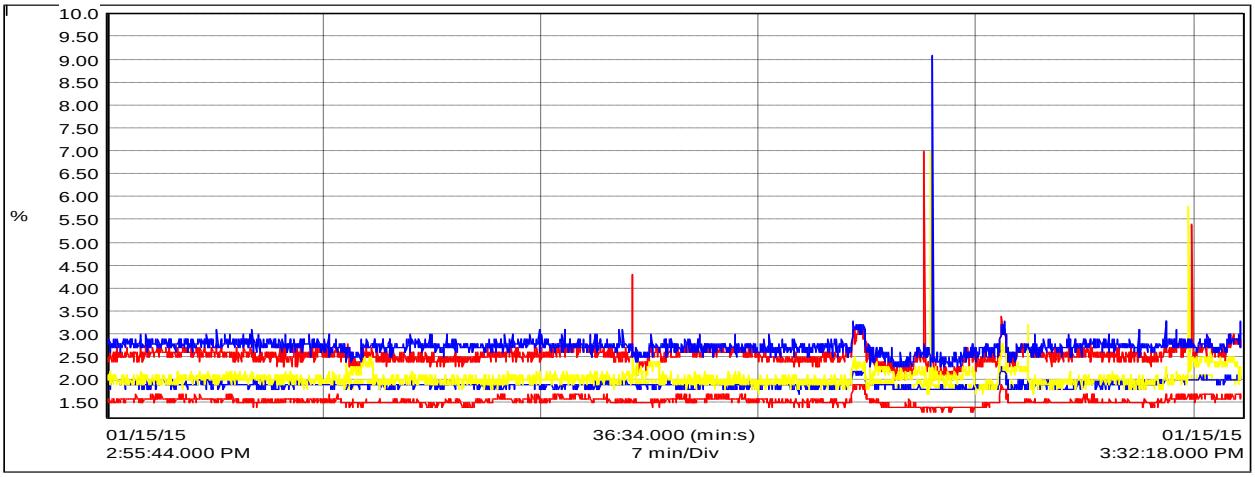
PARAMETERS (Phase to Neutral V)	AVG (V)	MIN (V)	MAX (V)
R Phase Voltage (V_{rms})	255.094	252.100	257.400
Y Phase Voltage (V_{rms})	255.718	252.100	257.900
B Phase Voltage (V_{rms})	256.785	254.100	258.500
Neutral to Earth Voltage	0.000	0.000	0.000

Current (ARMS)



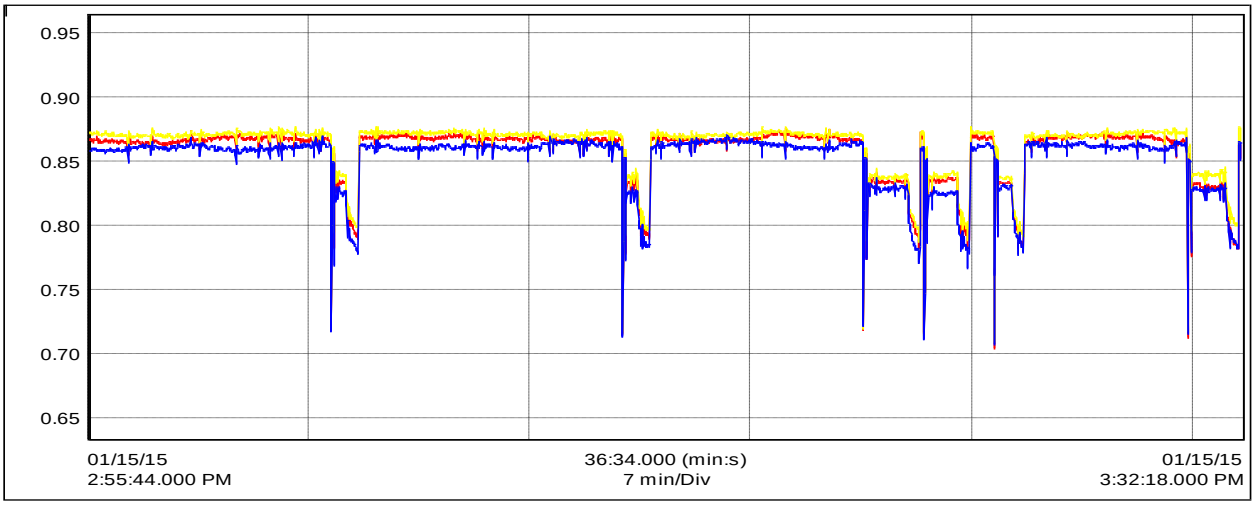
PARAMETERS	AVG (A)	MIN (A)	MAX (A)
R-Phase Load Current (A_{rms})	65.194	54.900	124.600
Y-Phase Load Current (A_{rms})	66.469	56.100	126.500
B-Phase Load Current (A_{rms})	67.062	56.700	126.800
Neutral Current (A_{rms})	0.000	0.000	0.000
Current Unbalance (%)	1.442	0.600	2.600

Total Current & Voltage Harmonics Distortion



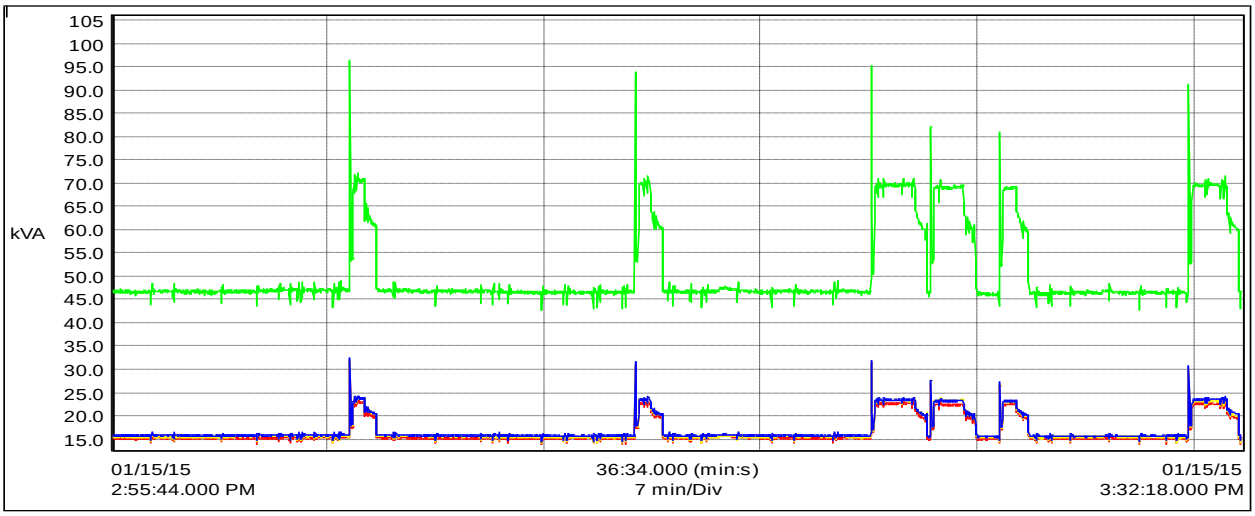
PARAMETERS	AVG (%)	MIN (%)	MAX (%)
R-Phase THD in Current (I_{thd})	2.540	2.000	7.000
Y- Phase THD in Current (I_{thd})	2.047	1.700	7.000
B- Phase THD in Current (I_{thd})	2.727	2.300	9.100
R-Phase THD in Voltage (V_{thd})	1.547	1.300	1.900
Y-Phase THD in Voltage (V_{thd})	1.974	1.800	2.400
B-Phase THD in Voltage (V_{thd})	1.899	1.700	2.300

Power Factor (pf)



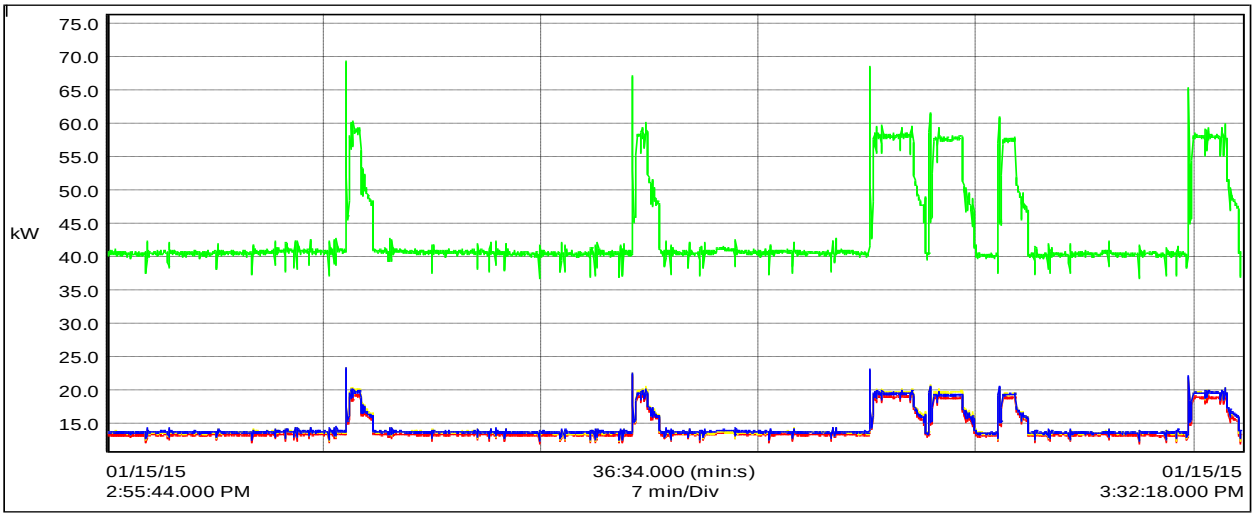
PARAMETERS	AVG (pf)	MIN (pf)	MAX (pf)
R- Phase Power Factor	**0.858**	**0.704**	**0.876**
Y- Phase Power Factor	**0.862**	**0.710**	**0.877**
B- Phase Power Factor	**0.852**	**0.708**	**0.871**

Load Power (kVA)



PARAMETERS	AVG (kVA)	MIN (kVA)	MAX (kVA)
R- Phase kVA	16.625	13.988	31.743
Y- Phase kVA	16.991	14.321	32.264
B- Phase kVA	17.217	14.530	32.528
Total kVA	50.833	42.840	96.536

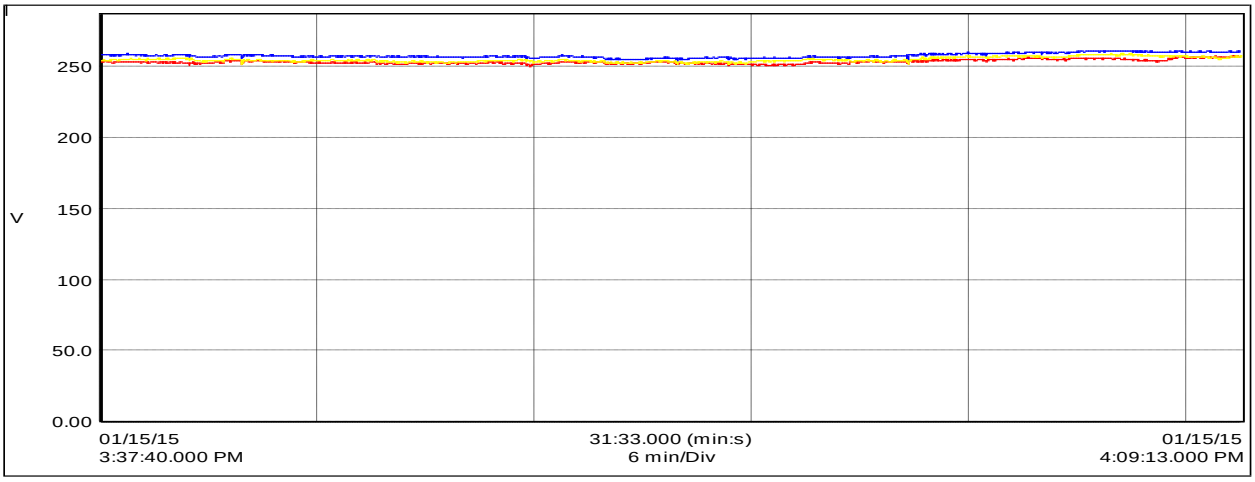
Load Power (kW)



PARAMETERS	AVG (kW)	MIN (kW)	MAX (kW)
R- Phase kW	14.216	11.928	22.816
Y- Phase kW	14.599	12.332	23.271
B- Phase kW	14.622	12.375	23.360
Total kW	43.437	36.700	69.447

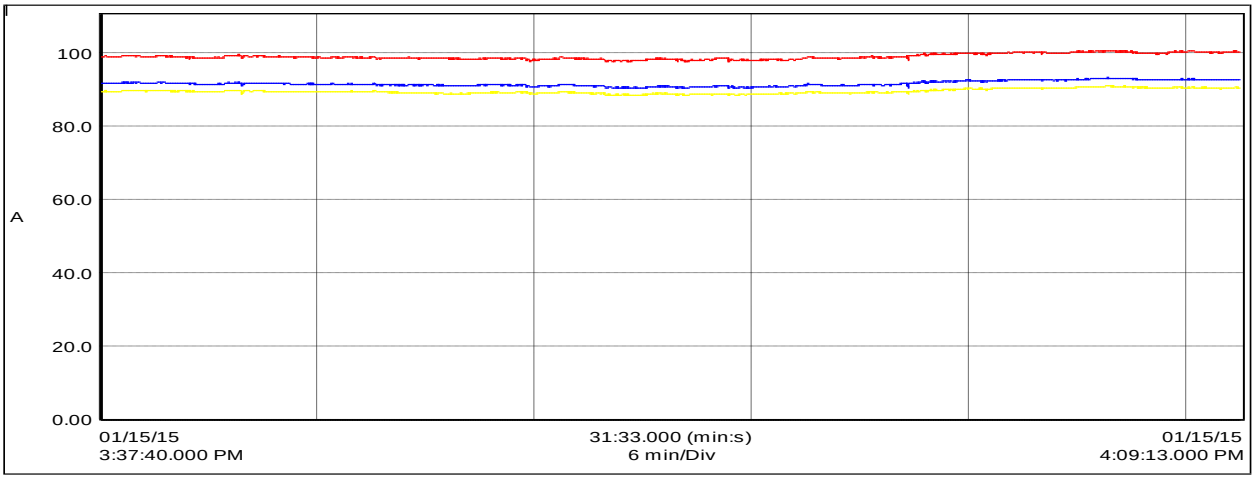
Raw Water Pump + Capacitor Feeder

Phase to Neutral Voltage (VRMS)



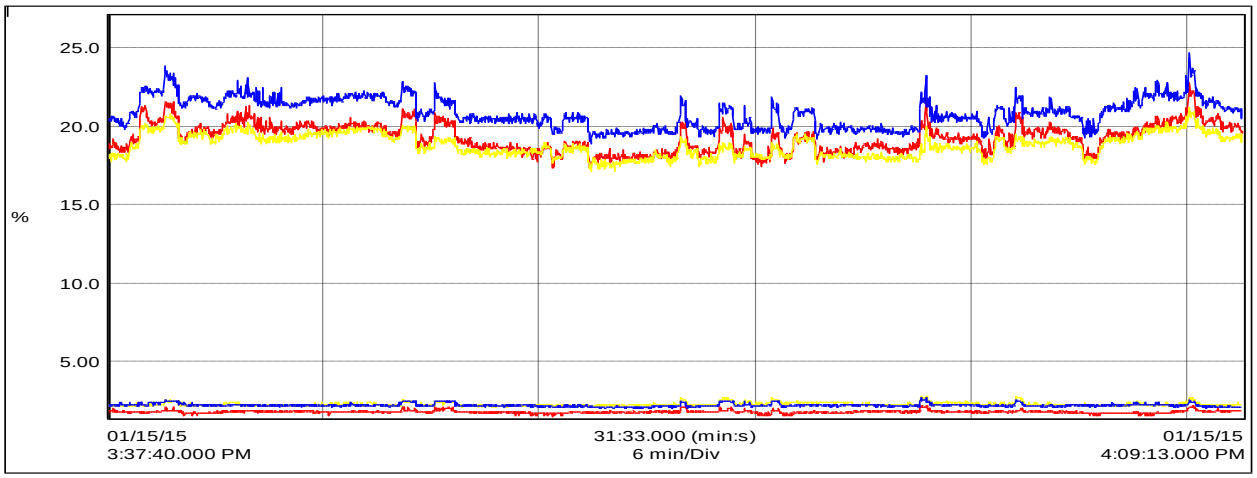
PARAMETERS (Phase to Neutral V)	AVG (V)	MIN (V)	MAX (V)
R Phase Voltage (V_{rms})	253.795	250.600	257.700
Y Phase Voltage (V_{rms})	255.294	251.900	259.500
B Phase Voltage (V_{rms})	258.139	254.700	261.600
Neutral to Earth Voltage	0.000	0.000	0.000

Current (ARMS)



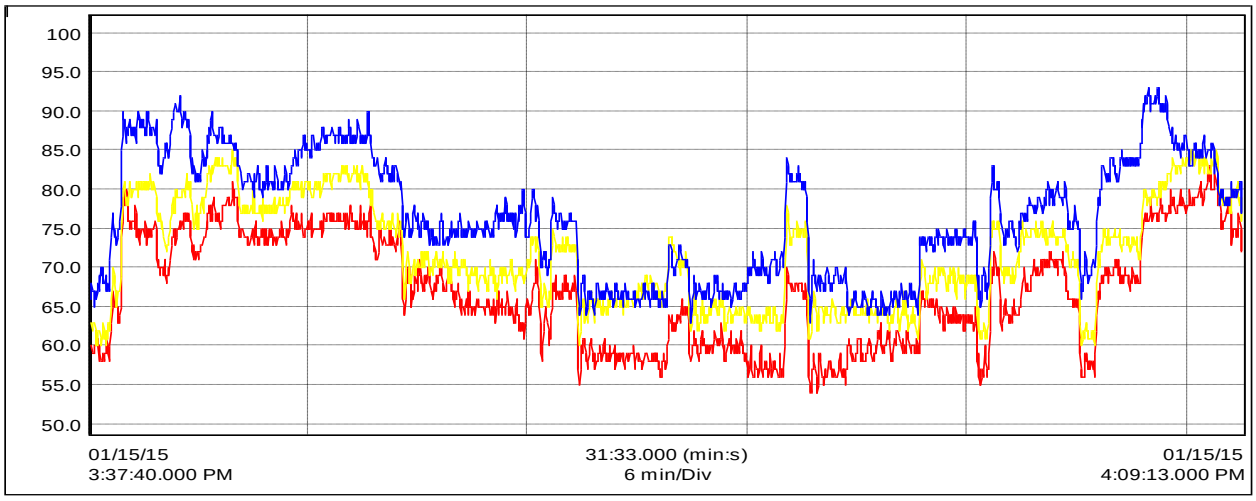
PARAMETERS	AVG (A)	MIN (A)	MAX (A)
R-Phase Load Current (A_{rms})	99.149	97.800	100.800
Y-Phase Load Current (A_{rms})	89.665	88.500	91.200
B-Phase Load Current (A_{rms})	91.779	90.400	93.400
Neutral Current (A_{rms})	0.000	0.000	0.000
Current Unbalance (%)	3.055	2.500	3.700

Total Current & Voltage Harmonics Distortion



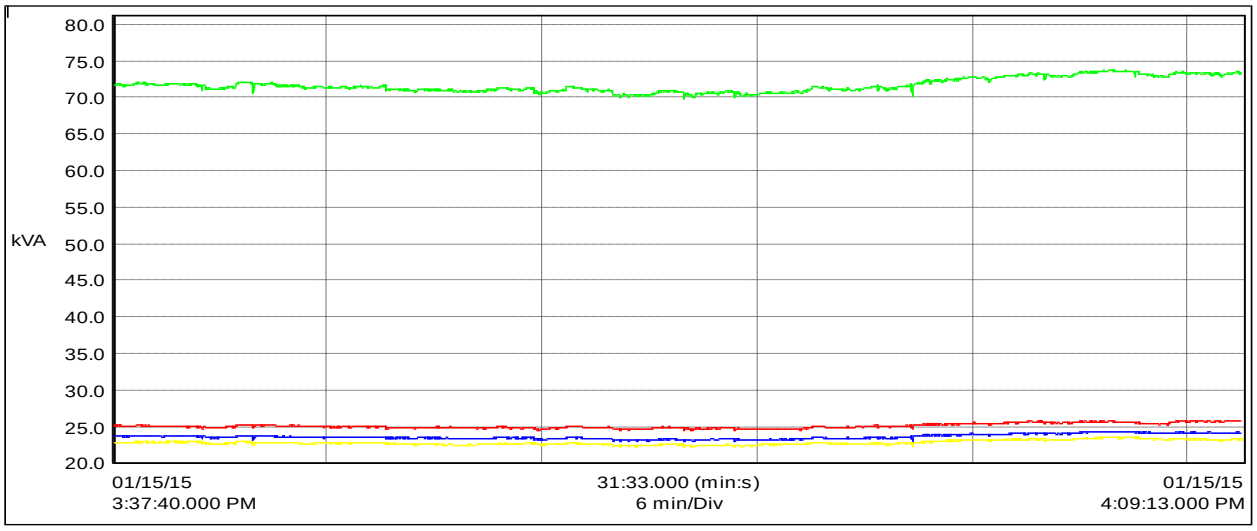
PARAMETERS	AVG (%)	MIN (%)	MAX (%)
R-Phase THD in Current (I_{thd})	19.315	17.400	22.800
Y- Phase THD in Current (I_{thd})	18.843	17.200	21.200
B- Phase THD in Current (I_{thd})	20.901	18.900	24.700
R-Phase THD in Voltage (V_{thd})	1.801	1.500	2.200
Y-Phase THD in Voltage (V_{thd})	2.312	2.100	2.800
B-Phase THD in Voltage (V_{thd})	2.249	2.000	2.700

Power Factor (pf)



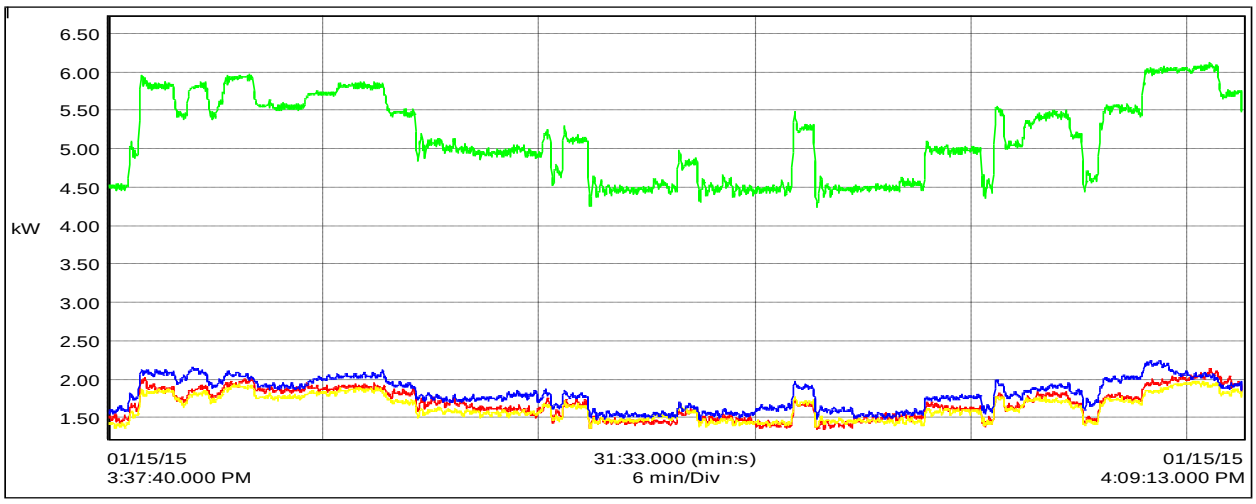
PARAMETERS	AVG (pf)	MIN (pf)	MAX (pf)
R- Phase Power Factor	0.67	0.54	0.83
Y- Phase Power Factor	0.71	0.60	0.85
B- Phase Power Factor	0.76	0.63	0.93

Load Power (kVA)



PARAMETERS	AVG (kVA)	MIN (kVA)	MAX (kVA)
R- Phase kVA	25.165	24.534	25.924
Y- Phase kVA	22.892	22.304	23.626
B- Phase kVA	23.693	23.022	24.422
Total kVA	71.751	69.962	73.880

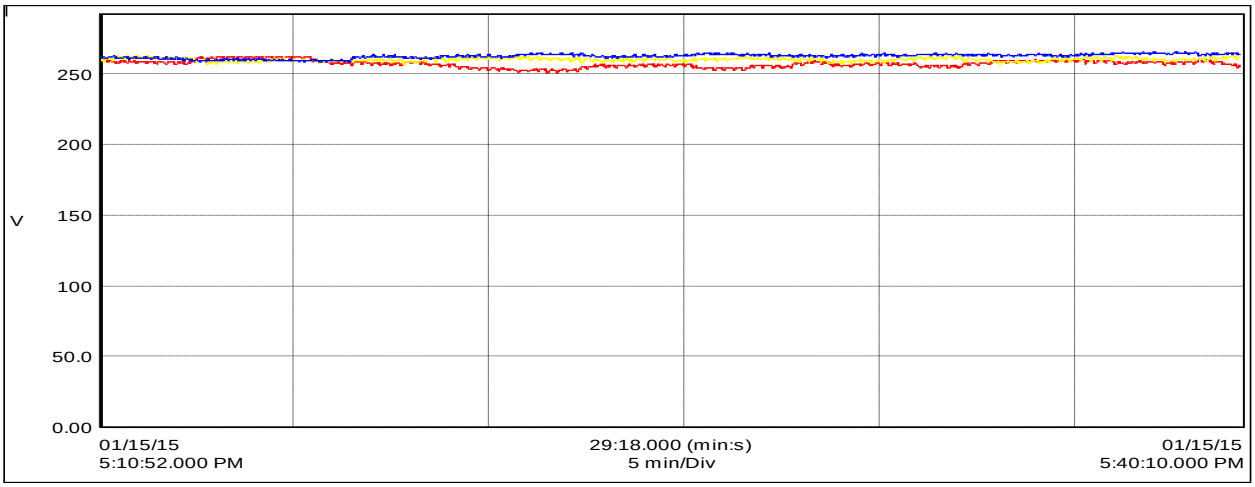
Load Power (kW)



PARAMETERS	AVG (kW)	MIN (kW)	MAX (kW)
R- Phase kW	1.689	1.357	2.147
Y- Phase kW	1.646	1.371	1.986
B- Phase kW	1.814	1.476	2.253
Total kW	5.149	4.239	6.121

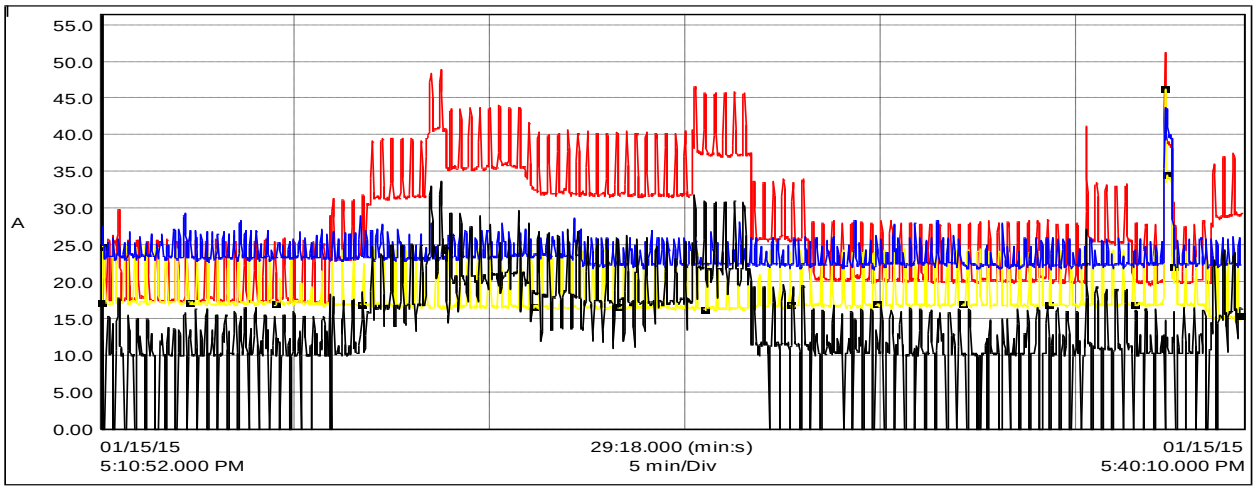
Feeder -1 (Sub Distribution – 1)

Phase to Neutral Voltage (VRMS)



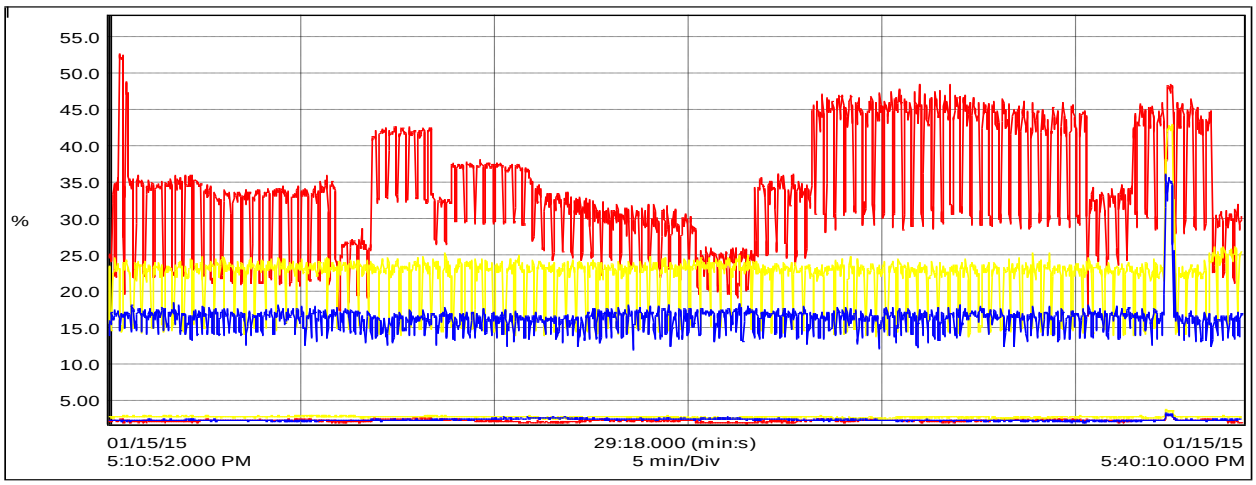
PARAMETERS (Phase to Neutral V)	AVG (V)	MIN (V)	MAX (V)
R Phase Voltage (V_{rms})	257.630	251.400	262.900
Y Phase Voltage (V_{rms})	260.628	257.200	263.700
B Phase Voltage (V_{rms})	263.029	258.600	266.200
Neutral to Earth Voltage	0.000	0.000	0.000

Current (ARMS)



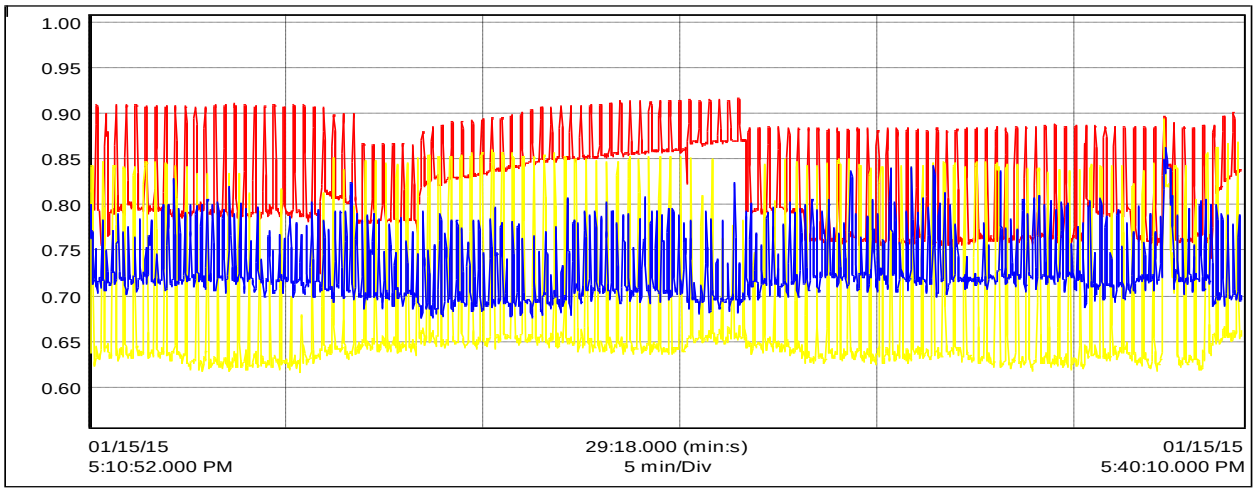
PARAMETERS	AVG (A)	MIN (A)	MAX (A)
R-Phase Load Current (A_{rms})	27.299	17.100	51.300
Y-Phase Load Current (A_{rms})	18.157	14.900	46.200
B-Phase Load Current (A_{rms})	23.717	21.700	43.800
Neutral Current (A_{rms})	**14.007**	**0.000**	**33.700**
Current Unbalance (%)	11.952	0.600	33.300

Total Current & Voltage Harmonics Distortion



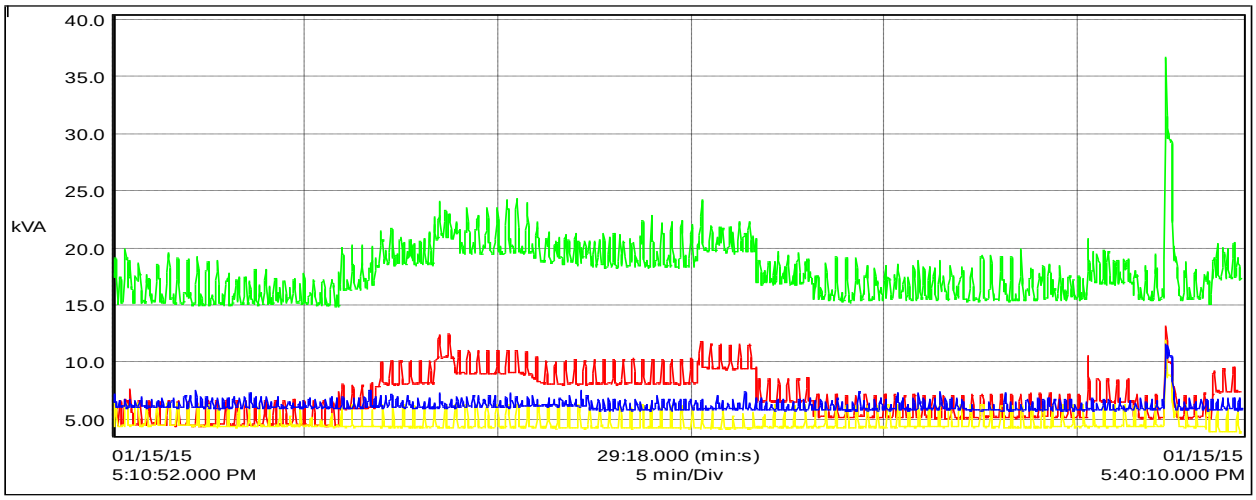
PARAMETERS	AVG (%)	MIN (%)	MAX (%)
R-Phase THD in Current (I_{thd})	34.262	16.700	52.800
Y- Phase THD in Current (I_{thd})	22.196	13.500	43.000
B- Phase THD in Current (I_{thd})	16.400	12.100	36.200
R-Phase THD in Voltage (V_{thd})	2.310	1.900	3.100
Y-Phase THD in Voltage (V_{thd})	2.809	2.500	3.800
B-Phase THD in Voltage (V_{thd})	2.421	2.100	3.400

Power Factor (pf)



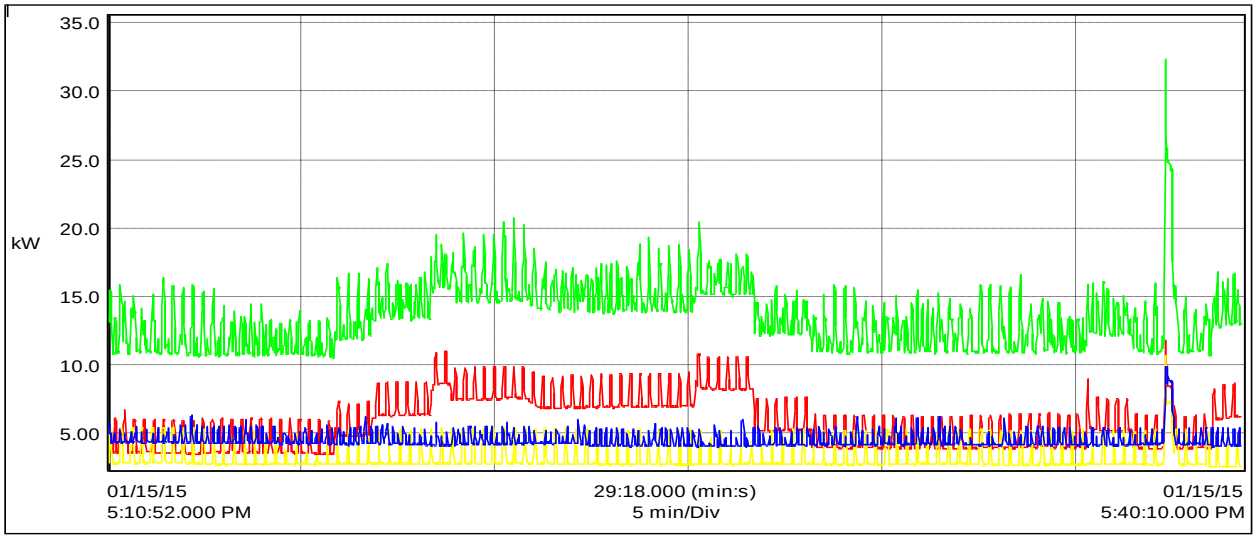
PARAMETERS	AVG (pf)	MIN (pf)	MAX (pf)
R- Phase Power Factor	0.823	0.725	0.917
Y- Phase Power Factor	0.674	0.617	0.894
B- Phase Power Factor	0.728	0.676	0.863

Load Power (kVA)



PARAMETERS	AVG (kVA)	MIN (kVA)	MAX (kVA)
R- Phase kVA	7.020	4.436	13.154
Y- Phase kVA	4.731	3.925	11.968
B- Phase kVA	6.238	5.746	11.622
Total kVA	17.988	14.866	36.744

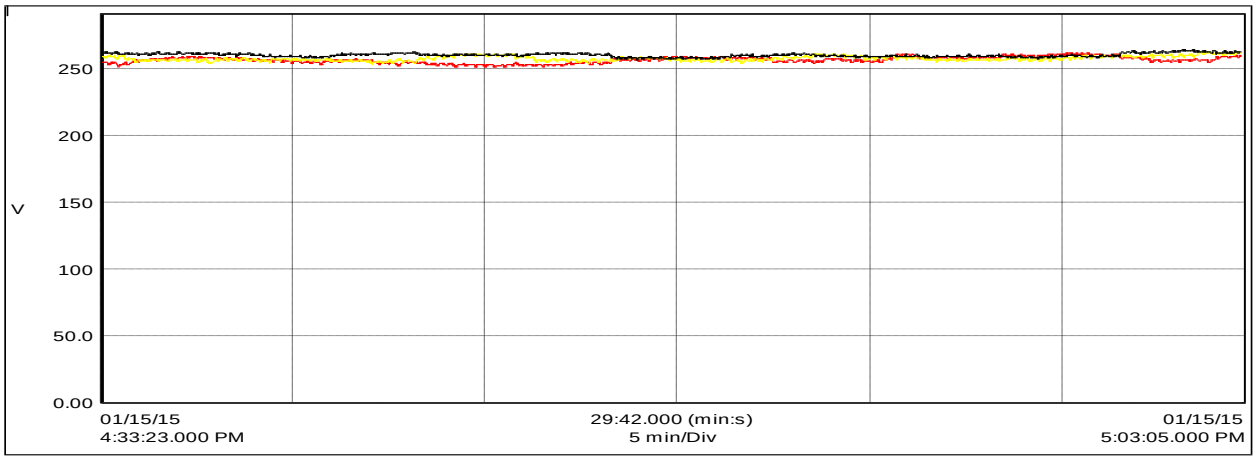
Load Power (kW)



PARAMETERS	AVG (kW)	MIN (kW)	MAX (kW)
R- Phase kW	5.844	3.494	11.805
Y- Phase kW	3.241	2.551	10.698
B- Phase kW	4.557	4.023	9.934
Total kW	13.641	10.568	32.393

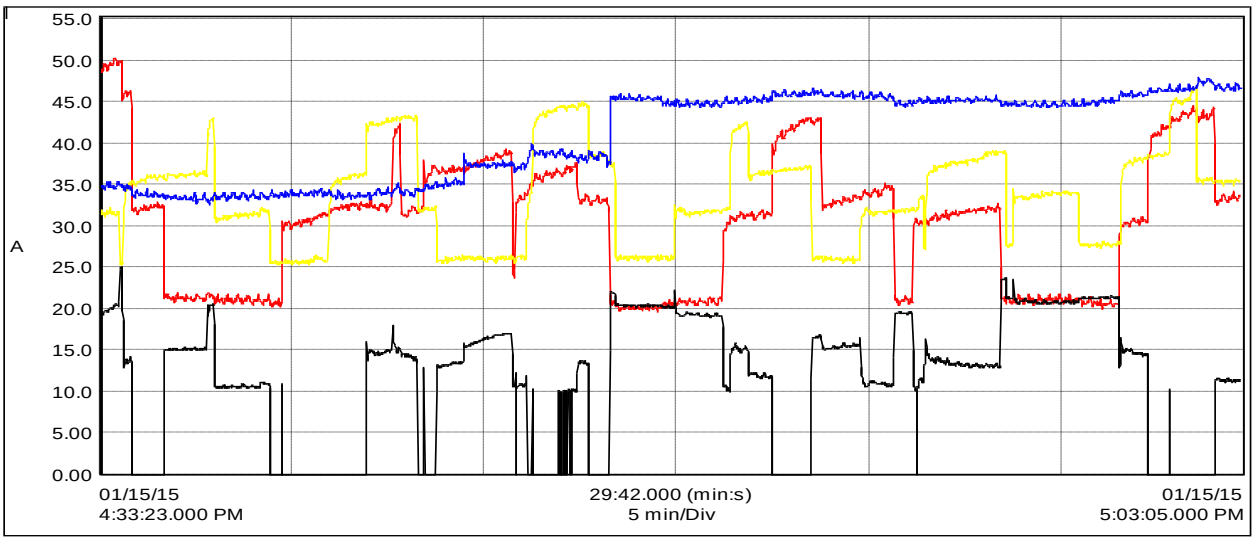
Feeder -1 (Sub Distribution – 1A)

Phase to Neutral Voltage (VRMS)



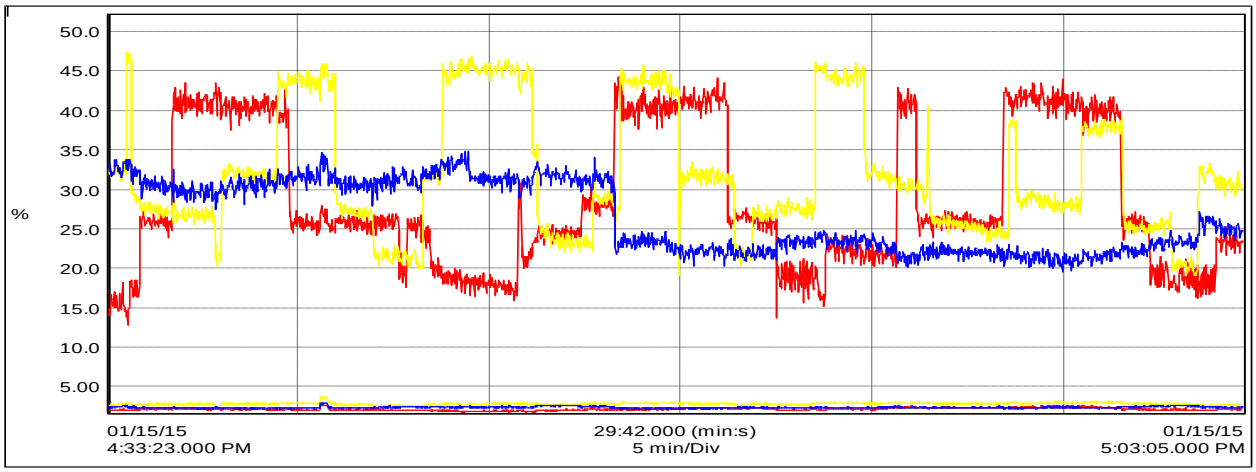
PARAMETERS (Phase to Neutral V)	AVG (V)	MIN (V)	MAX (V)
R Phase Voltage (V_{rms})	256.588	251.200	261.700
Y Phase Voltage (V_{rms})	257.635	253.500	262.700
B Phase Voltage (V_{rms})	260.125	256.900	264.500
Neutral to Earth Voltage	0.000	0.000	0.000

Current (ARMS)



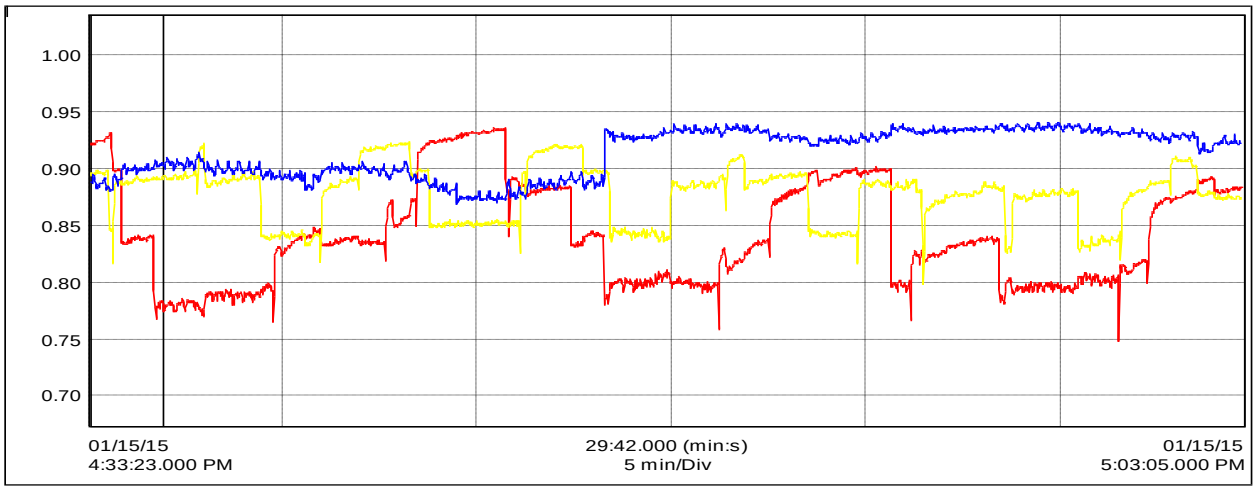
PARAMETERS	AVG (A)	MIN (A)	MAX (A)
R-Phase Load Current (A_{rms})	30.582	19.700	50.300
Y-Phase Load Current (A_{rms})	33.721	25.300	46.600
B-Phase Load Current (A_{rms})	40.874	32.600	48.000
Neutral Current (A_{rms})	**11.555**	**0.000**	**25.100**
Current Unbalance (%)	14.332	2.000	30.500

Total Current & Voltage Harmonics Distortion



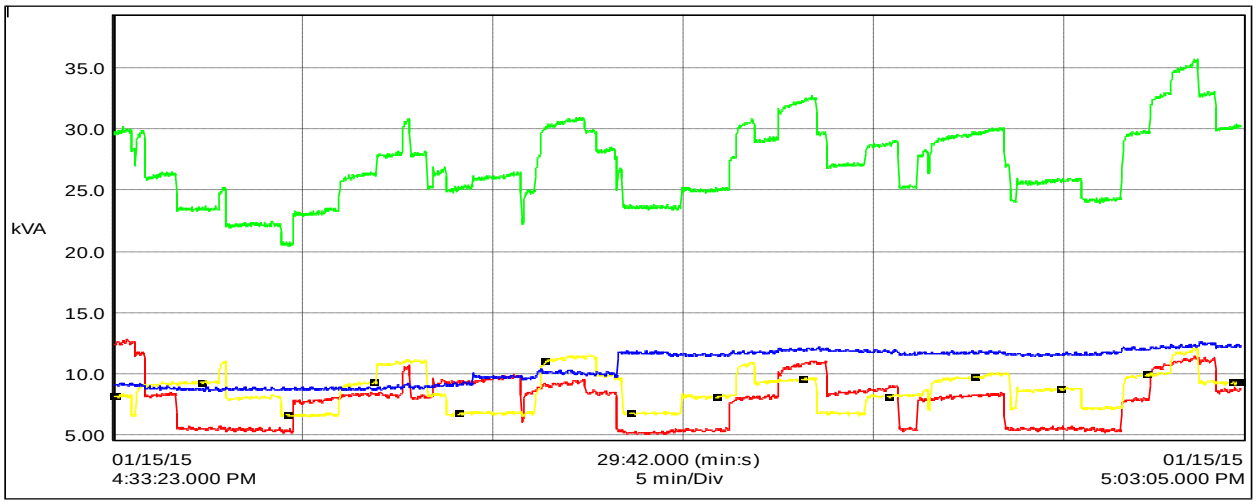
PARAMETERS	AVG (%)	MIN (%)	MAX (%)
R-Phase THD in Current (I_{thd})	28.801	12.900	44.300
Y- Phase THD in Current (I_{thd})	31.878	19.100	47.500
B- Phase THD in Current (I_{thd})	26.521	19.600	34.800
R-Phase THD in Voltage (V_{thd})	2.199	1.800	2.800
Y-Phase THD in Voltage (V_{thd})	2.858	2.500	3.800
B-Phase THD in Voltage (V_{thd})	2.399	2.200	3.000

Power Factor (pf)

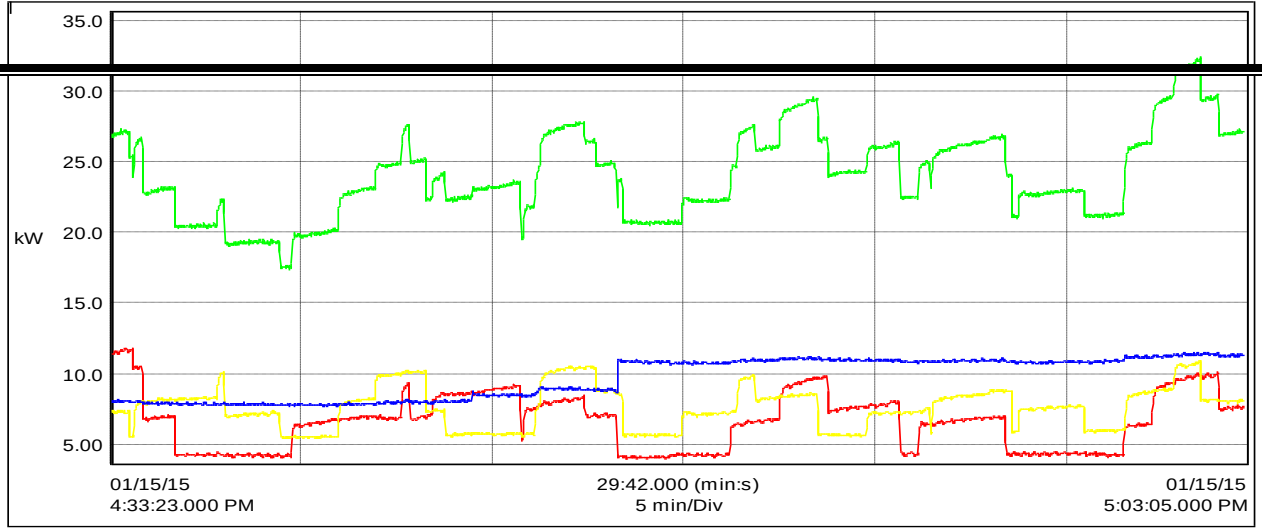


PARAMETERS	AVG (pf)	MIN (pf)	MAX (pf)
R- Phase Power Factor	0.843	0.748	0.936
Y- Phase Power Factor	0.878	0.798	0.924
B- Phase Power Factor	0.914	0.869	0.941

Load Power (kVA)



PARAMETERS	AVG (kVA)	MIN (kVA)	MAX (kVA)
R- Phase kVA	7.836	5.044	12.779
Y- Phase kVA	8.684	6.485	12.120
B- Phase kVA	10.631	8.545	12.605
Total kVA	27.151	20.432	35.815



Load Power (kW)

PARAMETERS	AVG (kW)	MIN (kW)	MAX (kW)
R- Phase kW	6.677	4.026	11.820
Y- Phase kW	7.653	5.437	10.942
B- Phase kW	9.736	7.726	11.539
Total kW	24.066	17.411	32.400