RECEIVED
MAR 26 2020
PUBLIC SERVICE COMMISSION

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the matter of:

Bert Kendall c/o Christ Church United Methodist
(Your Full Name)
COMPLAINANT

VS.

Louisville Gas & Electric
(Name of Utility)
DEFENDANT

COMPLAINT

The complaint of Bert Kendall c/o Christ Church United Methodist respectfully shows:
(Your Full Name)

(a) Bert Kendall c/o Christ Church United Methodist
(Your Full Name)

4614 Brownsboro Rd, Louisville, KY 40207
(Your Address)

(b) Louisville Gas & Electric
(Name of Utility)

820 West Broadway Louisville, KY 40202
(Address of Utility)

(c) That: * see attached *
(Describe here, attaching additional sheets if necessary, the specific act, fully and clearly, or facts that are the reason and basis for the complaint.)

Continued on Next Page

Formal Complaint

Bert Kendall % Christ Church United Methodist vs. Louisville Gas & Electric

Wherefore, complainant asks that the Public Service Commission
(Specifically state the relief desired.)
review the evidence and hold Louisville Gas & Electric liable for equipment failures, repairs and service calls as a result of the unstable power provided by Louisville Gas + Electric.

Dated at Louisville, Kentucky, this 3rd day
(Your City)
of March, 2020.
(Month)

(Your Signature*)

(Name and address of attorney, if any)

Date

*Complaints by corporations or associations, or any other organization having the right to file a complaint, must be signed by its attorney and show his post office address. No oral or unsigned complaints will be entertained or acted upon by the Commission.

QUESTEC MECHANICAL

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Summary Statement of Events

Christ Church United Methodist

QuesTec Mechanical began to service and maintain the HVAC equipment at Christ Church United Methodist on April 1, 2016. Over time and with gaining experience throughout the facility, QuesTec began to notice electrical failures within multiple pieces of equipment. Over time, this became to be much more prevalent. QuesTec informed the church staff. QuesTec was told by CCUM staff, previous contractors, and equipment manufacturers of the equipment being affected that they all have similar concerns.

On May 5, 2018, there was a major electrical issue. The electrical main to the building was tripped. Upon arrival, QuesTec found multiple electrical failures in many different pieces of equipment. This includes but is not limited to electrically failed motors, electrically failed compressors (3), electrically failed VFD's, melted contactors, etc.

Following this incident, QuesTec informed the Church staff again of the suspected electrical issues. QuesTec hired an electrical contractor to install electrical monitoring meters on the incoming power and recorded this data from 6-15-18 thru 6-22-18 and again from 7-3-18 thru 7-17-18. Upon reviewing the information, it was determined that the incoming power to the facility was poor and unstable power. During these time periods, QuesTec has service records to show matching dates to the data files for power related issues within the HVAC systems.

Christ Church United Methodist contacted LG&E to discuss these concerns up. LG&E responded by sending workers to the site who admitted to making adjustments as well as admitted to working in the area around the facility making adjustments and monitoring.

After working in the area and making adjustments for a period of time, LG&E then and only then installed data recording devices to monitor the incoming power. In order to protect the equipment, CCUM paid QuesTec to install devices on critical equipment to protect it in the event of more power quality issues. (Phase monitors, resistors, and arrestors) Since LG&E has made the adjustments, the power quality to the facility has been within acceptable standards and no further issues have occurred to the HVAC systems. The facility has not had any further power main trips since the adjustments.

QuesTec and LG&E have attempted to meet to discuss the issues but the representative from LG&E, Jason Tipton, refuses to agree or discuss the irrefutable information put forth by CCUM, QuesTec, Comstock Brother Electric, as well as an independent 3rd party who reviewed the data collected and wrote a formal summary of the findings.

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In January of 2019, Peyton Technical Services was contracted to perform an independent study and analysis of the data logger's information that was recorded during June and July of 2018. The report clearly stated the quality of power being provided to CCUM was unstable and outside of acceptable standards. This report was then presented to Jason Tipton with LG&E and several others with the same response and refusal to accept responsibility.

QusTec Mechanical asks the Commonwealth of Kentucky Public Service Commission to please review the data provided in the summary and allow this complaint to be further reviewed and heard.

Attached Documents;

- Power Quality Data Review – Christ Church Prepared By: Peyton Technical Services

Available Upon Request;

- Detailed Service records notes and dates available upon request
- All invoices related to the power quality issues available upon request
- Power monitoring data records
- Comstock Bros Electric notes, invoices and communications

Power Quality Data Review – Christ Church

Prepared For:

Bert Kendall
QuesTec Service
13040 Middletown Industrial Blvd
Louisville, KY 40223

Prepared By:

Peyton Technical Services
1548 Highway 62 NW
Corydon, Indiana 47112
Ph: 812-738-2016
Scott Nimon, Dan Powers

March 12, 2019

Background

The Christ Church facility in Louisville, Kentucky has experienced a high number of equipment failures, faults and interruptions on its HVAC systems. It was reported that some of these failures occurred during the periods of the power recordings used for this report. It has also been reported that the utility company LG&E was notified of the issues and performed their own metering and investigations. At some point after the recording period the equipment failures no longer occurred. No changes were made on the electrical system within the facility. Appendix A lists some of the equipment failures.

Power quality data was collected for a duration of approximately 29 days to determine the quality of the utility supply power relative to the high rate of equipment failures at the facility.

The meter utilized for the power recording was a Dranetz Power Xplorer PX5 placed on the main service equipment, 1600 ampere 480/277-volt circuit breaker. All of the trend summary reports generated by the Dran-View software are shown in Annex B. The recording periods were broken into three separate time periods in order to keep the data file sizes manageable. The recording periods were as follows: 6/7/18 (9:45am) – 6/15/18 (11:50am); 6/15/18 (12:05pm) – 6/22/18 (7:05am); and 7/3/18 (11:50am) – 7/17/18 (10am).

Data Findings

Voltage Regulating Level – Voltage regulating level refers to the steady state regulating voltage levels of the three-phase system voltage. According to ANSI C84.1 Range A, the recommended voltage, should operate between plus and minus (+/-) 5% of nominal voltage (277-volts to ground), and Range B, the acceptable voltage, should operate between plus and minus (+/-) 10% of nominal voltage. The steady-state three-phase voltage levels recorded trended between plus (+) 0.04% and plus (+) 7.2% of nominal voltage during the recording period.

Current Levels – The maximum 10-minute average current recorded was 475 amperes, while current peaks exceeded 1,000 amperes. The service has a rating of 1,600 amperes.

Voltage Sag – A voltage sag is defined as when the voltage decreases 10 to 90% of nominal voltage for less than one minute. During the recording period a total of 22 sag events occurred. The lowest magnitude sag dropped to 25.6-volts and had a duration of 225 milli seconds.

Voltage Interruptions – A voltage interruption a complete loss of voltage. Voltage interruptions are commonly the result of actions taken by utilities to clear faults on their systems. A total of three power interruptions were detected during the recording period. The longest interruption recorded was 29.9 seconds long.

Transient Over Voltages – Electrical transients are short duration, high magnitude voltages with fast rising edges often destructive to electrical equipment. Causes of transients can range from lightning strikes; to switching events like capacitor bank switching, reclosing operations, tap changing on transformers; to loose connections. A total of 415 transient over voltage events were recorded during the 29-day recording period. The highest magnitude transient was 984-volts (355% of nominal) with a duration of 2 milli seconds.

Voltage Unbalance – The steady state regulating three-phase voltage balance is important for the efficient operation of electrical equipment. The lower the unbalance the better, however, a maximum voltage unbalance of 3% is considered acceptable by most utility suppliers. The average recorded voltage unbalance was 0.75%.

Frequency – The AC voltage frequency measured between minus (-) 0.12% and plus (+) 0.083% of nominal 60 hertz. Frequency should not exceed plus or minus (+/-) 0.083% of nominal.

Voltage Harmonics – Voltage harmonics are a measure of voltage waveform distortion caused by non-sinusoidal (or non-linear) loads. Generally, the higher the percentage of a facility's loads that are non-linear, the higher the distortion level. Voltage distortion can cause many issues with electrical loads such as equipment heating, system losses, equipment damage, mis-operation of sensitive equipment and power interruptions. The recorded three-phase Voltage Total Harmonic Distortion (Vthd) averaged 1.5% and reached a maximum of 3.5%.

Flicker (Plt) – Flicker refers to rapid voltage fluctuations which can cause lights to "flicker" and cause other power quality issues. Flicker is due to a load change which produces a voltage drop across a system's impedance which, in turn, causes variations in the voltage applied to lighting equipment. The starting of large induction motors, arc furnaces and electric welders are typical industrial loads that can cause flicker. A flicker measurement of 1 describes the point at which 50% of the population becomes irritated by the flicker. The peak Plt measured was 2.85, while it averaged 0.2.

CBEMA (Computer Business Equipment Manufacturers Association) Curve

CEBEMA curve describes an AC input voltage envelope within which most electrical equipment can tolerate. It sets voltage limits as to the duration and amplitude of service voltages that are likely to cause problems with electrical equipment. The limits consider both voltage level and duration of voltage excursions from nominal values. These excursions can result in equipment failures, service interruptions, and mis operations. A total of 28 events were recorded of voltage excursions outside of the CBEMA curve.

Conclusions

Voltage Regulating Level – The steady state voltage levels regulated within the acceptable range of +/- 10%, however, operated slightly high in the recommended range of +/- 5%.

Current Levels – The operating current levels appear to be acceptable and well within the service breaker rating of 1,600 amperes.

Voltage Sag – The number and level of voltage sags was extreme and represent a problem with the electrical service. In looking at the events with waveform capture of the sag events, it appears that the event does not correspond with any high level of load or current spike, indicating the cause of the voltage sags are generated external to the facility.

Voltage Interruptions – The number of voltage interruptions, three in 29-days, was high and represents a significant issue with the reliability and quality of the utility service. A typical number of voltage interruptions for commercial or industrial facilities is in the order of three per year or less.

Transient Over Voltages – The number of transient over voltage events was 415 which is very high and represent a serious power quality issue. Most transients are caused by either lightning or switching events primarily occurring on the utility system. The waveform capture data from many of the transient events were related to a collapse of voltage with no corresponding spike or surge in current, indicating that the transients were generated external to the facility. Other transient events presented as an oscillating transient which is characteristic of the switching of capacitor banks. Some of the oscillating transients corresponded to a particular time of day indicating a utility power line switched capacitor operating by a timer relay.

Voltage Unbalance – The steady state regulating three-phase voltages measured as balanced with the exception of during transient or sag events. Therefore, the three-phase voltage balance appears adequate such that no voltage unbalance issues exited during the recording period.

Frequency – Frequency deviations are very rare and generally the responsibility of the utility provider. It appears that there were a number of frequency deviations at or above the acceptable range. This indicates a serious electrical supply issue.

Voltage Harmonics – The Voltage Total Harmonic Distortion (Vthd) limit for IEEE 519 is 5%. The lower the Vthd the better, however, generally levels below 5% do not present serious issues. The measured Vthd during the recording period was within acceptable levels.

Flicker (Plt) – The number and magnitude of Flicker events was significant and likely was very perceptible during the recording periods.

CBEMA Curve – The number of CBEMA curve excursions was significant at 28 events. This indicates a severe issue with the electrical service.

Recommendations

1. Collect additional power recording data to compare to the previous recordings to establish if there has been a significant improvement in power quality since last summer.
2. Record any further equipment failures noting the date and time of the failure.
3. Record any future power interruptions or disturbances noting the date and time of day.

Annex A

Partial List of Equipment Failures:

Carrier RTU 2
Found compressor electrically shorted, found contactor burnt up, found power exhaust motor shorted to ground. Also found VFD for main blower shorted to ground. We will need to replace compressor, blower VFD, power exhaust motor and contractor.

McQuay Chiller,
Found compressor 2 short to ground and controller bad.

Trane chiller
First stage VFD for condenser fan motor bad, 1 condenser motor failing due to bearings.
Found chiller water flow pump 2 with faulty VFD.

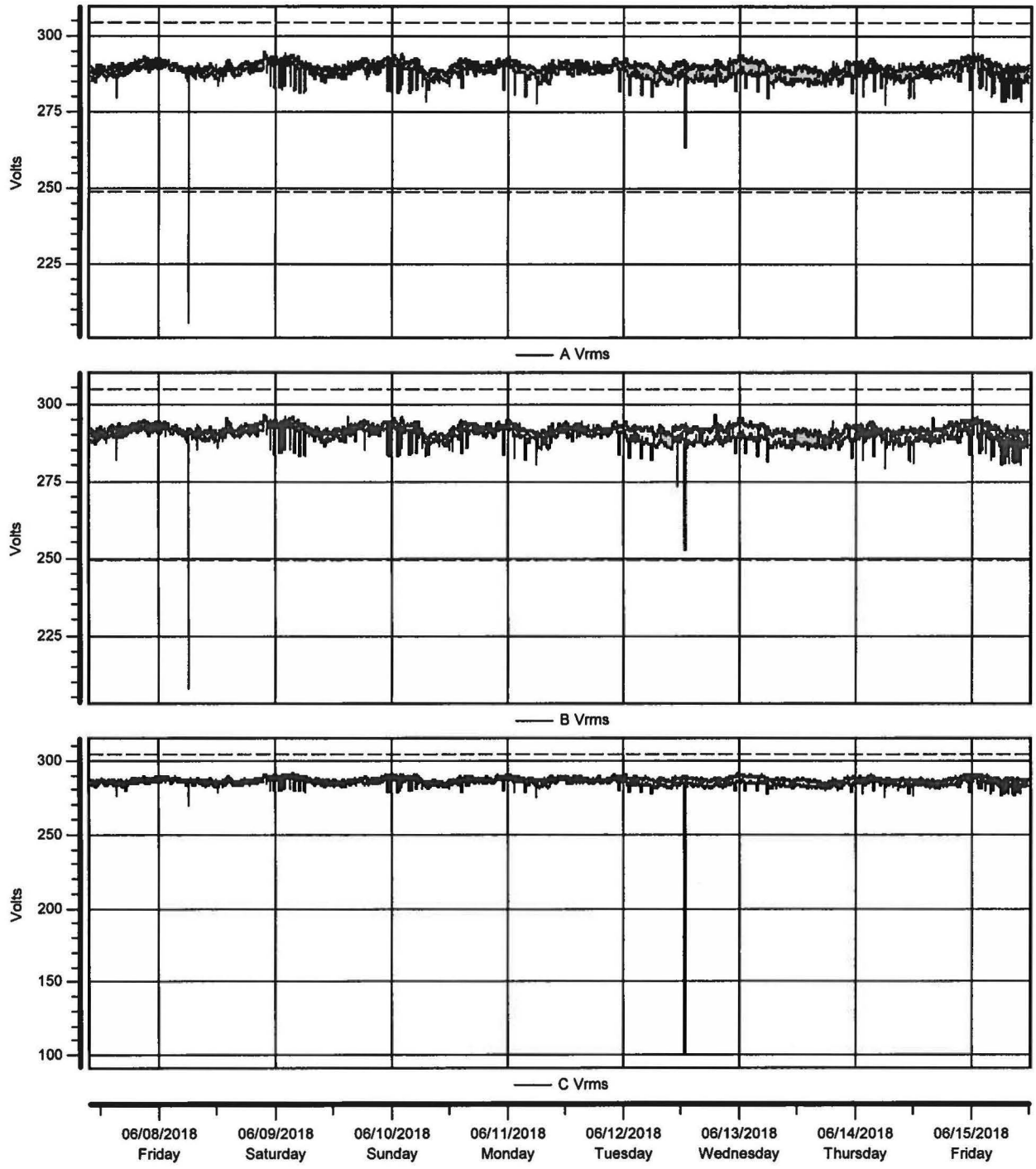
Annex B

		Date 03/05/2019 Page 1
		Issued by
		Filename Christ Church-060618-061518

VOLTAGE TIMEPLOTS

Site: CHRIST CHURCH NEW BUILDING GEAR

Measured from 06/07/2018 09:45:00.0 to 06/15/2018 11:50:00.0

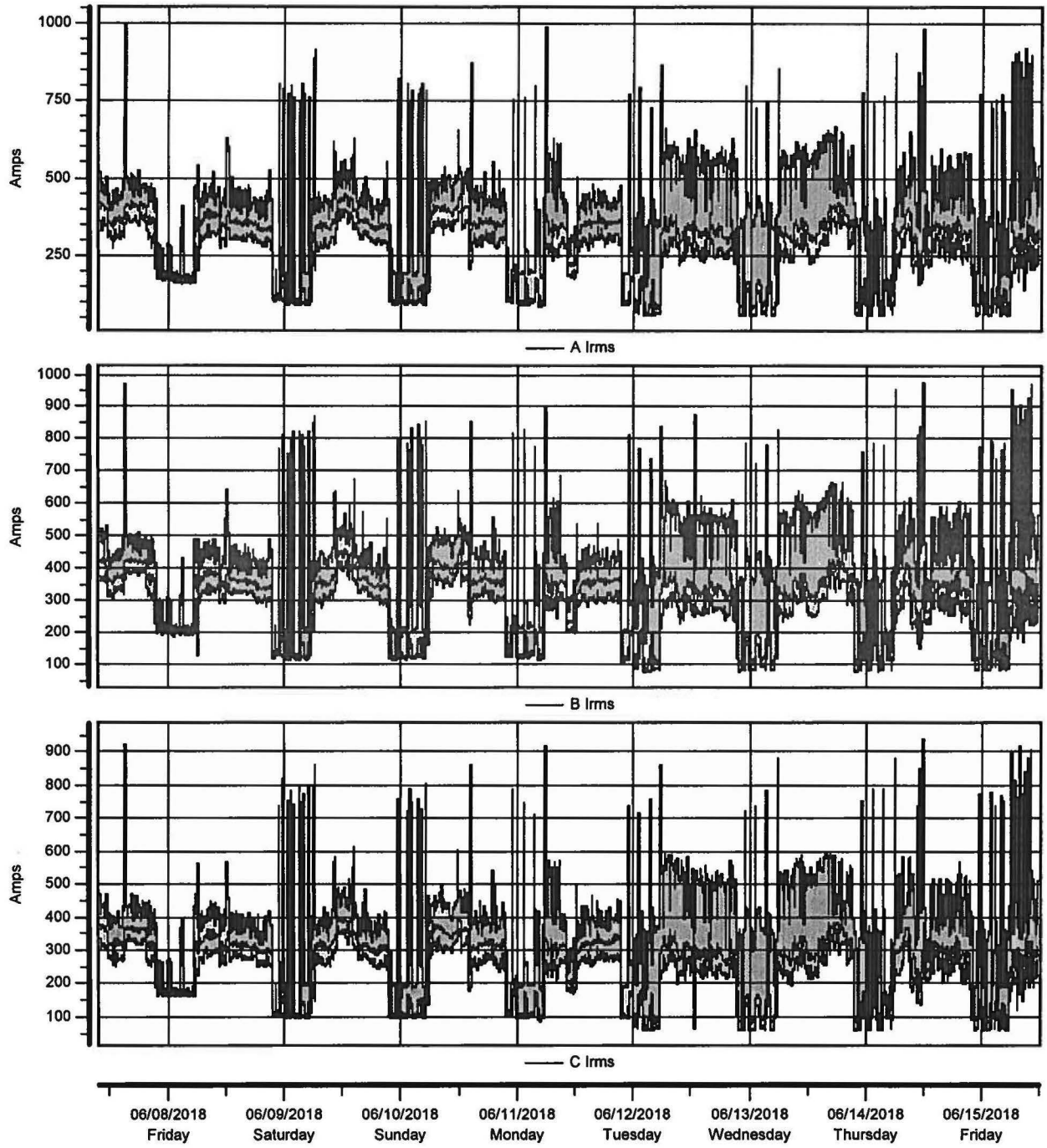


		Date 03/05/2019 Page 2
		Issued by
		Filename Christ Church-060618-061518

CURRENT TIMEPLOTS

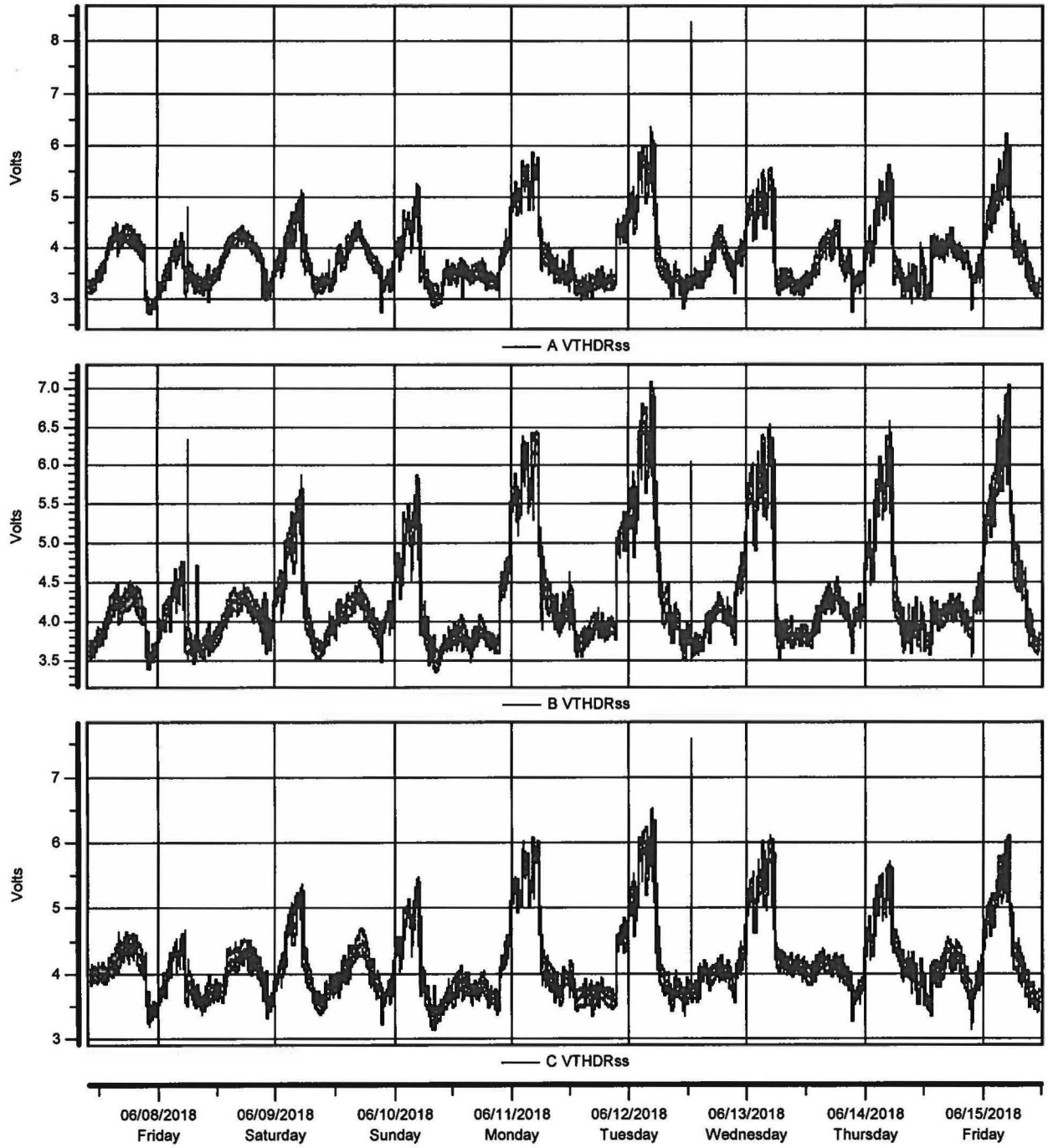
Site: CHRIST CHURCH NEW BUILDING GEAR

Measured from 06/07/2018 09:45:00.0 to 06/15/2018 11:50:00.0



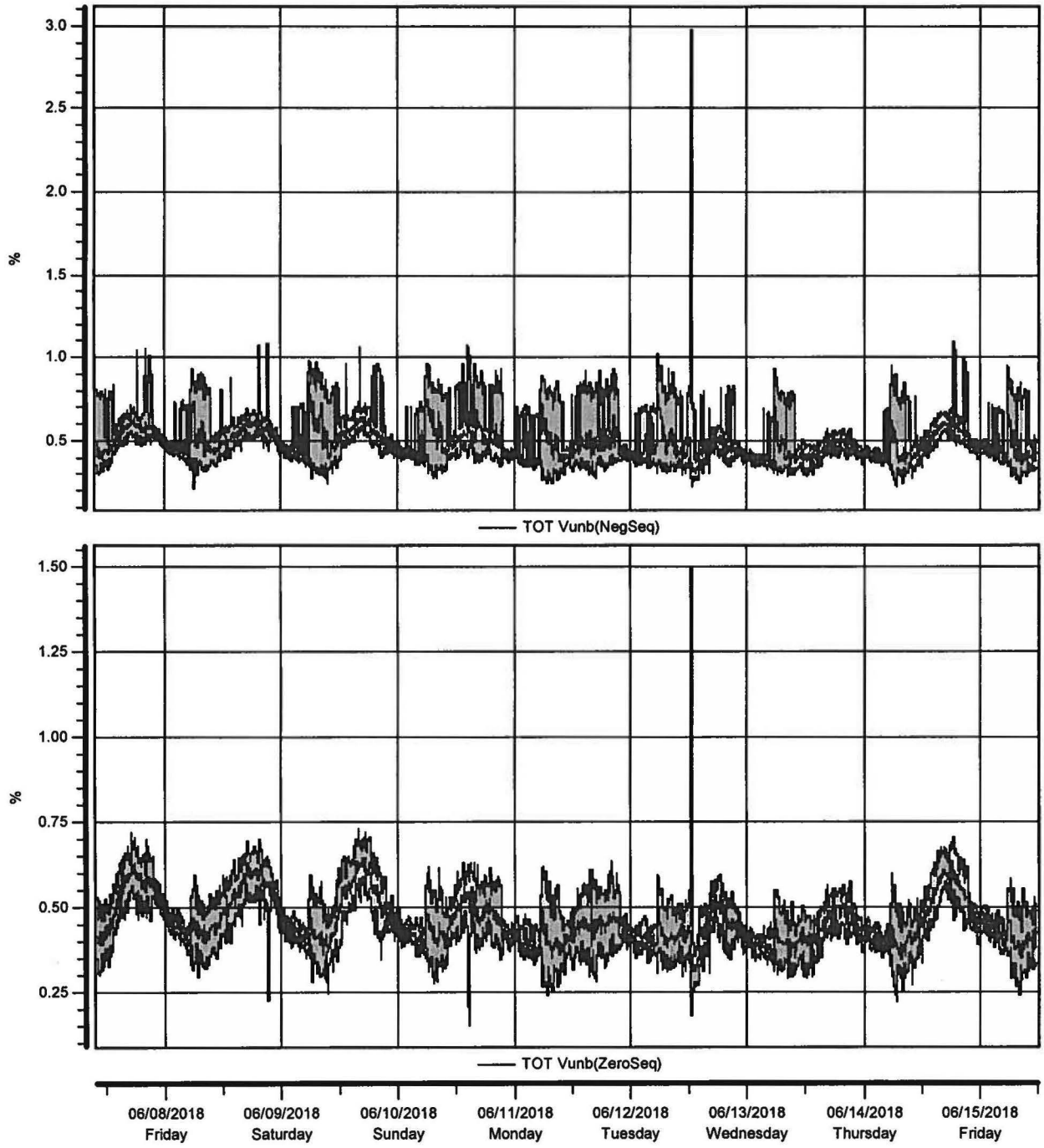
VTHD TIMEPLOTS

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/07/2018 09:45:00.0 to 06/15/2018 11:50:00.0



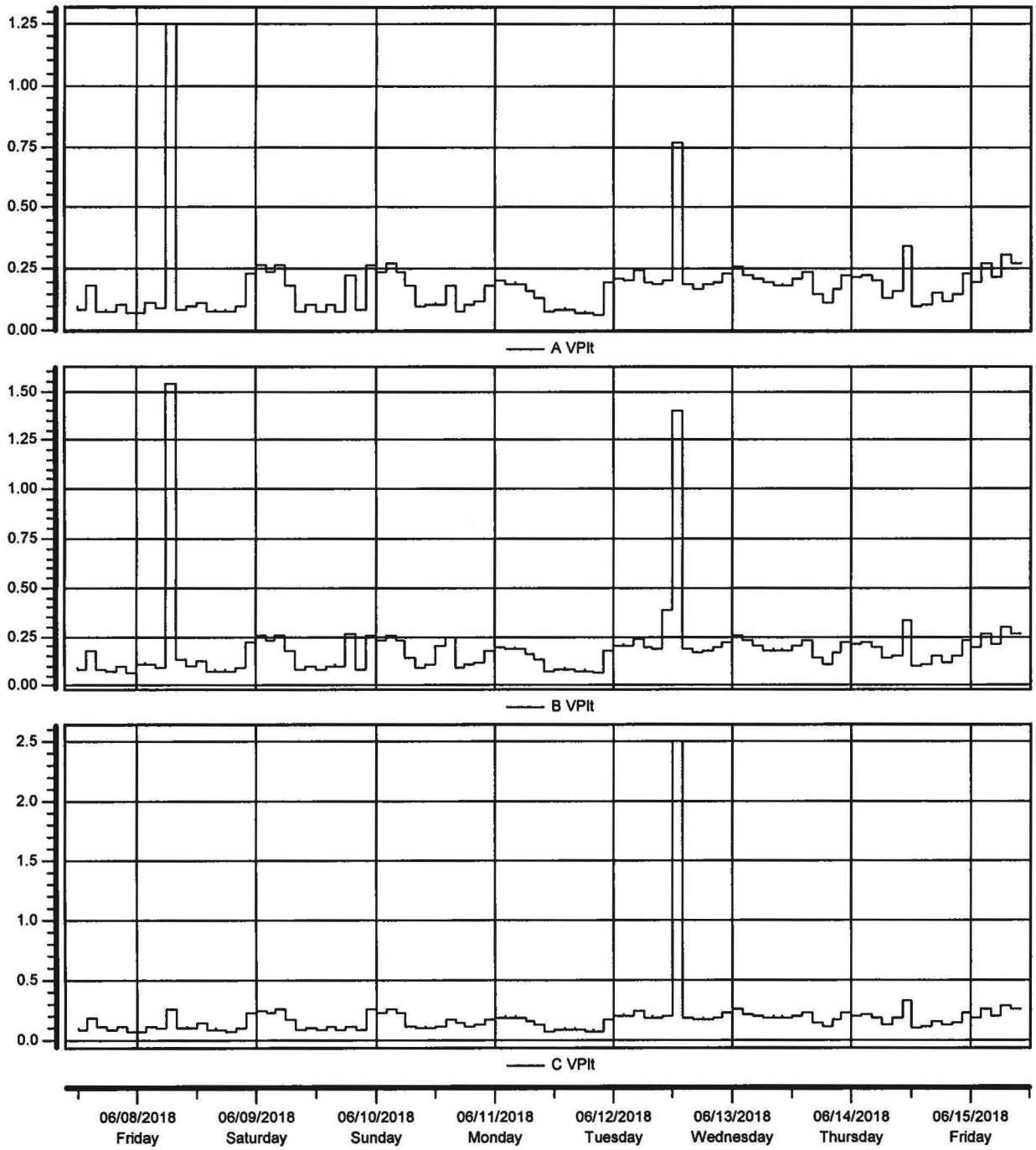
VOLTAGE UNBALANCE TIMEPLOTS

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/07/2018 09:45:00.0 to 06/15/2018 11:50:00.0



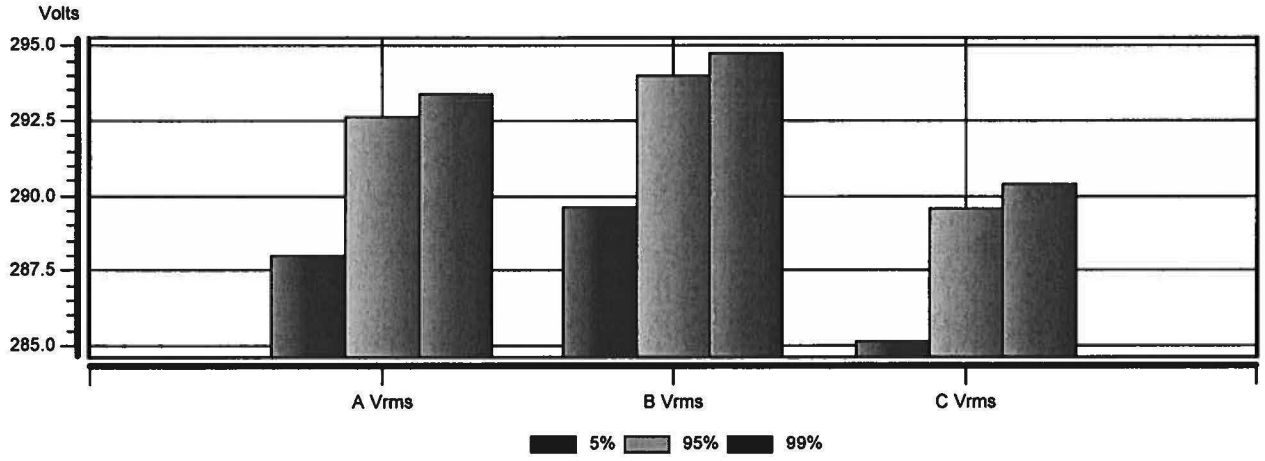
FLICKER (PLT) TIMEPLOTS

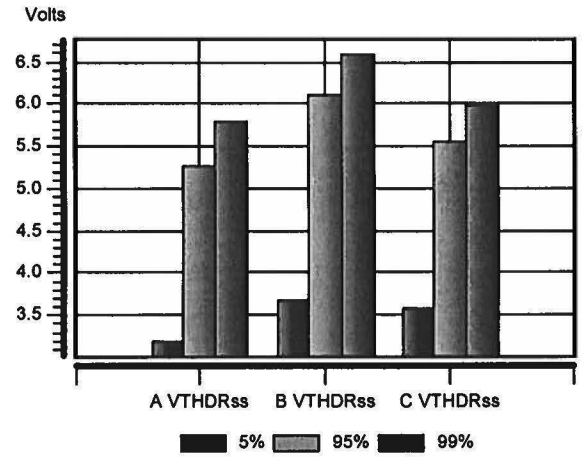
Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/07/2018 09:45:00.0 to 06/15/2018 11:50:00.0

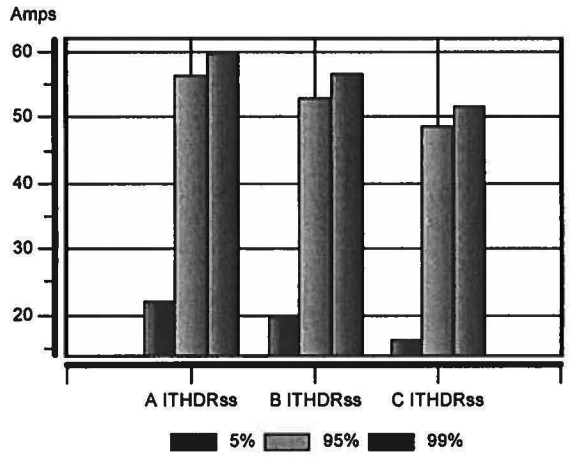


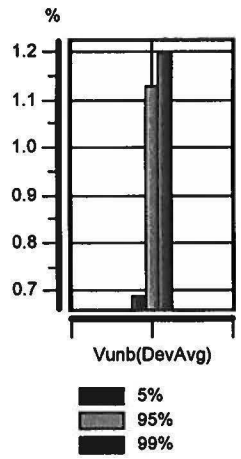
QUALITY OF SUPPLY

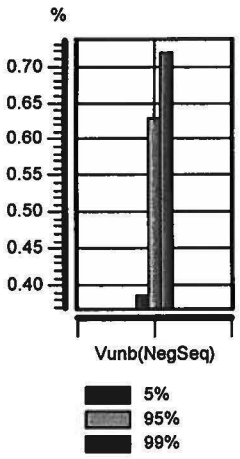
Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/07/2018 09:45:00.0 to 06/15/2018 11:50:00.0

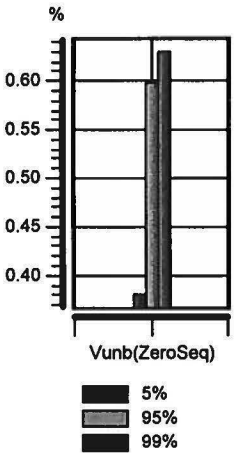


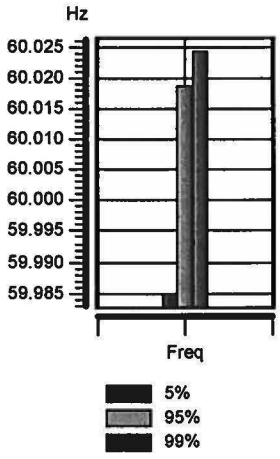








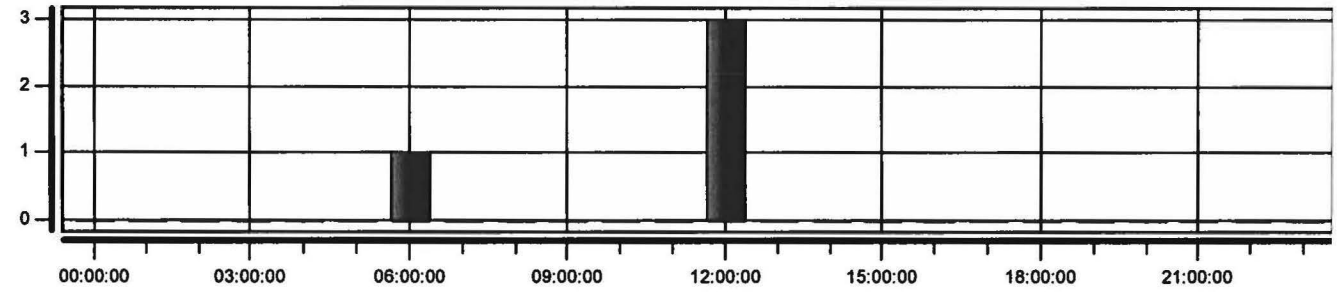




ACTIVITY PLOTS

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/07/2018 09:45:00.0 to 06/15/2018 11:50:00.0

VOLTAGE SAGS



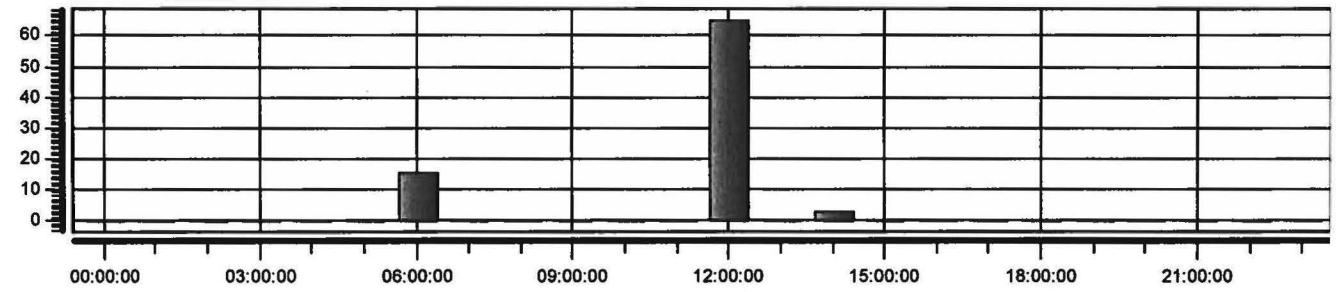
VOLTAGE SWELLS

NO EVENTS WERE FOUND IN THIS CATEGORY

VOLTAGE INTERRUPTIONS

NO EVENTS WERE FOUND IN THIS CATEGORY

VOLTAGE TRANSIENTS



WORST CASE SUMMARY

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/07/2018 09:45:00.0 to 06/15/2018 11:50:00.0

Of 4 total VOLTAGE SAGS

CRITERIA	PHASE	CATEGORY	DATA	DATE/TIME
Lowest Magnitude	C	INSTANTANEOUS	102.2V, 0.101 Sec.	06/12/2018 12:43:20.08
	C	INSTANTANEOUS	107.8V, 0.092 Sec.	06/12/2018 12:44:01.00
	C	INSTANTANEOUS	124.6V, 0.117 Sec.	06/12/2018 12:43:22.75
	A	INSTANTANEOUS	206.2V, 0.108 Sec.	06/08/2018 06:17:56.01
Longest Duration	C	INSTANTANEOUS	124.6V, 0.117 Sec.	06/12/2018 12:43:22.75
	A	INSTANTANEOUS	206.2V, 0.108 Sec.	06/08/2018 06:17:56.01
	C	INSTANTANEOUS	102.2V, 0.101 Sec.	06/12/2018 12:43:20.08
	C	INSTANTANEOUS	107.8V, 0.092 Sec.	06/12/2018 12:44:01.00
Most Energy Missing	B	INSTANTANEOUS	206.2V, 0.108 Sec.	06/08/2018 06:17:56.01
	C	INSTANTANEOUS	124.6V, 0.117 Sec.	06/12/2018 12:43:22.75
	C	INSTANTANEOUS	107.8V, 0.092 Sec.	06/12/2018 12:44:01.00
	C	INSTANTANEOUS	102.2V, 0.101 Sec.	06/12/2018 12:43:20.08

Of 0 total VOLTAGE SWELLS

CRITERIA	PHASE	CATEGORY	DATA	DATE/TIME

Of 0 total VOLTAGE INTERRUPTIONS

CRITERIA	PHASE	CATEGORY	DATA	DATE/TIME

Of 83 total VOLTAGE TRANSIENTS

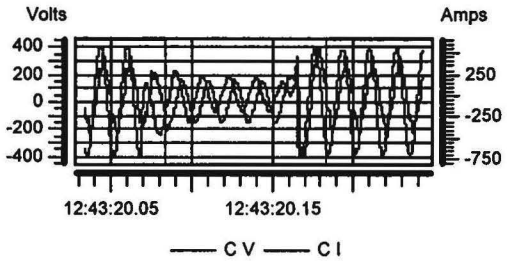
CRITERIA	PHASE	DATA	DATE/TIME
Largest Magnitude	C	545.2V, 0.000 Sec.	06/12/2018 12:43:20.09
	C	544.3V, 0.001 Sec.	06/12/2018 12:43:22.76
	C	534.9V, 0.001 Sec.	06/12/2018 12:44:00.99
	C	527.4V, 0.002 Sec.	06/12/2018 12:43:20.07

WORST CASE SUMMARY WAVEFORMS

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/07/2018 09:45:00.0 to 06/15/2018 11:50:00.0

Lowest Magnitude Voltage Sag: Phase C

Instantaneous 102.2V,0.101 Sec., on 06/12/2018 12:43:20.08

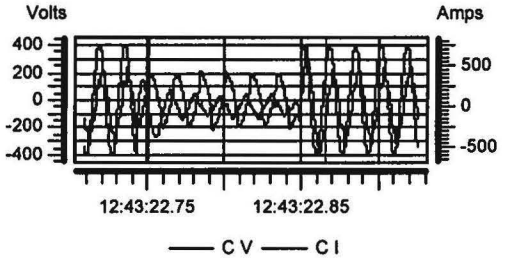


Highest Magnitude Voltage Swell:No event

NO WAVEFORM AVAILABLE

Longest Duration Voltage Sag: Phase C

Instantaneous 124.6V,0.117 Sec., on 06/12/2018 12:43:22.75

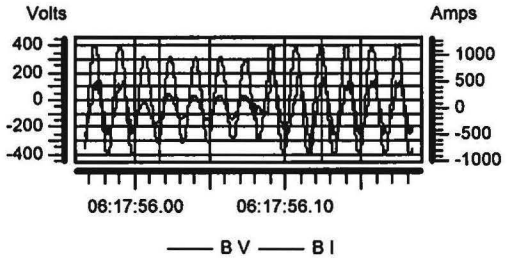


Longest Duration Voltage Swell:No event

NO WAVEFORM AVAILABLE

Most Energy Missing Voltage Sag: Phase B

Instantaneous 206.2V,0.108 Sec., on 06/08/2018 06:17:56.01



Most Energy Added Voltage Swell:No event

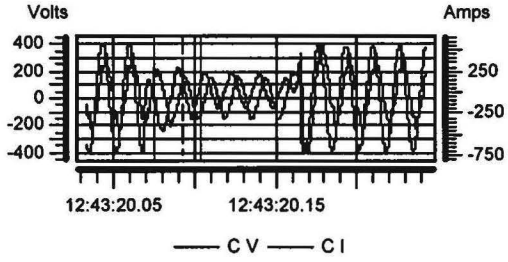
NO WAVEFORM AVAILABLE

Longest Duration Voltage Interruption:No event

NO WAVEFORM AVAILABLE

Largest Magnitude Voltage Transients: Phase C

545.2V,0.000 Sec., on 06/12/2018 12:43:20.09



MIN/MAX/AVG SUMMARY REPORT

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/07/2018 09:45:00.0 to 06/15/2018 11:50:00.0

VOLTAGE

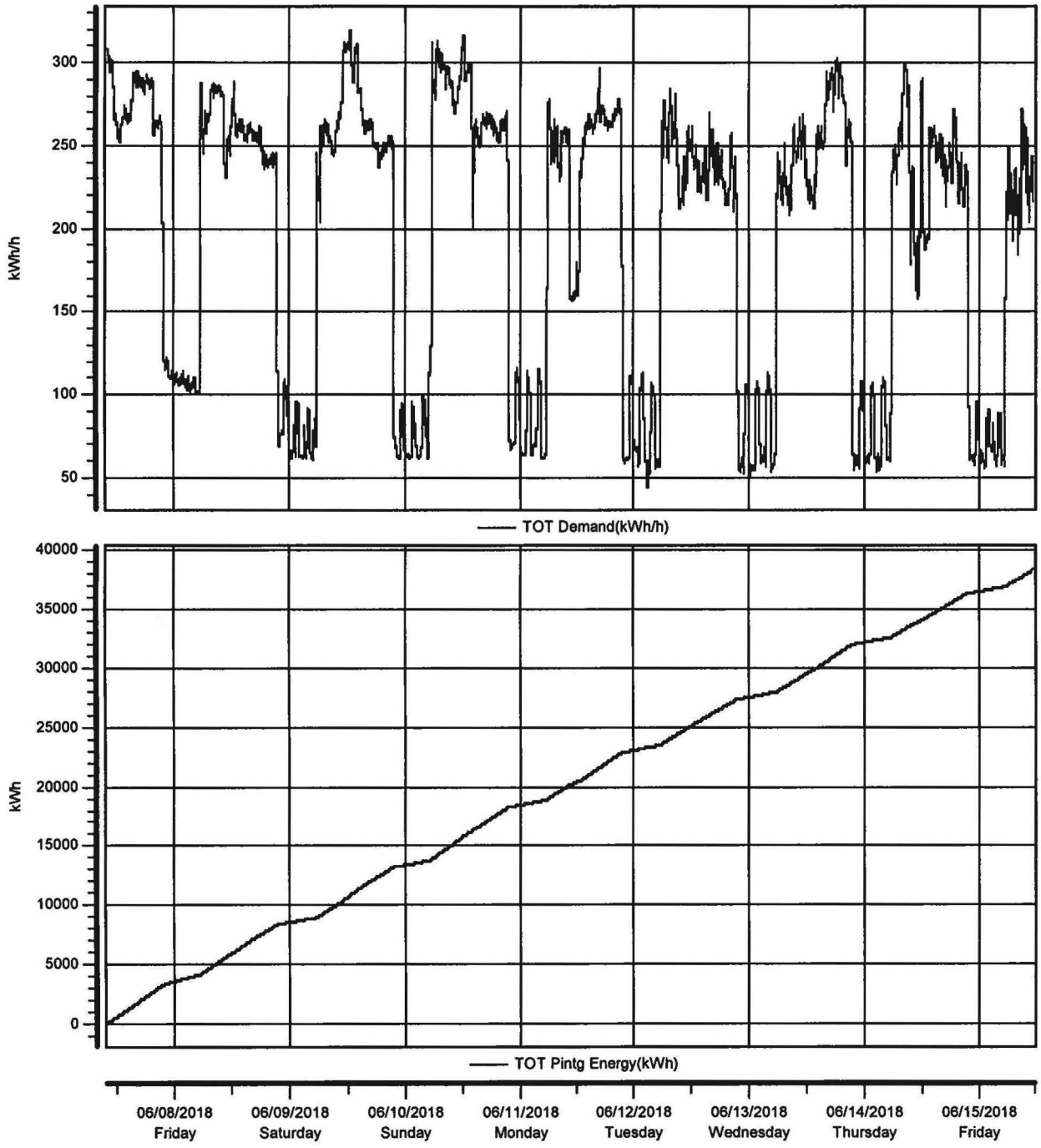
	Channel A	Channel B
Min Volts	206.23 on 06/08/2018 06:20:00	208.44 on 06/08/2018 06:20:00
Max Volts	295.03 on 06/08/2018 22:00:00	296.67 on 06/08/2018 22:00:00
Median Volts	289.96	291.66
Average Volts	290.10	291.71
	Channel C	**Channel A-B**
Min Volts	102.22 on 06/12/2018 12:50:00	352.2 on 06/08/2018 06:20:00
Max Volts	291.89 on 06/13/2018 00:10:00	513.7 on 06/08/2018 22:00:00
Median Volts	287.07	504.6
Average Volts	287.21	504.8
	Channel B-C	**Channel C-A**
Min Volts	281.7 on 06/12/2018 12:50:00	338.0 on 06/12/2018 12:50:00
Max Volts	509.7 on 06/13/2018 00:10:00	506.6 on 06/08/2018 22:00:00
Median Volts	501.7	498.3
Average Volts	501.8	498.5

CURRENT

	Channel A	Channel B
Min Amps	60.6 on 06/14/2018 02:30:00	76.9 on 06/13/2018 21:40:00
Max Amps	1000.5 on 06/07/2018 15:20:00	978.8 on 06/14/2018 11:50:00
Median Amps	326.9	336.8
Average Amps	275.3	288.9
	Channel C	
Min Amps	61.4 on 06/15/2018 03:40:00	
Max Amps	940.1 on 06/14/2018 11:50:00	
Median Amps	294.1	
Average Amps	251.4	

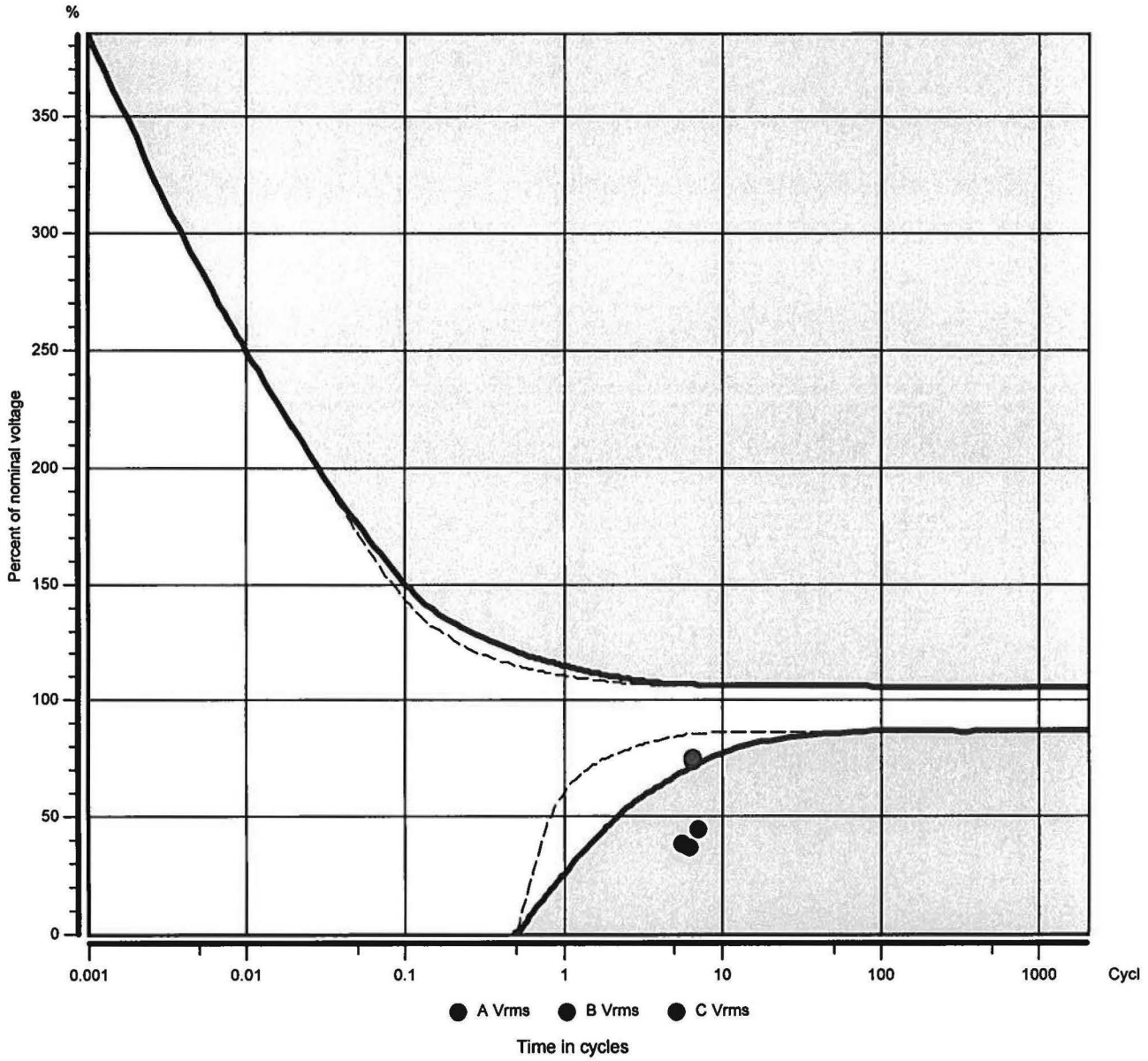
DEMAND AND ENERGY TIMEPLOTS

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/07/2018 09:45:00.0 to 06/15/2018 11:50:00.0



MAGNITUDE/DURATION DIAGRAM

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/07/2018 09:45:00.0 to 06/15/2018 11:50:00.0



TOLERANCE CURVE: CBEMA
Nominal voltage (100%) = 277 V

Variations ABOVE tolerance curve	0
Variations BELOW tolerance curve	3
Variations ABOVE recommendation curve	0
Variations BELOW recommendation curve	5

RVC Events with dUMax >= 5%

RVC Events with dUstationary >= 3%

Instrument Configuration

Dranetz Power Xplorer Configuration

Firmware	Power Xplorer (c) 2009 Dranetz-BMI Jan 10 2011 @ 09:46:34 Ver.: V 4.2, Build: 9, DB ver.: 0
Serial Number	PX50FA152
Site/Filename	CHRIST CHURCH NEW BUILDING GEAR
Measured from	06/07/2018 09:35:08
Measured to	06/15/2018 11:54:45
File ending	OK
Synchronization	Standard A
Configuration	4 WIRE / 3 PROBE (WYE)
Monitoring type	STANDARD PQ
Nominal voltage	277.0 V
Nominal current	387.9 A
Nominal frequency	60.0 Hz
Use inverse sequence	Yes
Using currents	Yes
Characterizer mode	IEEE 1159

Current probes

Chan A	3000XL, RR3035A (Range3), 3000A (Scale=2000.00)
Chan B	3000XL, RR3035A (Range3), 3000A (Scale=2000.00)
Chan C	3000XL, RR3035A (Range3), 3000A (Scale=2000.00)
Chan D	3000XL, RR3035A (Range2), 300A (Scale=200.00)

Voltage scale factors

Chan A	1.000
Chan B	1.000
Chan C	1.000
Chan D	1.000

Current scale factors

Chan A	1.000
Chan B	1.000
Chan C	1.000
Chan D	1.000

Trigger Response Setups

Summary Pre-trigger cycles	6 cycles
Summary Post-trigger cycles IN-TO-OUT	6 cycles

Summary Post-trigger cycles OUT-TO-IN 6 cycles
Waveform Pre-trigger cycles 2 cycles
Waveform Post-trigger cycles 2 cycles

Trigger-	Saved waveforms										
channel	Va	Vb	Vc	Vd	Ia	Ib	Ic	Id	AB	BC	CA
Volts A	Va	Vb	Vc	-	Ia	Ib	Ic	-	-	-	-
Volts B	Va	Vb	Vc	-	Ia	Ib	Ic	-	-	-	-
Volts C	Va	Vb	Vc	-	Ia	Ib	Ic	-	-	-	-
Volts D	-	-	-	Vd	-	-	-	-	-	-	-
Amps A	-	-	-	-	Ia	-	-	-	-	-	-
Amps B	-	-	-	-	-	Ib	-	-	-	-	-
Amps C	-	-	-	-	-	-	Ic	-	-	-	-
Amps D	-	-	-	-	-	-	-	Id	-	-	-
Volts A-B	-	-	-	-	-	-	-	-	-	-	-
Volts B-C	-	-	-	-	-	-	-	-	-	-	-
Volts C-A	-	-	-	-	-	-	-	-	-	-	-

Timed waveform savings: NOT active
After recording: REARM

Limit Setups

Voltages							
RMS High:	304.7	304.7	304.7	0.0	0.0	0.0	0.0
RMS Low:	249.3	249.3	249.3	0.0	0.0	0.0	0.0
RMS Very Low:	27.7	27.7	27.7	0.0	0.0	0.0	0.0
Crest:	588.6	588.6	588.6	0.0	0.0	0.0	0.0
Wave:	55.4	55.4	55.4	0.0	0.0	0.0	0.0
DC:	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEG:	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WAVE Window Mag:	55.4	55.4	55.4	0.0	0.0	0.0	0.0
WAVE Window Dur:	15.0	15.0	15.0	0.0	0.0	0.0	0.0
HF:	461.6	461.6	461.6	0.0	0.0	0.0	0.0

Currents	A	B	C	D
RMS High:	0.0	0.0	0.0	0.0
RMS Low:	0.0	0.0	0.0	0.0
RMS Very Low:	0.0	0.0	0.0	0.0
Crest:	0.0	0.0	0.0	0.0
Wave:	0.0	0.0	0.0	0.0
DC:	0.0	0.0	0.0	0.0
DEG:	0.0	0.0	0.0	0.0
WAVE Window Mag:	0.0	0.0	0.0	0.0
WAVE Window Dur:	0.0	0.0	0.0	0.0

HF:	0.0	0.0	0.0	0.0

Periodic Journal Intervals

Voltage	10.0 minutes
Current	10.0 minutes
Power	10.0 minutes
Harmonics	10.0 minutes
Demand	5.0 minutes, Subintervals/Intervals: 3
Energy	10.0 minutes
Inst. flicker	10.0 minutes
Short term flicker	10.0 minutes
Long term flicker	120.0 minutes
EN50160 compliance	10.0 minutes

Journal Limits

Voltage	VeryHi	High	Low	VeryLo	Sens.	Hyst.	Nom.
RMS_PhAN	332.4	304.7	249.3	221.6	-	-	-
RMS_PhBN	332.4	304.7	249.3	221.6	-	-	-
RMS_PhCN	332.4	304.7	249.3	221.6	-	-	-
CycRMS_PhAN	332.4	304.7	249.3	221.6	-	-	-
CycRMS_PhBN	332.4	304.7	249.3	221.6	-	-	-
CycRMS_PhCN	332.4	304.7	249.3	221.6	-	-	-
FreqHz	-	60.6	59.4	-	-	-	-

Current	VeryHi	High	Low	VeryLo	Sens.	Hyst.	Nom.
RMS_PhA	620.7	504.3	-	-	-	-	-
RMS_PhB	620.7	504.3	-	-	-	-	-
RMS_PhC	620.7	504.3	-	-	-	-	-
CycRMS_PhA	620.7	504.3	-	-	-	-	-
CycRMS_PhB	620.7	504.3	-	-	-	-	-
CycRMS_PhC	620.7	504.3	-	-	-	-	-

Harmonics	VeryHi	High	Low	VeryLo	Sens.	Hyst.	Nom.
VoltageFundNormTHD_PhA	8.0	5.0	-	-	-	-	-
VoltageFundNormTHD_PhB	8.0	5.0	-	-	-	-	-
VoltageFundNormTHD_PhC	8.0	5.0	-	-	-	-	-

Short term flicker	VeryHi	High	Low	VeryLo	Sens.	Hyst.	Nom.
Pst_PhA	-	1.0	-	-	-	-	-
Pst_PhB	-	1.0	-	-	-	-	-
Pst_PhC	-	1.0	-	-	-	-	-

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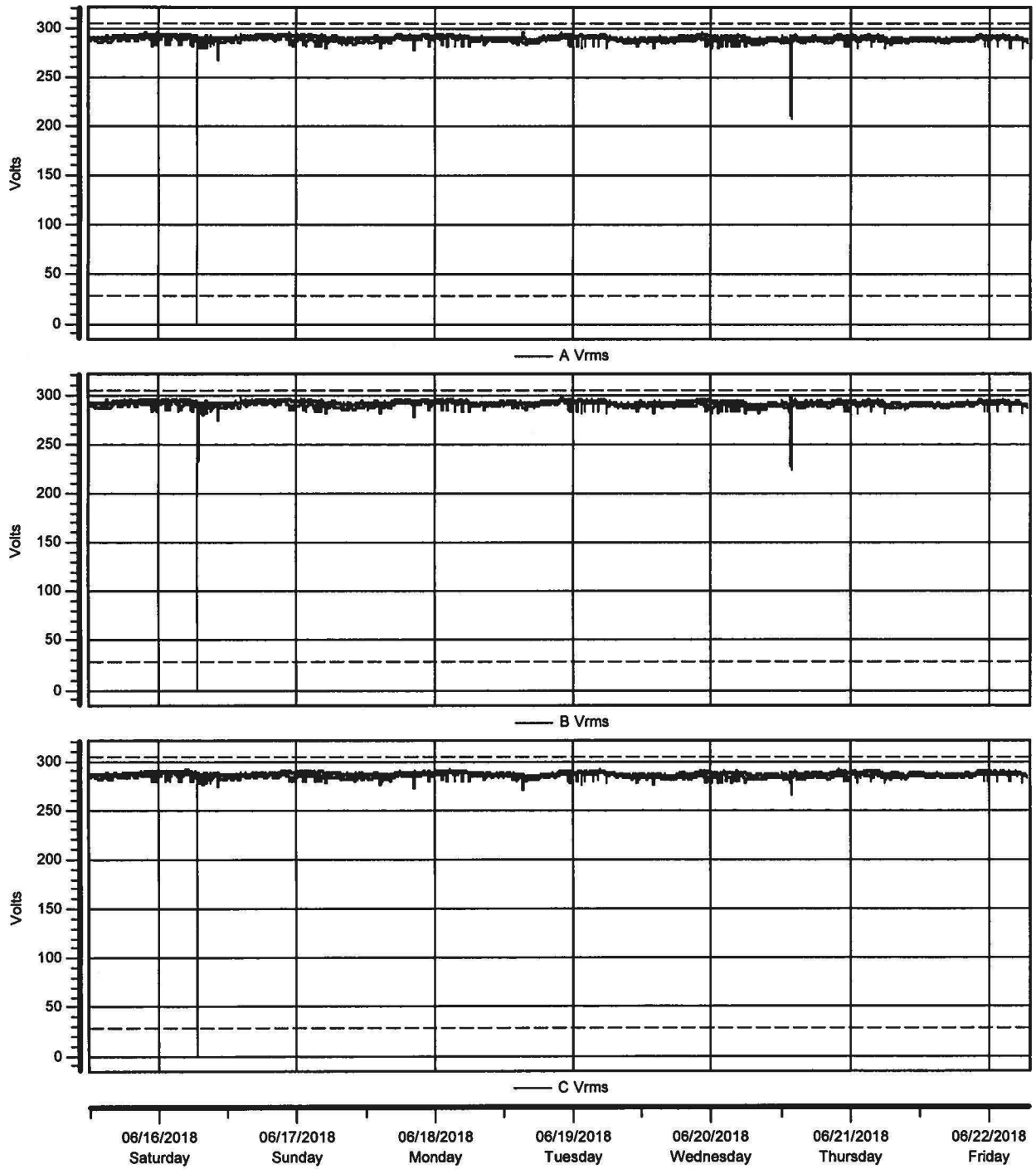
VOLTAGE TIMEPLOTS

Site: CHRIST CHURCH NEW BUILDING GEAR

Measured from 06/15/2018 12:05:00.0 to 06/22/2018 07:05:00.0



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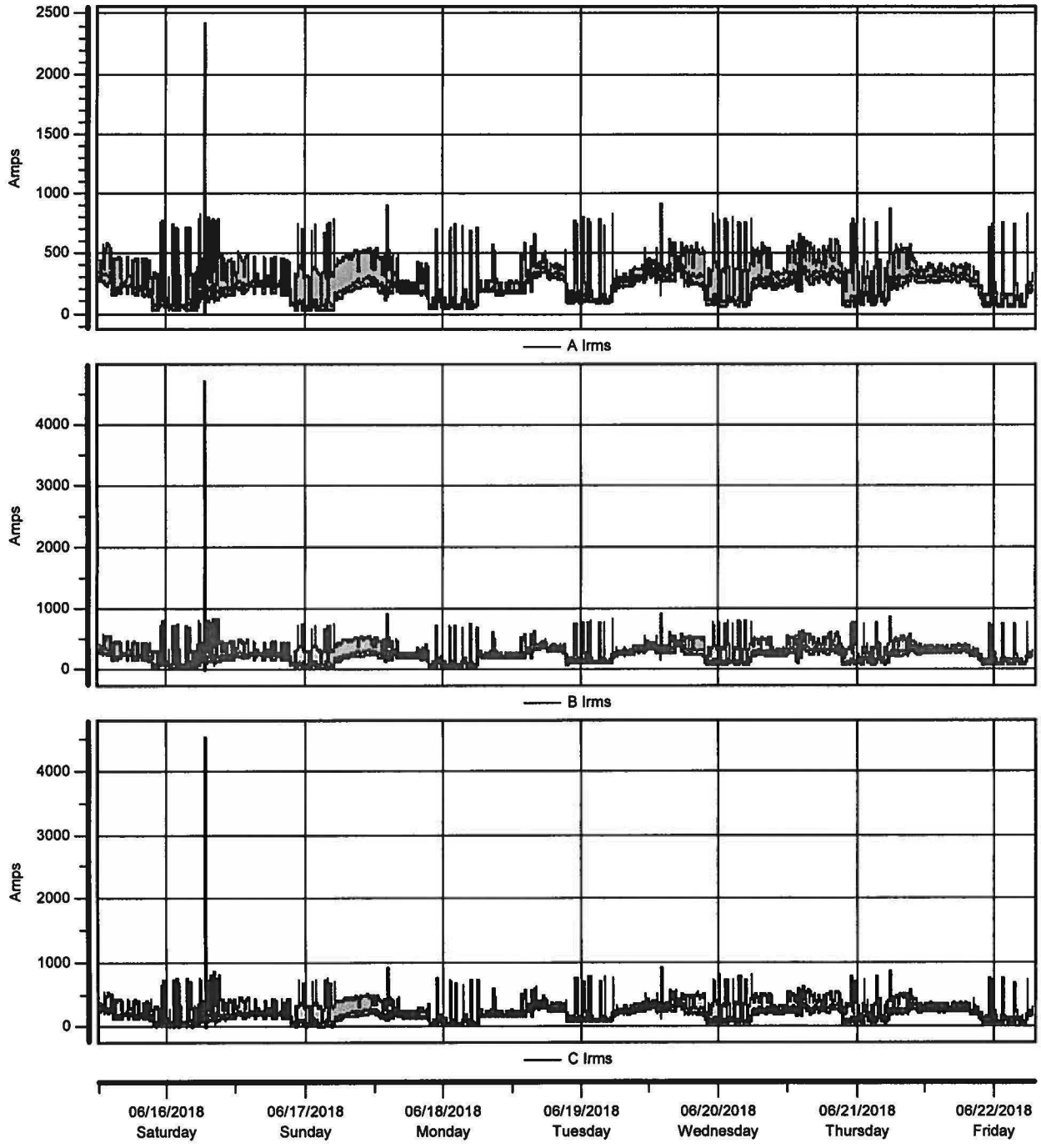
CURRENT TIMEPLOTS

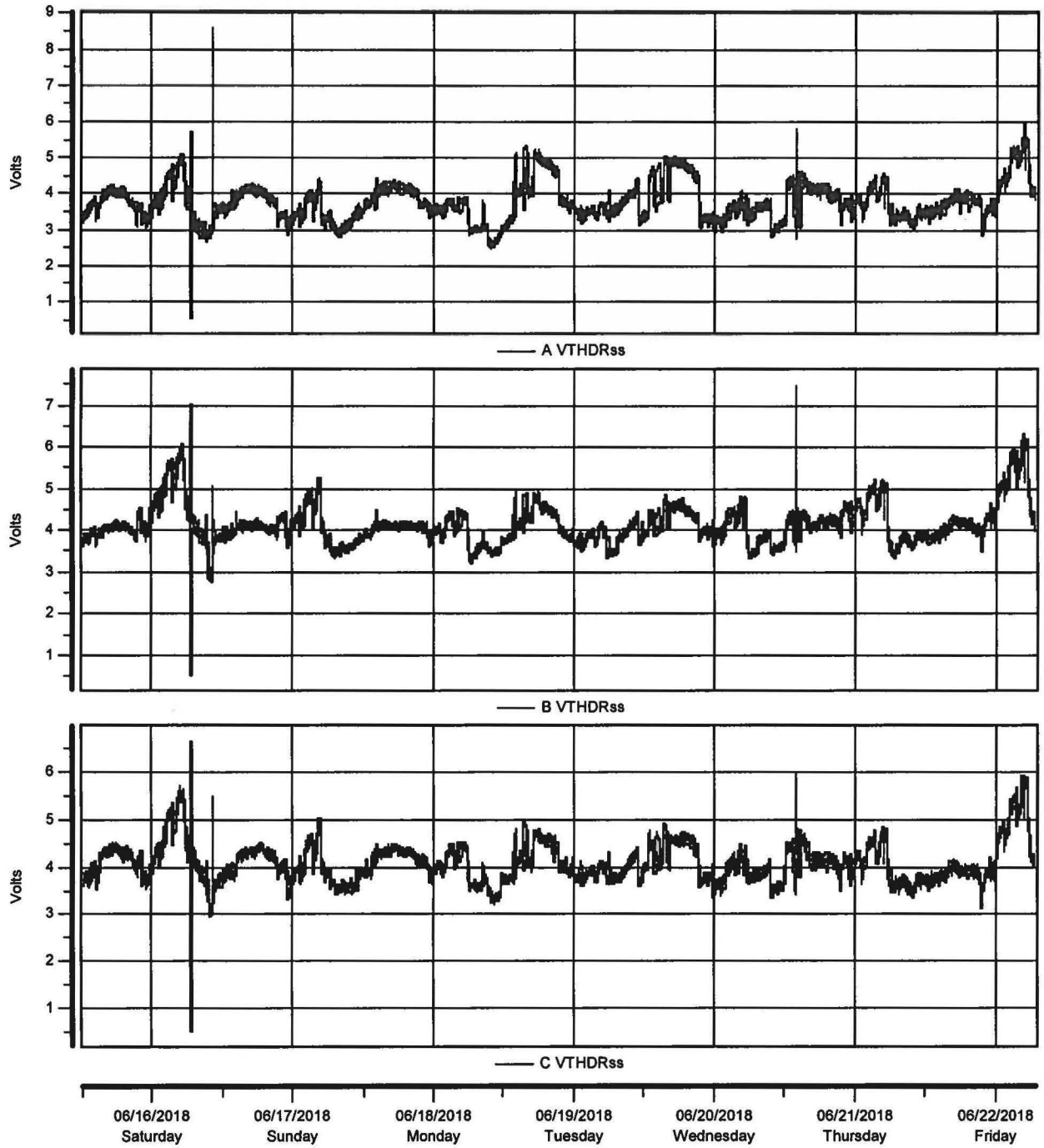
Site: CHRIST CHURCH NEW BUILDING GEAR

Measured from 06/15/2018 12:05:00.0 to 06/22/2018 07:05:00.0



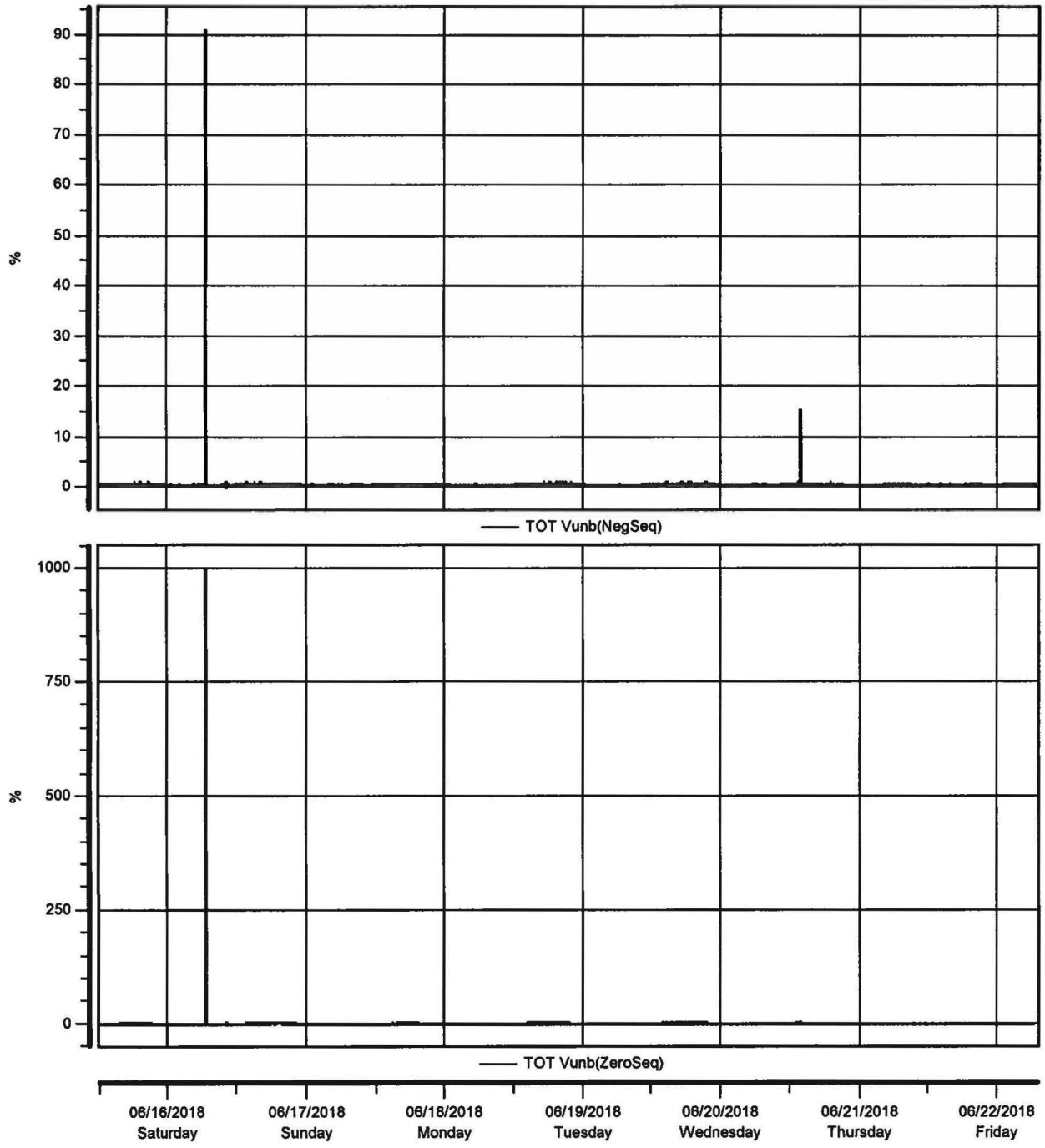
VTHD TIMEPLOTS

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/15/2018 12:05:00.0 to 06/22/2018 07:05:00.0



VOLTAGE UNBALANCE TIMEPLOTS

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/15/2018 12:05:00.0 to 06/22/2018 07:05:00.0



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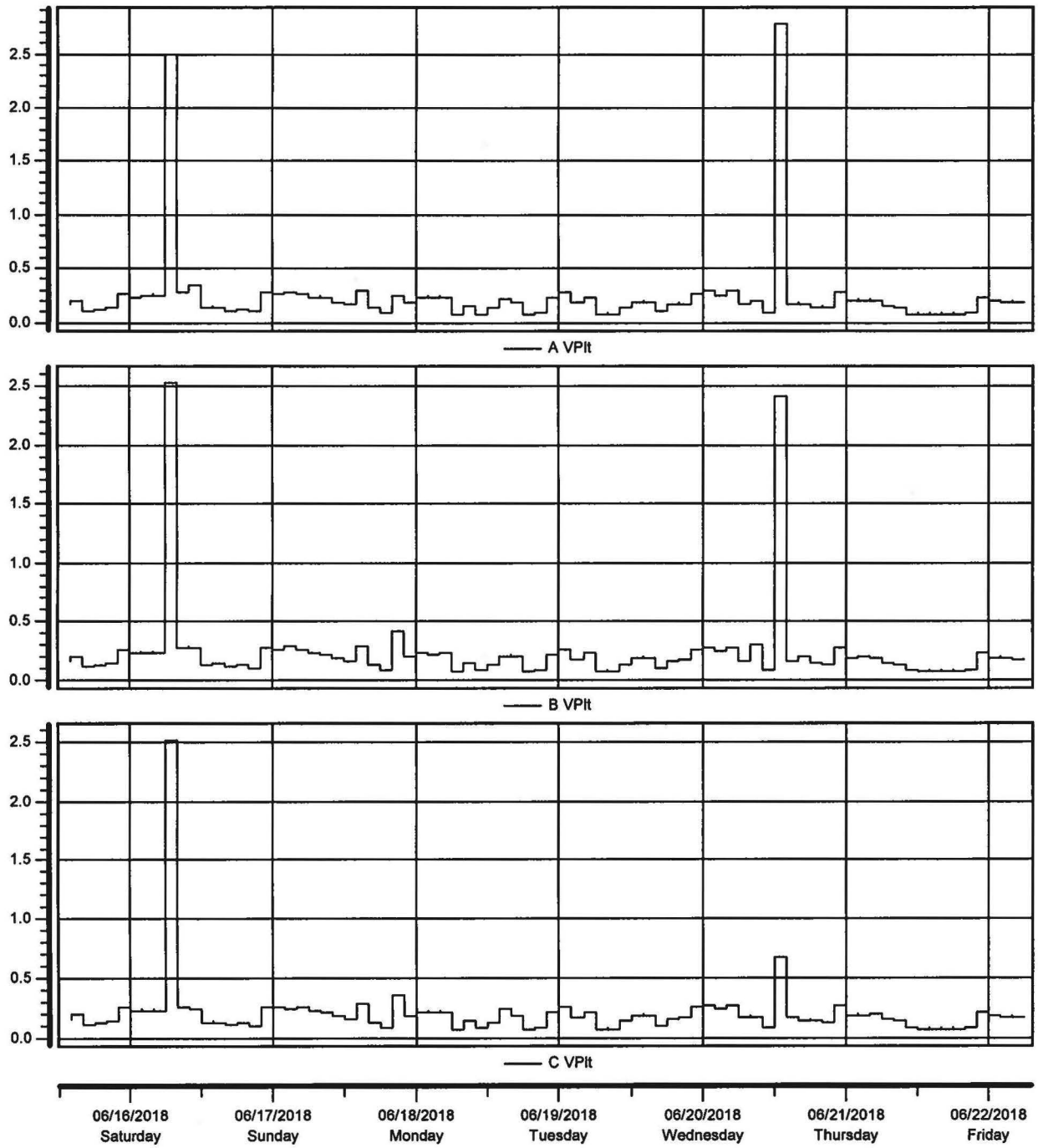
FLICKER (PLT) TIMEPLOTS

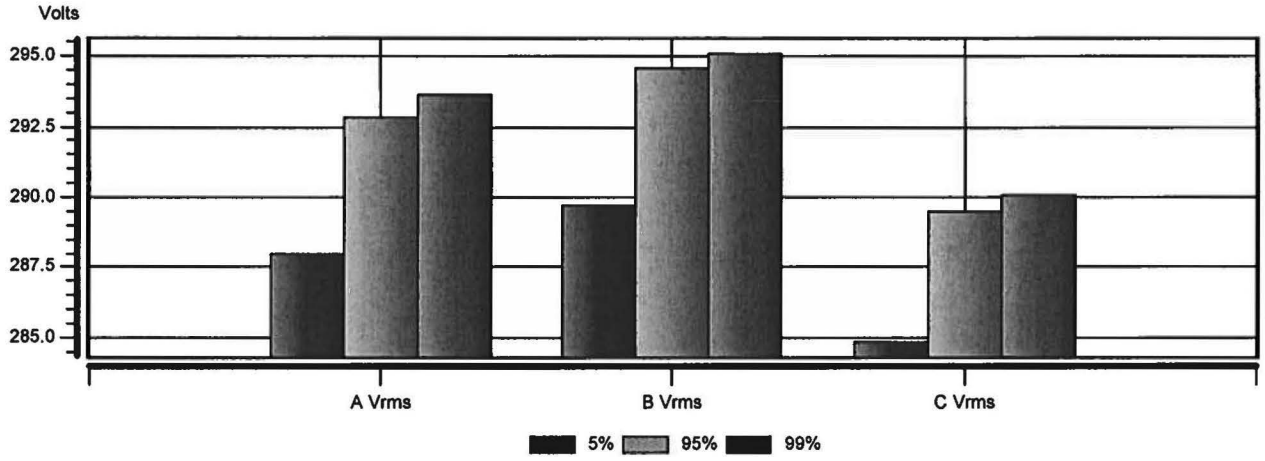
Site: CHRIST CHURCH NEW BUILDING GEAR

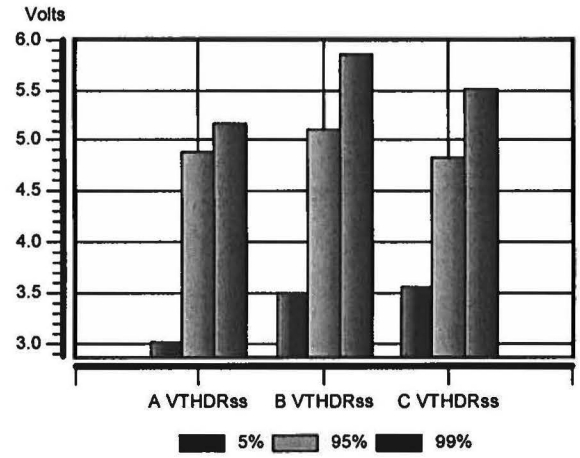
Measured from 06/15/2018 12:05:00.0 to 06/22/2018 07:05:00.0

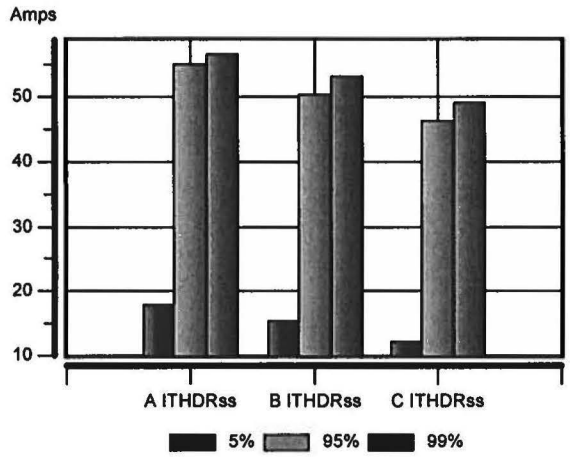


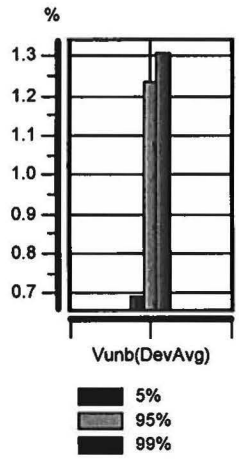
QUALITY OF SUPPLY

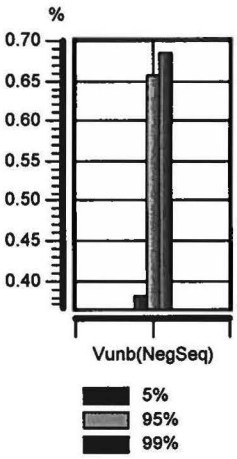
Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/15/2018 12:05:00.0 to 06/22/2018 07:05:00.0

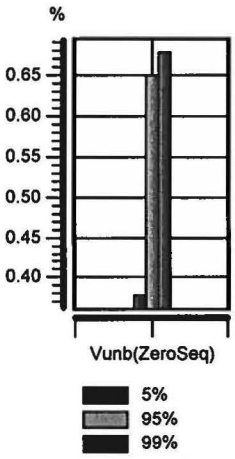


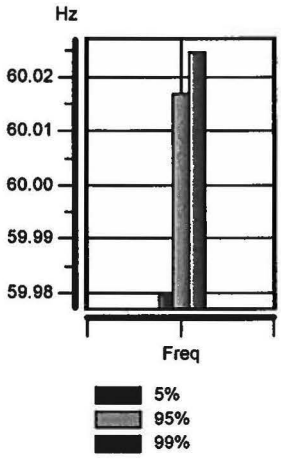








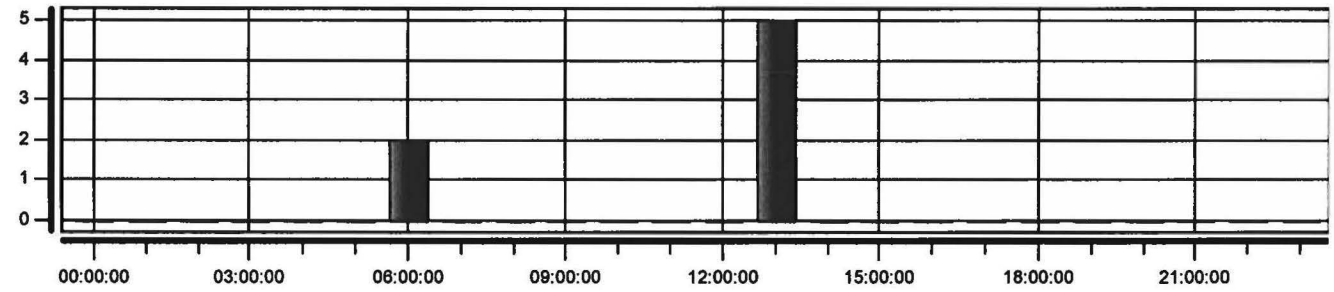




ACTIVITY PLOTS

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/15/2018 12:05:00.0 to 06/22/2018 07:05:00.0

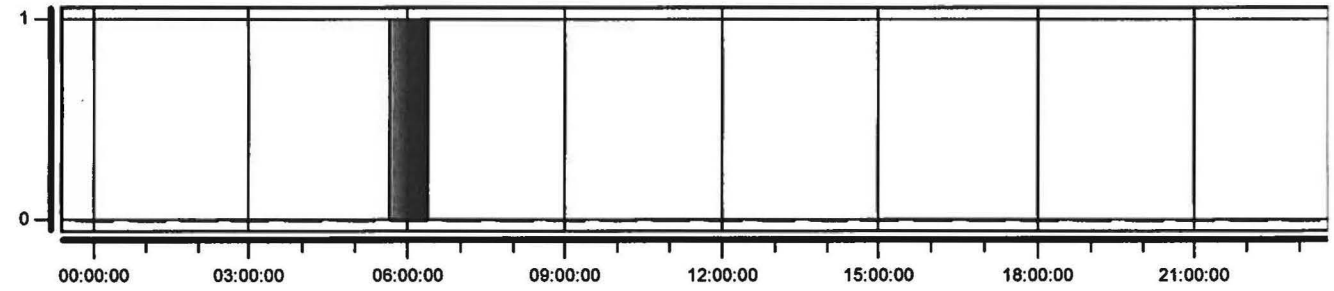
VOLTAGE SAGS



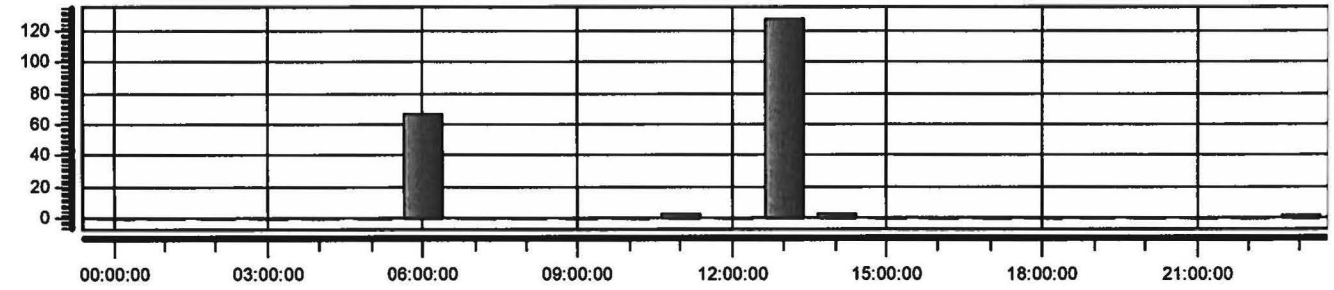
VOLTAGE SWELLS

NO EVENTS WERE FOUND IN THIS CATEGORY

VOLTAGE INTERRUPTIONS



VOLTAGE TRANSIENTS



WORST CASE SUMMARY

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/15/2018 12:05:00.0 to 06/22/2018 07:05:00.0

Of 7 total VOLTAGE SAGS

CRITERIA	PHASE	CATEGORY	DATA	DATE/TIME
Lowest Magnitude	A	INSTANTANEOUS	25.6V, 0.225 Sec.	06/16/2018 06:43:14.74
	A	INSTANTANEOUS	209.0V, 0.100 Sec.	06/20/2018 13:53:00.66
	A	MOMENTARY	209.2V, 1.492 Sec.	06/20/2018 13:53:03.46
	A	MOMENTARY	210.6V, 1.484 Sec.	06/20/2018 13:53:44.24
Longest Duration	A	MOMENTARY	209.2V, 1.492 Sec.	06/20/2018 13:53:03.46
	A	MOMENTARY	210.6V, 1.484 Sec.	06/20/2018 13:53:44.24
	A	INSTANTANEOUS	25.6V, 0.225 Sec.	06/16/2018 06:43:14.74
	A	INSTANTANEOUS	212.4V, 0.108 Sec.	06/20/2018 13:48:51.00
Most Energy Missing	B	MOMENTARY	210.6V, 1.484 Sec.	06/20/2018 13:53:44.24
	B	MOMENTARY	209.2V, 1.492 Sec.	06/20/2018 13:53:03.46
	B	INSTANTANEOUS	212.4V, 0.108 Sec.	06/20/2018 13:48:51.00
	B	INSTANTANEOUS	211.1V, 0.100 Sec.	06/20/2018 13:53:43.86

Of 0 total VOLTAGE SWELLS

CRITERIA	PHASE	CATEGORY	DATA	DATE/TIME

Of 1 total VOLTAGE INTERRUPTIONS

CRITERIA	PHASE	CATEGORY	DATA	DATE/TIME
Longest Duration	A	TEMPORARY	0.7V, 29.901 Sec.	06/16/2018 06:43:14.97

Of 202 total VOLTAGE TRANSIENTS

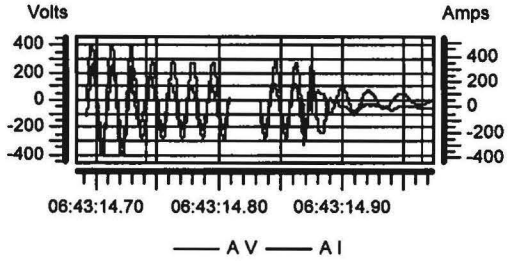
CRITERIA	PHASE	DATA	DATE/TIME
Largest Magnitude	B	984.2V, 0.002 Sec.	06/16/2018 06:43:16.46
	B	755.5V, 0.002 Sec.	06/16/2018 06:43:16.50
	A	697.2V, 0.000 Sec.	06/16/2018 06:43:44.76
	A	674.8V, 0.000 Sec.	06/16/2018 06:43:16.48

WORST CASE SUMMARY WAVEFORMS

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/15/2018 12:05:00.0 to 06/22/2018 07:05:00.0

Lowest Magnitude Voltage Sag: Phase A

Instantaneous 25.6V,0.225 Sec., on 06/16/2018 06:43:14.74

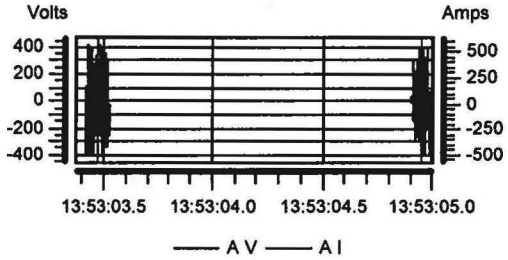


Highest Magnitude Voltage Swell:No event

NO WAVEFORM AVAILABLE

Longest Duration Voltage Sag: Phase A

Momentary 209.2V,1.492 Sec., on 06/20/2018 13:53:03.46

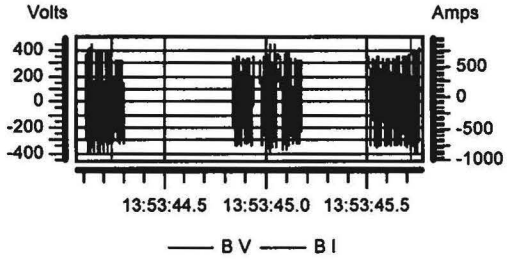


Longest Duration Voltage Swell:No event

NO WAVEFORM AVAILABLE

Most Energy Missing Voltage Sag: Phase B

Momentary 210.6V,1.484 Sec., on 06/20/2018 13:53:44.24

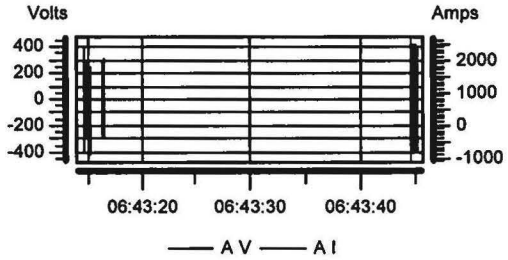


Most Energy Added Voltage Swell:No event

NO WAVEFORM AVAILABLE

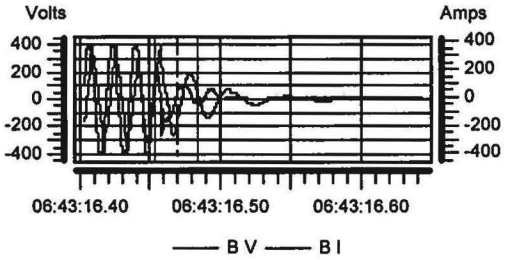
Longest Duration Voltage Interruption: Phase A

Temporary 0.7V,29.901 Sec., on 06/16/2018 06:43:14.97



Largest Magnitude Voltage Transients: Phase B

984.2V,0.002 Sec., on 06/16/2018 06:43:16.46



MIN/MAX/AVG SUMMARY REPORT

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/15/2018 12:05:00.0 to 06/22/2018 07:05:00.0

VOLTAGE

	Channel A	Channel B
Min Volts	0.64 on 06/16/2018 06:50:00	0.76 on 06/16/2018 06:50:00
Max Volts	295.46 on 06/18/2018 15:20:00	297.25 on 06/20/2018 13:50:00
Median Volts	290.16	292.00
Average Volts	290.30	292.06
	Channel C	**Channel A-B**
Min Volts	0.74 on 06/16/2018 06:50:00	0.2 on 06/16/2018 06:50:00
Max Volts	291.55 on 06/19/2018 01:20:00	513.5 on 06/15/2018 22:10:00
Median Volts	287.02	505.3
Average Volts	287.13	505.4
	Channel B-C	**Channel C-A**
Min Volts	0.3 on 06/16/2018 06:50:00	0.2 on 06/16/2018 06:50:00
Max Volts	513.0 on 06/20/2018 13:50:00	506.8 on 06/19/2018 01:20:00
Median Volts	501.4	498.7
Average Volts	501.7	498.9

CURRENT

	Channel A	Channel B
Min Amps	1.0 on 06/16/2018 06:50:00	1 on 06/16/2018 06:50:00
Max Amps	2428.2 on 06/16/2018 06:50:00	4722 on 06/16/2018 06:50:00
Median Amps	212.2	232
Average Amps	209.5	226
	Channel C	
Min Amps	1 on 06/16/2018 06:50:00	
Max Amps	4541 on 06/16/2018 06:50:00	
Median Amps	191	
Average Amps	190	

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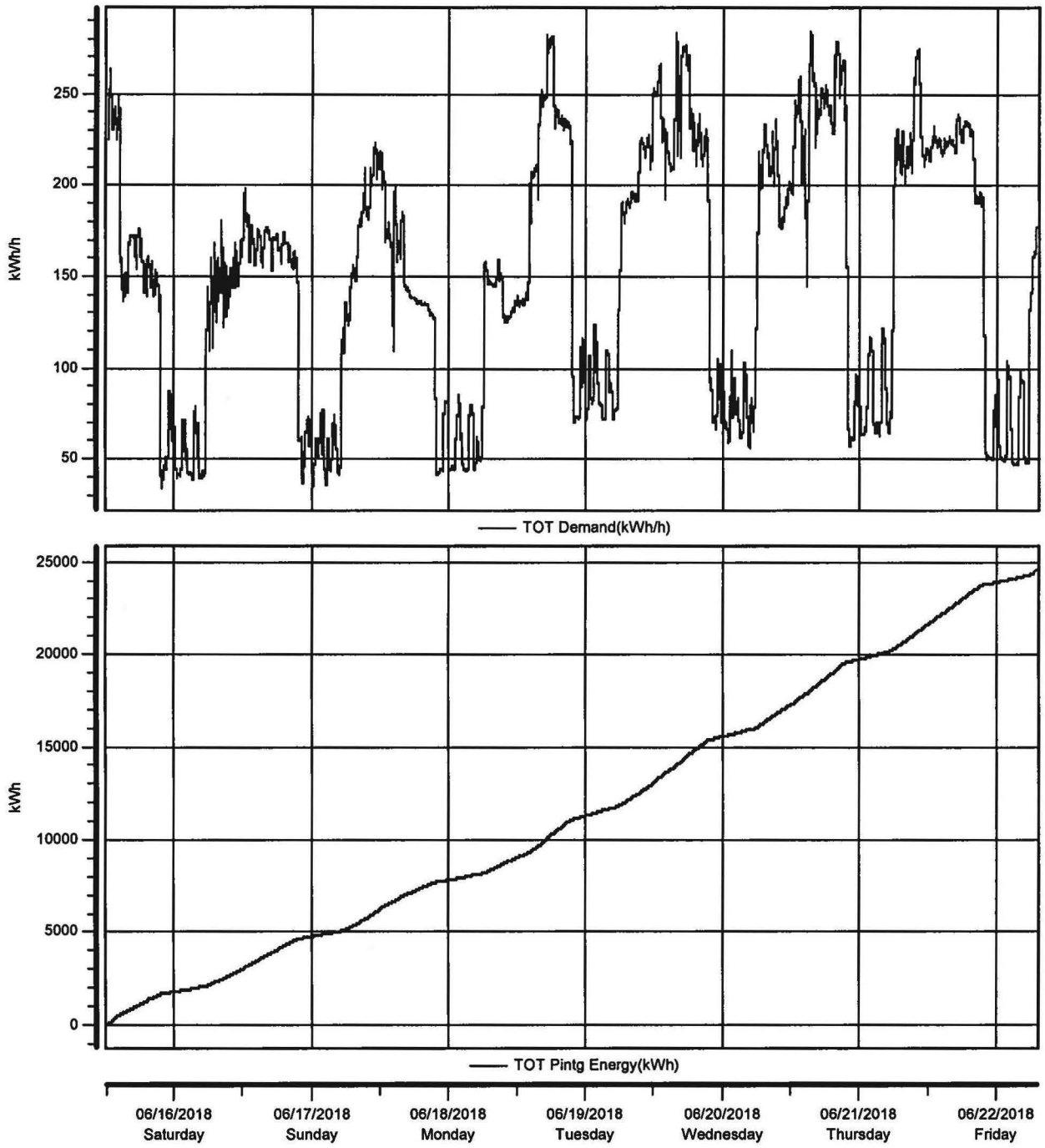
DEMAND AND ENERGY TIMEPLOTS

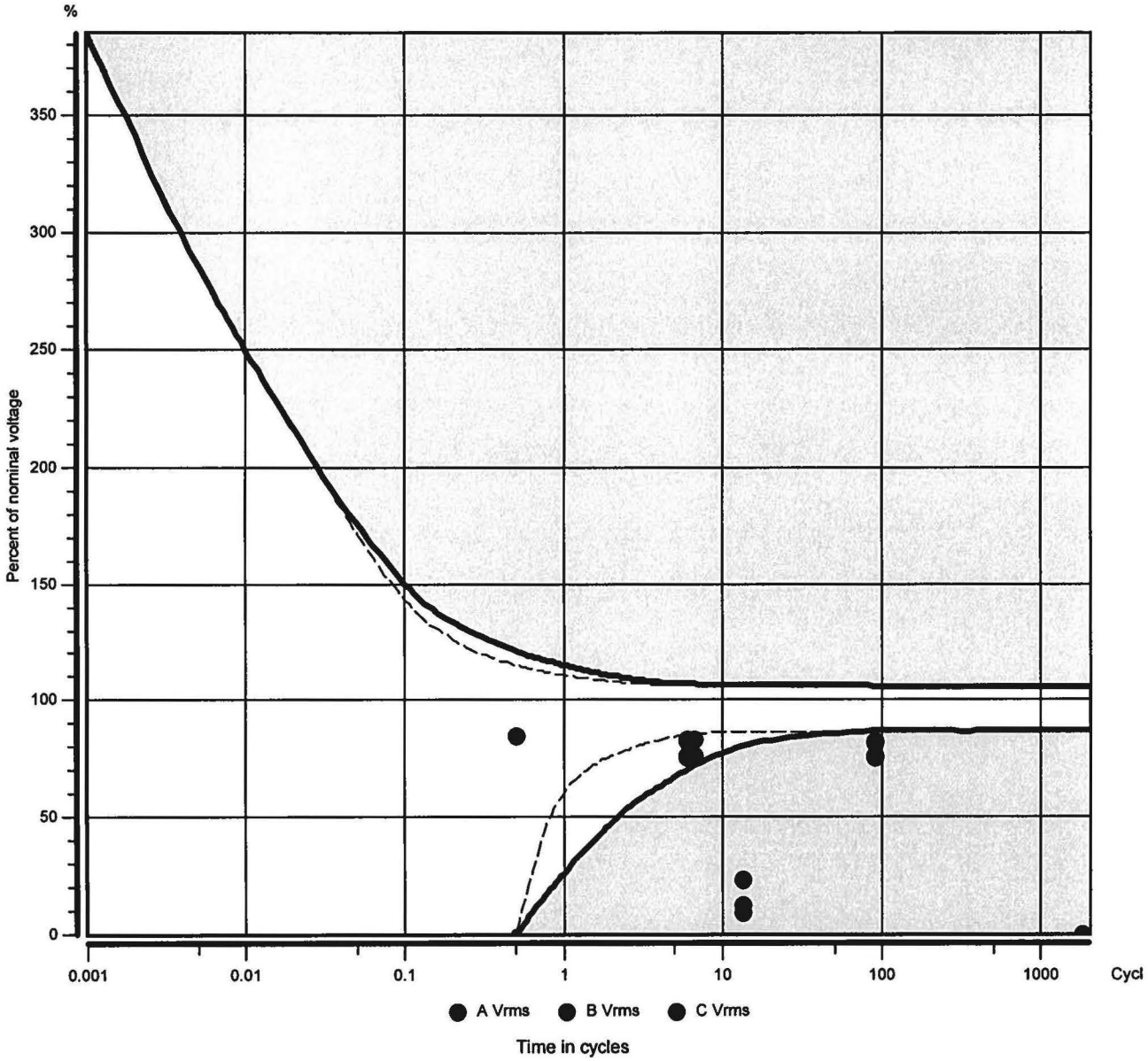
Site: CHRIST CHURCH NEW BUILDING GEAR

Measured from 06/15/2018 12:05:00.0 to 06/22/2018 07:05:00.0



MAGNITUDE/DURATION DIAGRAM

Site: CHRIST CHURCH NEW BUILDING GEAR
Measured from 06/15/2018 12:05:00.0 to 06/22/2018 07:05:00.0



TOLERANCE CURVE: CBEMA
Nominal voltage (100%) = 277 V

Variations ABOVE tolerance curve	0
Variations BELOW tolerance curve	10
Variations ABOVE recommendation curve	0
Variations BELOW recommendation curve	16

RVC Events with dUMax >= 5%

RVC Events with dUstationary >= 3%

Instrument Configuration

Dranetz Power Xplorer Configuration

Firmware	Power Xplorer (c) 2009 Dranetz-BMI Jan 10 2011 @ 09:46:34 Ver.: V 4.2, Build: 9, DB ver.: 0
Serial Number	PX50FA152
Site/Filename	CHRIST CHURCH NEW BUILDING GEAR
Measured from	06/15/2018 11:58:14
Measured to	06/22/2018 07:07:44
File ending	OK
Synchronization	Standard A
Configuration	4 WIRE / 3 PROBE (WYE)
Monitoring type	STANDARD PQ
Nominal voltage	277.0 V
Nominal current	357.1 A
Nominal frequency	60.0 Hz
Use inverse sequence	Yes
Using currents	Yes
Characterizer mode	IEEE 1159

Current probes

Chan A	3000XL, RR3035A (Range3), 3000A (Scale=2000.00)
Chan B	3000XL, RR3035A (Range3), 3000A (Scale=2000.00)
Chan C	3000XL, RR3035A (Range3), 3000A (Scale=2000.00)
Chan D	3000XL, RR3035A (Range2), 300A (Scale=200.00)

Voltage scale factors

Chan A	1.000
Chan B	1.000
Chan C	1.000
Chan D	1.000

Current scale factors

Chan A	1.000
Chan B	1.000
Chan C	1.000
Chan D	1.000

Trigger Response Setups

Summary Pre-trigger cycles	6 cycles

Summary Post-trigger cycles IN-TO-OUT 6 cycles
Summary Post-trigger cycles OUT-TO-IN 6 cycles
Waveform Pre-trigger cycles 2 cycles
Waveform Post-trigger cycles 2 cycles

Trigger-channel	Saved waveforms Va	Vb	Vc	Vd	Ia	Ib	Ic	Id	AB	BC	CA
Volts A	Va	Vb	Vc	-	Ia	Ib	Ic	-	-	-	-
Volts B	Va	Vb	Vc	-	Ia	Ib	Ic	-	-	-	-
Volts C	Va	Vb	Vc	-	Ia	Ib	Ic	-	-	-	-
Volts D	-	-	-	Vd	-	-	-	-	-	-	-
Amps A	-	-	-	-	Ia	-	-	-	-	-	-
Amps B	-	-	-	-	-	Ib	-	-	-	-	-
Amps C	-	-	-	-	-	-	Ic	-	-	-	-
Amps D	-	-	-	-	-	-	-	Id	-	-	-
Volts A-B	-	-	-	-	-	-	-	-	-	-	-
Volts B-C	-	-	-	-	-	-	-	-	-	-	-
Volts C-A	-	-	-	-	-	-	-	-	-	-	-

Timed waveform savings: NOT active
After recording: REARM

Limit Setups

Voltages							
RMS High:	304.7	304.7	304.7	0.0	0.0	0.0	0.0
RMS Low:	249.3	249.3	249.3	0.0	0.0	0.0	0.0
RMS Very Low:	27.7	27.7	27.7	0.0	0.0	0.0	0.0
Crest:	588.6	588.6	588.6	0.0	0.0	0.0	0.0
Wave:	55.4	55.4	55.4	0.0	0.0	0.0	0.0
DC:	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEG:	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WAVE Window Mag:	55.4	55.4	55.4	0.0	0.0	0.0	0.0
WAVE Window Dur:	15.0	15.0	15.0	0.0	0.0	0.0	0.0
HF:	461.6	461.6	461.6	0.0	0.0	0.0	0.0

Currents	A	B	C	D
RMS High:	0.0	0.0	0.0	0.0
RMS Low:	0.0	0.0	0.0	0.0
RMS Very Low:	0.0	0.0	0.0	0.0
Crest:	0.0	0.0	0.0	0.0
Wave:	0.0	0.0	0.0	0.0
DC:	0.0	0.0	0.0	0.0
DEG:	0.0	0.0	0.0	0.0
WAVE Window Mag:	0.0	0.0	0.0	0.0

WAVE Window Dur:	0.0	0.0	0.0	0.0
HF:	0.0	0.0	0.0	0.0

Periodic Journal Intervals

Voltage	10.0 minutes
Current	10.0 minutes
Power	10.0 minutes
Harmonics	10.0 minutes
Demand	5.0 minutes, Subintervals/Intervals: 3
Energy	10.0 minutes
Inst. flicker	10.0 minutes
Short term flicker	10.0 minutes
Long term flicker	120.0 minutes
EN50160 compliance	10.0 minutes

Journal Limits

Voltage	VeryHi	High	Low	VeryLo	Sens.	Hyst.	Nom.
RMS_PhAN	332.4	304.7	249.3	221.6	-	-	-
RMS_PhBN	332.4	304.7	249.3	221.6	-	-	-
RMS_PhCN	332.4	304.7	249.3	221.6	-	-	-
CycRMS_PhAN	332.4	304.7	249.3	221.6	-	-	-
CycRMS_PhBN	332.4	304.7	249.3	221.6	-	-	-
CycRMS_PhCN	332.4	304.7	249.3	221.6	-	-	-
FreqHz	-	60.6	59.4	-	-	-	-

Current	VeryHi	High	Low	VeryLo	Sens.	Hyst.	Nom.
RMS_PhA	571.4	464.3	-	-	-	-	-
RMS_PhB	571.4	464.3	-	-	-	-	-
RMS_PhC	571.4	464.3	-	-	-	-	-
CycRMS_PhA	571.4	464.3	-	-	-	-	-
CycRMS_PhB	571.4	464.3	-	-	-	-	-
CycRMS_PhC	571.4	464.3	-	-	-	-	-

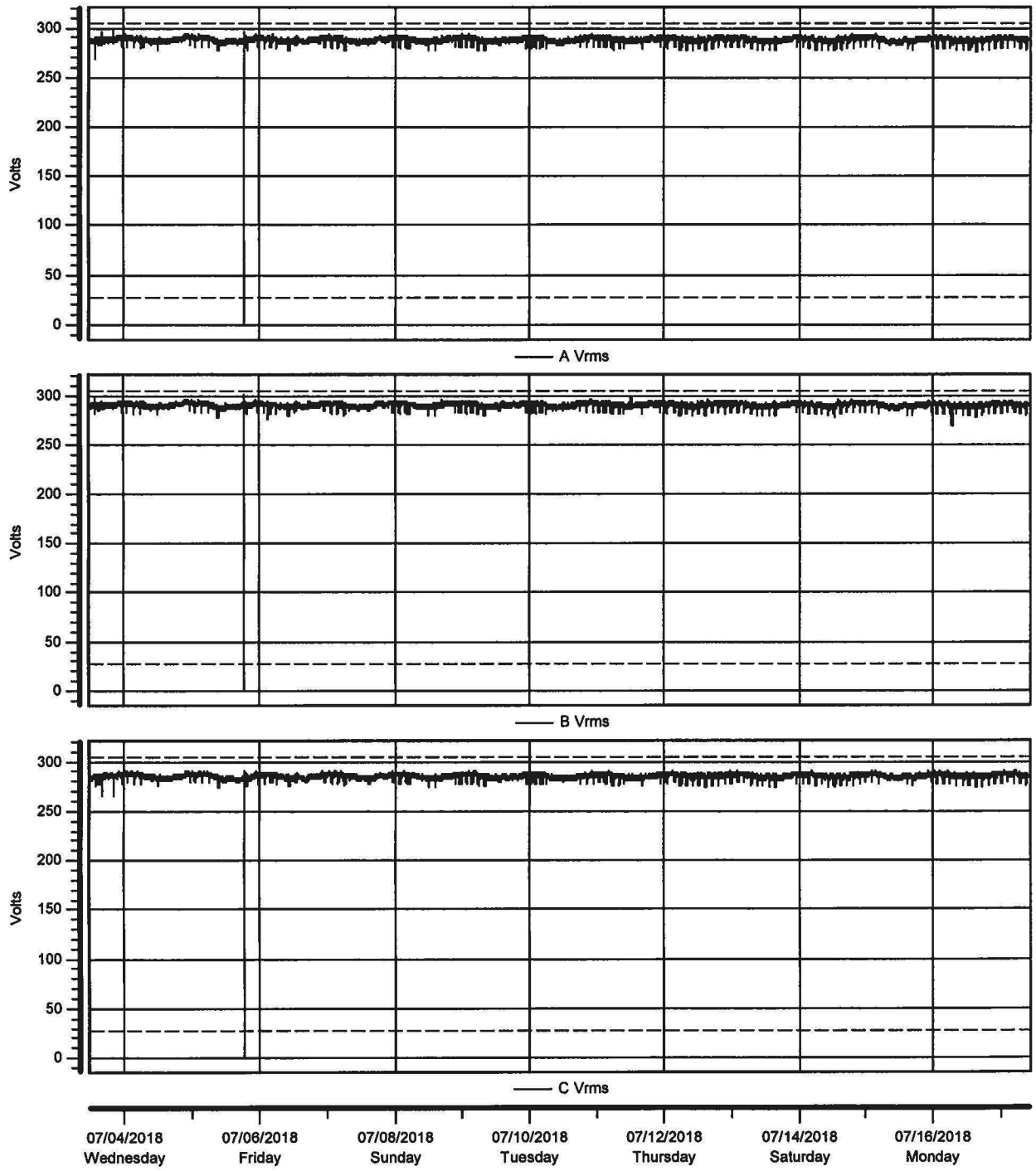
Harmonics	VeryHi	High	Low	VeryLo	Sens.	Hyst.	Nom.
VoltageFundNormTHD_PhA	8.0	5.0	-	-	-	-	-
VoltageFundNormTHD_PhB	8.0	5.0	-	-	-	-	-
VoltageFundNormTHD_PhC	8.0	5.0	-	-	-	-	-

Short term flicker	VeryHi	High	Low	VeryLo	Sens.	Hyst.	Nom.
Pst_PhA	-	1.0	-	-	-	-	-
Pst_PhB	-	1.0	-	-	-	-	-
Pst_PhC	-	1.0	-	-	-	-	-

VOLTAGE TIMEPLOTS

Site: Power Xplorer Site

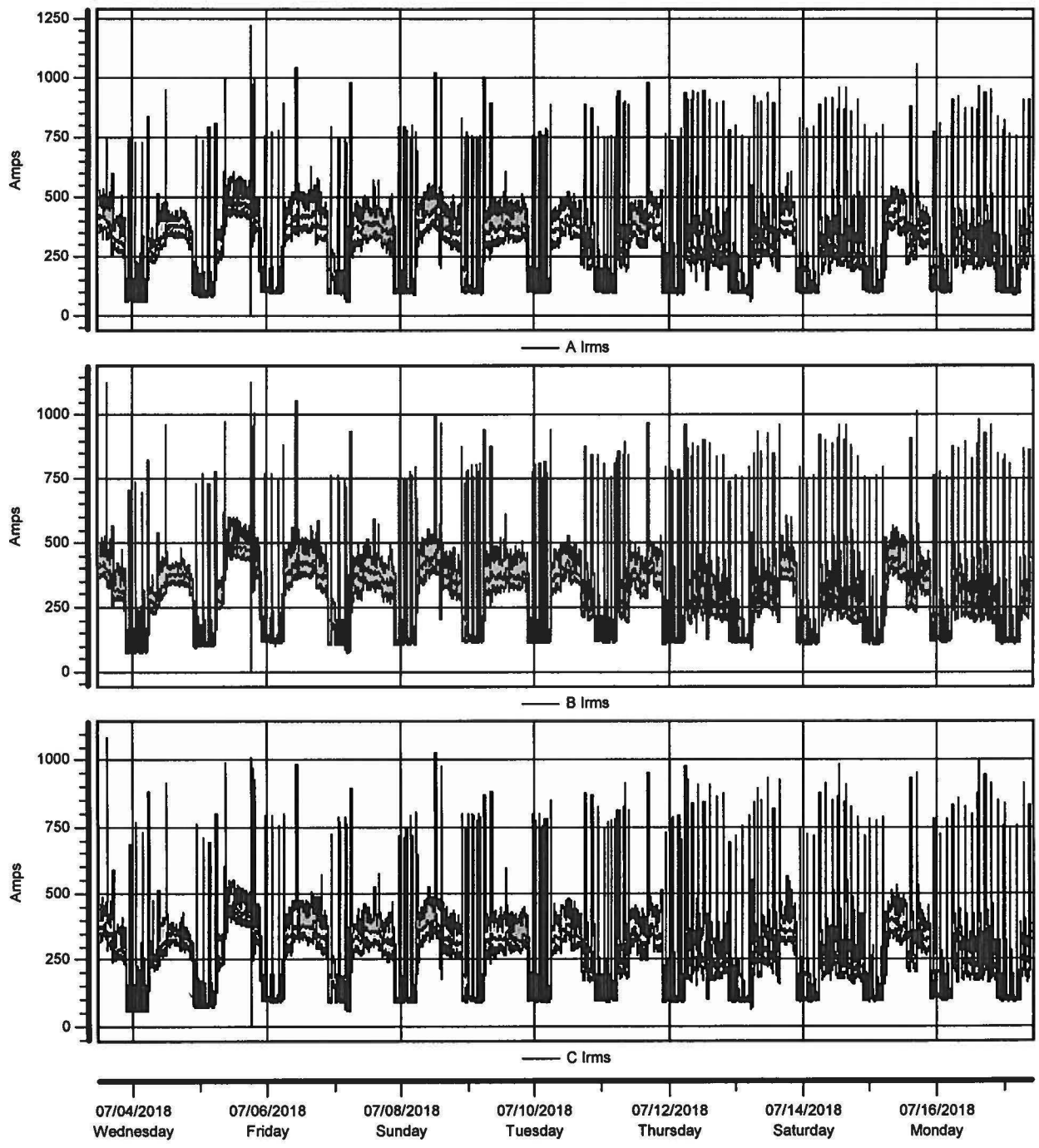
Measured from 07/03/2018 11:50:00.0 to 07/17/2018 10:00:00.0



CURRENT TIMEPLOTS

Site: Power Xplorer Site

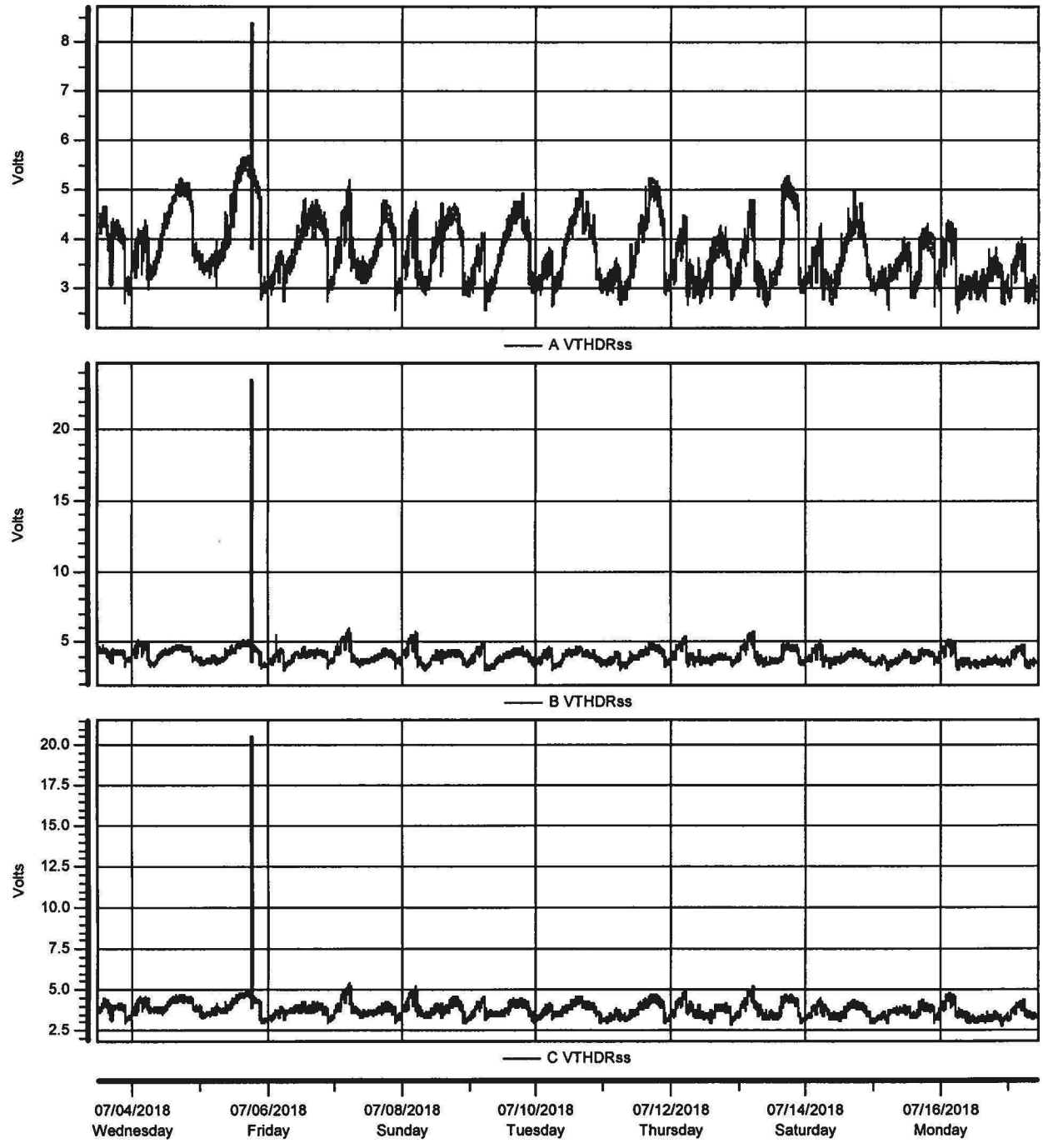
Measured from 07/03/2018 11:50:00.0 to 07/17/2018 10:00:00.0



VTHD TIMEPLOTS

Site: Power Xplorer Site

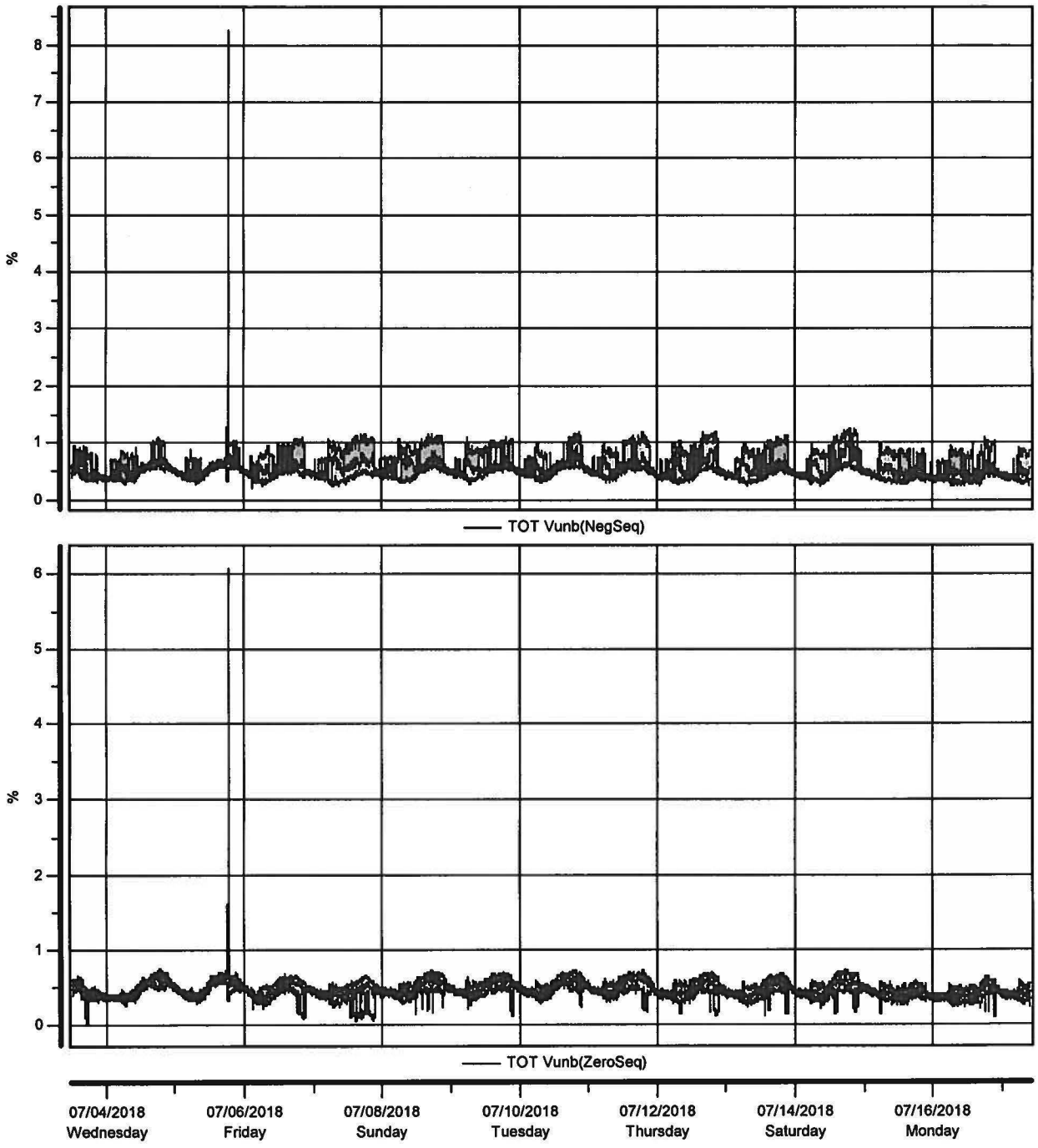
Measured from 07/03/2018 11:50:00.0 to 07/17/2018 10:00:00.0



VOLTAGE UNBALANCE TIMEPLOTS

Site: Power Xplorer Site

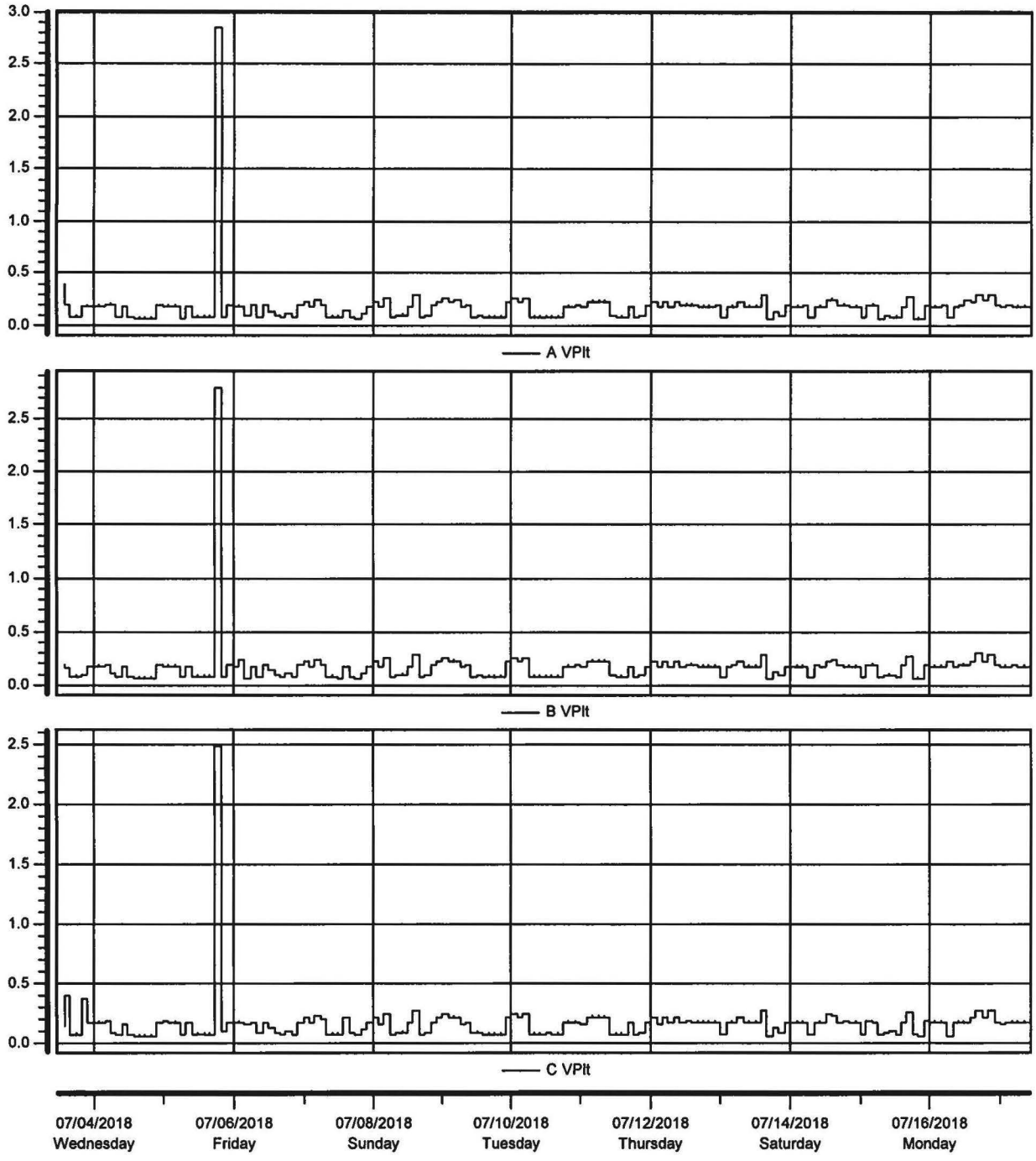
Measured from 07/03/2018 11:50:00.0 to 07/17/2018 10:00:00.0



FLICKER (PLT) TIMEPLOTS

Site: Power Xplorer Site

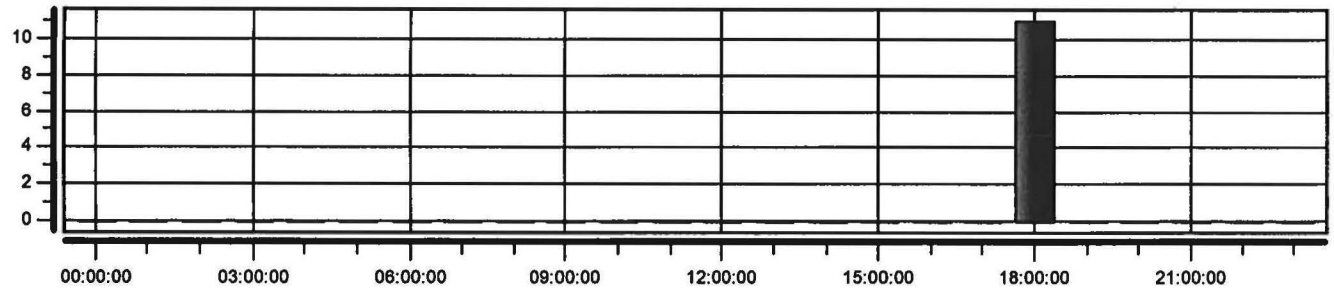
Measured from 07/03/2018 11:50:00.0 to 07/17/2018 10:00:00.0



ACTIVITY PLOTS

Site: Power Xplorer Site
Measured from 07/03/2018 11:50:00.0 to 07/17/2018 10:00:00.0

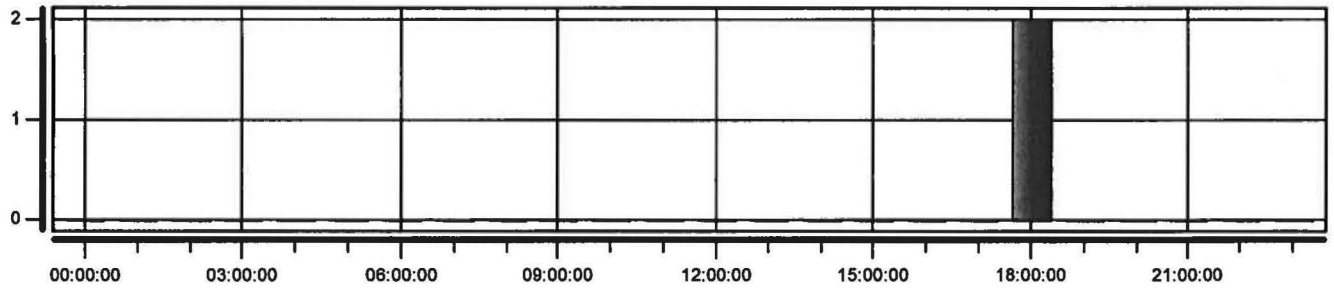
VOLTAGE SAGS



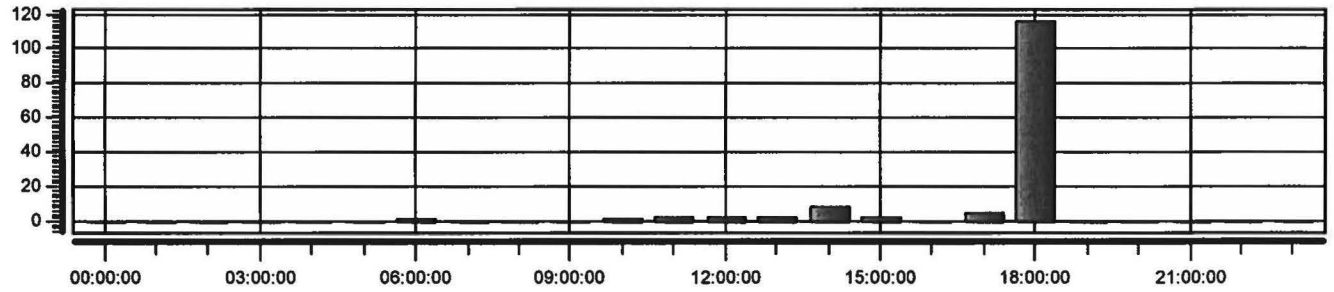
VOLTAGE SWELLS

NO EVENTS WERE FOUND IN THIS CATEGORY

VOLTAGE INTERRUPTIONS



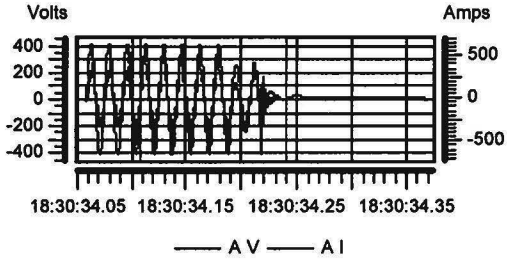
VOLTAGE TRANSIENTS



WORST CASE SUMMARY WAVEFORMS

Site: Power Xplorer Site
Measured from 07/03/2018 11:50:00.0 to 07/17/2018 10:00:00.0

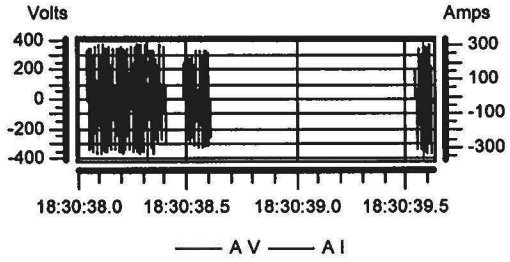
Lowest Magnitude Voltage Sag: Phase A
Instantaneous 8.0V,0.133 Sec., on 07/05/2018 18:30:34.10



Highest Magnitude Voltage Swell:No event

NO WAVEFORM AVAILABLE

Longest Duration Voltage Sag: Phase A
Momentary 178.1V,1.265 Sec., on 07/05/2018 18:30:38.32

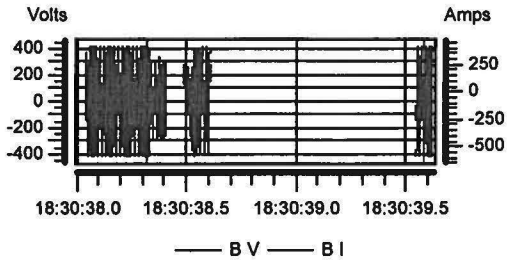


Longest Duration Voltage Swell:No event

NO WAVEFORM AVAILABLE

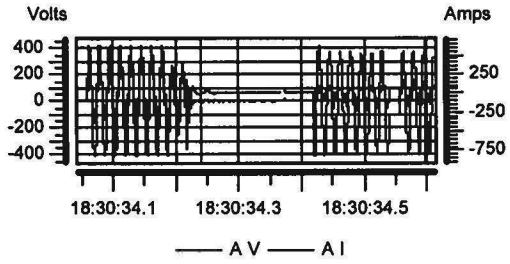
Most Energy Missing Voltage Sag: Phase B event
Momentary 178.1V,1.265 Sec., on 07/05/2018 18:30:38.32

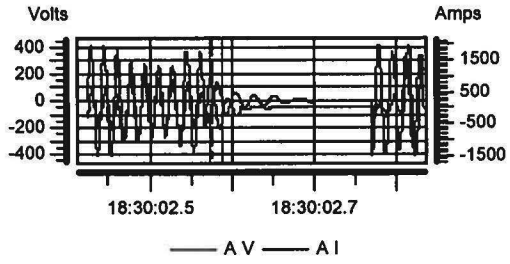
Most Energy Added Voltage Swell:No



NO WAVEFORM AVAILABLE

Longest Duration Voltage Interruption: Phase A
Phase A
Momentary 1.3V,0.357 Sec., on 07/05/2018 18:30:34.24





Largest Magnitude Voltage Transients:

841.3V,0.001 Sec., on 07/05/2018 18:30:02.57

MIN/MAX/AVG SUMMARY REPORT

Site: Power Xplorer Site
Measured from 07/03/2018 11:50:00.0 to 07/17/2018 10:00:00.0

VOLTAGE

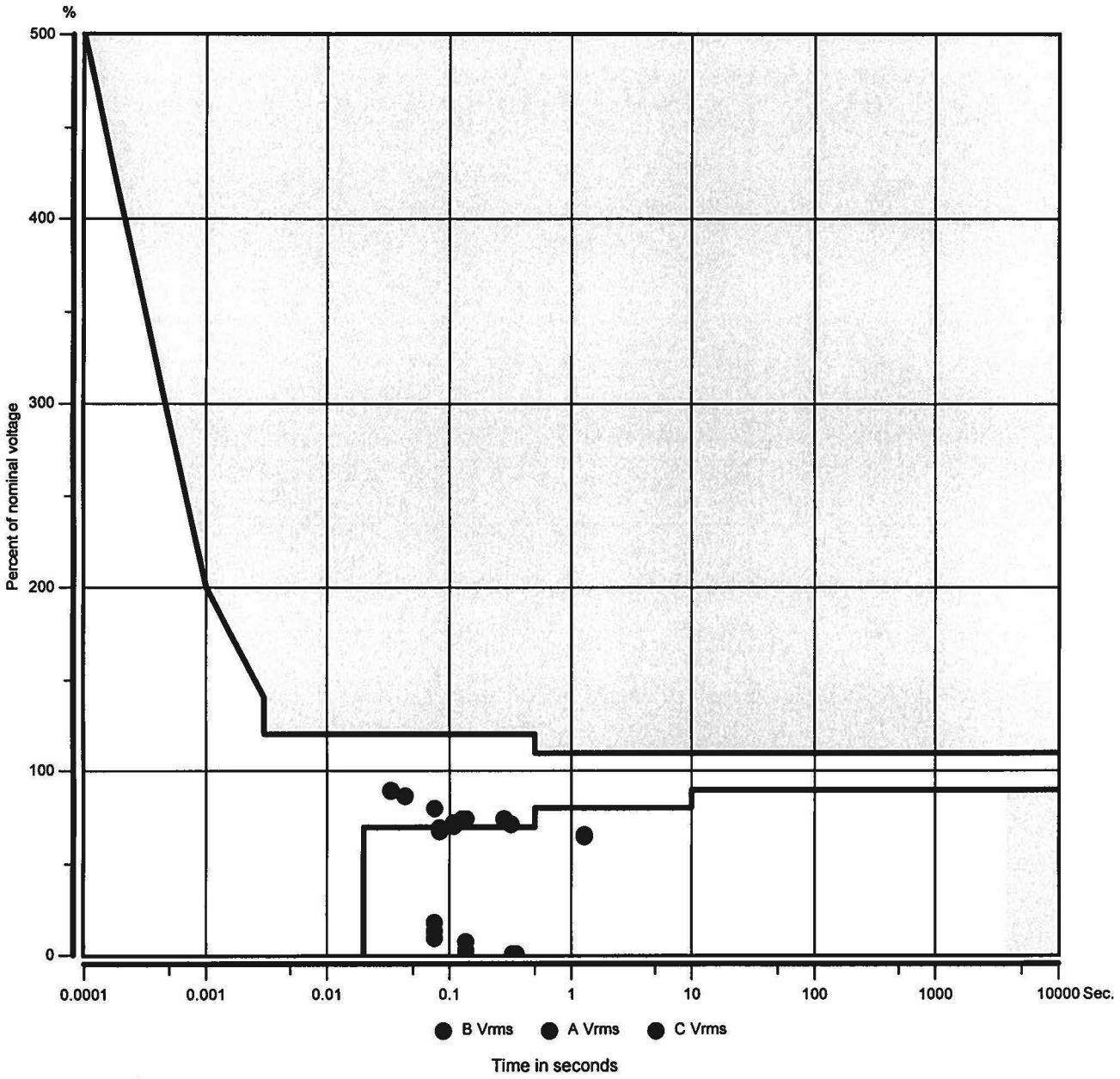
	Channel A	**Channel B**
Min Volts	0.93 on 07/05/2018 18:40:00	1.27 on 07/05/2018 18:40:00
Max Volts	297.35 on 07/03/2018 20:20:00	301.12 on 07/05/2018 18:40:00
Median Volts	289.10	291.06
Average Volts	289.16	291.06
	Channel C	**Channel A-B**
Min Volts	1.63 on 07/05/2018 18:40:00	1.0 on 07/05/2018 18:40:00
Max Volts	290.57 on 07/05/2018 18:40:00	515.3 on 07/05/2018 18:40:00
Median Volts	286.13	503.7
Average Volts	286.21	503.7
	Channel B-C	**Channel C-A**
Min Volts	1.4 on 07/05/2018 18:40:00	0.7 on 07/05/2018 18:40:00
Max Volts	508.4 on 07/05/2018 18:40:00	506.4 on 07/05/2018 18:40:00
Median Volts	500.1	496.6
Average Volts	500.2	496.8

CURRENT

	Channel A	**Channel B**
Min Amps	3.8 on 07/05/2018 18:40:00	2.4 on 07/05/2018 18:40:00
Max Amps	1221.7 on 07/05/2018 18:40:00	1131.5 on 07/03/2018 14:50:00
Median Amps	300.8	299.9
Average Amps	276.7	282.6
	Channel C	
Min Amps	1.9 on 07/05/2018 18:40:00	
Max Amps	1088.0 on 07/03/2018 14:50:00	
Median Amps	271.3	
Average Amps	252.5	

MAGNITUDE/DURATION DIAGRAM

Site: Power Xplorer Site
Measured from 07/03/2018 11:50:00.0 to 07/17/2018 10:00:00.0



TOLERANCE CURVE: ITIC
Nominal voltage (100%) = 277 V
Variations ABOVE tolerance curve 0
Variations BELOW tolerance curve 15