CSU 5 MW PV System

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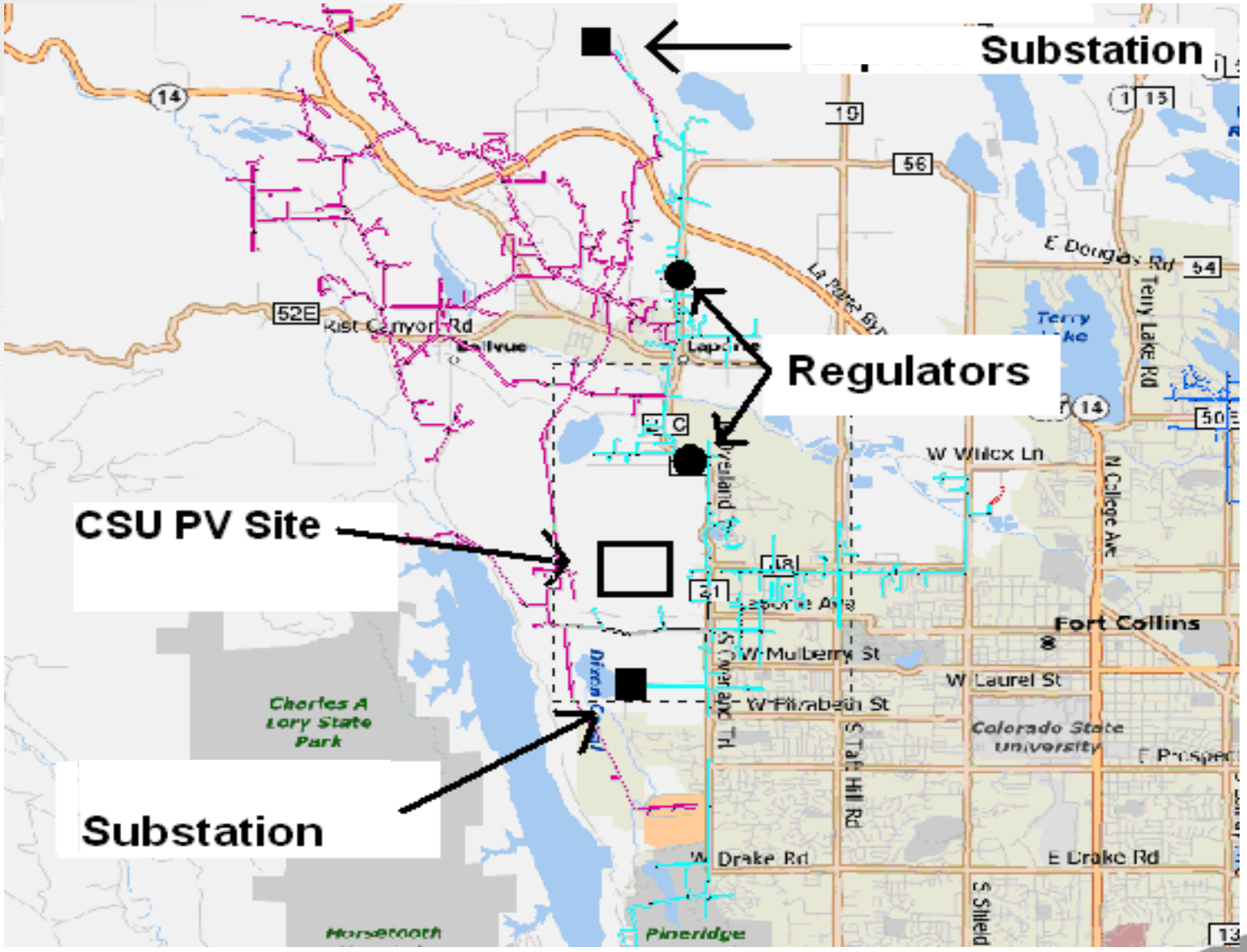
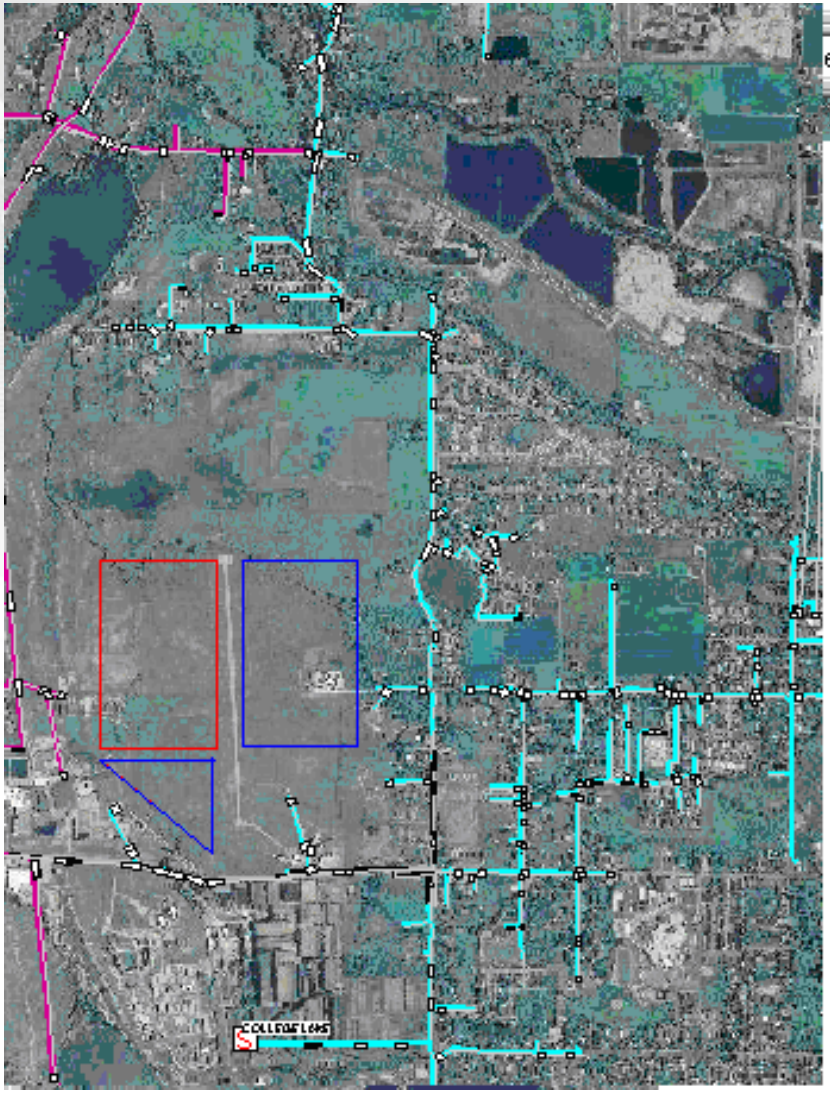
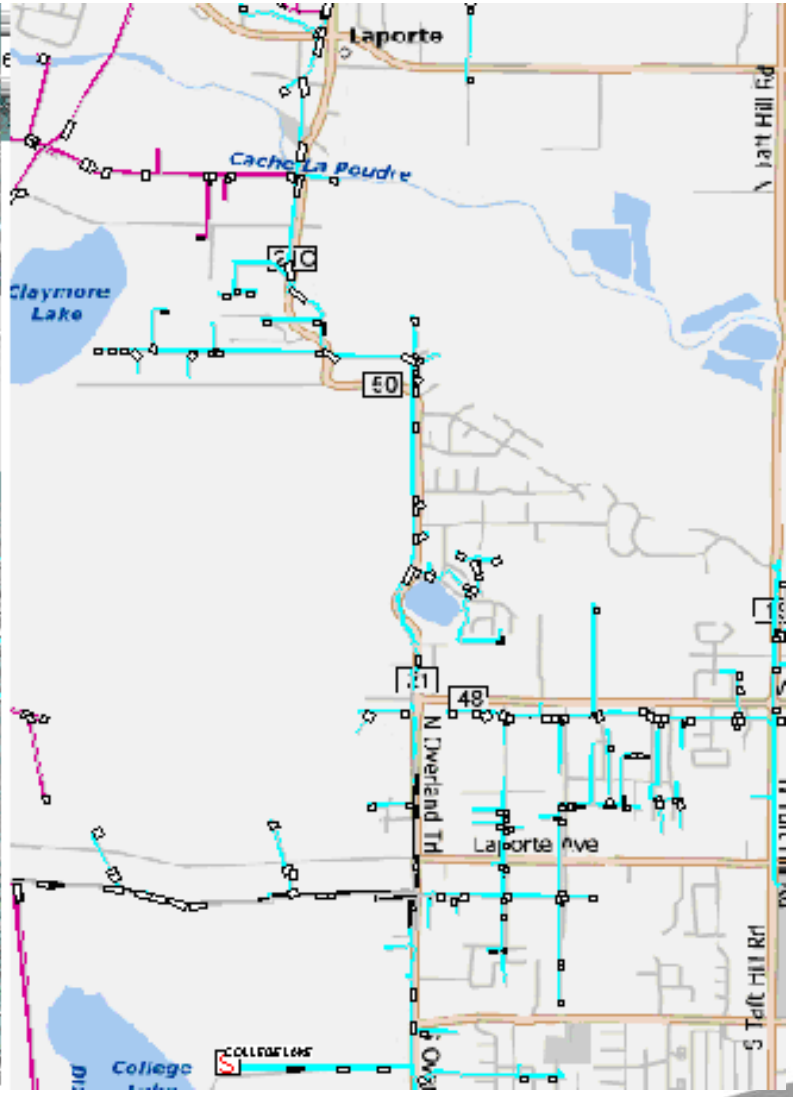
Feeder Layout



CSU PV Site Imagery





Feeder Characteristics

-Penetration Of PV On The Feeder Will Be At 76% During Light Loading Periods In The Fall Season.

-PV Site Is 6.5 Mi. Away From existing Substation.

-Feeder Is Grounded-Wye Configuration @ 13.2kV.

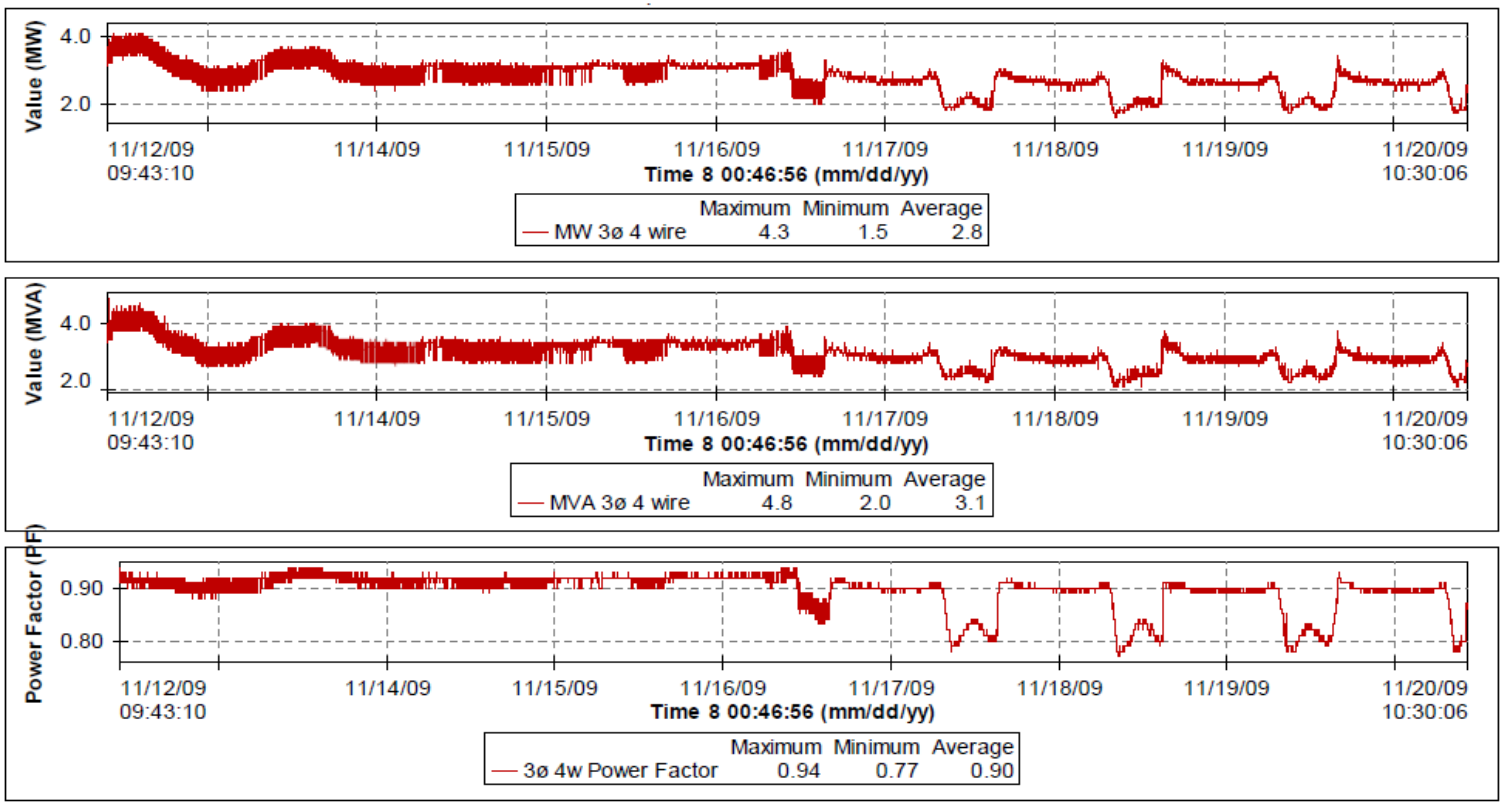
-2 Sets Of 3-Single Phase Bi-Directional Regulators.

-Phase I Of CSU PV Installation Is 2 MW.

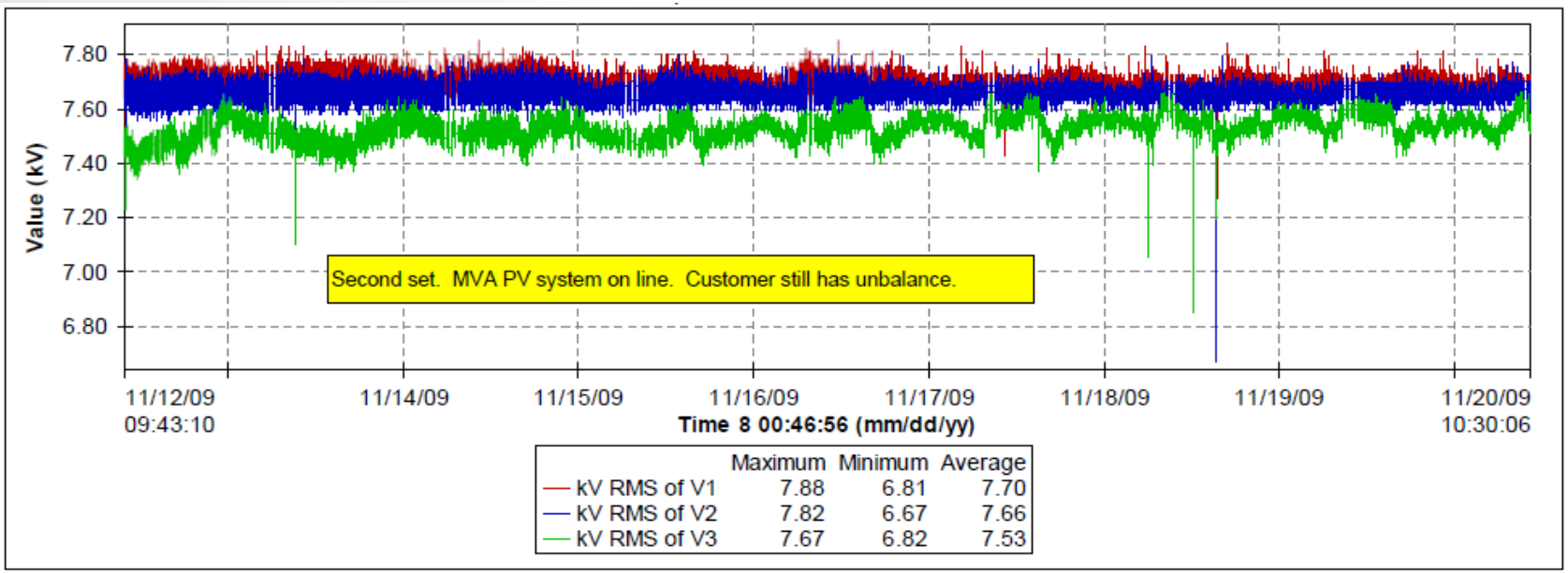
-Phase II Of CSU PV Installation Is 3 MW.

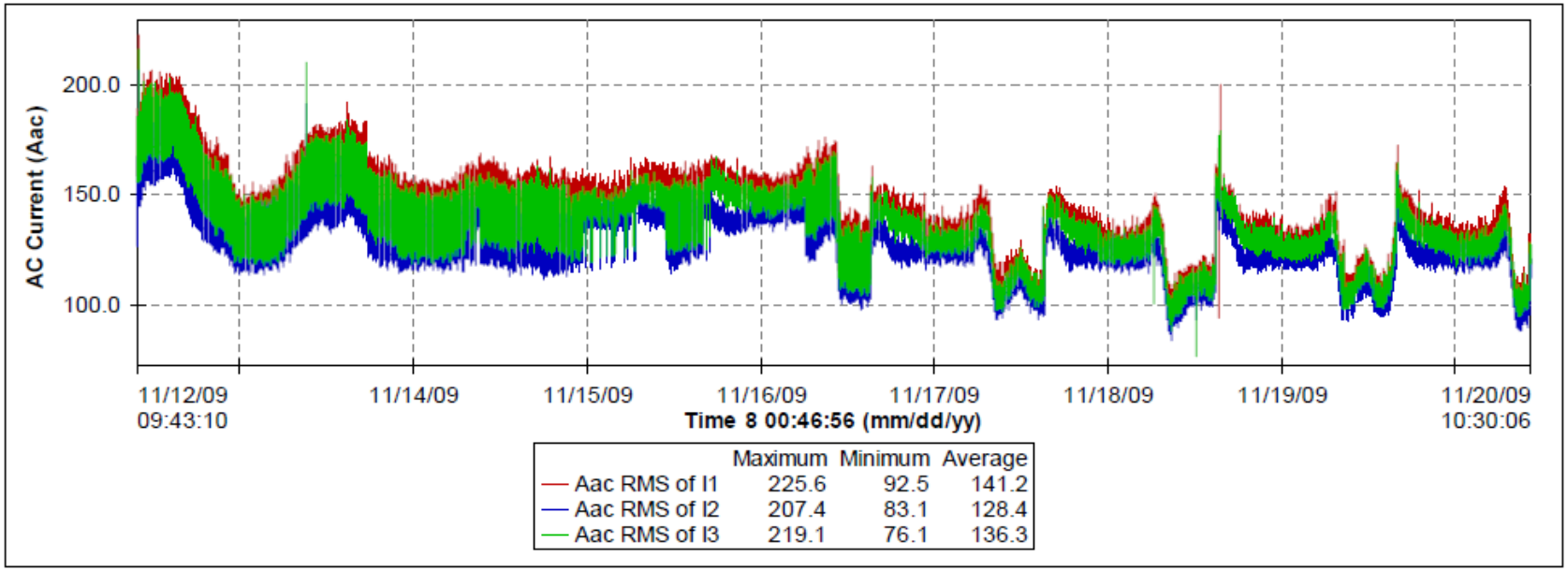
CSU Phase I – 2 MW

CSU Interconnects Phase I In November 2009.



CSU Phase I – 2 MW





CSU Phase I and II - Regulators

-The Regulators Upstream From The PV Site Are Set At A 1V Bandwidth. This Is Due To CSU Operating Their Distribution Circuit As A Delta System From Xcel Energy's Wye-Grounded System.

-The Regulators Were Recorded As Having 250k Operations Due To The 1V Bandwidth.

-The Regulators Also Utilize The Line Drop Compensation Feature To Compensate For Voltage Drop From The Regs To The Primary Metering For CSU.

-No Customer Complaints.

Line Drop Compensation

-The Resistive Element of 336 ACSR = 0.2736 Ohms/Mi.

-328A Regulators Installed On The Feeder.

-The Primary Meter For CSU is 2.362 Mi. From The Regs.

$$V_{Drop} = 328A*(0.2736\ Ohms/Mi. * 2.362\ Mi.) = 212V$$

$$= 212V*(120V/7620V) = 3.338V$$

-Use 3.3V For the R Compensation Component.

(Use The Same Iteration For X Component.)

CSU Phase II – 3 MW

-Phase II To Be Energized on December 3, 2010.

-Xcel Energy Personnel Will Check Voltage Instantaneously in Field To Verify Acceptable Voltage on Feeder Upon Start-Up.

-All Capacitors Will Be Turned Off On The Feeder To Prevent Voltage Rise Exceeding Residential Voltage Limits of ±5%.

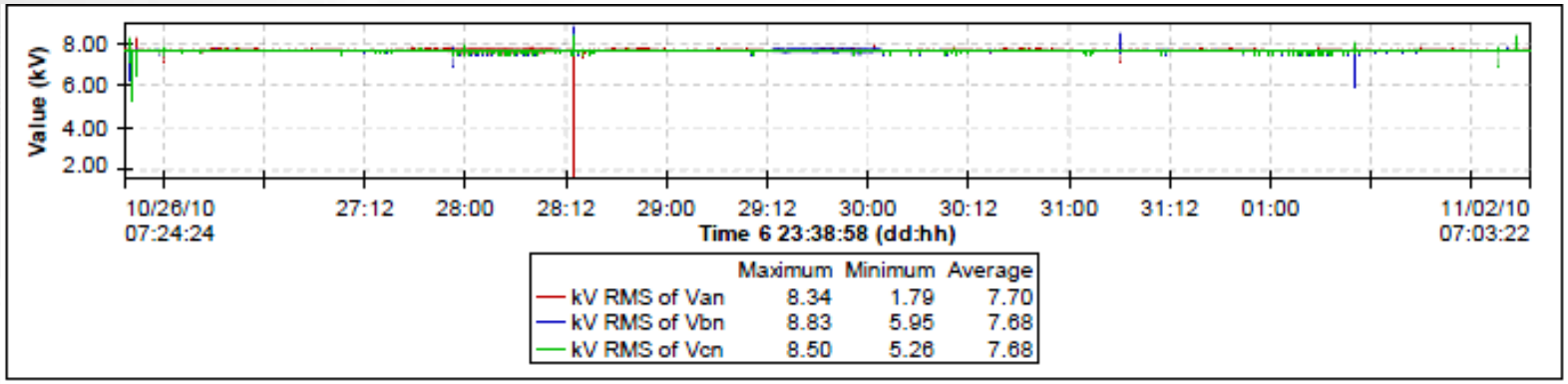
-Power Quality Metering Equipment Will Be Recording The Events Upon Start-Up.

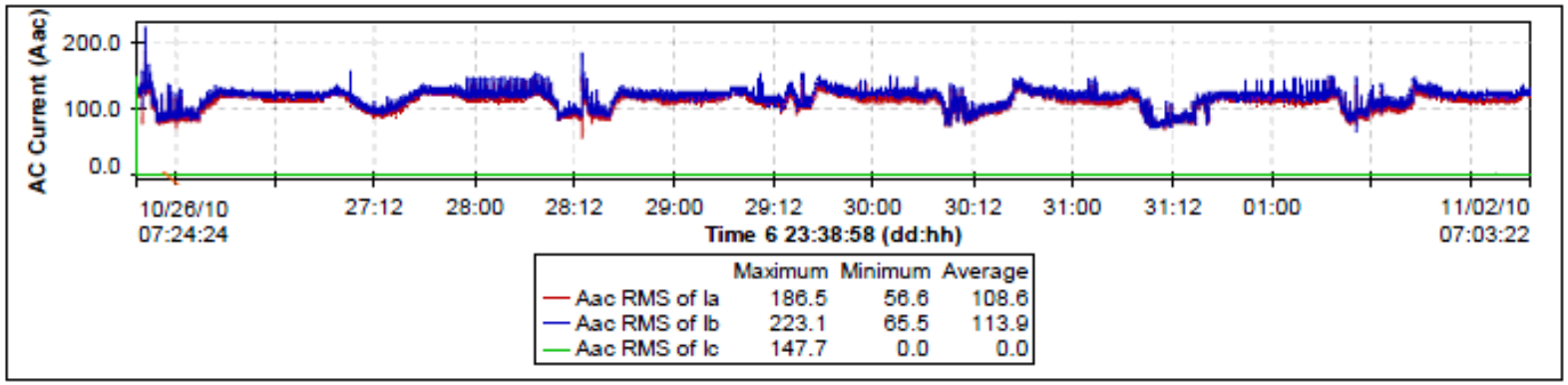
CSU Phase II – 3 MW

- **If Upon-Start-Up Voltage Exceeds Acceptable Limits, Then The Customer Will Be Instructed To Set The 6-500kW Inverters Leading - 100 kVAr For a Total of 600kVar To Compensate For Phase I and Phase II.**
- **If Upon Re-Energization The Voltage Is Not Acceptable, Then The Inverter Settings Will Be Modified To Output 150kVAr Per Inverter For A Total Of 900kVAR Leading.**
- **This Leading Power Factor Will Lower The Voltage On The Feeder As The PV Generation Will Then Absorb VAr's.**

CSU Phase II – 3 MW

Recent Power Quality Data To Verify That There Are Not Any Existing Problems On the Feeder.





Questions?