NYSERDA / DOE ENERGY STORAGE
DEMONSTRATION PROJECTS

EnerNex
CORPORATION

ENERGY STORAGE

Demonstration Projects

Prepared for

NYSERDA / DOE

Sandia National Laboratory
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Third Quarter 2009
July Through September 2009

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Introduction

The third quarter of 2009 saw normal operation of the bus terminal and the refueling operations. The battery system operated as expected, supplying energy to the refueling compressors during the day and recharging at night. The intended operation is to offset the use of commercial energy during the day when the price is high, replacing that with nighttime electricity use.

The time-of-use electricity rates charged to the bus refueling terminal are intended to encourage displacing peak-time energy use to non-peak-time. Electric rates with a time-of-use feature are intended to encourage customers to shift electric use to the nighttime hours. In operations that cannot actually postpone activity until nighttime, using the energy storage technology effectively does the same thing. The electric energy is purchased during the off-peak period and stored for use the next day during the on-peak price period.

The normal off-peak time period for Long Island Power is from 11 PM to 7 AM[1], an appropriate nighttime period. The system operational mode reported by the battery system shows that the system charges the battery from midnight to 10 AM and discharges the battery from 2 PM until 10 PM. The battery system duty cycle is therefore twelve hours of charge and ten hours of discharge. The discharge hours reported mean that the battery energy is available for operating the gas compressors. The battery does not actually discharge during all of that time; the energy is simply made available for operating the gas compressors.

Operation

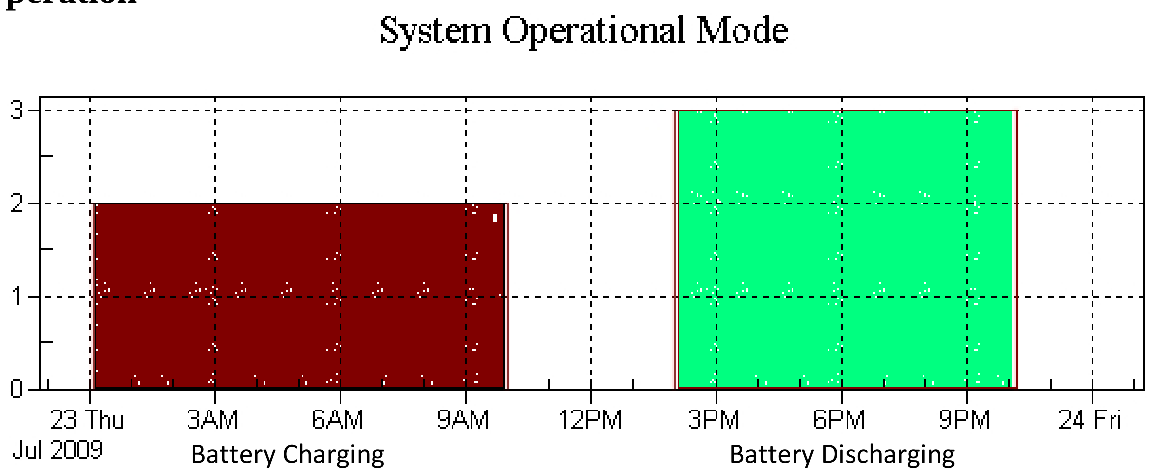

Figure 1 – The operational mode of 2 indicates battery charge and a mode of 3 indicates battery discharge mode.

The utility off-peak period of only eight hours does not match the duty cycle of the battery system of ten hours of charging. Some of the battery charging is done with on-peak utility energy. The battery charging/discharging cycle is a function of the battery system. If the charging period was shortened to match the utility off-peak cost period exactly (eight hours), the discharge available period would have to be shortened as well. The present arrangement could be improved if the charging cycle were moved up to start at 11 PM, when the rate changes to off-peak, rather than waiting until midnight. If the entire charging cycle were moved that one-hour difference, the one-hour on-peak purchase would be changed to a one-hour off-peak purchase. The present pricing differential between on-peak and off-peak energy is 1.7 and the utility predicts that will change to 3.0 to 5.0 in order to encourage customers to shift load from on-peak to off-peak times. Moving the charging period by one hour would save about $33 per day in

[1] Yan Kishinevsky, New York Power Authority, *US DOE PEER REVIEW* report, 3 November, 2006

energy charges and more in the demand charge, or in excess of $1,000 per month today and perhaps twice that in the future.

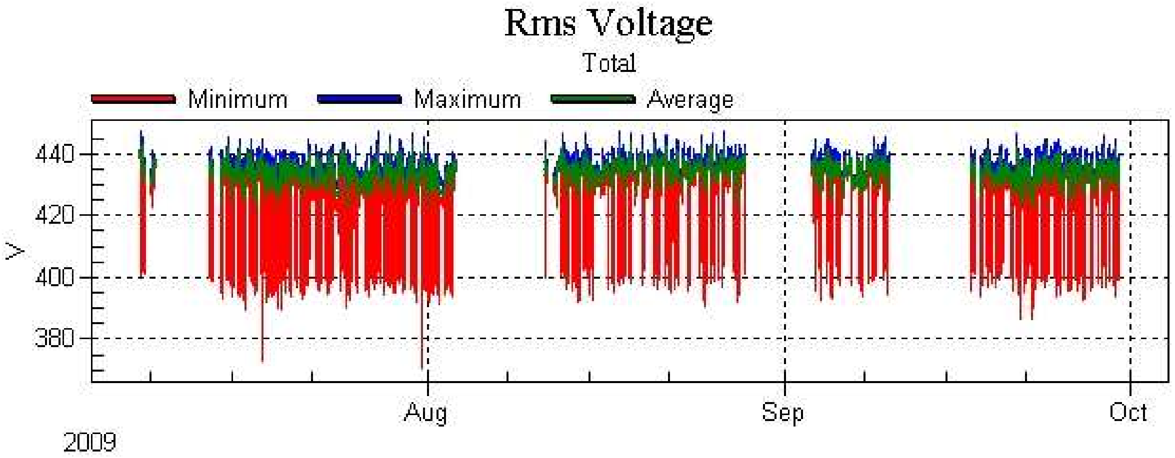

Figure 2 - Utility voltage during the period July - September 2009.

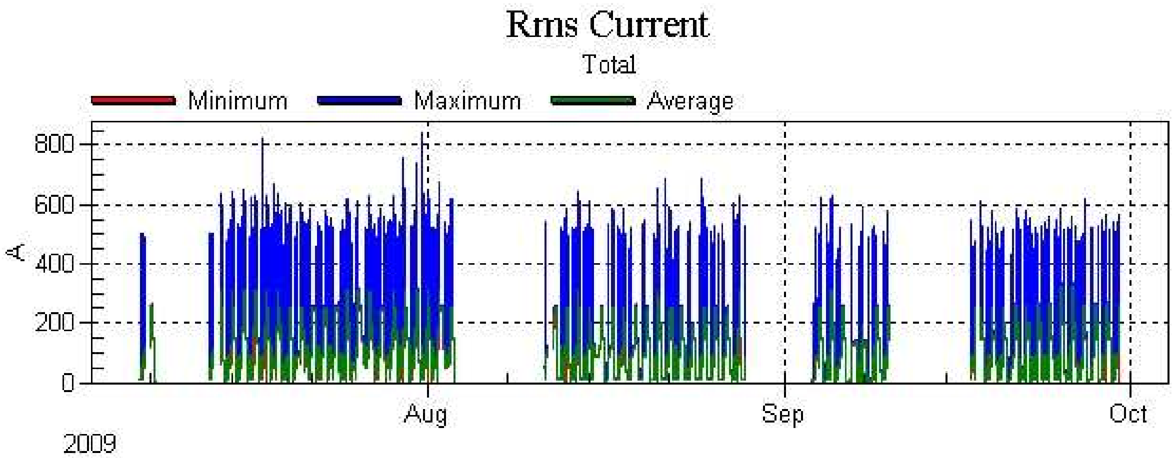

Figure 3 – Current drawn from the utility during the period.

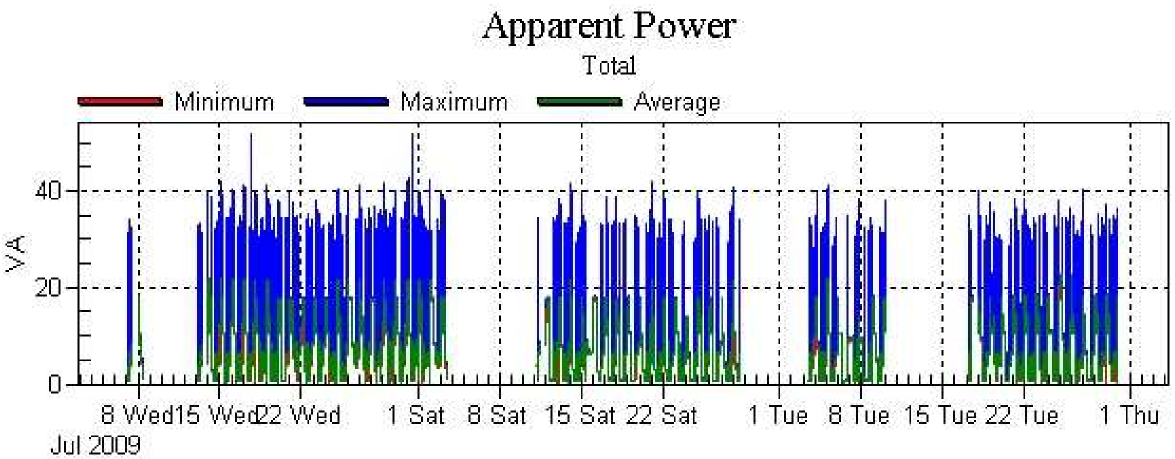

Figure 4 – The kilovolt-amps drawn from the system. Apply a multiplier of 10,000 to convert to kVA.

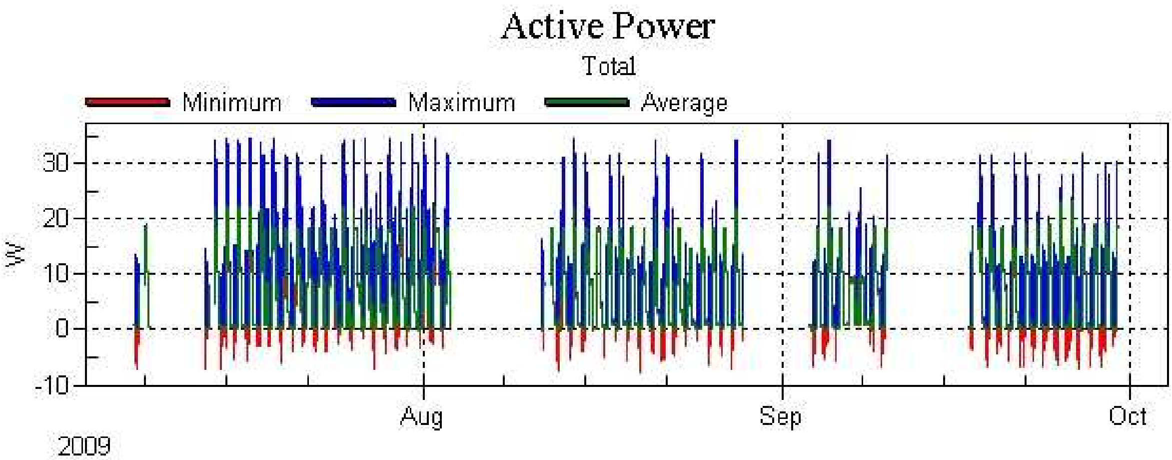

Figure 5 – The kilowatts delivered to the system. Multiply by 10,000 to convert to kW.

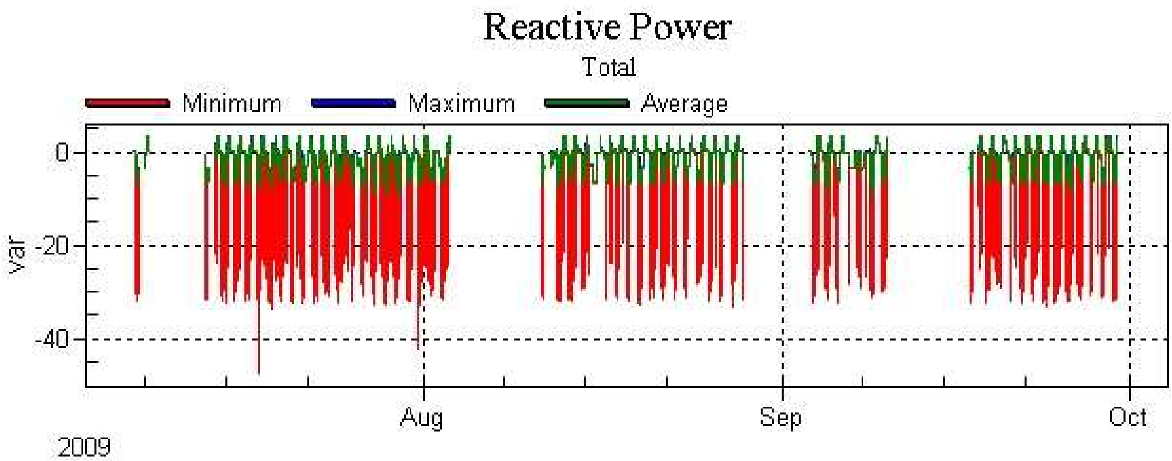

Figure 6 – Vars

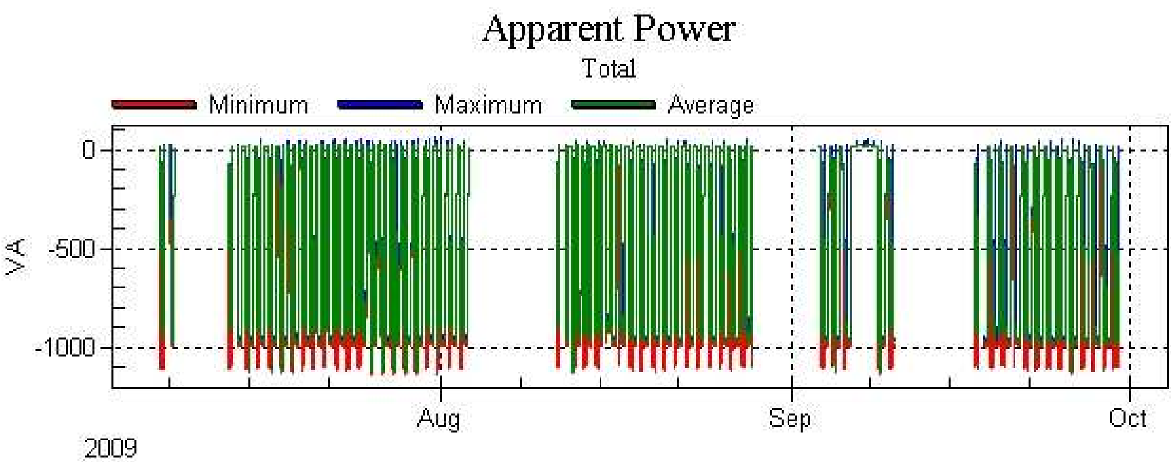

Figure 7 – Battery load delivered by the battery system.

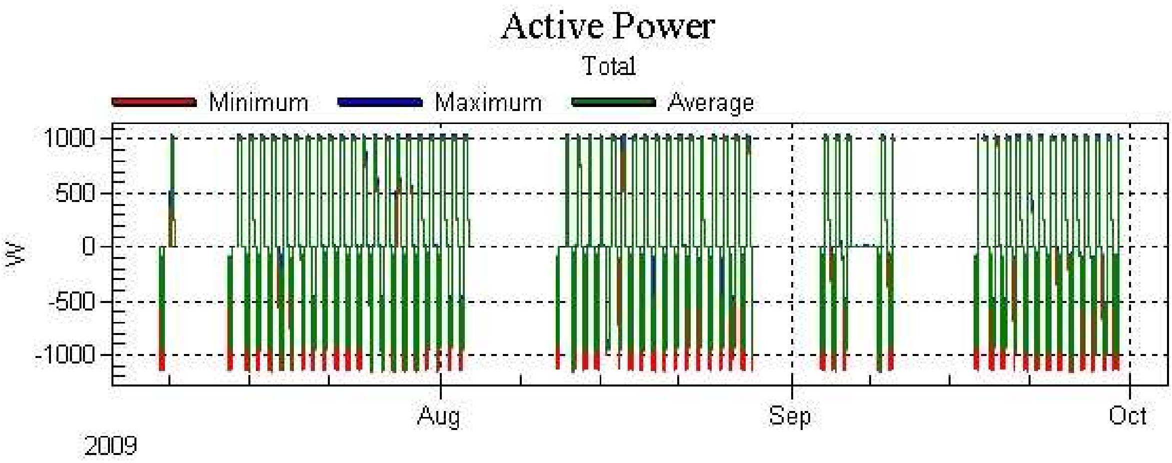

Figure 8 – Watts at the battery system. The daily charge/discharge cycles are clearly seen.

The Active Power display shows the daily operational cycle very well. The point of view for this instrumentation is the battery power conditioning system, or PCS. The positive power is directed into the battery and is electronically limited to 1000 kilowatts. The system charges at that rate for much of the charging period. On some days, the charging rate tapers off during the later hours of the period.

The negative power shown is the power demanded from the battery to be supplied to the compressors. That current is also electronically limited, and it is programmed to allow a short discharge of 1200 kilowatts.

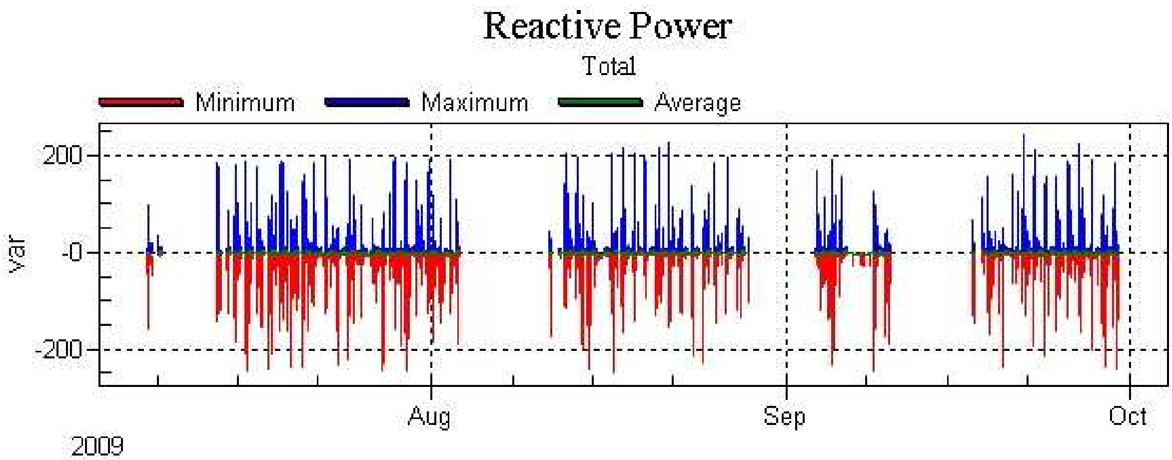

Figure 9 – Vars at the power conditioning system.

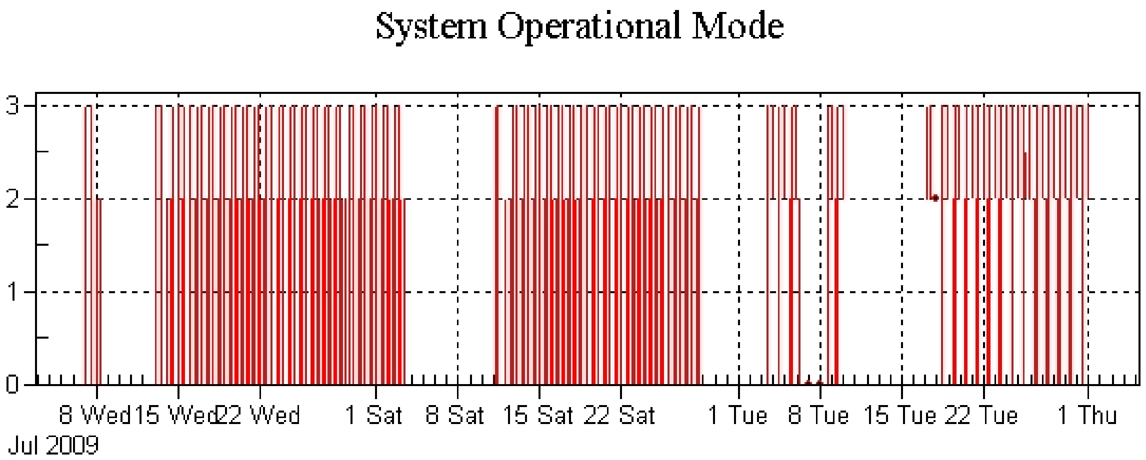

Figure 10 – The System Operational Mode recording shows that the system cycles through the shutdown – charge – discharge sequence every day. 0=shutdown, 1=standby, 2=charge, 3=discharge.

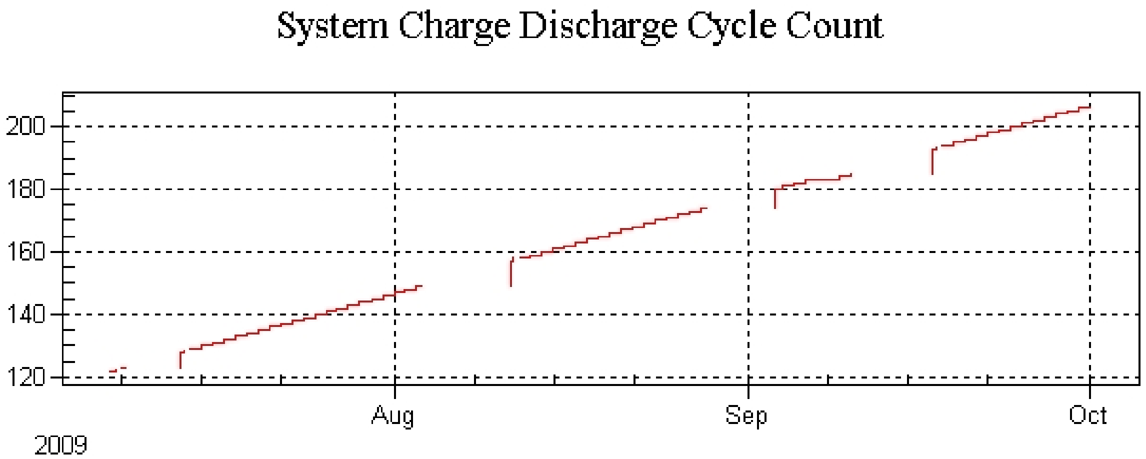

Figure 11 – The steady increase in the charge-discharge cycle count suggests that the system operated during the periods that no data was recorded.

The abrupt jump in the count shown at the end of the gaps indicates that the data collection service was off during the gap and reported the previous count as soon as the service was turned back on. The next report, five minutes later, shows that the discharge count was updated. The counter is incremented at the conclusion of a discharge cycle, scheduled to occur each day at noon.

The data here is from the website. The data provided to the website for presentation comes from the ABB data collection system which monitors the rectifier/inverters or the Power Conditioning System (PCS) system. The data gaps indicate periods during which the data collection system was not gathering data, not necessarily periods when the equipment was not operating. Ordinarily, this is due to a computer halt at the collection site.

The communications system between the data collection system and the website is important, but not critical. The website gathers data from the data collection system periodically during each day and retries if the communications system indicates a problem. No data is lost because of communications errors.

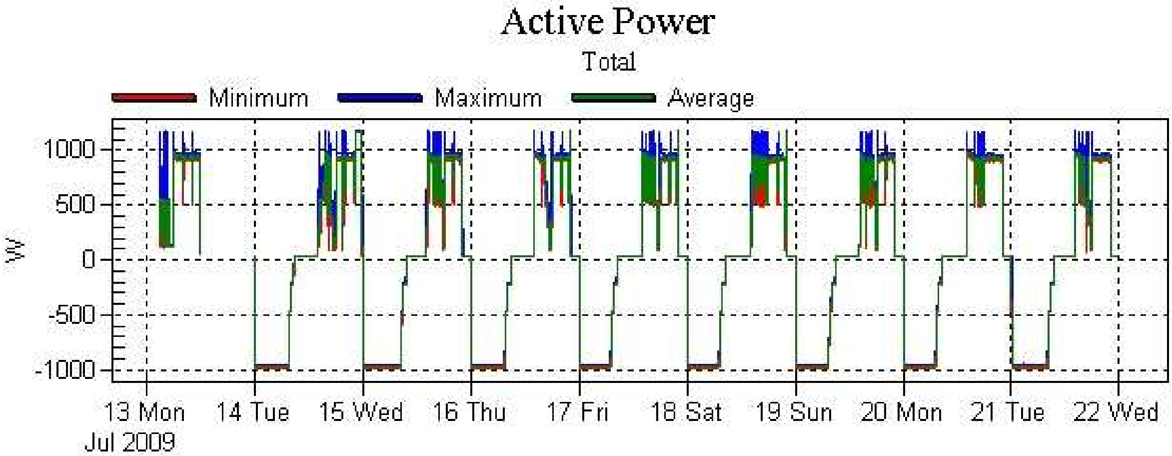

Figure 12 – Typical week of operation of the battery system. The battery discharges during the day and recharges at night. While the operation of the compressors varies each day, the charge-discharge cycle is the same day after day.