PEM Fuel Cell Power Generation System (PV Demo Site at IIT)

IPRO-016

Team Members

- Faculty Advisor
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- Other Advisors
  - Dave Osowski, V.S. Donepudi, Brian Gahan, Said Alhallaj, and Kurt Uhlir
- Students
  - Jeom-Soo Kim, Seun Solesi, Tim Hadley, Elias Kyriakides, Peter Kelly, Mobolaji Durodola, Alexis Hadley, Jochen Schafer, Junaid Akhtar Khan, and Richard Buck

Sponsors

- Com-Ed
- Solarex
- Alcad
- IIT
  - Undergraduate college
  - Armour College
  - ChEE Dept.
  - Office of External Affairs
  - Facilities

“Big Picture” Goals

- Promote renewable energy
  - Demonstrate the application of solar energy in a high tech integrated (hybrid) system
  - Create interest and initiate contact with the industry
  - Initiate contacts with the local community and search for applications of this technology in future community-oriented projects
  - Give IIT students an opportunity to get hands-on experience with these future technologies

Fall 99’ Semester Goals

- Coordinate Sign Installation
- Configure System Reliability
- Organize Data
- Prepare for the Fuel Cell

Introduction

- Areas of Investigation
  - Hardware
  - Battery and System Operation
  - Sign Installation
  - Data Organization
- Conclusion
- Future
- Questions?

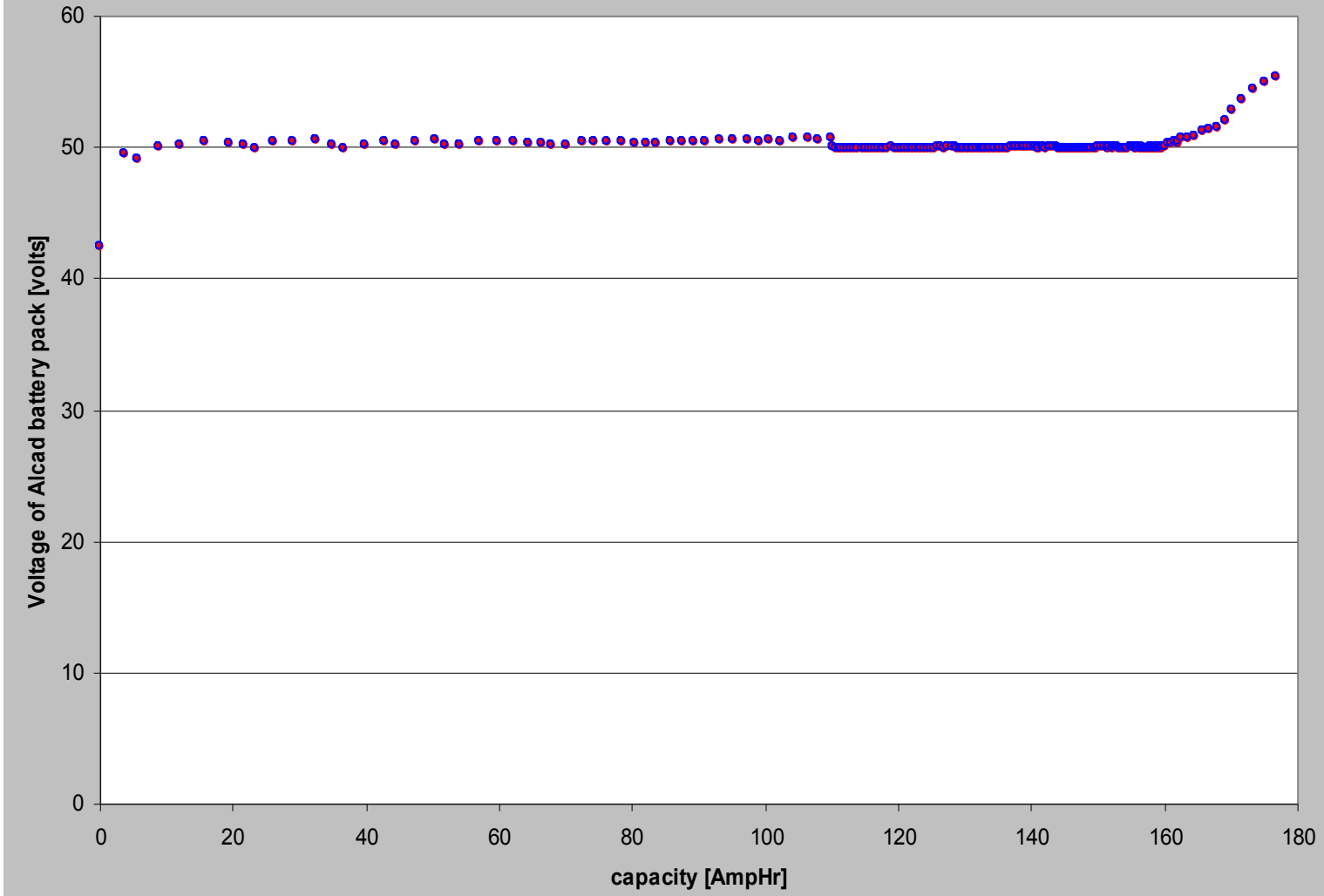
Hardware

- Goals
  - Bring Inverter On-line
  - Assess Damage of Solar Panels

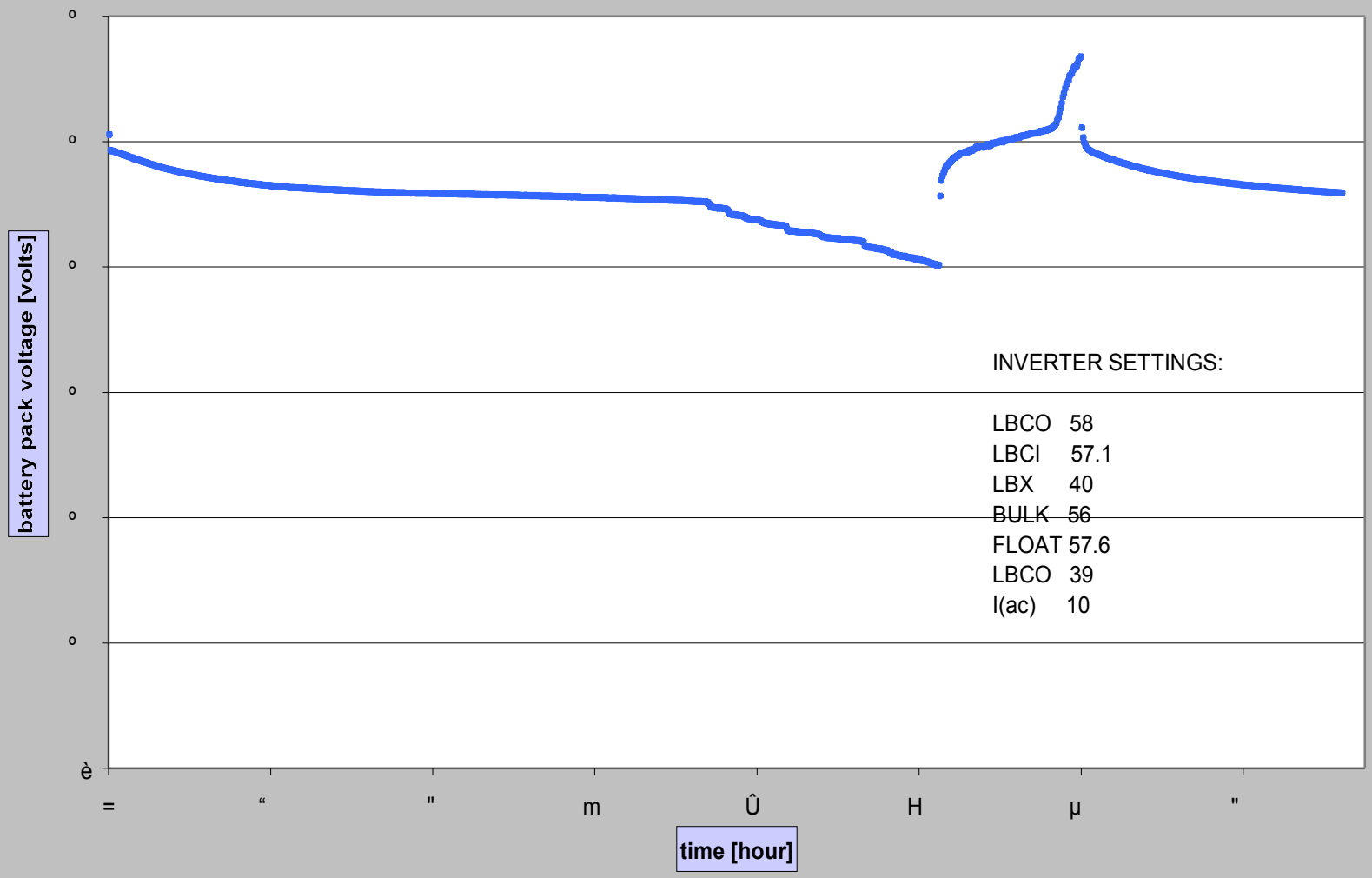
Hardware (continued)

- Inverter Operation
  - Battery Protection
    - Discharge Protection
    - Overcharge Protection
  - Float Control
  - Management Of The System

INVERTER PERFORMANCE TEST:
Alcad Battery bank Charging Characteristics during an inverter charging cycle
Charge Start: 9/29/99 3:10pm



Cycling Behavior of Alcad Battery pack: During Continuous Sign Operation
(inverter controlled charge/discharge cycle)

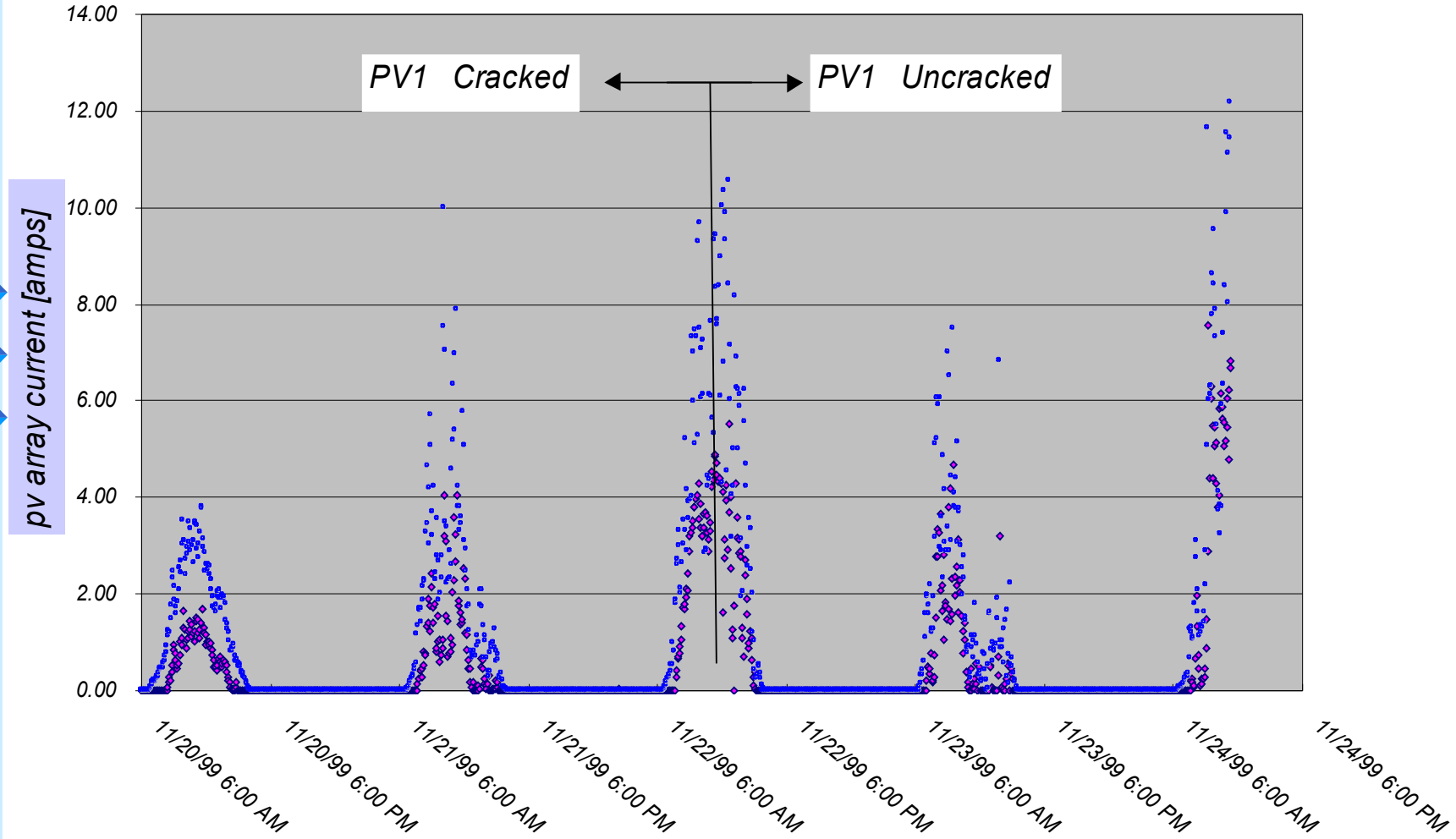


Hardware (continued)

- Solar Panel Damage Assessment
  - Isolate cracked/uncracked panels
  - Compare to fully functional panel array

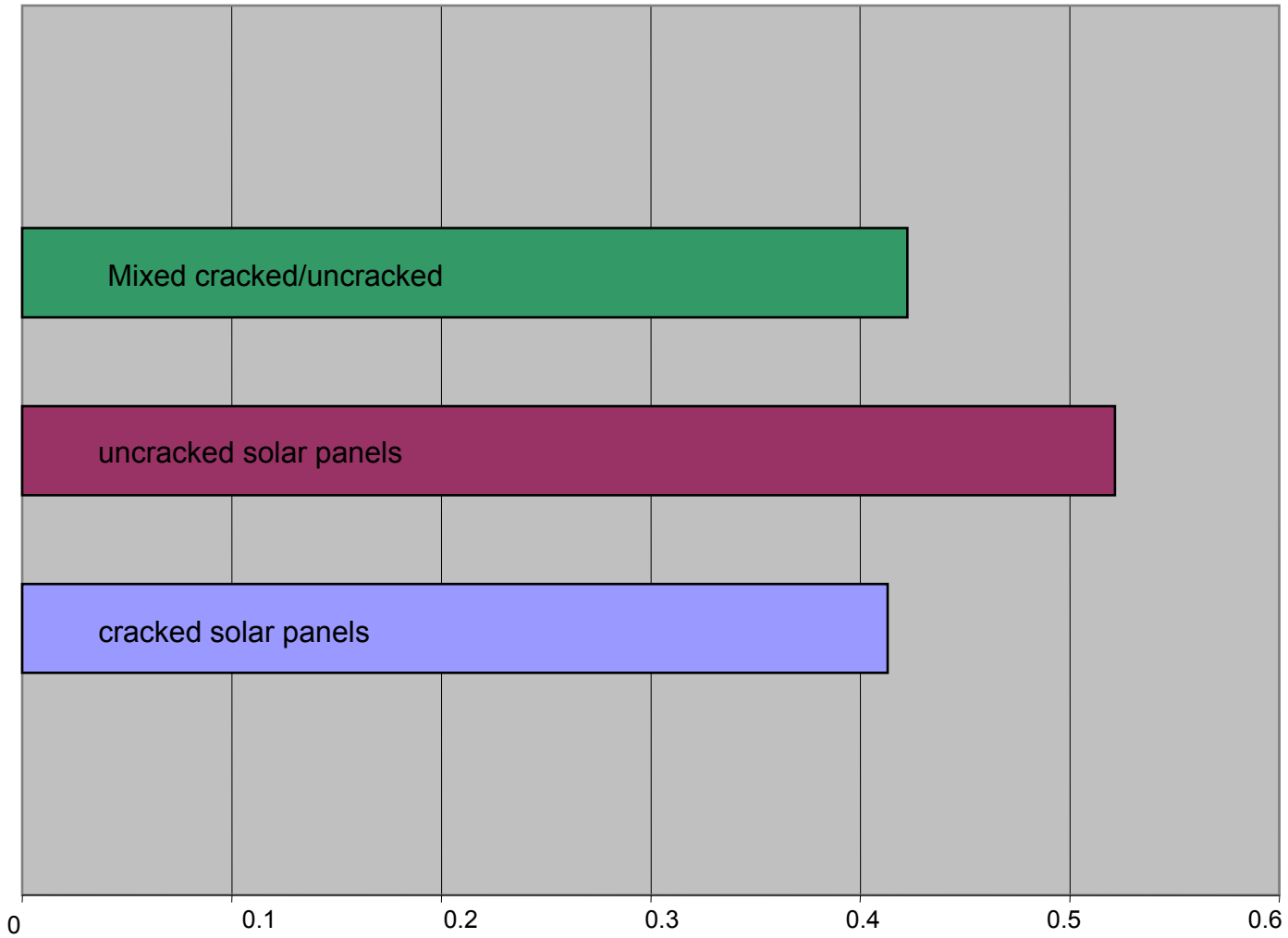
Comparison of Current Production Characteristics

cracked panels vs. uncracked panels



Comparison of Current Production Characteristics

testing completed 11/19/99-11/24/99

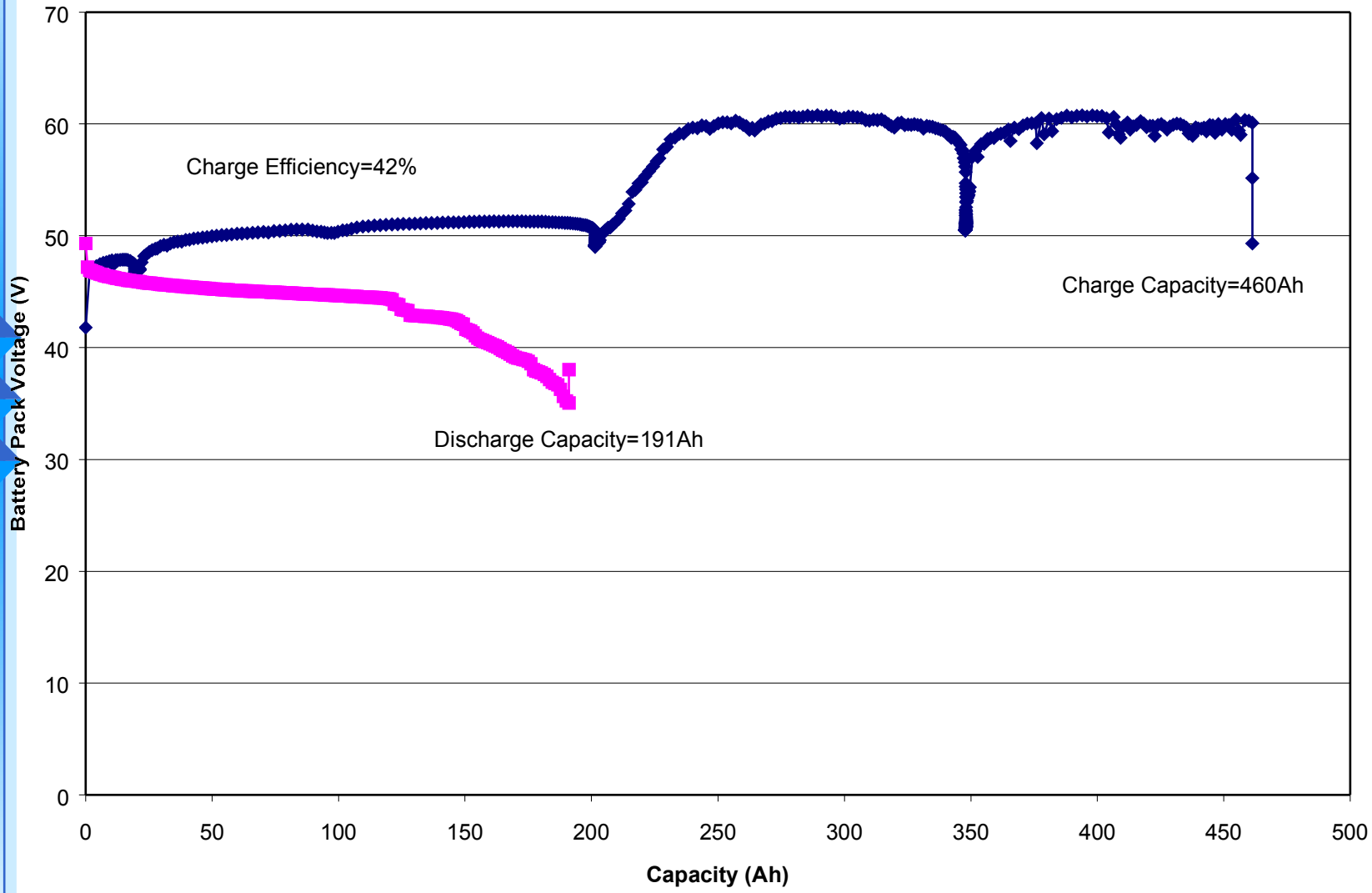


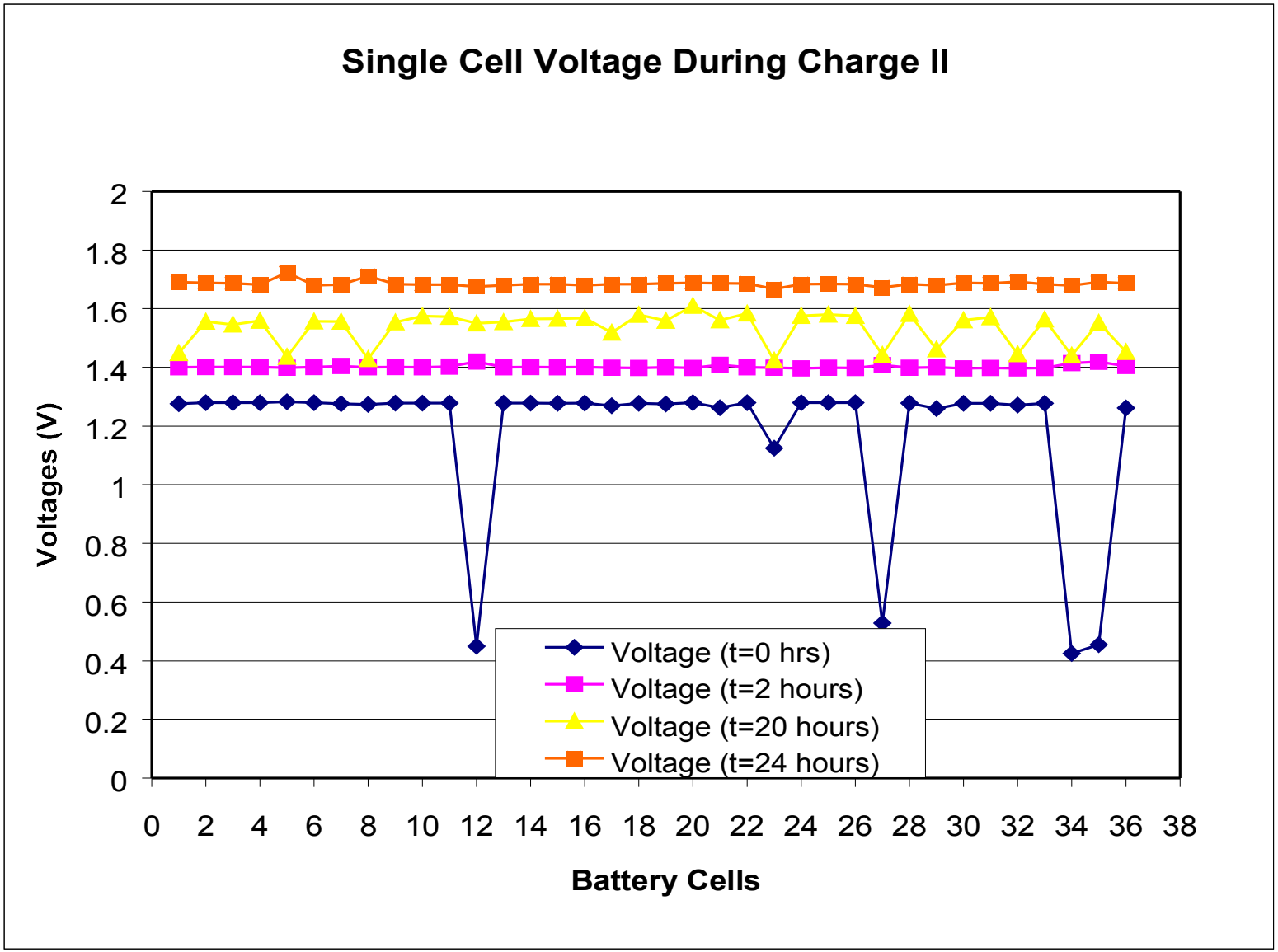
Ratio of current developed in amorphous solar panel array / polycrystiline PV panels

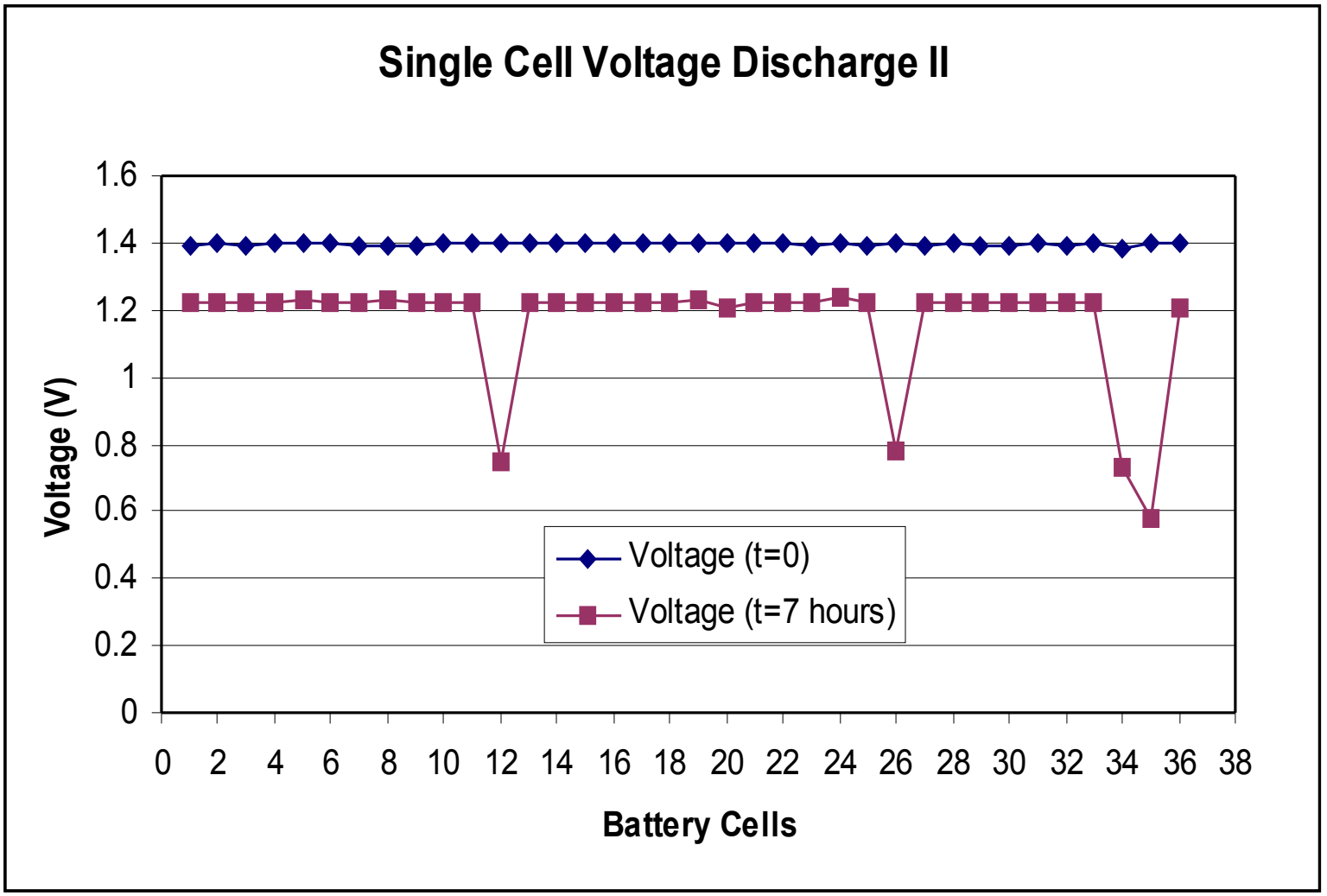
Batteries

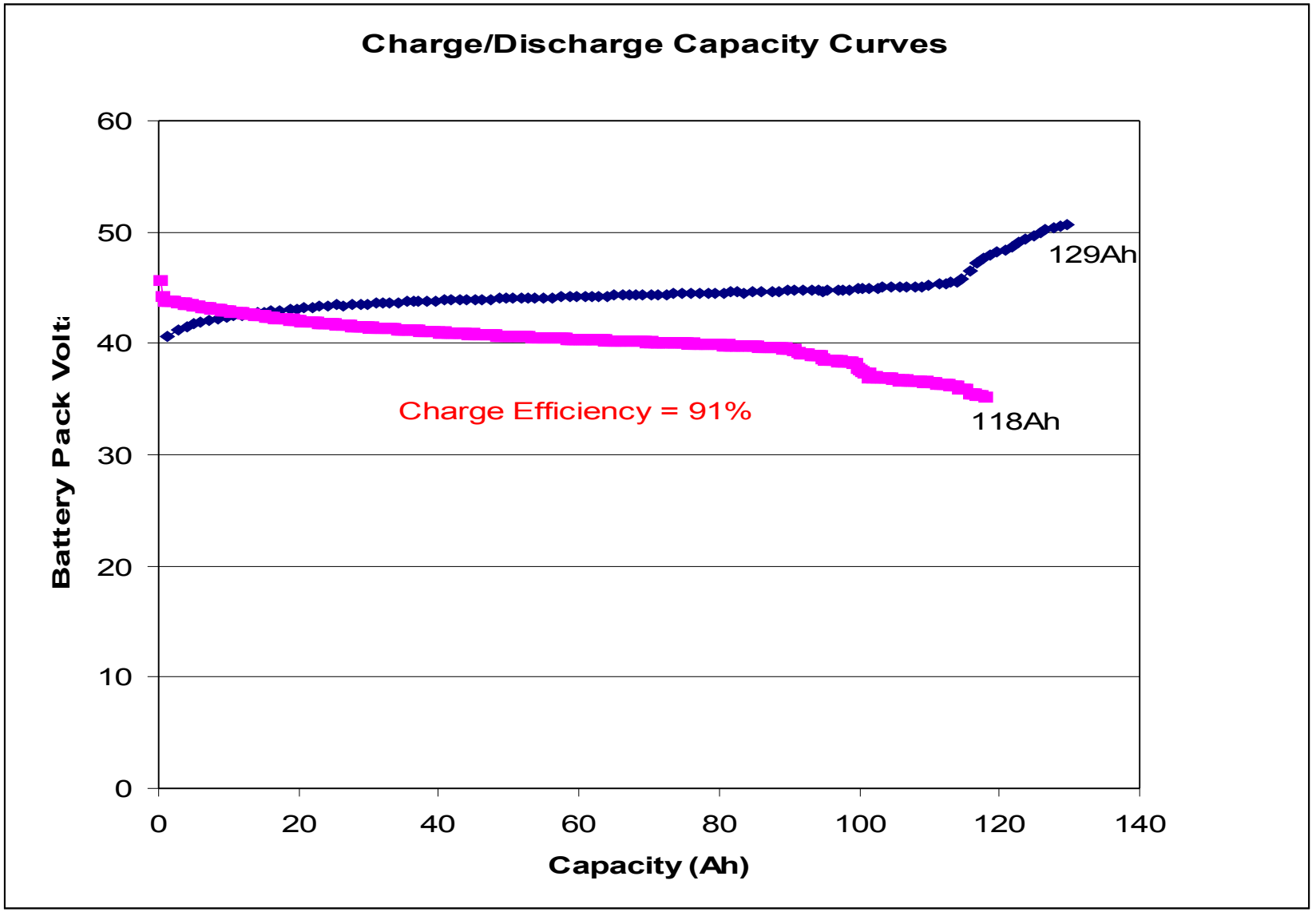
- Goals:
  - Test the batteries to determine charge and discharge efficiency
  - Locate bad cells
    - remove from system
    - repair or replace

Charge/Discharge Capacity Curves




Single Cell Voltage During Charge II
Voltages (V)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Battery Cells
Voltage (t=0 hrs)
Voltage (t=2 hours)
Voltage (t=20 hours)
Voltage (t=24 hours)


Single Cell Voltage Discharge II
Voltage (V)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38
Battery Cells
Voltage (t=0)
Voltage (t=7 hours)


Charge/Discharge Capacity Curves
Battery Pack Volt
60
50
40
30
20
10
0
0
20
40
60
80
100
120
140
Capacity (Ah)
129Ah
Charge Efficiency = 91%
118Ah

Batteries (continued)

- Summary
  - Efficiency- 42%
    - much lower than 80% expected
  - 6 bad cells, out of a total 36 cells, were located and removed from the system
    - 4 cells were fixed temporarily, but became bad again
    - efficiency 91% with bad cells removed

Sign Installation

- Goal: To get a contract to have the LED sign installed on the roof of the co-generation building

- Accomplishments: Sign will be installed by March 1st of next semester by All Steel Structures, Inc.

Data

- Goals:
  - To organize the tabulated and graphical data of the past
  - To make entering future data easier and more organized
- Accomplishments:
  - Old data was organized
  - New recording format was instituted
  - New data storage technique was implemented
  - A modem was installed to make data retrieval easier in the future

Conclusion

- Hardware
  - Inverter was successfully brought on-line
  - Damaged solar panels cause some loss in efficiency but do not need to be replaced
- Battery
  - 6 bad cells were located and removed from the system, increasing efficiency from 42% to 91%
  - Batteries can operate sign for at least 24hrs

Conclusion (continued)

- Sign Installation
  - by March 1st of next semester
- Data
  - has been organized
  - new format has been implemented
  - modem is installed

Future

- Monitor efficiency of batteries and solar panels
- Look for a large PEM Fuel Cell
- Fuel Cell buses running in Chicago
  - Already three running: #20 Madison, #65 Grand, #66 Chicago
  - Perhaps another one could run in the IIT and Bronzeville area

Are There Any Questions?