Monitoring Health and Performance of MW Scale Battery Installations Using OSISoft

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OSIsoft

UET UniEnergy Technologies

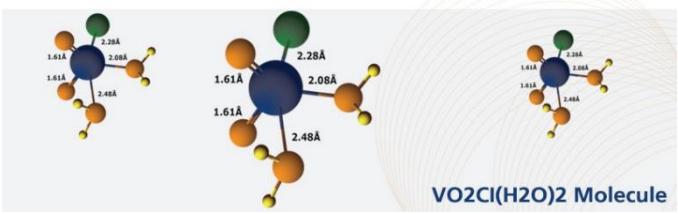
Agenda

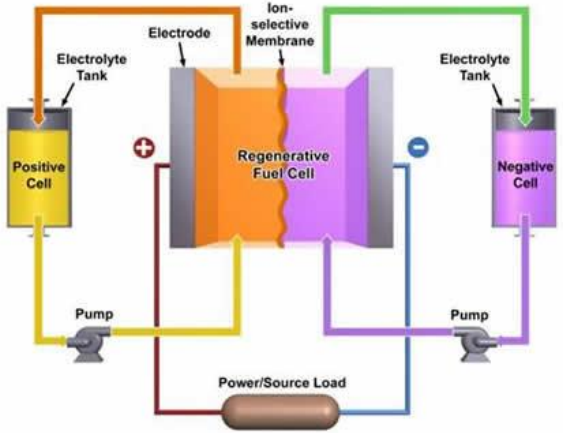
- About UET
- Remote Monitoring: Health and Performance
- Use Case Description: Weekly Health Reports for Service Monitoring
- Savings in Time and Money
- Summary and Questions

About UET

UniEnergy Technologies

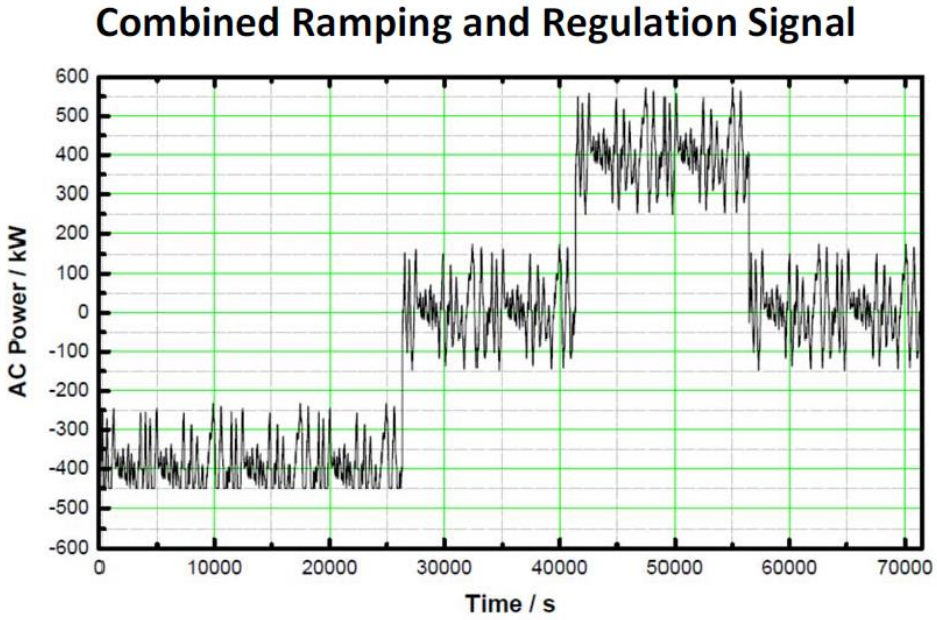
- Large Scale Energy Storage
- Founded in 2012 by Gary Yang and Liyu Li
- Based in Mukilteo, WA
- Molecules to MW (2012-2014):
  - Licensed Advanced Vanadium Electrolyte from PNNL
  - Developed Energy Dense, Containerized Flow Battery with Advanced Stack and Electrolyte Technology
  - Manufactured and Deployed the First 1MW System in Q1 2015
- Monitoring, Evaluation, Maintenance



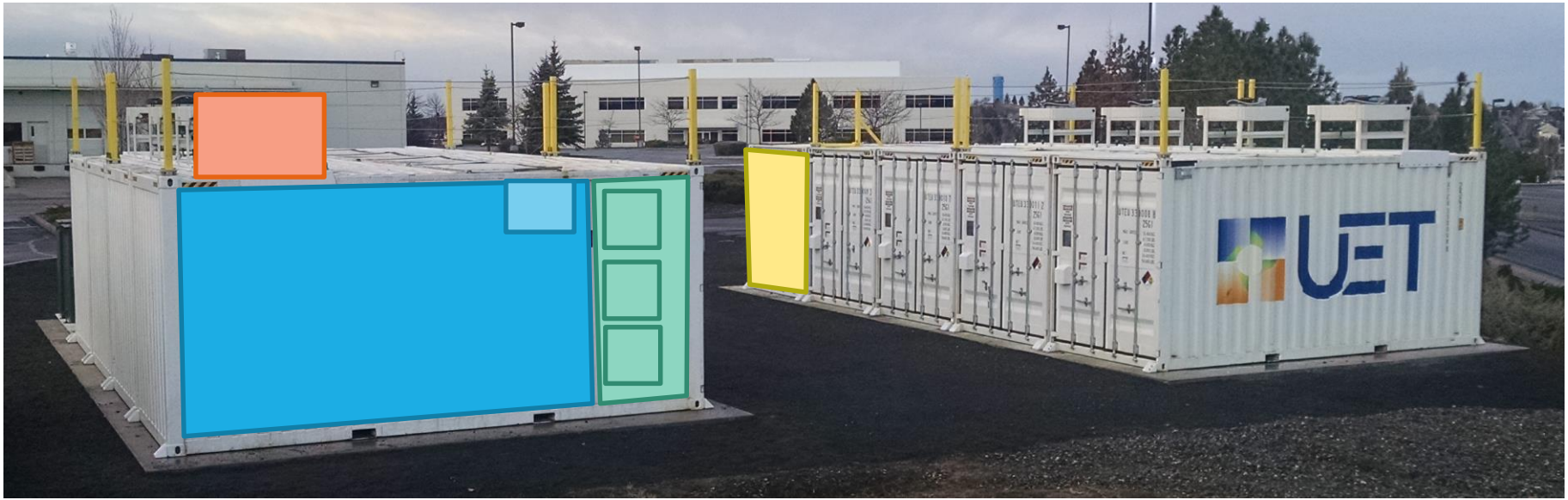


Uni.System – 4 Hour Integrated AC Battery

- Energy Battery with Power Battery Capabilities
- Prime Applications
  - Micro-Grids especially for renewable integration
  - Transmission or Generation Deferral
  - Peak Shaving
  - Layered Applications
    - Backup Power
    - Frequency Regulation



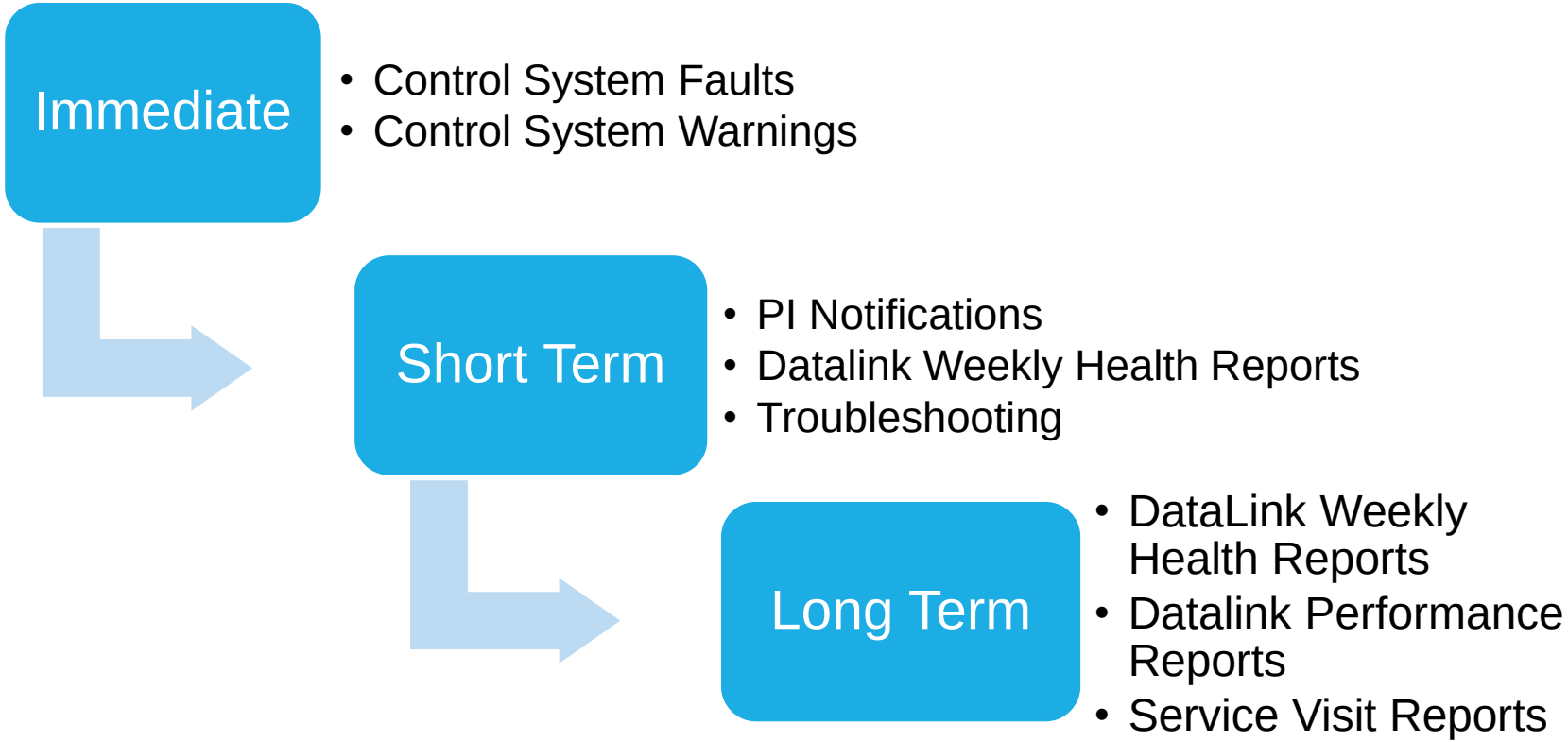
Uni.System Basics



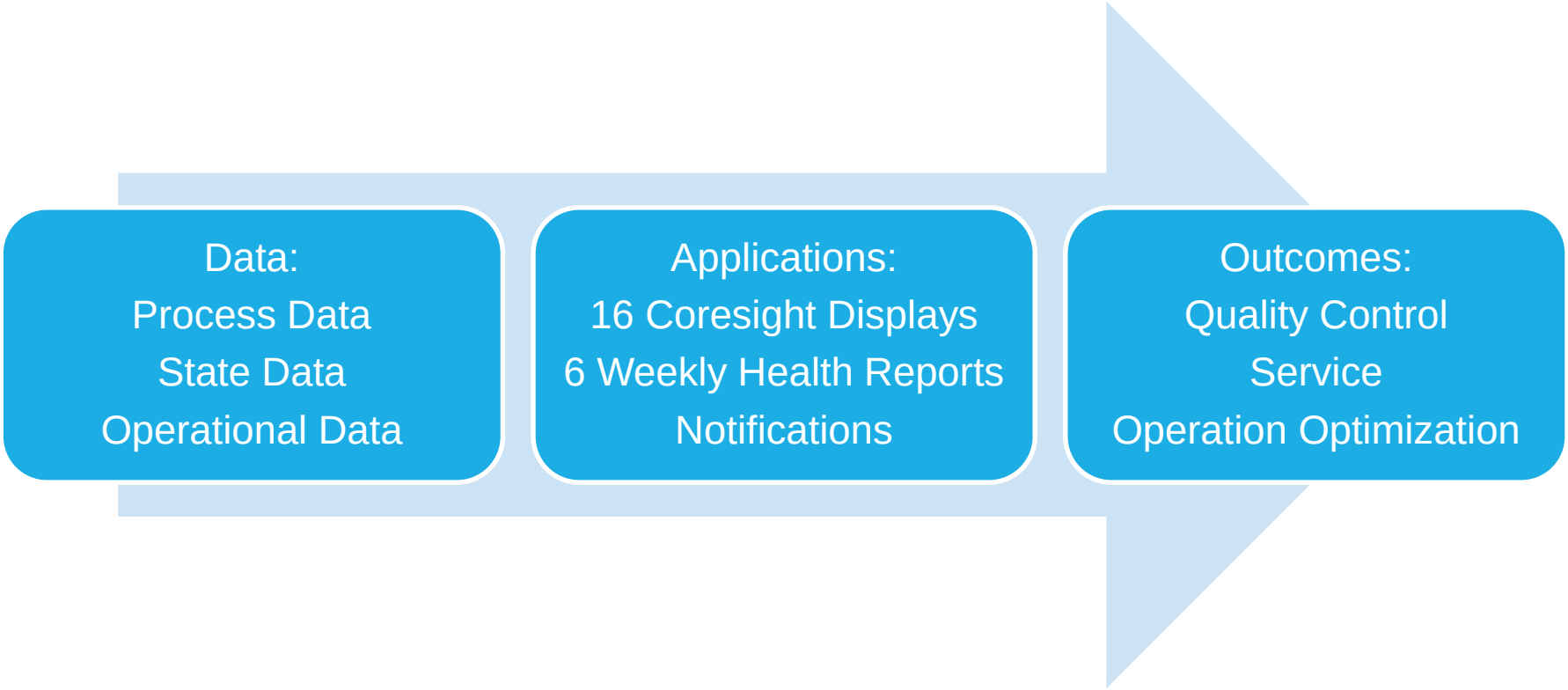
1 MW installation in Pullman, WA for Avista

Remote Monitoring

Tiered Response

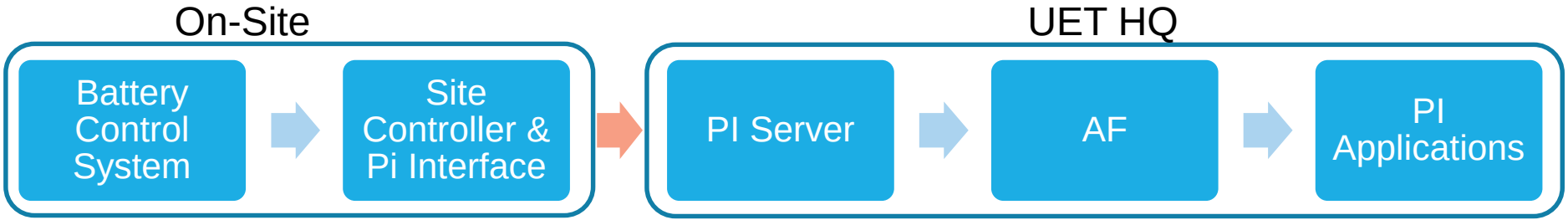


PI Data and OSI Applications



Use Case Description: Service Monitoring

Data Flow



- New data points feed directly to AF
- Freedom to specify PI points (edges for events, smooth for integration)
- AF performs simple calculations, creates Event Frames needed for DataLink, and sends Notifications
- PI Applications
  - Coresight references AF for HTML coding
  - DataLink References AF to include Event Frames and calculations, for ease of replication

Health Reports

- 1 page weekly summary per 0.5 MW battery string
- Subsystem analysis calculated and compared to known failure or low performance parameters
  - Cooling System
  - Pump
  - Stacks (2 page report)
  - Gas Management
  - Matching
  - PCS
  - Sensors

Health Report: Cooling System

HEX/Radiator System - Health Report (4/29/15 to 5/5/15)

Site	Avista1
String	String1
Week Begin	4/29/2015
Week End	5/6/2015

Overall Assessment:

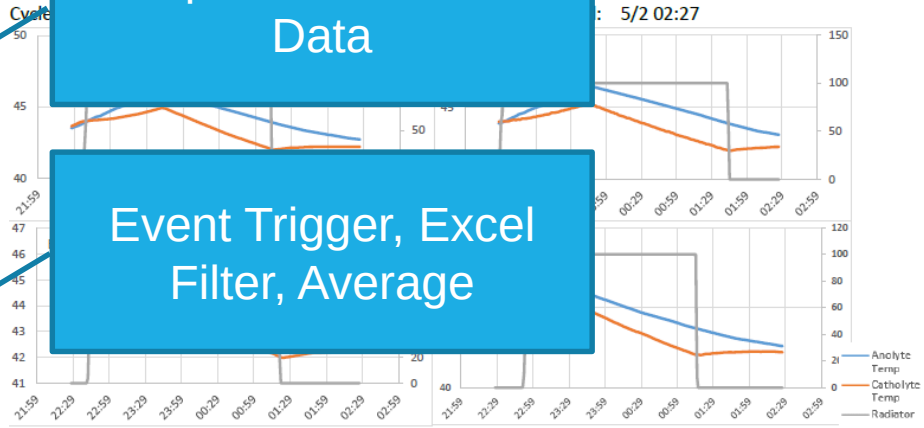
OK

Checks for 1) Usage deviations above/below average usage 2) on/off steps above 2 kW 3) Lack of separation between anaolyte and Catholyte Temperatures after the HEX turns on 4) Conductivity above 100 5) Life use > 35000 hrs

			This wk	last wk	2 wks ago	Life Use	Flags
HEX/ Radiator System Usage	Time Discharging		62%	74%	4%		
	Avg. Ambient Temp		13	9	12		
	Total Discharge (KWh)						
	Battery1	%Time On	10%	8%	0%	40 hr	OK
	Battery2	%Time On	15%	19%	7%	79 hr	OK
	Battery3	%Time On	14%	18%	7%	77 hr	OK
	Battery4	%Time On	11%	8%	0%	43 hr	OK

		Step On		Step Off			
		Avg ΔP (kW)	Count	Avg ΔP (kW)	Count	Conduct-ivity	
Power Usage & Conductivity	Battery1		0		5	55	OK
	Battery2		0		5	96	OK
	Battery3		0		9	8	OK
	Battery4		0		5	69	OK

	Anolyte Temp-Catholyte Temp					
	Start	30 min	1 hr	2 hr	3 hr	
Battery1	-0.1	1.0	1.3	1.7		OK
				1.7	1.9	OK
				1.6		OK
				1.6		OK



One Word Summary

Simple Time-Filtered Data

Event Trigger, Excel Filter, Average

Health Report: Cooling System

HEX/Radiator System - Health Report (4/29/15 to 5/5/15)

Site	Avista1
String	String1
Week Begin	4/29/2015
Week End	5/6/2015

Checks for 1) Usage deviations over 20%
) Power draws during
ck of separation
te Temperatures after
ty above 100 5) Life

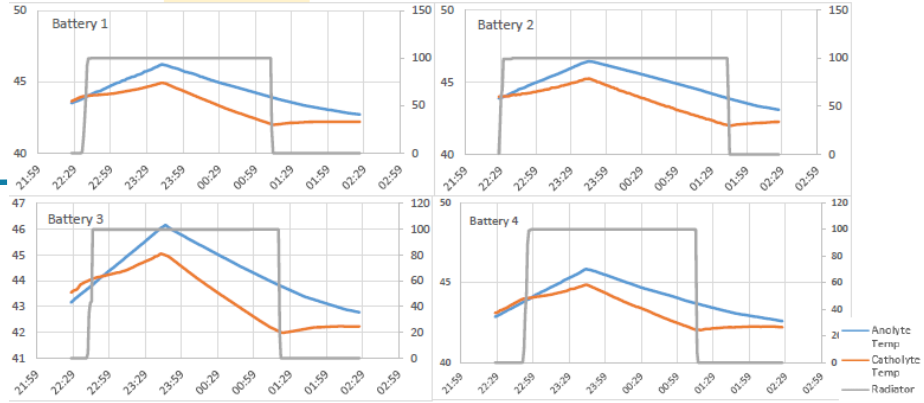
Event Trigger and Excel analysis of future Time

							Flags
HEX/ Radiator System Usage	Time Discharg						
	Avg. Ambien						
	Total Discharge (KWh)						
	Battery1	%Time On	10%	8%	0%	40 hr	OK
	Battery2						OK
	Battery3						OK
	Battery4						OK
Power Usage & Conductivity	Battery1		0		5	55	OK
	Battery2		0		5	96	OK
	Battery3		0		9	8	OK
	Battery4		0		5	69	OK

Graph of Events

Anolyte Catholyte Temp Separation Stats		Anolyte Temp-Catholyte Temp					
		Start	30 min	1 hr	2 hr	3 hr	
	Battery1	-0.1	1.0	1.3	1.7		OK
	Battery2	-0.1	0.9	1.4	1.7	1.9	OK
	Battery3	-0.2	0.9	1.3	1.6		OK
	Battery4	-0.2	0.9	1.3	1.6		OK

Cycle on graph **Cycle2** Start: 5/1 22:27 End: 5/2 02:27



Health report: Pump

Time-filtered averages for current time period and for baseline time period

Current period graphs

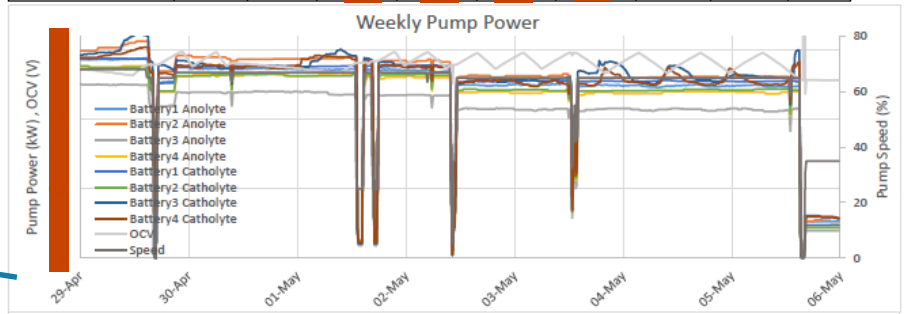
Electrolyte Pumps - Health Report (4/29/15 to 5/5/15)

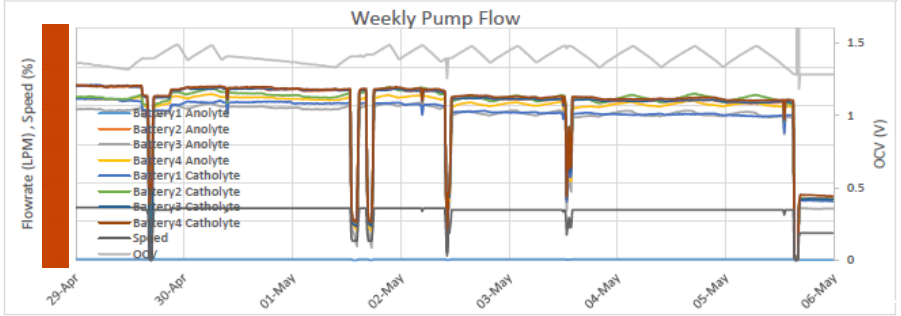
Site	Avista1
String	String1
Start	4/29/2015
End	5/6/2015

Overall Assessment: OK

Checks that none of the averages (Flow, Power, Pressure) deviated from the baseline average for that average speed by more than 20%

		% Time on	Avg. Speed (%)	Average Power (kW)	Expected Avg. Power (kW)	Avg. Flow (LPM)	Expected Avg. Flow (LPM)	Avg. Pressure (psi)	Expected Avg. Pressure (psi)	Life-time Use (days)	Flag
Battery1	Anolyte	99%	63					20.9	20.5	27	OK
Battery2	Anolyte	99%	63					19.4	20.5	26	OK
Battery3	Anolyte	99%	63					22.1	20.5	26	OK
Battery4	Anolyte	100%	63					21.2	20.4	26	OK
Battery1	Catholyte	99%	64					20.6	20.5	26	OK
Battery2	Catholyte	99%	64					21.1	20.5	26	OK
Battery3	Catholyte	99%	64					21.9	20.5	26	OK
Battery4	Catholyte	100%	63					20.4	20.4	27	OK





Health Report: PCS

Messages with dates/times and code interpretation based on error codes

"Pivot" efficiencies using and AF calculation, ranges and averaging with a complex filtering statement for current period and baseline

PCS Health report (week 4-29-15 to 5-5-15)

Site	Avista1	Overall Assessment:	
String	String1	OK	OK Assessment indicates no System Trips and efficiencies greater than 95% at 200-600 kW power
Start	4/29/2015		
End	5/6/2015		

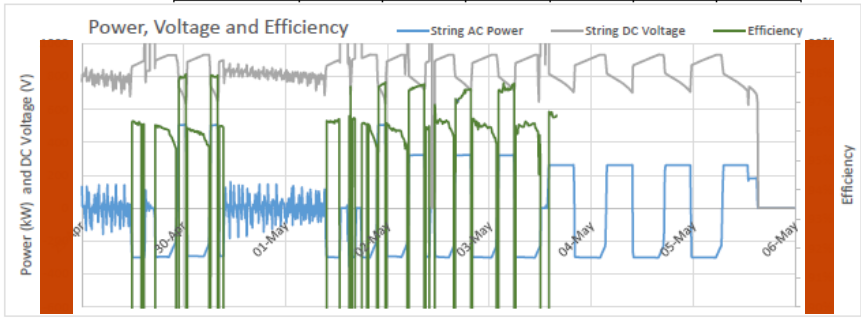
System Trips: No Trips
PCS Trips
Descriptions:
PCS Temp deratings:
BMS Faults None
Descriptions:

Charging

Throughput		This week (kWh):		-959	Lifetime (MWh):		-1.9	
Time		This week (h):		87	Lifetime (days):		0	
Efficiency Averages:		Charging Power (+/- 10kW)						Flag
		100 kW	200 kW	300 kW	400 kW	500 kW	600 kW	
DC Voltage range	750V - 800V							
	800V - 850V							
	850V - 900V			96.2%				OK
	900V - 950V		95.1%	96.2%				OK

Discharging

Throughput		This week (kWh):		714	Lifetime (MWh):		1.2	
Time		This week (h):		63	Lifetime (days):		0	
Efficiency Averages:		Discharging Power (+/- 10kW)						
		100 kW	200 kW	300 kW	400 kW	500 kW	600 kW	
DC Voltage range	550V - 600V		97.7%	97.7%	98.1%	98.2%	98.1%	OK
	600V - 650V		96.2%	97.3%	98.0%	97.9%	97.7%	OK
	650V - 700V	39.8%	94.9%	97.4%	97.8%	97.8%	97.6%	OK
	700V - 750V	93.3%	96.3%	97.3%	97.7%	97.7%	97.5%	OK
	750V - 800V	94.2%	96.4%	97.4%				OK



Health Report: Stack

- Automatically Generate Coresight HTML for in-depth study on a cell by cell basis
- Key health parameters:
  - Max CV – Min CV
  - Resistance
- More multi-parameter filtering with various summary statistics reported (average, max)
- Event triggers to watch for outlying cells or BOC/EOC specific parameters

Savings in Time and Money

Using Health Reports

- Implementation
  - Automated 8 page report generation for each string
  - Human review
  - Where possible create notifications from insight gained through reports and experience
  - Some notifications may evolve to real time controls over time as applicable
- Feedback
  - Improved real time controls where applicable.
  - Aided design team in identifying areas of improvement

Benefits

- Automate to the extent reasonable
- Create visuals and summary KPIs that allow quick review and interpretation
- Reduce service visits through predictive maintenance
- Feedback to reduce service
  - Improve maintenance Schedules
  - Improve design
  - Create operation- specific design

Summary

Pi system monitoring for weekly health reporting

COMPANY and GOAL

Unienergy Technologies manufactures, deploys, and maintains Large scale energy storage system for Utility, Industrial and Microgrid Customers. We use Pi to record, troubleshoot and monitor.

UniEnergy Technologies

CHALLENGE

We provide all customers with a warranty and need a way to quickly scan data for issues.

- Many subsystems each of which requires slicing unique set of data
- Minimal sensors requires creative use of data to extract knowledge.

SOLUTION

Created Health reports for the deployed strings to be run weekly

- Each susbsystem report results in a single word summary
- Reports contain details for investigating slow degradation or false alarms.

RESULTS

Saved time and money by reducing workforce requirements and remote deployments

- Reduces manpower requirements for monitoring
- Fed metrics from health reports to notifications and controls as required
- Reduced investigative trips and minimized field service time.

Contact Information

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UniEnergy Technologies

Questions

Please wait for the **microphone** before asking your questions

State your **name & company**

Please don't forget to…

Complete the Survey for this session

The Power of Data
DECISION READY IN REAL-TIME

Evaluation Form (Seminar Location - Date)

Name:_____ Company: _____

Email:_____

Quality and content of the presentations	Poor	Good	Excellent	N/A
Welcome	○	○	○	○
The Journey To Real-Time Operational Intelligence	○	○	○	○
The Power of Connection	○	○	○	○
Tank Level Management System	○	○	○	○
Using the PI System to Aid in Troubleshooting Operational Aspects of Oil and Gas Well Drilling and Completion	○	○	○	○
Unleash your Infrastructure	○	○	○	○
Information on the Spot	○	○	○	○
Wrap-up/Seminar Conclusion	○	○	○	○

Quality and organization of the seminar				
Choice of date	○	○	○	○
Time allowed for lunch/breaks	○	○	○	○
Choice of presentations	○	○	○	○
Pace and time allowed for the presentations	○	○	○	○

감사합니다

谢谢

Danke

Gracias

Merci

Thank You

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Спасибо

Obrigado