SynchroPhasor Update Success story

David Hawkins - CAISO

NASPI Meeting – June 2008

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Phasor Workstation in CAISO Control Room

Application Highlights

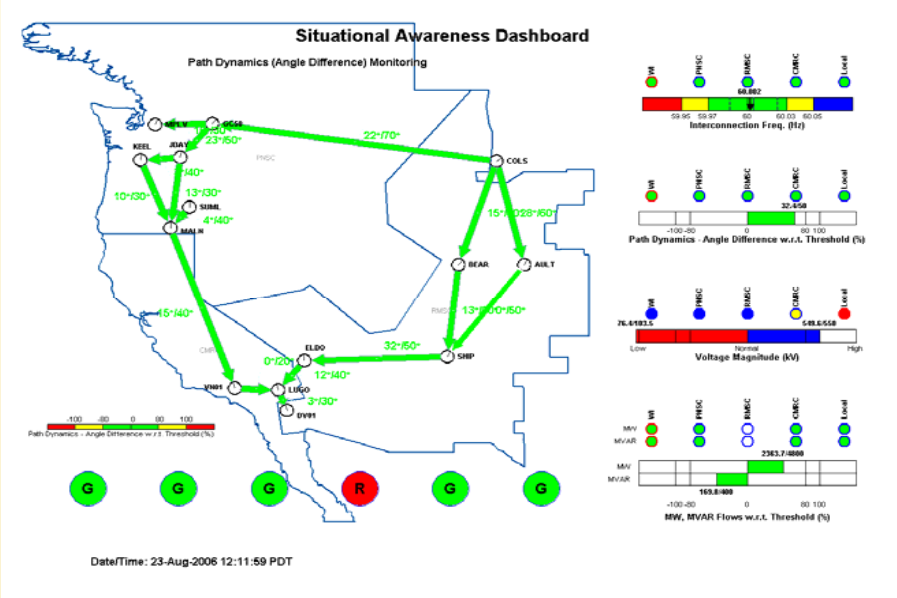
Real Time Dynamics Monitoring System (RTDMS)

New release of the RTDMS software is now being installed and tested at the CAISO.

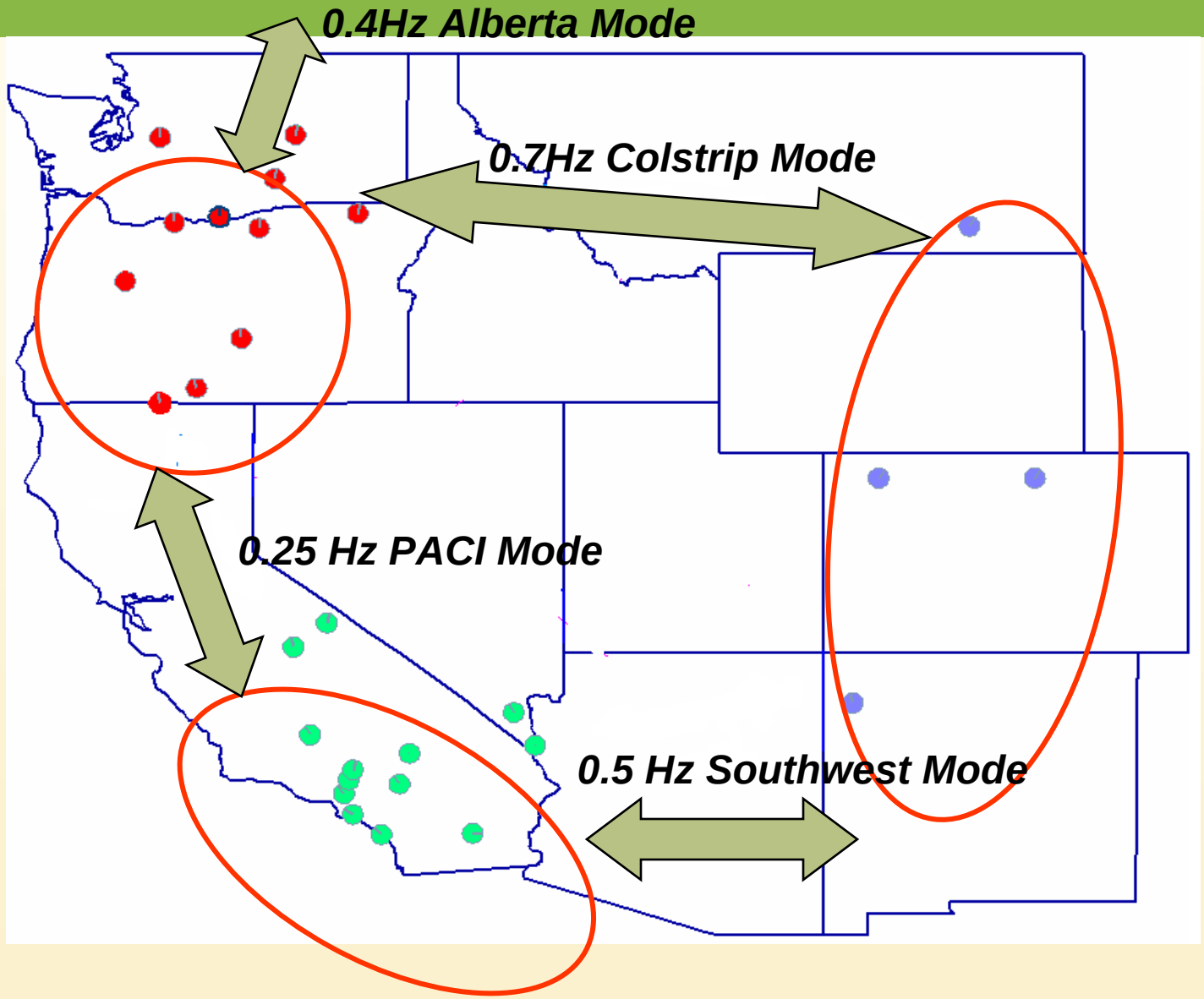
Includes new voltage trend analysis

Small Signal Analysis, oscillation modes, and grid damping analysis now imbedding in the RTDMS application

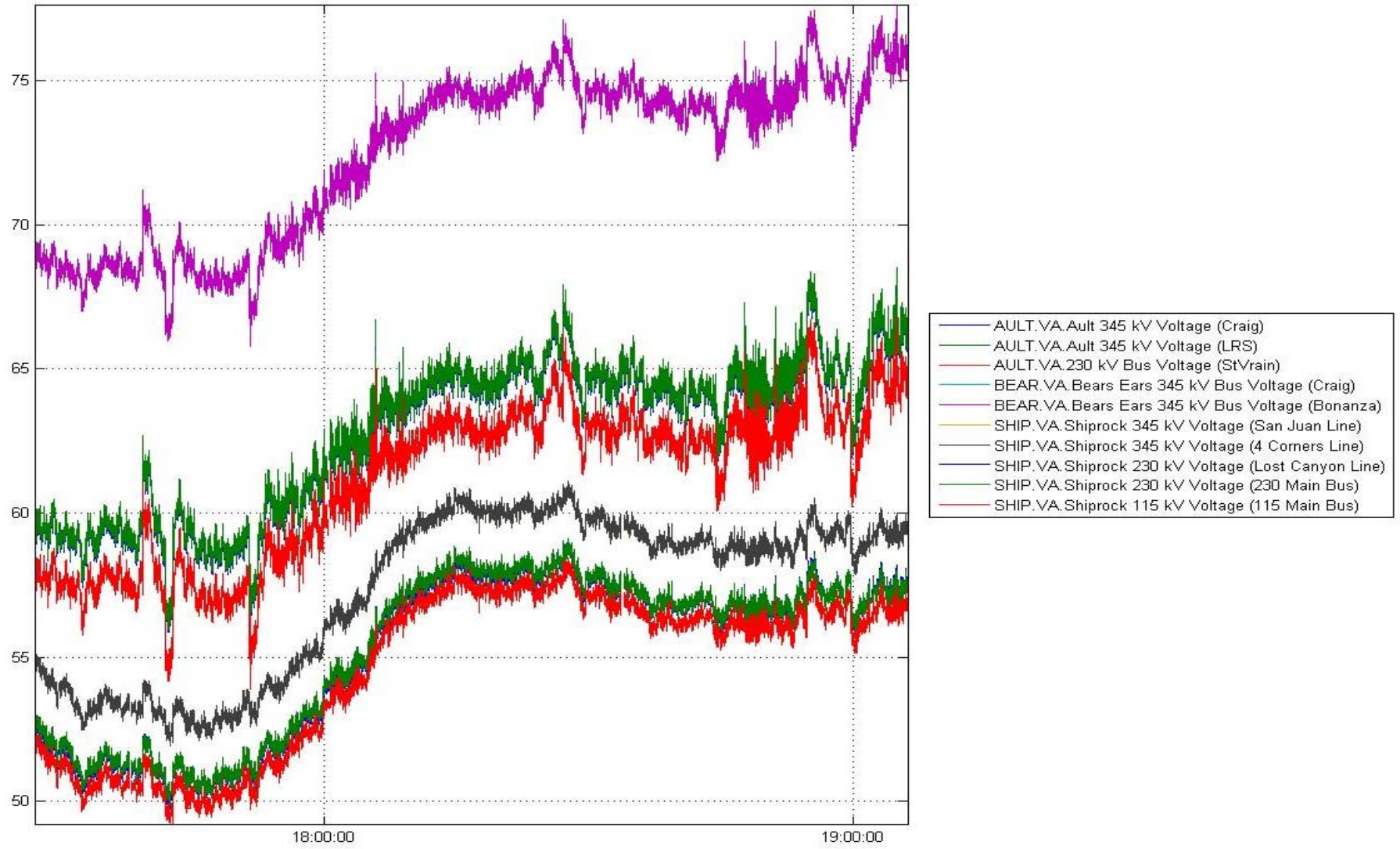
Phasor data was used to analyze the January PCDI Oscillation problem



MODE CLUSTERS & OBSERVABILITY (MODE SHAPE ANALYSIS)



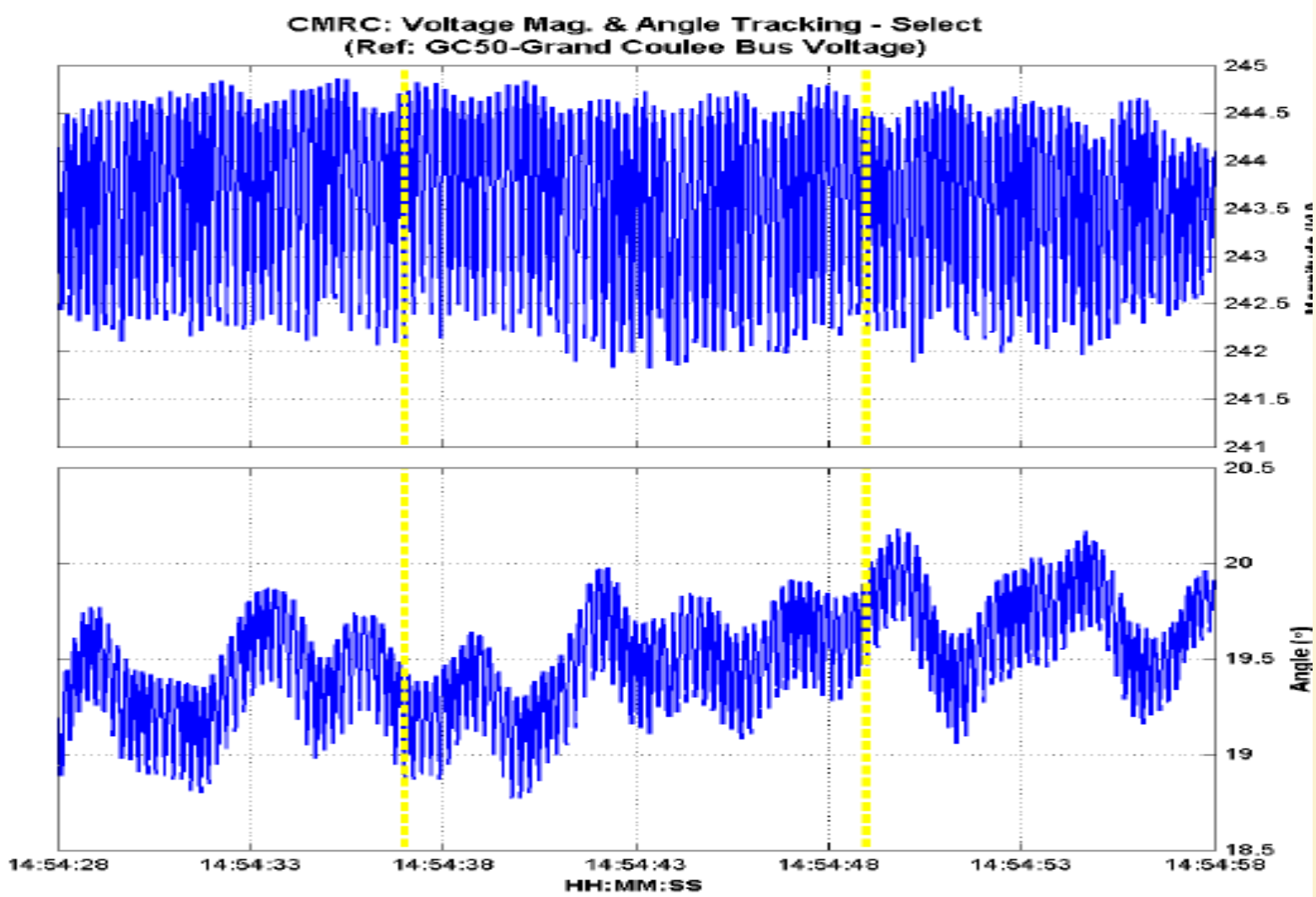
Angle Clusters & Long-term Angle Trends (West)



2008-1-26 Pacific DC Line event

- PCDI – Path 65 operating at 1700 MW - South to North flow
- Short circuit at Big Eddie substation resulted in loss of transformers between 500Kv and 230kV
- The loss of the Big Eddy 500/230 kV ties affected the PDCI controls and an oscillation occurred with the DC current fluctuating approximately +/- 150 amps.
- The SCE operator noticed the oscillations on the analog recorder but the oscillations were not visible on SCADA
- Oscillations continued for an extended period of time and were finally observed by the CMRC on the phasor monitoring system.
- PCDI link was then shut down.

2008-1-26 PDCI event – Sylmar voltage oscillation



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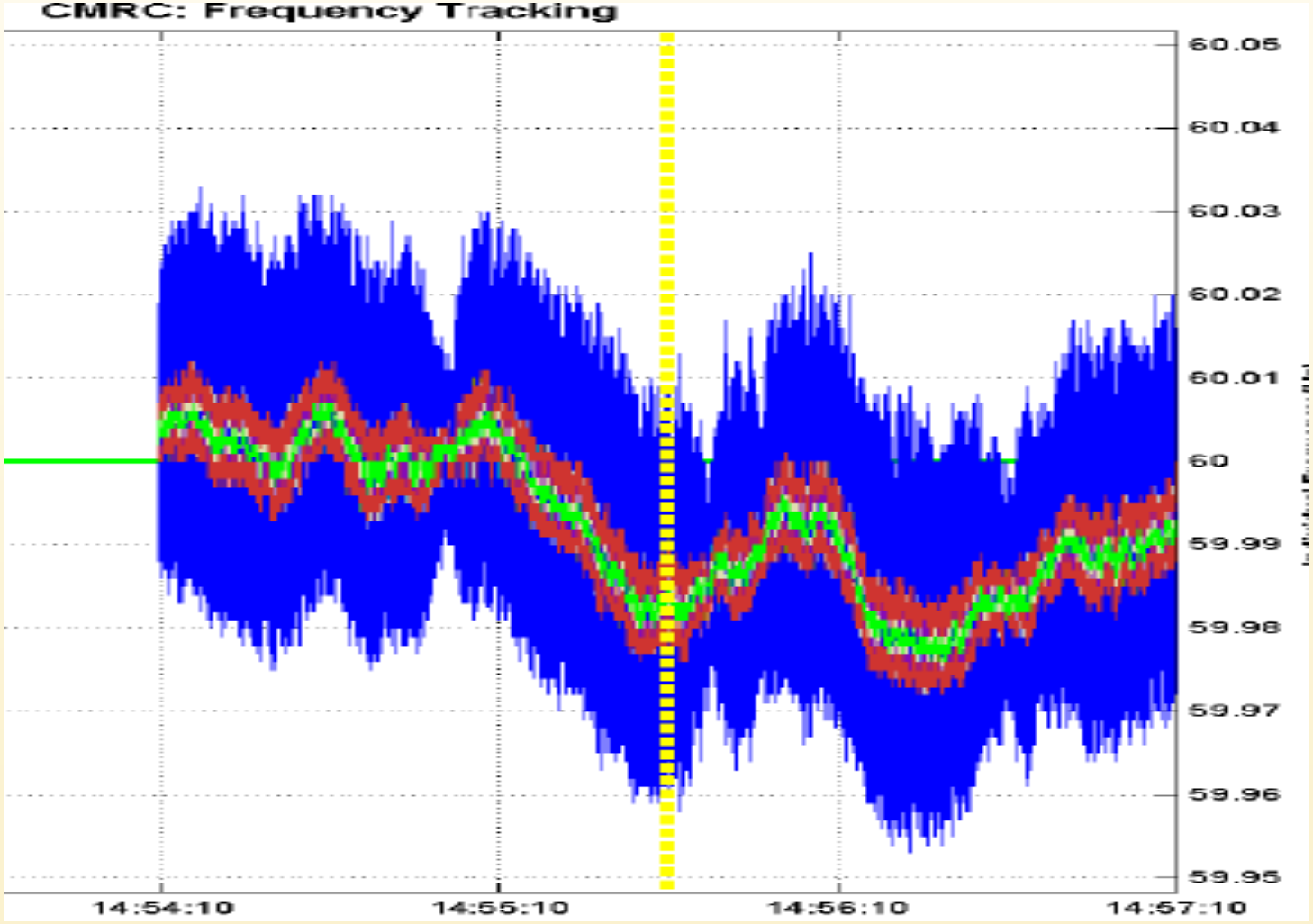
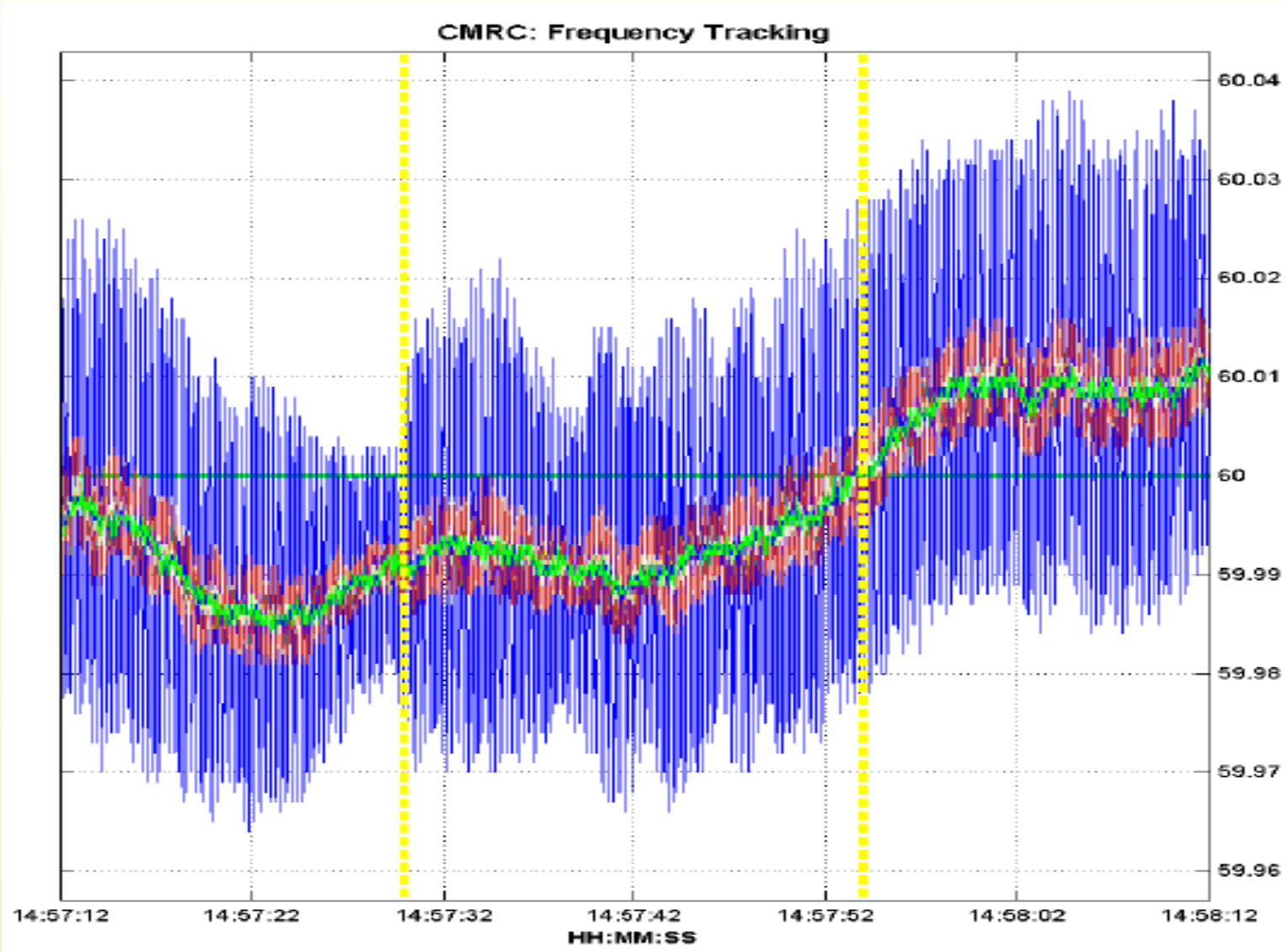
2008-1-26 PDCI Frequency Oscillation



2008-1-26 PDCI event - Frequency



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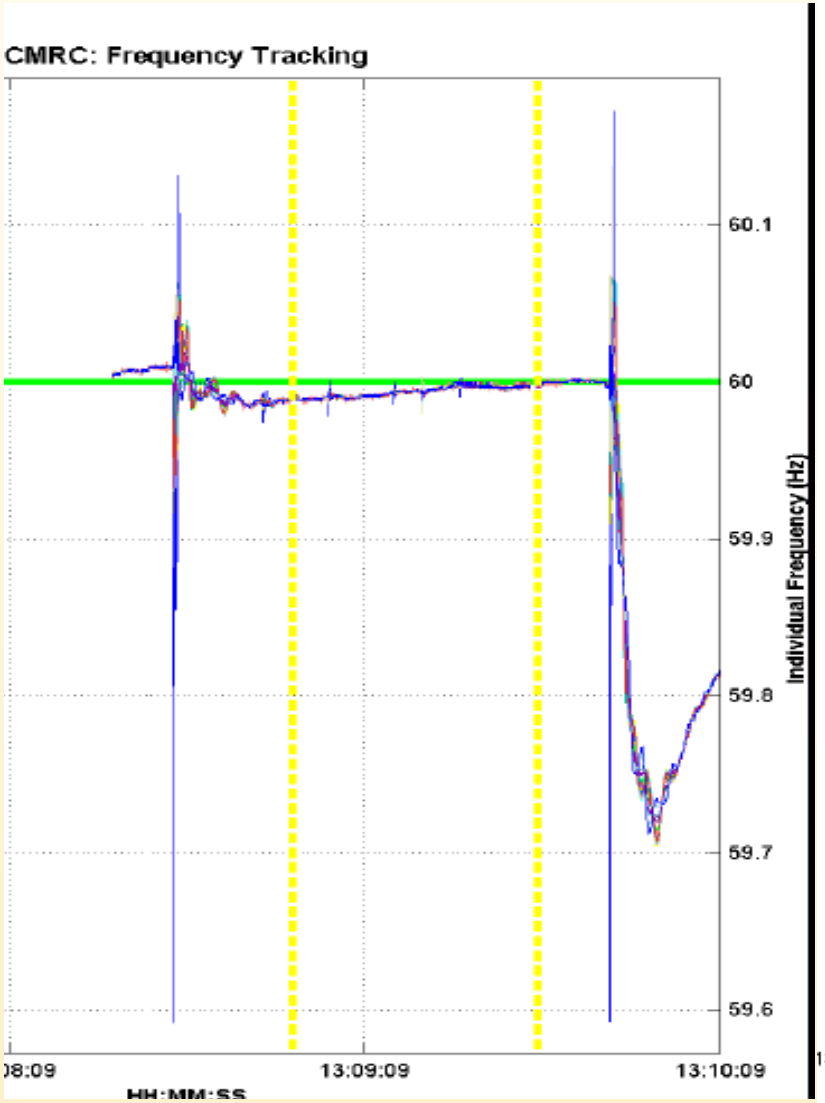
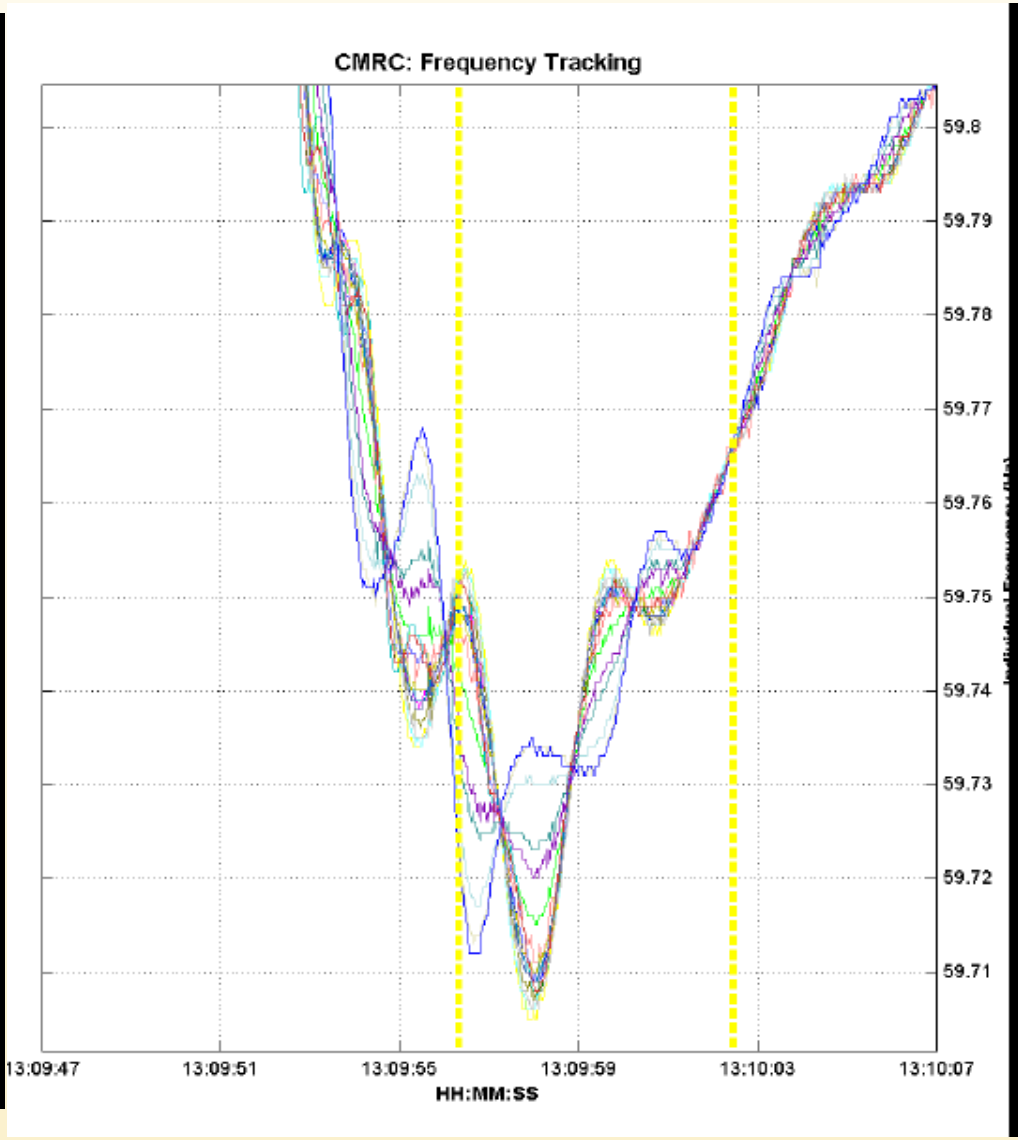
2008-5-20 PDCI multiple events-BPA gen. trip





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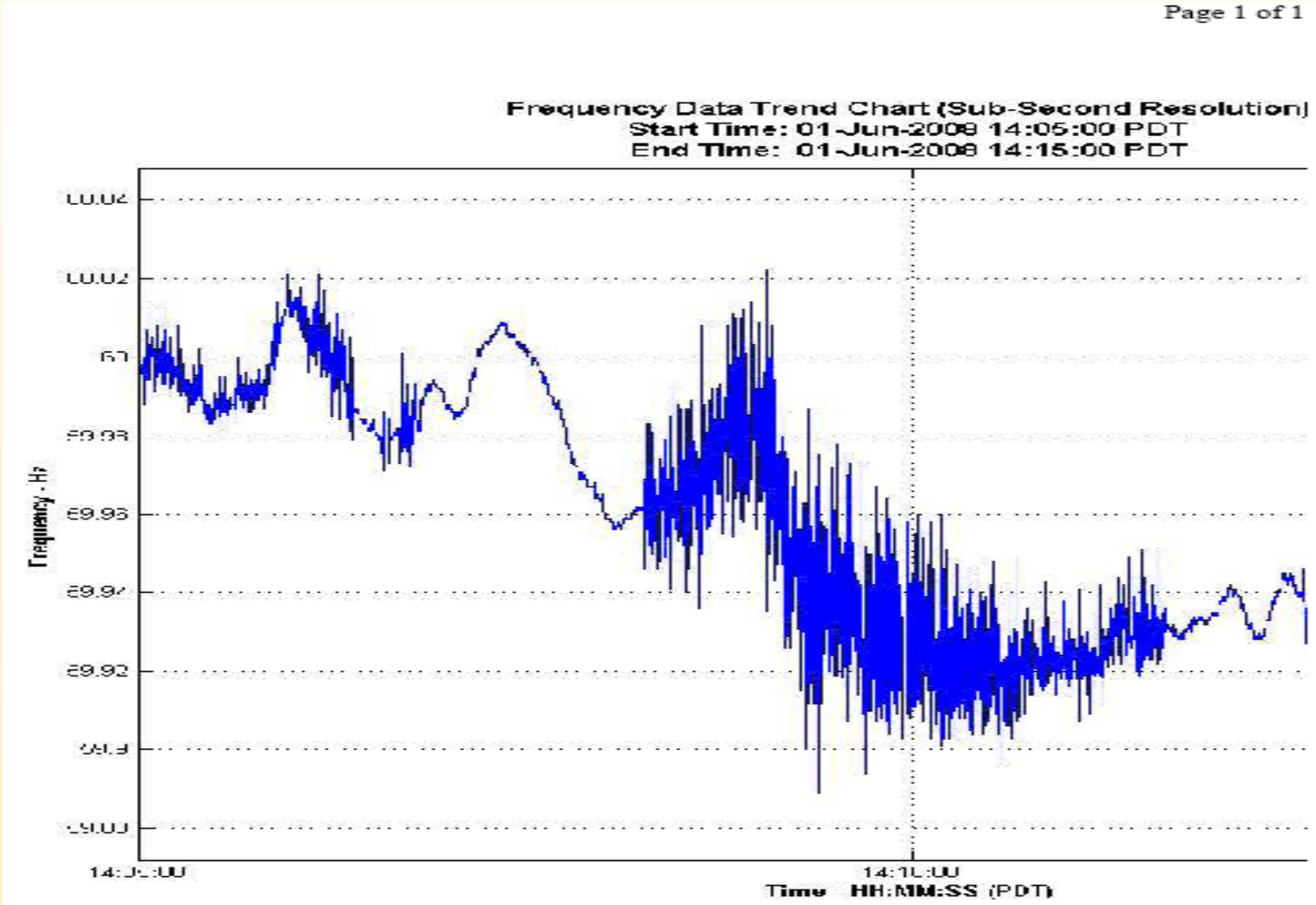
June 1 – Pacific DC Interconnection Oscillation



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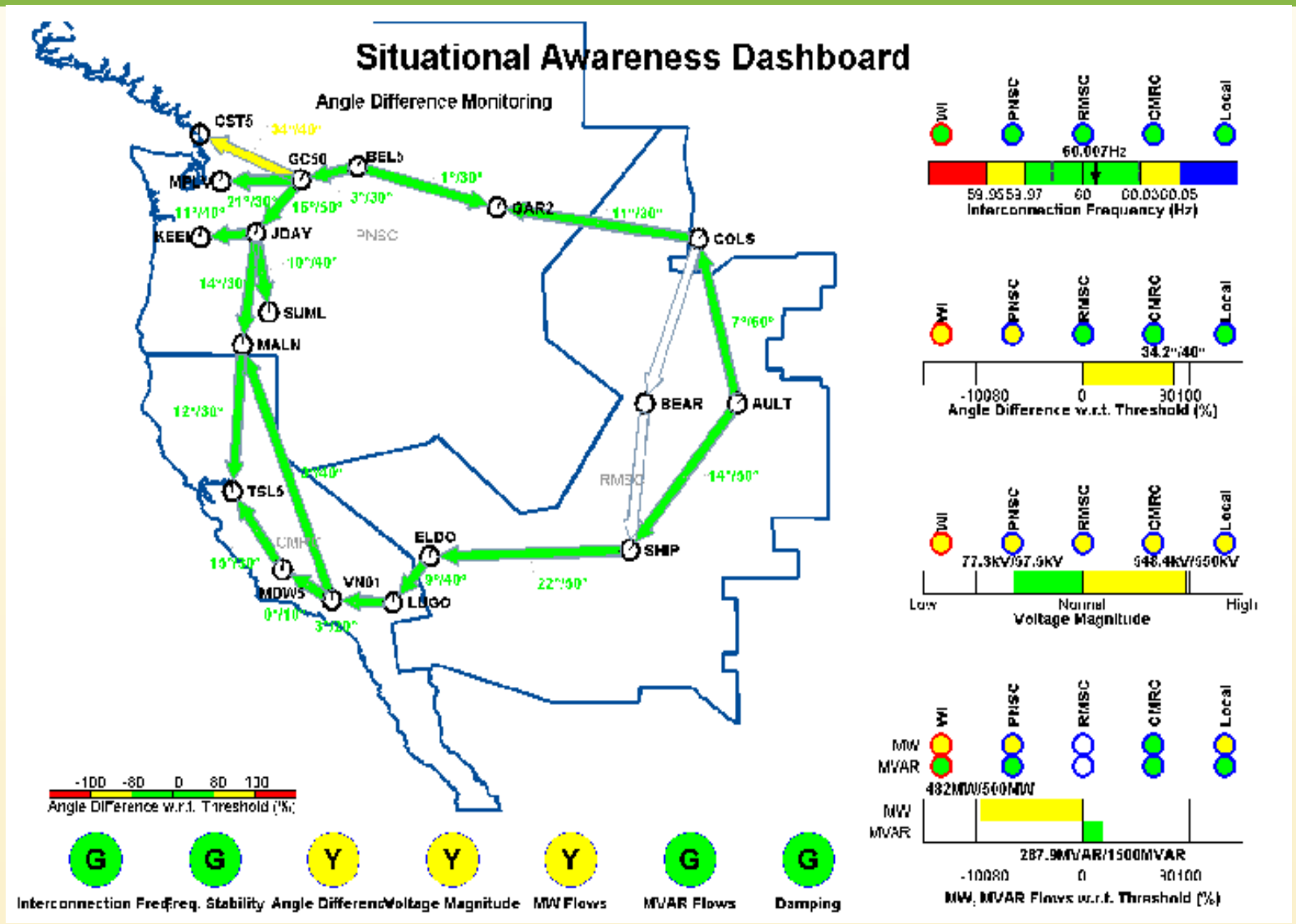
RTDMS Dashboard



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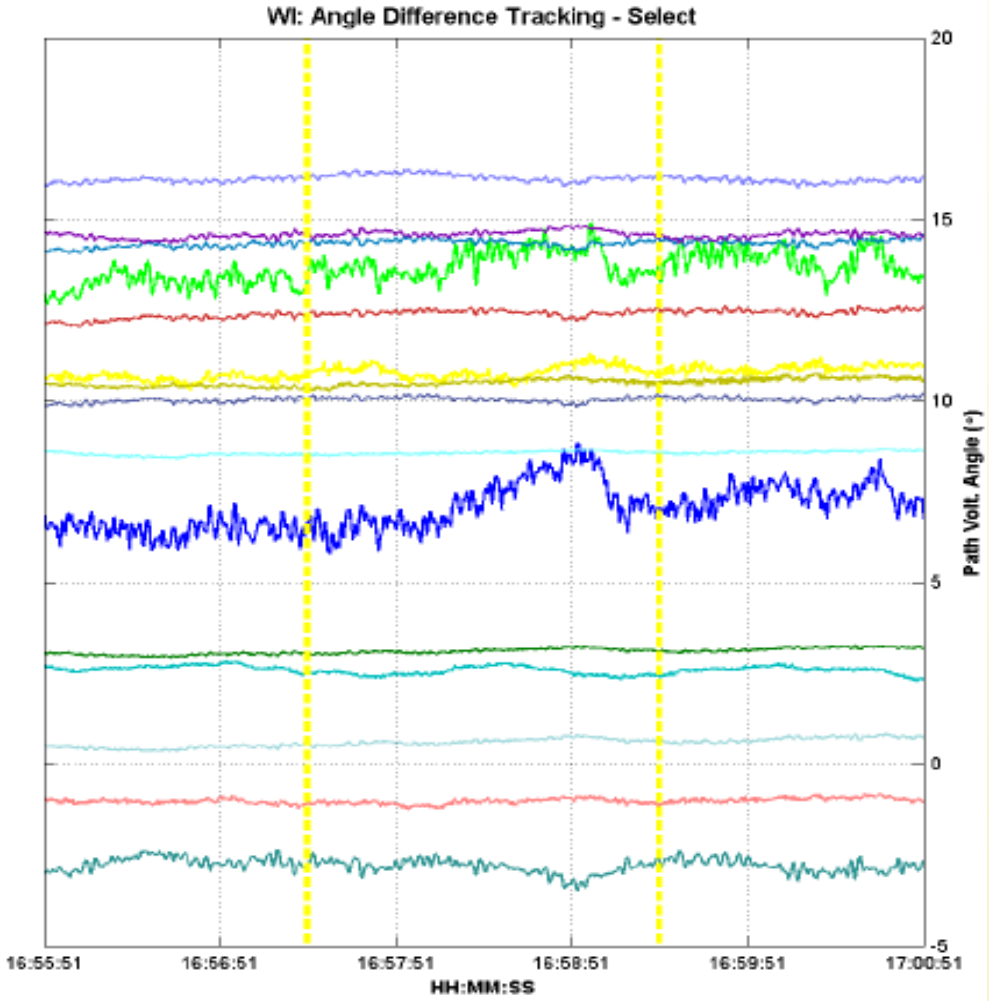
Angle Difference Tracking

Deselect All / Select All	AngDiff(°)	AngDiff(°)	Delta(°)
VN01-MDW5	0.56	0.63	0.07
SHIP-ELDO			
MDW5-TSL5	14.64	14.54	-0.1
MALN-VN01	-2.84	-2.66	0.18
MALN-TSL5	12.36	12.51	0.15
LUGO-VN01	3.08	3.12	0.04
JDAY-SUML	10.07	10.15	0.08
JDAY-MALN	14.34	14.46	0.12
JDAY-KEEL	10.38	10.54	0.16
GC50-MPLV			
GC50-JDAY	16.13	16.21	0.08
GC50-CS75			
GAR2-BEL5	-1.04	-1.12	-0.08
ELDO-LUGO	8.54	8.57	0.03
COLS-GAR2	10.85	10.65	-0.2
COLS-BEAR	---	---	---
BEL5-GC50	2.49	2.43	-0.06
BEAR-SHIP	---	---	---
AULT-SHIP	13.33	13.45	0.12
AULT-COLS	6.55	7	0.45
Time (HH:MM:SS)	16:57:21.967	16:59:21.967	Delta(s) 120



Date/Time: 29-May-2008 17:00:51 PDT

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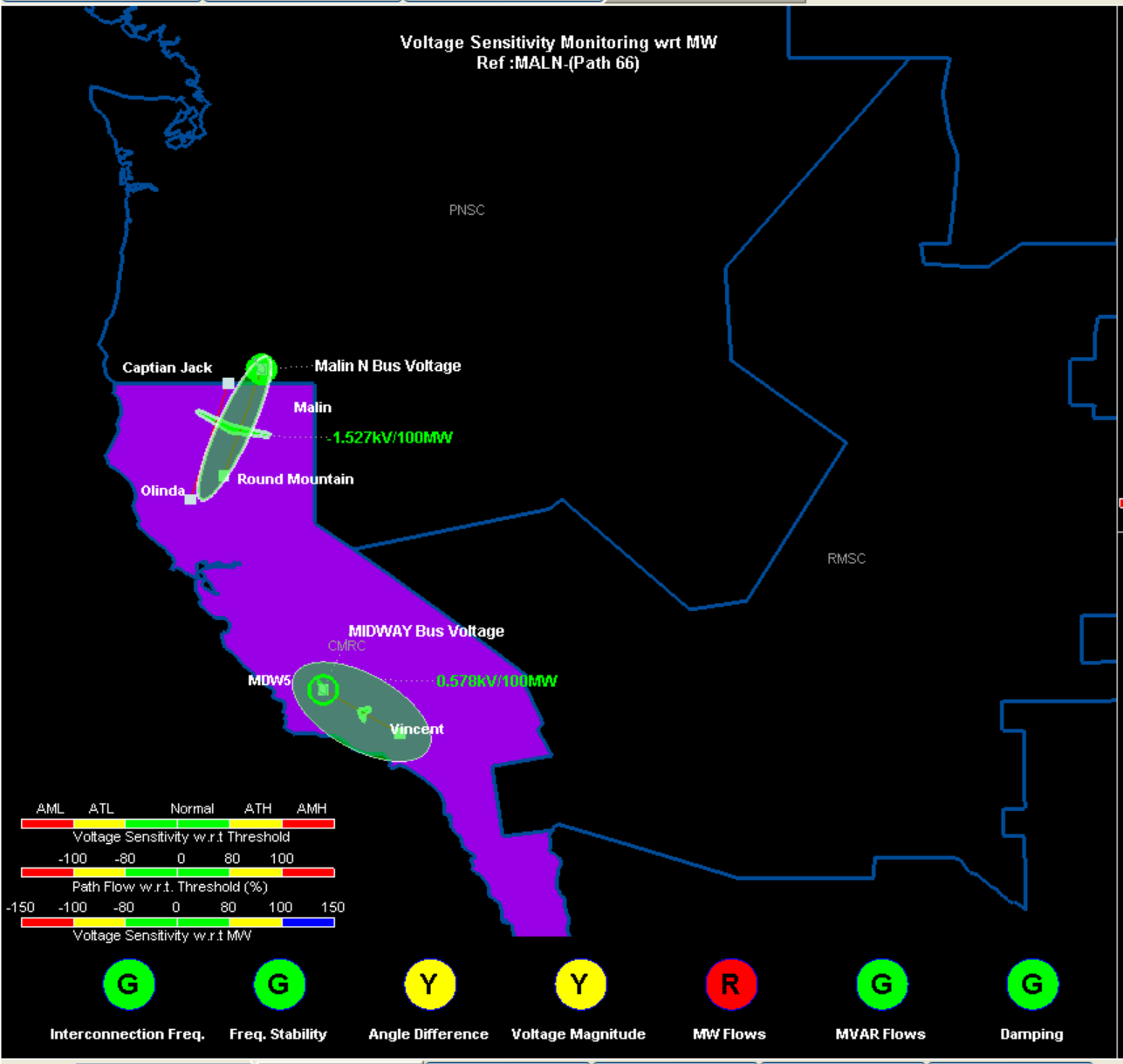
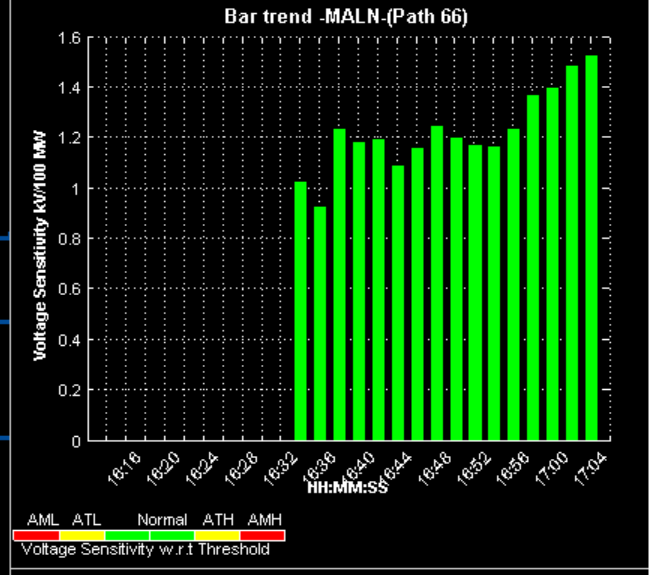
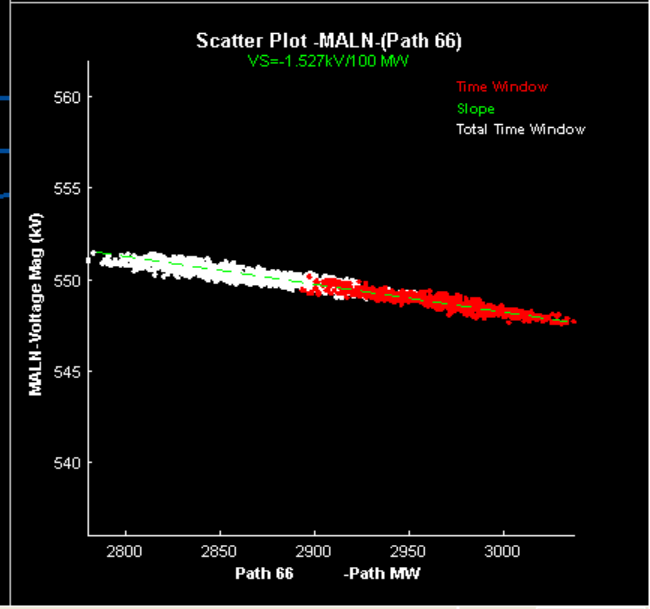
Phasor Real Time Dynamics Monitoring System (Phasor-RTDMS™) - Visualization and Event Alarms Client v5.5

Dashboard | Interconnection | Reliability Coordinator | Local Area | Reports | Event Files | Alarms | Configurati... | Help







G	G	Y	Y	R	G	G
Interconnection Freq.	Freq. Stability	Angle Difference	Voltage Magnitude	MW Flows	MVAR Flows	Damping

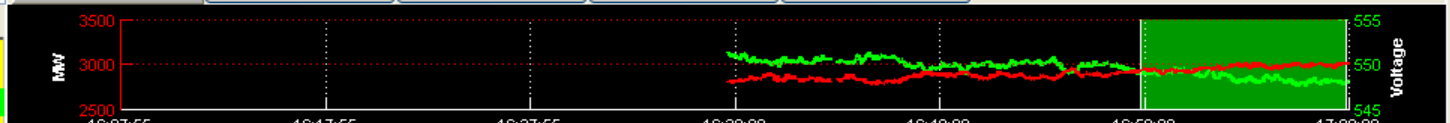
Date/Time 29-May-2008 17:08:00 PDT

Auto Refresh

VS Flows (MW)

Connected (Refresh Rate: 5 Second)

Scrolling Chart | Panel 1 Data | Panel 2 Data | Panel 3 Data | Panel 4 Data

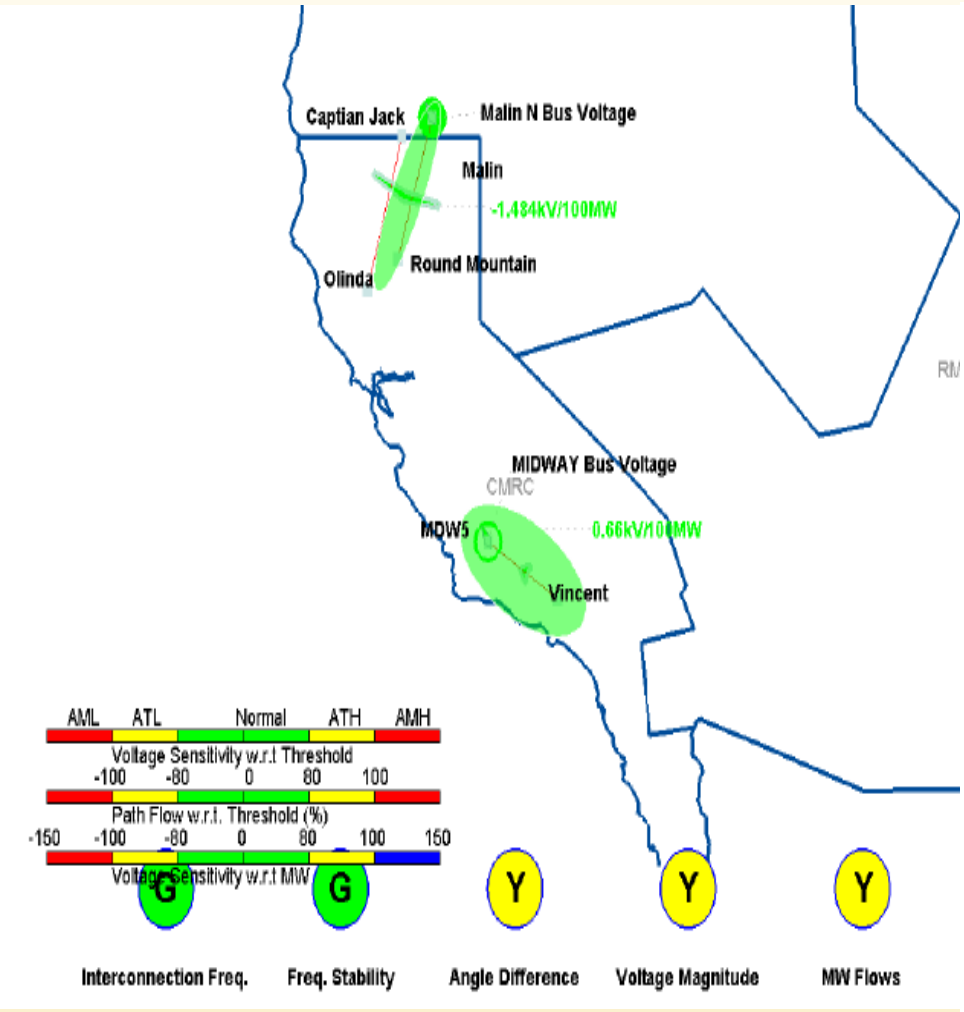


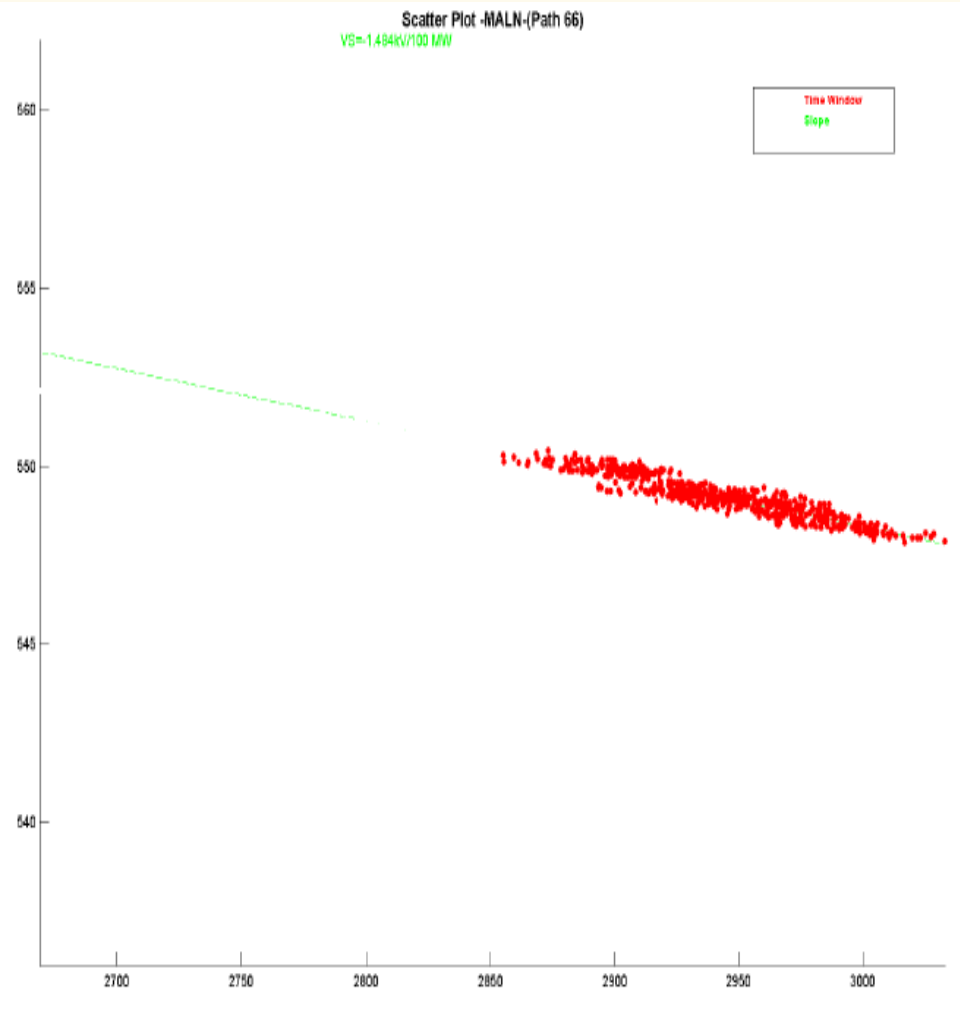
Replay

Frame:

Normal

Voltage Sensitive Plots





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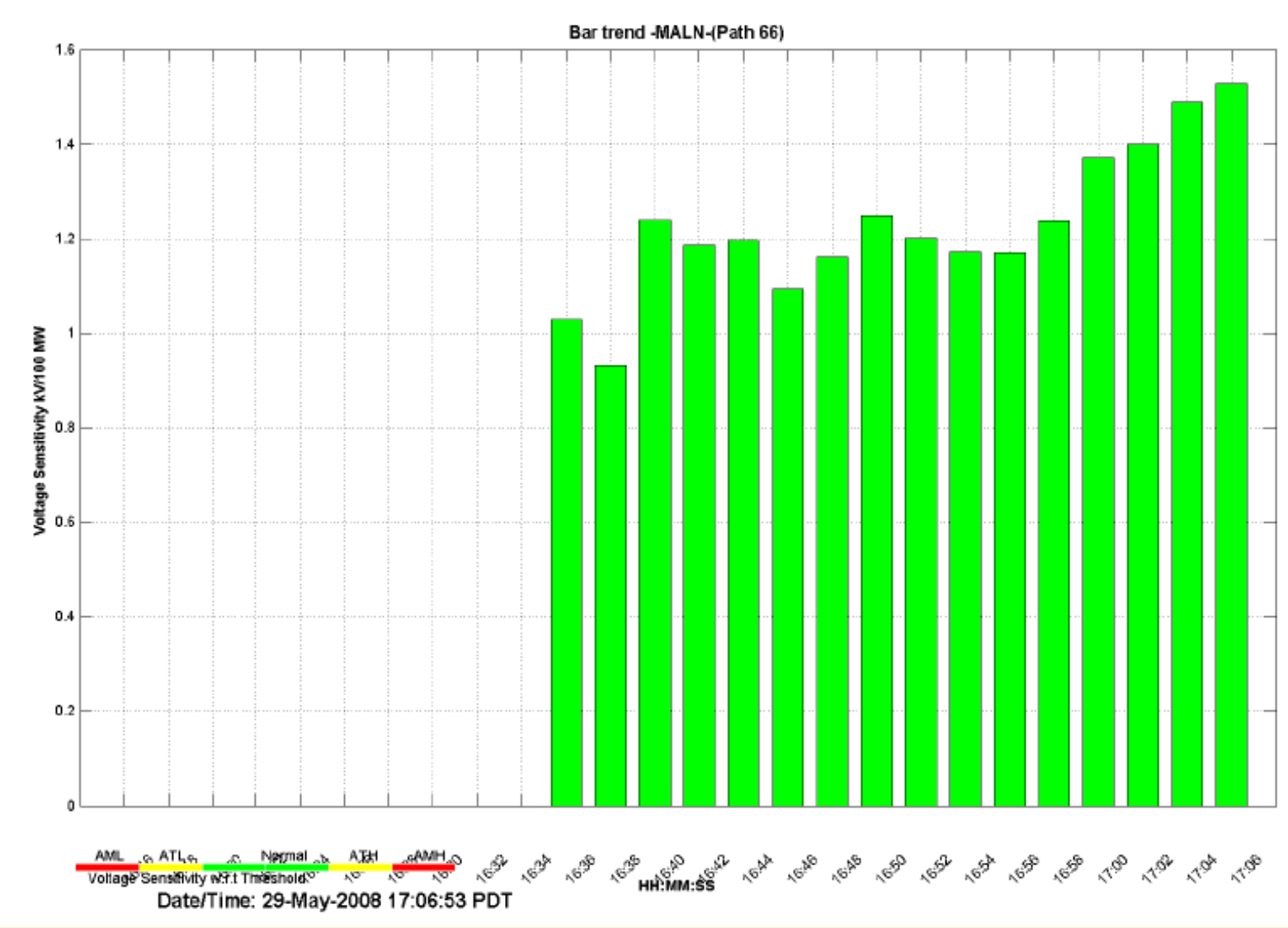
Voltage Sensitive



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Phasor Real Time Dynamics Monitoring System (Phasor-RTDMS™) - Visualization and Event Alarms Client v5.5

Dashboard | Interconnection | Reliability Coordinator | Local Area | Reports | Event Files | Alarms | Configurati... | Help

All: Voltage (Magnitude & Angle) Monitoring
(Ref: GC50.Grand Coulee Line Voltage)

BEL5.Bell 500 kV Voltage-W
545kV∠2°

PNSC

JDAY.John Day Bus Voltage
548kV∠-17°

703/3000
Broadview
Colstrip

Captian Jack
Malin
3072/4800
Round Mountain
Olinda

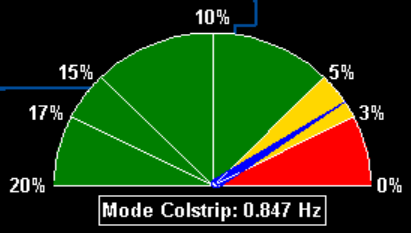
RMSC

CMRC
MDW5
175/3000
Vincent
VN01.Vincent 500 kV Voltage
540kV∠-31°

Low Normal High
Voltage Maganitude Legend

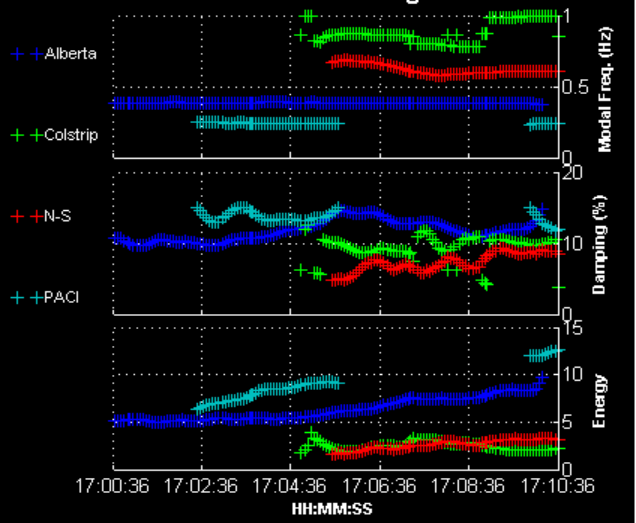
-90 -60 -30 0 30 60 90
Voltage Angle Legend (°)

-100 -80 0 80 100
Path Flow w.r.t. Threshold (%)

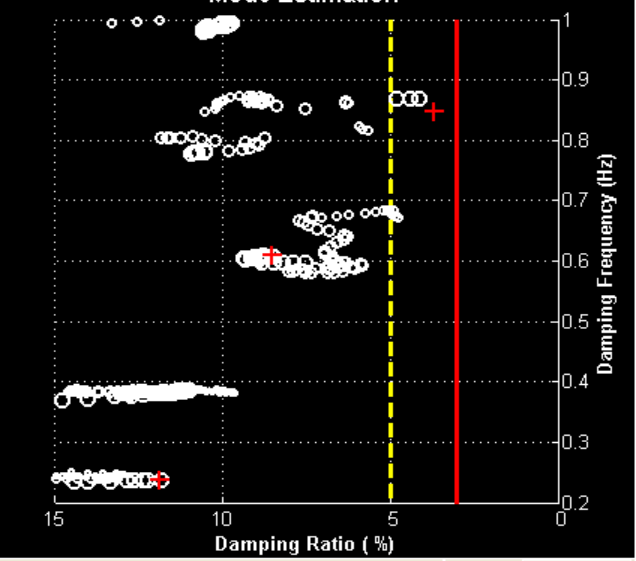


G	G	Y	Y	R	G	Y
Interconnection Freq.	Freq. Stability	Angle Difference	Voltage Magnitude	MW Flows	MVAR Flows	Damping

Mode Trending



Mode Estimation



Date/Time 29-May-2008 17:10:38 PDT

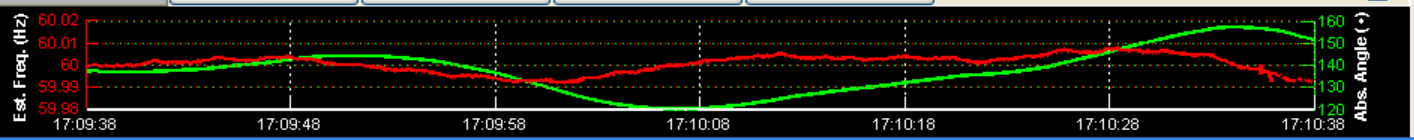
Auto Refresh

Voltage Angle

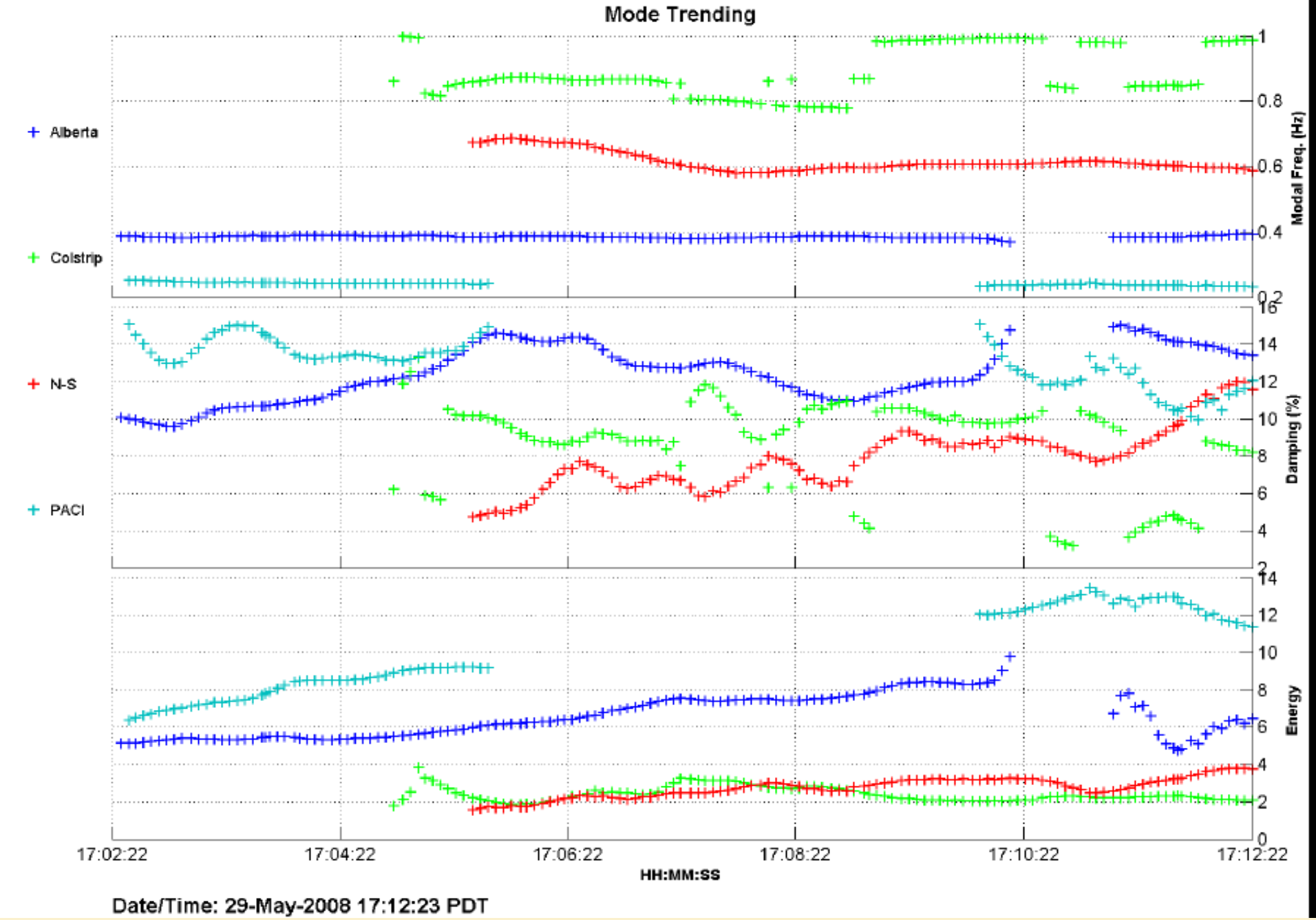
Connected (Refresh Rate: 5 Second)

EPG GRID-3P®, U.S. Patent 7,233,843

Scrolling Chart | Panel 1 Data | Panel 2 Data | Panel 3 Data | Panel 4 Data



Replay


Mode Trending
Alberta
Colstrip
N-S
PACI
Modal Freq. (Hz)
Damping (%)
Energy
17:02:22
17:04:22
17:06:22
17:08:22
17:10:22
17:12:22
HH:MM:SS
Date/Time: 29-May-2008 17:12:23 PDT

WECC Wide Area Measurement Task Force Update

- ***2008 Goals:***

  Sign data sharing agreement

  Rebroadcast real-time SynchroPhasor Data to participating transmission operators

  - SCE, BPA, PG&E, WALC
  - Provide secure web portal for access to key files

  Add new TO participants (BC Hydro, others?)

  Improve real-time displays for operators

  Improve off-line tools for analysis of events

  New training materials of users of the system

WECC Wide Area Measurement Task Force Update

- ***Status:***

  Data Sharing agreement -
  Ready to review draft with Transmission Operator participants

  Rebroadcast real-time SynchroPhasor Data –
  Ready to test final software implementation.

  Provide secure web portal for access to key files –
  Design complete and ready for participant testing

  Add new TO participants (BC Hydro, others?) - pending

  Improve real-time displays for operators – new software installed

  Improve off-line tools for analysis of events – new tool ready

  New training materials for users of the system – done

  Create WECC Project Plan - started