

### PMU Signal Validation – Needs and Ongoing Efforts

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## WECC RC October 22, 2012 NASPI

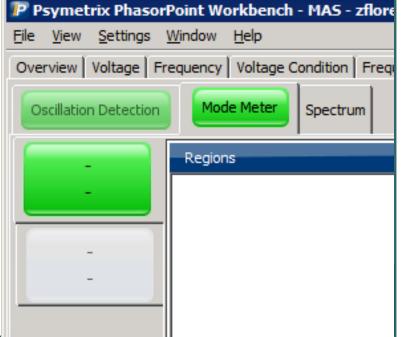
## Today's Objective

- Discuss the need for PMU data validation;
- Provide some real-life examples of bad data and what is being done to make it usable in operations; and
- Describe methods being used to measure signal quality



## Quality Data Need

- Data must be reliable and available prior to operating staff trust and accept
- Applications are dependent on "good data"
  - Oscillation Detection
  - Mode Meter
  - Voltage Stability Analysis
     State Estimator



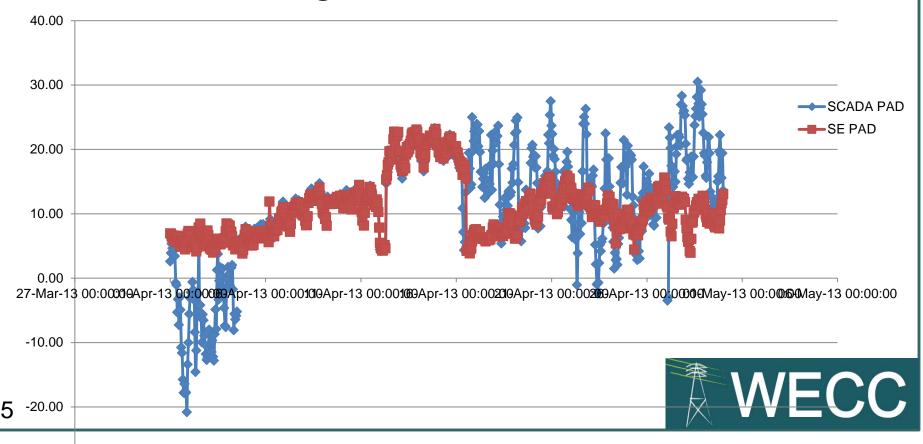
## WECC RC Phasors

- RC collaborates with entities to set-up
- Nearly 1,000 phasors ready for evaluation
   From 15 entities
- RC analyzes each phasor



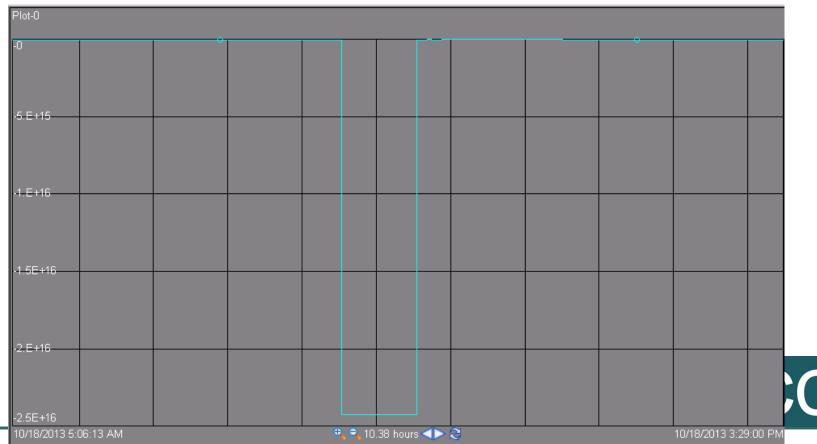
## State Estimator Example

• Angle integration provides a much more consistent angle solution



## State Estimator Example

 Angle measurements need application level validation through reasonability checks



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# Systems in PMU set-up

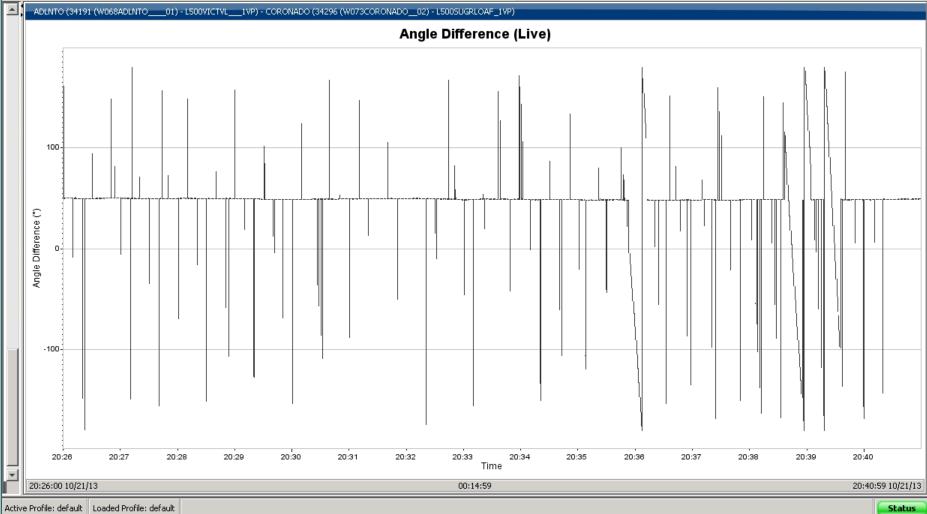
- There are five general types of systems involved in data transfer:
  - Measurement units (PMUs);
  - Signal collection units (PDCs);
  - PMU data analysis and display (VSA, WAV, PP, eTV);
  - Network infrastructure (WAN); and
  - o Data archive and configuration (PI, Registry).

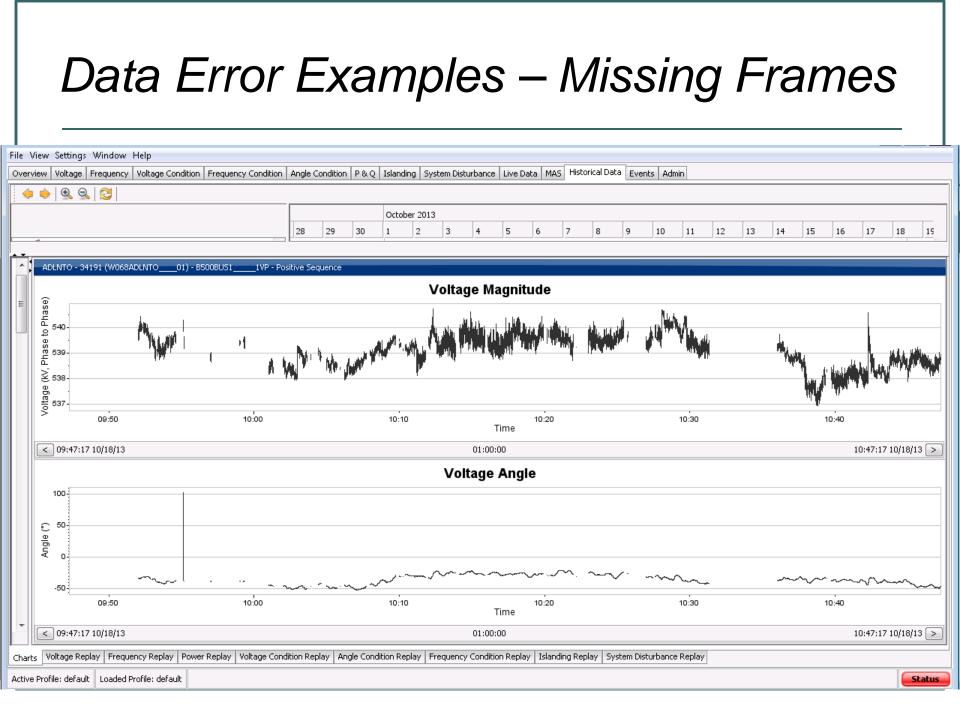


## Data Error Examples - Spikes

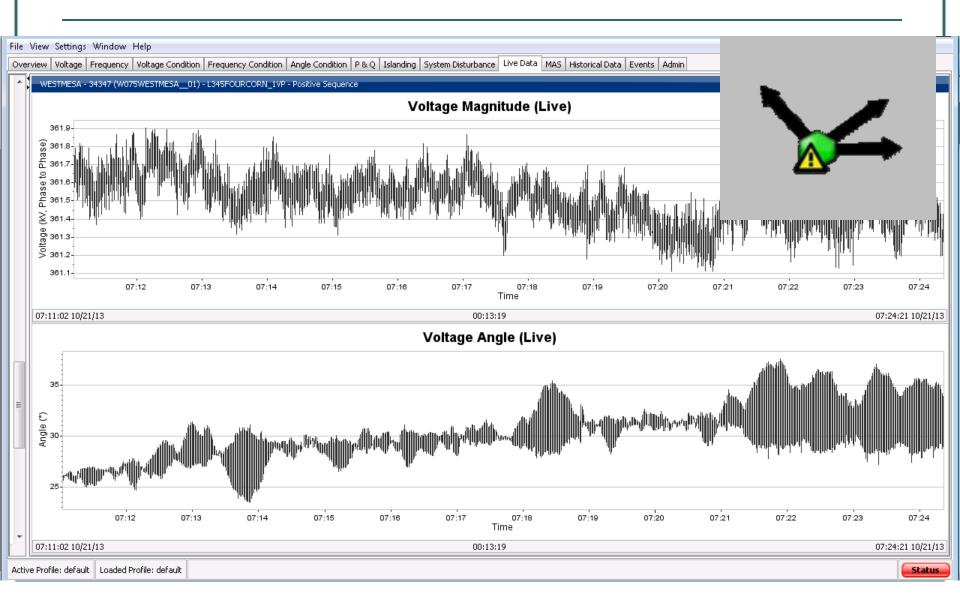
File View Settings Window Help

Overview Islanding MAS System Disturbance P & Q Frequency Voltage Frequency Condition Voltage Condition Angle Condition Live Data Historical Data Events Admin Test





## Data Error Examples – Angle Error



## Collaborations

- The setup process involves these roles:
  - o Entity participant users;
  - Modeling engineers;
  - Application Support engineers (ASE);
  - o EMS support engineers; and
  - Harris Corporation network engineers (WAN connectivity).



## **Phasor Validation**

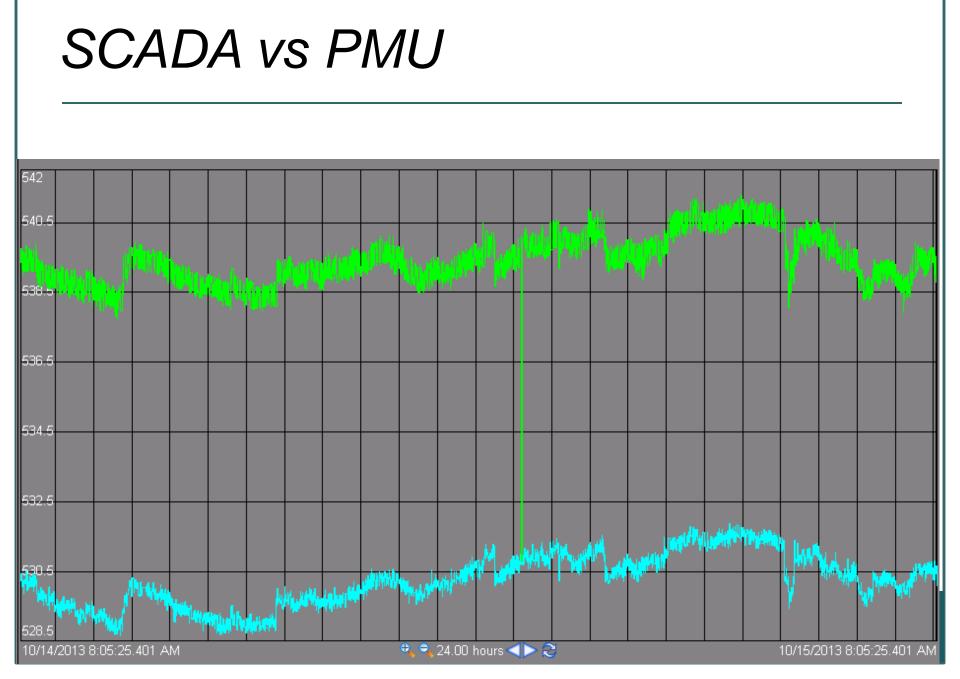
- First validation test includes:
  - Naming Convention
  - o Latency
  - o Missing Frames
  - o Positive Sequence
  - No analog or digital signals
  - o Flat line
  - o Spikes



## **Phasor Validation**

- Reasonability Check
  - o Phasors are polar
  - o Voltages are volts
  - o Currents are amps
- Second validation test includes:
  - Names align with actual equipment being metered
  - Within a tolerance of SCADA or SE values
     Angles align with interconnection





## Data Validation Tools

### PhasorPoint

#### 🛯 Statistics

Current Time Period: 12:42:48 10/9/13 - 13:12:48 10/9/13

Start	12:42:48	Wed 10/09/2013	•
End	13:12:48	Wed 10/09/2013	•
Duration	00:30:00 🛨	Time Zone Local Time	•

10	D Name	%Available %GPS	Locked %Da	ata Valid
	34401W017HALLEN06	100	100	100
	34283 W030CRANBROK01	100	100	100
	34442 W030DUNSMUIR01	100	100	99.998
	34284 W030INGLEDOW01	100	100	99.998
	34286W030MICA01	100	100	100
	34440W030MINETTE01	100	100	0
	34287 W030NICOLA01	100	100	0
-	34288 W030REVELSTK01	100	100	100
•				



## PDC Data Dashboard

– PMU(s) Flatlined Frequencies –			PMU(s) Flatlined Phasors	
W030NICOLA01 W030MINETTE01 W066PINPKAPS01 W066WESTWING01 W066WESTWING02		•	W030SELKIRK01.L500CRANBROK_1IP W066FOURCORN02.T345FCORN230_2IP W068SYLMARCM01.L220CELILO1VP W068SYLMARCM02.L220CELILO1IP W073HASSYYAM01.L500PALOVRDE_2IP	•
	Count:	11	Count:	8

PMU(s) In Error State W030NICOLA01 W030MINETTE01 W068MCLLGH01 W073CORONADO02 W092LUGO01 W092SONGS01 W106LANGDON01 W106LANGDON03 W092MIR_LOMA01			
	Count:	9	

- Disconnected PDCs
- Flatlined signals
- PMUs in Error State



## PDC Data Dashboard

#### W001BOUNDARY\_01

PMU	Individual PMU details include:
ID Code: 34331	<ul> <li>Manufacturer</li> </ul>
Manufacturer: SEL	
Serial Number:	Signals
Comissioned Date: 3/31/2015 12:00:00 AM	• Owner
Sub Station: Boundary	<ul> <li>Substation</li> </ul>
Owner: Bonneville Power Administration	
PDC: Select a PDC View	
Backup: Select a PMU View	
Measurements — Measurement Description —	
A230FREQ 1R This is measuring the dfreq of a(n)	) analog. The nominal voltage for this lated warning thresholds are: LOW- 0 esholds are: LOW- 0 HIGH- 0.

Measurement Reviews

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#### A230FREQ\_\_\_\_1F\_\_ L230USK\_\_\_\_1IP L230

L230NELWAY

1F

2IP

A230FRE0

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## PDC Data Dashboard

MainWindow								
Dashboard Live PMU Status PMU(s) Iss	ue Trac	ker Co	ontacts	• [	Export csv			
· · · · · · · · · · · · · · · · · · ·					•			
Search:								
W001BOUNDARY_01		A	В	С	D			
W001BOUNDARY02	1		Station Name	_	Signal Name			
W001BOUNDARY03	2		ALLSTON	W001ALLSTON 01	A500FREQ 1R			
W001BOUNDARY04 W001ALLSTON 01	3		CRGCU	W010CRGCU 01	A345FREQ 1R			
W001ALLSTON02	4	TSGT	CRGCU	W010CRGCU 01	A345FREQ 1F			
W001ALVEY01	5	TSGT	CRGCU	W010CRGCU 01	L345AULT 1IP			
W001ALVEY02	6	TSGT	CRGCU	W010CRGCU 01	L345AULT 1VP			
W001ASHE01 W001ASHE 02	7	NVE	HALLEN	W017HALLEN 01	A500FREQ 1R			
W0018ELL 01	8	BCH	CRANBROK	W030CRANBROK 01				
W001BELL02	9	IPCO	BOISEBCH	W034BOISEBCH 01	A230FREQ 1F			
W001BELL03	10	IPCO	BOISEBCH	W034BOISEBCH 01	A230FREQ 1R			
W001BELL04	11	I IPCO	BOISEBCH	W034BOISEBCH 01	B230BUS 1VP			
W001BIG_EDDY01 W001BIG_EDDY_02								
	A							
1 10/9/2013 11:44:03 PM -	10/9/2013 11:44:03 PM - [Error] - W001JOHN DAY 03.B500EAST 1VP could not be found in the registry							
2 10/9/2013 11:44:03 PM - [Error] - W001JOHN DAY 03.B500WEST 1VP could not be found in								
3 10/9/2013 11:44:04 PM -				ld not be found in the registr				
4 10/9/2013 11:44:04 PM - [Error] - W001MARION 03.L500ASHE 2IP could not be								
5 10/9/2013 11:44:05 PM					d not be found in the regist			
3				X	VVECU			

## Excel and PI

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- Calculates statistics only on application signals
  - Phase Angle Difference monitoring, Mode Meter, and VSA

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#### **Bad Phasor Point Data Statistics- 30 Days Sampling**

Based on below filter angle and non-numerical values.

180	Click F9 to Recalculate When Data Have been Modified or CLICK Autocalculate bu								
-180									
SUBSTN	Bad Points	% Bad Points							
AULT	457	5.3							
COLSTRIP	3748	43.4							
CUSTER	45	0.5							
HALLEN	64	0.7							
HASSYYAM	783	9.1							
INTMTN	46	0.5							
LANGDON	3534	40.9							
MALIN	45	0.5							
MIDPOINT	48	0.6							
MIGUEL	45	0.5							

## VBA and PI with Excel Interface

### Utilizes VBA to run multiple loops through both Phasor and EMS PI historians

ICCP Tag Name									
SUBSTN.NICOLA.ZBR.MICA_NIC19Z2.MEA.KV				DMILE	Error Da	ta			╧┓
PMU Tag Name	PMU Error	Juration (s)	PMII Error Value			PMU Error Start Tin	PMILEr	ror Cleared Tin	ne
W030NICOLA01.L500MICA1VP.M			I/O Timeout	T MO TOLU	Enors	9/5/2013 16:		9/26/2013 9	_
			I/O Timeout			9/26/2013 9:		9/29/2013 0	
ICCP Total Points			iyo milcout			5/20/2015 5.		5/25/2015 0	
1352									
PMU Total Points									Т
2583315									
ICCP Expected Points	ICCP D	eviation Dat	a	PMU Deviation Data					
	ICCP Time	ICCP Value	(KV) PMU Devia	tion Time	PMU D	eviation Value (KV)	PMU Tota	l Deviations	
PMU Expected Points									
% Good PMU Performance									
% PMU Error Performance									

## Challenges

- The massive amount of data and the collaboration involved requires new tools and processes
- Send results to entities

   Verify results on their end
   Work together to correct issues
- What is "good data"?
   O What values should be used for tolerances?



