

NASPI WG Panel Session

PG&E Experience and Lessons Learned

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Initial Synchrophasor Deployment at PG&E

- Installed for WISP with DOE Cost Share (2009)
- PMUs in existing RAS relays
- 202 PMUs, 101 redundant measurement locations (line voltages and currents)
- 24 Substation PDCs, 12 redundant locations
- 4 control center PDCs, 2 redundant locations
- Architecture is NERC CIP compliant (Operational Data Network, PCAs vs BCAs)
- 61850 communications protocol between PMUs and substation PDCs, and between substation PDCs and control center PDCs (Field Gateways)
- 2 WISP Gateways delivering data to PeakRC

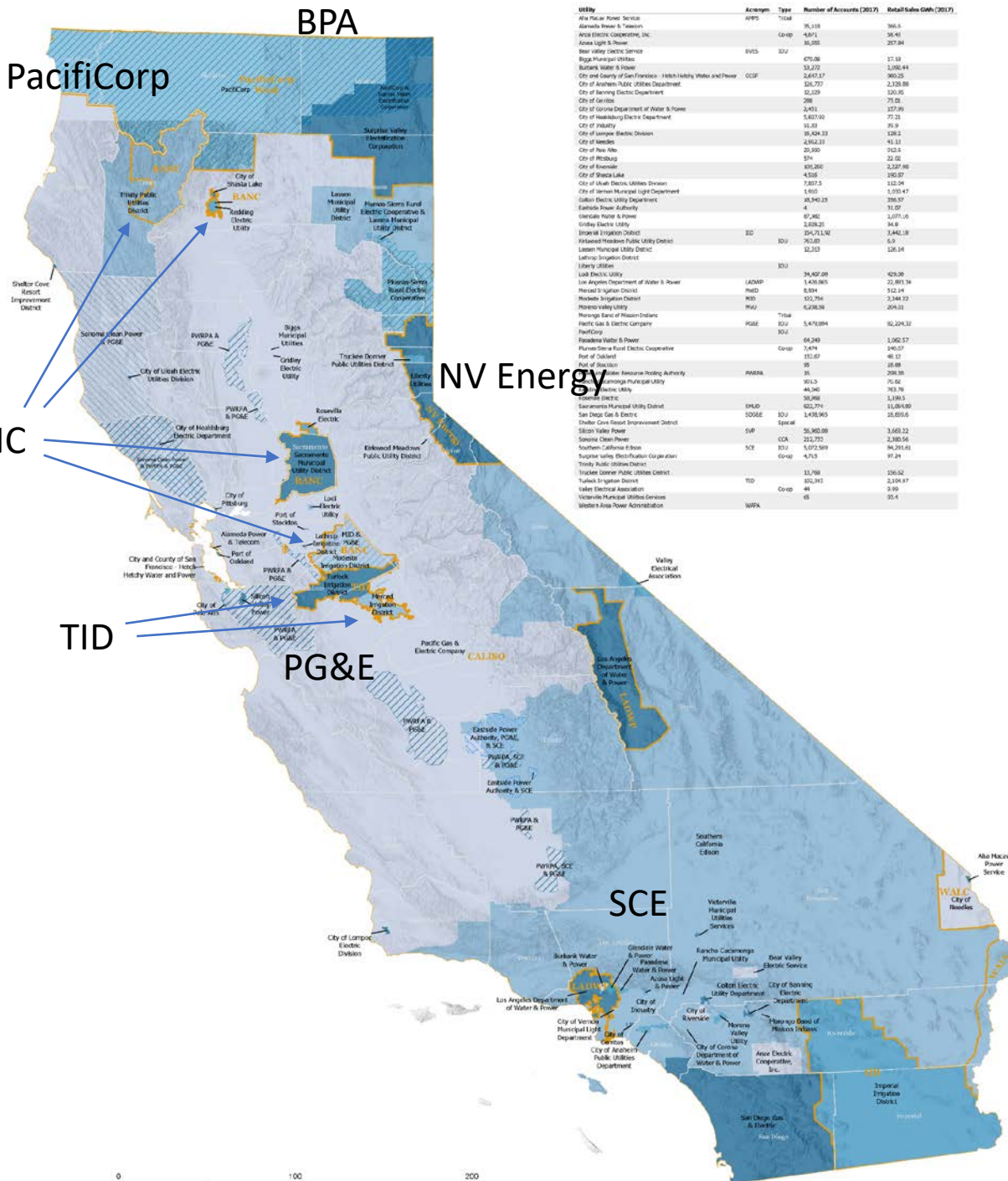
Enhancements

- Installed 3 PMUs on generator terminals at 2x1 combined cycle power plant (MOD-26 & MOD-27)
- Established Transmission Operations Synchrophasor Test Lab (TOSTL)
- Initial deployment had low availability and high latency, changed communications protocol from substation PDCs to control center PDCs to 37.118 resulting in greatly enhanced data availability
- Replaced all substation GPS clocks
- Added 6 PMUs monitoring 500 kV bus voltages and line currents
- Standardized on general purpose PMU/PDC appliance for future PMU/PDC installations monitoring bus voltages and line currents
- Established PMU/PDC lifecycle program
- 2 WISP Gateways sending data to CAISO RC West via managed ethernet 10Mbps

Future Enhancements

- All lifecycle PMU/PDCs will stream 37.118 to control center Field Gateways and measure bus voltages and line currents
- PMUs will be independent of substation relays
- Improve system-wide availability
- Improve access to archived data
- Establish OSISoft PI archive on corporate network
- Install PMUs on 500 kV tie-lines to two STATCOMs (Gates and Round Mountain)
- Install PMUs on 500 kV tie-lines to the 300 MW/1200 MWh Dallas Battery Energy Storage System at Moss Landing (world's largest battery energy storage project)
- Install PMUs on all tie-lines with other utilities (BAL-003)

Neighboring Electric Utilities and Balancing Authorities



Utility	Agency	Type	Number of Accounts (2017)	Retail Sales GWh (2017)
Alta Power Service	APPS	Total	35,118	36.6
Alameda Area Electric	Co-op		4,871	36.41
Area Electric Cooperative, Inc.	Co-op		30,305	257.94
Area Light & Power	BVPS	337	479.28	17.19
Bear Valley Electric Service			50,272	1,036.44
Bay Municipal Utility			2,643.17	360.25
City and County of San Francisco - Hetch Hetchy Water and Power	CCSF		101,757	2,128.88
City of Anaheim Public Utilities Department			52,109	120.09
City of Berkeley Electric Department			298	71.02
City of Carlsbad			2,451	127.99
City of Concord Department of Water & Power			5,827.92	77.21
City of Industry			91.81	91.9
City of Long Beach Electric Division			95,426.13	1,082.1
City of Los Angeles			2,922.31	41.11
City of Los Altos			25,750	122.5
City of Pittsburg			379	22.02
City of Escondido			891,265	2,237.88
City of Escalon			4,555	105.07
City of Ukiah Electric Utilities Division			7,817.3	112.24
City of Yuba Municipal Light Department			1,610	1,015.47
Colton Electric Utility Department			25,942.13	208.97
Eastside Power Authority			4	31.07
Golden Gate & Power			97,242	1,077.15
Gridley Electric Utility			2,038.21	34.6
Imperial Irrigation District	ID		254,711.92	3,442.18
Imperial Municipal Public Utility District	ID	101	70,820	6.9
La Grange Municipal Utility District			12,113	126.14
Liberty Utilities	UD		34,407.28	429.26
Los Angeles Department of Water & Power	LAOWP		1,416,265	22,903.38
Madera Irrigation District	MID		8,934	512.14
Madera Municipal Utility District	MUD		152,794	2,344.12
Mendocino Electric Utility	MEU		6,248.28	409.11
Monrovia Banc of Mission-Indians	MBI	Total	5,470,894	92,224.32
North Coast Electric Company	NCEC		64,249	1,062.17
Northridge Water & Power	Co-op		7,474	146.07
Northridge Public Utilities Cooperative	Co-op		157.67	46.12
Northridge Public Utilities			99	18.88
Orange Electric Utility	OEU		35	208.98
Orange Municipal Utility	OMU		301.3	70.52
Orange Electric Utility			46,246	787.76
Orland Electric			58,968	1,194.5
Sacramento Municipal Utility District	SMUD		425,774	11,064.89
San Diego Gas & Electric	SDG&E	UD	1,418,265	21,659.6
Shafter City of Shafter Improvement District	SCID	Special	36,380.88	3,662.12
Silicon Valley Power	SVP		212,723	2,380.56
Sonoma Clean Power	SCP	UD	1,072,589	84,291.61
Southern California Edison	SCE	UD	47.13	97.24
Southern Valley Distribution Corporation	Co-op		53,768	126.62
Tulare County Public Utilities District	TCPUD		25,742	2,194.17
Tulare Irrigation District	ID		48	9.99
Valley Electrical Association	Co-op		68	92.4
Vallejo Area Power Administration	WAPA			

Archives

- Original archives openHistorian and PhasorPoint distributed among multiple servers
- Future archives moving to a combination of openHistorian and OSISoft PI (150 TB, 3 years)
- OSISoft PI will be deployed on corporate network to make data available enterprise wide (PRC-002-2, MOD-033)

Lessons Learned

- Utilize 37.118 until there is a new standard
- Install on NERC CIP-compliant network even if applications will not be used by grid operators initially
- Install reliable GPS clocks
- Utilize PMU/PDCs independent of substation relays
- Establish support network including IT system administrators, network operations, communications technicians, protection engineers, automation engineers, and substation electrical technicians

Data Availability Dashboards

