



# PI System Rollout in Remote Hydroelectric System



Presented by **Matt McPheeters**  
**Power Generation**



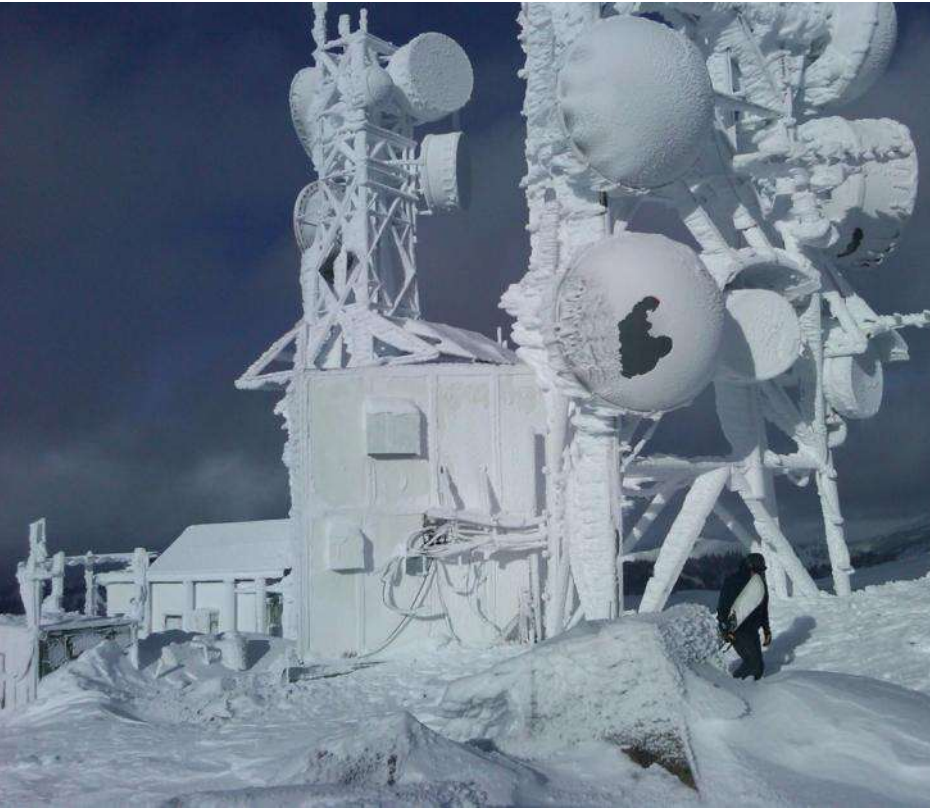
## Power Generation Department operates the nation's largest privately-owned hydroelectric system.

- **68** powerhouses with **109** units
- **413** miles of water conveyance
- **99** reservoirs
- **171** dams
- **16** river basins stretching nearly
- **500** miles from Redding to Bakersfield.
- **140,000** acres of watershed lands
- **26** operating licenses issued by the Federal Energy Regulatory Commission (FERC).

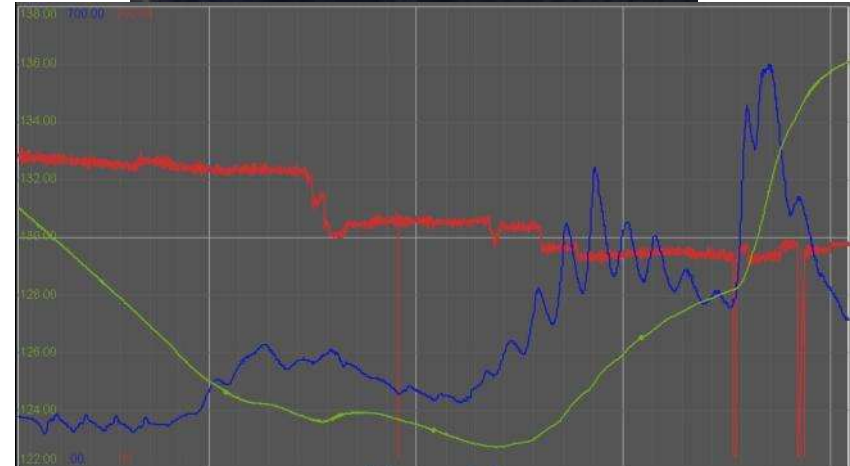
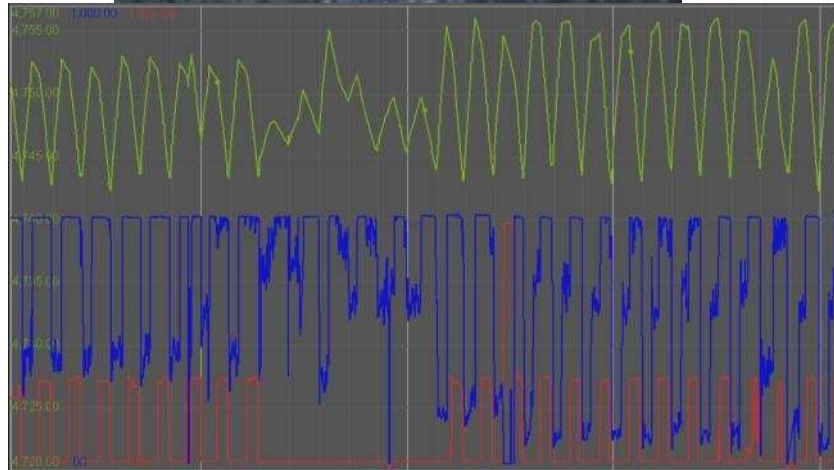
Power Generation also operates and maintains several solar generating facilities, natural-gas-powered generating stations at Gateway, Colusa, and Humboldt Bay.



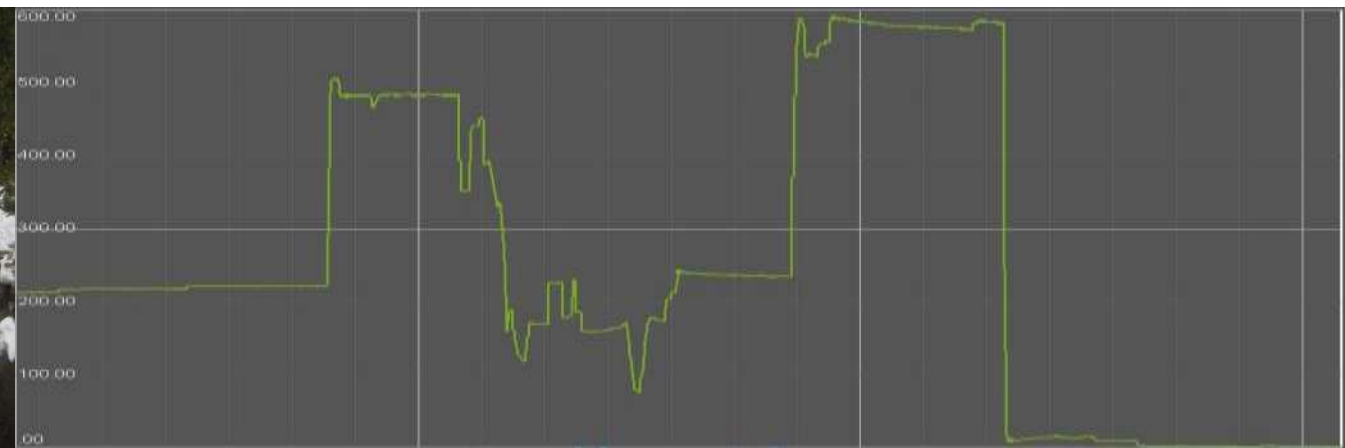
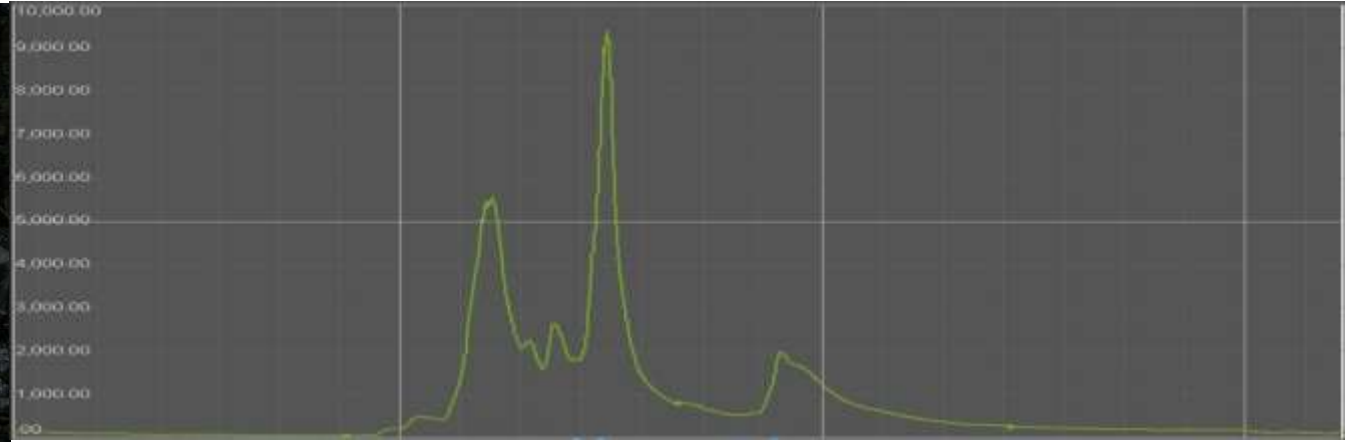
# Challenge 1: Remote Location



# Hydro Source Data – Reservoir Storages

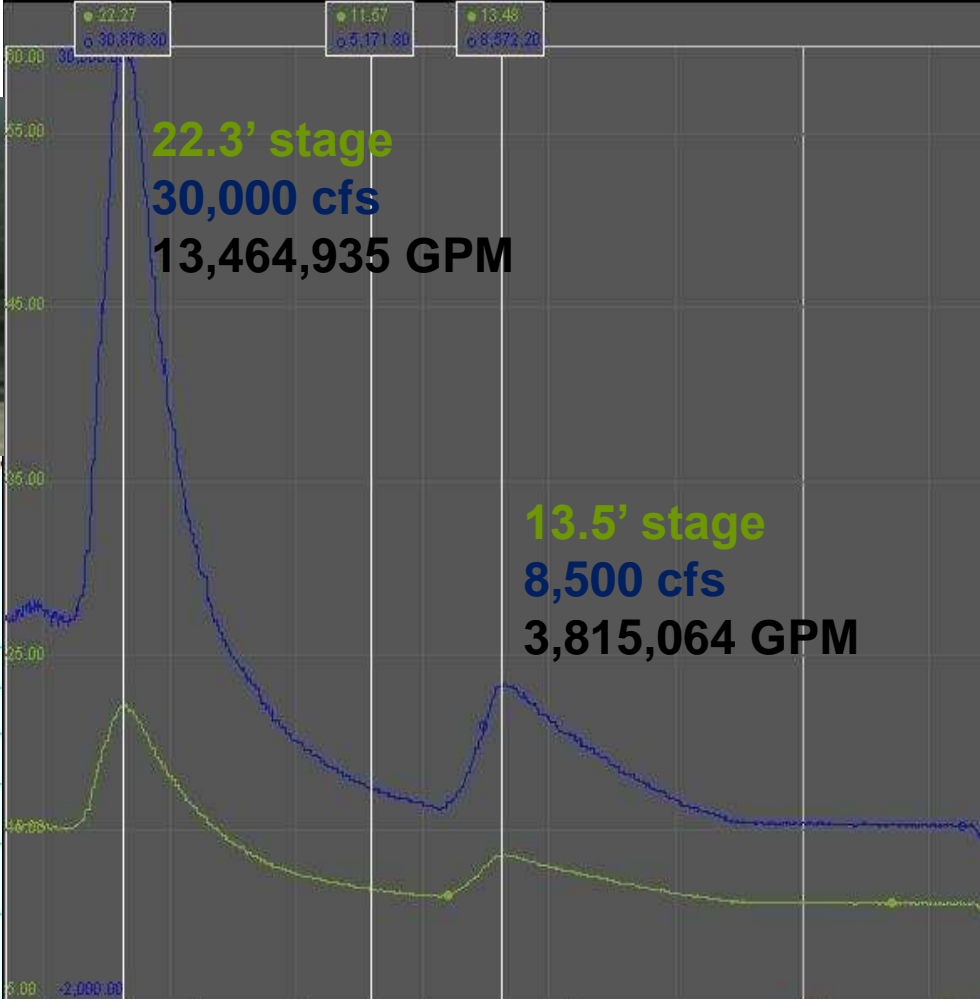
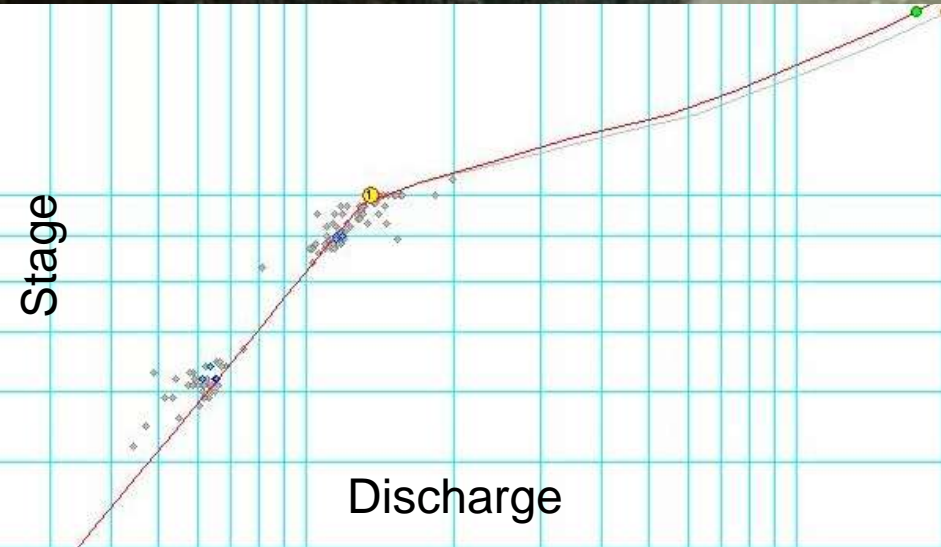


# Hydro Source Data – Conveyance Flows

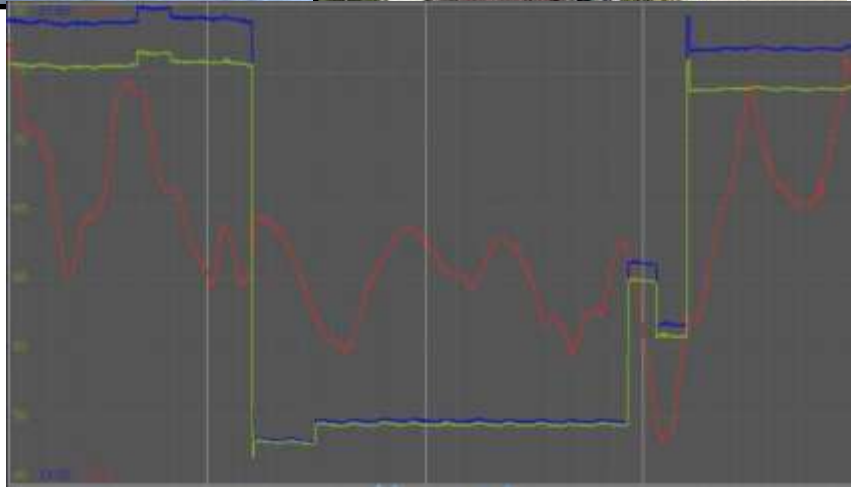
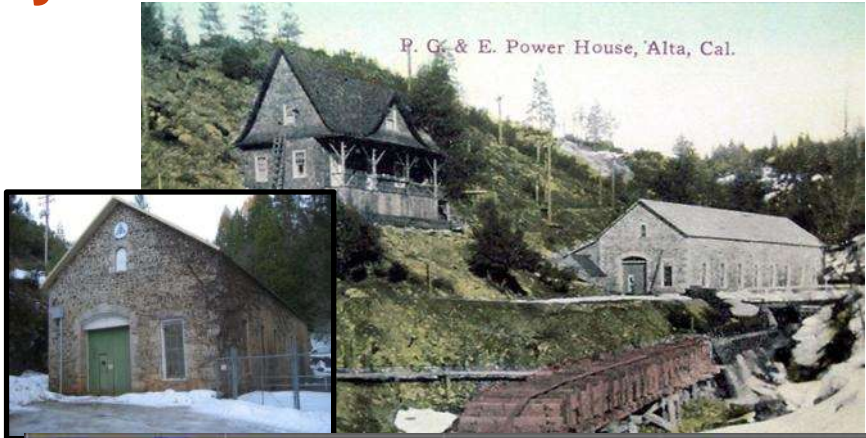




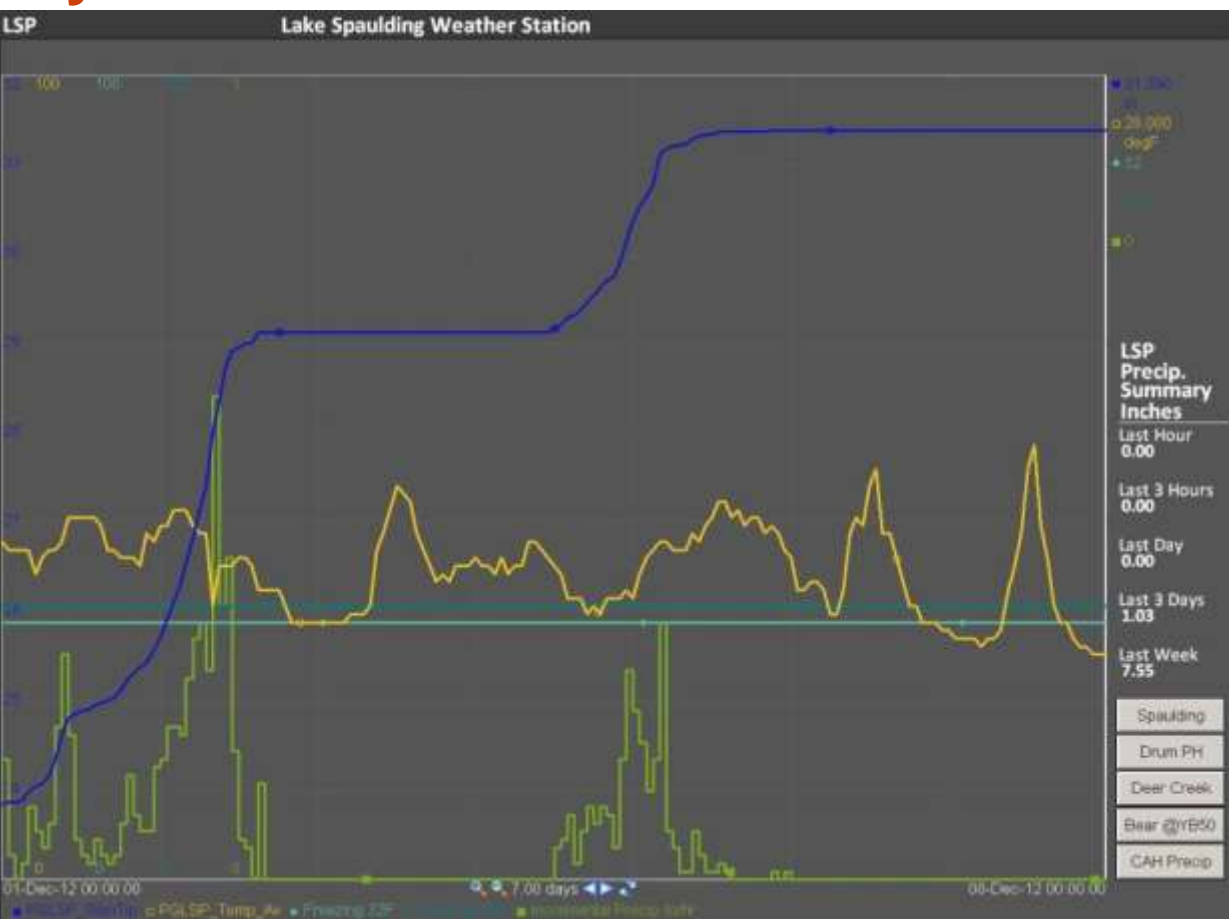
# Rated Flows



# Hydro Source Data – Powerhouses



# Hydro Source Data – Weather Stations

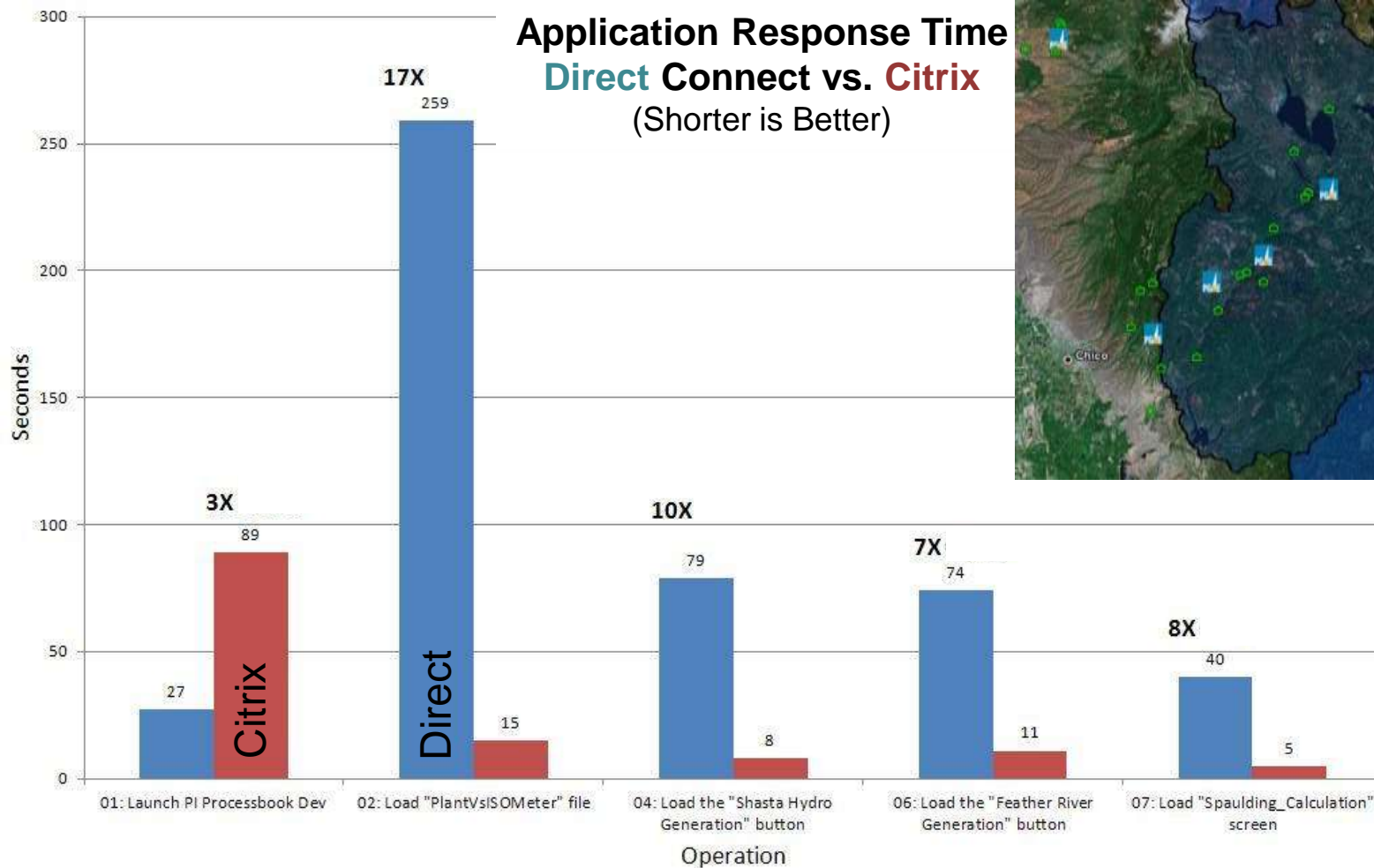




# Application Response Time

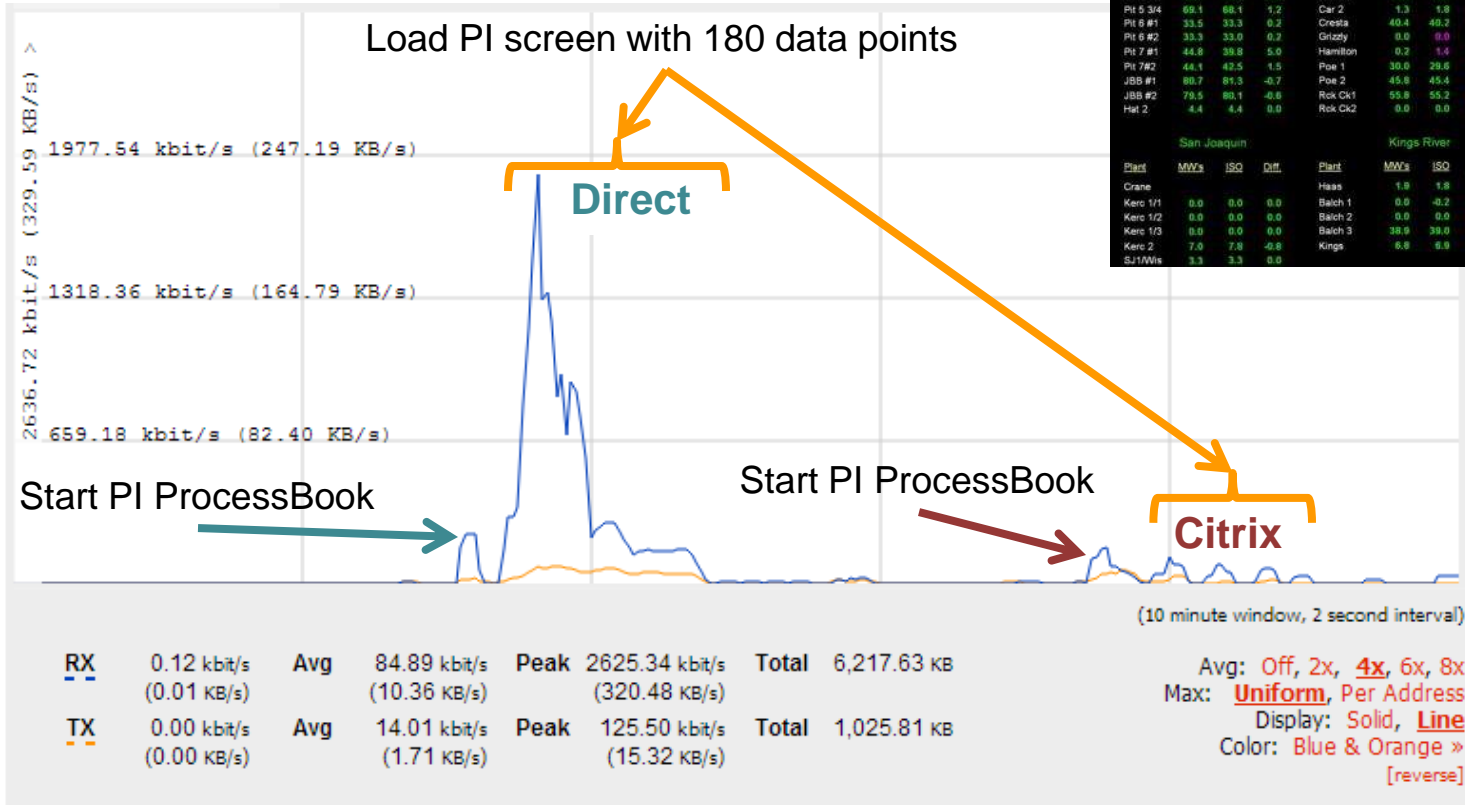
## Direct Connect vs. Citrix

(Shorter is Better)



# Direct Connection vs Citrix Connection

## Data Transmission Comparison



PG&E Generation MW's vs. ISO metering

Grip Main Menu

Shasta				Feather				So. Yuba				Mokelumne			
Plant	MW's	ISO	Diff.	Plant	MW's	ISO	Diff.	Plant	MW's	ISO	Diff.	Plant	MW's	ISO	Diff.
Plt 1 #1	22.1	21.9	0.2	Belden	0.0	0.0	0.0	Alta	0.1	0.1	0.0	Electra	64.8	75.0	-9.0
Plt 1 #2	9.1	9.0	0.1	Bucks	0.0	0.0	0.0	Deer Creek	0.0	0.0	0.0	Salt 1/2	3.8	3.8	0.0
Plt 3	0.0	-0.4	0.4	Butt Vly	0.0	0.0	0.0	Drum 1/2	0.0	-0.1	0.1	Tiger Ck	40.9	40.1	0.8
Plt 4	41.6	41.3	0.3	Car 1-1	0.9	0.8	0.1	Drum 3/4	0.0	-0.2	0.2	West Pt.	14.0	13.9	0.1
Plt 5 1/2	14.7	14.3	0.5	Car 2/3	0.0	0.0	0.0	Drum 2	50.5	50.3	0.1				
Plt 5 3/4	69.1	68.1	1.0	Car 2	1.3	1.8	-0.3	Dutch 1	22.4	22.2	0.3				
Plt 6 #1	33.5	33.3	0.2	Cresta	40.4	40.2	0.1	Dutch 2	0.0	0.0	0.0				
Plt 6 #2	33.3	33.0	0.2	Groby	0.0	0.0	0.0	Halsey	5.4	5.3	0.1				
Plt 7 #1	44.8	39.8	5.0	Hamilton	0.2	1.4	-1.3	Newcast	4.3	4.0	0.3				
Plt 7 #2	44.1	42.5	1.5	Poe 1	30.0	29.6	0.2	Wise 1	9.3	9.0	0.2				
JBB #1	80.7	81.3	-0.7	Poe 2	45.9	45.4	0.4	Wise 2	0.0	0.0	0.0				
JBB #2	79.5	80.1	-0.6	Rok Ck1	53.8	53.2	0.6	Spauld 1+2	2.0	2.0	0.0				
Hat 2	4.4	4.4	0.0	Rok Ck2	0.0	0.0	0.0	Spauld 3	0.0	0.0	0.0				

San Joaquin				Kings River				Helms				Narrow 1			
Plant	MW's	ISO	Diff.	Plant	MW's	ISO	Diff.	Plant	MW's	ISO	Diff.	Plant	MW's	ISO	Diff.
Crane	0.0	0.0	0.0	Haas	1.8	1.8	0.1	Unit 1	0.0	0.0	0.0				
Kerc 1/1	0.0	0.0	0.0	Batch 1	0.0	-0.2	0.2	Unit 2	0.0	0.0	0.0				
Kerc 1/2	0.0	0.0	0.0	Batch 2	0.0	0.0	0.0	Unit 3	0.0	0.0	0.0				
Kerc 1/3	0.0	0.0	0.0	Batch 3	39.9	39.0	0.2								
Kerc 2	7.0	7.8	-0.8	Kings	6.8	6.9	-0.1								
SJ1W's	3.3	3.3	0.0												

Download total 6.2 MB,  
 Direct download 5.1 MB  
 Citrix download 1.1 MB  
 About same TX, 500 KB



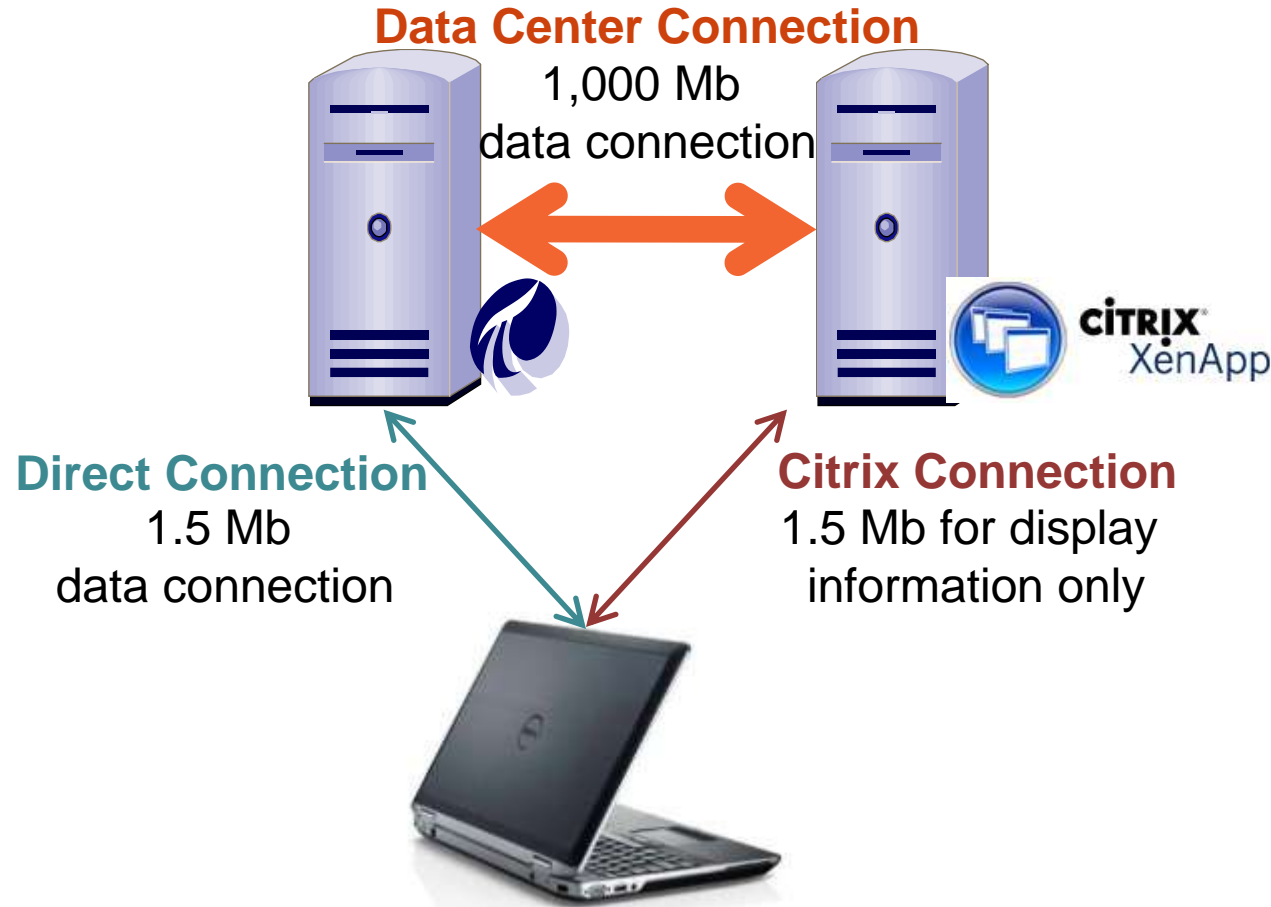
# Citrix Application Virtualization

## Citrix Advantages

- Usable in remote locations
- Centralized management
- No data leaves the center

## Disadvantages

- “Cover Charge”
- Cost



# Citrix: Cross-Platform and Mobile Access ready

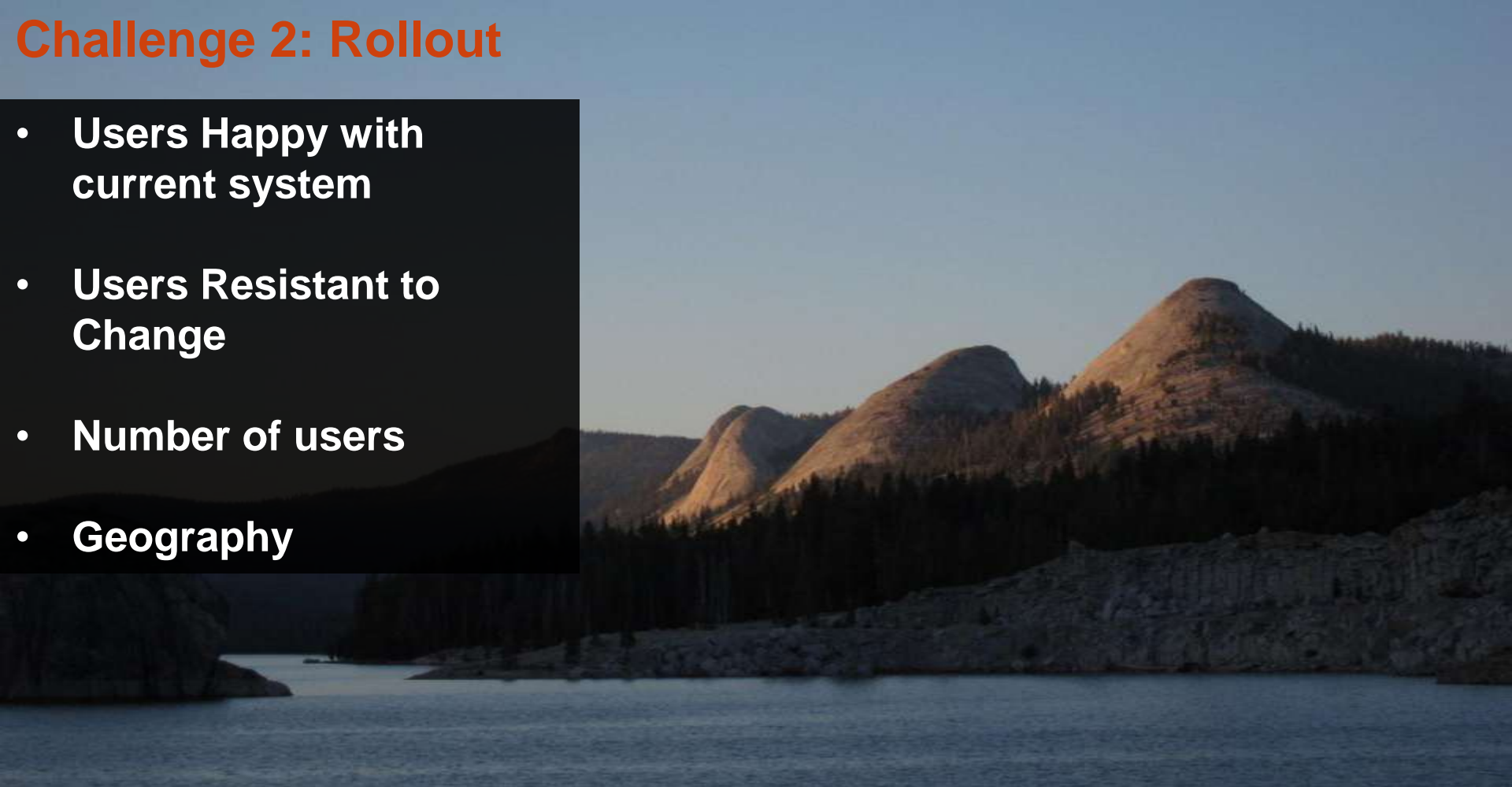
Logos and Trademarks for Nominative OS identification use only. PG&E is not affiliated with, sponsored, or endorsed by any trademark holder. PI usage simulated in most cases.





## Challenge 2: Rollout

- **Users Happy with current system**
- **Users Resistant to Change**
- **Number of users**
- **Geography**



[illegible]

<b>Shasta</b>	<b>DeSable</b>	<b>Drum / Wise</b>
Shasta Hydro Generation	Feather River Generation	North Yuba map
Upper Pit map	Upper Feather map	South Yuba map
Upper Pit Head-Corrected Flow	Upper Feather Head-Corrected Flow	South Yuba/Bear W.
Lower Pit map	Middle Feather map	Upper Bear map
Lower Pit Head-Corrected Flow	Middle Feather Head-Corrected Flow	Upper Bear Catchment
Pit 6 and 7 Head-Corrected Summary	Lower Feather map	Lower Bear map
Shasta Water World	Lower Feather Head-Corrected Flow	Lower Bear PCWA
	Feather River Water World	American map
	California Cloudreaders	Upper Drum RTU B
	DeSable Generation	
	Butte Creek map	
	Camp One Water World	
	Eel River Generation	
	Eel River map	
<b>Manton</b>	<b>Southern</b>	<b>Overviews</b>
Cow/Battle Hydro Generation	Kings River map	Hydro Generation Overview
Kilarc/Cow Creek map	Merced River map	Generation Schedule
North Battle map	Crane Valley/Willow Creek map	Reservoir Elevations
South Battle map	San Joaquin map	Irrigation Districts at Plant Gen Meters vs Vaca-Olson Solar
Manton Water World	South Feather map	Humboldt Bay Area Non-Hydro Gen 1
Manton RTU Batteries	Helms Transformer Monitor	Non-Hydro Gen 2 9F Overview    Colu
<b>Nevada</b>		
Nevada		
<b>Mokelumne</b>	<b>Tiger Creek Main Menu</b>	<b>Schedules</b>
Mokelumne Hydro Generation	Batteries	Generation Schedules
Upper Mokelumne map	Cloud Seeders	Shasta Schedules
Upper Mokelumne Head-Corrected Flow	Generation	Hall-Coy Creek Sched
Lower Mokelumne map	Philadelphia	Feather River Sched
	Lvons	Drum/Mokelumne Sched
		Kings/Crocker-Helms





# PI ProcessBook Enhancements

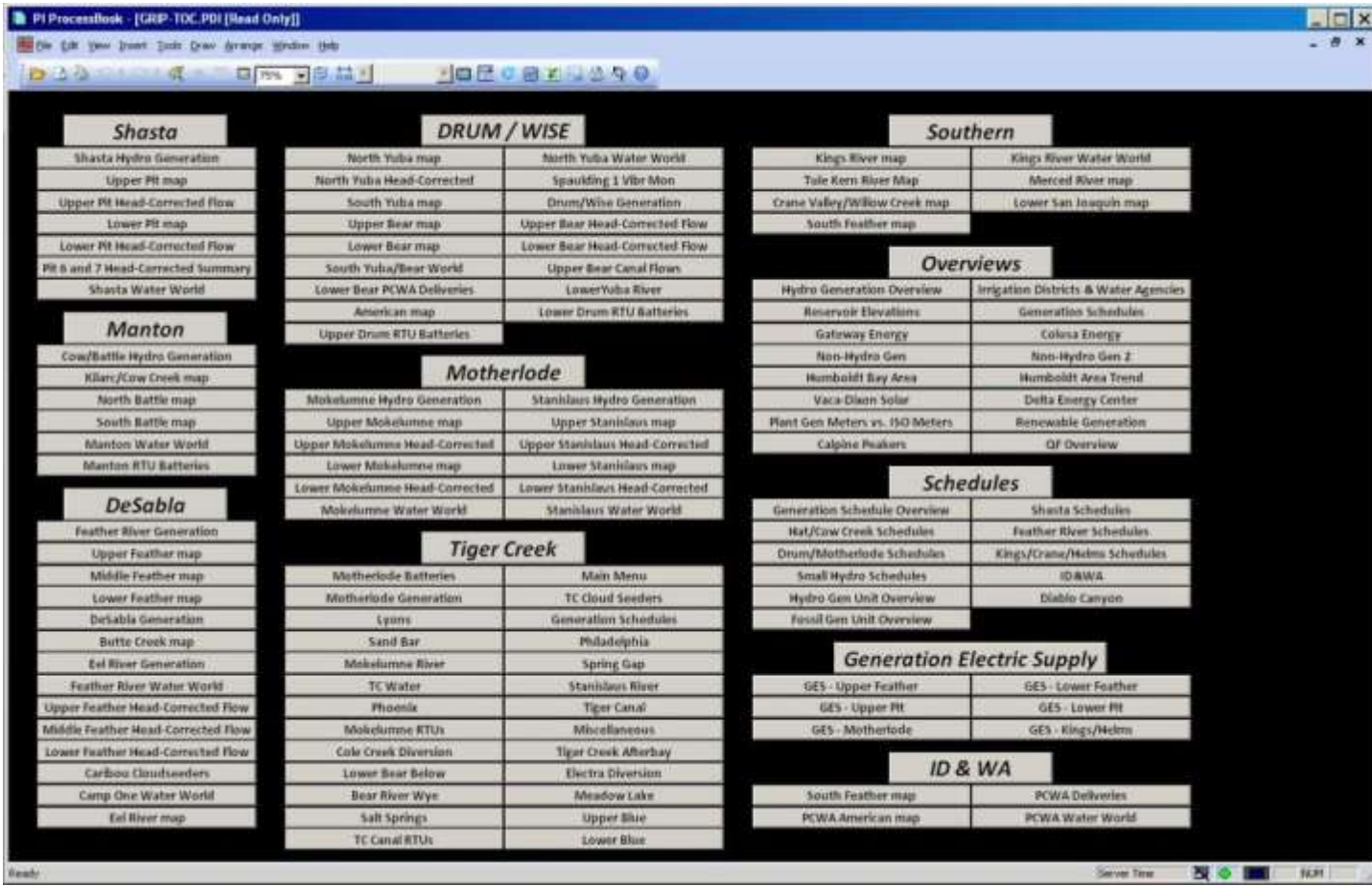
“Advanced” toolbars removed on startup

Custom Add-in functions added to toolbar

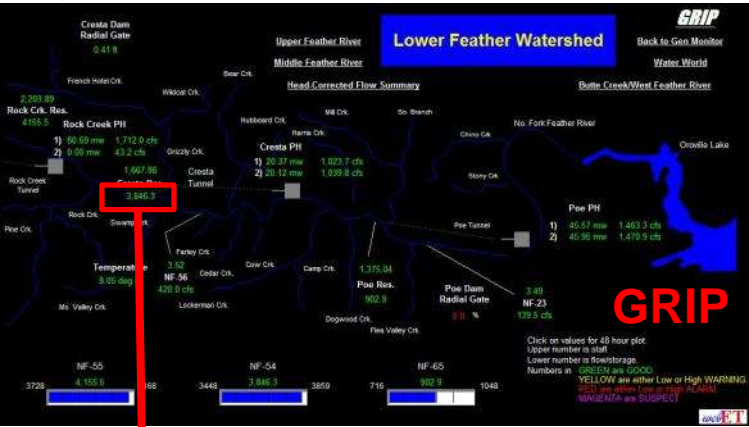
Table of Contents screen loads by default

Auto-fit all displays to current screen resolution

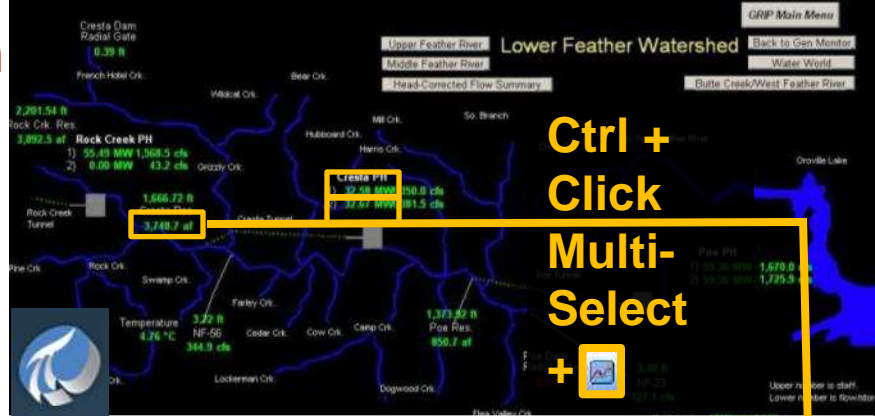
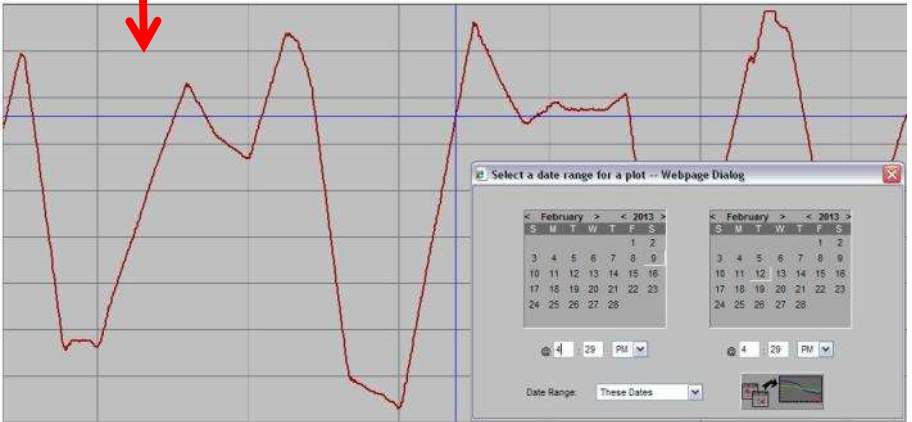
- Same defaults
- Time range
  - Trend formatting
  - Tooltip statistics



# Quick Trend & Time Range Add-In

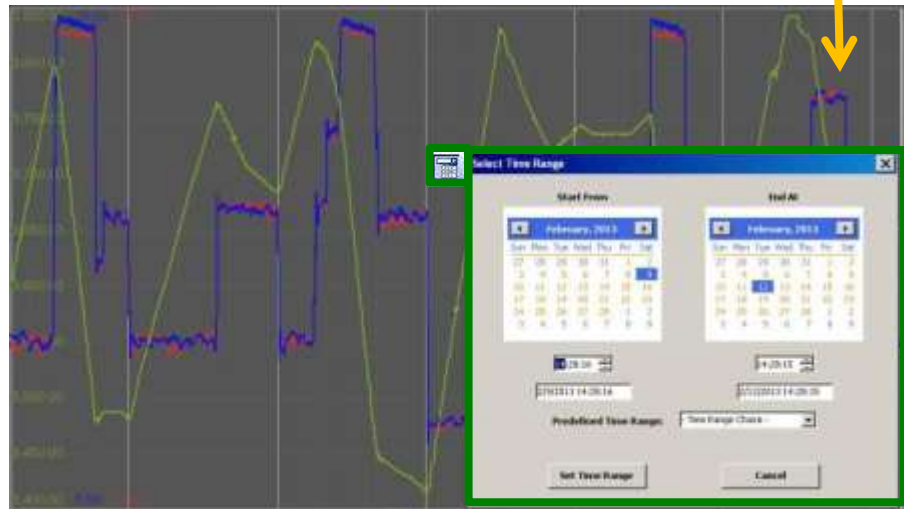


Click for default trend

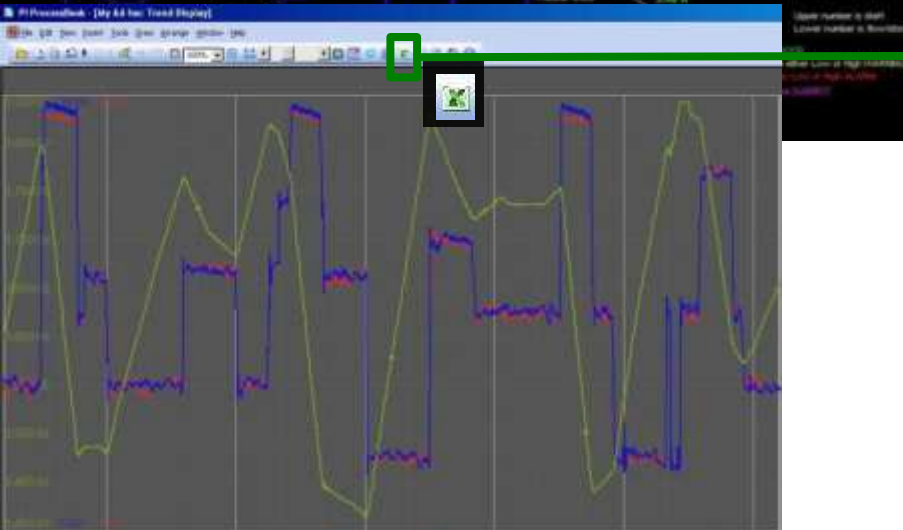
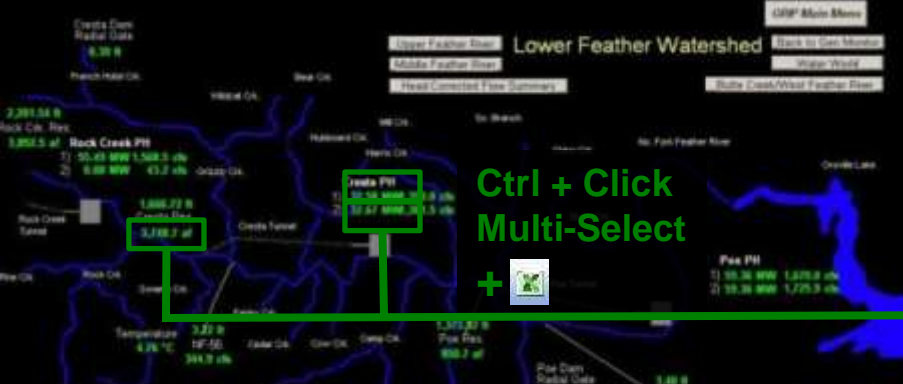
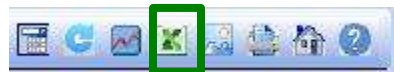


Ctrl + Click Multi-Select

PI ProcessBook Add-In Toolbar



# Export to Excel Add-In



1	\\DHUENPI\PG.POWERGEN.V\	
2	PG.POWERGEN.WA1POWERG PG	
3	02/09/2013 14:28:16	02
4	02/12/2013 14:28:15	02
5	Interval (h)	1 Int
6	Retrieval Time (ms)	31.2024 Rel
7	# of Data Points	72 # o
8		
9		
10	02/09/2013 14:28:16	3,599.20 02
11	02/09/2013 15:28:16	3,658.30 02/09/2013 15:28:16 15.58
12	02/09/2013 16:28:16	3,716.10 02/09/2013 16:28:16 15.14
13	02/09/2013 17:28:16	3,772.60 02/09/2013 17:28:16 14.95
14	02/09/2013 18:28:16	3,766.15 02/09/2013 18:28:16 34.43
15	02/09/2013 19:28:16	3,669.46 02/09/2013 19:28:16 34.19
16	02/09/2013 20:28:16	3,564.60 02/09/2013 20:28:16 33.99
17	02/09/2013 21:28:16	3,477.30 02/09/2013 21:28:16 19.88
18	02/09/2013 22:28:16	3,487.50 02/09/2013 22:28:16 22.47

Export to Excel

Start From

February, 2013

Sun Mon Tue Wed Thu Fri Sat

27 28 29 30 31 1 2

3 4 5 6 7 8 9

10 11 12 13 14 15 16

17 18 19 20 21 22 23

24 25 26 27 28 1 2

3 4 5 6 7 8 9

End At

February, 2013

Sun Mon Tue Wed Thu Fri Sat

27 28 29 30 31 1 2

3 4 5 6 7 8 9

10 11 12 13 14 15 16

17 18 19 20 21 22 23

24 25 26 27 28 1 2

3 4 5 6 7 8 9

14:28:16

14:28:15

2/9/2013 14:28:16

2/12/2013 14:28:15

Predefined Time Range:

- Time Range Choice -

Data

☐ Archived Data

☒ Interpolated Data

☐ Average

Interval

☐ Minute(s) 15

☒ Hour(s) 1

☐ Day(s) 1

Note: the first time Excel is started it can take up to a minute to load. If prompted for "Switch To" or "Retry", wait a minute and click Retry.

Export

Cancel

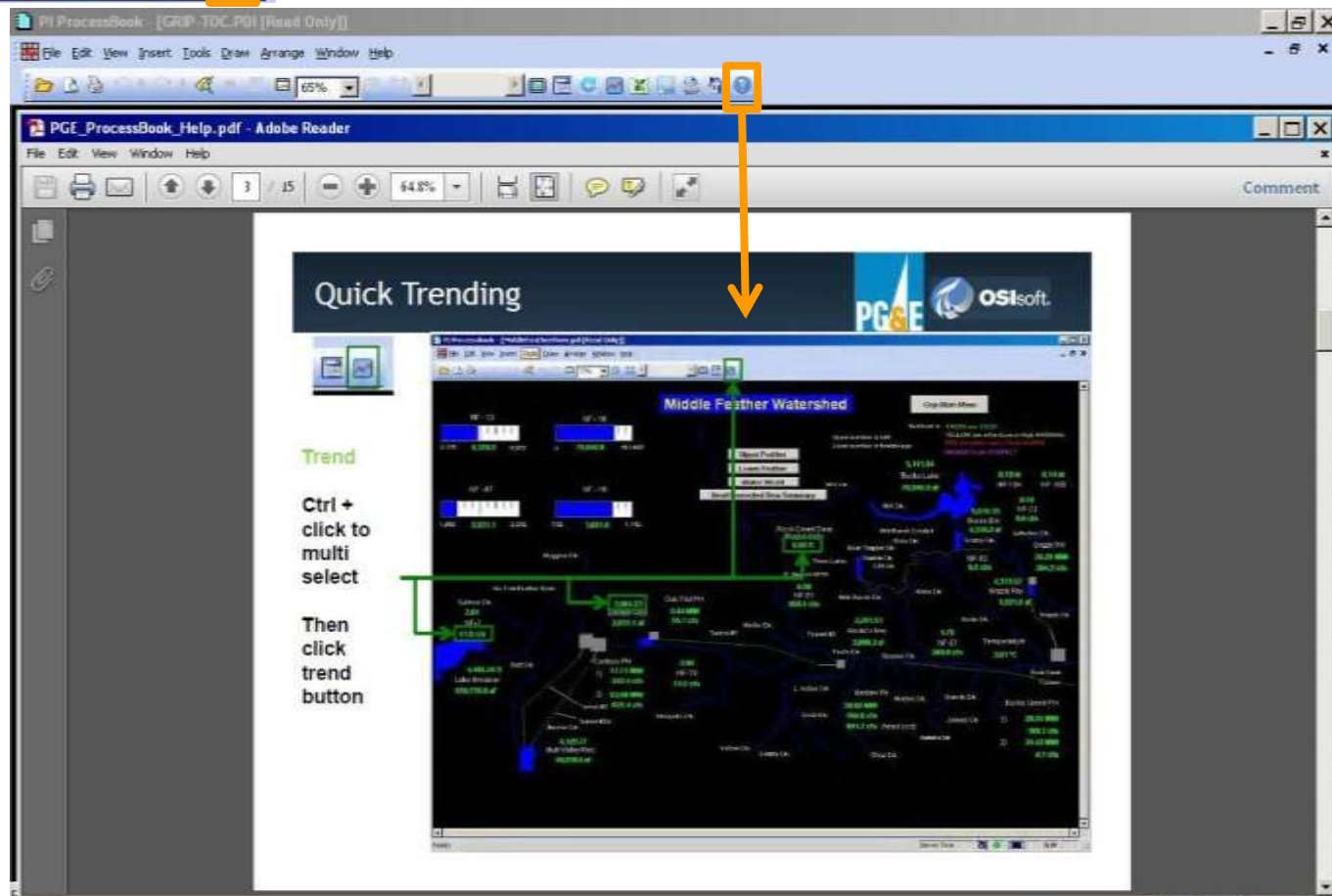


- 
- The screenshot shows a web browser window titled "P1 ProcessBook - [CRP-TOC.PDI] [Local Only]". The address bar shows "http://localhost:8080/". The browser window displays a navigation menu with various links organized into categories. A blue arrow points to the "Drum/Wise" category.
- Shasta**
- Shasta Hydro Generation
  - Upper Pit map
  - Upper Pit Head-Corrected Flow
  - Lower Pit map
  - Lower Pit Head-Corrected Flow
  - Pit 6 and 7 Head-Corrected Summary
  - Shasta Water World
- Drum / WISE**
- North Yuba map
  - North Yuba Head-Corrected
  - South Yuba map
  - Upper Bear map
  - Lower Bear map
  - South Yuba/Bear World
  - Lower Bear PCWA Deliveries
  - American map
  - Upper Drum RTU Batteries
  - North Yuba Water World
  - Spaulding 1 Vibe Mon
  - Drum/Wise Generation
  - Upper Bear Head-Corrected Flow
  - Lower Bear Head-Corrected Flow
  - Upper Bear Canal Flows
  - Lower Yuba River
  - Lower Drum RTU Batteries
- Southern**
- Kings River map
  - Tule Kern River Map
  - Crane Valley/Willow Creek map
  - South Feather map
  - Kings River Water World
  - Merced River map
  - Lower San Joaquin map
- Manton**
- Cow/Battle Hydro Generation
  - Kilar/Cow Creek map
  - North Battle map
  - South Battle map
  - Manton Water World
  - Manton RTU Batteries
- Motherlode**
- Mokelumne Hydro Generation
  - Upper Mokelumne map
  - Upper Mokelumne Head-Corrected
  - Lower Mokelumne map
  - Lower Mokelumne Head-Corrected
  - Mokelumne Water World
  - Stanislaus Hydro Generation
  - Upper Stanislaus map
  - Upper Stanislaus Head-Corrected
  - Lower Stanislaus map
  - Lower Stanislaus Head-Corrected
  - Stanislaus Water World
- DeSaba**
- Feather River Generation
  - Upper Feather map
  - Middle Feather map
  - Lower Feather map
  - DeSaba Generation
  - Butte Creek map
  - Est River Generation
  - Feather River Water World
  - Upper Feather Head-Corrected Flow
  - Middle Feather Head-Corrected Flow
  - Lower Feather Head-Corrected Flow
  - Caribou Cloudseeder
  - Camp One Water World
  - Est River map
- Tiger Creek**
- Motherlode Batteries
  - Motherlode Generation
  - Lyons
  - Sand Bar
  - Mokelumne River
  - TC Water
  - Phoenix
  - Mokelumne RTUs
  - Cole Creek Diversion
  - Lower Bear Below
  - Bear River Wye
  - Salt Springs
  - TC Canal RTUs
  - Main Menu
  - TC Cloud Seeder
  - Generation Schedules
  - Philadelphia
  - Spring Gap
  - Stanislaus River
  - Tiger Canal
  - Miscellaneous
  - Tiger Creek Afterbay
  - Electra Diversion
  - Meadow Lake
  - Upper Blue
  - Lower Blue
- Overviews**
- Hydro Generation Overview
  - Reservoir Elevations
  - Gateway Energy
  - Non-Hydro Gen
  - Humboldt Bay Area
  - Vaca-Dixon Solar
  - Plant Gen Meters vs. ISO Meters
  - Calpine Peakers
  - Irrigation Districts & Water Agencies
  - Generation Schedules
  - Colusa Energy
  - Non-Hydro Gen 2
  - Humboldt Area Trend
  - Delta Energy Center
  - Renewable Generation
  - Off Overview
- Schedules**
- Generation Schedule Overview
  - Kar/Cow Creek Schedules
  - Drum/Motherlode Schedules
  - Small Hydro Schedules
  - Hydro Gen Unit Overview
  - Fossil Gen Unit Overview
  - Shasta Schedules
  - Feather River Schedules
  - Kings/Crane/Helms Schedules
  - ID&WA
  - Diablo Canyon
- Generation Electric Supply**
- GES - Upper Feather
  - GES - Upper Pit
  - GES - Motherlode
  - GES - Lower Feather
  - GES - Lower Pit
  - GES - Kings/Helms
- ID & WA**
- South Feather map
  - PCWA American map
  - PCWA Deliveries
  - PCWA Water World

# Help Add-In

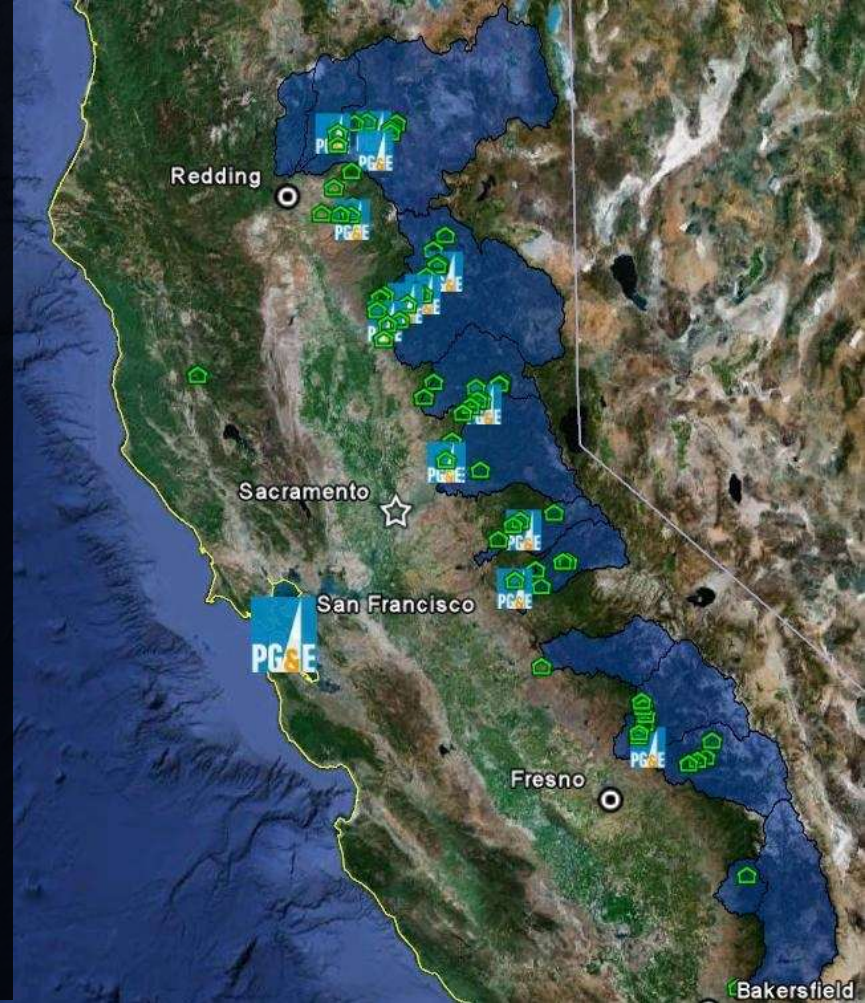


- Loads PDF of training slides presented during rollout



# Training in Remote Locations

- Initial PI System Rollout Q4 2011
- 3 Day Training for “power users”
- Wave1 PI System Training Q4 2012
- 4 hour Training for “early adopters”
- Wave2 PI System Training Q1/Q2 2013
- 2 hour Training for remaining users





## Challenge 3: The Future

- 61,000+ tags, Need AF Structure!
- Dashboards and Mobile Screens
- Integrating Future Forecasted Data



# AF Structure



Currently only have flat structure for data abstraction and tag mapping

61,000+ tags representing 30,000+ data points have varied naming convention

Working towards organizing hierarchy geographically by area

Want to start using PI Notifications, element relative displays

Difficulty with templating Generator data with 100+ year span of Technology and varied data availability

Late 19<sup>th</sup> / Early 20<sup>th</sup> Century



Mid 20<sup>th</sup> Century



Late 20<sup>th</sup> / Early 21<sup>st</sup> Century





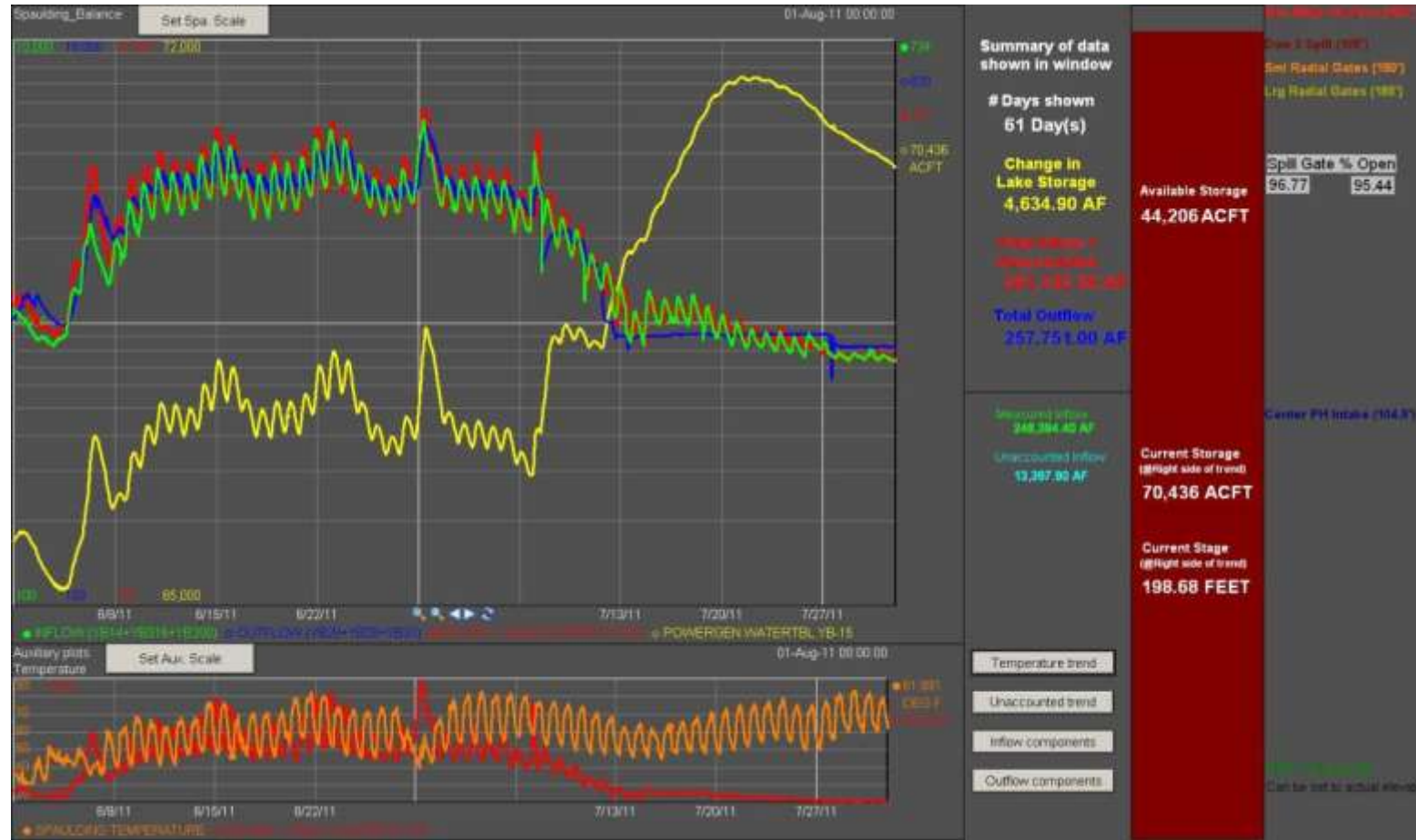
# Dashboards and Mobile Screens

Rollout screens are the familiar GRIP screens

Create enhanced dashboard screens for managing specific resources

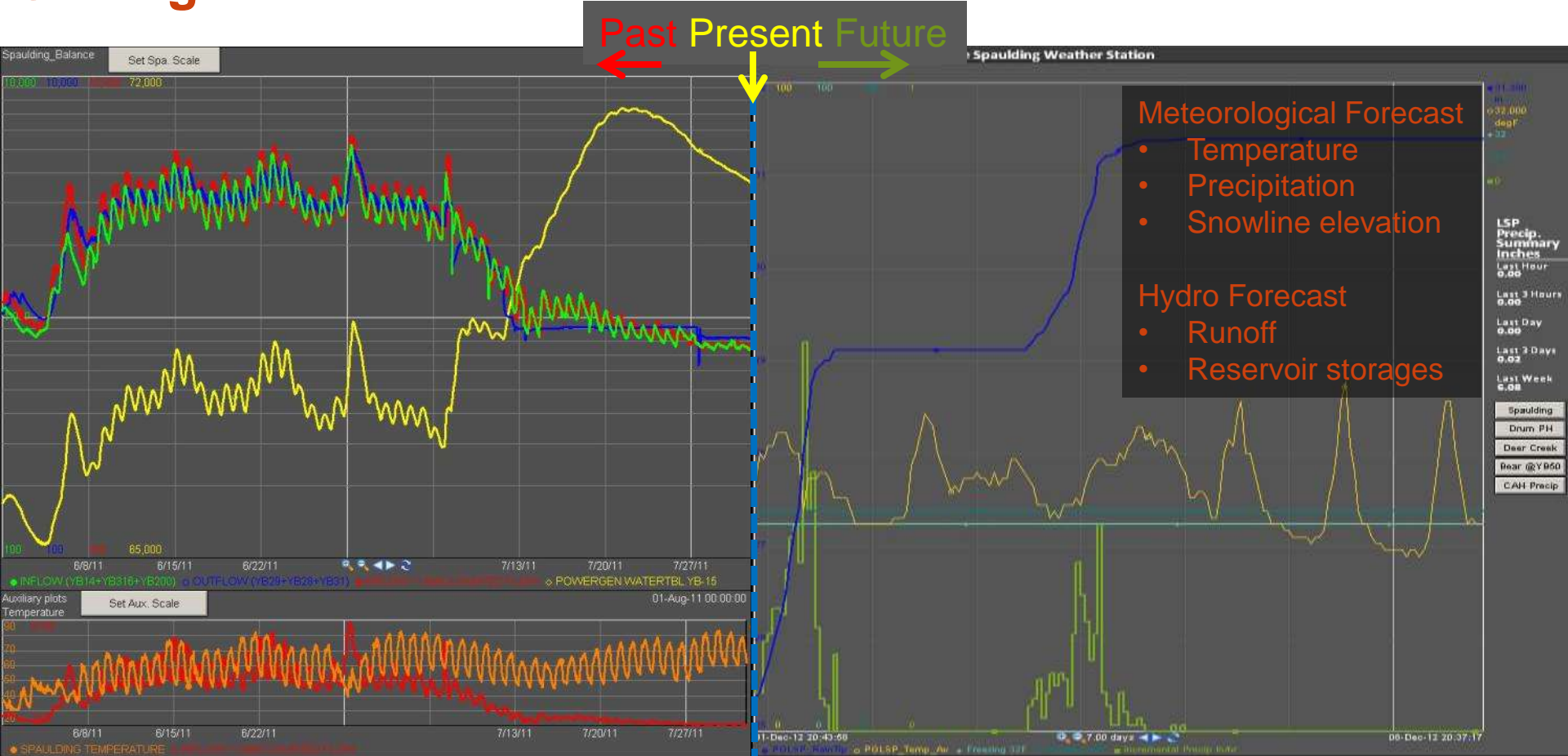
Create element relative screens for common AF elements

Create mobile screens for optimized viewing on limited screens





# Storing Future Forecasted Data





# Matt McPheeters

Senior Hydrographer

Power Generation, PG&E

[m4m9@pge.com](mailto:m4m9@pge.com)



# THANK

# YOU

Brought to you by

