



OSIsoft.
**T&D USERS
GROUP** 2014
The **Power** of **Data**



DECISION READY IN REAL-TIME

Presented by **Matt Tolbirt (PG&E), Kevin Bellflower (PG&E),
Mike Nettler (PG&E), Greg Dumas (DST Controls)**

About PG&E Electric Transmission

Electricity and Gas

- Northern and Central California
- 15 million people
- 70,000-sq-mile service area
- 140,000 circuit miles
- All-time Peak
22,544MW (07/25/06)

Transmission

(Circuit Miles)

500 kV	1,330
230 kV	5,420
115 kV	6,230
<u>60/70 kV</u>	<u>5,660</u>
Total	18,640

Substations

Transmission 142

We Serve 1 in 20 Americans



Honoring Innovation

Electric Operations Systems Dispatchers are Rewarded for Innovation

By Alex Jespersen-Wheat | April 25, 2013

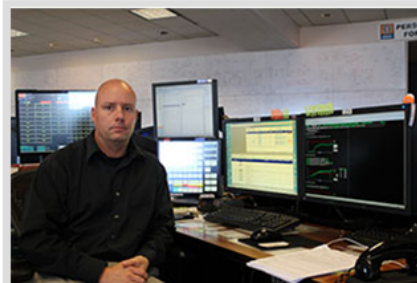
Mike Nettler knows that the saying, "if it ain't broke, don't fix it" doesn't hold true at PG&E. In fact, it's quite the opposite.

Here, employees are rewarded for speaking up about processes that are working, but could be made even better. For example, Mike—a Senior Systems Dispatcher in Electric Operations—has been working over the past year-and-a-half to develop a new process for monitoring power flow limits during outages.

PG&E's Transmission and Distribution System has over 141,000 circuit miles, and on average, 63 pieces of transmission equipment are taken out of service each day. In order to provide our customers with safe, uninterrupted service, our operating transmission lines must reliably carry more power even if nearby equipment is removed from service.

This is where systems dispatchers like Mike and his co-worker **Kevin Bellflower** come in. Their role is to monitor the entire electric transmission system and ensure that power flow increases don't exceed the allowable limit for each line.

Previously, systems dispatchers would need to create monitoring and alarming programs for new power flow limits whenever an outage occurred. The



Senior Systems Dispatcher Mike Nettler helped develop a new tool to monitor power flow limits during outages. He and his colleague will be inducted into PG&E's Inventor Hall of Fame. (Photos by Alex Jespersen-Wheat)



Services	Organizations	2013 YTD	PMVI	0.112	46.49
		Read More	47	1.411	+0.35
			13	0.3900	

ONS

I Need To... [+ Show](#)

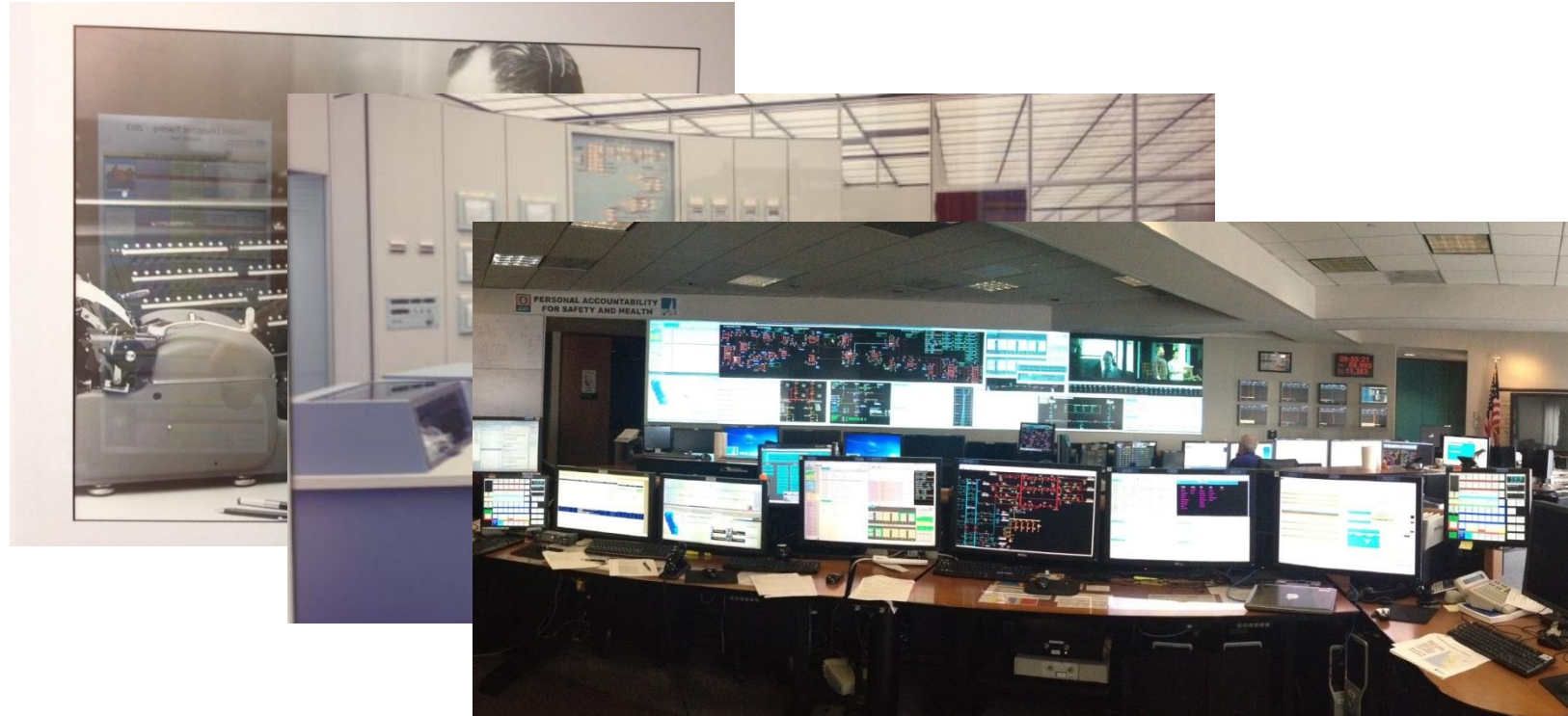


A Message from Nick

March 7, 2013
Great companies do the right thing. The "right thing" for PG&E means we have no priority more important than ensuring public and employee safety as we deliver reliable and affordable natural gas and electricity to millions of Californians.

[Read More >](#)
[Previous Messages from Nick >](#)

Control Room Evolution



Constant Maintenance

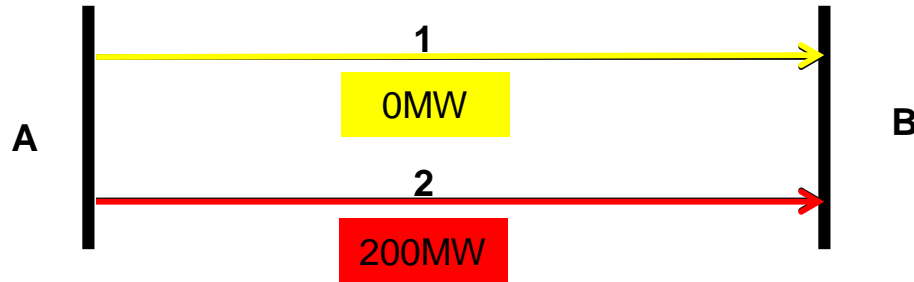
Equipment Out of Service:

- 2012 approx. **23,000** equipment maintenance outages.
- Average of **63** per day
- **Every** scheduled outage requires an Engineering study to determine if adjacent equipment is **At Risk**
- System Dispatch routinely monitors **20 to 40** flow limits per day for overloads
- We already use **>50 Tools/Programs**



Equipment “At Risk”

Constant Maintenance means that adjacent equipment is being placed “At Risk” of Overload.

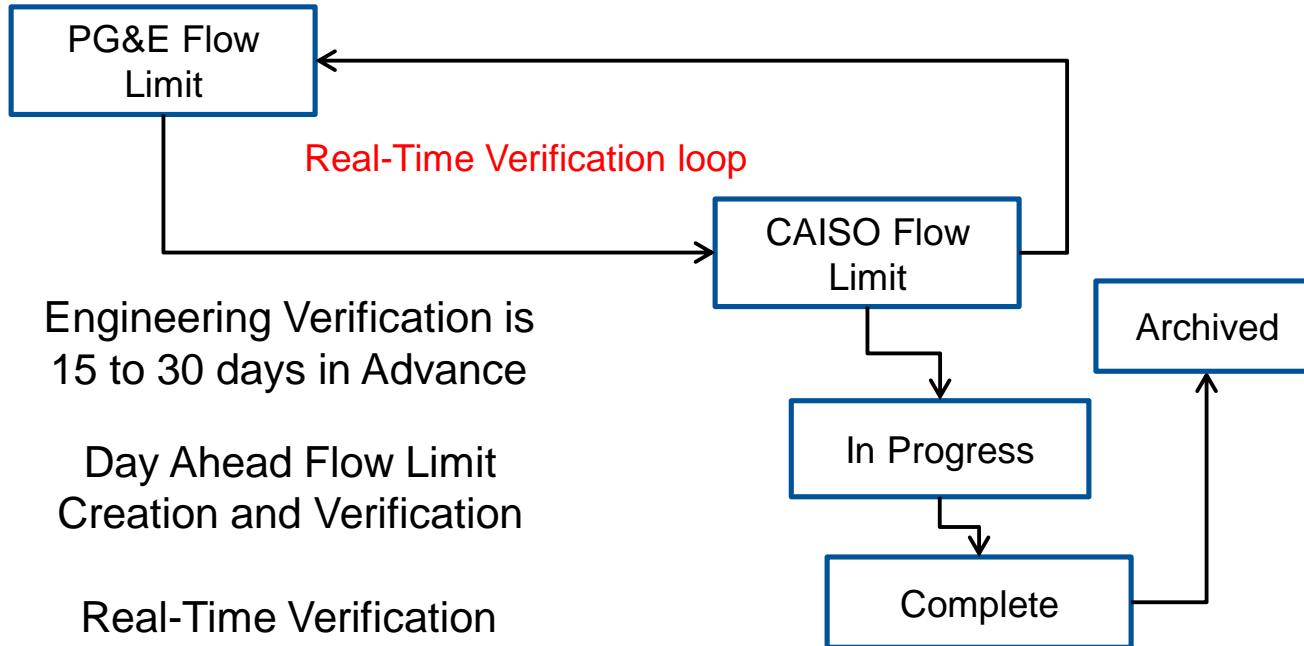


It Doesn't stop at Equipment "At Risk"

Super Bowl Power Disturbance



Coordinating with CAISO



Engineering Verification is
15 to 30 days in Advance

Day Ahead Flow Limit
Creation and Verification

Real-Time Verification

Today's Process

Spreadsheet

Tesla-Tracy 115kV line & Ellis 115kV Tap sect Cleared				TE	194628	9/11
Pre-Clearance Requirements - Flow Limit #1						
0.65 * Tesla-Tracy 115kV line (-> @ Tracy)		10				
0.84 * Tesla-Shulte #2-115kV line (-> @ Tesla)		-5				
Tesla-Shulte #1-115kV line (-> @ Tesla)		-6				Limit
	Total	-1	MW			178
Pre-Clearance Requirements - Flow Limit #2						
0.59 * Tesla-Tracy 115kV line (-> @ Tracy)		9				
0.72 * Schulte-Lammers 115kV line (-> @ Schulte)		47				
Schulte-Manteca 115kV line (-> @ Schulte)		40				Limit
	Total	97	MW			219
Real Time Requirement - Flow Limit #1						
0.84 * Tesla-Shulte #2-115kV line (-> @ Tesla)		-5				
Tesla-Shulte #1-115kV line (-> @ Tesla)		-6				Limit
	Total	-11	MW			178
		47				
		40				Limit
	Total	88	MW			219



Room for error

Generic Non-Audible Alarms

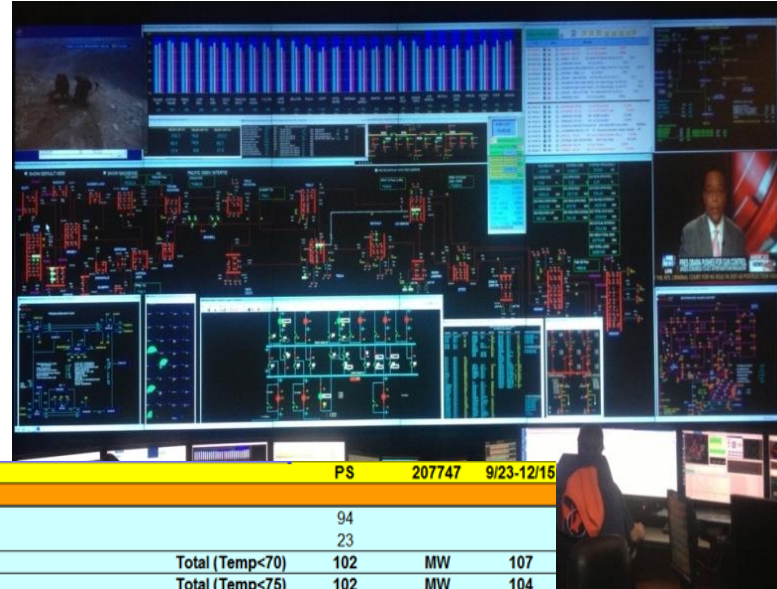
annunciator	
2Clearance Alarm	
7320 (T-133)	
Humboldt	
7430 (T-129)	
7230 (T-165)	
7410 (T-167)	
T-126	
P6110	
Donnels-Curtis	
7120 (T-151)	
T-173	
Diablo_O-23	
PMU	
7240 (T-154)	



Additional Challenges

Static Limits for Dynamic Variables:

- *Temperature*
- *Weather*
- *Time of Day*
- *Or other exceptional condition*



Pittsburg-San Mateo 230kV line cleared	PS	207747	9/23-12/15
Real-Time Requirement - Flow Limit #1			
Newark-Ames #2-115kV Line (-> @ Newark)	94		
0.08*Newark-Ravenswood 230kV Line	23		
	Total (Temp<70)	102	MW 107
	Total (Temp<75)	102	MW 104
	Total (Temp<80)	102	MW 102
	Total (Temp<85)	102	MW 99
	Total (Temp<90)	102	MW 96
	Total (Temp<95)	102	MW 94
	Total (Temp>95)	102	MW 91

More room for Error

Opportunity for Change

The Must haves:

- *Dynamic*
- *Trend*
- *Audible Alarm*
- *Standardized*
- *Repeatable*
- *Easy to Use and Teach*



Reality Check-Who is this Tool for?

Real Time Operations / Operators

Real Time Tool:

- We're building as many as **20** of these limits per night
- ProcessBook has repeatability **limitations** when building displays
- This is **one** of the **70+ tasks** performed Daily...using just one of those **50+ Tools** we mentioned earlier

Dispatchers are **NOT** Display Builders

The Solution – Flow Limit Tool

The screenshot displays the 'Flow Limit Tool' interface with several key components:

- Flow Limit Alarms:** A large red banner at the top left. Below it are buttons for 'Sound Disabled' and 'Acknowledge'.
- Flow Limit Information:** A table showing flow limits for three different categories.

Name	Total	Limit	Units
Real Time - Flow Limit #1	51.3	115	MW
Real Time - Flow Limit #2	58.2	100	MW
Real Time - Flow Limit #3	59.9	92	MW
- Real Time Monitoring:** A section showing 'Real Time Flow Limit #1' for the period 01/21/2013 - 01/23/2013. It lists various power lines and their current flow rates, such as 'Colgate-Rio Oso' at 11.4 MW and 'Olivehurst Bank #1' at 3.3 MW.
- Weather Station:** A small window showing 'Weather Station: PLACR Auburn' and 'Last updated at 3/27/2013 9:20 AM'.
- Alarm Annunciator:** A grid of percentage-based indicators. The top row shows 38%, 101% (highlighted in red), 34%, 31%, 89% (highlighted in yellow), and 92% (highlighted in yellow). The bottom row shows 65%, 54%, 54%, 83%, 100% (highlighted in yellow), and 51%.
- Real Time Graph:** A line graph showing flow over time from 3:00 to 10:00. A red horizontal line at 115.0 MW represents the limit, and a green line shows the actual flow at 51.0 MW. A 'Mitigation' button is visible on the right side of the graph.

Flow Limit Tool

- Limit Screen
- Alarm Annunciator

Flow Limit Tool

Flow Limit Information:

- Area of Control
- Resource and Type
- Voltage

(This Information is updated Daily from Outage Database)

- Outage Type
- Date
- Weather Station info
(AF Tables)

Limits:

Type, Actual Flow Total, Limit

Flow Limit Information

Op. Procedure: Limits

SLIC Number: 199675 Status: Verified

Control Center: TABLE MTN Abv: TM

SWC ID: TM-20 12-1291

Area: North State

Facility/Res Type: STATION

Resource: Rio Oso

Voltage: 230

Equipment: Rio Oso CB 232

Outage Type: BP and C

Start Date: 1/21/2013

End Date: 1/25/2013

Non-Critical: Forced Outage:

Test Program:

Cut-Plane File: ...

Weather Station: PLACR Auburn Clear

Last updated at 3/27/2013 9:20 AM by p2b7

Buttons: Open/New, Copy, Clear, Save

Name	Total	Limit	Units
Real Time - Flow Limit #1	51.3	115	MW
Real Time - Flow Limit #2	58.2	100	MW
Real Time - Flow Limit #3	59.9	92	MW
Real Time - Flow Limit #4	24.4	130	MW
Real Time - Flow Limit #5	48.1	100	MW
Real Time - Flow Limit #6	63.0	100	MW
Real Time - Flow Limit #7	58.9	92	MW
Real Time - Flow Limit #8	26.8	130	MW

Buttons: Add Limit, Modify, Copy, Paste, Delete

Limit Components Total: 51.3 Limit: 115 MW

Name	Total
Colgate-Rio Oso	11.4
Table Mountain-Rio Oso	10.3
Olivehurst Bank #2	6.0
Rio Oso 230/115 Bank #1	2.2
Rio Oso 230/115 Bank #2	2.1
Poe-Rio Oso 230kV line	7.3
Cresta-Rio Oso 230kV line	1.7
Pease-Rio Oso 230kV line	7.0
Olivehurst Bank #1	3.3

Buttons: Add Component, Modify, Copy, Paste, Delete

(Updated in Real Time)

Display Generator

Add-in to Processbook:

Search Fields

- Control Number
- Verification Status
- Date
- Description
- EZ Buttons

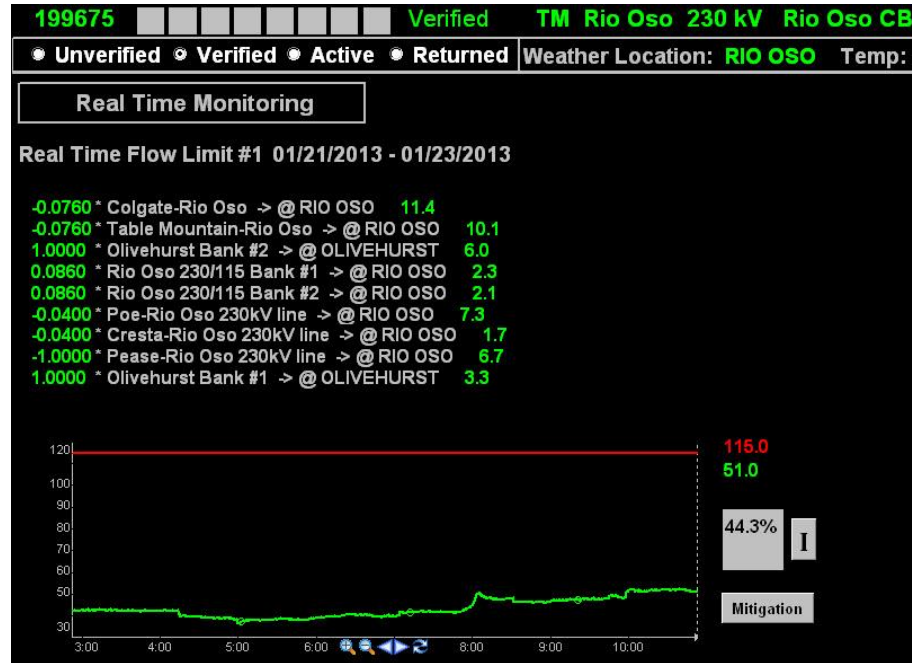
Ease of Use for the END USER was a Priority

SLIC	FlowLimitState	OutageStart	Description
198855	Unverified	1/28/2013 4:31:41 PM	SAN MATED San Mateo
198969	Active	12/16/2012 8:00:00 AM	SAN MATED San Mateo
198972	Unverified	11/19/2012 9:43:08 AM	DIABLO C. SW Morro Bay-Midway #2
198996	Unverified	12/13/2012 2:45:48 PM	PITTSBURG SW Jenny-Cartwright
199153	Verified	3/5/2013 8:00:00 AM	FULTON Mendocino-Redbud
199208	Unverified	12/20/2012 4:23:46 PM	VACA-DIXON Pleasant Grove
199265	Unverified	1/3/2013 8:00:00 AM	FULTON Fulton #1
199340	Unverified	1/31/2013 2:13:30 PM	PITTSBURG SW Moraga-Dakland #3
199436	Verified	1/3/2013 8:00:00 AM	TABLE MTN Palermo
199464	Unverified	1/3/2013 8:00:00 AM	LDS BANDS Merced Falls-Exchequer
199675	Verified	1/21/2013 8:11:44 AM	TABLE MTN Rio Oso
199832	Unverified	3/5/2013 8:00:00 AM	FRESNO DISP Helms-Gregg #1-230kV line
200018	Unverified	1/22/2013 1:37:46 PM	PITTSBURG SW Moraga-Claremont #1
200257	Unverified	1/22/2013 3:07:53 PM	SAN MATED H-Y #1 Cable
200438	Unverified	1/27/2013 8:00:00 AM	SAN MATED Cooley Landing-Stanford

Limit Screen

Standard Display:

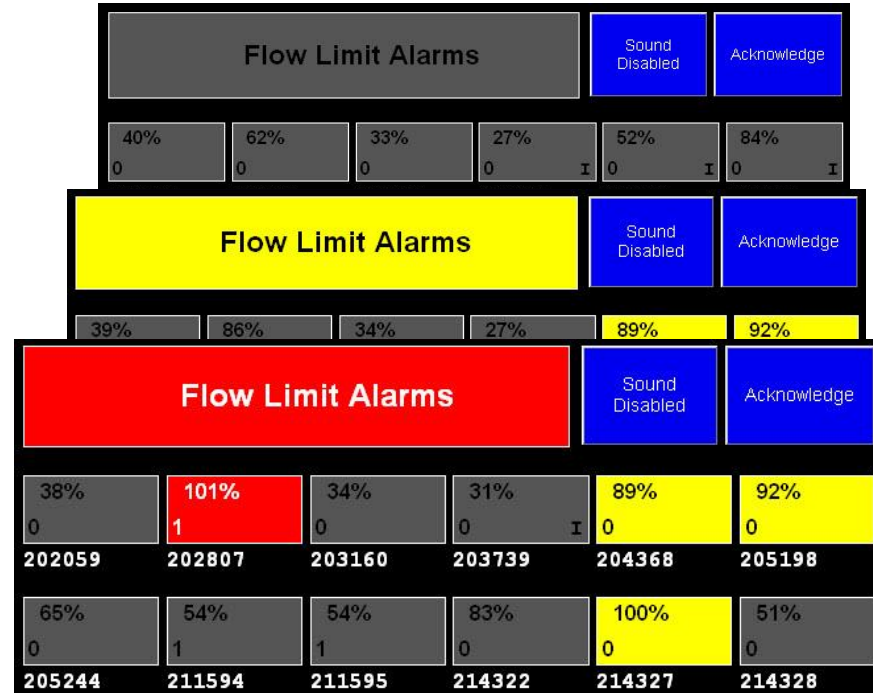
- Real Time Line flows
- Trend with Proximity to alarm
- Staggered Alarm points
(*Staged at 85% and 100%*)
- Mitigation info button



Alarm Annunciator

Standard Display:

- Real Time **percentage** to alarm
- **Color Coded** Alarm points (85% and 100%)
- **Audible**
- **Linked** to Limit Screen
- Provides **Rapid Situational Awareness**



Adding Weather data

Real time weather always available to dispatchers

The image shows a software interface for weather data integration. On the left, a 'Select Weather Station' dialog box lists various stations. The 'Weather City' field is set to 'Buttonwillow'. On the right, the 'PI ProcessBook' application displays real-time weather data for station 308570. The data includes: 'Unverified MD Temperature Test 230 kV Clear 12-16-2012-12-18-2012'. Below this, a status bar shows: 'Unverified Verified Active Returned Weather Location: BUTTONWILLOW Temp: 69 @ 3/3/2013 1:53:00 PM Wind: 5 Knots'. A 'Real Time Monitoring' button is visible, and the text 'Real Time Flow Limit #1 CDWR Pumping Limit' is shown at the bottom.

Name	Weather City
	Buttonwillow
SISQU	ORCUTT
TESLA	LIVERMORE
MARTIN	DALY CITY
OROLM	DOS PALOS
SEMIT	WASSO
NOKMT	
RIOSO	
ARCO	
HENRI	
BENTN	
CYTNO	
SOLED	
RDMTN	

PI ProcessBook - [Weather From 308570.PDI]

File Edit View Insert Tools Draw Arrange Window Help

SLIC Help

308570 Unverified MD Temperature Test 230 kV Clear 12-16-2012-12-18-2012

Unverified Verified Active Returned Weather Location: BUTTONWILLOW Temp: 69 @ 3/3/2013 1:53:00 PM Wind: 5 Knots

Real Time Monitoring

Real Time Flow Limit #1 CDWR Pumping Limit

Lets see how we did - Results

The Must haves:

- **Dynamic**
- **Trend**
- **Audible Alarm**
- **Standardized**
- **Repeatable**
- **Easy to Use**

Flow Limit Tool

Flow Limit Information

Op. Procedure: Status: Verified

SLIC Number: 199675

Control Center: TABLE MTN

SWC ID: TM-2012-1291

Area: North State

Facility/Res Type: STATION

Resource: Rio Oso

Voltage: 230

Equipment: Rio Oso CB 232

Outage Type: BP and C

Start Date: 1/21/2013

End Date: 1/25/2013

Non-Critical: Forced Outage:

Test Program:

Cut-Plane File:

Weather Station: PLACR Auburn

Updated at 3/27/2013 9:20 AM by p2b7

Limits

Name	Total	Limit	Units
Real Time - Flow Limit #1	51.3	115	MW
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Real Time - Flow Limit #4	24.4	130	MW
Real Time - Flow Limit #5	48.1	100	MW
Real Time - Flow Limit #6	63.0	100	MW
Real Time - Flow Limit #7	58.9	92	MW
Real Time - Flow Limit #8	26.8	130	MW

Limit Components

Total: 51.3 Limit: 115 MW

Name	Total
Culgate-Rio Oso	115
Table Mountain-Rio Oso	100
Olivehurst Bank #2	100
Rio Oso 230/115 Bank #1	100
Rio Oso 230/115 Bank #2	100
Poe-Rio Oso 230kV line	100
Cresta-Rio Oso 230kV line	100
Pease-Rio Oso 230kV line	100
Olivehurst Bank #1	100

Benefits: Enhanced Situational Awareness

Trends

- *Visual Proximity to Limit*
- *Rapid Situational Assessment*

Alarming

- *Audible*
- *Staged 95% and 100%*
- *Color Coded*

Weather

- *Real-Time Temperature*
- *Wind measurements*

Data Quality

- *Displays quality (Good, etc.)*

Efficiency

- *Reduced Set-up time*
- *Lower Training Time*

Financial

- *Rapid implementation of mitigation based on actual data*
- *Customer Power Outages are Expensive*

Security

- *Equipment 'At Risk' is more secure*

Safety

- *Crews working on equipment*

Questions?



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