



# ***Electric Transmission Flow Monitoring***

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

# Evolution



# Constant Maintenance

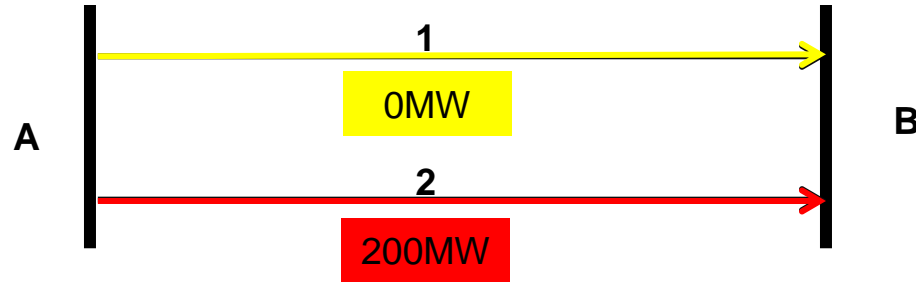
## Equipment Out of Service:

- 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 being placed **At Risk**
- System Dispatch routinely monitors **20 to 40** of these outages per day for overloads
- We already use **>50 Tools/Programs**

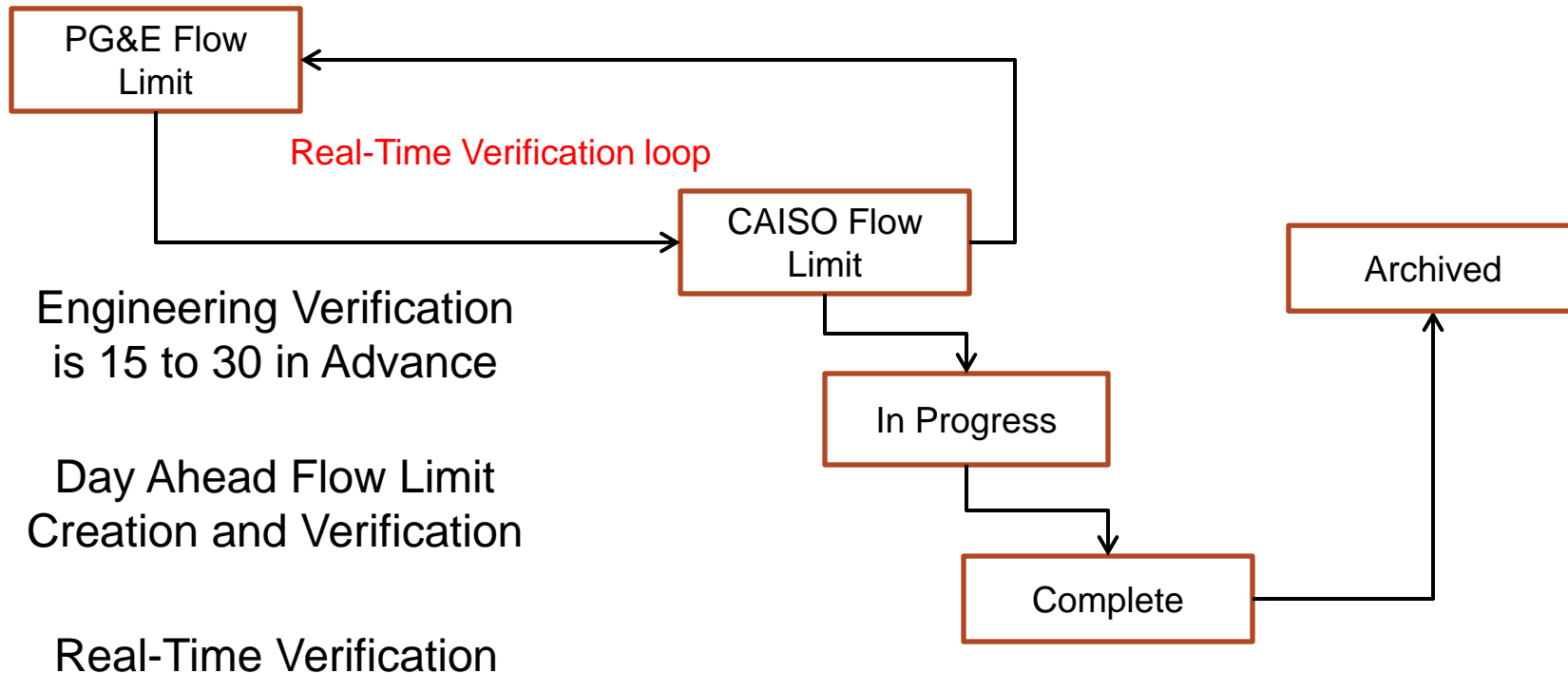


# Equipment “At Risk”

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



# Coordinating with CAISO



# 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
Real Time Requirement - Flow Limit #2						
0.72 * Schulte-Lammers 115kV line (-> @ Schulte)				47		
Schulte-Manteca 115kV line (-> @ Schulte)				40		Limit
Total				88	MW	219



*Room for error*

## Generic Non-Audible Alarms

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 any other exceptional condition*



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
Real Time Requirement - Flow Limit #2			
0.72 * Schulte-Lammers 115kV line (-> @ Schulte)	47		
Schulte-Manteca 115kV line (-> @ Schulte)	40		Limit
Total	88	MW	219

*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?

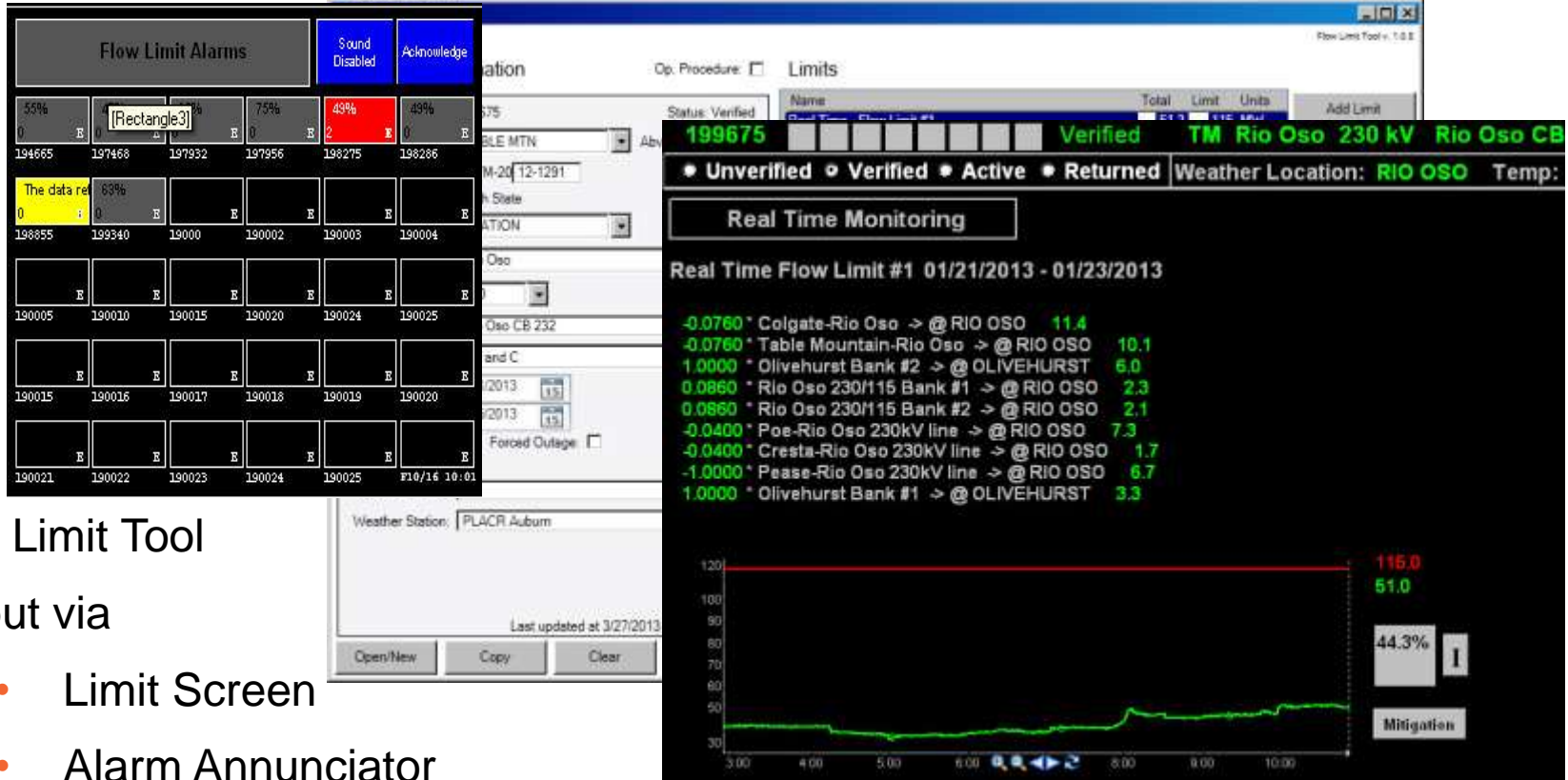
## Real Time Operations

### Real Time Tool:

- Were building as many as **16** per night
- ProcessBook has repeatability **limitations** when building displays
- This is **one** of many tasks performed Daily

Dispatchers are **NOT** Display Builders

# The Solution – PI Flow Limit Tool



Flow Limit Tool

Output via

- Limit Screen
- Alarm Annunciator

# Flow Limit Tool

## Flow Limit Information:

- Area of Control
  - Resources Type
  - Voltage
- (Information updates Daily from Outage Database)
- Outage Type
  - Date
  - Weather Station info (AF Tables)
- 
- Last updated by: (Time and User ID for version control)

Flow Limit Tool

Flow Limit Information

Op. Procedure: ☐

SLIC Number: 189675

Status: Verified

Control Center: TABLE MTN

Abv: TM

SLIC 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: ☐

Cur-Plane File:

Weather Station: PLACR Auburn

Clear

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

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Limits

Name	Total	Limit	Units
Real Time - Flow Limit #1	51.3	115 MW	
Real Time - Flow Limit #2	56.2	100 MVA	
Real Time - Flow Limit #3	59.9	92 MVA	
Real Time - Flow Limit #4	24.4	130 MVA	
Real Time - Flow Limit #5	48.1	100 MVA	
Real Time - Flow Limit #6	63.0	100 MVA	
Real Time - Flow Limit #7	58.9	92 MVA	
Real Time - Flow Limit #8	26.8	130 MVA	

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

Add Component

Modify

Copy

Paste

## Limits:

Type, Actual Flow Total, Limit

## Limit Components:

Tag Real-time value

Copy (Rapid outage reproduction)

# Limit Screen

## Standard Display:

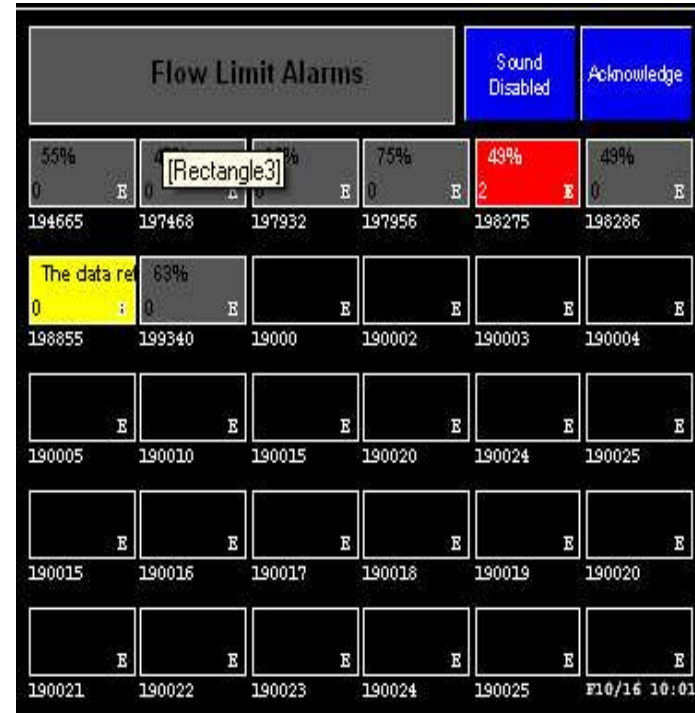
- Real Time Line flows
- Trend with Proximity to alarm
- Staggered Alarm points (*Staged at 85%, 95% & 100%*)
- Mitigation info button



# Alarm Annunciator

## Standard Display:

- Real Time **percentage** to alarm
- Staggered **Color Coded** Alarm points (*Staged at 85%,95% & 100%*)
- **Audible**
- **Linked** to Limit Screen
- Provides **Rapid Situational Awareness**

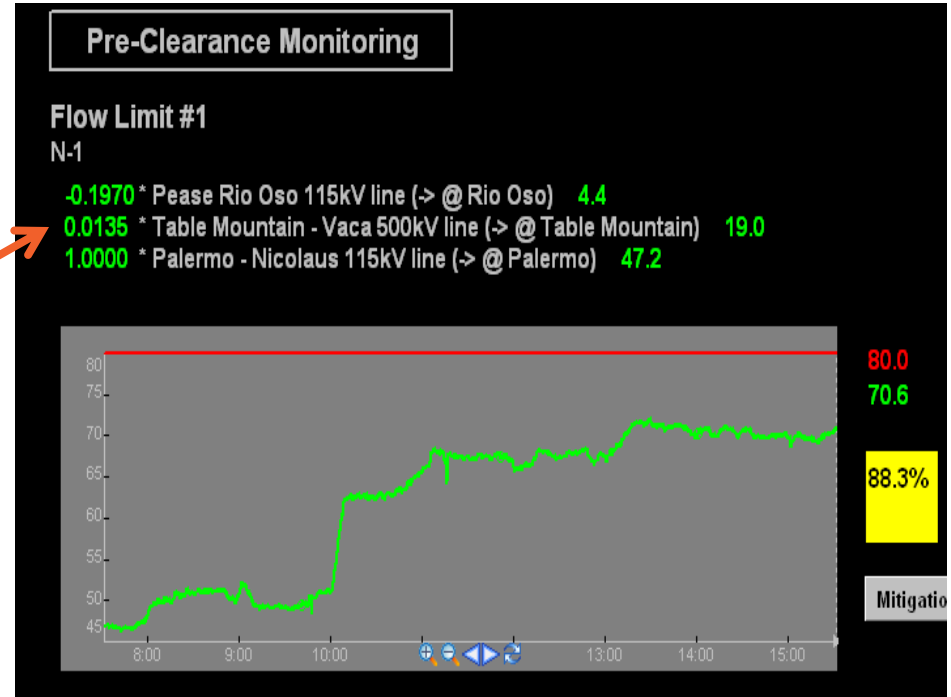




# From PI AF to PI Screen

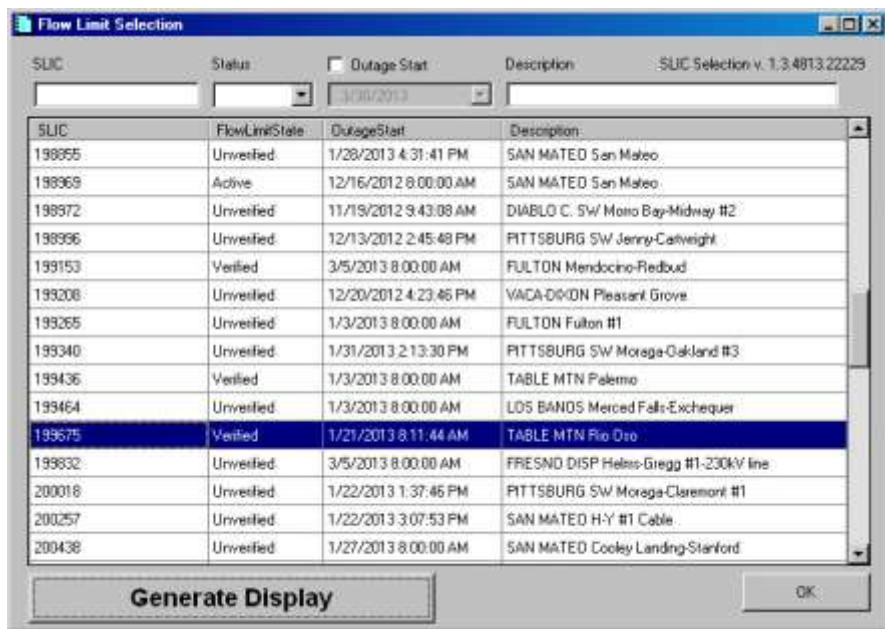
The screenshot shows the 'PI System Explorer' interface. On the left, a tree view under 'Elements' shows 'Limit' expanded, with 'RS' selected. The main pane shows the 'Limit' configuration for 'Pease Rio Oso 115kV line'. A red box highlights the 'Limit' configuration table, and an orange arrow points from it to the 'Pre-Clearance Monitoring' screen.

SLIC #	Control Center, Line,.....	Limit	Maximum, Adjustments	Resource	Line, PI Point
0					
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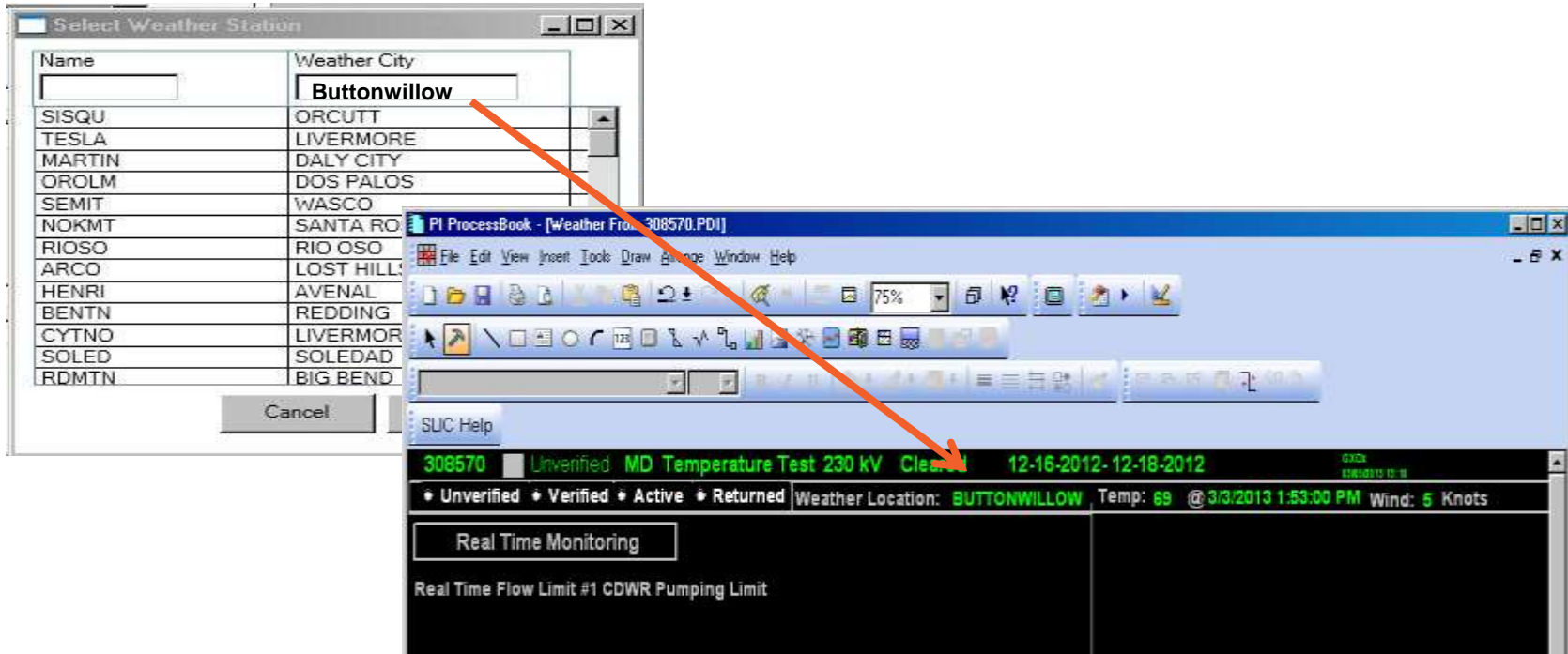
# Building the Screen

- Add-in to ProcessBook



# Adding Weather data

*Real time weather delivered immediately to dispatchers*



# Lets see how we did - Results

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Poe-Rio Oso 230kV line	7.0
Olivehurst Bank #1	3.3

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# Benefits: Enhanced Situational Awareness

## **Trends**

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

## **Alarming**

- *Audible*
- *Staged 85%,95% & 100%*
- *Color Coded*

## **Weather**

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

## **Data Quality**

- *Displays EMS quality (Good, Suspect, Replaced or Estimated)*

## **Efficiency**

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

## **Financial**

- *Accurate implementation of actual limits*
- *Customer Power Outages are Expensive*

## **Security**

- *PI is a stable platform (few glitches)*
- *Equipment 'At Risk' is more secure*
- *Customer Power Outages*

## **Safety**

- *Crews working on equipment*
- *Equipment itself*



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# THANK

# YOU

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