Electric Transmission Flow Monitoring

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

Evolution

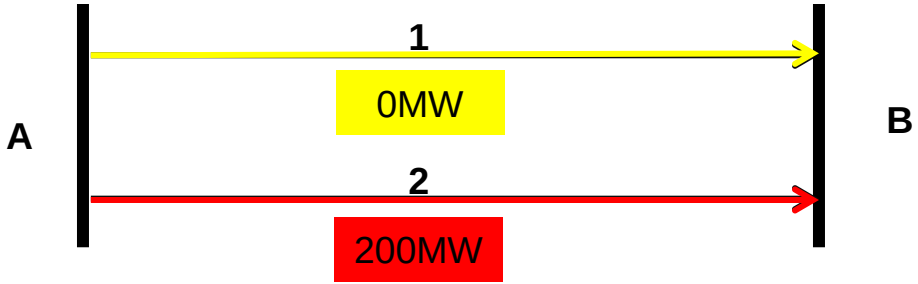
Constant Maintenance

Equipment Out of Service:

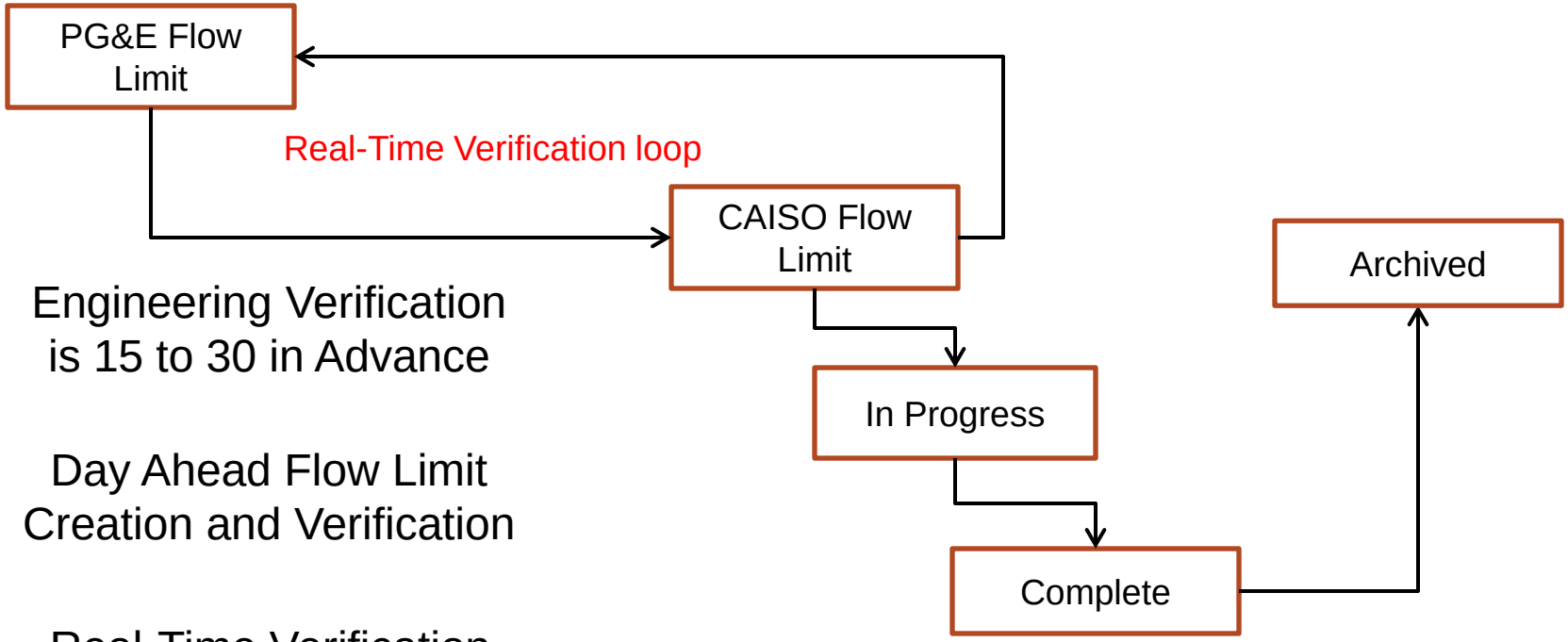
- 2012 approx. **23,000** equipment maintenance outages.
- Average of **63** per day
- **Every** scheduled outage requires an Engineering study to determine if adjacent equipment is being placed **At Risk**
- System Dispatch routinely monitors **20 to 40** of these outages per day for overloads
- We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

Equipment “At Risk”

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



Coordinating with CAISO



Engineering Verification is 15 to 30 in Advance

Day Ahead Flow Limit Creation and Verification

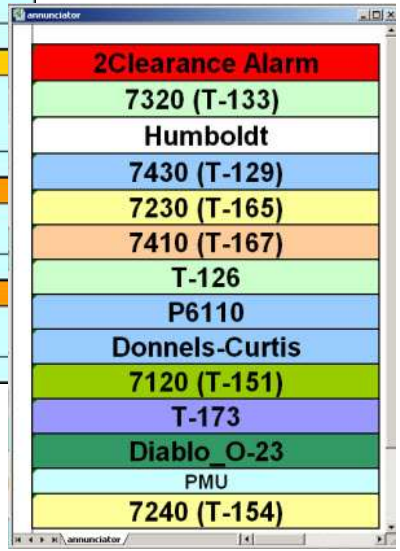
Real-Time Verification

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

Generic Non-Audible Alarms



Room for error

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?

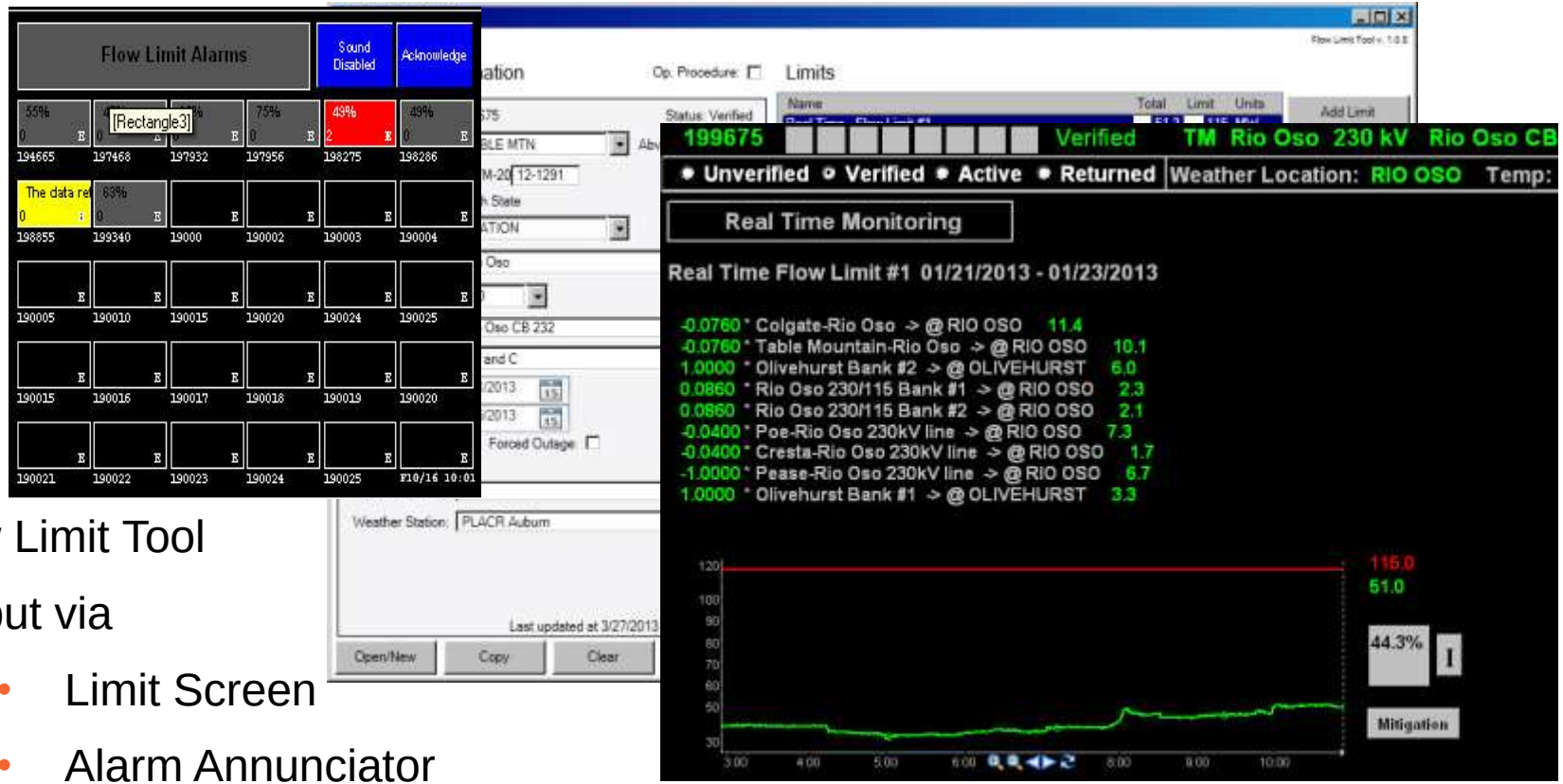
Real Time Operations

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

Limits:
Type, Actual Flow Total, Limit

Flow Limit Information:

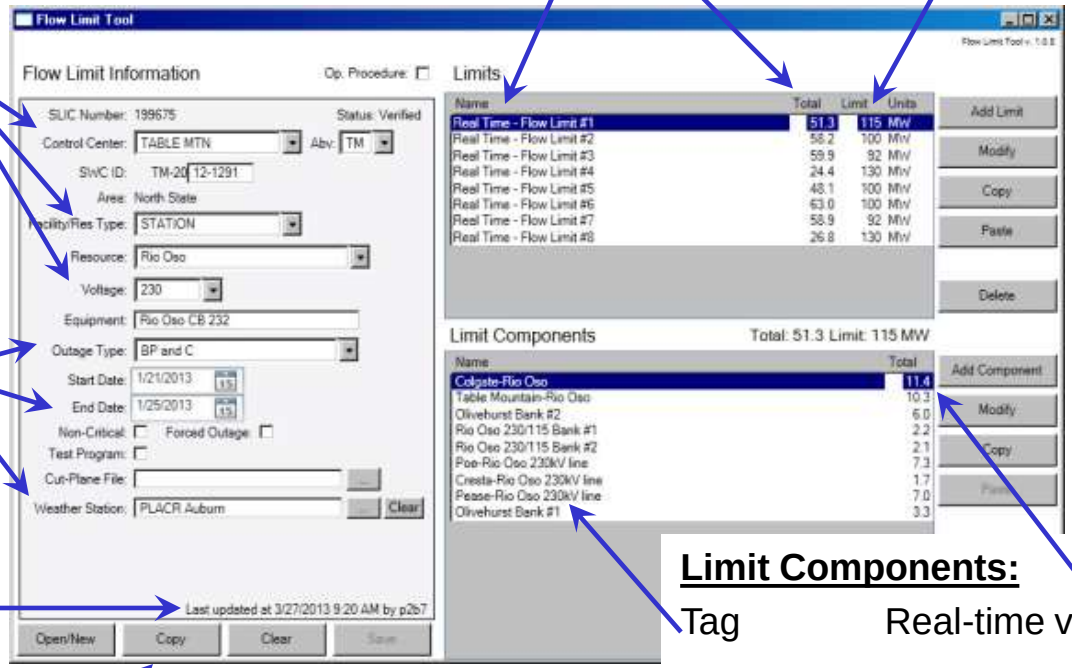
- Area of Control
- Resources Type
- Voltage

(Information updates Daily from Outage Database)

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

- Last updated by:

(Time and User ID for version control)



Limit Components:
Tag Real-time value

Copy (Rapid outage reproduction)

Limit Screen

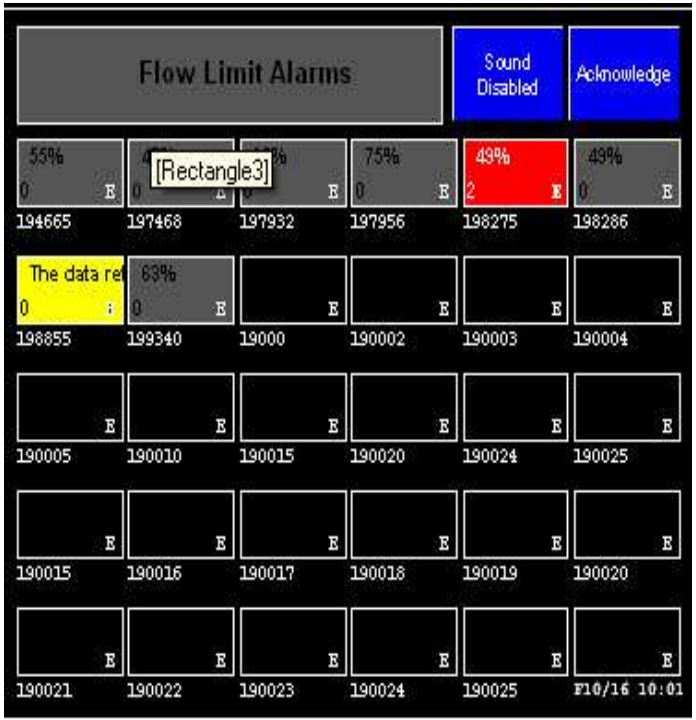
Standard Display:

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

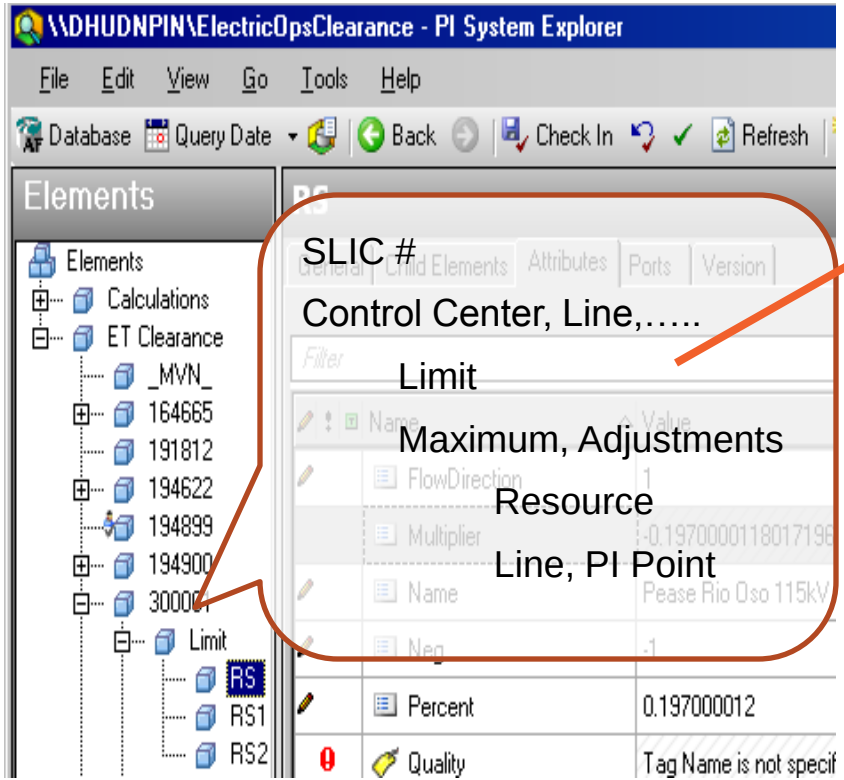
Alarm Annunciator

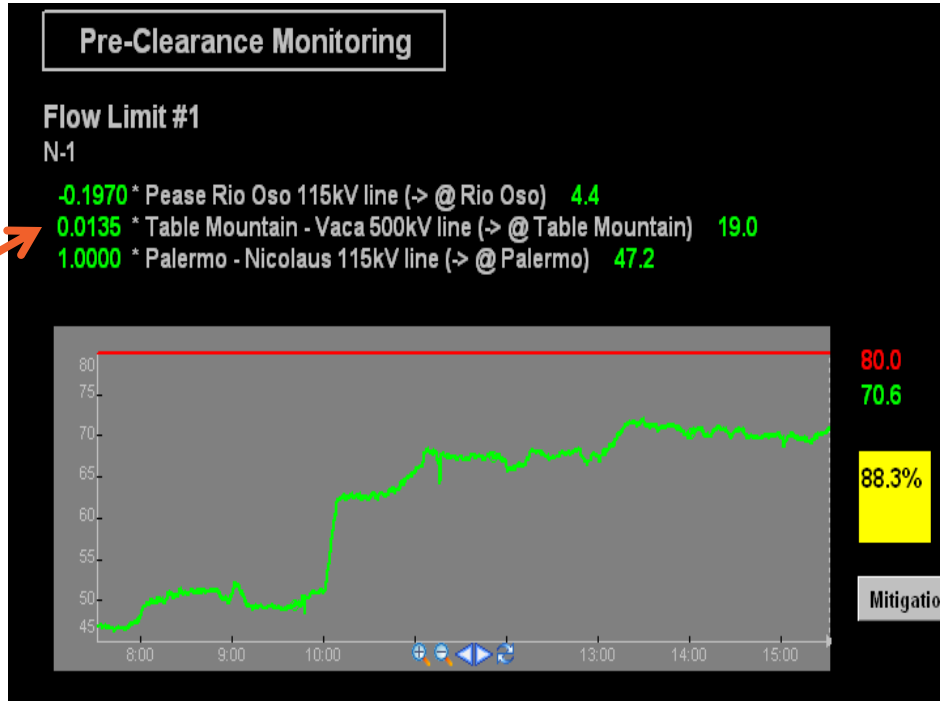
Standard Display:

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



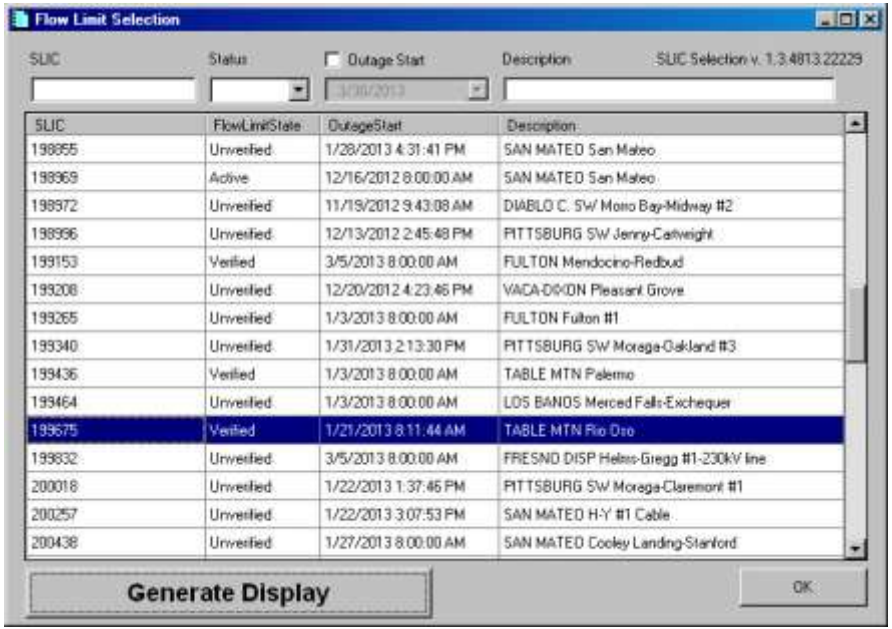
From PI AF to PI Screen





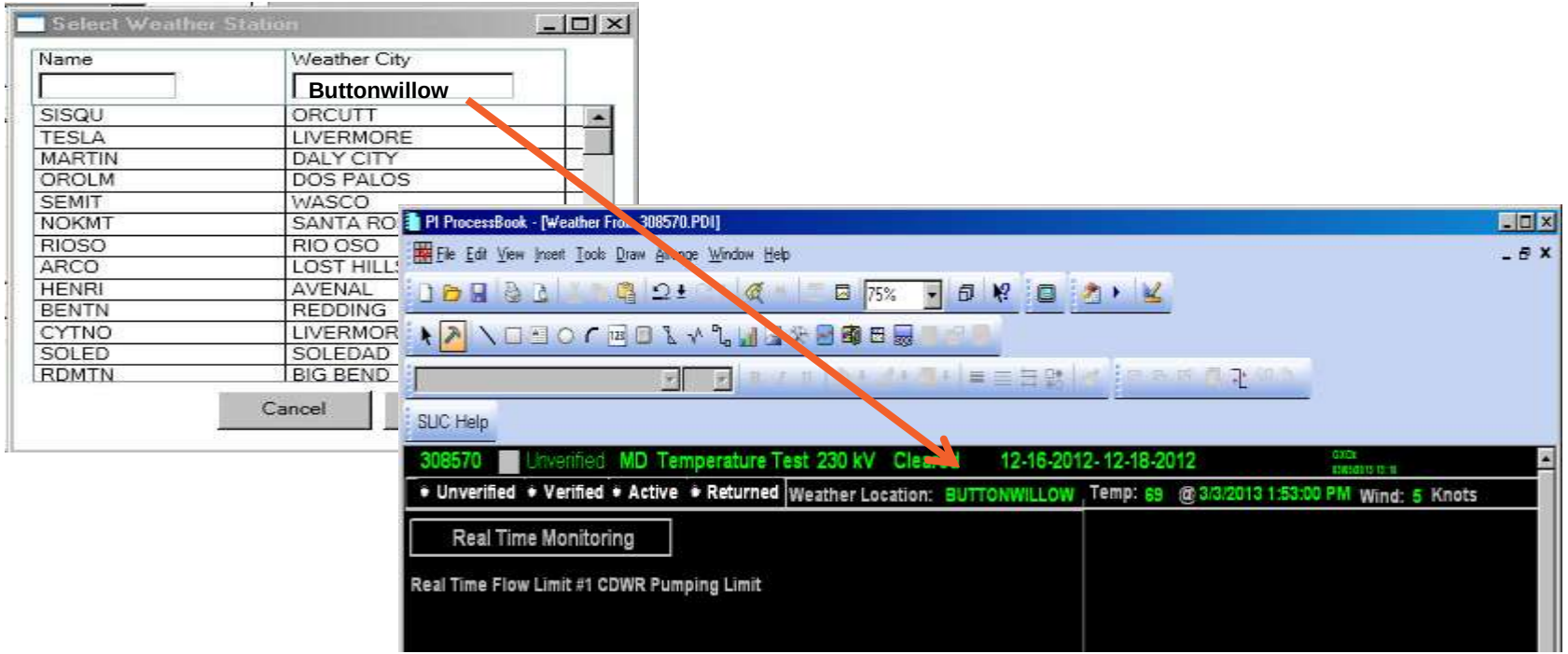
Building the Screen

- Add-in to ProcessBook



Adding Weather data

Real time weather delivered immediately to dispatchers



Lets see how we did - Results

The Must haves:

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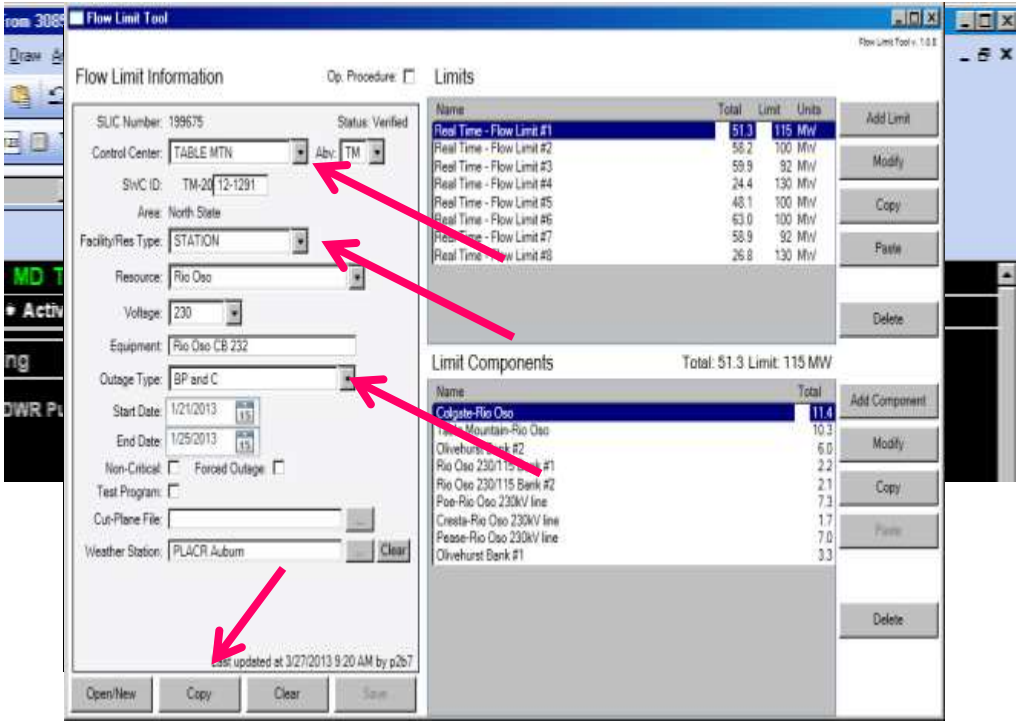
- ***Trend***
- ***Audible Alarm***
- ***Standardized***
- ***Repeatable***
- ***Easy to Use and Teach***



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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Ivan Goodwin	Kevin Cross	

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