



Data Visualization in a Utility Control Center

Bruce McCamant

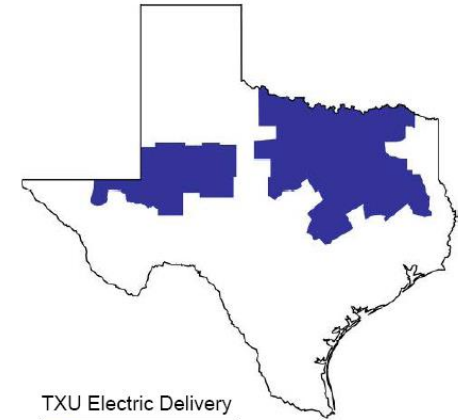
TXU Electric Delivery





TXU Electric Delivery is the nation's sixth-largest transmission and distribution company, operating in a high-growth service area.

- Supplies electricity to over three million points of delivery, or about one third of the state's population.
- Operates in a service area in east, west and north central Texas with 402 incorporated municipalities and 92 counties.
- 6,500 Employees and Contractors
- 100,000 Miles of Distribution Lines
- 14,000 Miles of Transmission Lines



TXU Electric Delivery
■ Service area

VALUE NOW, VALUE OVER TIME



Northeast Blackout

— *Aug. 14, 2003*



VALUE NOW, VALUE OVER TIME



Northeast Blackout

— *Aug. 14, 2003*



VALUE NOW, VALUE OVER TIME



Northeast Blackout

— *Aug. 14, 2003*



VALUE NOW, VALUE OVER TIME



Northeast Blackout

— Aug. 14, 2003



VALUE NOW, VALUE OVER TIME



NERC Reliability Regions



VALUE NOW, VALUE OVER TIME



NERC Findings

- *The August 14 blackout had many similarities with previous large-scale blackouts, including the 1965 Northeast blackout that was the basis for forming NERC in 1968, and the July 1996 outages in the West. Common factors include: conductor contacts with trees, **inability of system operators to visualize events on the system**, failure to operate within known safe limits, ineffective operational communications and coordination, inadequate training of operators to recognize and respond to system emergencies, and inadequate reactive power resources.*
- *NERC Final Blackout Recommendations – July, 2004*

VALUE NOW, VALUE OVER TIME



ERCOT Interconnection

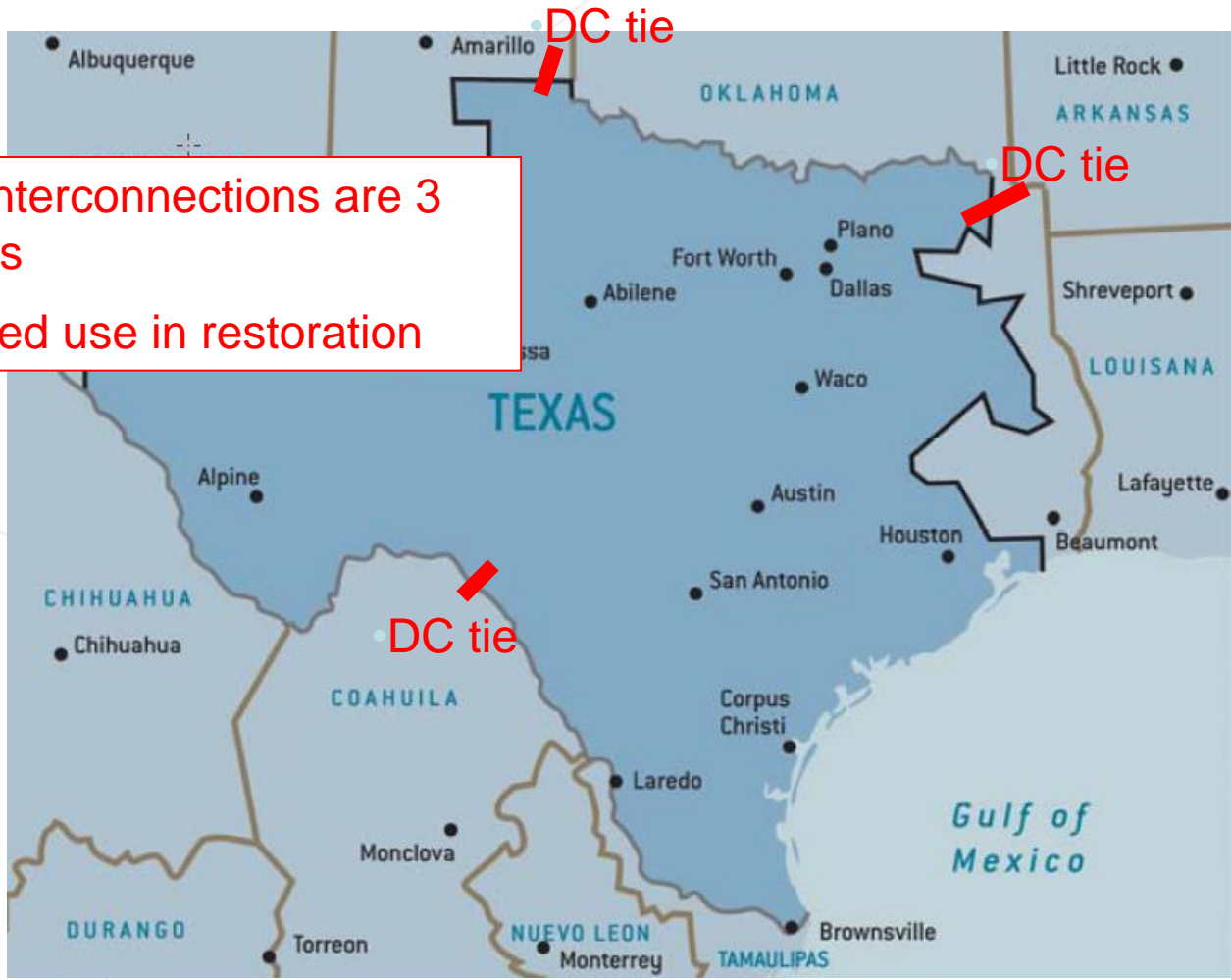


VALUE NOW, VALUE OVER TIME



ERCOT Interconnection

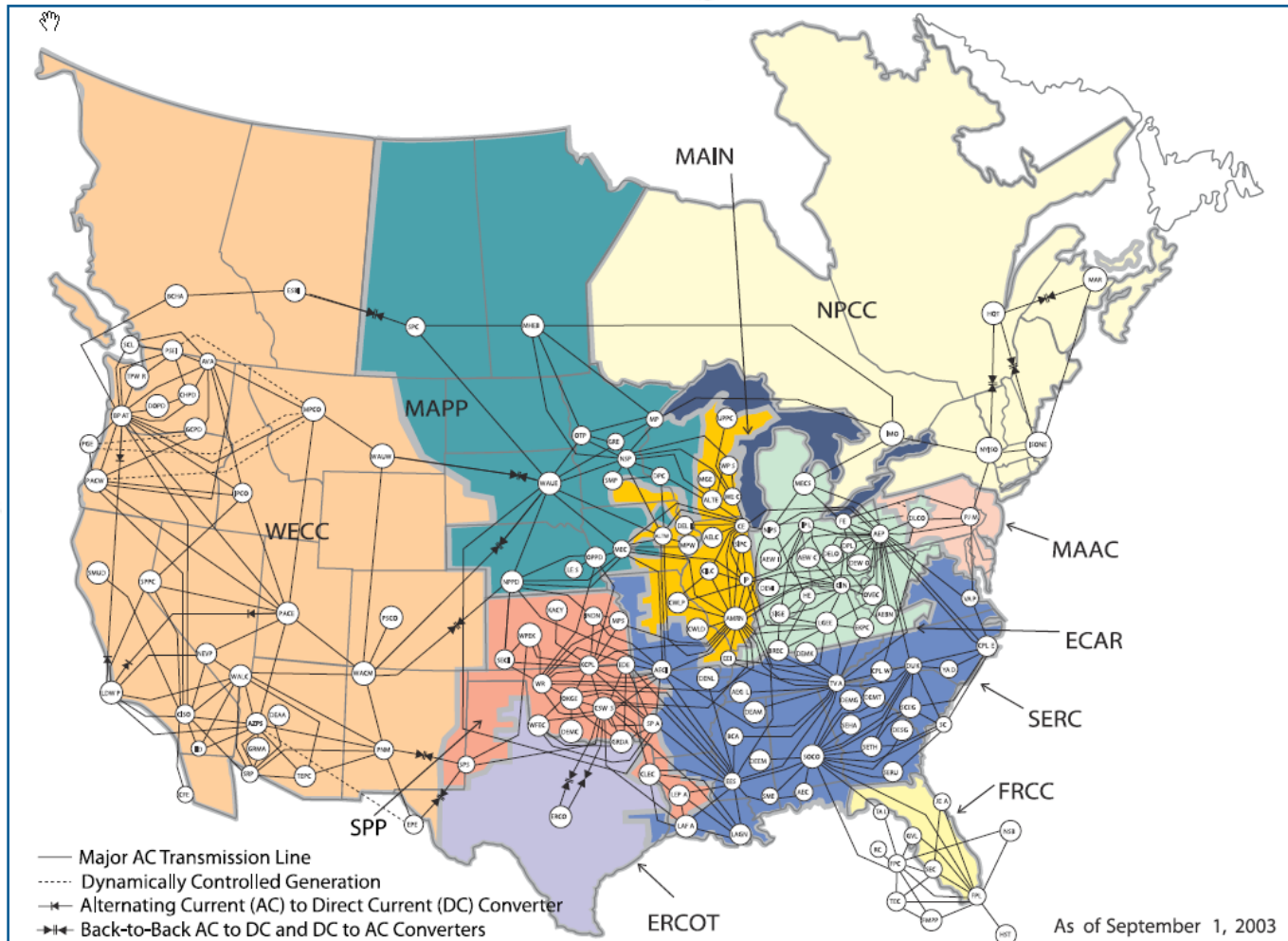
Only interconnections are 3 DC ties
- Limited use in restoration



VALUE NOW, VALUE OVER TIME



NERC Reliability Regions



VALUE NOW, VALUE OVER TIME



ERCOT Interconnection



VALUE NOW, VALUE OVER TIME



ERCOT Interconnection

MSNBC Home » Local news » Temple/Waco/Killeen, TX

KCEN-TV | Local Sports | Your Weather

KCEN-TV—Temple/Waco/Killeen, TX

• MAKE THIS YOUR LOCAL NEWS TOP STORIES FROM:

Electricity blackouts roll across Texas as record-breaking heat grips the state

KCEN-TV
April 17

Rolling blackouts swept across the State and Central Texas on Monday night. State energy officials say the unusual April heat was to blame along with a lack of energy production in Texas. Roughly 15 percent of State power is off line before the summer season while repairs are being done to the system. In Waco, Temple and other areas, the blackouts started happening just before 5 o'clock and lasted a few hours. Local TXU officials say they were notified at the last minute, leaving some residents caught by surprise.

"My oldest son jumped up from the computer and said, 'what happened?' The fans quit. I was in the kitchen and things started heating up. The neighbors called and said, 'Did yours go out?'" said Waco resident Karen Buchanan. Officials say there may be more blackouts this week, but areas with hospitals, nursing homes and police stations won't be affected.

Story by: Matt Gebhard

MORE LOCAL LINKS FROM KCEN-TV/DT

- Temple Daily Telegram
- Killeen Daily Herald

RELATED STORIES | What's this?

- Record Heat Prompts Rolling Brownouts
- Texas utilities end rolling blackouts

MOST POPULAR

Most Viewed • Top Rated • Most E-mailed

- 5 teens arrested in foiled school shooting plot
- Iran leader hails rising oil prices as 'very good'
- Ready to rethink toilet paper for Earth Day?
- 2nd stripper now believes accuser's story
- Gasoline supply problems hit U.S. East Coast
- **Most viewed on MSNBC.com**

MORE NEWS FROM YOUR REGION

- Dallas/Ft. Worth
- Austin
- San Angelo
- Houston
- Select Another City

Done



VALUE NOW, VALUE OVER TIME



ERCOT Interconnection

MSNBC Home » Local news » Temple/Waco/Killeen, TX

KCEN-TV | Local Sports | Your Weather

KCEN-TV—Temple/Waco/Killeen, TX

• MAKE THIS YOUR LOCAL NEWS TOP STORIES FROM:

Electricity blackouts roll across Texas as record-breaking heat grips the state

KCEN-TV
April 17

Rolling blackouts swept across the State and Central Texas on Monday night. State energy officials say the unusual April heat was to blame along with a lack of energy production in Texas. Roughly 15 percent of State power is off line before the summer season while repairs are being done to the system. In Waco, Temple and other areas, the blackouts started happening just before 5 o'clock and lasted a few hours. Local TXU officials say they were notified at the last minute, leaving some residents caught by surprise.

"My oldest son jumped up from the computer and said, 'what happened?' The fans quit. I was in the kitchen and things started heating up. The neighbors called and said, 'Did yours go out?'" said Waco resident Karen Buchanan. Officials say there may be more blackouts this week, but areas with hospitals, nursing homes and police stations won't be affected.

Story by: Matt Gebhard

MORE LOCAL LINKS FROM KCEN-TV/DT

- Temple Daily Telegram
- Killeen Daily Herald

RELATED STORIES | What's this?

- Record Heat Prompts Rolling Brownouts
- Texas utilities end rolling blackouts

MOST POPULAR

Most Viewed • Top Rated • Most E-mailed

- 5 teens arrested in foiled school shooting plot
- Iran leader hails rising oil prices as 'very good'
- Ready to rethink toilet paper for Earth Day?
- 2nd stripper now believes accuser's story
- Gasoline supply problems hit U.S. East Coast
- **Most viewed on MSNBC.com**

MORE NEWS FROM YOUR REGION

- Dallas/Ft. Worth
- Austin
- San Angelo
- Houston
- Select Another City

Done

Stress on power grid sparks rolling blackouts across Texas

In Austin, power shut off 10 minutes at a time Monday afternoon throughout city

By Tony Plohotski, Claudia Grisales
AMERICAN-STATESMAN STAFF

Tuesday, April 18, 2006

Scorching temperatures sent power usage spiraling throughout Texas on Monday, overwhelming the state's power grid and triggering mandatory blackouts in Austin and around the state.

A repeat is not expected today, according to Austin Energy, even with record temperatures in the forecast once again. Still, residents are being asked to conserve power from 3 to 7 p.m. today.



Rodolfo Gonzalez
AMERICAN-STATESMAN

(enlarge photo)

Traffic stacks up Monday on

The Electric Reliability Council of Texas, which runs the state's power grid, said the statewide shortage was caused by record-breaking heat striking at a time when as much as 15 percent of the state's power supply was already off-line for seasonal maintenance. Then four power-generating plants shut down unexpectedly, ERCOT spokesman Paul Wattles said.

So ERCOT ordered utilities to begin reducing the load on the grid before it could appeal to the public for voluntary reductions.

The result was rolling blackouts that sent businesses and homes into darkness, extinguished traffic signals and snarled rush-hour traffic for about two peak temperature of 100 was the highest in different parts of the city for about 10 minutes which sent police officers scrambling to dir

Gulf of Mexico

VALUE NOW, VALUE OVER TIME



PI at TXU

- Initial installation in 1999 for fossil generation plant monitoring
- Installed in 2001 at Comanche Peak Nuclear Plant
- Procured in 1999 at TXU Transmission (now Electric Delivery) for MAXIMO

VALUE NOW, VALUE OVER TIME



PI at TXU Electric Delivery

- Approved transition to PI as primary archive at Transmission Grid Management (TGM) as primary archive in 2003
- Installed IT Monitor in fall of 2004
- Began phase 2 of PI data presentation in Summer of 2005

VALUE NOW, VALUE OVER TIME



PI at TXU Electric Delivery

- Fall of 2005 – received approval for expansion of development environment for PI visualization
 - MS-SQL Server cluster
 - Web servers
 - File servers managing SAN storage
 - Microsoft Sharepoint
 - RtWebparts
 - RtAlerts

VALUE NOW, VALUE OVER TIME



Technologies used for PI @TGM

- Siemens ICCP (using SISCO MMS)-AIX
- SISCO AXS4-ICCP
- PI OPC Interface
- PI to PI Interface as part of IDC implementation
- PI-Batchfile Interface
- PI-RDBMS Interface
- PI Data Access Pack
- PI-ACE
- PI RtAlerts
- PI RtWebparts
- Microsoft Sharepoint Portal
- IT Monitor
 - PI-snmp
 - PI-Netflow
 - PI-Syslog
 - PI-Ping
 - PI-TCP Response
 - PI-Perfmon
 - PI-WinEvent
- Infragistics NetAdvantage
- Dundas Chart
- .NET
- MS-SQL Server 2000

VALUE NOW, VALUE OVER TIME



PI at TXU Electric Delivery

- Two weeks later – TGM received approval for installation of wide-area visualization display system
 - AVI Video Wall System
 - PowerWorld Retriever

VALUE NOW, VALUE OVER TIME



Before...



VALUE NOW, VALUE OVER TIME



During...



Required moving dispatchers to the backup center during reconstruction

VALUE NOW, VALUE OVER TIME



After...

VALUE NOW, VALUE OVER TIME





VALUE NOW, VALUE OVER TIME





VALUE NOW, VALUE OVER TIME





VALUE NOW, VALUE OVER TIME





VALUE NOW, VALUE OVER TIME





VALUE NOW, VALUE OVER TIME



Visualization at TXUED

- Present a concise view of system and regional conditions
 - Geographic
 - Contextual (lines, transformers, reactive reserve...)
- Extend this philosophy to support infrastructure
- Bring to bear expanded and flexible tools and views to explore data
 - Client tools
 - Web-based

VALUE NOW, VALUE OVER TIME



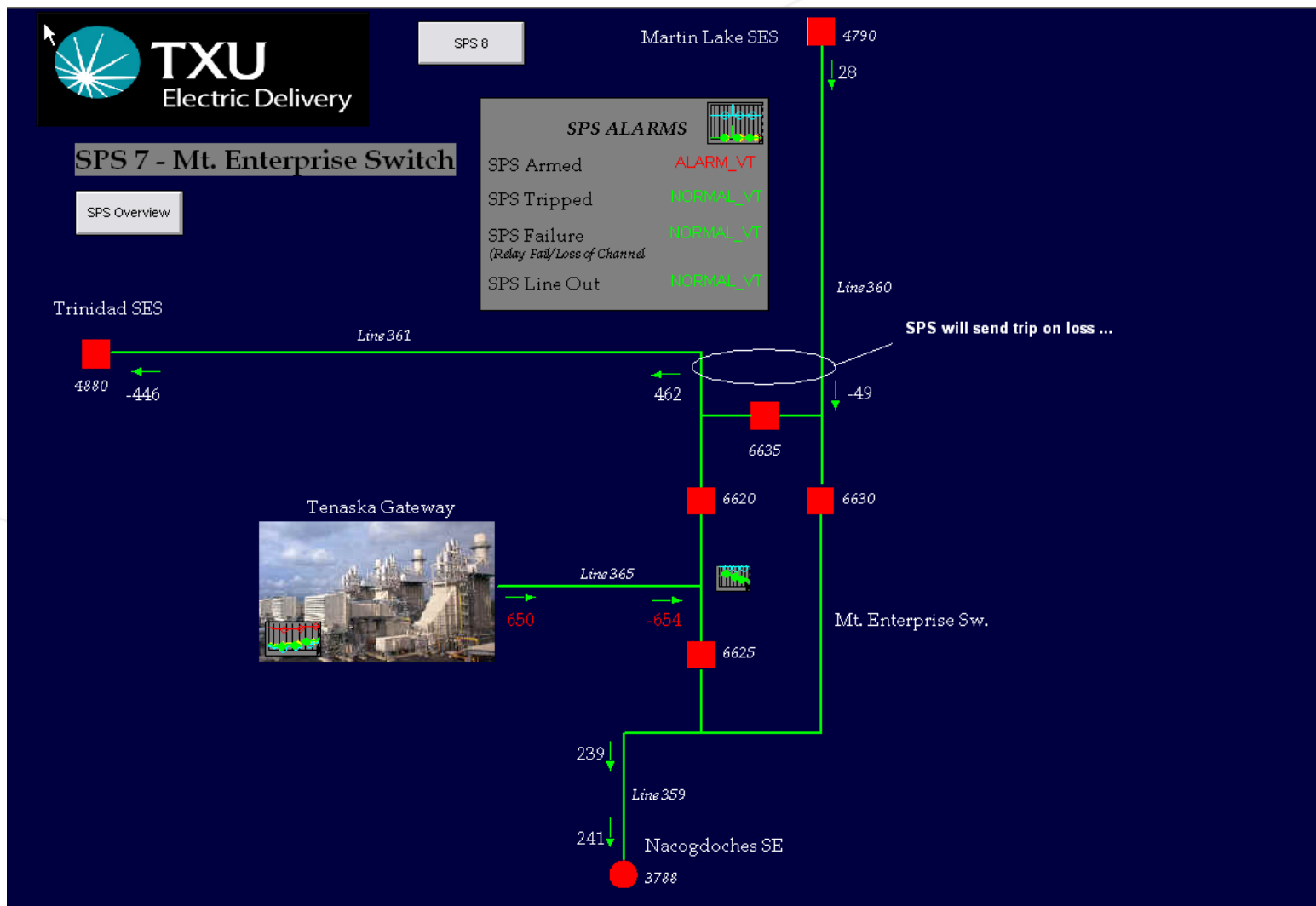
Visualization Resources at TXUED

- PI Data using client tools
 - ProcessBook
 - Datalink
 - RtWebparts
- Dataviews and tools using Sharepoint
- Geographic tools using PowerWorld and GeoMedia WebMap displaying PI data
- Static Maps
- Results from advanced applications

VALUE NOW, VALUE OVER TIME



Process Book



VALUE NOW, VALUE OVER TIME



Process Book (continued)



TXU
Electric Delivery

OUTSIDE TEMPERATURES

Wednesday April 12, 2006 21:43:41

SYSTEM FREQUENCY



TOTAL Transmission Load



TOTAL Net Interchange

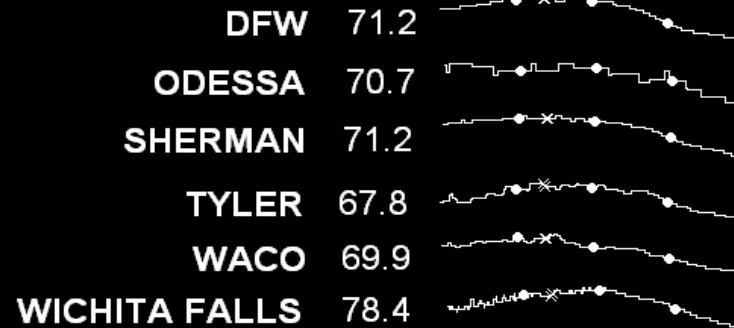


Temps

NetInchg

CSC

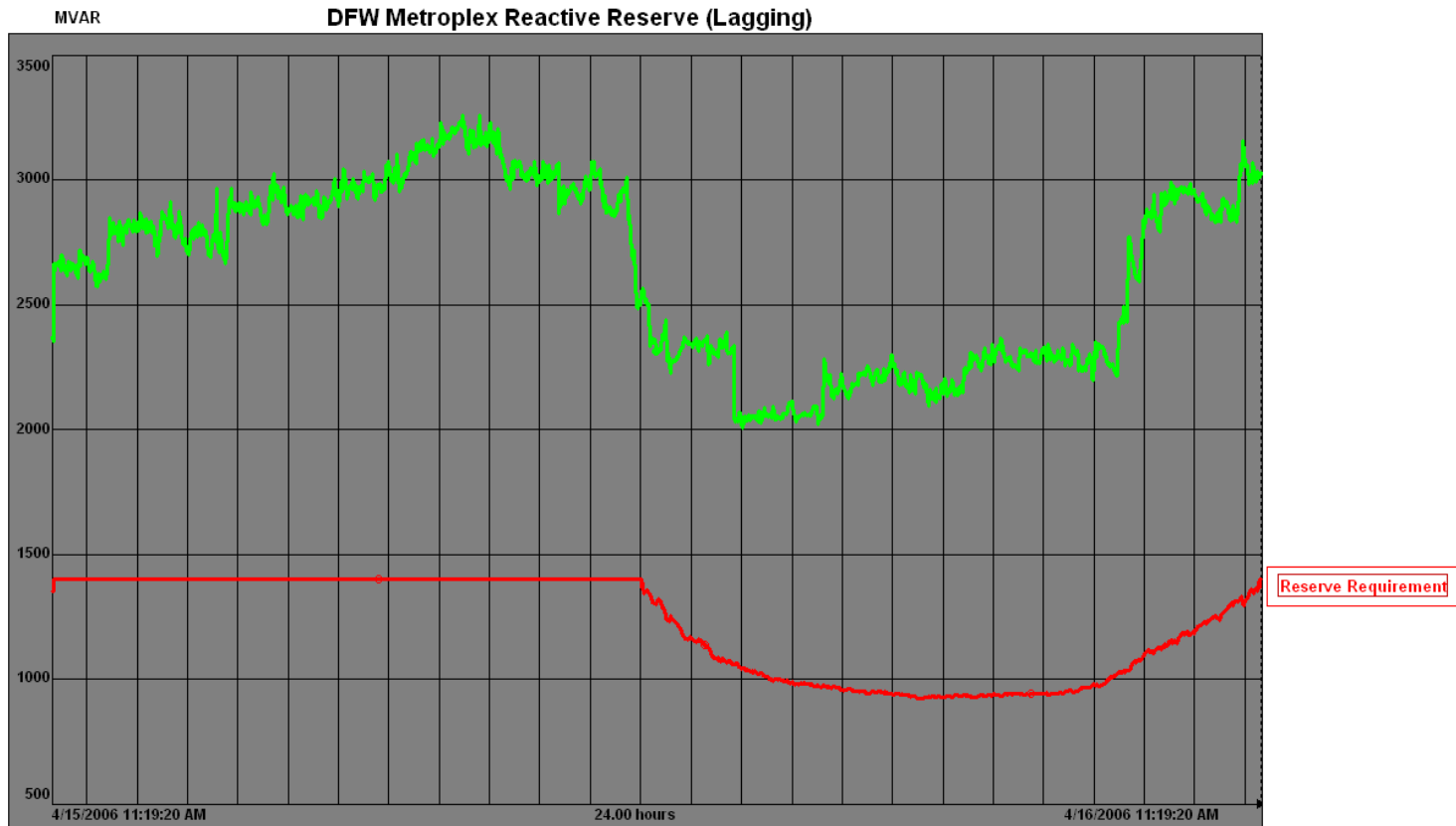
TEMPERATURE



VALUE NOW, VALUE OVER TIME



ProcessBook (continued)



Current Instantaneous Data

| | Actual Reserve | Reserve Reqmt. | System Load |
|-------------------|----------------|----------------|-------------|
| Total DFW Reserve | 3025 MVAR | 1400 MVAR | 13557 MW |

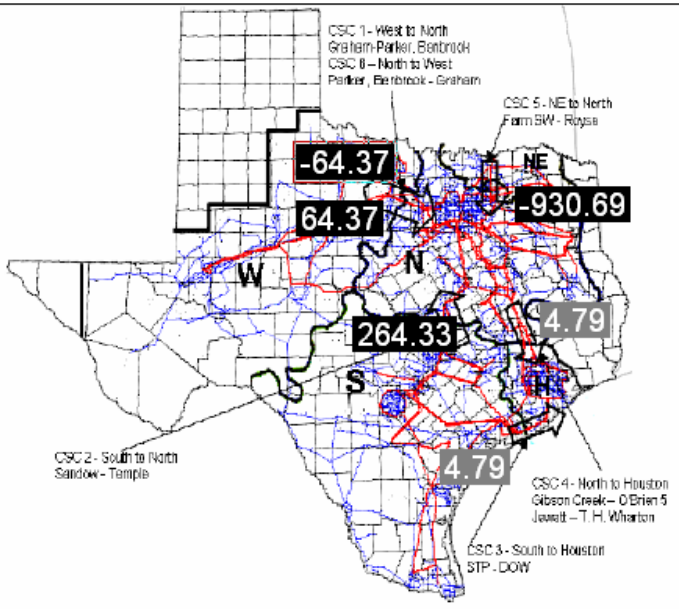
VALUE NOW, VALUE OVER TIME



ProcessBook (continued)



CSC OVERVIEW



| | | |
|--------------------|--|----------------------|
| CSC 1 W - N | | 10.06 % of MaxLimit: |
| Limit: 640 | | |
| Flow: -64.37 | | |
| CSC 2 S - N | | 20.11 % of MaxLimit: |
| Limit: 810 | | |
| Flow: 32.63 | | |
| CSC 3S - H | | 10.06 % of MaxLimit: |
| Limit: 1930 | | |
| Flow: 4.79 | | |
| CSC 4 N - H | | 10.06 % of MaxLimit: |
| Limit: 2470 | | |
| Flow: 4.79 | | |
| CSC 5 N - N | | 62.05 % of MaxLimit: |
| Limit: 1500 | | |
| Flow: -930.69 | | |
| CSC 6 N - W | | 20.11 % of MaxLimit: |
| Limit: 320 | | |
| Flow: 64.37 | | |

CSC 3,4 CURRENTLY NOT IN SERVICE

Temp Net Inchg CSC

VALUE NOW, VALUE OVER TIME



RtWebparts - Sharepoint

Home Documents and Lists Create Site Settings Help

TMS PI Archive Data Modify Shared Page ▾



Time Range

Start Time: *6h

End Time: *

TGM Substation Data Values

| Dataset | Time | Value | IntervalMaximum | Max Time | IntervalMinimum | Min Time |
|------------------------------------|-----------------------|--------|-----------------|----------------------|-----------------|----------------------|
| \\s_ent03\WDGWD_Dist_FD1561_Amps1A | 4/16/2006 10:58:52 AM | 128.97 | 184.07 | 4/15/2006 5:24:48 PM | 81.485 | 4/16/2006 6:55:31 AM |
| \\s_ent03\WDGWD_Dist_FD1561_Amps1C | 4/16/2006 10:58:52 AM | 119 | 180.56 | 4/15/2006 5:24:48 PM | 79.726 | 4/16/2006 5:37:58 AM |
| \\s_ent03\WDGWD_Dist_FD1561_Amps1B | 4/16/2006 10:58:36 AM | 134.25 | 193.45 | 4/15/2006 4:19:29 PM | 86.175 | 4/16/2006 7:15:30 AM |

Start Time=4/15/2006 10:58:56 AM, End Time=4/16/2006 10:58:56 AM Showing 1 to 3 of 3

Select a Component

- TXU Electric Delivery
 - Dallas Region
 - Fort Worth Region
 - Fort Worth District
 - Wedgewood
 - Dist
 - Feeder 1512
 - Feeder 1513
 - Feeder 1522
 - Feeder 1523
 - Feeder 1531
 - Feeder 1541
 - Feeder 1552
 - Feeder 1561
 - Amps
 - Load
 - Feeder 1572
 - Feeder 1581
 - Feeder 1591
 - Feeder 1592
 - LTC Xfmr 1
 - LTC Xfmr 2
 - Xfmr 3

- UV Relay

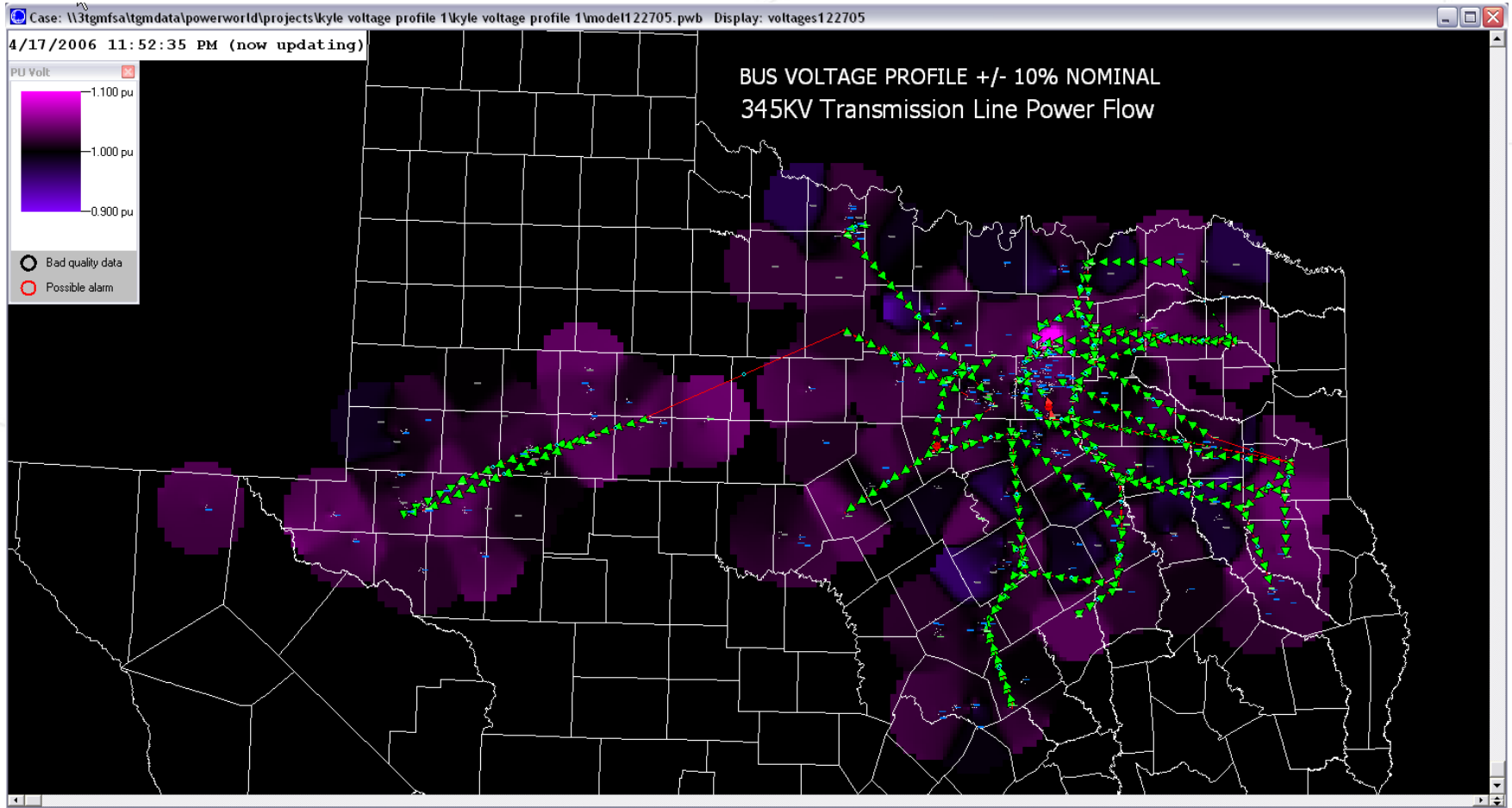
TGM Substation Data



VALUE NOW, VALUE OVER TIME



PowerWorld Retriever

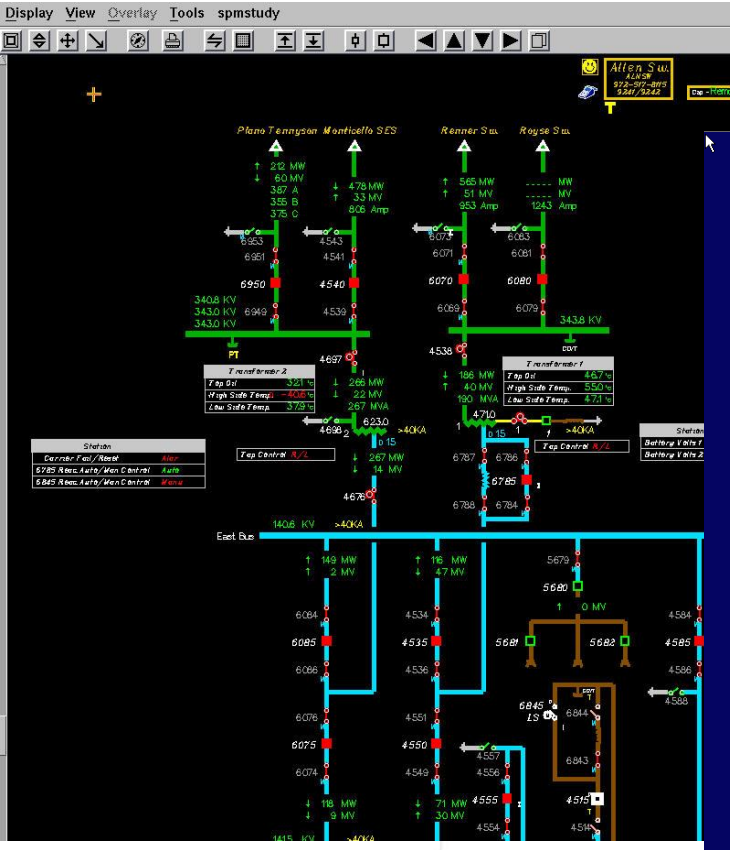
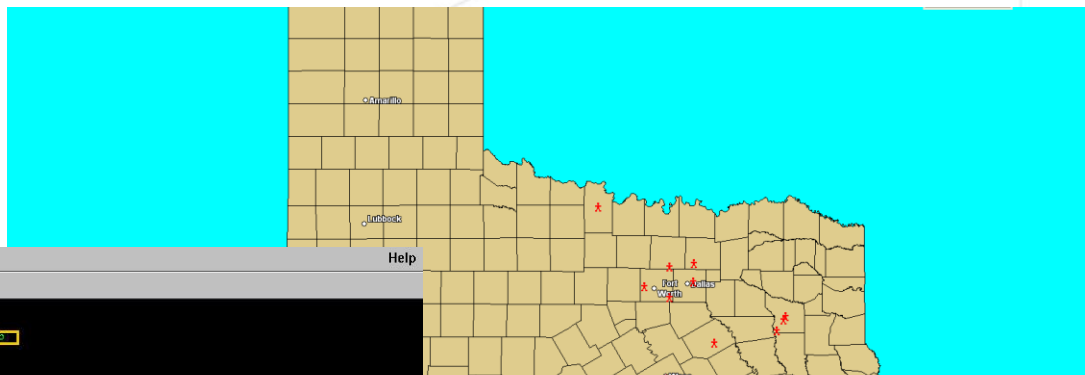


- Data from PI or TMS

VALUE NOW, VALUE OVER TIME



SEEN- Substation Entry/Exit Notification



Transmission .Net Web Portal

TXU Electric Delivery

Transmission | Field Tools | Documents | Resources | Apps | TGM | Training | Weather | Distribution

SEEN Activity Log

Start Date: 4/28/2006 End Date: 4/28/2006 Start Time: 00:01 End Time: 23:59

Station: ALL Employee: ALL Job Title: ALL TGM Desk: ALL

| Date/Time | Station | Employee | Job Title | Action | Tech Area | TGM Desk |
|-------------------|------------------|----------------------|---------------------------|--------|-----------------|-------------------|
| 04/28/06 23:13:41 | EAST ZACHA | BERRY, JAMES | | EXIT | DALLAS (76) | DALLAS |
| 04/28/06 06:38:49 | COPPELL SOUTH | MELTON, JOHNNY | CONTRACTOR - TRANSMISSION | ENTRY | FORT WORTH (80) | FORT WORTHWESTERN |
| 04/28/06 13:57:42 | COPPELL SOUTH | MELTON, JOHNNY | CONTRACTOR - TRANSMISSION | EXIT | FORT WORTH (80) | FORT WORTHWESTERN |
| 04/28/06 06:40:51 | IRVING LBJ | CARUTHERS, DON | CONTRACTOR - TRANSMISSION | ENTRY | DALLAS (76) | DALLAS |
| 04/28/06 17:33:13 | IRVING LBJ | CARUTHERS, DON | CONTRACTOR - TRANSMISSION | EXIT | DALLAS (76) | DALLAS |
| 04/28/06 06:41:15 | DIALVILLE | HARRISON, JOE | CONTRACTOR - TRANSMISSION | ENTRY | PALESTINE (88) | SOUTHEAST |
| 04/28/06 22:20:10 | DIALVILLE | HARRISON, JOE | CONTRACTOR - TRANSMISSION | EXIT | PALESTINE (88) | SOUTHEAST |
| 04/28/06 06:44:08 | AIRPORT - A EAST | MCKINNEY, JAMES | CONTRACTOR - TRANSMISSION | ENTRY | DALLAS (76) | DALLAS |
| 04/28/06 16:29:16 | AIRPORT - A EAST | MCKINNEY, JAMES | CONTRACTOR - TRANSMISSION | EXIT | DALLAS (76) | DALLAS |
| 04/28/06 06:45:23 | HILLSBORO | DOWDLE, MILLARD | CONTRACTOR - TRANSMISSION | ENTRY | WACO (85) | SOUTHEAST |
| 04/28/06 15:06:08 | HILLSBORO | DOWDLE, MILLARD | CONTRACTOR - TRANSMISSION | EXIT | WACO (85) | SOUTHEAST |
| 04/28/06 06:48:50 | COCKRELL HILL | COSPER, LARRY DEAN | ELECT SR-S & T | ENTRY | DALLAS (76) | DALLAS |
| 04/28/06 08:47:27 | COCKRELL HILL | COSPER, LARRY DEAN | ELECT SR-S & T | EXIT | DALLAS (76) | DALLAS |
| 04/28/06 06:48:57 | WEBB | WALKER, STEVE | CONTRACTOR - TRANSMISSION | ENTRY | FORT WORTH (80) | FORT WORTHWESTERN |
| 04/28/06 14:12:13 | WEBB | WALKER, STEVE | CONTRACTOR - TRANSMISSION | EXIT | FORT WORTH (80) | FORT WORTHWESTERN |
| 04/28/06 06:51:28 | COCKRELL HILL | HUNSAKER, RICKY LYNN | ELECT SR-S & T | ENTRY | DALLAS (76) | DALLAS |
| 04/28/06 08:47:17 | COCKRELL HILL | HUNSAKER, RICKY LYNN | ELECT SR-S & T | EXIT | DALLAS (76) | DALLAS |

VALUE NOW, VALUE OVER TIME



Top Ten Loaded Lines



- Using AJAX

VALUE NOW, VALUE OVER TIME



RED FLAG WARNING

Texas Weather Flag

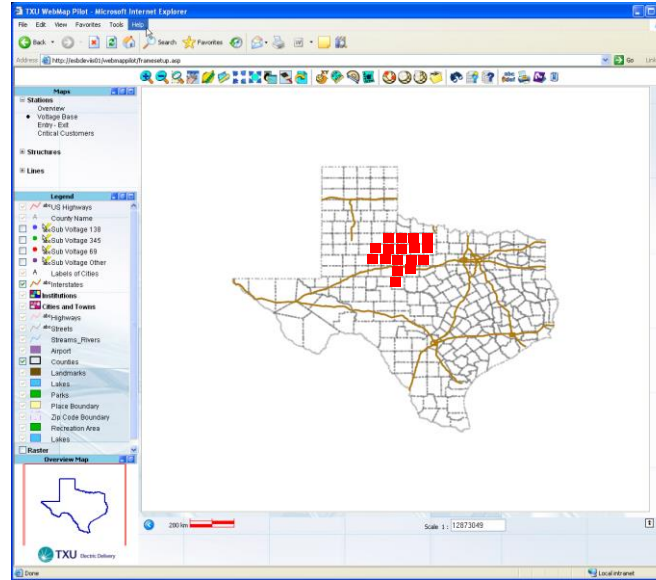
Feed Address: <http://www.weather.gov/alerts/tx.rss> Start Stop

PI Update Status RSS Read Service Tags

Drag a column header here to group by that column.

| PI Host | County | Flag Type | Tag Name | Last Update | Current Status |
|---------|------------|------------------|-------------------------------------|-------------|----------------|
| s_eni03 | Pecos | Red Flag Warning | Pecos_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Reagan | Red Flag Warning | Reagan_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Reeves | Red Flag Warning | Reeves_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Robertson | Red Flag Warning | Robertson_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Rockwall | Red Flag Warning | Rockwall_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Rusk | Red Flag Warning | Rusk_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Scurry | Red Flag Warning | Scurry_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Smith | Red Flag Warning | Smith_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Somervell | Red Flag Warning | Somervell_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Stephens | Red Flag Warning | Stephens_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Tarrant | Red Flag Warning | Tarrant_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Taylor | Red Flag Warning | Taylor_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Titus | Red Flag Warning | Titus_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Travis | Red Flag Warning | Travis_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Upton | Red Flag Warning | Upton_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Van Zandt | Red Flag Warning | Van Zandt_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Ward | Red Flag Warning | Ward_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Wichita | Red Flag Warning | Wichita_Red_Flag_Warning_Status | 10:21:43 AM | Set |
| s_eni03 | Williamson | Red Flag Warning | Williamson_Red_Flag_Warning_Stat... | 4:31:41 AM | Not Set |
| s_eni03 | Winkler | Red Flag Warning | Winkler_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Wise | Red Flag Warning | Wise_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |
| s_eni03 | Young | Red Flag Warning | Young_Red_Flag_Warning_Status | 4:31:41 AM | Not Set |

10:22:39 RSS Idle Last Update: 10:22:11 AM Next Update: 10:24:11 AM



VALUE NOW, VALUE OVER TIME



Datalink – RTU Performance Metrics

| RTU PERFORMANCE METRICS.XLS | | | | 4/24/2006 8:16 |
|---|------------------|-------------------|------------------------|---------------------------|
| Begin date | 14-Apr-06 | | | |
| End date | 23-Apr-06 | | | |
| Number of Days | 10.00 | | | |
| Total RTU's | 989 | | | Recalculate |
| Total Inservice RTU's | 970 | | | TA AREA |
| Total Inservice Hours | 232,800 | | | all |
| Quantity RTU's Affected | 365 | | | pick list |
| Total Disturbed hours | 3,796.83 | | | |
| Total Disturbed Events | 3,204 | | | |
| Disturbed Hours / Insvc RTU | 3.84 | | | |
| Average RTU Uptime % | 98.37% | | | |
| Total Hours Off Between | Qty RTU's | Qty Events | Disturbed Hours | |
| 0<1 | 218 | 806 | 25.72 | |
| 1<10 | 87 | 1,039 | 297.00 | |
| 10<100 | 52 | 1,103 | 1,708.50 | |
| >100 | 8 | 259 | 1,765.48 | |
| check | 365 | 3,207 | 3,796.70 | |
| NOTE: Qty Events may have multiple reads for individual outages greater than 8 hours. | | | | |
| BLUE items are the only cells that can be changed. | | | | |
| TOP TEN HOURS DISTURBED | | | | |
| | | Total hours | Hours Disturbed | Number of Times Disturbed |
| R.WHCCS_DIS | R.WHCCS_DIS=2 | 240 | 239.00 | 34 |
| R.NUCOR_DIS | R.NUCOR_DIS=2 | 240 | 238.99 | 31 |
| R.RNFLF_DIS | R.RNFLF_DIS=2 | 240 | 238.99 | 31 |
| R.TXSTL_DIS | R.TXSTL_DIS=2 | 240 | 238.99 | 31 |
| R.SFTPE_DIS | R.SFTPE_DIS=2 | 240 | 238.99 | 31 |
| R.HKBRY2_DIS | R.HKBRY2_DIS=2 | 240 | 238.99 | 33 |
| R.MDHOL_DIS | R.MDHOL_DIS=2 | 240 | 225.18 | 34 |
| R.LKTMS_DIS | R.LKTMS_DIS=2 | 240 | 106.33 | 34 |
| R.FLCNS2_DIS | R.FLCNS2_DIS=2 | 240 | 84.63 | 68 |
| R.GYVLM_DIS | R.GYVLM_DIS=2 | 240 | 80.66 | 93 |
| TOP TEN NUMBER OF TIMES DISTURBED | | | | |
| | | Total hours | Hours Disturbed | Number of Times Disturbed |
| R.ODNTH2_DIS | R.ODNTH2_DIS=2 | 240 | 29.78 | 110 |
| R.GYVLM_DIS | R.GYVLM_DIS=2 | 240 | 80.66 | 93 |
| R.BRKTN_DIS | R.BRKTN_DIS=2 | 240 | 62.48 | 69 |
| R.FLCNS2_DIS | R.FLCNS2_DIS=2 | 240 | 84.63 | 68 |
| R.BARRY_DIS | R.BARRY_DIS=2 | 240 | 6.43 | 59 |
| R.MRKLY_DIS | R.MRKLY_DIS=2 | 240 | 1.91 | 58 |
| R.MESQN_DIS | R.MESQN_DIS=2 | 240 | 2.55 | 57 |
| R.BKWWF_DIS | R.BKWWF_DIS=2 | 240 | 1.86 | 54 |
| R.WFSSW_DIS | R.WFSSW_DIS=2 | 240 | 1.72 | 54 |
| R.HOLDY_DIS | R.HOLDY_DIS=2 | 240 | 2.03 | 52 |

VALUE NOW, VALUE OVER TIME



Capacitor Control – Cannon Technologies

Feeder - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites

Address http://172.29.3.22:8080/capcontrol/feeders.jsp

GridSmartEnergy capacitorcontrol.com Powered by Yukon

Create Modify Reporting View Module: Select a location... Log Out

SubBus Areas > Substations > Feeders Find: GO

Substation

| Sub Name | State | Target | VAR Load / Est. | Date/Time | PFactor / Est. | Watts / Volts | Daily / Max Ops |
|---|---------|-----------|-----------------|---------------------|-----------------|---------------|-----------------|
| <input type="checkbox"/> Hackberry Bank 1 | ENABLED | 0 to 0 Pk | -420 / 6780 | 04-24-2006 09:06:02 | -100.0% / 94.4% | -19326 / ---- | 4 / NA |

Feeders

| Feeder Name | State | Target | VAR Load / Est. | Date/Time | PFactor / Est. | Watts / Volts | Daily / Max Ops |
|---|---------|-----------------|-----------------|---------------------|-----------------|---------------|-----------------|
| <input type="checkbox"/> Hackberry 1101 | ENABLED | -900 to 1100 Pk | 464 / 3164 | 04-24-2006 09:06:19 | 99.8% / 93.2% | 8147 / ---- | 1 / NA |
| <input type="checkbox"/> Hackberry 1109 | ENABLED | -900 to 1100 Pk | -106 / 4394 | 04-24-2006 09:02:46 | -100.0% / 93.1% | 11207 / ---- | 3 / NA |

Capacitor Banks

| CB Name (Order) | State | Bank Address | Date/Time | Bank Size | Parent Feeder | Op Count |
|--|-------|-------------------------------|---------------------|-----------|----------------|----------|
| <input type="checkbox"/> 700000012 (5) | Open | W. of Beltline, S. of Gateway | 04-21-2006 23:56:05 | 1800 | Hackberry 1101 | 206 |
| <input type="checkbox"/> 700000875 (1) | Close | S. Coppell Rd. and Burns | 04-21-2006 23:38:35 | 900 | Hackberry 1109 | 8 |
| <input type="checkbox"/> 700000876 (2) | Close | S Coppell Rd and Kaye | 04-24-2006 03:12:19 | 1800 | Hackberry 1109 | 18 |
| <input type="checkbox"/> 700000874 (3) | Close | 260 Southwest Blvd. | 04-24-2006 08:22:12 | 1800 | Hackberry 1109 | 261 |
| <input type="checkbox"/> 700000871 (4) | Open | Wrangler and Executive Dr. | 04-22-2006 00:06:31 | 1800 | Hackberry 1109 | 54 |
| <input type="checkbox"/> 700000836 (5) | Open | Beltline N. of Wrangler | 04-22-2006 00:11:55 | 900 | Hackberry 1109 | 9 |

Copyright © 2002-2006, Cannon Technologies, Inc. All rights reserved.

VALUE NOW, VALUE OVER TIME



UV Feeder Management Support

Substation Under Voltage Relay Overview

- Alpha
- Bravo
- Charlie
- Delta
- Echo
- Foxtrot
- Golf
- Hotel

Substation Bravo

Transmission Under Voltage Area Alarm

| Status | UV | Max Amps | Time | Estimated | |
|-----------|----|----------|---------------|-----------|--------|
| | | Current | Hour Prior To | Cold Load | |
| | | Amps | Last Bkr Open | Bkr Open | Pickup |
| Breaker 1 | | 52.38 | | | |
| Breaker 2 | | 60.92 | | | |
| Breaker 3 | | 246.08 | | | |
| Breaker 4 | UV | - | 126.42 | 1:22:36 | 137.85 |
| Breaker 5 | | 28.89 | | | |
| Breaker 6 | | 169.18 | | | |
| Breaker 7 | | - | 143.56 | 0:42:16 | 145.61 |

VALUE NOW, VALUE OVER TIME



IT Monitor at TXU Electric Delivery



VALUE NOW, VALUE OVER TIME



Tag Builder in SMT for IT Monitor

PI System Management Tools - Active Plug-In: Performance Monitor Points

File Tools Help

PI Servers

- DDCUTLPHVPV01
- esboncpi01
- localhost
- s_ent03
- e_ent04
- s_itm03

Tag Settings Build Tag

PI Archive Subsystem

- ArcEvent Calls/sec
- Archive Cycles/Sec
- Archived Events/sec
- Cache Clean Operations/sec
- Cache Flush Operations/sec
- Cache Record Count
- Cache Record Disk Reads/sec
- Cache Record Memory Reads/sec
- Cache Records Created/sec
- Cache Records Deleted/sec
- CompEvents Calls/sec
- Config. Max Unflushed Events/pt
- Connector Event Read Exec Time
- Connector Events Read/sec
- Connector Read Operations/sec
- Connector Summaries Exec Time
- Connector Summaries/sec
- Current Cache Record Pool
- Current Max Unflushed Events/pt
- Events Cascade/Sec

| Build? | Tag Name | Performance Counter | Value | Type |
|-------------------------------------|---|---|--------|---------|
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_ArcEvent Calls/sec | \\S_ITM03\PI Archive Subsystem\ArcEvent Calls/sec | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Archive Cycles/S... | \\S_ITM03\PI Archive Subsystem\Archive Cycles/S... | 9 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Archived Events... | \\S_ITM03\PI Archive Subsystem\Archived Events... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Cache Clean Op... | \\S_ITM03\PI Archive Subsystem\Cache Clean Op... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Cache Flush Dpe... | \\S_ITM03\PI Archive Subsystem\Cache Flush Dpe... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Cache Record C... | \\S_ITM03\PI Archive Subsystem\Cache Record C... | 189 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Cache Record Di... | \\S_ITM03\PI Archive Subsystem\Cache Record Di... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Cache Record M... | \\S_ITM03\PI Archive Subsystem\Cache Record M... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Cache Records ... | \\S_ITM03\PI Archive Subsystem\Cache Records ... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Cache Records ... | \\S_ITM03\PI Archive Subsystem\Cache Records ... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_CompEvents Call... | \\S_ITM03\PI Archive Subsystem\CompEvents Call... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Config. Max Unfl... | \\S_ITM03\PI Archive Subsystem\Config. Max Unfl... | 256 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Configured Cach... | \\S_ITM03\PI Archive Subsystem\Configured Cach... | 240... | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Connector Event... | \\S_ITM03\PI Archive Subsystem\Connector Event... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Connector Event... | \\S_ITM03\PI Archive Subsystem\Connector Event... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Connector Event... | \\S_ITM03\PI Archive Subsystem\Connector Event... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Connector Read ... | \\S_ITM03\PI Archive Subsystem\Connector Read ... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Connector Summ... | \\S_ITM03\PI Archive Subsystem\Connector Summ... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Connector Summ... | \\S_ITM03\PI Archive Subsystem\Connector Summ... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Current Cache R... | \\S_ITM03\PI Archive Subsystem\Current Cache R... | 240... | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Current Max Unfl... | \\S_ITM03\PI Archive Subsystem\Current Max Unfl... | 256 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Events Cascade... | \\S_ITM03\PI Archive Subsystem\Events Cascade... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_Events Read/sec | \\S_ITM03\PI Archive Subsystem\Events Read/sec | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_GetSnapshot Call... | \\S_ITM03\PI Archive Subsystem\GetSnapshot Call... | 0 | Float32 |
| <input checked="" type="checkbox"/> | S_ITM03_PI Archive Subsystem_InterpEvents Call... | \\S_ITM03\PI Archive Subsystem\InterpEvents Call... | 0 | Float32 |

Tag Count: 55

Build Tags

Create tags on PI Server:

Write tags to CSV File

Create Tags

Session Record

VALUE NOW, VALUE OVER TIME



Server Overview display in PB with IT Overview

S_ENT03 Windows

| Status | Processor | Memory |
|---|---|---|
| ■ Online: 19.3 Days | ■ Processor Usage %: 22 | ■ Committed Memory %: 9 |
| Errors Since start-up (1d): | Processor Usage 1hr Avg.: 19 | Available Memory: 3161 MBytes |
| Logon: 0 0 | Processor Queue Length: 0 | Memory Pages/sec: 1 |
| System: 0 0 | Processor Queue 1hr Avg.: 0 | Private Bytes Total: 370,700,288 |

| Logical Disks | | | |
|---|---------------|------------|------------|
| Disk | Free Space | Delta (1d) | %Disk Time |
| ■ C: | 63,866 MBytes | -5 | 0 |
| ■ E: | 18,248 MBytes | -1 | 1 |

| System | |
|----------------------|--------------------------------|
| Processes: 45 | Context Switches: 11440 |
| Threads: 545 | Interrupts: 1396 |

| Network | |
|--------------------------------|------------|
| Received - Intel-R-PRO_1000 MT | 1.4845E+05 |
| Sent - Intel-R-PRO_1000 MT | 1.0152E+05 |

VALUE NOW, VALUE OVER TIME



Switch Overview display in PB with IT Overview

The screenshot displays the IT Overview software interface for a switch named BL01 - 172.26.XAH.Y. On the left, a tree view shows the network hierarchy: (s_itm03) > CFE > Network > Switches. Under Switches, several IP addresses are listed, including 172.26.XAH.Y (2). The main display area is divided into several sections:

- System:** Shows the switch is Online and has an uptime of 473.8 Days. Below this is a CPU Utilization graph showing usage over time.
- Memory:** Contains two panels: Memory Utilization (Processor) and Port0.
- Uplink Traffic:** Features two line graphs: Interface Octets (showing traffic volume) and Interface Errors (showing error counts).
- Physical Switch:** A detailed diagram of the switch hardware, showing a row of ports with status indicators (green, red, blue) and a console port on the right.


VALUE NOW, VALUE OVER TIME



IT Monitor in ProcessBook

ITOverview

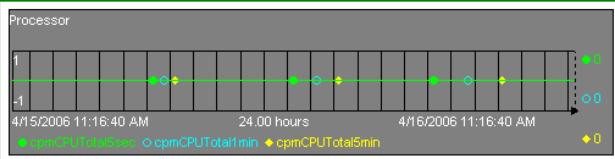
- (s_itm03)
- CFE
- Network
 - Firewall
 - ASA1
 - Routers
 - Switches
- PI Servers
- TGMGates Domain Con
- TGMGates File Servers
- TGMGates SQL Servers
- TGMGates Web Server



TGMASA1

System Up Time: 109.7 Days

Processor



Memory Pool Usage (Bytes)

| | |
|---------------------|-------------|
| System memory | |
| Used | 71,510,688 |
| Free | 465,360,832 |
| Largest Free | 462,036,992 |


| | | InOctets | OutOctets | | InErrors | OutErrors | |
|--|-----------------------|----------|-----------|--|----------|-----------|--|
| | Failover G0/0 | 126 | 1,274 | | 0 | 0 | |
| | Inside G0/1 | 82,135 | 7,057 | | 0 | 0 | |
| | TXUCORP G0/2 | 2,608 | 11,796 | | 0 | 0 | |
| | ERCOT G0/3.1 | 1,824 | 11,993 | | 0 | 0 | |
| | LCRA G0/3.2 | 116 | 783 | | 0 | 0 | |
| | SIEMENS G0/3.3 | 1,224 | 35,587 | | 0 | 0 | |

VALUE NOW, VALUE OVER TIME

Copyright © 2006 OSISOFT, Inc. Company Confidential. All rights reserved.

46

IT Monitor in ProcessBook (continued)



Syslog Viewer

Help

Select Data and Time Range

Select Syslog Data

Select Time Range

Display Messages

Message Count

16

Filters

Clear Filters

Message ID

Text String

| TimeStamp | Message ID | Message | HostName | F... |
|----------------------|---------------|--|--------------------------------------|-------------|
| 4/21/2006 2:59:25 PM | %ASA-4-106023 | Deny tcp src txucorp:146 34.100/4617 dst inside:172. | .11/42 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 2:59:28 PM | %ASA-4-106023 | Deny tcp src txucorp:146 34.100/4617 dst inside:172. | .11/42 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 2:59:34 PM | %ASA-4-106023 | Deny tcp src txucorp:146 34.100/4617 dst inside:172. | .11/42 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:00:07 PM | %ASA-4-106023 | Deny tcp src txucorp:146 34.100/4619 dst inside:172. | .11/42 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:00:10 PM | %ASA-4-106023 | Deny tcp src txucorp:146 34.100/4619 dst inside:172. | .11/42 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:00:16 PM | %ASA-4-106023 | Deny tcp src txucorp:146 34.100/4619 dst inside:172. | .11/42 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:02:54 PM | %ASA-4-106023 | Deny udp src txucorp:172 114.62/1037 dst inside:172 | .115/161 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:03:00 PM | %ASA-4-106023 | Deny udp src txucorp:172 114.62/1037 dst inside:172 | .115/161 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:03:06 PM | %ASA-4-106023 | Deny udp src txucorp:172 114.62/1037 dst inside:172 | .115/161 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:03:12 PM | %ASA-4-106023 | Deny udp src txucorp:172 114.62/1037 dst inside:172 | .115/161 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:05:16 PM | %ASA-4-106023 | Deny tcp src txucorp:146 34.100/4621 dst inside:172. | .11/42 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:05:19 PM | %ASA-4-106023 | Deny tcp src txucorp:146 34.100/4621 dst inside:172. | .11/42 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:05:25 PM | %ASA-4-106023 | Deny tcp src txucorp:146 34.100/4621 dst inside:172. | .11/42 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:05:58 PM | %ASA-4-106023 | Deny tcp src txucorp:146 34.100/4623 dst inside:172. | .11/42 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:06:01 PM | %ASA-4-106023 | Deny tcp src txucorp:146 34.100/4623 dst inside:172. | .11/42 by access-group "TXUCORPin" | ESBxF00C 20 |
| 4/21/2006 3:06:07 PM | %ASA-4-106023 | Deny tcp src txucorp:146 34.100/4623 dst inside:172. | .11/42 by access-group "TXUCORPin" | ESBxF00C 20 |

Tag Name: Syslog_Msg_PIXESB Use PI timestamp instead of Syslog message timestamp.

Server: s_itm03

VALUE NOW, VALUE OVER TIME



IT Monitor in ProcessBook (continued)

PI ProcessBook - [Corp netflow.pdf*]

File Edit View Insert Tools Draw Arrange Window Help

Corp Netflow Traffic

Choose a Netflow Tag:
 NF_CORP_ALLTRAFFIC
 Get Details

| Date/Time | Source | Src... | Destination | Des... | Octets | Protocol | |
|----------------|---------|--------|-------------|------------|--------|----------|-----|
| 24-Apr-06 0... | 66.1... | 7.37 | 443 | 172.17.93 | 2660 | 1,490 | TCP |
| 24-Apr-06 0... | 172 | 18.47 | 3960 | 172.17.45 | 80 | 4,118 | TCP |
| 24-Apr-06 0... | 146 | 43.58 | 1494 | 172.17.150 | 4772 | 75,777 | TCP |
| 24-Apr-06 0... | 65.1 | 5.165 | 80 | 172.17.81 | 2116 | 5,840 | TCP |
| 24-Apr-06 0... | 146 | 0.222 | 1782 | 172.17.147 | 1174 | 21,756 | TCP |
| 24-Apr-06 0... | 66.1 | 7.37 | 443 | 172.17.93 | 2659 | 1,713 | TCP |
| 24-Apr-06 0... | 66.1 | 7.37 | 443 | 172.17.93 | 2659 | 3,126 | TCP |
| 24-Apr-06 0... | 66.1 | 7.37 | 443 | 172.17.93 | 2658 | 5,793 | TCP |
| 24-Apr-06 0... | 146 | 0.222 | 1782 | 172.17.147 | 1174 | 21,816 | TCP |
| 24-Apr-06 0... | 146 | 4.227 | 2525 | 172.17.176 | 2975 | 1,316 | TCP |
| 24-Apr-06 0... | 66.1 | 7.37 | 443 | 172.17.93 | 2661 | 11,755 | TCP |

I want the records bigger than Mb to be added into this second list:

| Date/Time | Source | Src... | Destination | Des... | Octets | Protocol | |
|----------------|--------|--------|-------------|-----------|--------|-----------|-----|
| 24-Apr-06 0... | 146 | 8.165 | 139 | 172.2.147 | 1103 | 1,225,392 | TCP |
| 24-Apr-06 0... | 146 | 8.165 | 139 | 172.2.147 | 1103 | 1,209,255 | TCP |
| 24-Apr-06 0... | 206 | 74.9 | 1935 | 172.2.91 | 2055 | 1,124,317 | TCP |
| 24-Apr-06 0... | 206 | 74.9 | 1935 | 172.2.91 | 2055 | 1,096,611 | TCP |
| 24-Apr-06 0... | 64.1 | .45 | 80 | 172.2.91 | 2018 | 1,031,833 | TCP |
| 24-Apr-06 0... | 64.1 | .45 | 80 | 172.2.91 | 2018 | 1,055,357 | TCP |
| 24-Apr-06 0... | 172 | 0.63 | 6005 | 172.2.150 | 1333 | 3,899,843 | TCP |
| 24-Apr-06 0... | 146 | 0.223 | 2756 | 172.2.137 | 1137 | 2,268,072 | TCP |
| 24-Apr-06 0... | 146 | 0.223 | 2756 | 172.2.137 | 1137 | 2,291,581 | TCP |
| 24-Apr-06 0... | 146 | 4.226 | 1804 | 172.2.112 | 2603 | 1,159,293 | TCP |
| 24-Apr-06 0... | 146 | 4.226 | 1804 | 172.2.112 | 2603 | 1,164,337 | TCP |

Ready

VALUE NOW, VALUE OVER TIME



IT Monitor in RtWebparts

Home Documents and Lists Create Site Settings Help

IT Monitor Servers

Modify Shared Page

Select a Server

- Network Servers
 - CFE System Servers
 - PI System Servers
 - 3TGMDCA
 - 3TGMDCB
 - 3TGMFSA
 - 3TGMFSB
 - 3TGMSSA
 - 3TGMSSB
 - 3TGMWSA
 - 3TGMWSB
 - s_ace03
 - s_ent03
 - s_ent04
 - s_int03
 - s_int04
 - s_tm03

RtTimeRange

Start Time *-2h End Time * Apply

Server Detail

3TGMDCA

Windows

| Status | Processor | Memory |
|----------------------|-----------------------------|----------------------------------|
| Online: 42.1 Days | Processor Usage %: 8 | Committed Memory %: 14 |
| Errors Since Today | Processor Usage 1hr Avg.: 7 | Available Memory: 2343 MBytes |
| Errors start-up (1d) | Processor Queue Length: 0 | Memory Pages/sec: 0 |
| Logon: 0 0 | Processor Queue 1hr Avg.: 0 | Private Bytes Total: 653,099,008 |
| System: 0 0 | | |

| Logical Disk | Free Space | Delta (1d) | %Disk Time |
|--------------|----------------|------------|------------|
| C: | 133,941 MBytes | -47 | 0 |

| System | Context Switches |
|----------------|------------------|
| Processes: 173 | 4478 |
| Threads: 767 | 1130 |
| Interrupts: | |

| Network |
|---------|
| |

MEMORY and CPU

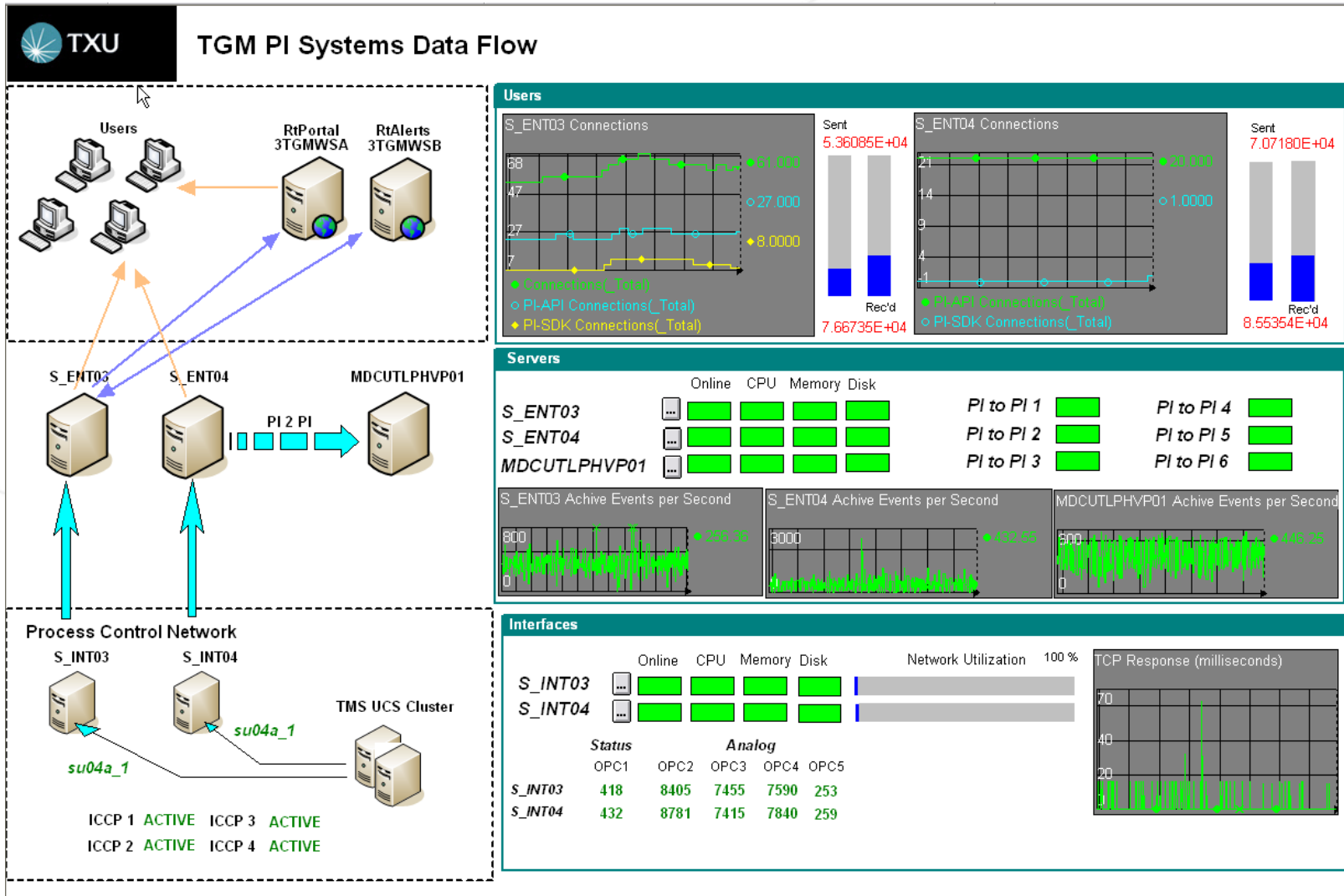
(Bytes) = 14.335

(%) = 3.75

VALUE NOW, VALUE OVER TIME



IDC Overview



VALUE NOW, VALUE OVER TIME



RT Alerts

Configuration

Name: T11_UCS ALARM Comment:

Owner: TXUCORP\GCAV

Status: Enabled Disabled

Alert Trigger

Type: Limits Digital

Source: PI Tag PI Expression

PI Tag: WS_ENT03\T11_UCS

Limits: LoLo Limit Low Limit

High Limit HiHi Limit

Filters: Deadband Non-Repetition Renotification

0 Seconds 5 Minutes

Alert On Bad Status

Additional Trigger Tags:

Message Definition

Recipients: bruce.mccamant@txued.com;
2143620419@page.metrocall.com
(semicolon delimited)

From: TGMRTAlerts@txued.com

Importance: Normal Low High

Subject: T11_UCS ALARM

Body: (sample) Include pre-defined body

\\piserver1\TC107 High Limit exceeded. Current value: 702.16 deg F at 27-Jun-2002 10:51 AM. High Limit 700.00 deg F

Postscript:

Status: Ready

VALUE NOW, VALUE OVER TIME



The future of PI at TGM



- NERC CIP Compliance with IT Monitor
- Expand use of PowerWorld and GeoMedia
- Expanded use of RtAlerts
- Server changes
- BPL

VALUE NOW, VALUE OVER TIME





TXU
Electric Delivery

Questions...

VALUE NOW, VALUE OVER TIME

