OSIsoft™

REAL-TIME PRODUCTION

THROUGHOUT THE ENTERPRISE

Real Time Monitoring and Regulation of the US Electric Power Grid

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Why is this important?

- **FERC has a new office of**
  - Market Oversight and Investigation (OMOI)
  - Will hire 50 new staff for this office
  - Will have a total of 250 staff in FY2003
  - Budget of $28 million

Office of Market Oversight and Investigations (OMOI)

- "Good scrutiny makes for good markets"
- Responsibilities
  - **Understanding energy market operations**
  - **Vigilant and fair oversight**
  - **Alerts and forecasts of system behavior**
- Real-time monitoring
  - **Markets**
  - **Infrastructure**
  - **Background**

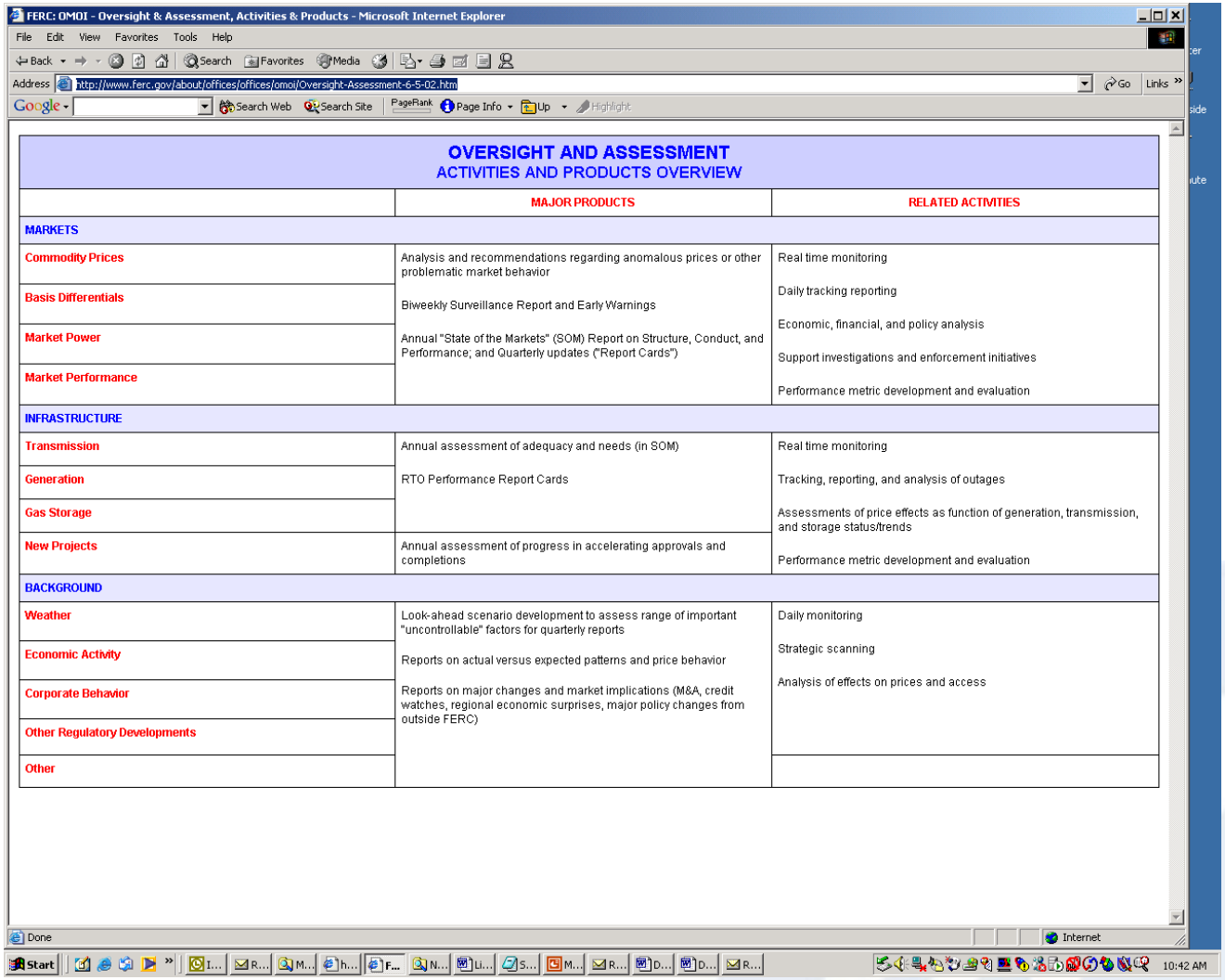
One component of OMOI

Market Oversight. Our ability to oversee the operation of energy markets, particularly with the widespread use of electronic trading, depends in part on our ability to identify and use accurate data from all over the country. We have implemented a market observation room to facilitate real-time monitoring and are reviewing current information collection activities. We are developing a network of IT and telecommunications systems to share information; tools such as “spiders,” “data mining,” and “search technology” to access real time data, monitor information and establish pattern recognition processes and deviations; analytical tools to “digest” information; and decision support systems to evaluate market performance.

We will also participate in establishing standards for information reliability, and facilitate information and knowledge sharing. We will promote the formation of national data warehouses to promote standards, economies of scale, and accurate and reliable reporting.

Pg 33 FY03 Budget

OMOI Requirements



OVERSIGHT AND ASSESSMENT
ACTIVITIES AND PRODUCTS OVERVIEW

	MAJOR PRODUCTS	RELATED ACTIVITIES
MARKETS		
Commodity Prices	Analysis and recommendations regarding anomalous prices or other problematic market behavior	Real time monitoring
Basis Differentials	Biweekly Surveillance Report and Early Warnings	Daily tracking reporting
Market Power	Annual "State of the Markets" (SOM) Report on Structure, Conduct, and Performance; and Quarterly updates ("Report Cards")	Economic, financial, and policy analysis
Market Performance		Support investigations and enforcement initiatives Performance metric development and evaluation
INFRASTRUCTURE		
Transmission	Annual assessment of adequacy and needs (in SOM)	Real time monitoring
Generation	RTO Performance Report Cards	Tracking, reporting, and analysis of outages
Gas Storage		Assessments of price effects as function of generation, transmission, and storage status/trends
New Projects	Annual assessment of progress in accelerating approvals and completions	Performance metric development and evaluation
BACKGROUND		
Weather	Look-ahead scenario development to assess range of important "uncontrollable" factors for quarterly reports	Daily monitoring
Economic Activity	Reports on actual versus expected patterns and price behavior	Strategic scanning
Corporate Behavior	Reports on major changes and market implications (M&A, credit watches, regional economic surprises, major policy changes from outside FERC)	Analysis of effects on prices and access
Other Regulatory Developments		
Other		

Oversight and Investigations

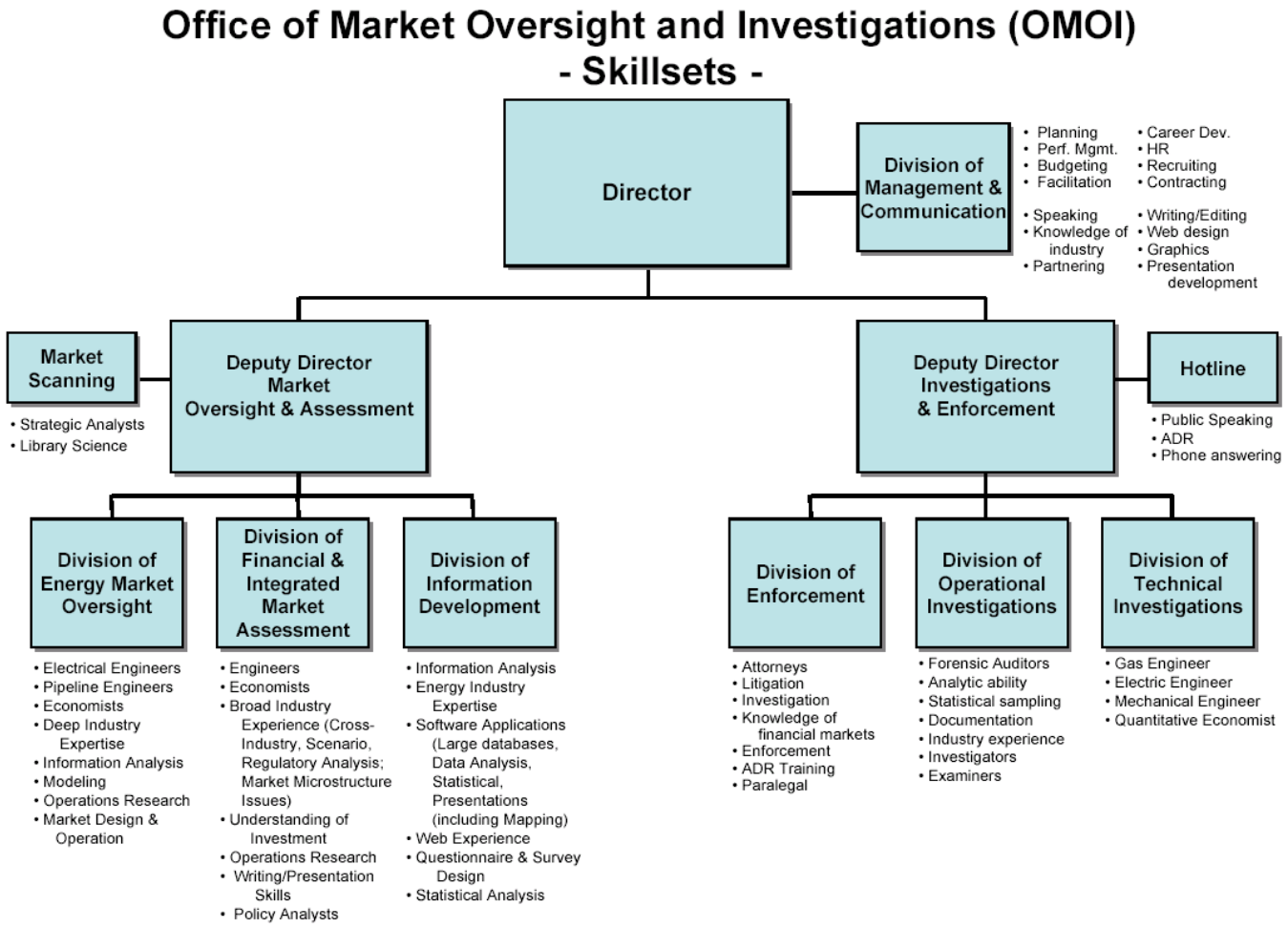
- **Real-time monitoring**
  - Transmission
  - Generation
- **Tracking, reporting, analysis of outages**
- **Assessment of price effects as function of generation, transmission and storage trends**
- **Performance metric development and evaluation**

Using OSI PI for Real-time Oversight applications

- **Functions**
  - Automatic trending
  - Automatic alerts via SMS or email
  - Compute real-time performance
  - Loop flow detection
  - Automatic report and publishing
  - Historical investigations
  - Avoid terrorists attacks on critical nodes

OMOI Organization

Draft 6/5/02

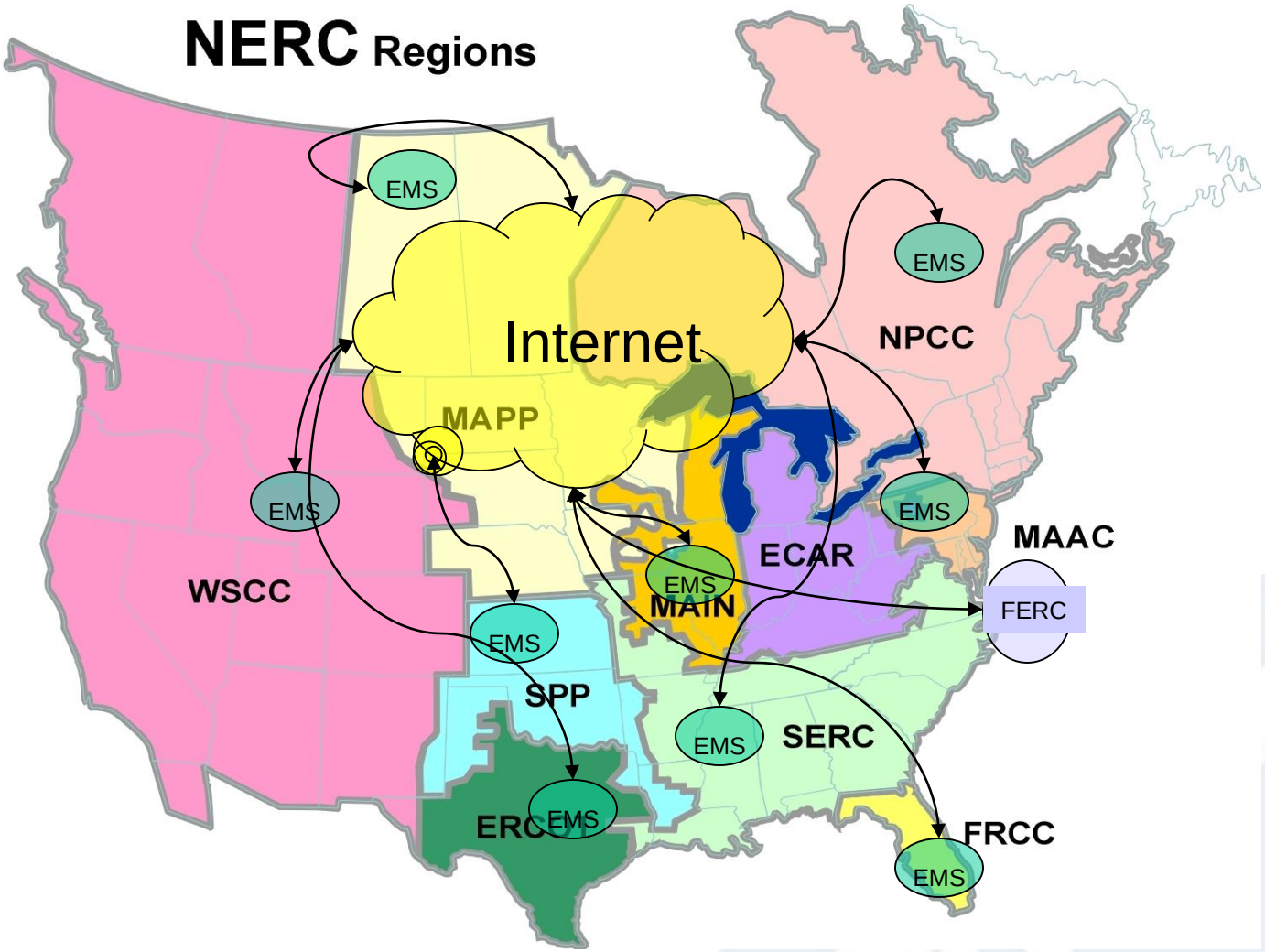


Current staffing

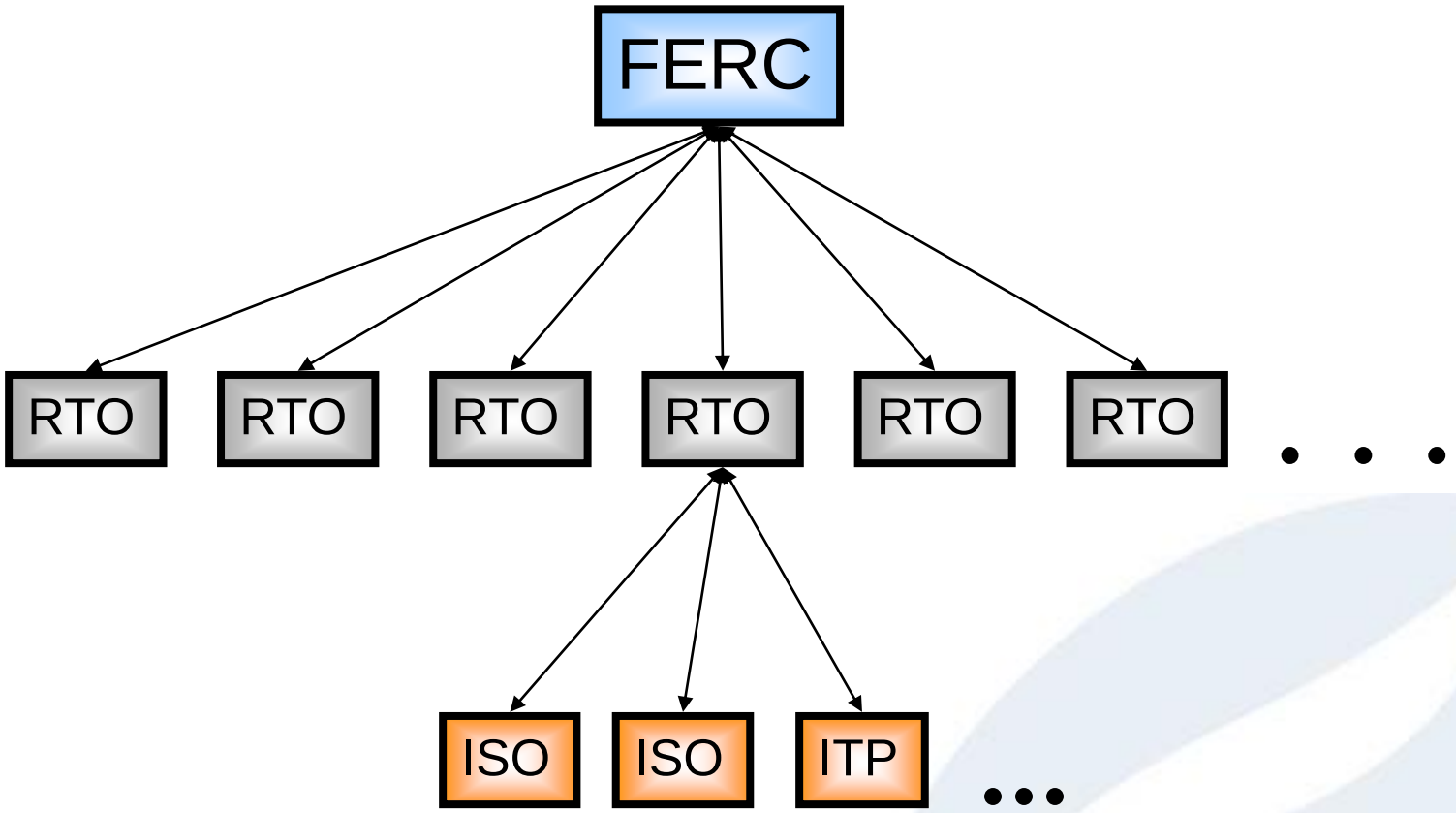
OMOI needs

- Easy to collect data
- Easy to extract archived data
- Built-in data viewing tools
- Large expandable archive
- Open and fast access
- Data security
- Access security

Network Structure



Data Architecture under new SMD



Interfaces

- **ICCP**
  - Standard interface for EMS
- **PI to PI**
  - Standard PI interface (more efficient than ICCP)
- **Both interfaces work over the Internet**
  - VPN
  - Server to Server authentication
    128 bit encryption via https
- **Most large enterprises use PItoPI**
- **CIM to Module Data Base (CAL ISO)**

System architecture

- **Data acquisition**
  - Establish “PItoPI” interfaces from host to data sources using PI
  - Use ICCP interfaces for others
- **Data analysis**
  - Run pattern detection software on the host Run software analysis programs
  - Run report programs

Data Security

- **VPN between source and mirror**
- **Mutual authentication, Kerberos**
  - Included in W2K, XP, …
- **Encrypted packets (128 bit, or 3DES)**
- **National Strategy for Secure Cyberspace**
  - Authentication (smart cards)
  - Authorization (access rights)

Cyber Security Recommendations

R4-5 A public-private partnership should, as a high priority, develop best practices and new technology to increase security of digital control systems and supervisory control and data acquisition systems (SCADA) in utilities, manufacturing, and other networks.

R4-6 Government and industry, working in partnership, should determine the most critical DCS/SCADA-related sites and develop a prioritized plan for short-term cybersecurity improvements in those sites. DCS/SCADA users should consider adopting the Department of Energy's *"21 Steps to Improve Cybersecurity of SCADA Networks."*

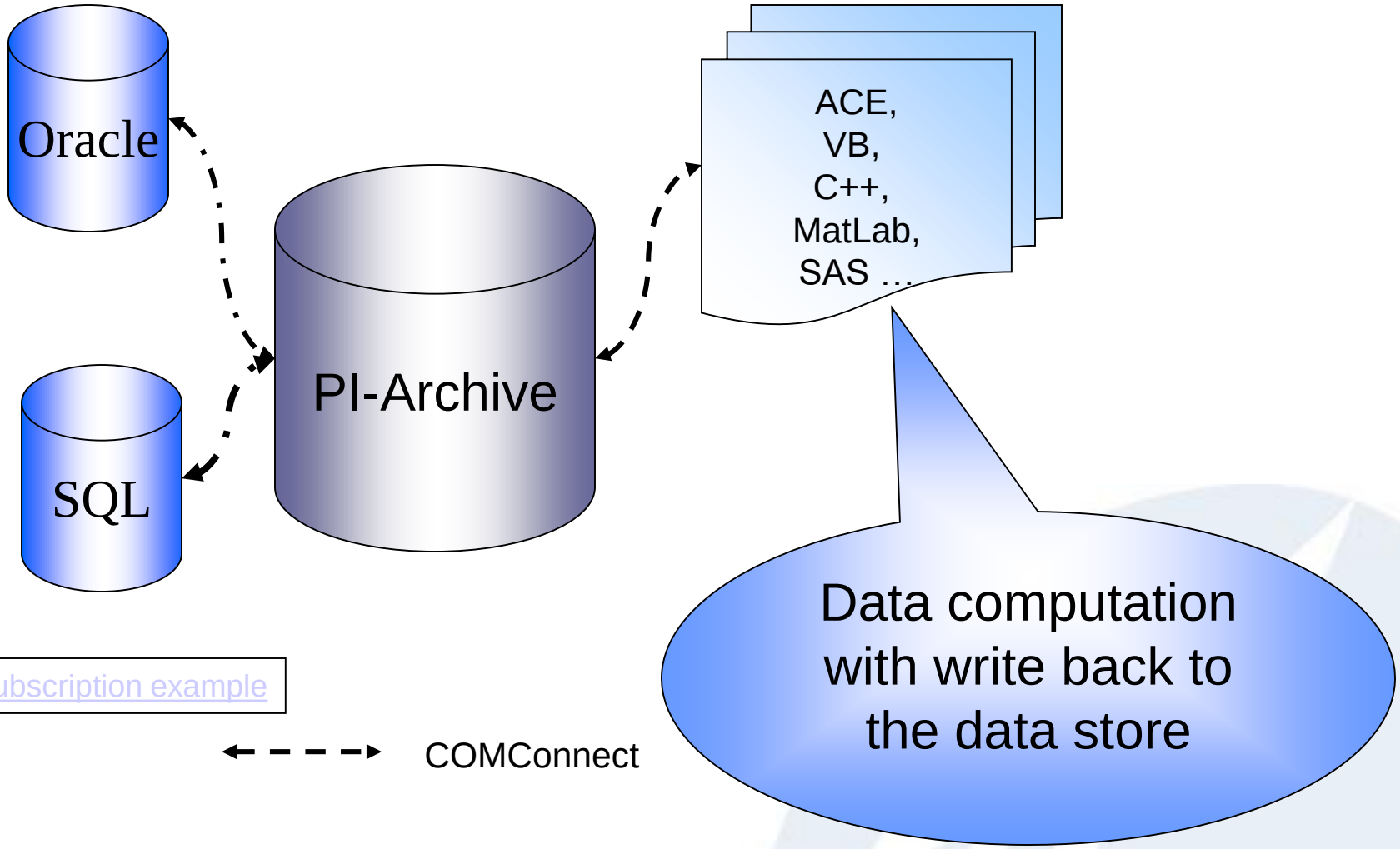
Tagname issues

- **Each organization uses different naming convention**
- **Solution PI Module Database**
  - Hierarchical modules
  - Tag aliases
  - Module properties

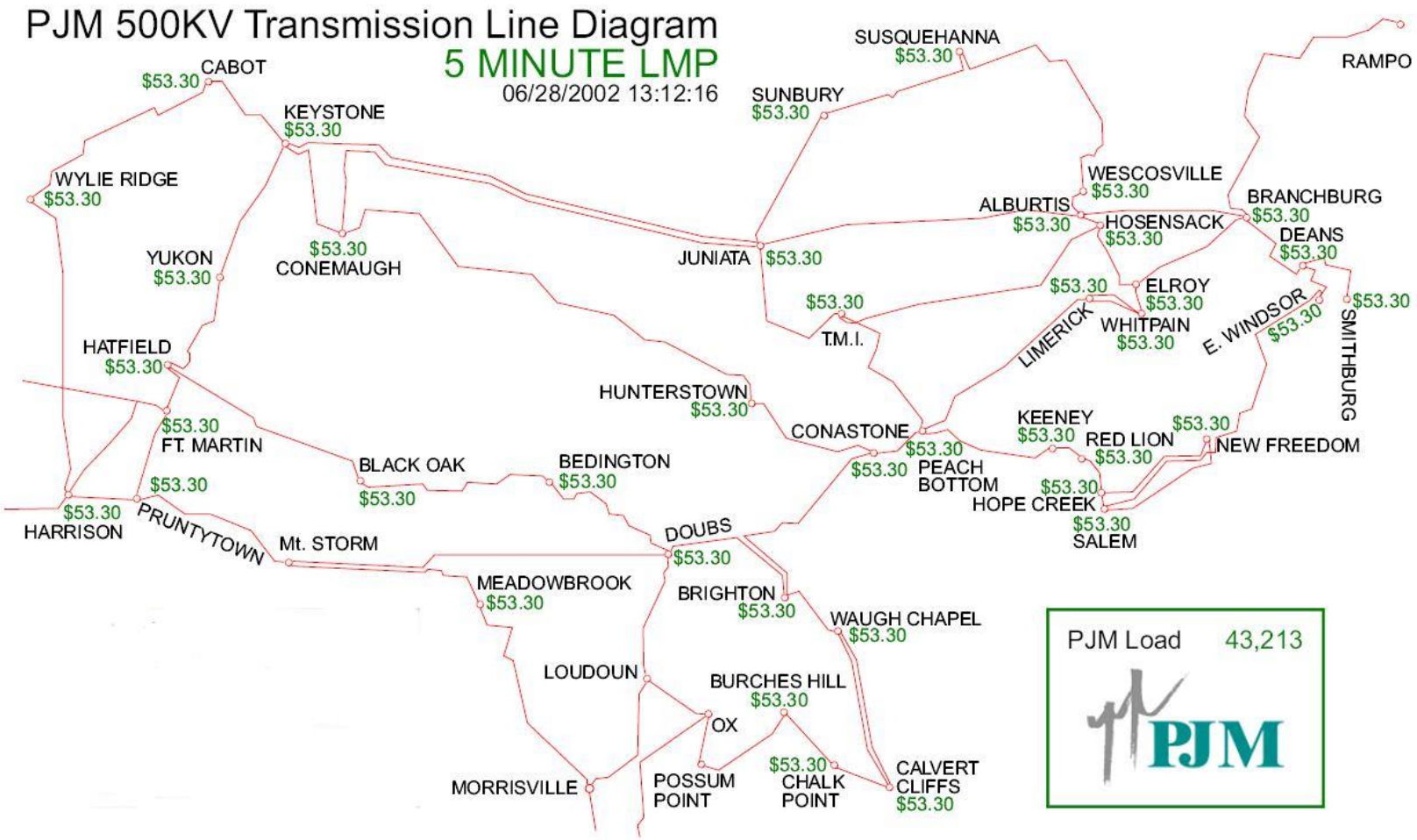
Access Security

- **Standard username, password, plus**
- **Authentication**
  - SecurID, includes authentication code
  - Digital certificates
- **Encrypted sessions**
- **VPN connections**

Data Mining


Oracle
SQL
PI-Archive
ACE,
VB,
C++,
MatLab,
SAS …
Data computation with write back to the data store
Subscription example
COMConnect

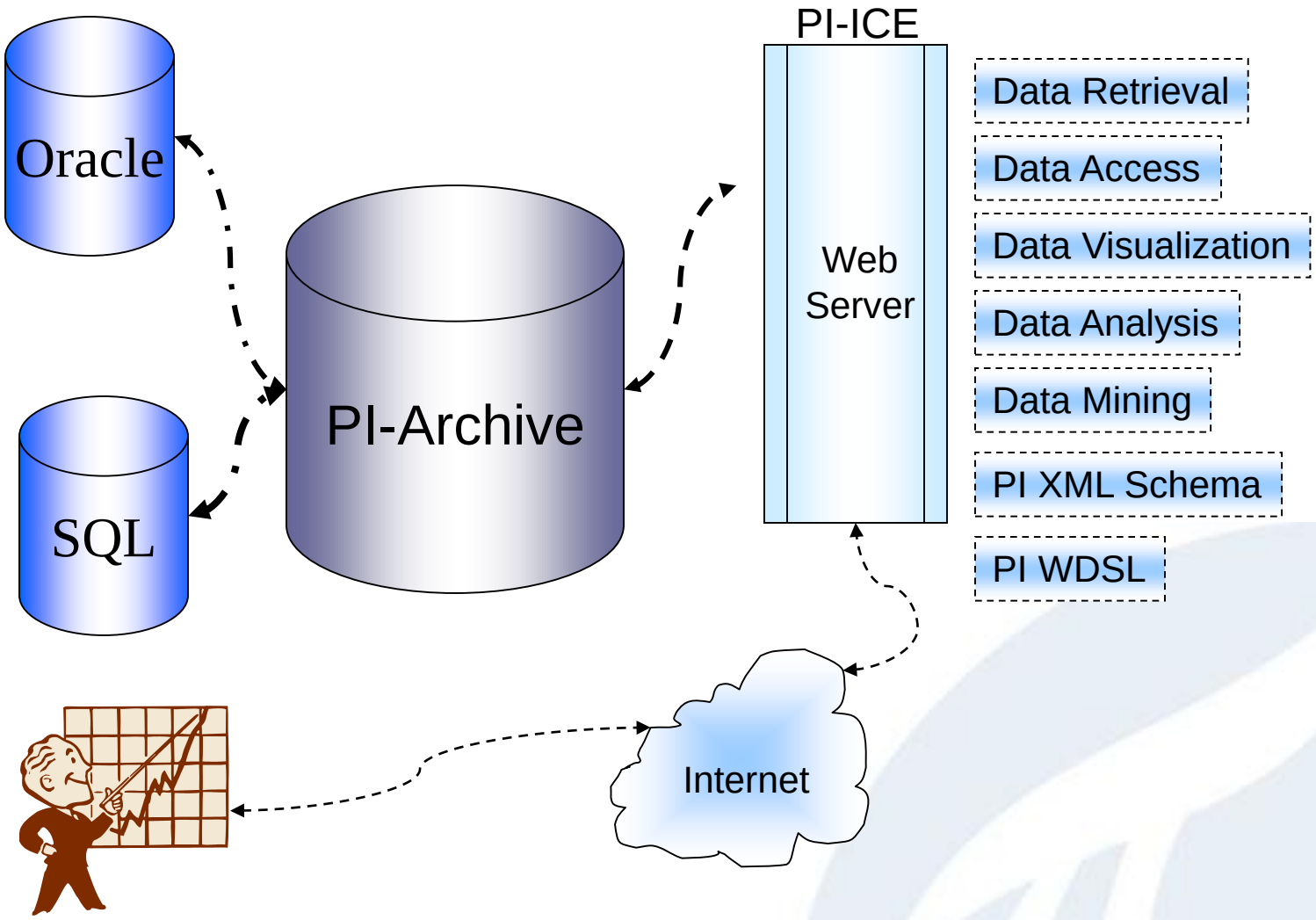
Nodal pricing



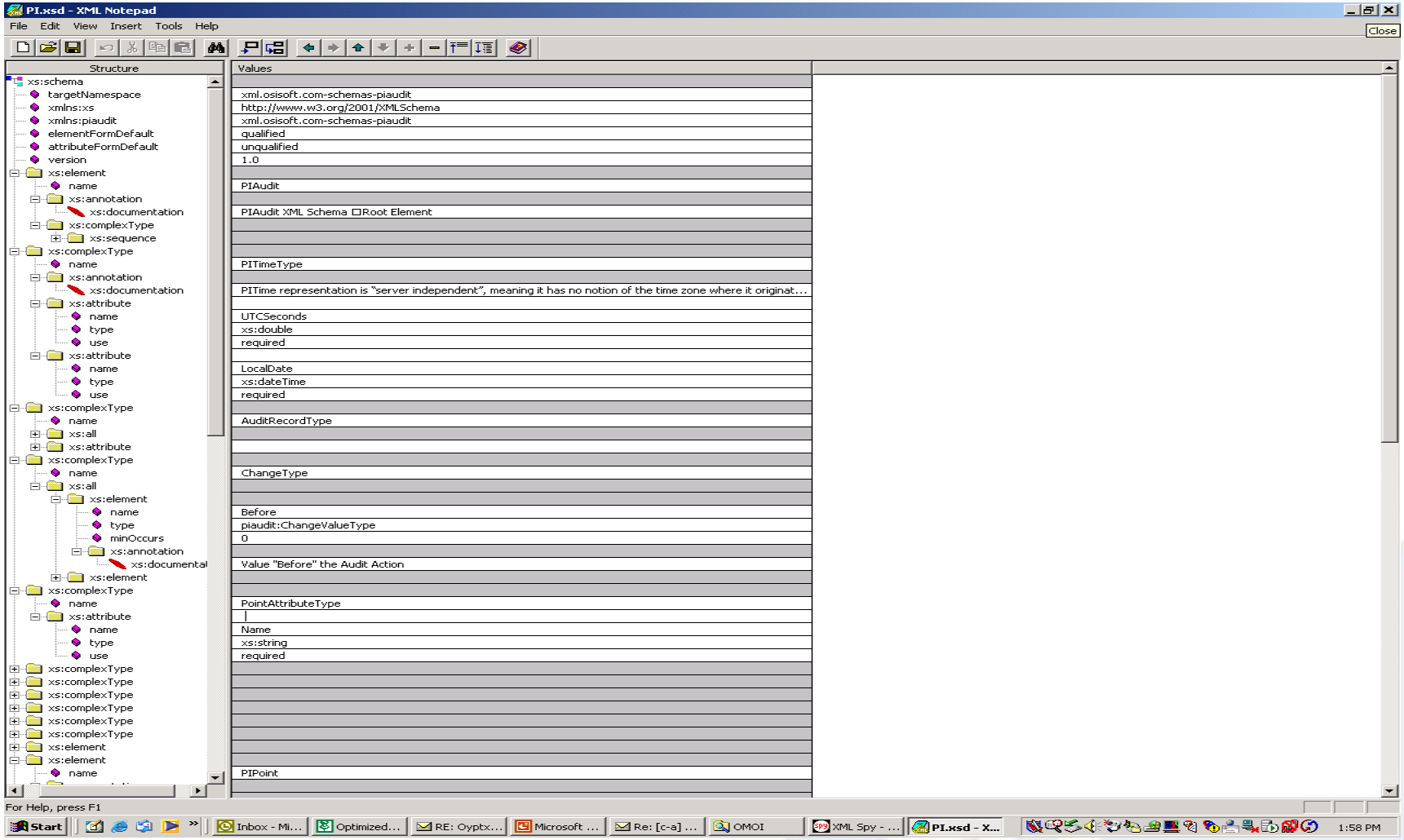
Zoom

Web Services

Remote data archives



PI XML Schema



FERC Applications

- **Large power system analysis**
- **Near real time load flows**
- **Real time performance measures**
- **Congestion detection**
- **Trading patterns**
- **Daily reports, etc.**

Analysis software

- **Nodal analysis (Zaborszky)**
  - Observation decoupled state space
  - Max, min voltages
  - Max power (current)
  - Bus reactive excess
  - ….

Performance calculations

- **Run OPF in near real time**
  - Compute distance to actual
  - Measure in terms of dollars or MWatts
- **Runs on host**
  - Uses DEW technology (partially EPRI funded)

    Linked lists

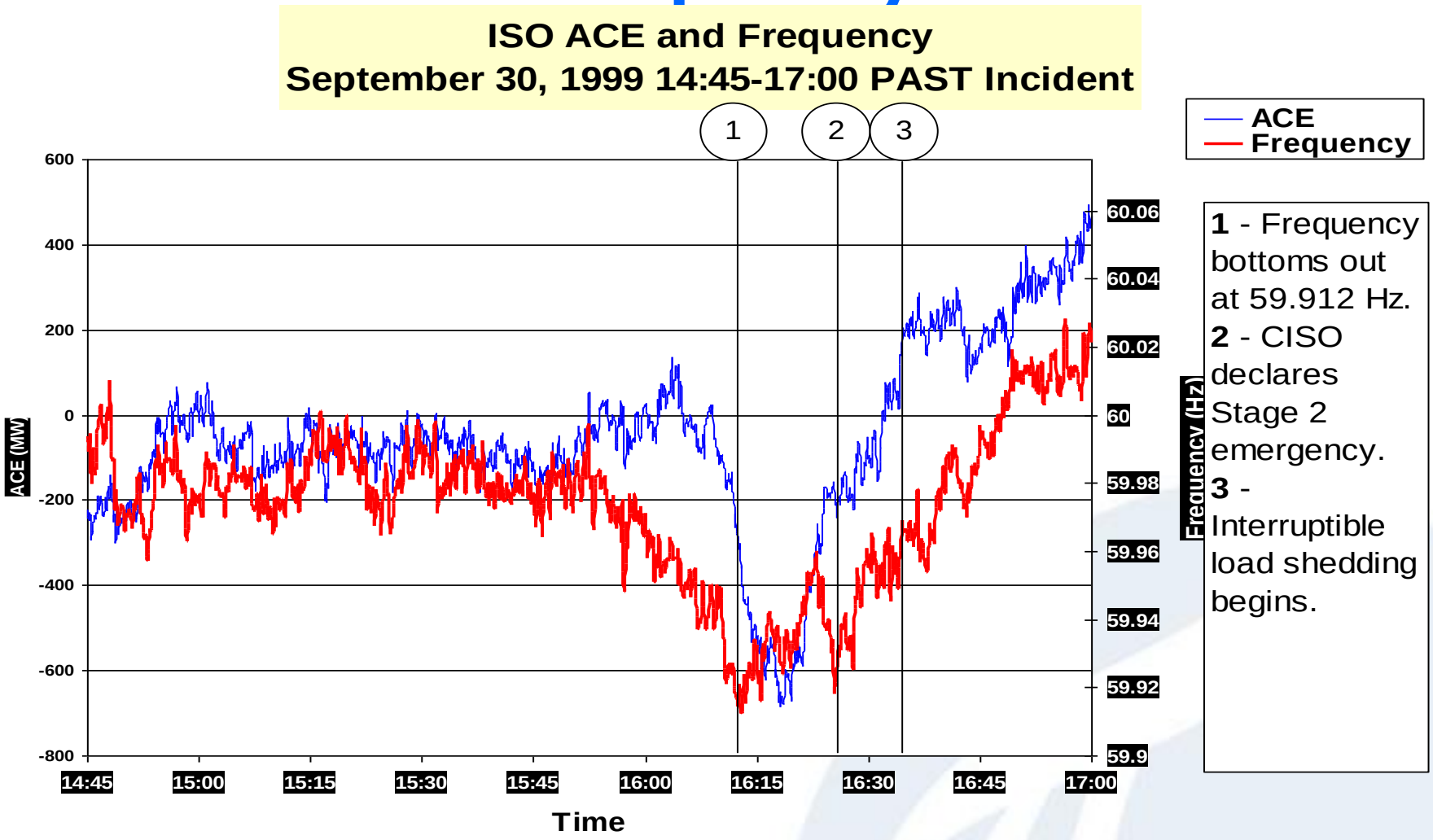
    Object oriented software design

    Distributed computing

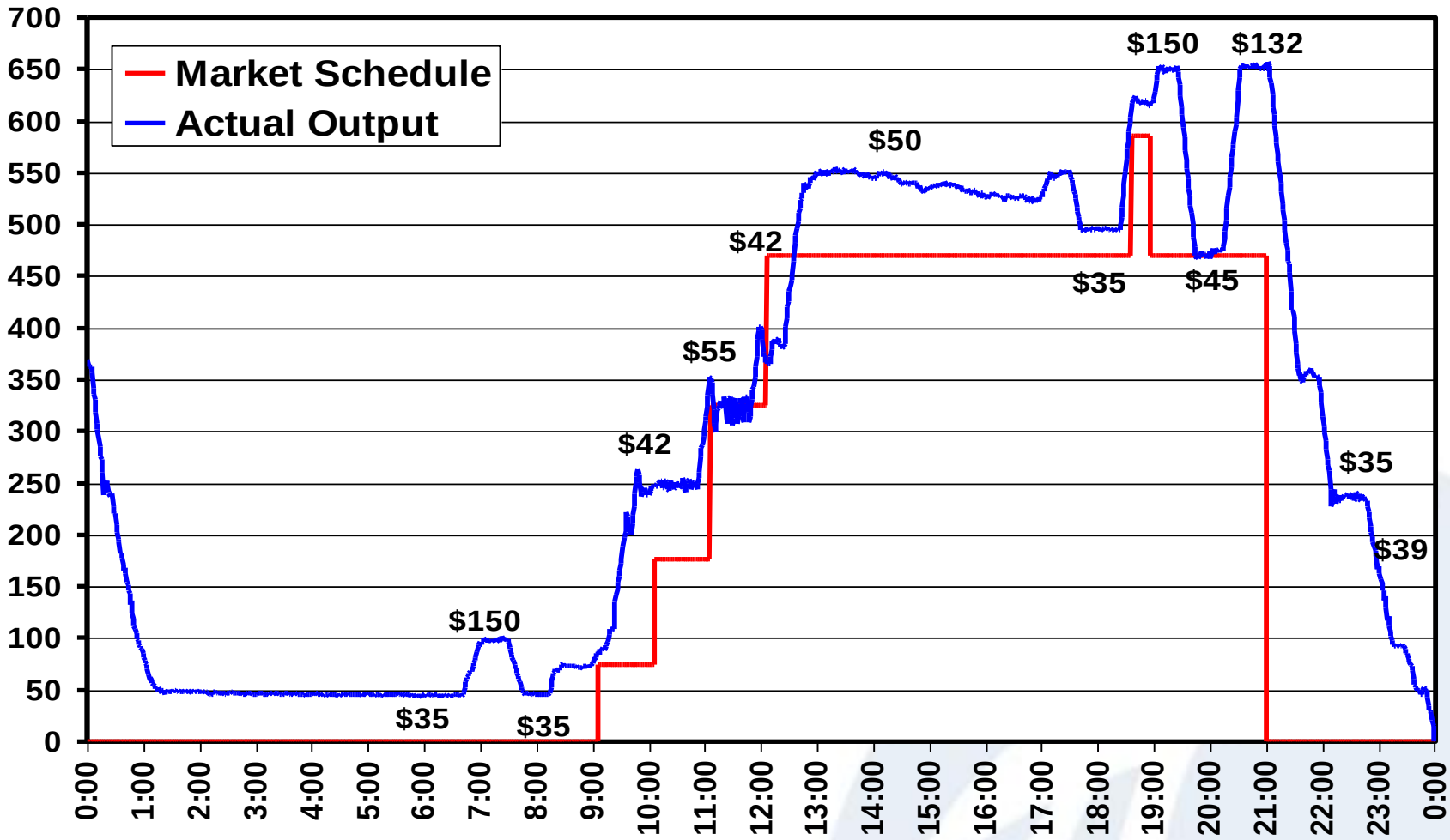
    Discrete Ascent Optimal Programming

    A new solution every 5 minutes

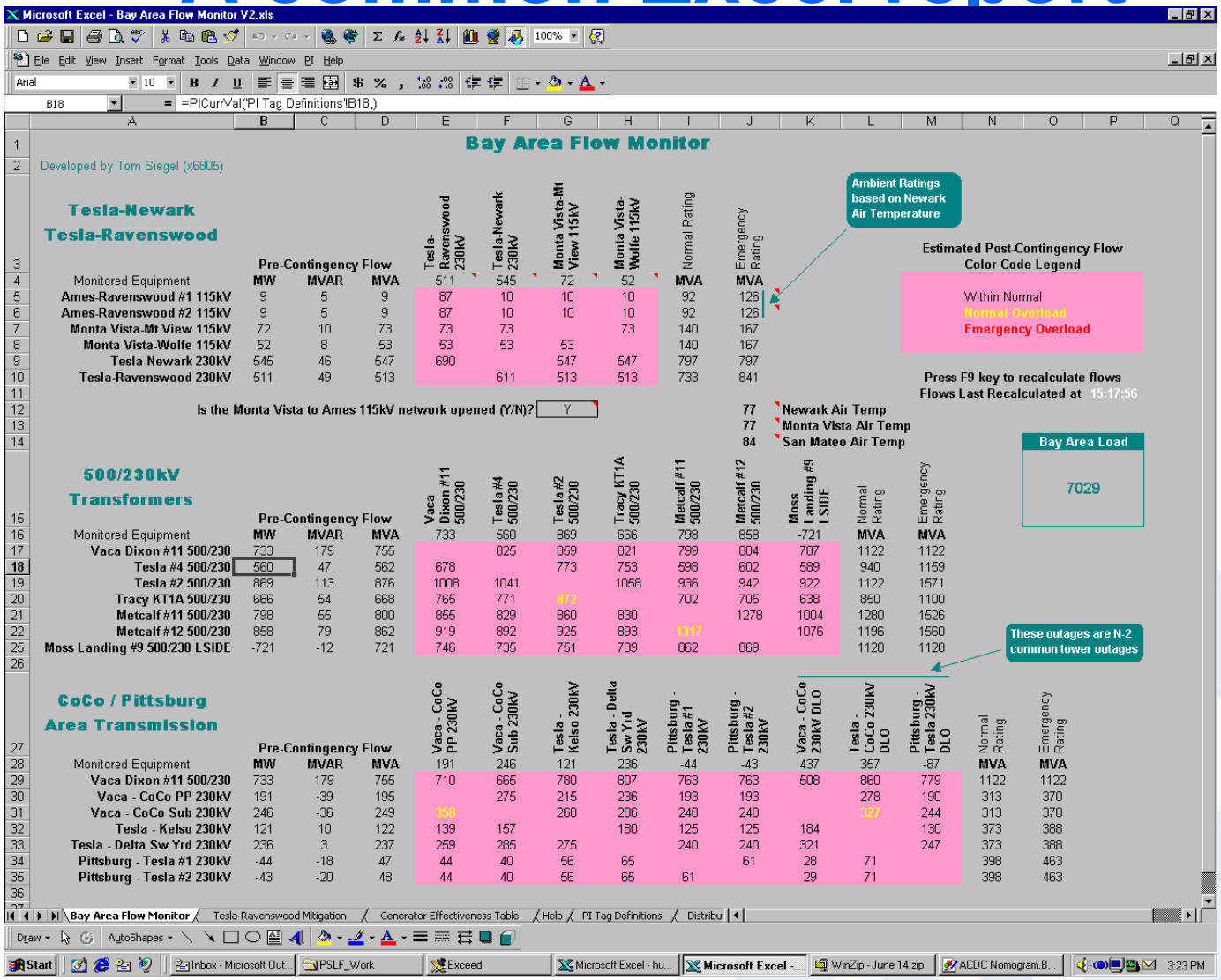
Historical Analysis ACE and Frequency



Uninstructed deviations



A common Excel report



Microsoft Excel - Bay Area Flow Monitor V2.xls

=PICurrVal('PI Tag Definitions'!B18,)

Bay Area Flow Monitor

Developed by Tom Siegel (x6805)

Tesla-Newark
Tesla-Ravenswood

Monitored Equipment	Pre-Contingency Flow MW	MVAR	MVA	Tesla-Ravenswood 230kV	Tesla-Newark 230kV	Monta Vista-Mt View 115kV	Monta Vista-Wolfe 115kV	Normal Rating MVA	Emergency Rating MVA
Ames-Ravenswood #1 115kV	9	5	9	87	10	10	10	92	126
Ames-Ravenswood #2 115kV	9	5	9	87	10	10	10	92	126
Monta Vista-Mt View 115kV	72	10	73	73	73		73	140	167
Monta Vista-Wolfe 115kV	52	8	53	53	53	53		140	167
Tesla-Newark 230kV	545	46	547	690		547	547	797	797
Tesla-Ravenswood 230kV	511	49	513		611	513	513	733	841

Ambient Ratings based on Newark Air Temperature

Estimated Post-Contingency Flow Color Code Legend

Within Normal
Normal Overload
Emergency Overload

Press F9 key to recalculate flows
Flows Last Recalculated at 15:17:56

Is the Monta Vista to Ames 115kV network opened (Y/N)? Y

77 Newark Air Temp
77 Monta Vista Air Temp
84 San Mateo Air Temp

Bay Area Load
7029

500/230kV Transformers

Monitored Equipment	Pre-Contingency Flow MW	MVAR	MVA	Vaca Dixon #11 500/230	Tesla #4 500/230	Tesla #2 500/230	Tracy KT1A 500/230	Metcalf #11 500/230	Metcalf #12 500/230	Moss Landing #9 LSIDE	Normal Rating MVA	Emergency Rating MVA
Vaca Dixon #11 500/230	733	179	755		825	859	821	799	804	787	1122	1122
Tesla #4 500/230	560	47	562	678		773	753	598	602	589	940	1159
Tesla #2 500/230	869	113	876	1008	1041		1058	936	942	922	1122	1571
Tracy KT1A 500/230	666	54	668	765	771	872		702	705	638	850	1100
Metcalf #11 500/230	798	55	800	855	829	860	830		1278	1004	1280	1526
Metcalf #12 500/230	858	79	862	919	892	925	893	1317		1076	1196	1560
Moss Landing #9 500/230 LSIDE	-721	-12	721	746	735	751	739	862	869		1120	1120

These outages are N-2 common tower outages

CoCo / Pittsburg Area Transmission

Monitored Equipment	Pre-Contingency Flow MW	MVAR	MVA	Vaca - CoCo PP 230kV	Vaca - CoCo Sub 230kV	Tesla - Kelso 230kV	Tesla - Delta Sw Yrd 230kV	Pittsburg - Tesla #1 230kV	Pittsburg - Tesla #2 230kV	Vaca - CoCo 230kV DLO	Tesla - CoCo 230kV DLO	Pittsburg - Tesla 230kV DLO	Normal Rating MVA	Emergency Rating MVA
Vaca Dixon #11 500/230	733	179	755	710	665	780	807	763	763	508	860	779	1122	1122
Vaca - CoCo PP 230kV	191	-39	195		275	215	236	193	193		278	190	313	370
Vaca - CoCo Sub 230kV	246	-36	249	358		268	286	248	248		327	244	313	370
Tesla - Kelso 230kV	121	10	122	139	157		180	125	125	184		130	373	388
Tesla - Delta Sw Yrd 230kV	236	3	237	259	285	275		240	240	321		247	373	388
Pittsburg - Tesla #1 230kV	-44	-18	47	44	40	56	65		61	28	71		398	463
Pittsburg - Tesla #2 230kV	-43	-20	48	44	40	56	65	61		29	71		398	463

Bay Area Flow Monitor | Tesla-Ravenswood Mitigation | Generator Effectiveness Table | Help | PI Tag Definitions | Distribul

Summary

- **A mirrored host database can be used to solve FERC's Real-time monitoring needs**
- **Off the shelf solution, available now**
- **Software is open and fully expandable**
- **Automated reports**
- **Automatic alerts**
- **Third party software is available**
  - DEW, PSS/E, BRE, other standard tools
  - SAS, Expert Systems, other data mining tools