

DTE Energy Case Study

Using PI for Distribution Network Analysis and DG Control

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Outline

- Introduction to DTE
- DOE Project Overview
- Model and Control Algorithm
- DOE Results
- Q/A

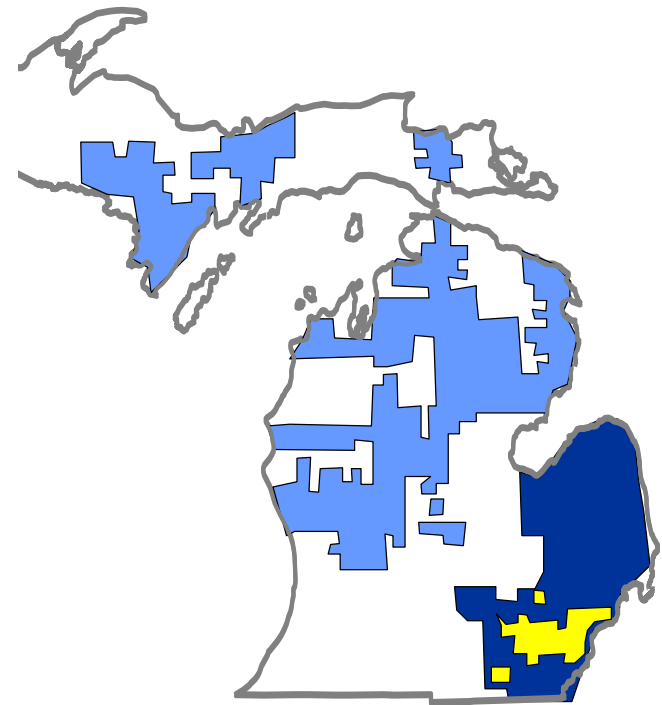


OSIsoft



Company Overview - DTE Energy

- **Overall**
 - Full-spectrum regional energy provider
 - An electric and natural gas utility
 - Growing non-regulated energy related businesses
 - Assets of \$19 billion
 - Annual revenues over \$7 billion
- **Electric and Gas**
 - 2.6 million customers
 - 11,000 MW of generation
 - 600 BCF natural gas delivery
 - 11,500 employees



Utility Service Territory

- Detroit Edison
- MichCon
- Overlap

DTE Energy's Commitment to Distributed Generation

“ Several years ago, the leadership at DTE tried to envision what the electric utility business would look like in a decade. One of our conclusions was that this industry would go through the same transformation that the computer business has experienced. There, mainframe computers gave way to desktops which gave way to laptops.

In the electric industry, the day of large central station power plants has already given way to modular, combined cycle gas powered plants. We envisioned a day when the next step, distributed (or personal) generation would play a major role.

We wanted to lead that transformation.” **Anthony F. Earley, Jr.**
Chairman & CEO, DTE Energy

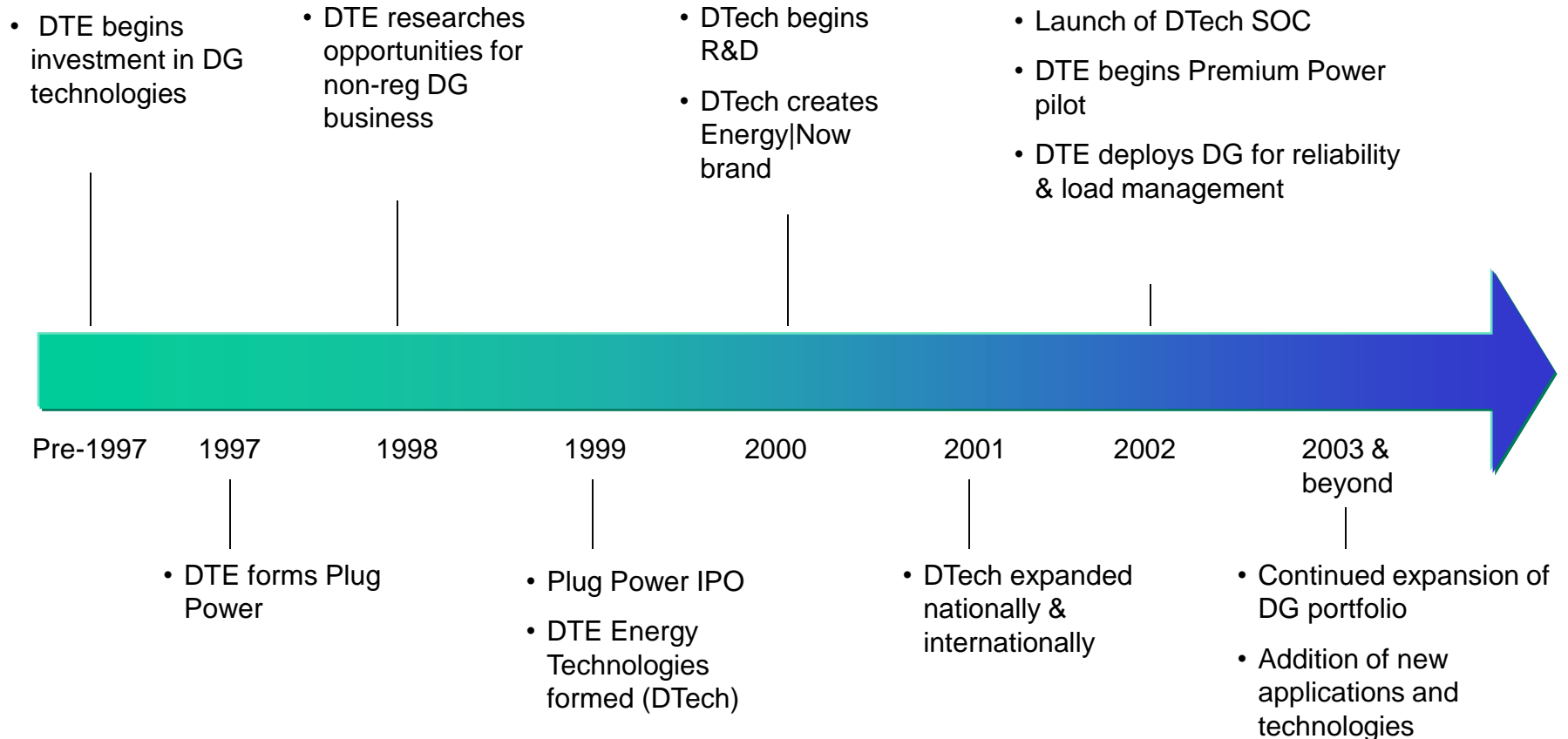
DTE's Vision for Distributed Generation (DG)

**Traditional Electric
System**



**Traditional Electric System
+
Personalized Power through
Distributed Generation (DG)**

DTE Energy's History with Distributed Generation

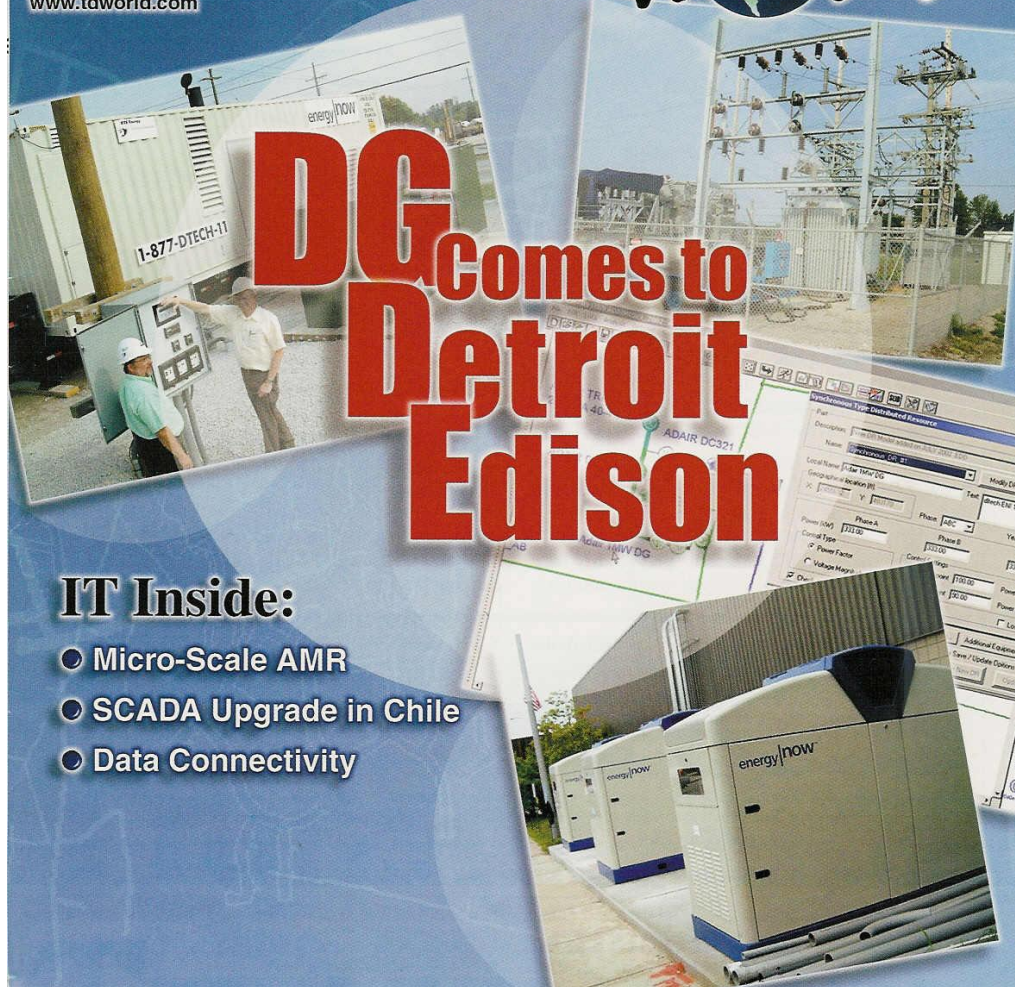


Transmission & Distribution

The Information Leader Serving The Worldwide Power-Delivery Industry

A PRIMEDIA Publication
www.tdworld.com

October 2002



DG Comes to Detroit Edison

IT Inside:

- Micro-Scale AMR
- SCADA Upgrade in Chile
- Data Connectivity



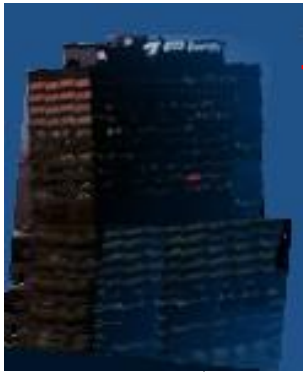
DE-SC02-03CH11139 :

The United States Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Distributed Energy and Electric Reliability (DEER) Program, invites applications for federal assistance for research, development and demonstration for **communication and control solutions** to enable **interoperable and integrated** operation of **large numbers** of distributed energy resources (DER) from **varying suppliers** to achieve optimization in **power quality, power reliability**, and **economic performance**.

Genesis of Project in 2003

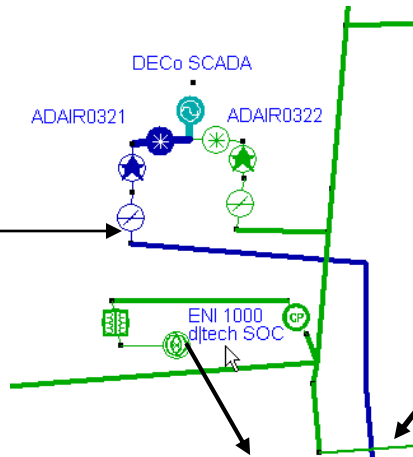
DTE Owns but does not Operate?

Detroit Edison



Control Request

DTEtech



Monitoring

Control

Maintenance

Safety

Monitors DER

Ability to Operate

Status

Sends Generation schedule

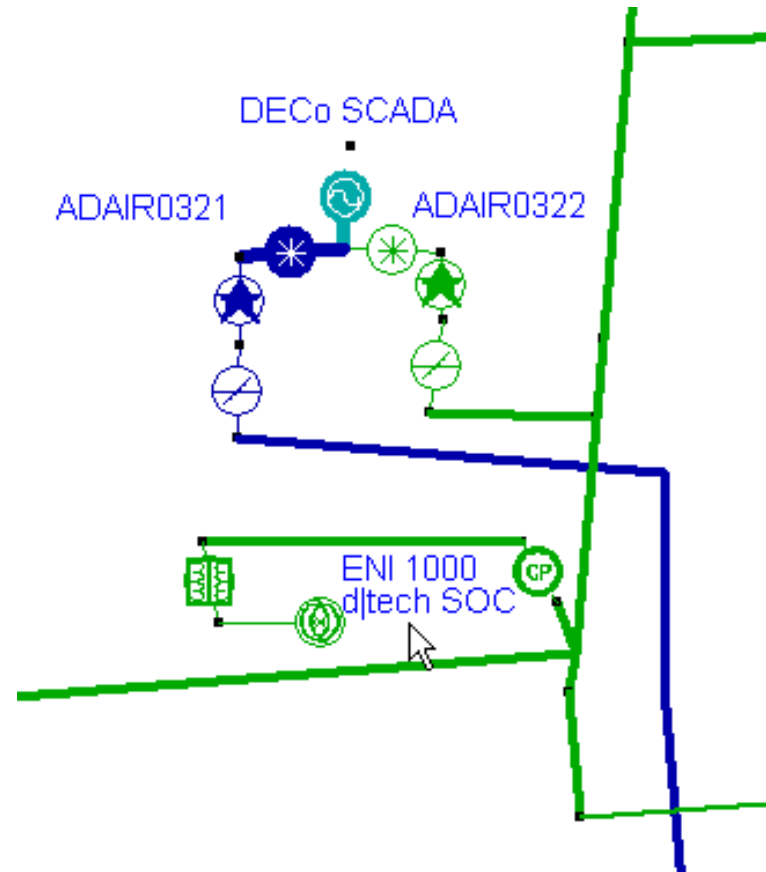
Control



DER

Distribution Engineering Workstation (DEW) by EDD

- Has model of Distribution Network
- Solves network based upon “static” research data.
- Proposes operational solutions.
- No operator feedback nor action vs. network reaction.



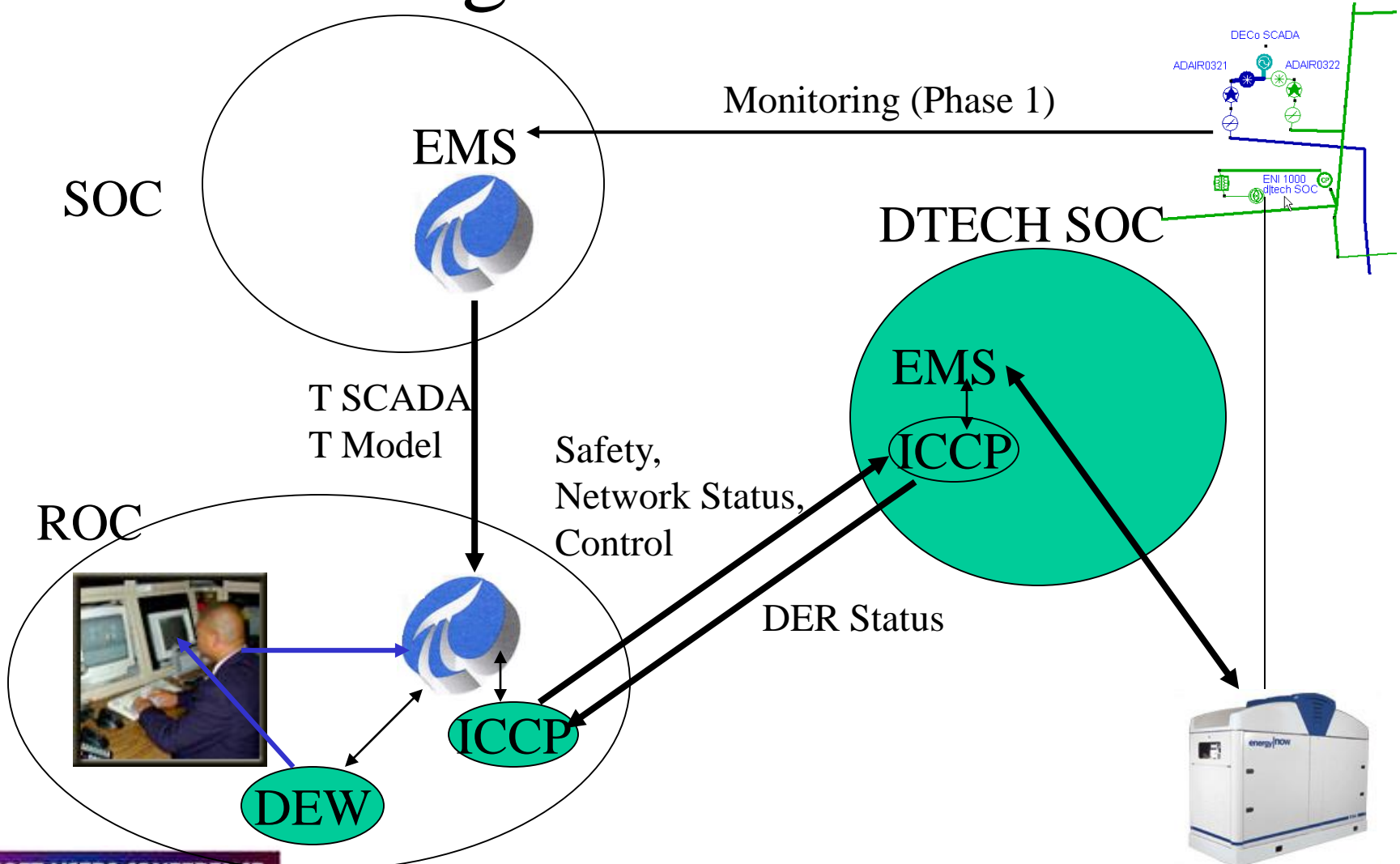
What was needed?

- Automate Processes
 - Control
 - Model Evaluation
 - Information Exchange
- Verify model algorithms and operator actions.
- Perform modeling and power aggregation for future power trading.
- FERC guidelines on DERs.

How accomplished?

- Automate Processes
 - Control (Processbook, DEW, PI)
 - Model Evaluation (DEW, PI)
 - Information Exchange (PI-to-PI, and PI-OPC/ICCP)
- Verify model algorithms and operator actions.
(DEW)
- Perform modeling and power aggregation for future power trading (DEW, PI).
- FERC guidelines on DERs (still in process).

Automating the Process – Part 1



ICCP Link

- DTE ROC implementation was OSIsoft OPC Client Interface with SISCO AXS4-ICCP
 - Used to acquire data from DTECH
 - Used to send control signals and tag-outs to DTECH.

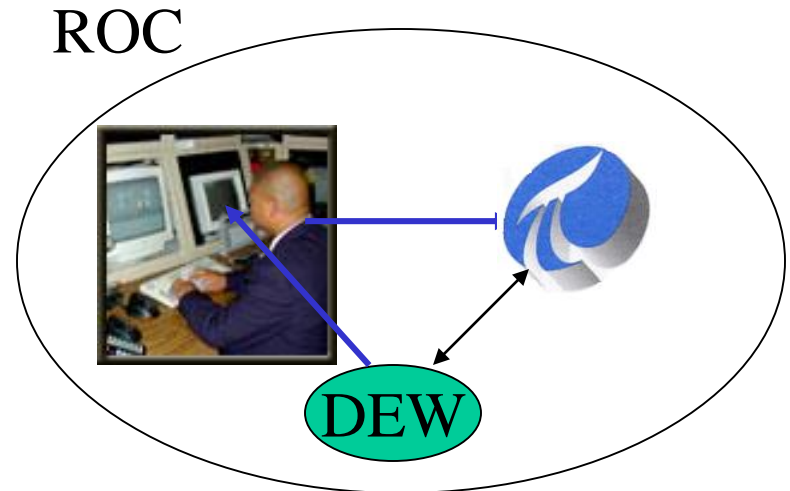
ICCP Link

Installation/Commissioning

- Initial installation/commissioning completed in 2 days.
- DTE IT staff “accidentally” decommissioned the link while project was active.
 - Did not communicate with project team that a VPN changeover would require addressing changes.

DEW

- DEW obtains real-time data from PI
- DEW calculates possible actions and “loads”.
- Puts possible actions into PI and to Operator.
- Operator through PB takes action.
- Real-time monitoring of network reflects action.

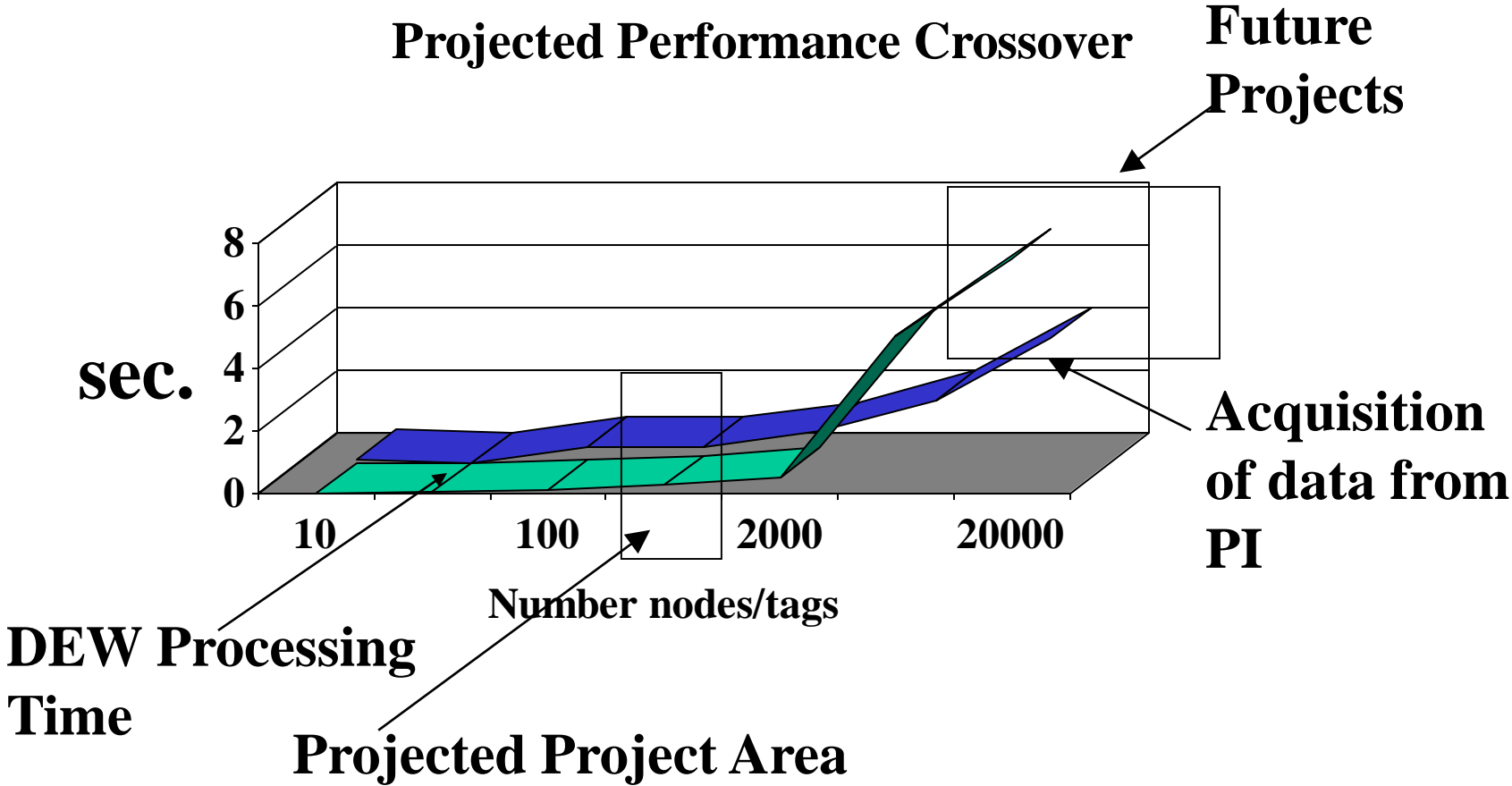


Can now analyze DEW algorithms and Operator Actions

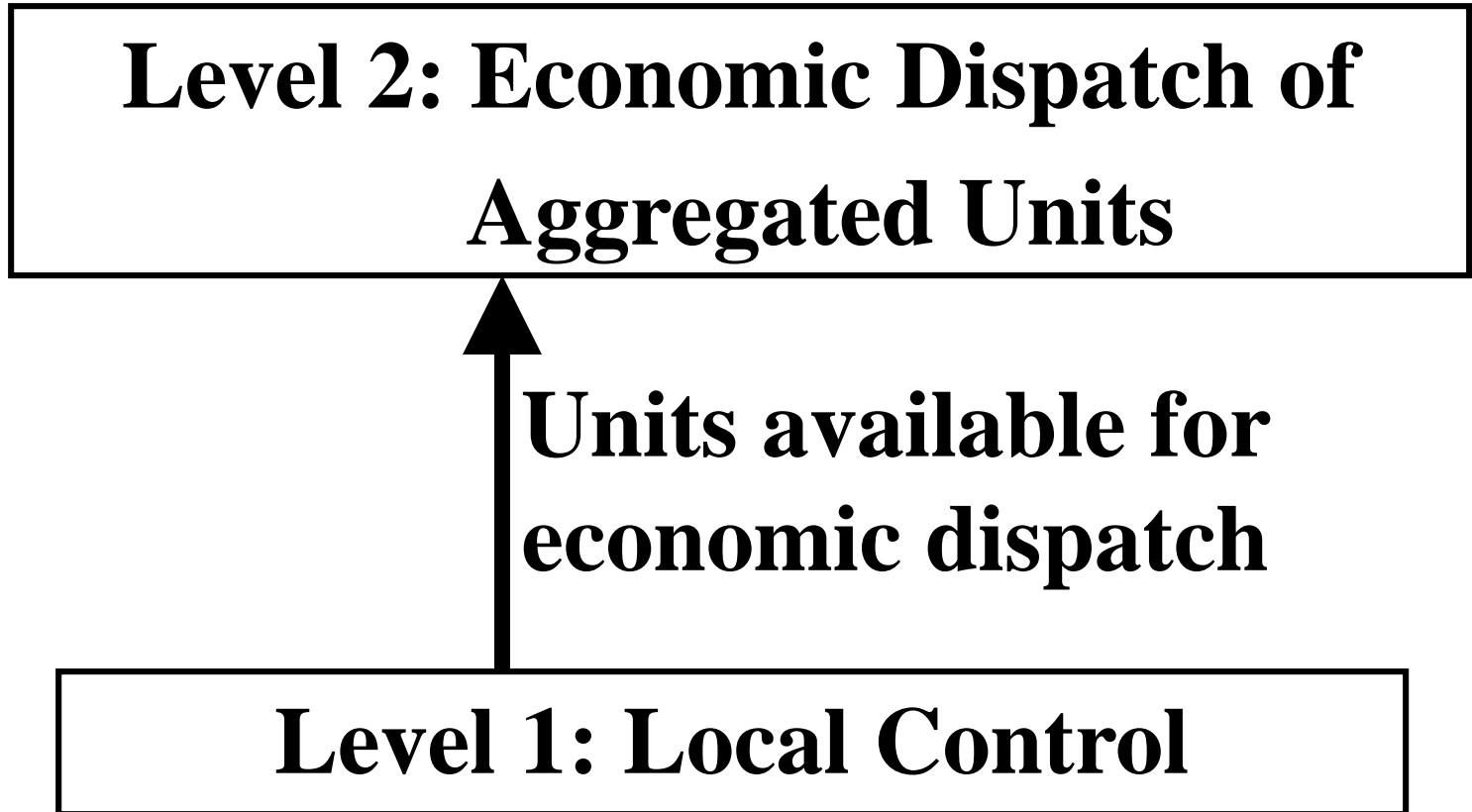
Speed Kills!

- DEW is quick (sparse matrix calculations).
- DEW calculated on static research data prior to project.
- Needed an interface design that allowed DEW to scale.
- Needed an interface that addressed the performance crossover.

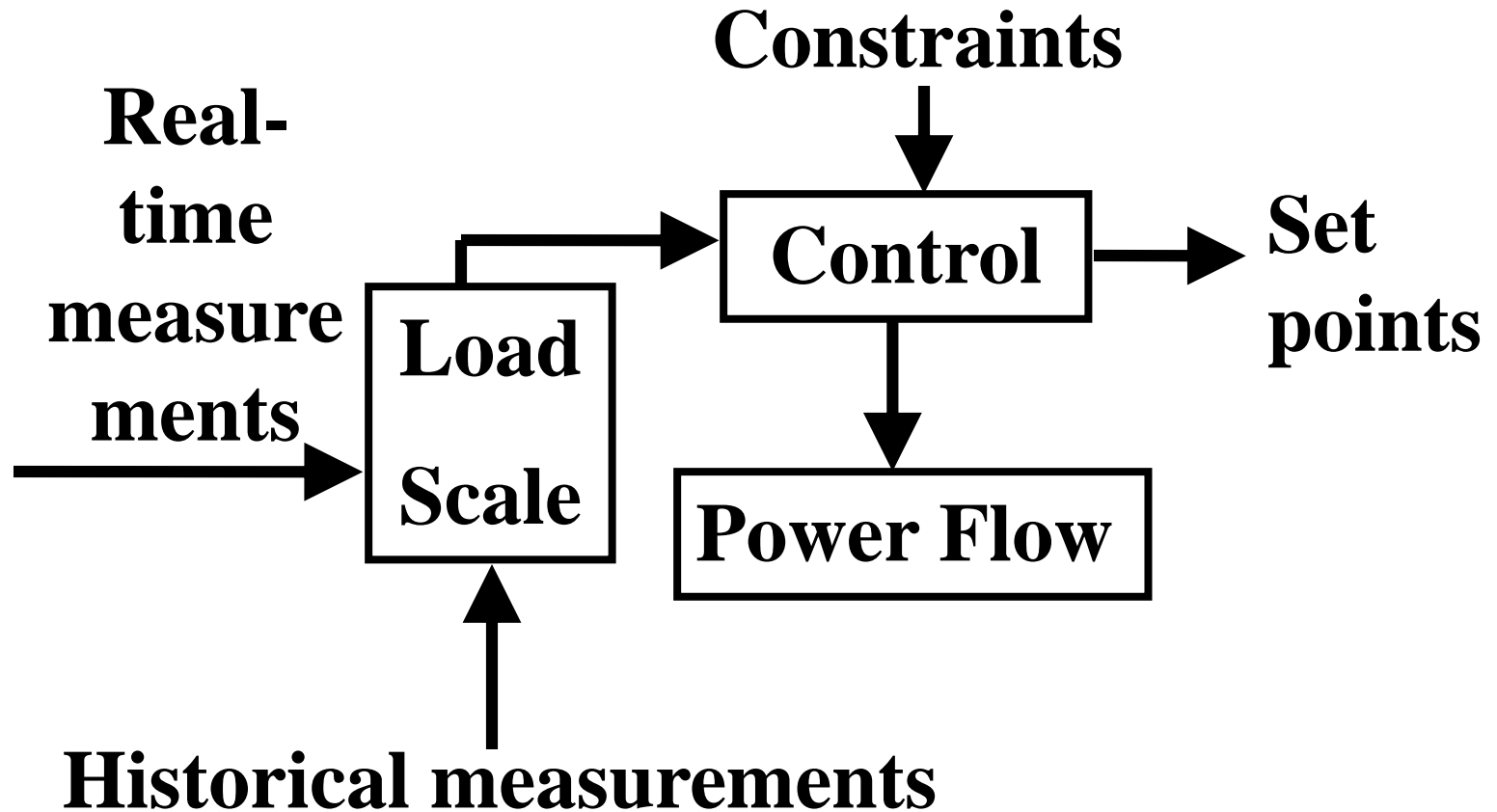
What Performance Crossover?



Hierarchical Control



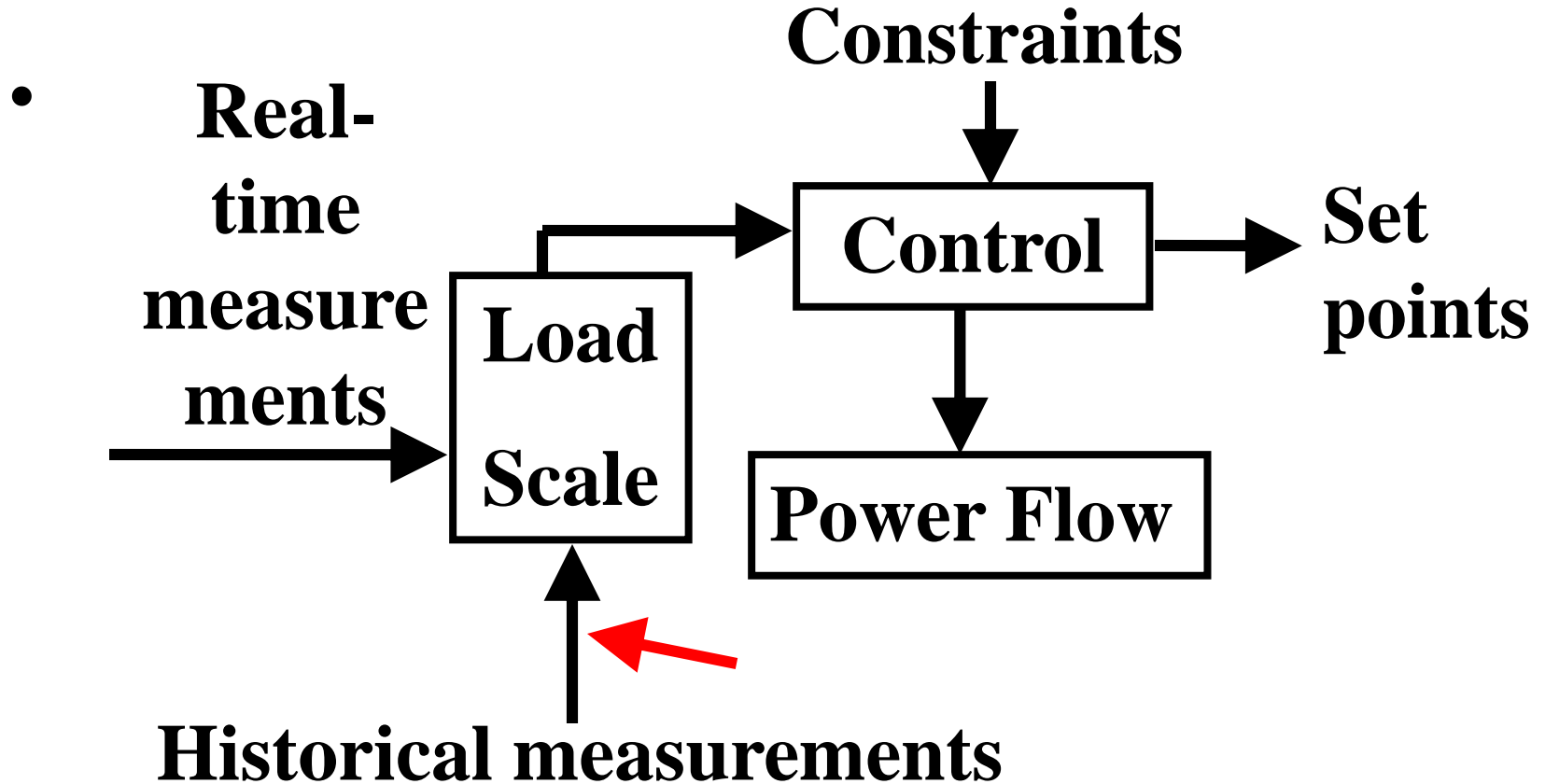
Control of Local Problems



Real-Time Measurements

- **Start of circuit**
 - **Voltage magnitude**
 - **Current**
- **DG**
 - **kW generation**
 - **kVar generation**

Control of Local Problems



Historical Measurements

- **8760 hourly kW, kVar measurements for some large customers**
- **12 kWhr measurements for other loads**
 - **Load research statistics are used to estimate kW, kVar loads**

Circuit Models

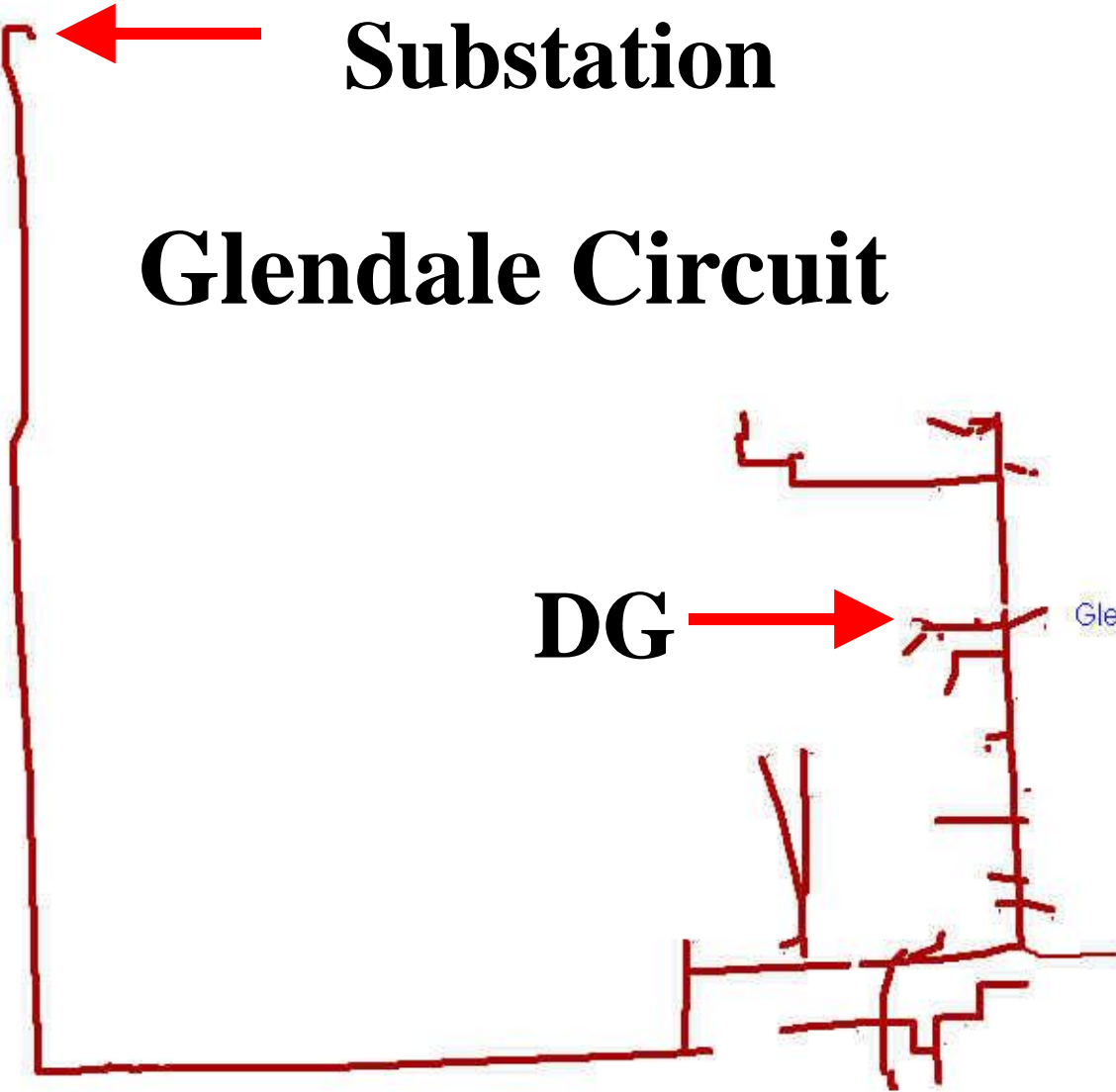
- **Model distribution transformers**
- **Model “parsed” kWhr loads**
- **Model kW, kVar load measurements**
- **Model circuit measurements**

Substation

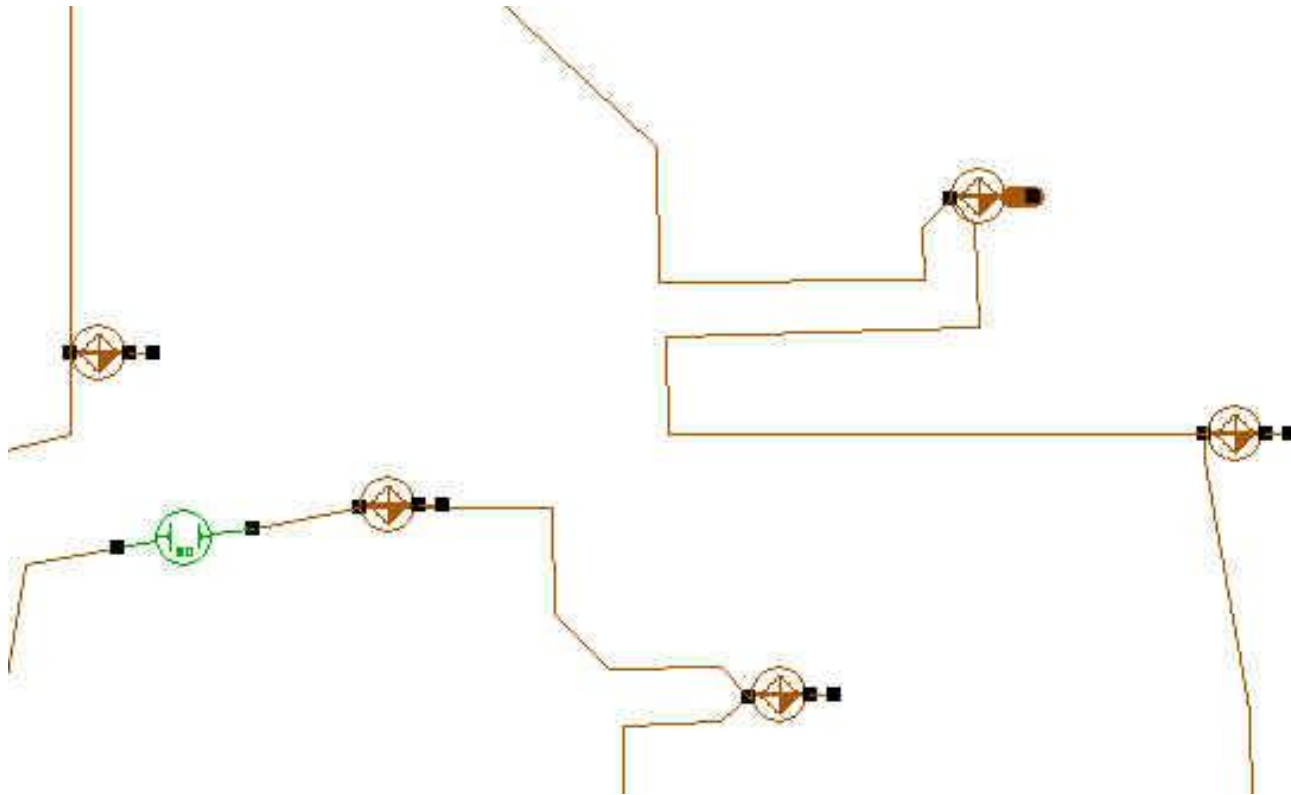
Glendale Circuit

DG

Glendale 150kW DG



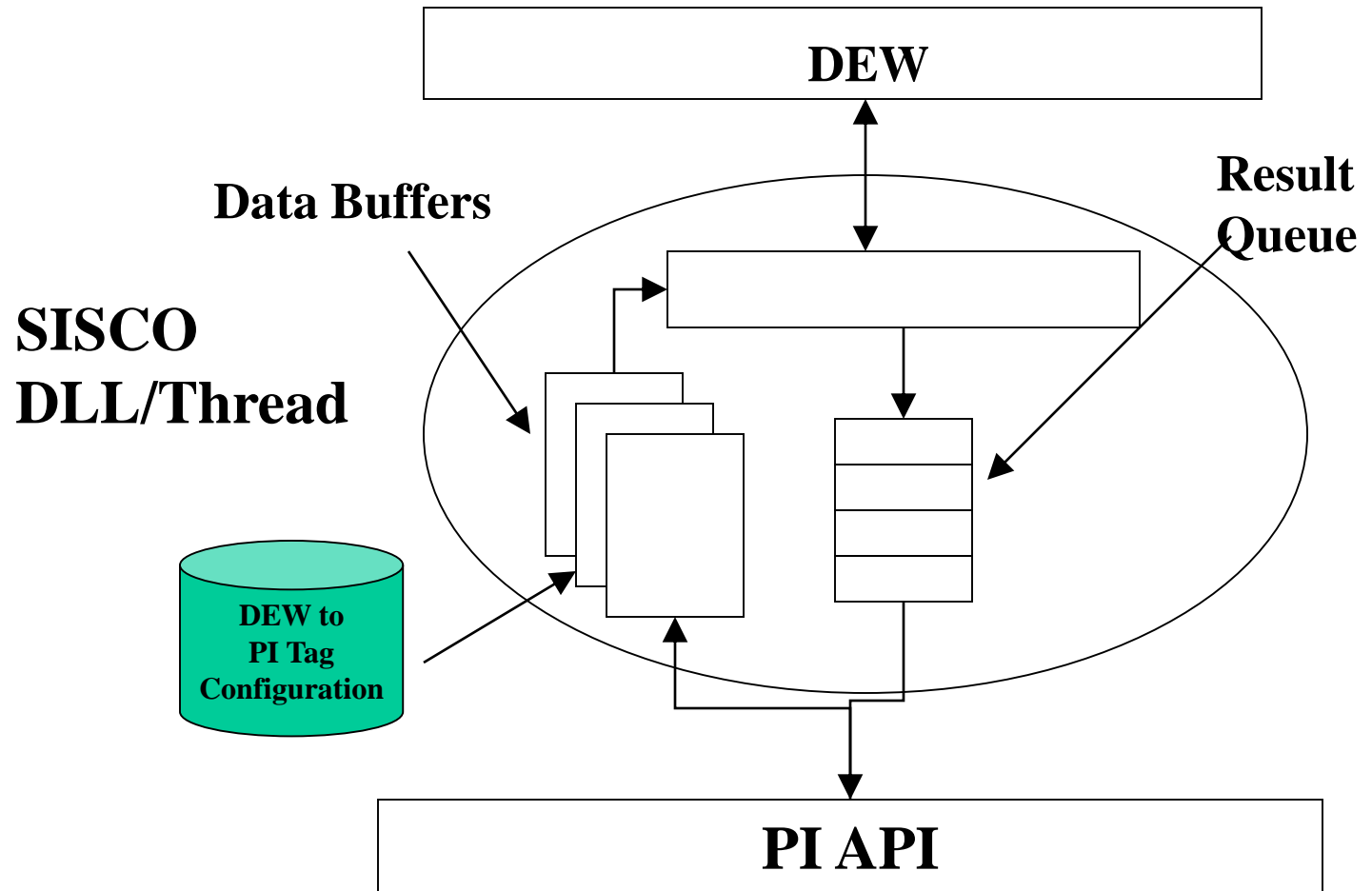
Distribution Transformers



DEW to PI Interface Requirements

- Multi-threading to allow DEW to process while next set of data being acquired by PI.
- Ability to provide non-torn data to DEW for analysis.
- Ability to allow DEW to write results/control suggestions back to PI.
- Ability to perform all calculations in current time or back in history.

What was developed



About the buffers

- Although configured, SISCO interface allowed DEW to specify obtain the data independently of buffer layout.
- DEW can request current data or data from a point in time.
- DEW is “locked” until first buffer is filled.
- If current data are being requested to be obtained, as soon as DEW is “unlocked”. The next buffer is begun to be filled as soon as the first is filled.

Other benefits...

- Same technique can be used to allow non-Windows DEW applications (e.g. supercomputer) to access data without change.
 - DLL has to be replaced with an RPC based remote method (actually was bid on another project).

More...

- Interface allows DEW to be independent of internal changes to the SISCO DLL or buffer layout.
- Tested interface to 100K points.

DEW Results in PB

PI - ProcessBook - [DER (DG) General Display]

File Edit View Insert Tools Draw Arrange Window Help

100%

CIRCUIT NAME	ACTUAL STATE		DEW Recommended Values and State		
	STATUS	Power Level	KW	KVARS	Action Needed
ADAIR	ON	310	0	0	
FARMINGTON	ON	75	0	0	
REDFORD	OFF	0	0	0	
SOUTHFIELD	OFF	0	0	0	
UNION LAKE	OFF	0	Failed	Failed	BAD STATE
WAYNE	OFF	0	0	0	
STDF	OFF	0	Failed	Failed	BAD STATE

Contacts and SOP

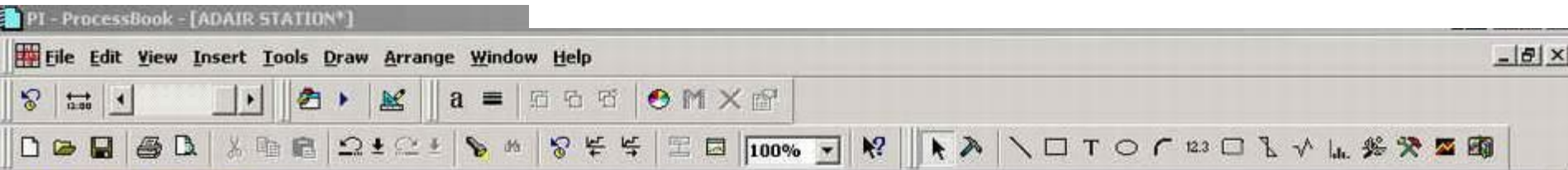
COMM STAT

DTE SOC	DTECH
ON	ON

Status Legend

- OFF
- ON
- BAD STATE
- Operator Action Needed

Adair ENI 1000 – 1 MW Natural Gas

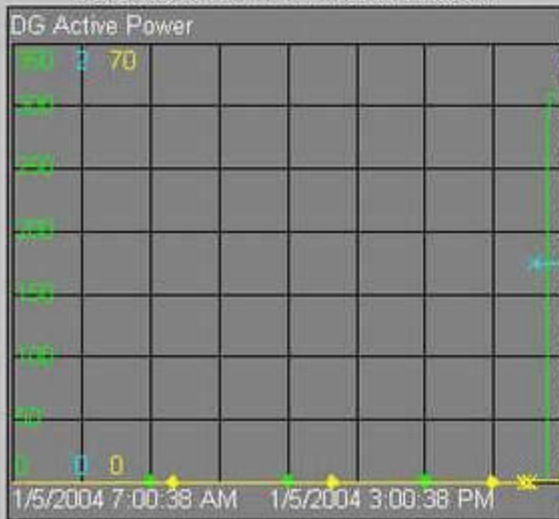


COMM STAT

DTE SOC ● DTECH ●

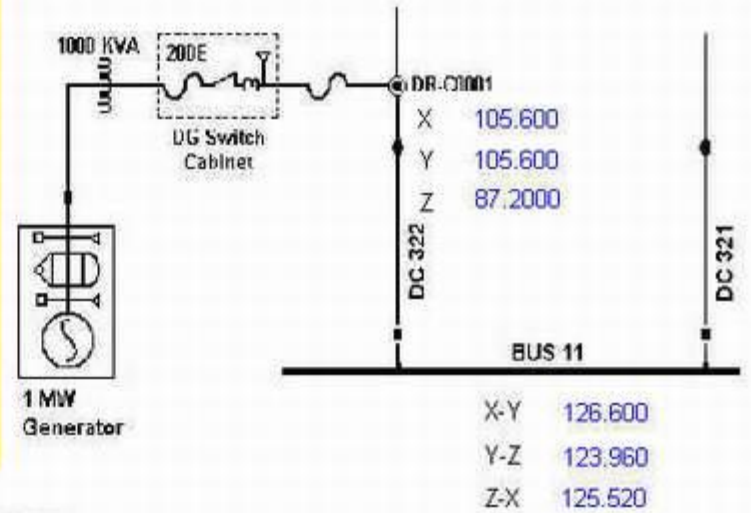
Contacts and SOP

Double Click on Trend in order to Zoom



	ACT.	REC.
X AMPS	362	
Y AMPS	319	
Z AMPS	388	
TOTAL KW	308	0
TOTAL KVAr	66	0
TOTAL VA	315	
TOTAL PF	0	
X-Y Volts	505	
Y-Z Volts	504	
Z-X Volts	499	

Adair DC 322



Control Interlock

Control Information

Controlable ● OFF ● ON ● Current State ●

Controllable ●

ENI 1000 kW
Internal Combustion Engine



Control Interlock

- DTE developed paper procedure to make sure that operators did not request operation at an in-opportune time.
- Found that paper procedures can still leave windows that could create problems.
- Team decided to implement the paper procedure electronically.

Paper procedure

DTE



DTECH



**Enters into Log
Checks DG state
Gives OK/NOK**

Calls →
← **OK**

**Control Request
via ICCP** →

However nothing to stop

DTE



DTECH



Control Request
via ICCP 

New Approach

DTE

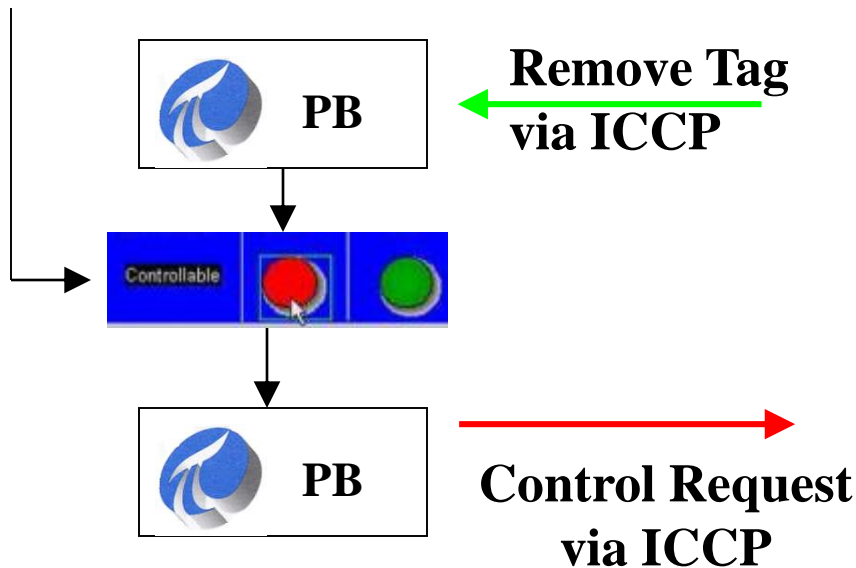


Calls
→
OK
←

DTECH

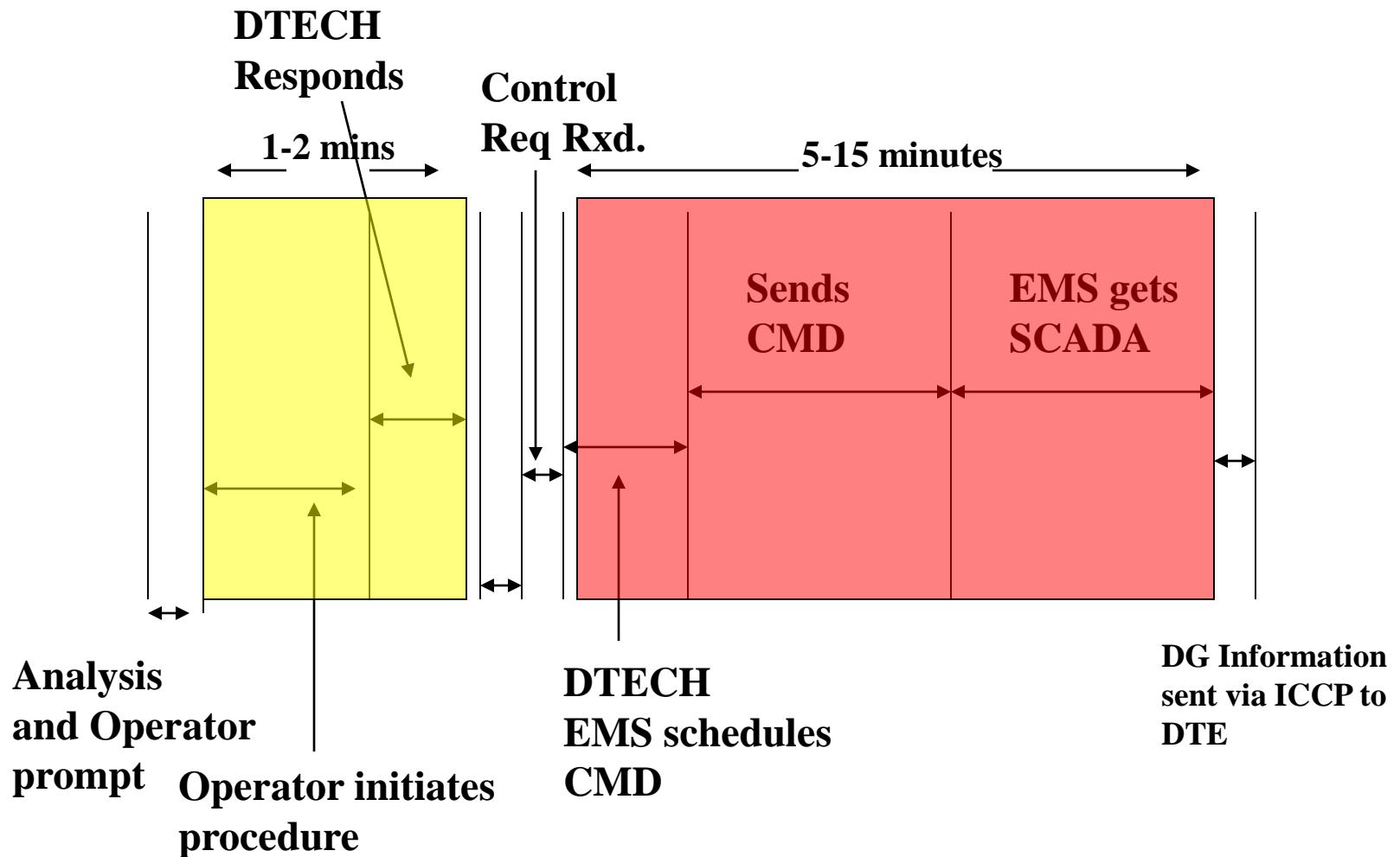


Enters into Log
Checks DG state
Gives OK/NOK



Don't attempt this
unless your procedures
are symmetrical for the
control point (e.g. on and
off).

How did the system perform



Learned Valuable lessons

- Having all data/control commands in PI captured the problems.
 - Need to remove human factors or increase response time.
 - Operating TPY DGs is not as responsive as normal SCADA.
 - Improvements in TPY communications has a dramatic impact on overall system performance.

Also found something else

PI - ProcessBook - [DER (DG) General Display]

File Edit View Insert Tools Draw Arrange Window Help

100%

CIRCUIT NAME	ACTUAL STATE		DEW Recommended Values and State		
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SOUTHFIELD	OFF	0	0	0	
UNION LAKE	OFF	0	Failed	Failed	●
WAYNE	OFF	0	0	0	
STDF	OFF	0	Failed	Failed	●

COMM STAT

DTE SOC DTECH

Contacts and SOP

Status Legend

- OFF
- ON
- BAD STATE
- Operator Action Needed

Why did these calculations fail?

Data Validity

- MW Readings from DG Circuit.

Can you see the problems?

21-Dec-03 08:19:01	Equip Fail
21-Dec-03 08:20:01	0.7972
21-Dec-03 09:35:01	0.8238
21-Dec-03 09:36:01	Equip Fail
21-Dec-03 09:37:02	0.84375
21-Dec-03 15:06:36	0.71075
21-Dec-03 15:07:36	Equip Fail
21-Dec-03 15:08:36	0.7041
21-Dec-03 20:00:14	1.01

Other Issues Encountered

- IT and Corporate Policies
- Security Issues
- Pilot system mentality
- Data validity
- Two Operation Centers with different operational philosophies.
- EMS Upgrade

IT and Corporate Issues

- DTE does not allow any incoming connections.
- IT staff is not responsive to requests outside of normal IT requests.
- On-site connectivity is un-available during start-up/integration.

Pilot System Mentality

- Team knew that system was proto-type of future operations.
- Operations knew it was a temporary pilot system.
- Operations did not take the system seriously until visibility of data was demonstrated.

DOE Phase II

- Add economic dispatch links to MISO via SOAP/XML messaging
 - Make use of RTPortal and develop additional web parts.
 - Extend system over multiple utilities
 - Extend system to operate with other DG operators.
- Award of Phase II notification due around User Group.

Questions?

For More Information, Contact:

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