Using PI for DER at DTE

Control and Trading
(an early glimpse)

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**.

DOE: DE-SC02-03CH11139

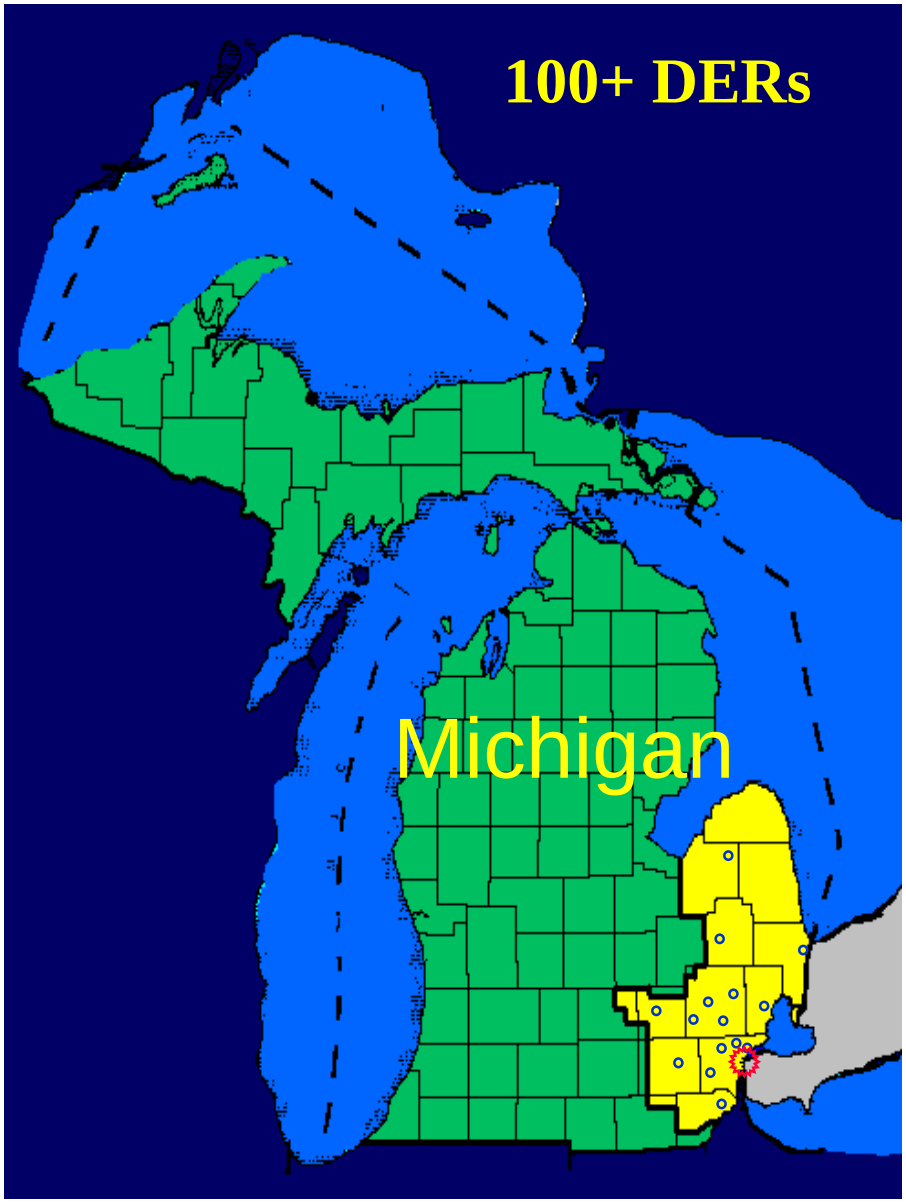
DOE Requested:

- Phase 1
  - develop methodology (4 teams selected $300K*/6 Months)
- Phase 2
  - deploy and determine what changes are needed. (2 teams of 4 selected)

DTE Team Responded:

- Phase 1
  - Develop methodology and deploy to obtain real results within 6 month timeframe of phase 1.
- Phase 2
  - Analyze “real” data from phase 1, correct any issues, and expand system.

Detroit Edison Service Territory



Service Area: 7,600 Sq. Miles

Customers: 2.1 million

System Peak Load: 12,132 MW
Annual Sales: 56,000 GWH

- **37% Commercial**
- **29% Residential**
- **29% Industrial**
- **5% Wholesale & Interconnection**

Distribution Substations	**662**
Distribution Circuits	**2,808**
1,876 @ 4.8kV	
932 @ 13.2kV	
Distribution Circuit Miles	**38,939**
20,184 @ 4.8kV	
18,755 @ 13.2kV	
Transmission Towers	**12,634**
Transmission Circuit Miles	**2,416**
1,366 @ 120kV	
1,050 @ 230/345kV	

DG Vision

Let's imagine a semi-truck load of new DG technology starting up and heading toward the utility; there are 3 ways to deal with it:

Throw yourself in front of the truck and hope it stops

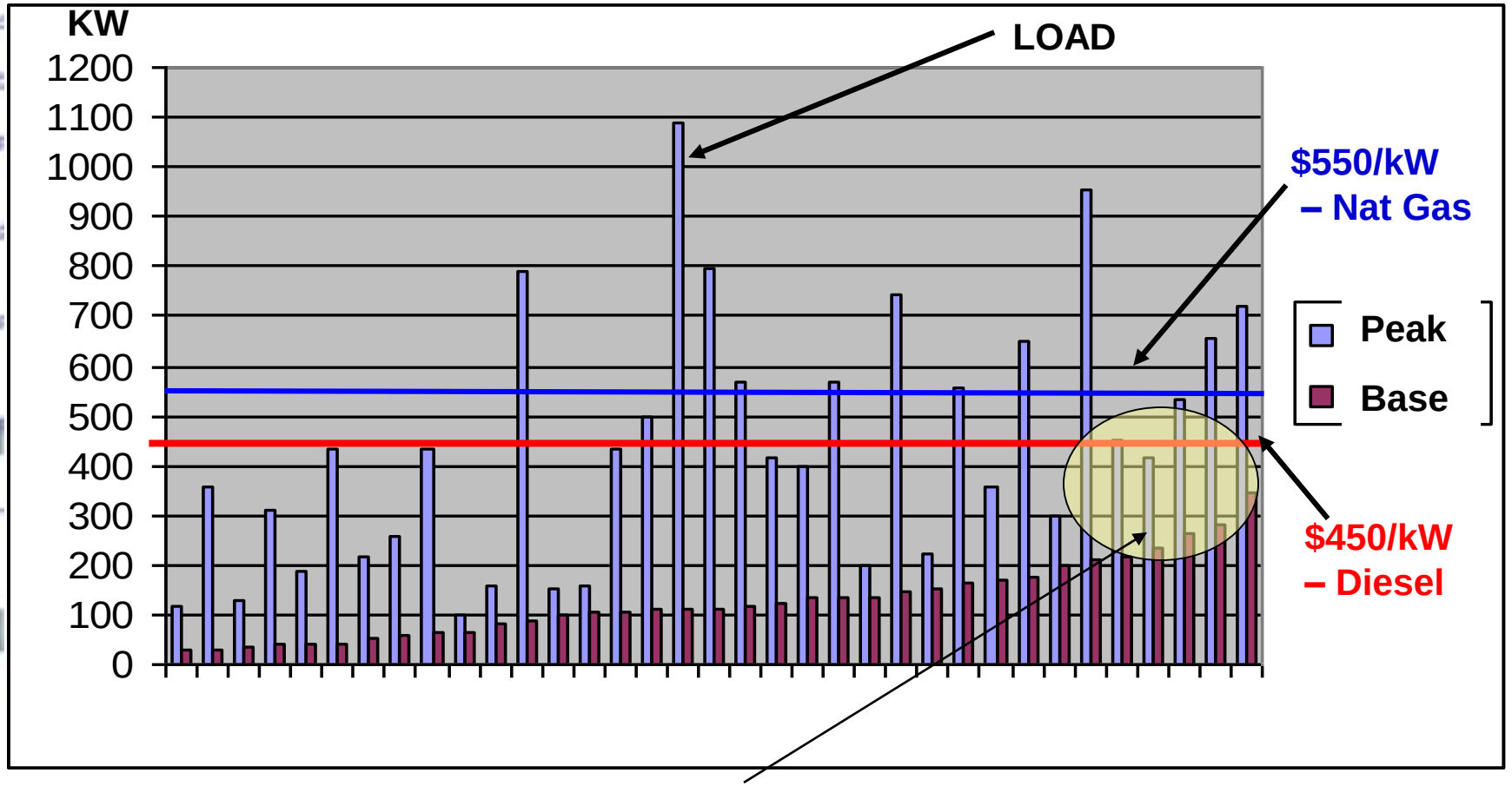
Grab on to the back bumper and drag your feet

Jump into the cab of the truck and help to steer it.

DTE Energy
Detroit Edison

DER Integration – The Business Rationale

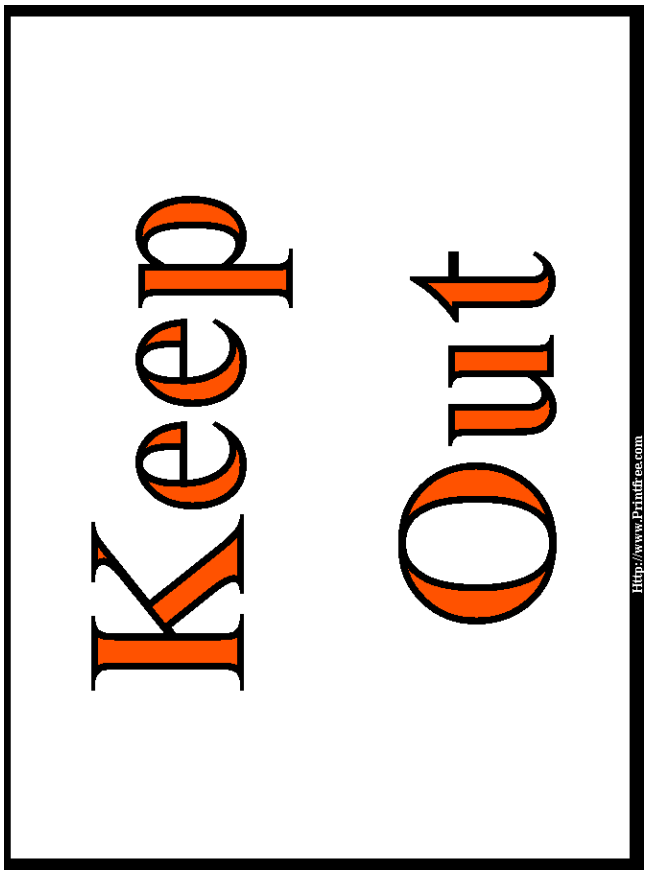
Build a new substation or use DER?



Time to Build a new Substation?

Other Reasons for DER

- Cost of Building new substations.
- Not in my Backyard (NIMBY)
- Build Anything Nowhere and Nothing Anywhere (BANANA)



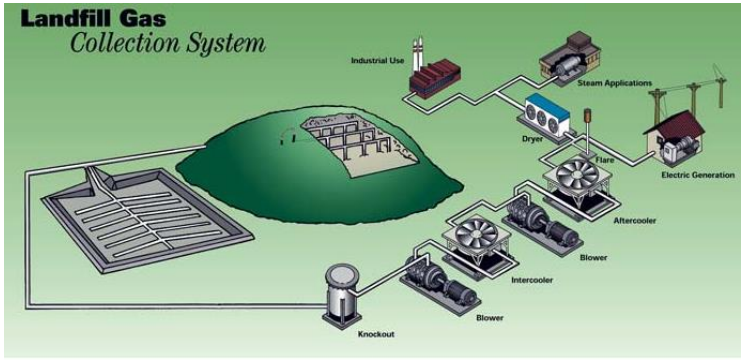
Quail - 2MW Diesel DG - Islanding

Varying Technologies at DTE

Solar

External Combustion

Mini Turbine



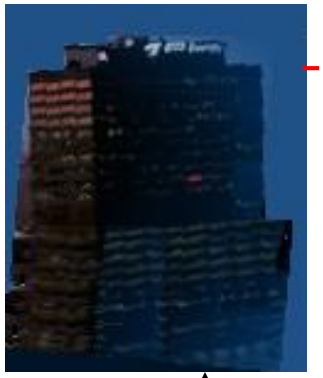
Biomass

Battery Storage

Natural Gas and Hydrogen Fuel Cell

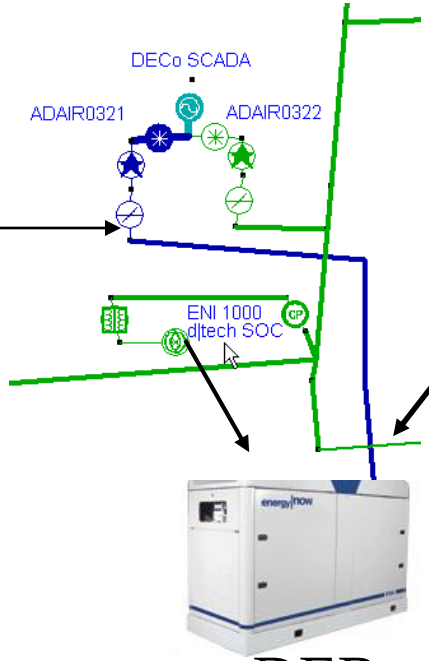
DTE Owns but does not Operate?

Detroit Edison



Control Request

DTEtech



Monitors DER

Ability to Operate

Status

Monitoring

Control

Maintenance

Safety

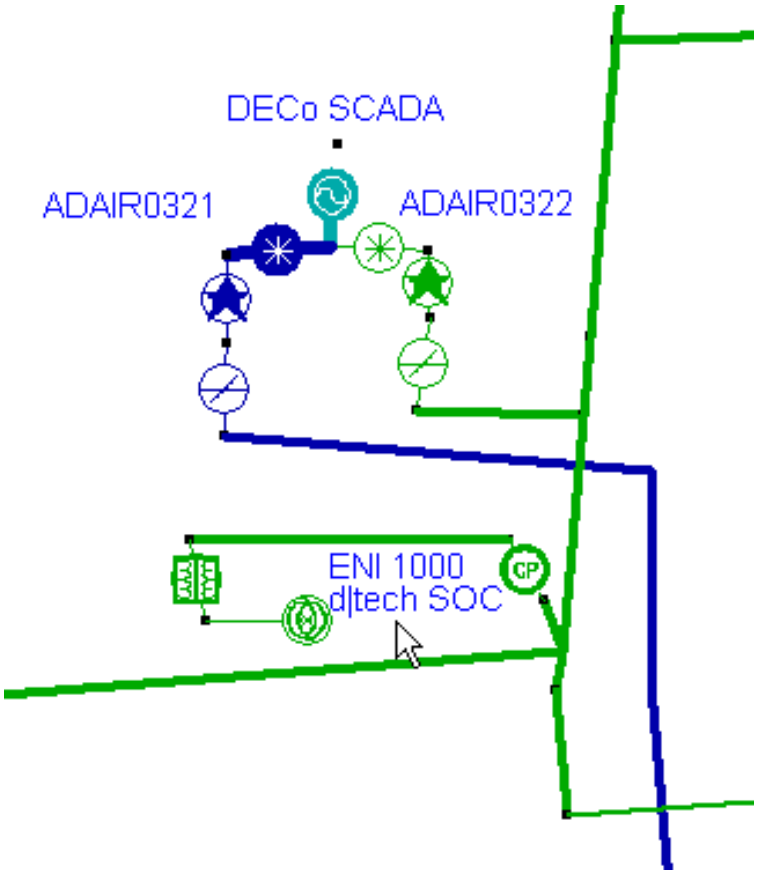
Sends Generation schedule

Control

DER

Distribution Engineering Workstation (DEW) by EDD

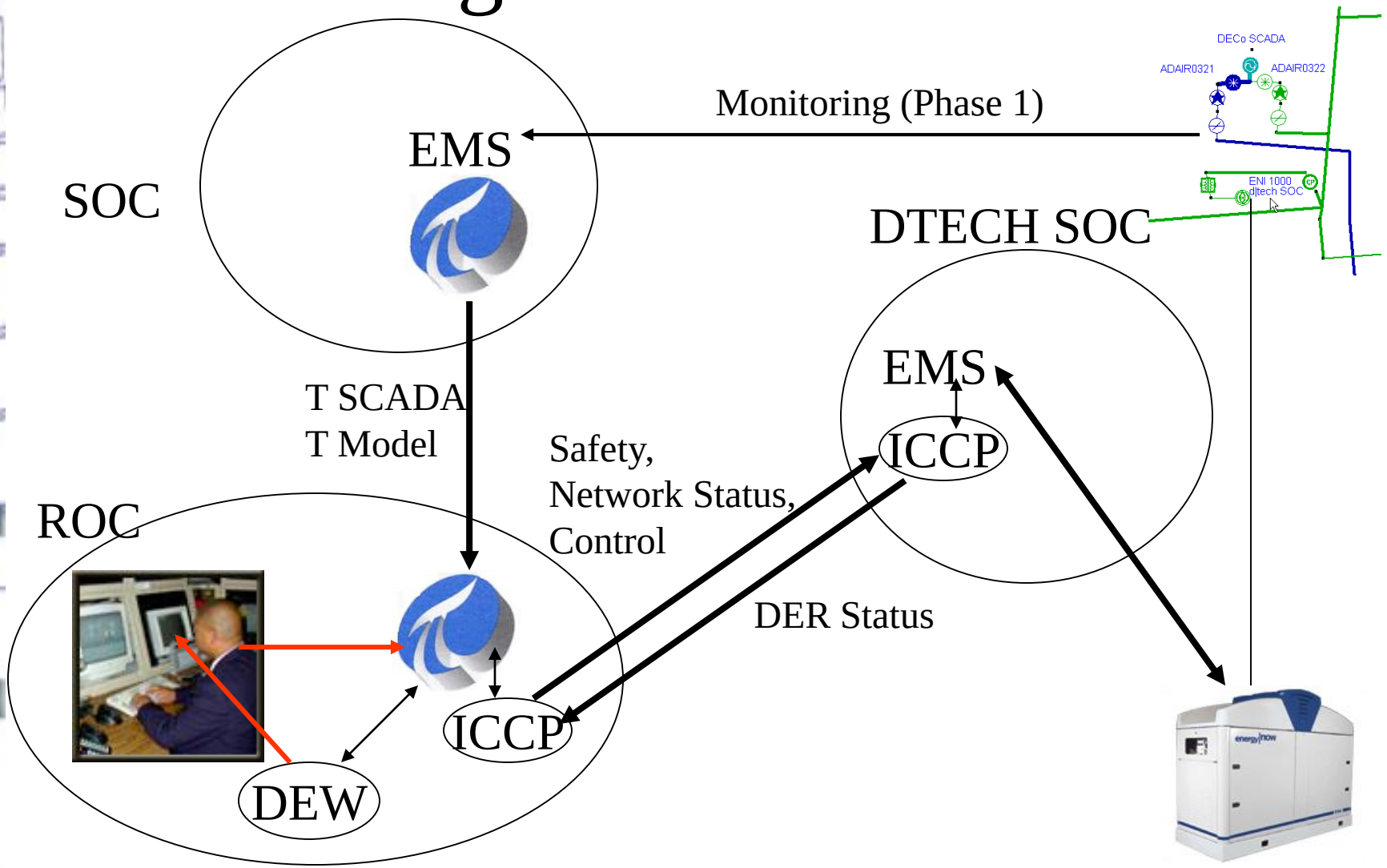
- Has model of Distribution Network
- Solves network based upon “static” research data.
- Proposes operational solutions.
- No operator feedback nor action vs. network reaction.



What is 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.

Automating the Process – Part 1

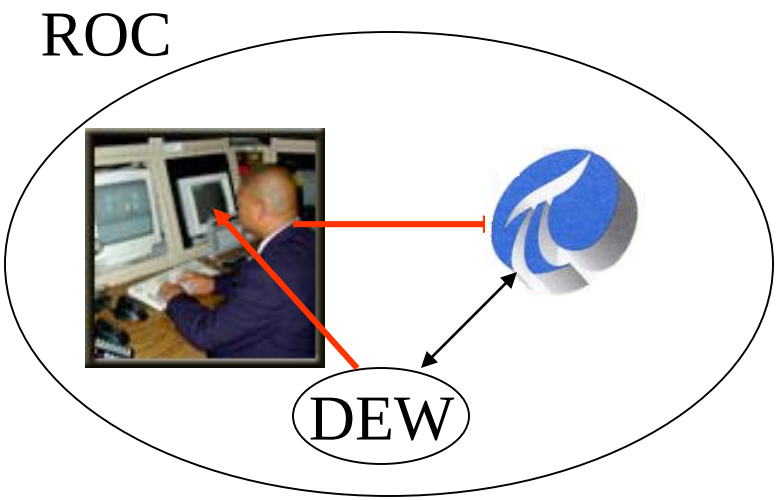


Important Metrics

- Scheduled Source (EMS, PI, Customer) vs. Actual Load (PI)
- Maximum power allowed (DEW, PI, MDB)
- Reserve distribution/transmission capacity (DEW, PI)
- Flow direction allowed (MDB)
- Cost and Tariffs (Customer, ICE, ACE)
- Penalties (Customer)

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

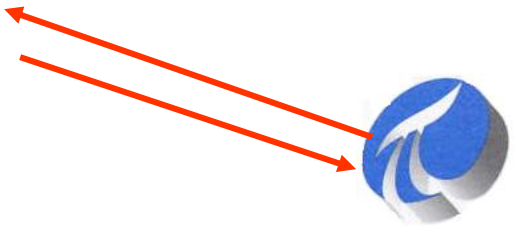
Some Issues to Resolve

DEW solves distribution network on a “scan” basis” (hopefully 2 minutes or less)

DEW outputs solutions and suggested operations into PI.

Process Book and/or Application Framework display suggestions. (2 seconds).

Operator acts on suggestion.

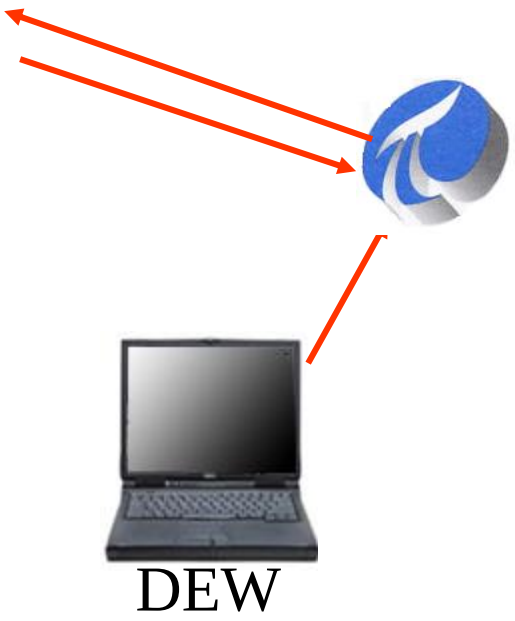


DEW

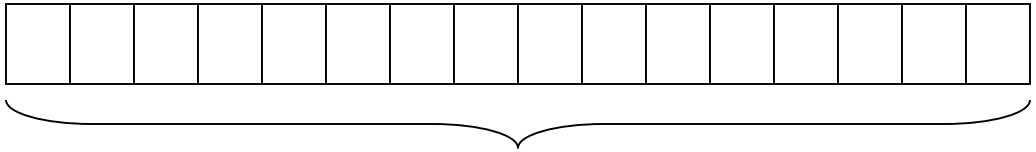
What if state of network has changed?

Need back-check (PB or AF)

Need to develop a mechanism that is well understood.



Encode information into tag values:



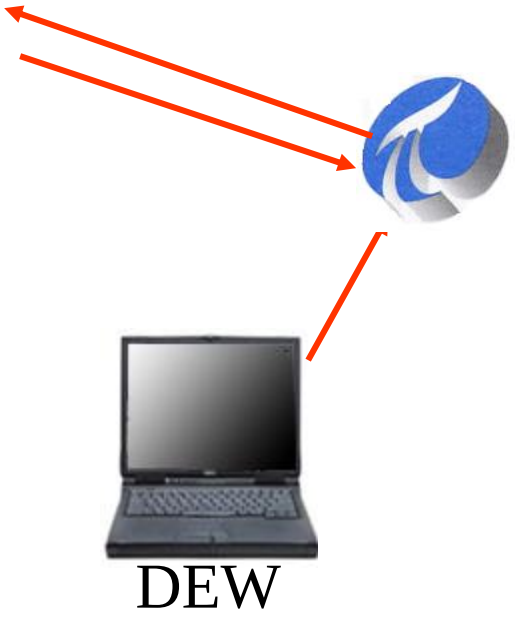
Operator Action

Operator chooses action.

PB or AF can flag error if Action is no longer suggested.

Need back-check (PB or AF)

Operator choice needs to be historized, even if in error.



This allows the response time to be analyzed and to see if procedures need to be changed or staff added.

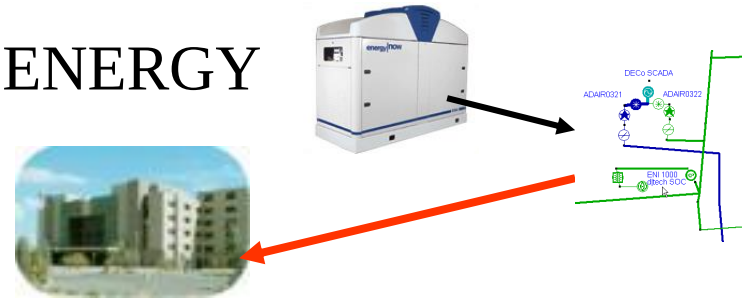
Once a non-error request is made, control must happen quickly.

Three tags needed, initially implement for DER operation only.

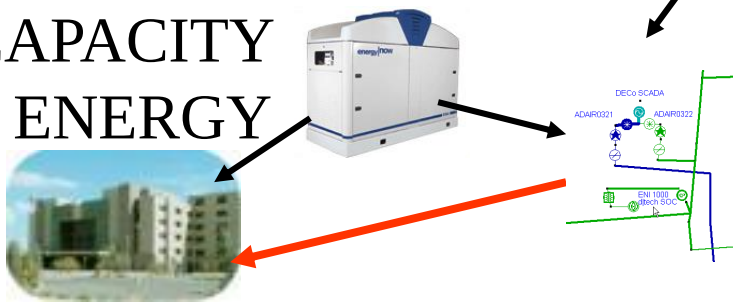
DERs Provide:

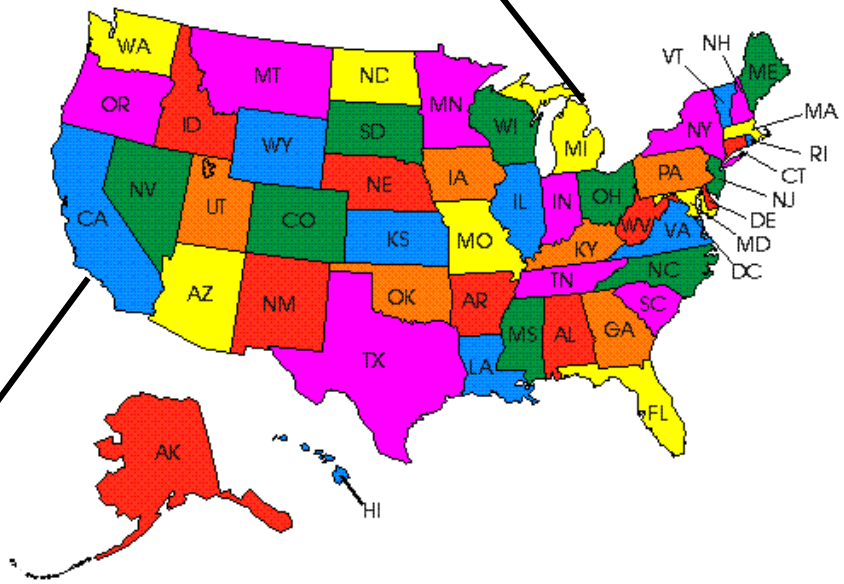
CAPACITY

ENERGY



CAPACITY
+ ENERGY





Different States have different economic factors.

Energy Aggregation/Pricing

- Requires “Distribution Tariffs”
- Maximum Loading models for all components on delivery path.
- Lower profit/higher cost to implement than Capacity?

Distribution of Power: Same Distribution Network?

(1)

(2)

Case 1: Capacity

(1) + (2) + DER = Total Power

Distribution Load unchanged

Customer

Transmission Substation

Transmission Substation

Distribution Substation

Case 2: Energy?

(1) + (2)+DER = DNET_LOAD

DNET_LOAD< MAX_DLOAD?

Who knows what(the important ones)?

- Transmission Company
  - Schedule of Power Delivery
  - Actual Delivery
- Customer
  - Scheduled Delivery
  - Predicted Load
- DER Owner
  - Capacity Scheduled
  - Capacity Available
- Distribution Network Supplier
  - Maximum Loads
  - Predicted Loads

PI ACE

Possible ACE Calculations

T-SUB

S-Power
A-Power
P-Power

1:n

D-SUB

S-Power
A-Power
P-Power

Capacity planning at 15 minute intervals

1:1

Capacity

A-Power
S-Power
M-Power

Sum of DERs at 5 minute evaluations

1:n

DER

M-Power
S-Power
A-Power
Status
Price

1:n

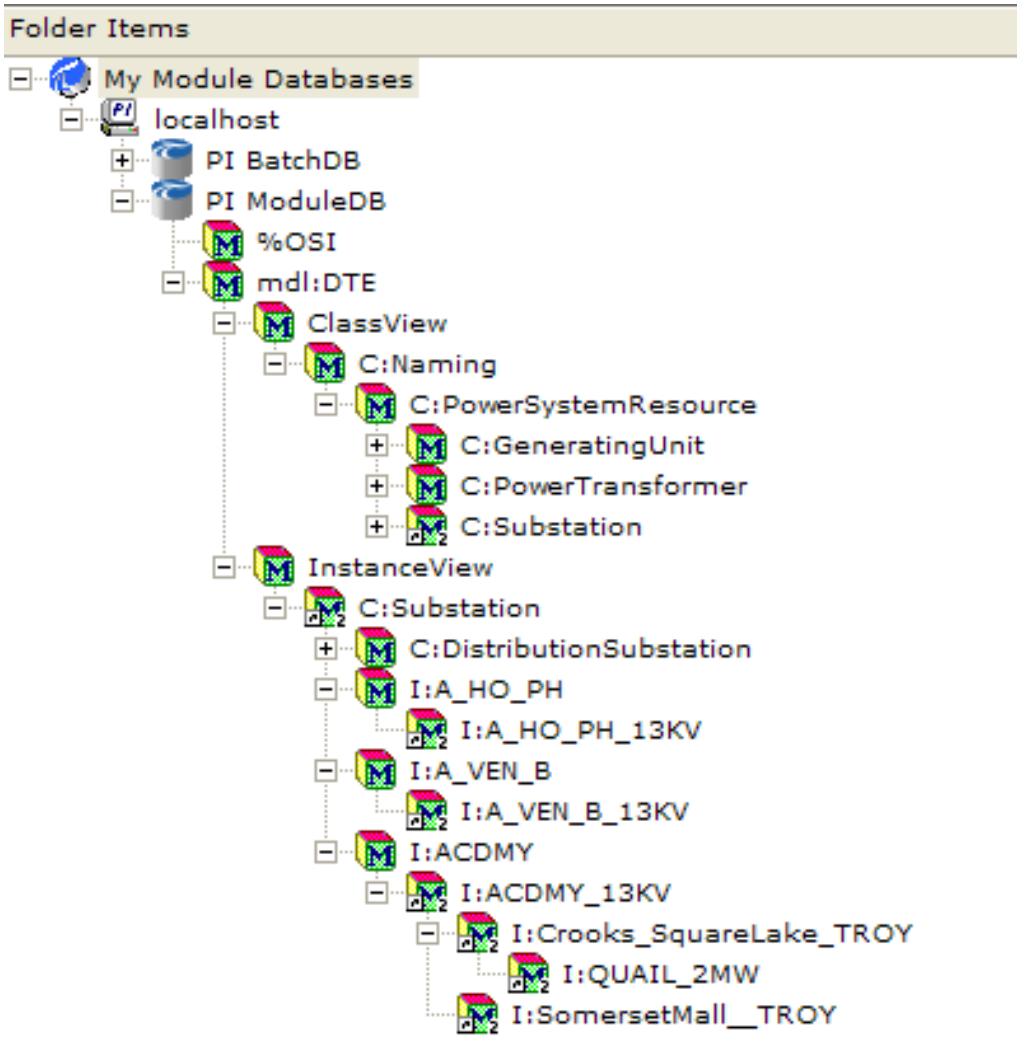
- DEW

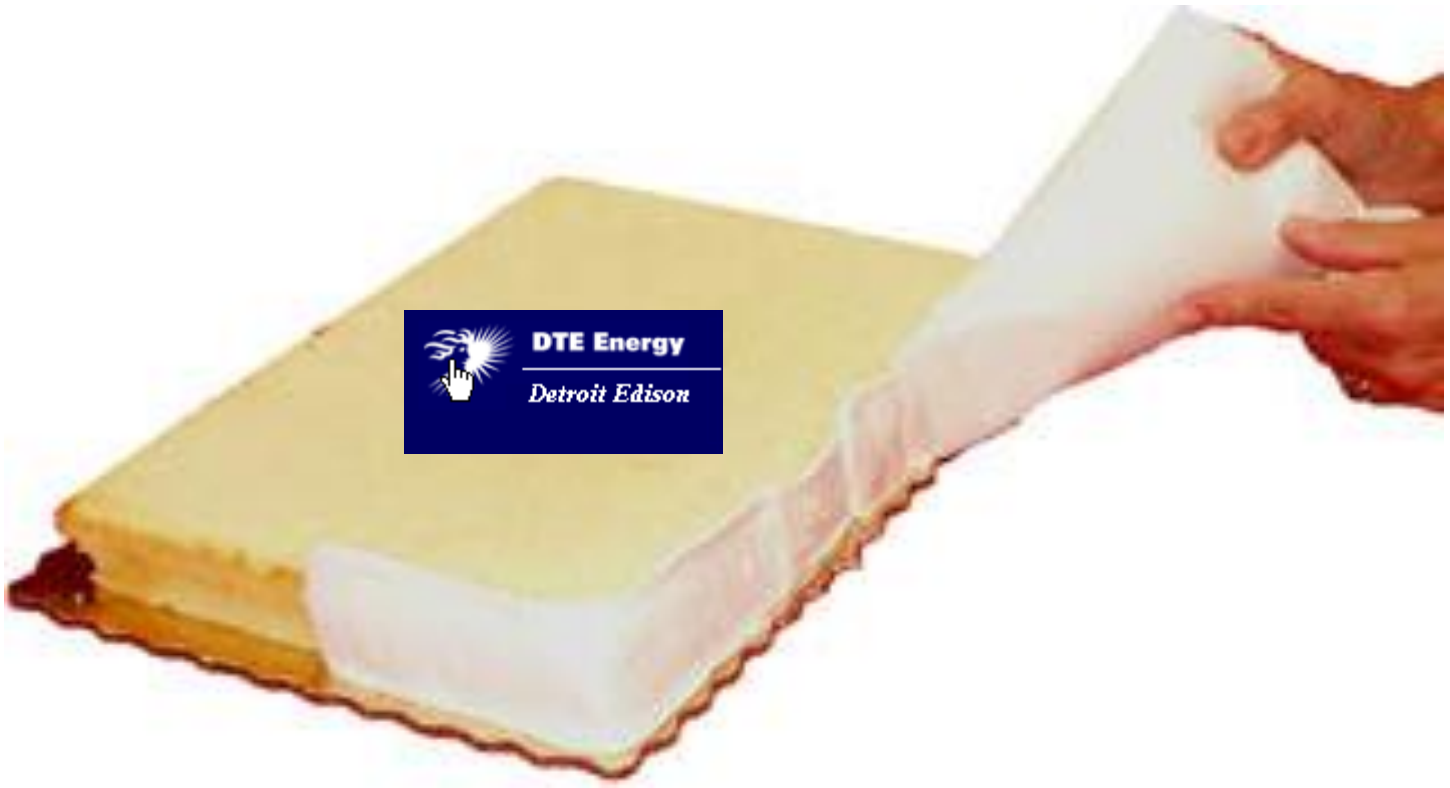
Preventative Maintenance

Pricing may vary

S- Scheduled
A – Actual
P – Predicted
M - Maximum

How it could look in the MDB



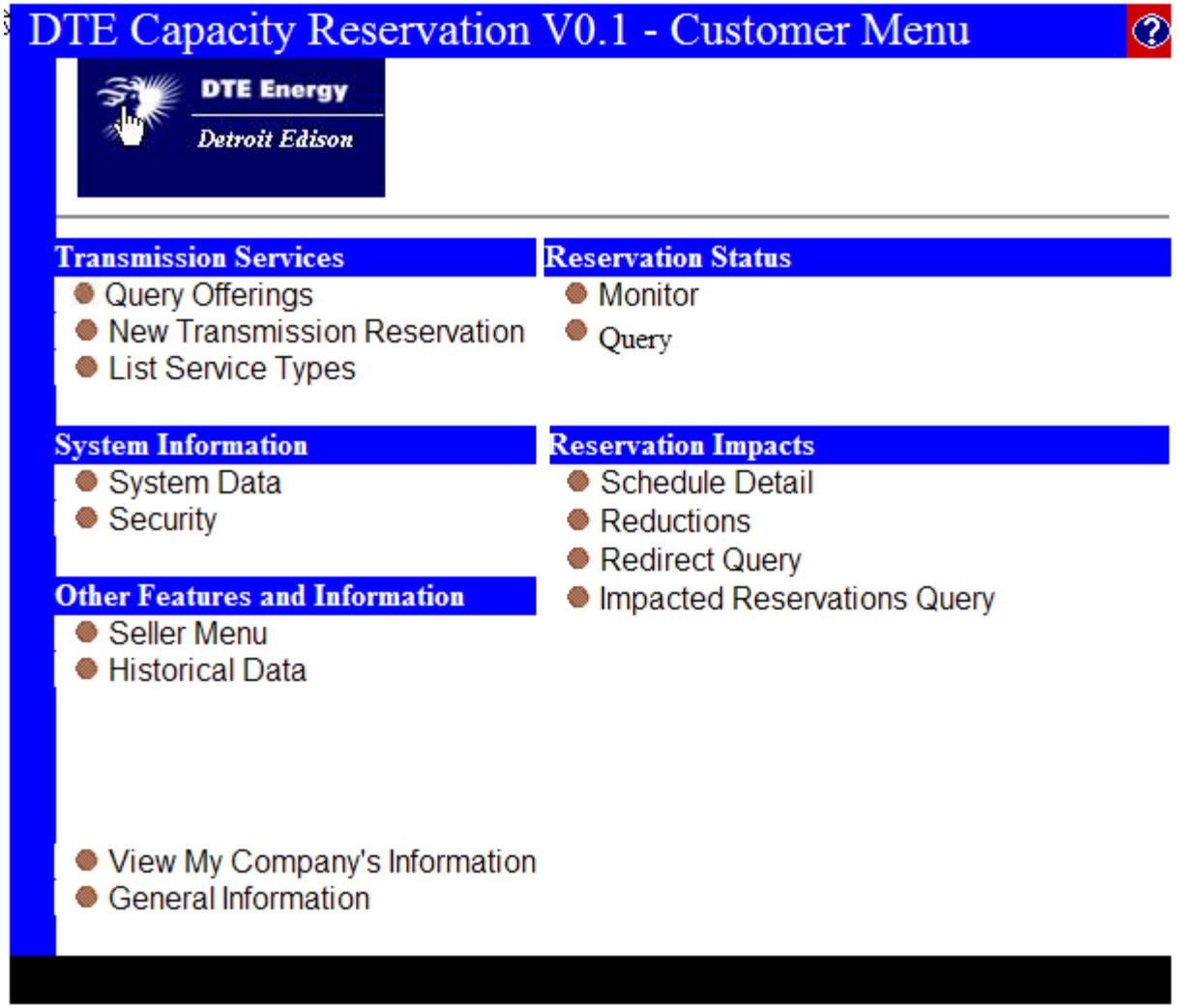


Adding ICEing to the Project

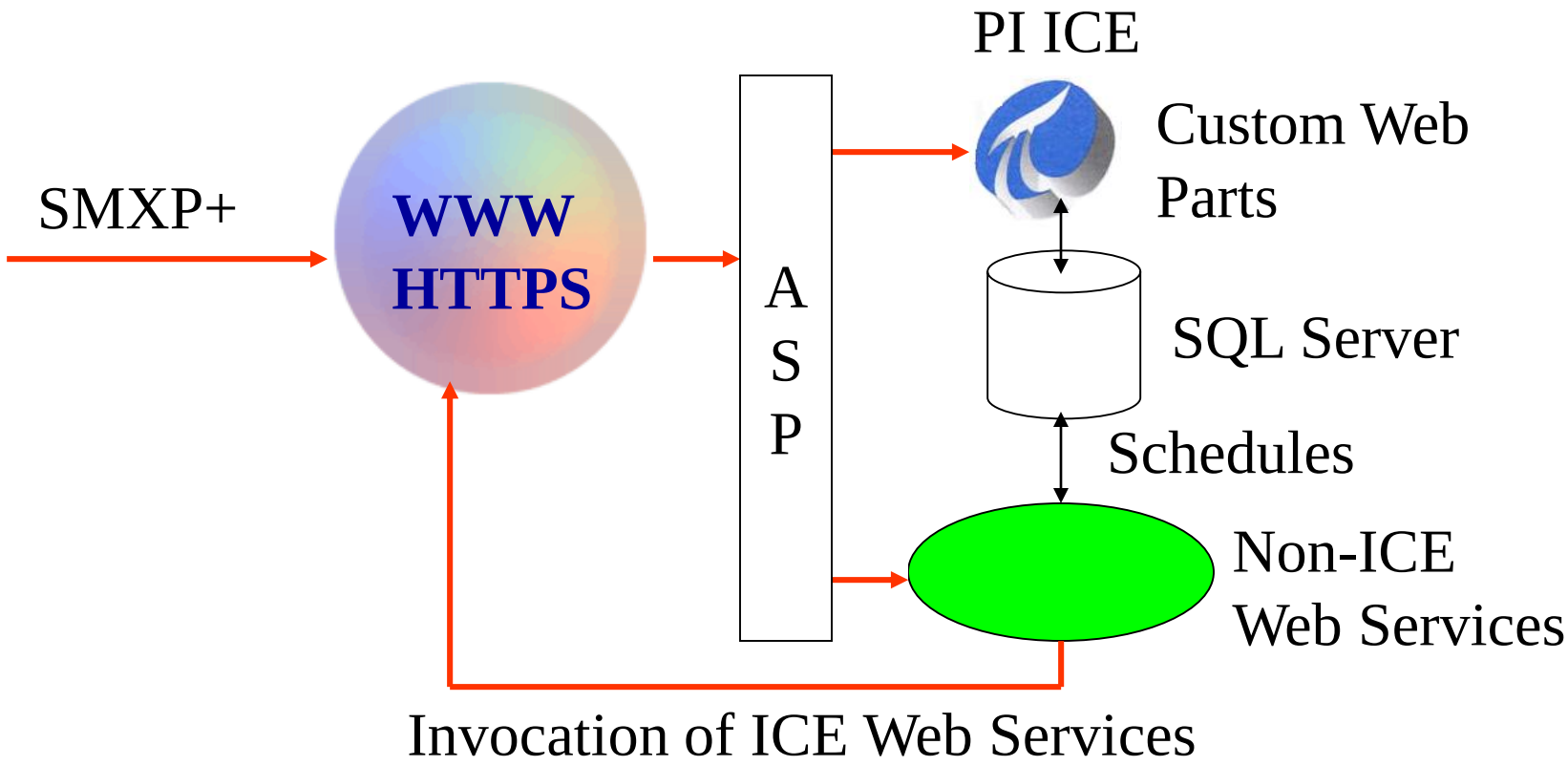
ICE and Web Services (Phase 2)

- Needs ability to schedule capacity reservation in the future (Web Service).
- Needs ability to trend reservation vs. actual and shortfall (ICE).
- Need total financial bidding/transaction system similar to SMXP (E-Tagging) once FERC/NERC specifies (Web Services).
- Security and encryption needed.

Sample


DTE Capacity Reservation V0.1 - Customer Menu
DTE Energy
Detroit Edison
Transmission Services
Query Offerings
New Transmission Reservation
List Service Types
Reservation Status
Monitor
Query
System Information
System Data
Security
Reservation Impacts
Schedule Detail
Reductions
Redirect Query
Impacted Reservations Query
Other Features and Information
Seller Menu
Historical Data
View My Company's Information
General Information

ICE/Web Services Architecture



Important Functions (top 5 list)

(5) 24x7 Operation

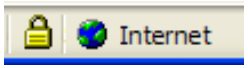
(4) Auto-generation of reports that are Web Enabled (e.g. XML/XSLT). Primarily for Billing and reconciliation.

(3) Ease of configuration and use. Must be able to adapt rapidly as new requirements arise.

(2) Must be maintainable by DTE staff (may not be DER knowledgeable).

(1) SECURE, SECURE, SECURE

Security Issues

- HTTPS – “providing” encryption
  - SSL 1,2 need to be deprecated
  - TLS cipher suites need to be managed.
    - Negotiation of no encryption or message authentication currently may still result 

    - Need to manage certificates to prevent this, but how to verify?
- OASIS Security requirements enforcement?
- Energy Market Access and Reliability Certificates (e-MARC) Enforcement?

Use of ICE

- Primary use for retrieval of information and interacting with a “remote” PI Server.
- Allows relocation of primary Web Business Interface.
- Tertiary assistance in screen generation. (dependant upon final GUI design)
- Need to address non-Microsoft Browsers

Summary

- Quick implementation
  - Believe that DTE proposal will be on-line (e.g. not theoretical within 5 months).
- Believe that the solution is low-risk.
- System flexibility and audit capabilities will allow issues to be identified and corrected in phase 2.
- Detail design work still is needed.