Detroit Edison Advanced Communication & Control of Distributed Energy Resources

Presented at EDT Annual Peer Review Meeting October 29, 2003

DE-FC02-03CH11161

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Detroit Edison
Advanced Communication & Control of Distributed Energy Resources

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Electric Distribution Transformation 2004 Annual Program and Peer Review Meeting, October 28-30, 2003

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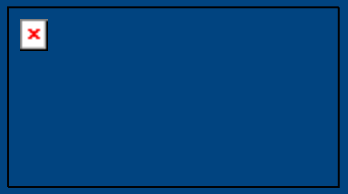
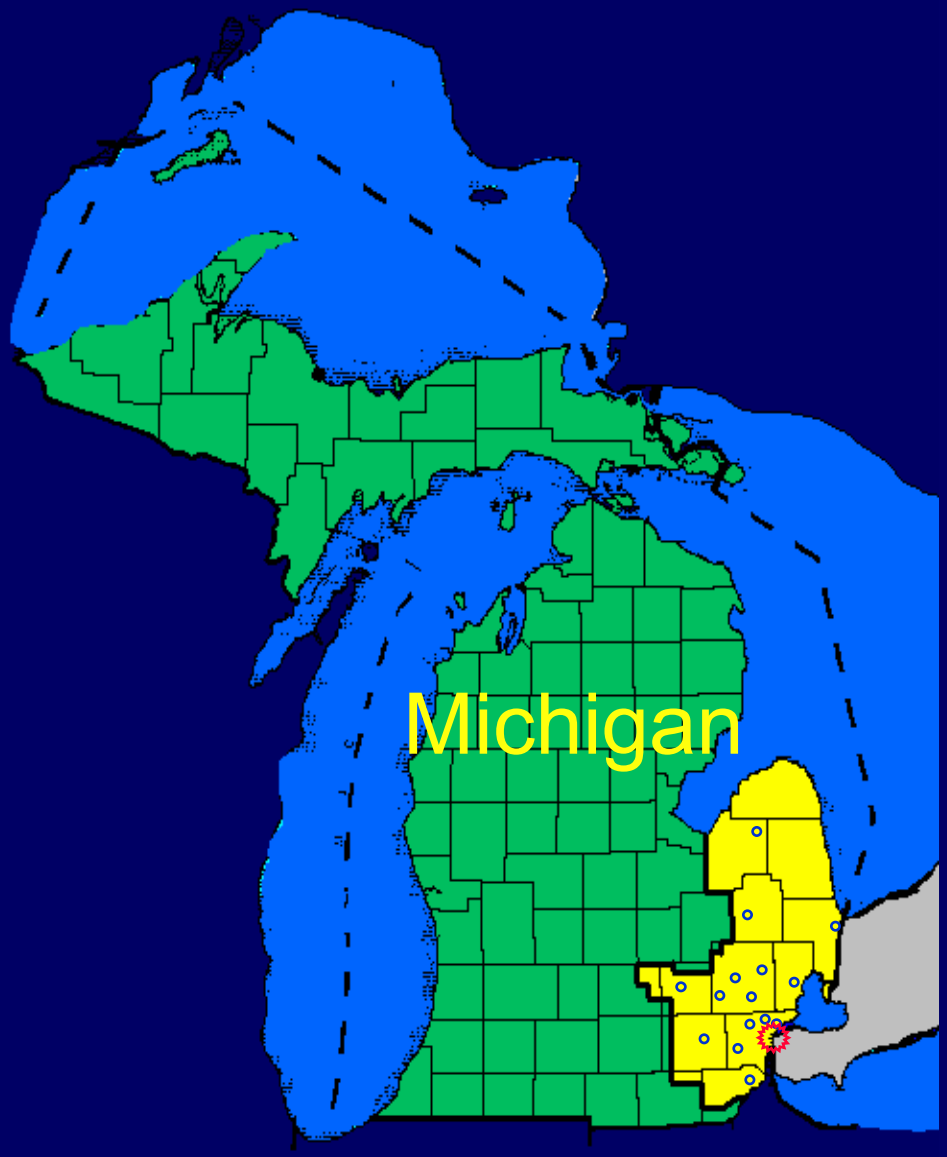
Agenda



- Present problem
- Project objective
- Project scope
- Technical challenges to current practices
- Technical approach
- 2003 progress and accomplishments
- 2004 planned activities
- Impact and benefits
- Team members

Detroit Edison Service Territory

DTE Energy



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

Distributed Generation: 1,427 MW
or 12 % of Peak Load
(Does not include < 100kW units)

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
Subtransmission	2,664 @ 24 kV
	797 @ 41.6kV

Present Problem

- **Owners of various Distributed Energy Resources (DER) do not have the means to participate in the energy “market.”**

Project Objective

- To develop and demonstrate communication and control solutions to enable large numbers of distributed energy resources (DER), from varying suppliers, to be operated and integrated together to achieve optimization in power quality, power reliability, and economic performance.
- Allow the owners of various DERs to have their resources operated in a safe manner that protects the electric utility distribution network and personnel that may be working on the network.

Project Scope – Phase 1 (FY03)

- Develop secure communication paths for remote monitoring and control of DERs.
- Demonstrate the control and monitoring of DER equipment from remote sites.
- Develop real-time model of the electric distribution system to ensure the DER output can be accepted by the electric system.
- Monitor and/or control seven DER sites in Southeastern Michigan connected in parallel to the Detroit Edison electric distribution system.

Project Scope – Phase 1 (FY03)

- Identify and document the issues with control and/or monitoring.
- Develop and document potential resolutions to the identified issues.
- Develop and document procedures for remote control from Detroit Edison.
- Verify model algorithms and operator actions.

Present State of DER on Detroit Edison System

Detroit Edison
Electric Utility

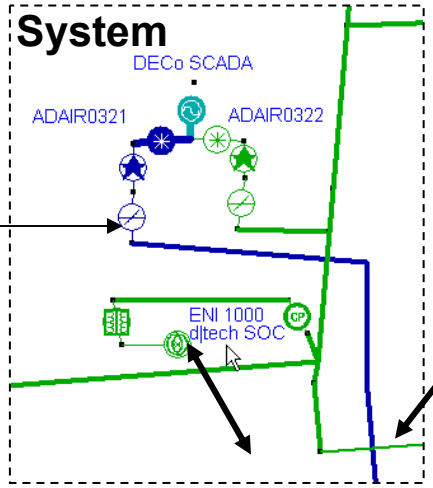
Monitoring &
System Integrity

Control

Maintenance

Safety

Electric Distribution System



DER

DTE Energy Technologies
(Energy Aggregator)

Monitors DER
Ability to Operate
Status

Sends Generation
schedule to DER site
Control

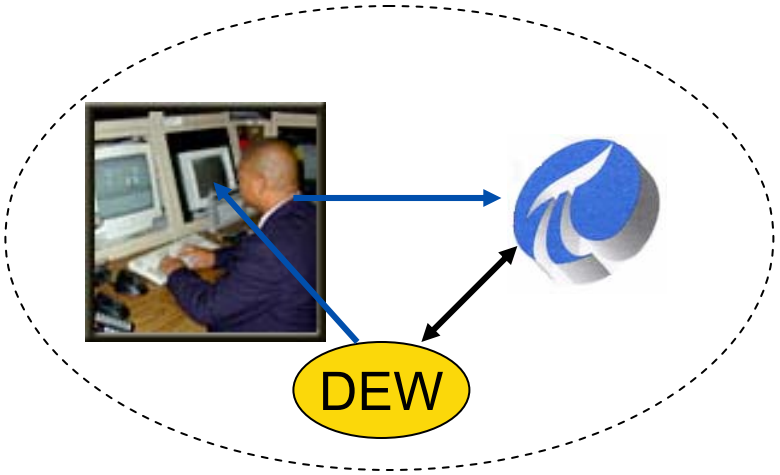
Distribution Engineering Workstation (DEW) Modeling and Analysis

- DEW is a graphical analysis tool used to model distribution electrical systems
- DEW is used to
  - Identifying locations for DR
  - Quantify impact of DR's on the distribution system
  - Model cogen, induction, inverter and synchronous generators
  - Perform planning engineering analysis
    - Load analysis
    - Voltage studies
    - Harmonic Analysis
  - Perform multiple source fault analysis
    - Fault studies
    - Protection coordination
    - Time varying analysis

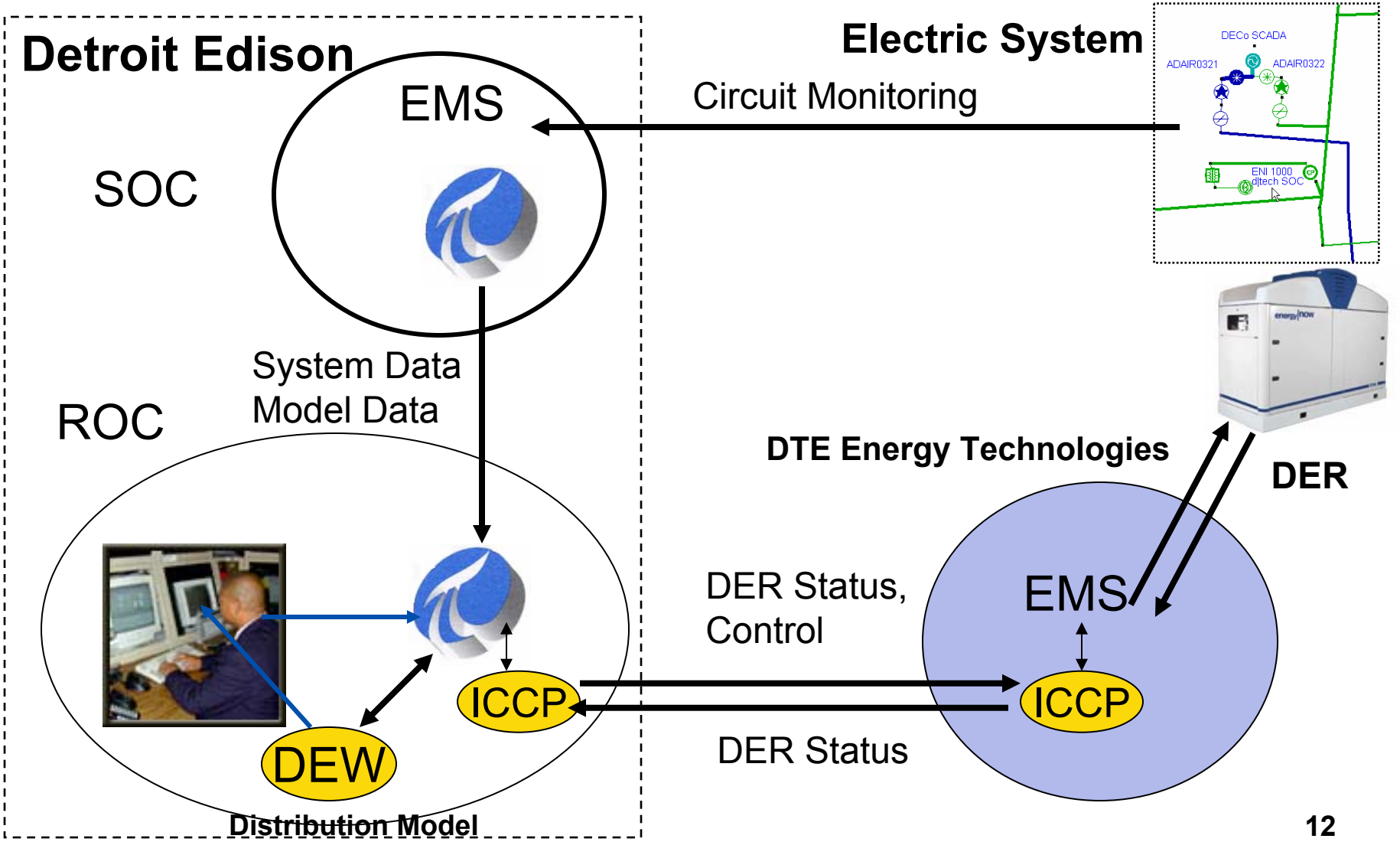
Real-Time DEW

- **DEW obtains real-time data from PI Data Historian**
- **DEW calculates possible actions and acceptable load level.**
- **Puts possible actions into PI and to Operator.**
- **Operator through Process Book takes action.**
- **Real-time monitoring of network reflects action.**

Detroit Edison
Regional Operation Center (ROC)

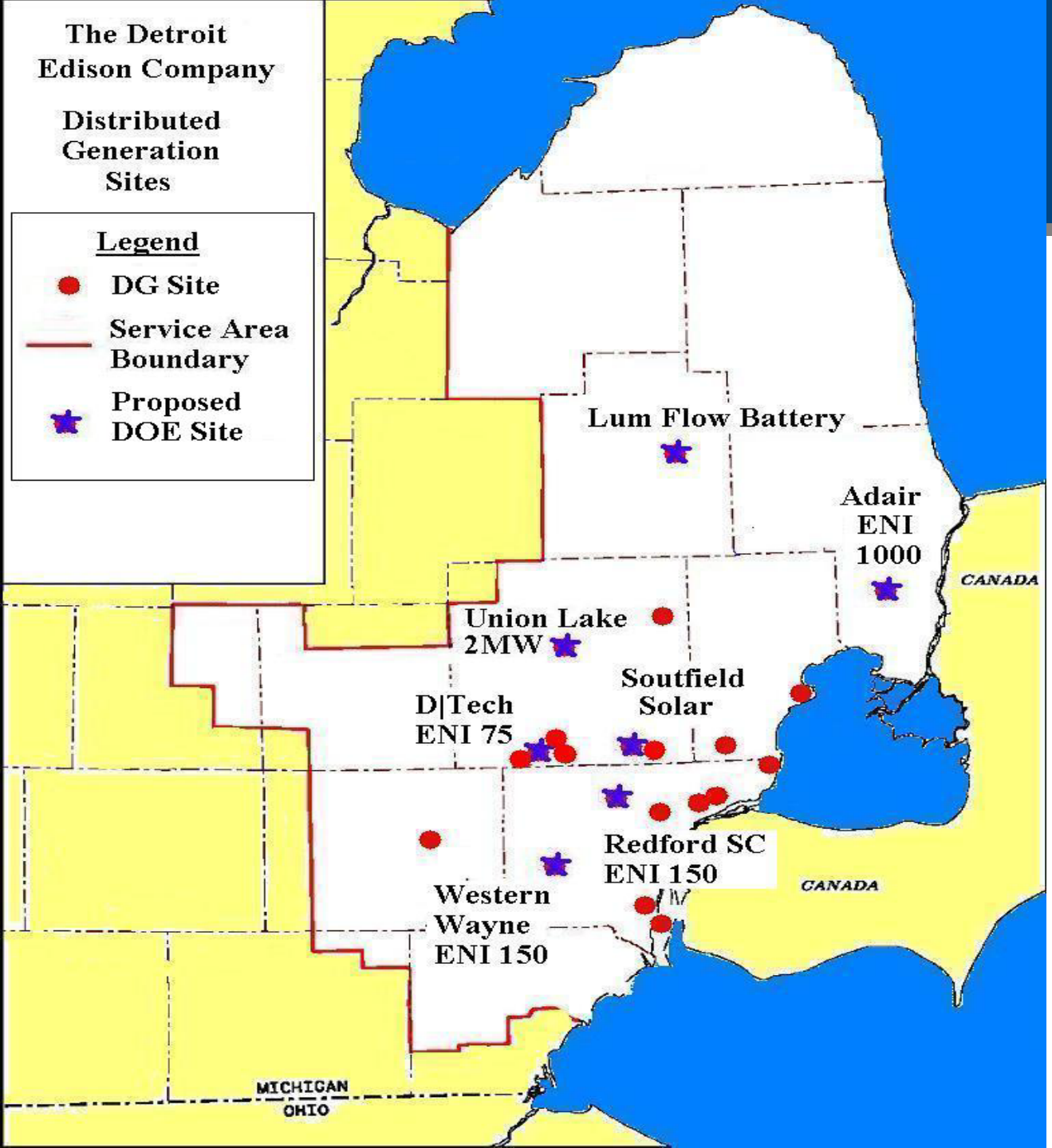


Technical Approach



Important Metrics

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



35 Units

16.6 MW of Generation

- **Diesel**
- **Natural Gas**
- **Fuel Cell**
- **Solar Cell**
- **Flow Battery**
- **Biomass**

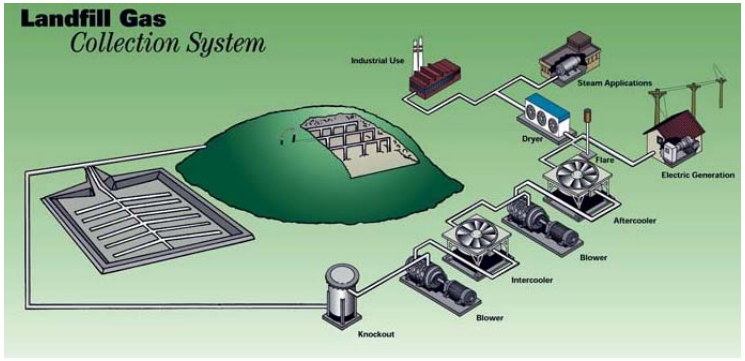
DER Units – Phase 1

DER Type	Location	Model	Size in kW	Control/Monitor
Natural Gas Recip.	Adair Substation	ENI 1000	1,000	Control
Natural Gas IC	Farmington Hills - Sunset Circuit	ENI 75	75	Control
Natural Gas IC	Redford SC - Glendale Circuit	ENI 150	150	Control
Photovoltaic	SolarCurrents Siemens Cells - Southfield Circuit	Siemens	26	Monitor
Diesel Recip.	Union Lake Substation	ENR 2000	2,000	Control
Natural Gas IC	Western Wayne SC - Zachary Circuit	ENI 150	450	Control
Energy Storage	ZBB Technology Energy Storage Flow Battery - Lum Circuit	ZBB	200	Monitor
		Total	3,901	

Varying DER Technologies at DTE

Solar

Battery Storage



Biomass

Natural Gas IC Engine

1 MW Natural Gas

2 MW Diesel

Natural Gas and Hydrogen Fuel Cell

External Combustion

Mini Turbine

2003 Progress & Accomplishments

- Complete DOE Proposal and Project Plan – June 7, 2003
  - Gate 1 – Acceptance and Signoff on Project Plan
- Concept Development Phase – May 28 to July 22, 2003
  - Installation Proposals
  - Control Proposal
  - Initial ICCP Integration
  - Technical Design Review
  - Gate 2 - Accept Installation and Control Proposals

2003 Progress & Accomplishments

- Development Phase – July 22 to August 25, 2003
  - Install and Test ICCP Link
  - Install and Test PI Data Historian
  - Implement Control Schemes
  - Develop and Document Operating Procedures
  - Test Systems and Procedures at Western Wayne and Farmington Hills Sites
  - Corrective Action
  - Gate 3 – Acceptance of Pilot Results
- Roll-Out Phase – August 25 to October 20, 2003
  - Complete Installation Work at Remaining Sites
  - Test Systems and Procedures at All Included Sites
  - Gate 4 – Acceptance of Results

2003 Progress & Accomplishments

- Operate, Test, Analyze and Document – October 20 to December 16, 2003
  - Identify and Document Issues
  - Prepare DOE Materials
  - Gate 5 – Approve Material to be Sent/Presented to DOE
  - Send/Present Material to DOE
- Project Budget $255,197

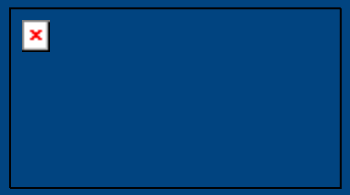
Proposed Project Scope – Phase 2 (FY04)

- Make required modifications to phase 1 system.
- Increase the number of DERs to be operated.
- Implement control & monitoring of a customer owned DER.
- Perform modeling and power aggregation for future power trading.
- Establish the marketing process for the DERs to participate in the energy market.
- Implement OASIS/SMXP to allow ISOs to schedule/buy the DER generated power.

Impact and Benefits

- This project establishes the process that will allow customer DERs to participate in the energy market and operate in parallel with the electric utility distribution system.

Project Team Organization



Detroit Edison

Haukur Asgeirsson, Project Manager
Richard Seguin - DER, DEW, circuits, planning & operations
- Overall functional and acceptance testing
- Documentation lead

Curtis Yanoski - DECo SOCs, SCADA/DAS, ICCP, PI
- Acceptance testing of data interfaces

David Costyk - Technical advisor
- Relay & protection coordination
- Red tagging & safety

John O'Donnell - DTECH SOC, ICCP integration
- DER Field integration

EDD
Dr. Robert Broadwater
- DEW programming
- Real time data inputs
- Aggregation Algorithm

SISCO
Herb Falk
- ICCP Integration
- Economic scheduling
- Real-time integration
- OSIsoft PI data historian

DTECH
Murray Davis
Chief Technical Advisor
- DTECH SOC
- ICCP integration
- DER Field integration

Questions?

EDD