Detroit Edison's Advanced Implementation of A123's Community Energy Storage Systems for Grid Support (DE-OE0000229)

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DTE Energy

Community Energy Storage

- The project is a proof of concept of an aggregated Community Energy Storage (CES) system in a utility territory; demonstrating the following capabilities:
  - Voltage/VAR Support
  - Integration renewable generation
  - Islanding during outages
  - Frequency Regulation
- Demonstrate the application of secondary-use EV batteries as CES devices. Identifying alternative applications for EV type batteries may accelerate the reduction of cost for electric vehicle batteries.
- Identify gaps, areas of improvement, and provide suggestions on how CES devices and control algorithms can be standardized across the U.S.
- Provide a functional and economic analysis for using the CES system in electric utility applications.

Project Team and Role

Team Members and Roles	
DTE Energy	•Project lead & Project Management •Hosting sites
A123 SYSTEMS	•CES Supplier •Technical Support
edd	•Distribution modeling •Develop dispatching algorithm
KEMA	•Verification of performance •Economic analysis support
CHRYSLER	•Supplier of used PEV batteries •Data sharing
NEXTENERGY	•Economic benefit assessment •Additional applications for storage
nationalgrid The power of action.	•Participate in CES development •Interoperability in another utility area

Project Phases

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Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Project Definition and NEPA Compliance	**Final Design and Construction**	**Commissioning and Operations**	**Utilization of Secondary Use Batteries**	**Write Up of Demonstration Assessment**
• Update Project Management Plan • NEPA Compliance • Baseline for Evaluating Project Performance • Preliminary Design & Planning	• Finalize Design of CES System • CES System Design for Project • Planning, Measuring, Architecture and Algorithms • Creation of Dispatch Algorithms •Communications and Control •Procurement of CES Systems for Installation	• Commissioning of Operational Functionalities • Field Testing of Designed CES Capabilities • Data Monitoring and Collection of Performance Data • Reporting of Data and Operation	• Integration of Secondary Use Batteries	• Write final report
01/2010-05/2011	**01/2011-06/2011**	**07/2011-06/2013**	**07/2013-06/2014**	**07/2014-12/2014**

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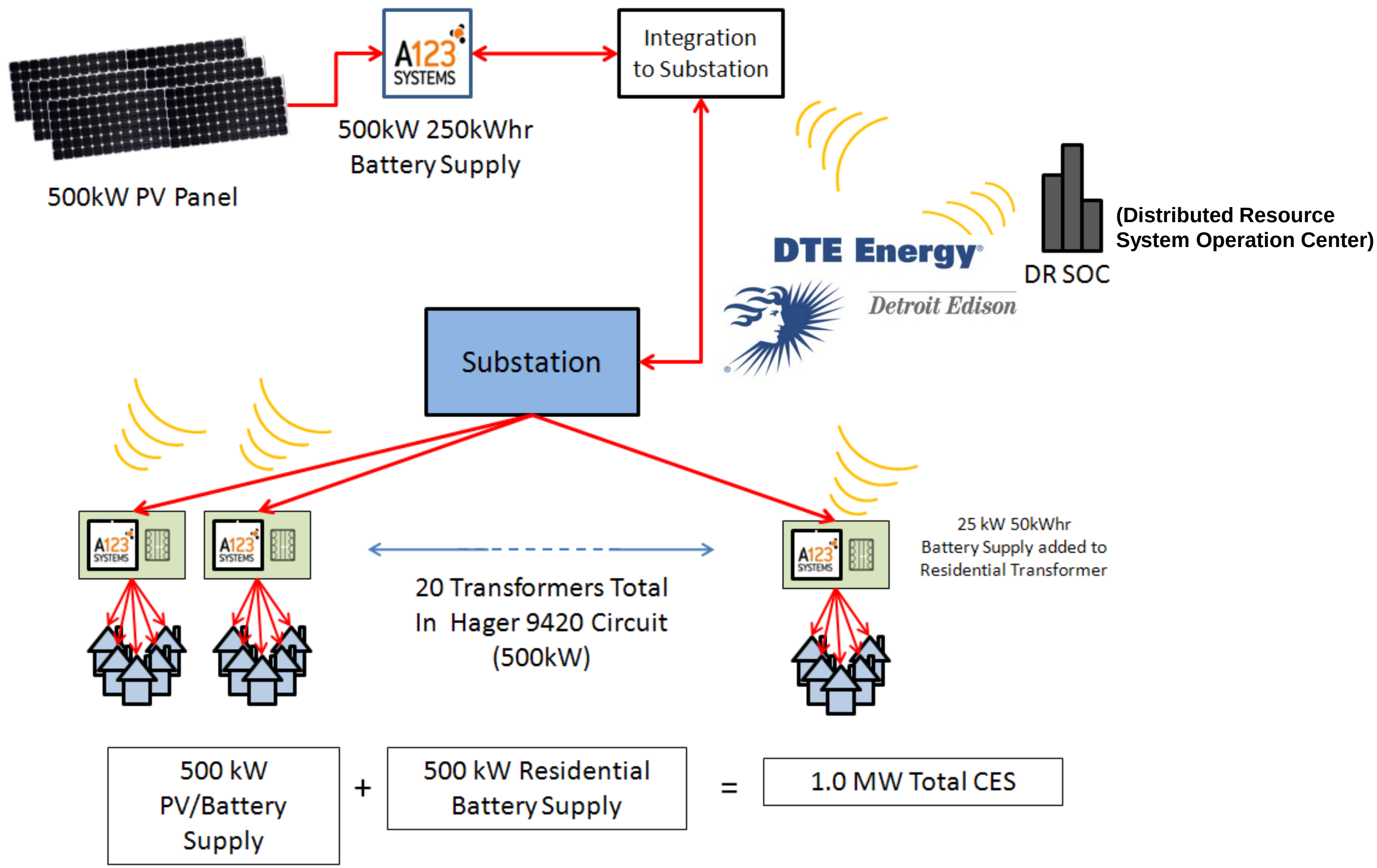
CES System Overview



CES Modes of Operation

Smart Grid Infrastructure Enabling Multi-mode Operation

Demonstration Items:

1. **Frequency Regulation:** (DR-SOC dispatch, Retransmit AGC from MISO)

2.a **VAR Support** : (Local control, PF management)

2.b **Voltage support:** (Local control, Meet utility v-schedule)

3.a **PV output shifting:** (Local control, Time of day)

3.b **PV output leveling:** (Local control ,Ramp management)

4. **Demand response**

- 4.a Grid support: (DR-SOC dispatch, ‘N-1’)
- 4.b Distribution circuit peak shaving: (DR-SOC dispatch or schedule)
- 4.c Customer peak shaving: (Local control, demand charge mgmt)

5. **Islanding:** Control scheme development for intentional islanding

Communication & Control Architecture

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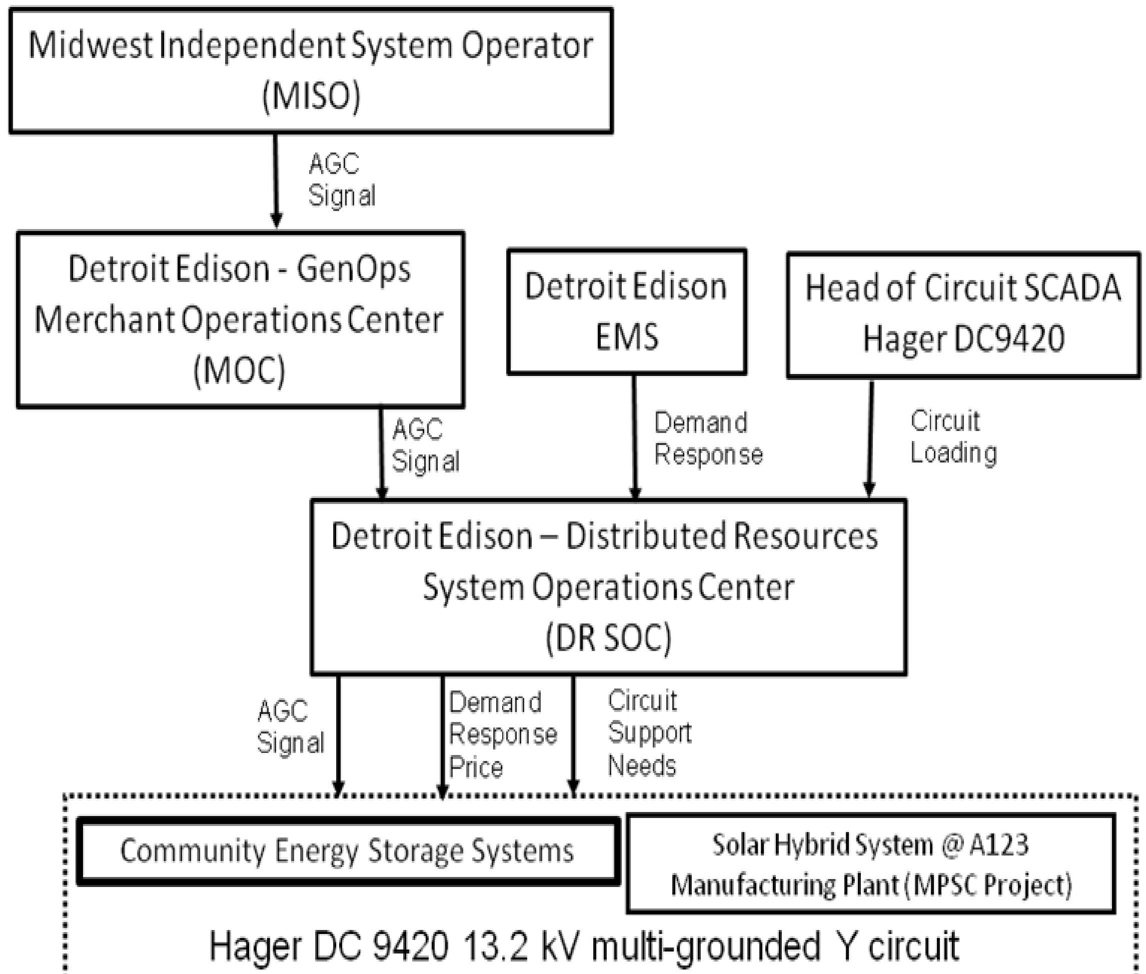
<u>Communication and Controls</u>

- DTE Energy DR-SOC
- A123 Systems BMS
- S&C Inverter

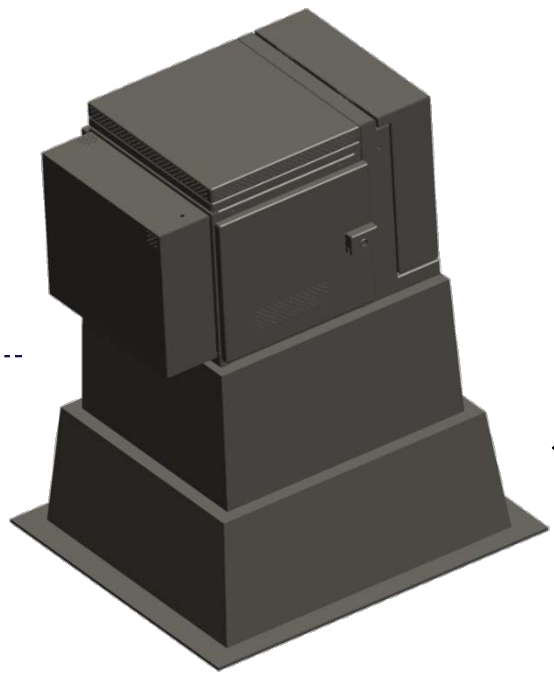


Community Energy Storage Concept

- Leverage the independent work done by S&C
- Split packaging solution
  - Bi-directional inverter with communications and control to Utility (DTE DR SOC)
  - Battery system with communications and control to inverter system
- Above ground inverter / Below ground battery system

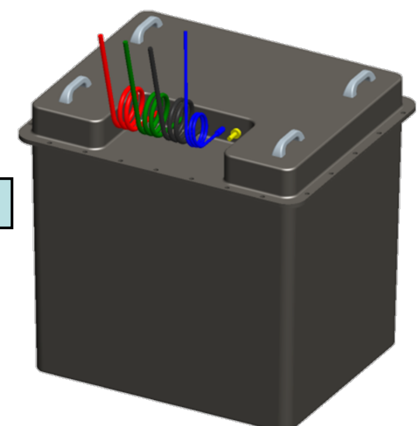
Inverter System
(Above grade)

Fiberglass Box Pad
(Below grade)



A123 SYSTEMS

Battery System

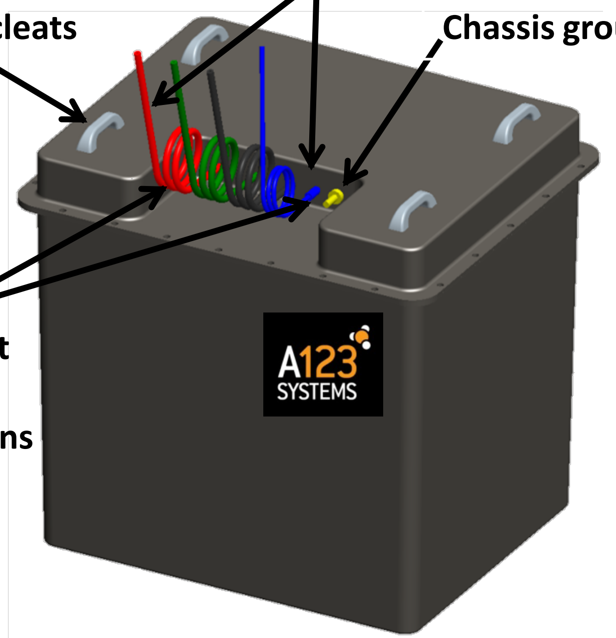


Preliminary CES Features

- 25 kW, 2-hour run-time, single-phase, pad-mounted
- Battery life targeted for at least 1000 full-power discharges
- Aggregated at DTE’s DR SOC
- Peak shaving programmable or dispatched
- Contactor to separate customers from utility source in the event of a disturbance
  - Improves SAIDI
  - Seamless return to normal utility source
- Local voltage regulation by controlling inverter VARs
  - Flatten feeder voltage to reduce losses
- No maintenance – “set it and forget it”
  - No fans, no air filters
- Below-ground battery vault
  - Smaller exposed system footprint for easier siting
  - Cool & near constant temperature for passive cooling

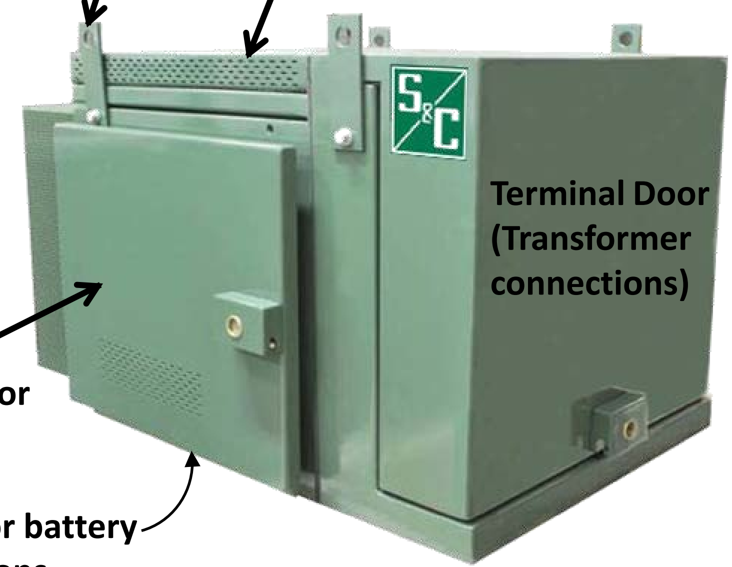
CES External Features

Battery System



Sealed resin transfer molded cover and base container
Approx Dims: 30 in x 33 in x 35 in tall

Inverter System



Utility Grade NEMA 4 Enclosure
Approx Dims: 33 in x 39 in x 30 in tall

Preliminary Battery System Specifications

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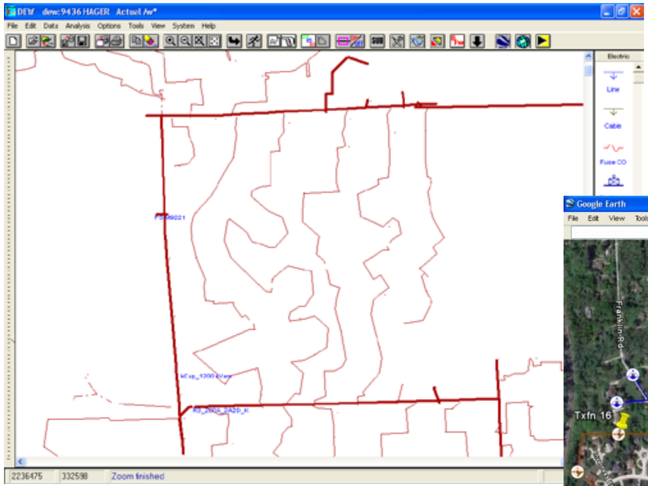
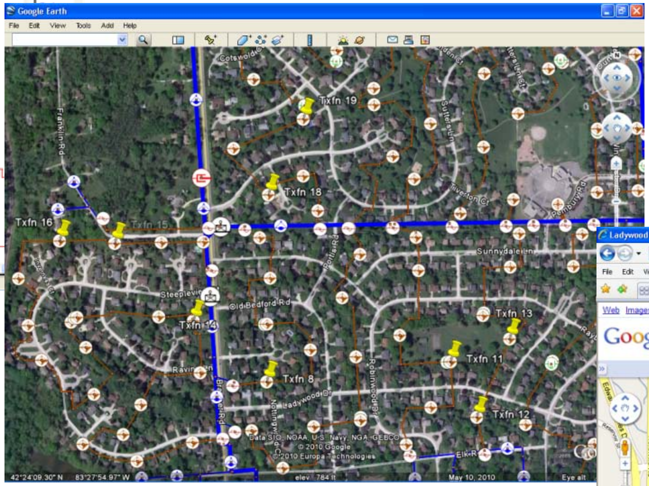
	475 Vdc 50 kWh CES Battery Pack			
	Charge		***Discharge***	
Duration	cont	10 sec	cont	10 sec
Test Pack Power (kW)	13.2	26.3	26.3	79.0
Pack Vmax	542	544	540	540
Pack Vnom	482	484	476	468
Pack Vmin	405	405	401	393
Pack Capacity (AH)	117.6			
Pack Energy (kWHr)	54.6	54.2	54.2	53.4
Total Cell Weight (lbs)	950			
Est Pack Weight (lbs)	1,250			
Pack Dimensions (in)	30 x 33 x 35			
Pack Volume (ft^3)	20.1			

Modeling and Power Flow Analysis

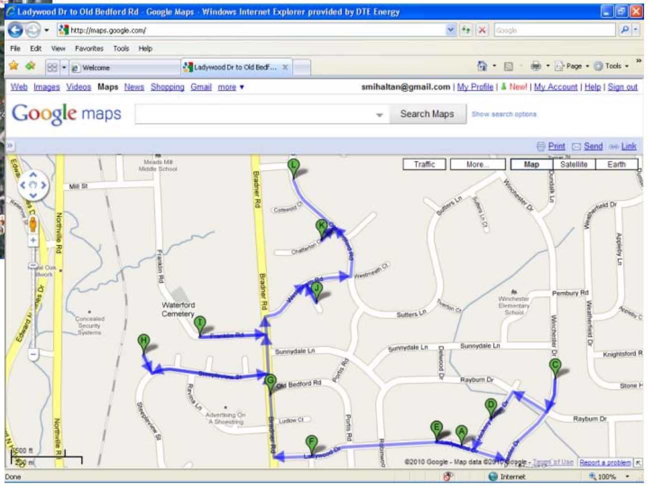
HAGER DC 9420



DEW Circuit Model



Google Earth overlay



Google maps transformer locations

Finding Optimal Transformer Locations

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Criteria for List of 50 Transformers:

- Rated at 25 or 50 kVA
- 5-10 Customers
- Max Annual kVA between 25 and 50
- Heavily loaded
- Frequent outages
- Circuit phase imbalance
- Accessibility

Field Evaluation:

Summary/Conclusions

- A123 and S&C have been collaborating on the development of an integrated CES system
- Initial communication and control architecture has been outlined using Detroit Edison’s DR-SOC
- Detroit Edison has evaluated several distribution transformers and has identified potential locations for CES units

Future Tasks

- Finalize contract process with DOE and sub-award team members
- Identify key project and CES product requirements
- Finalize CES installation sites and begin gathering transformer baseline data
- Create use cases for each capability demonstration