



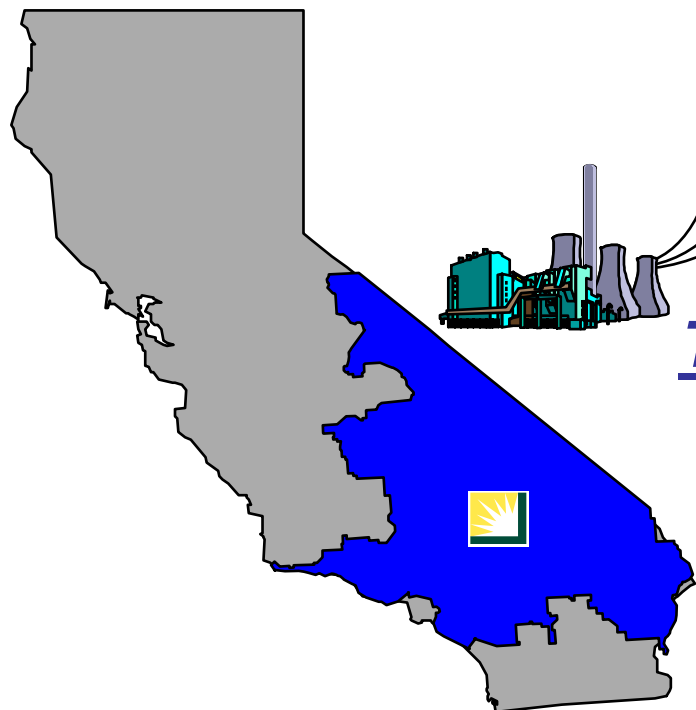
Southern California Edison's Circuit of the Future

Charlie Vartanian
SCE Distributed Energy Resources (DER)

3rd Microgrid Symposium
April 6, 2007

SCE Profile

- 50,000 Mile² Service Territory
- 120 years of service
- \$17 Billion T&D Assets
- \$9 Billion Planned T&D Investment '05-'09



Distribution

- 85,000 Circuit Miles
- 690,000 Transformers

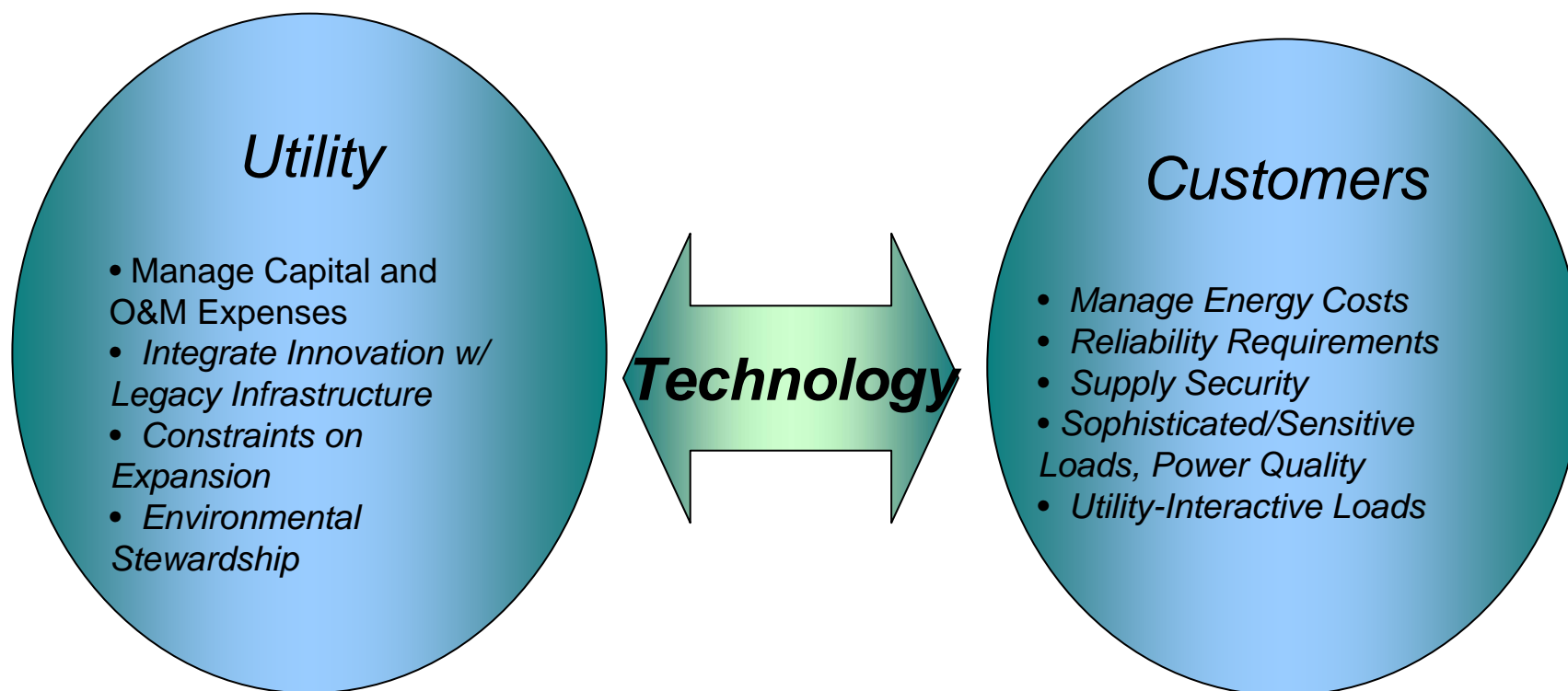
Customers

- 4.7 Million Meters
- 13 Million Customers
- 22,889 MW Load

Transmission

- 12,600 Circuit Miles
- 4,200 Transformers

Research Drivers for SCE



DER Oriented Research at SCE

- Microturbine Testing, Complete →
- Advanced Communication & Control, Catalina MTG Complete
- Solid Oxide Fuel Cells
- Improved DC-AC Inverters & Controls
- DER for Grid Support and Optimization



Test Facility at UC Irvine

- » *SCE has tested microturbines since they first emerged in 1997, 14 MTG's, 80,000 hours*
- » *SCE tests for performance against manufacturer's spec*
- » *Evaluate installation and operation experience*

Microturbine Testing at SCE

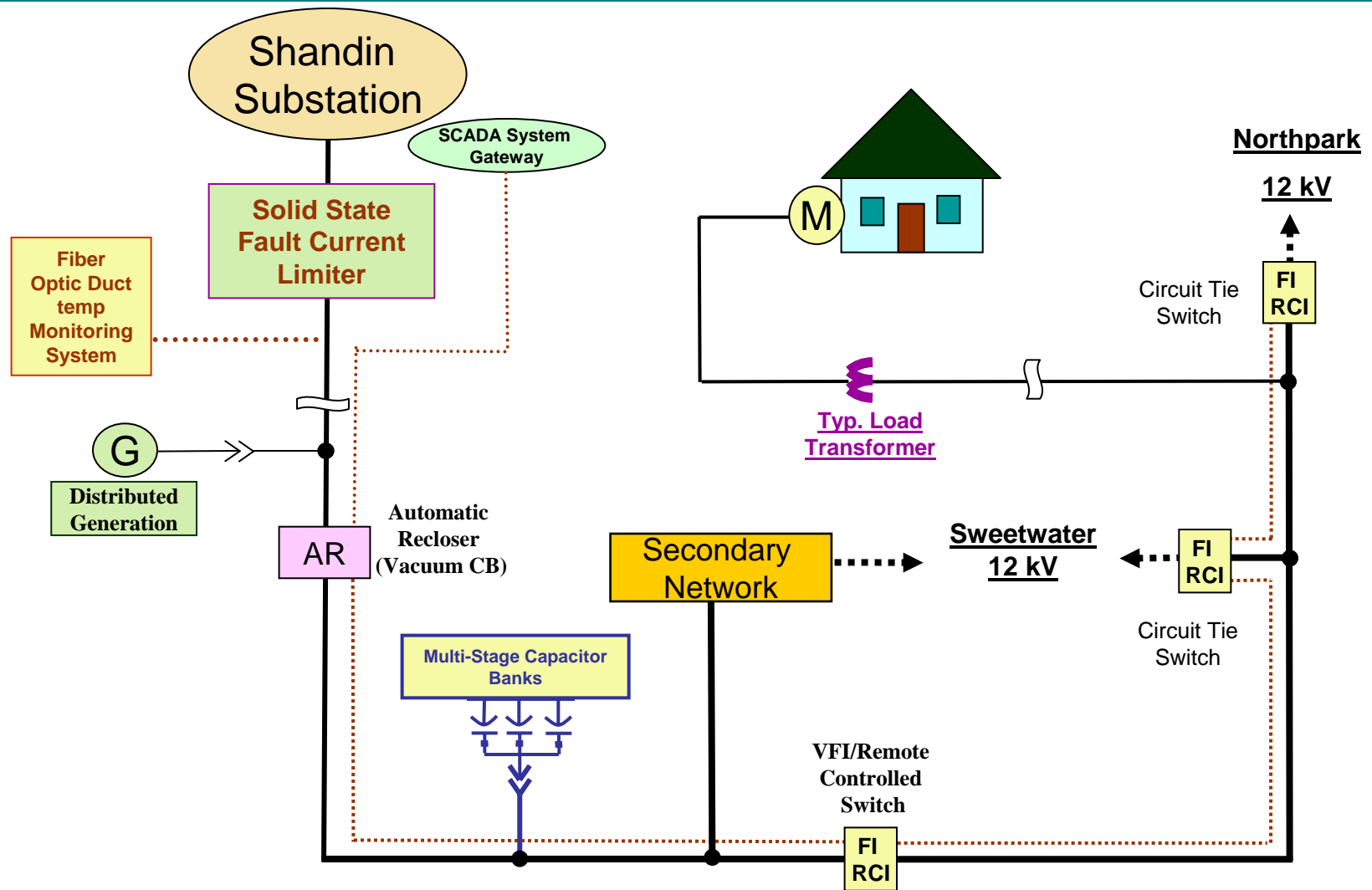
<i>MTG</i>	<i>Installation Date</i>	<i>Total-Op. Hours</i>	<i>Status</i>
Capstone "B" 30 kW	Jan-97	958	Completed
Capstone "B" 30 kW	Jan-97	967	Completed
Capstone 10 Pack	Apr-97	26	Completed
Capstone "C" 30 kW	May-97	3,794	Completed
Capstone "C" 30 kW	Jul-97	2,079	Completed
Bowman 35 kW	Feb-99	100	Completed
Bowman 60 kW	Jun-99	60	Completed
Honeywell Parallon 75 kW	Jun-00	5,806	Completed
Capstone HP 30 kW	Apr-99	21,984	Completed
Capstone LP 30 kW	Aug-00	16,085	Completed
Bowman 80 kW	Jun-01	15,962	Completed
Elliott 80 kW	Jan-02	2,932	Replaced
Ingersoll-Rand 70 kW	Nov-02	6,014	Completed
Elliott 100 kW	Jun-04	5,871	Completed
Total		82,648	



SCE's Circuit of the Future (CoF),
near term 'physical' deployment, active 'virtual' research

- Deploy commercially available advanced distribution devices, July 2007
 - IED-ready relays for breakers and switches
 - Vacuum Fault Interrupters
 - Fiber optic communication backbone
 - Thermal duct temperature monitoring
- Deploy pre/early-commercial advanced devices and systems, late 2007 and beyond
 - Fault Current Limiter
 - D-FACTS, SVC versus STATCON selection active
- Active research through simulation of a 'virtual' CoF. DoE and CEC funded research on advanced devices and system operating concepts.

The Circuit of the Future, Avanti 12 kV

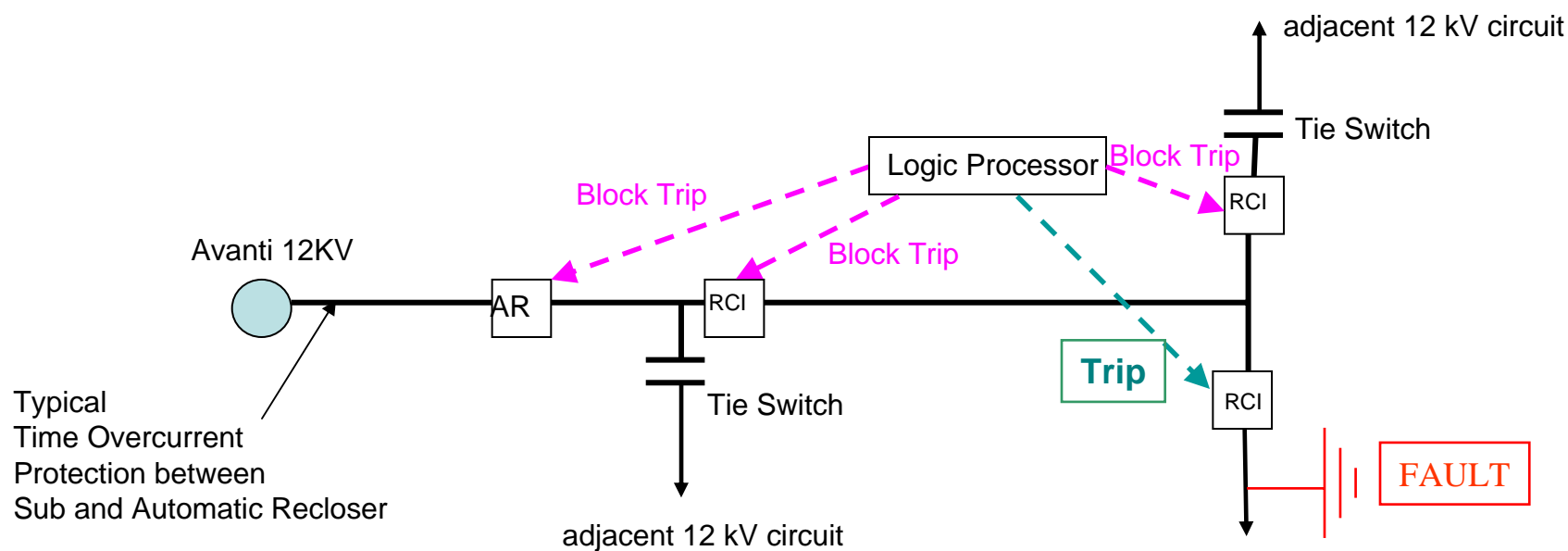


SCE's DoE Research for the Circuit of the Future

Advanced protection methods on the Circuit of the Future

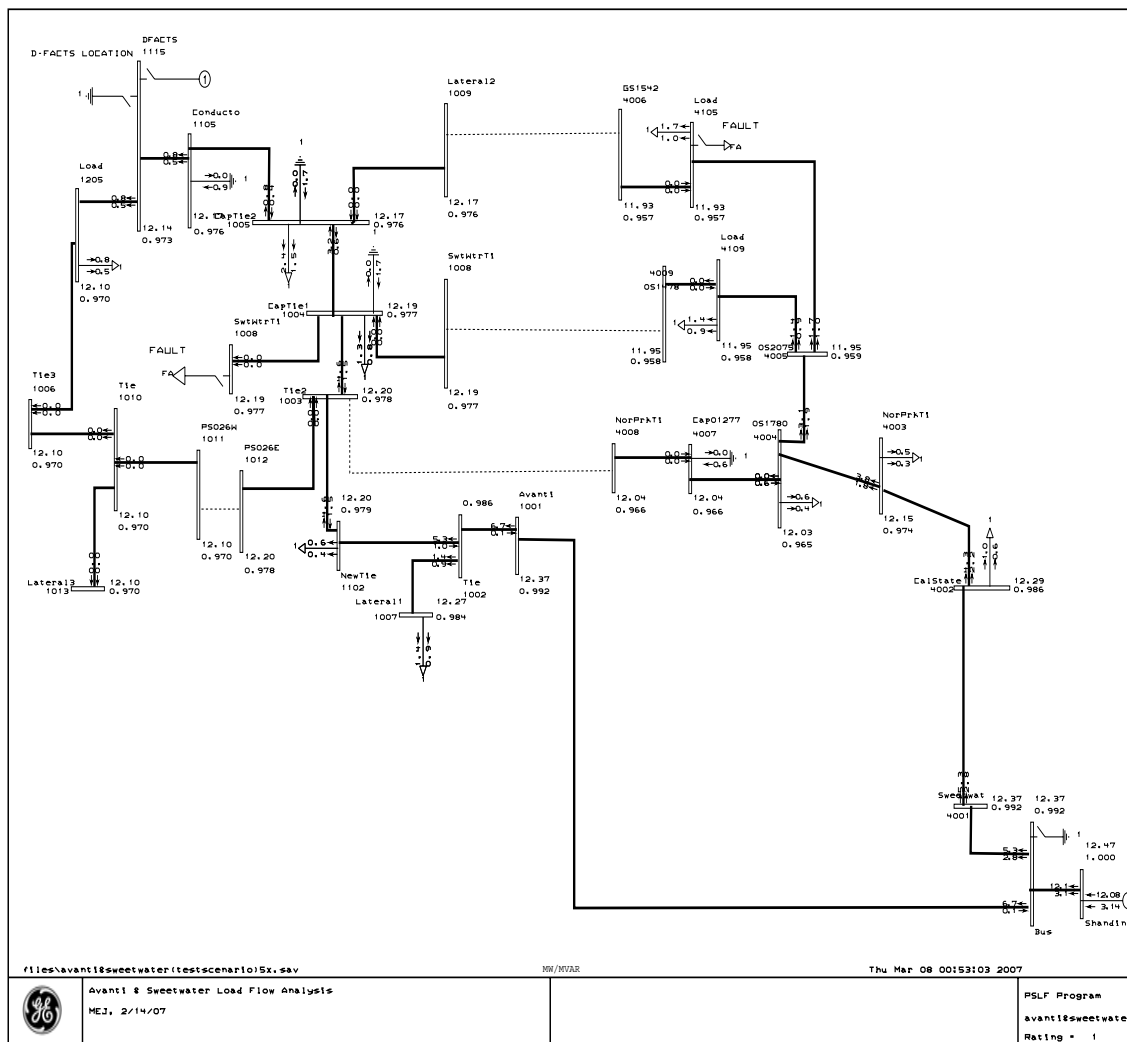
SCE (project lead), KEMA, Virginia Tech

- Three tasks over 3 years:
 - Evaluation of new protection scheme
 - Design and evaluation of protection scheme with fault current limiter
 - Develop and test advanced fault sensing and prediction methods





"Virtual" Circuit of the Future



	D-SVC MVAR	D-STAT MVAR
No Voltage regulation	0	0
-2.5% Bus V	-2.3	n/a
+2.5% Bus V	+2.2	n/a
+5.0% Bus V	+4.3	n/a
+7.5% Bus V	+6.4	n/a
+10.0% Bus V	+8.4	n/a
-2.5% Bus V	n/a	-2.0
+2.5% Bus V	n/a	+2.0
+5.0% Bus V	n/a	+4.0
+7.5% Bus V	n/a	+6.3
+10.0% Bus V	n/a	+8.5



Other DoE Research: SCE DER Co-Participant

Integrated Control of Next Generation Power Systems

- West Virginia University (project lead), SCE and NETL (Carnegie-Mellon)
 - System models to evaluate advanced control protocols using ‘smart agents’. Perform simulation and analysis **using CoF based models**, w/ PSLF, PS-CAD, MATLAB
 - Reconfiguration for load restoration
 - Reactive device control
 - Potential follow-on project phases will deploy and test a ‘smart agent’ based control protocol

Advanced Communication and Control

- Connected Energy (project lead) and SCE
 - Deploy and evaluate microturbine dispatch and control systems, Catalina Island, L.A. Sanitation District
 - *May be potential opportunity to leverage project metering/infrastructure for future research on microgrid stability*



Other DoE Research: SCE DER Co-Participant, continued

High Efficiency Inverter for Solid Oxide Fuel Cells

- Virginia Tech (project lead) and SCE
 - SCE providing utility technical requirements to support development of an advanced high efficiency DC/AC inverter
 - Potential to deploy device on the CoF or other SCE location as future phase of research

DC-AC Inverter with Reactive Power Management Functionality

- Mesta Electronics (project lead) and SCE
 - SCE providing utility technical requirements to support mod./design of distribution level inverter to support system efficiency, power quality, and disturbance “ride-thru”.
 - Potential to deploy device on the CoF or other SCE location as future phase of research



Questions?

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