

GIS Data Preparation for ADMS and Smart Grid Implementation

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Esri User Conference
17 July 2014



Agenda

1. About Schneider Electric and Burbank Water and Power
2. Determining your Advanced Distribution Management System and Smart Grid Drivers
3. Source Data Preparation

Where are you going?

How do you get there?

How do you survive the trip?



the global specialist
in energy management

A global company

\$34 billion revenue in 2013

43% of sales in new economies

160,000+ people in 100+ countries

committed to innovation

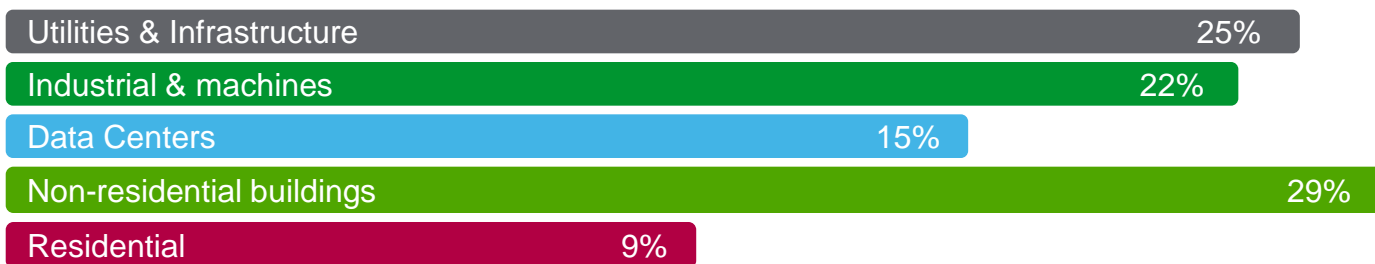
4-5% of sales devoted to R&D

~\$1.5 billion devoted to R&D

Some of the world class brands that we have built or acquired in our 175 year history

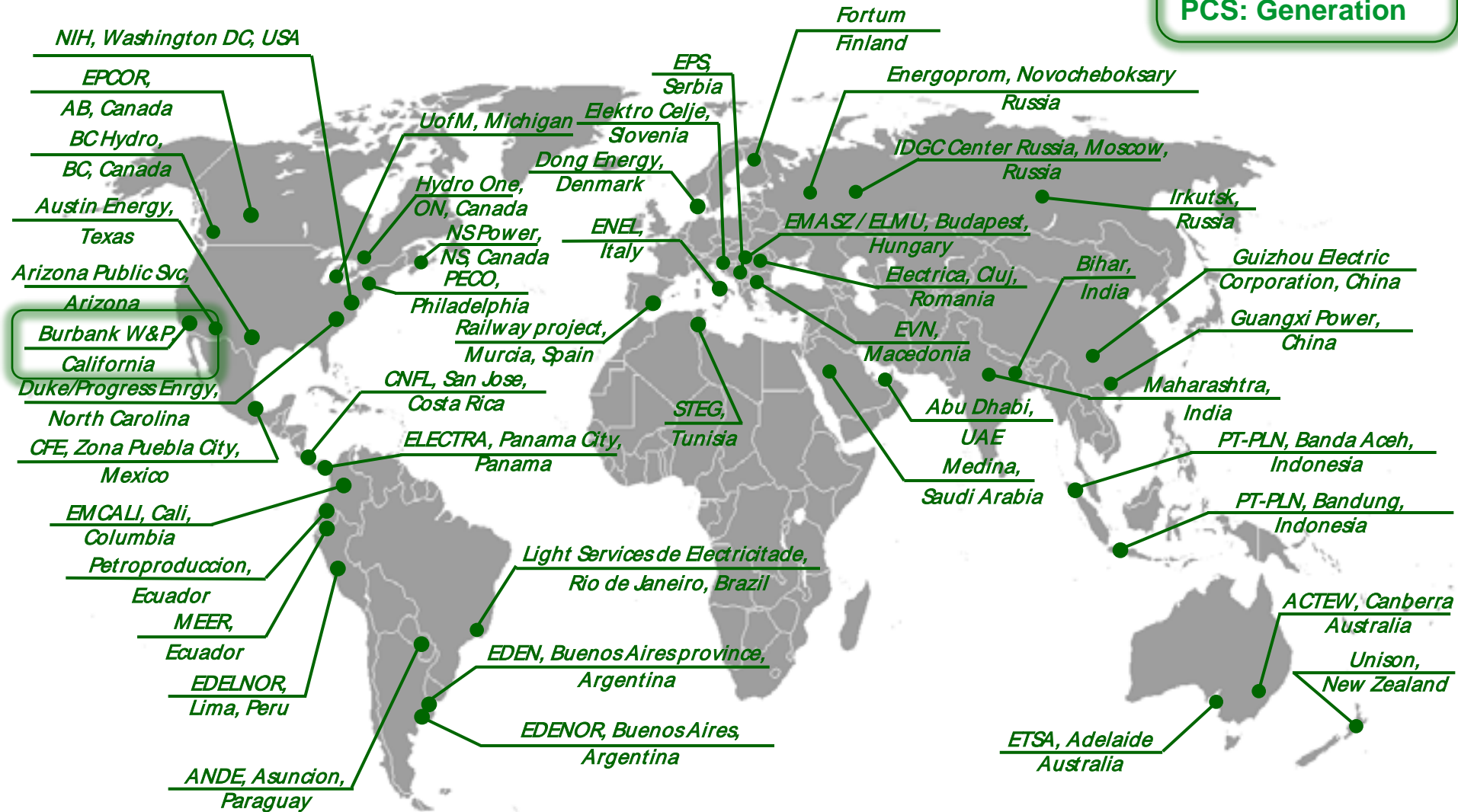


Delivering Solutions for End Users



ADMS/PCS Projects Worldwide

ADMS: Distribution
 EMS: Transmission
 PCS: Generation



Over 180 control centers and 88M meters

Only ADMS to be awarded Gartner's highest rating in 2012, 2013, 2014

Burbank Water and Power

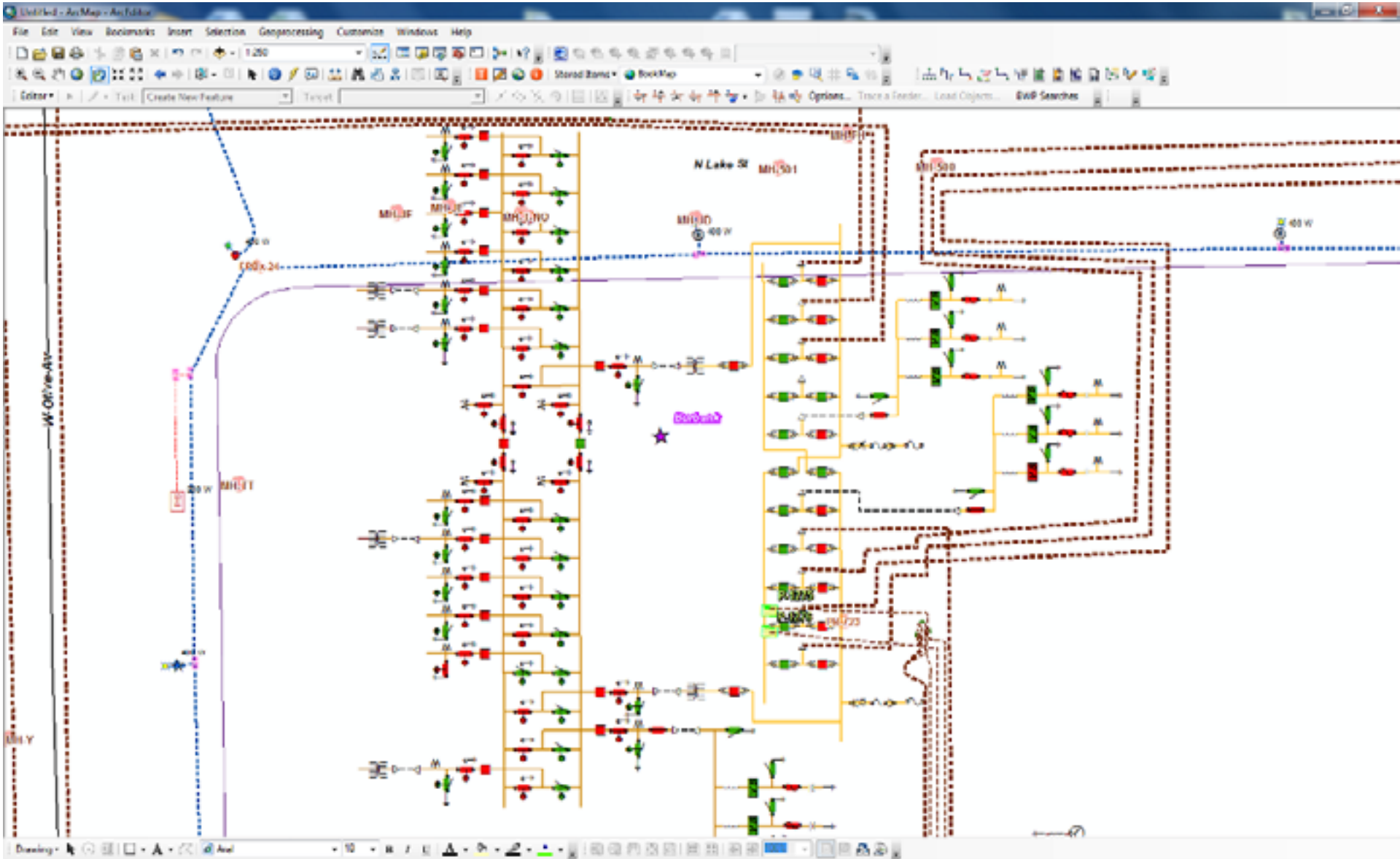
- Services 45,000 households and 7,000 businesses in Burbank, California with water, electricity, and communications
- 20 Substations, 120 feeders, 320MW peak load



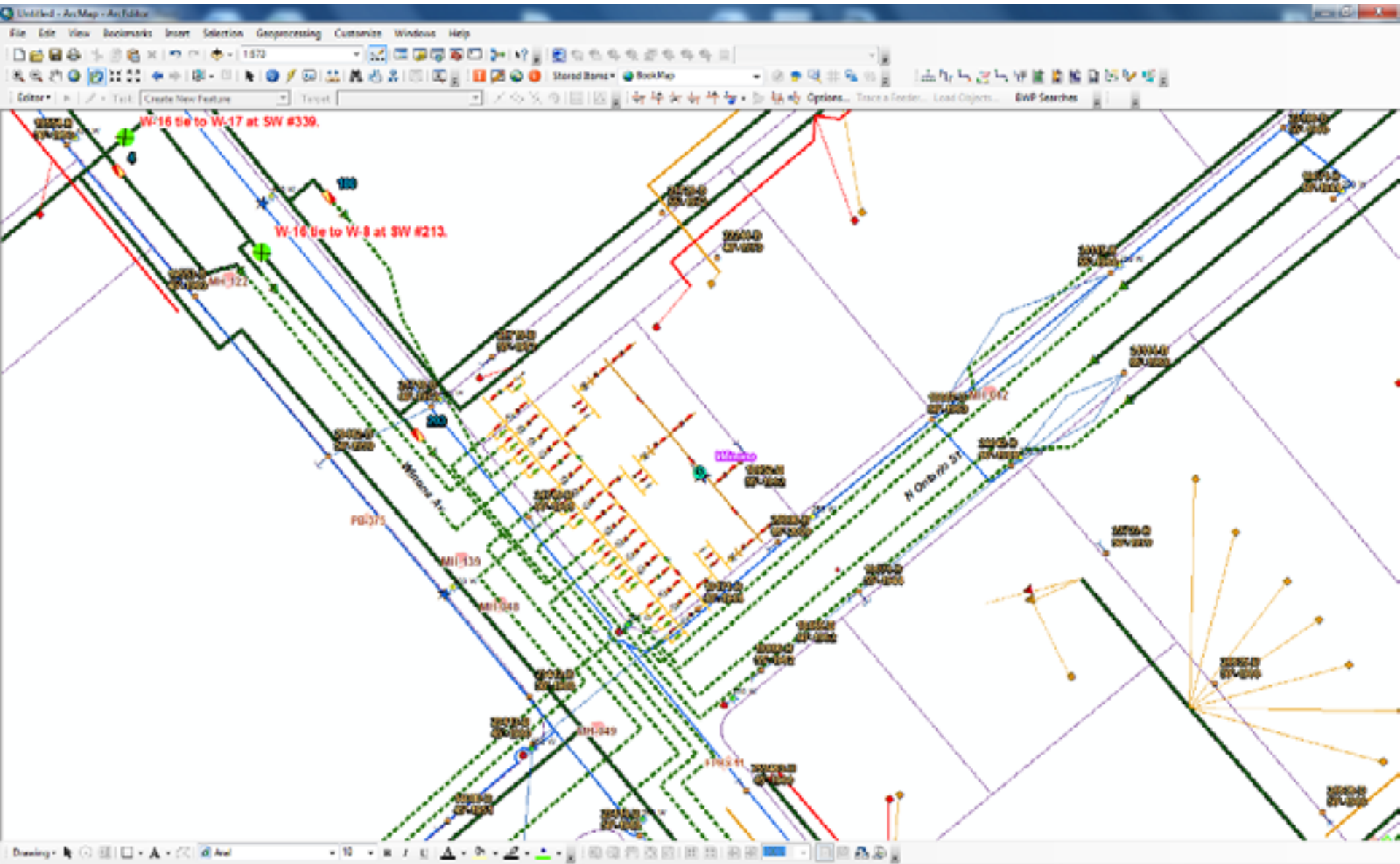
Burbank Water and Power

- Miner & Miner customer #10 of ~600
- Started in production with ArcFM v8.0 in 1999
- Long-time user of Esri and Schneider Electric products, now running version 10.0.2
 - ArcGIS
 - ArcGIS Server
 - ArcFM
 - Responder OMS
 - Conduit Manager/UFM
 - Fiber Manager
 - OASyS SCADA
 - SAGE RTU's
- Working to implement:
 - Schneider Electric's Power Control System (PCS) with integration to OASyS SCADA, DTN WeatherSentry, and OATI WebDistribute (completed)
 - Demand Response and Load Management (ongoing)
 - Schneider Electric's Advanced Distribution Management System (proposed)

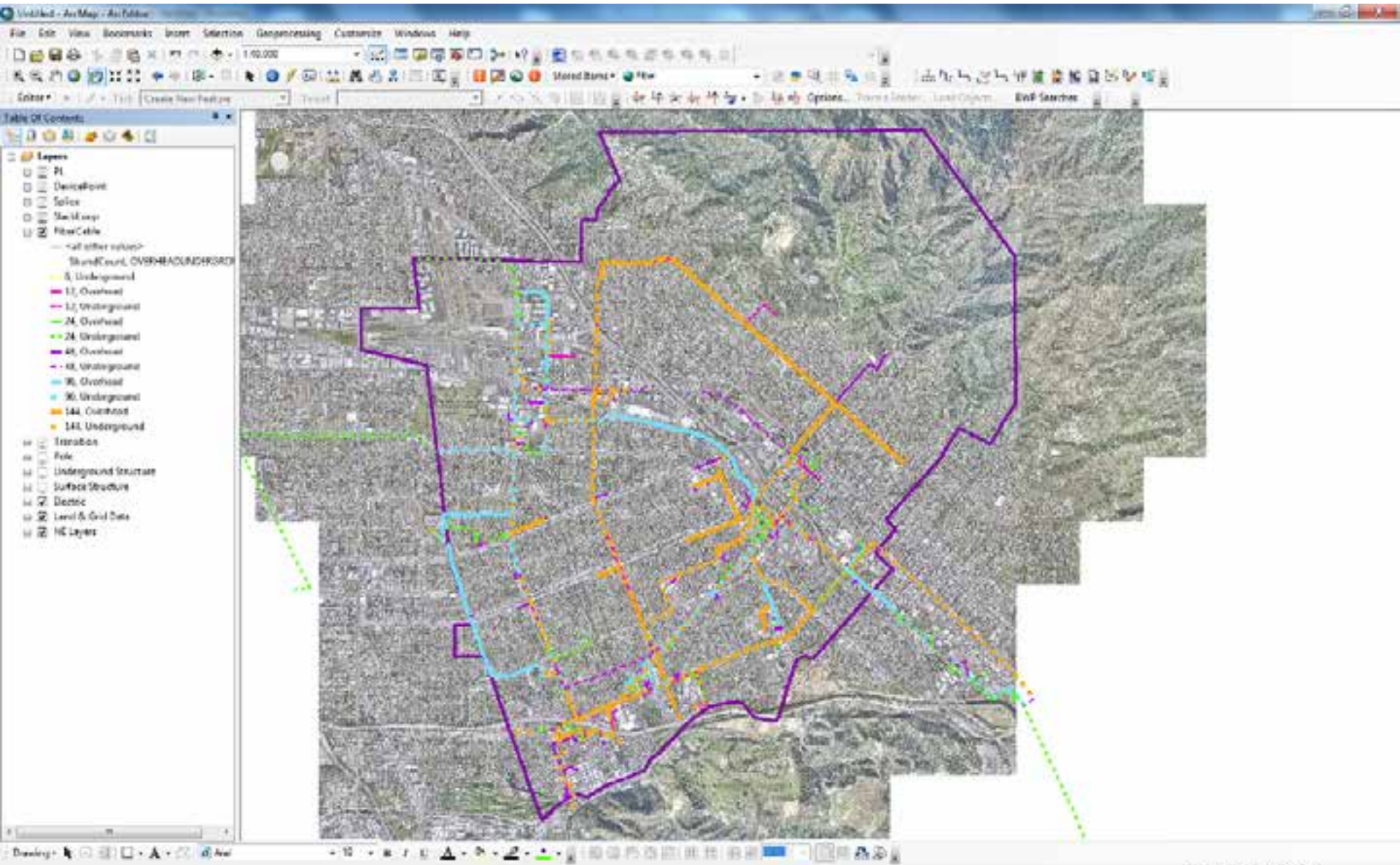
ArcFM with Substation Internals



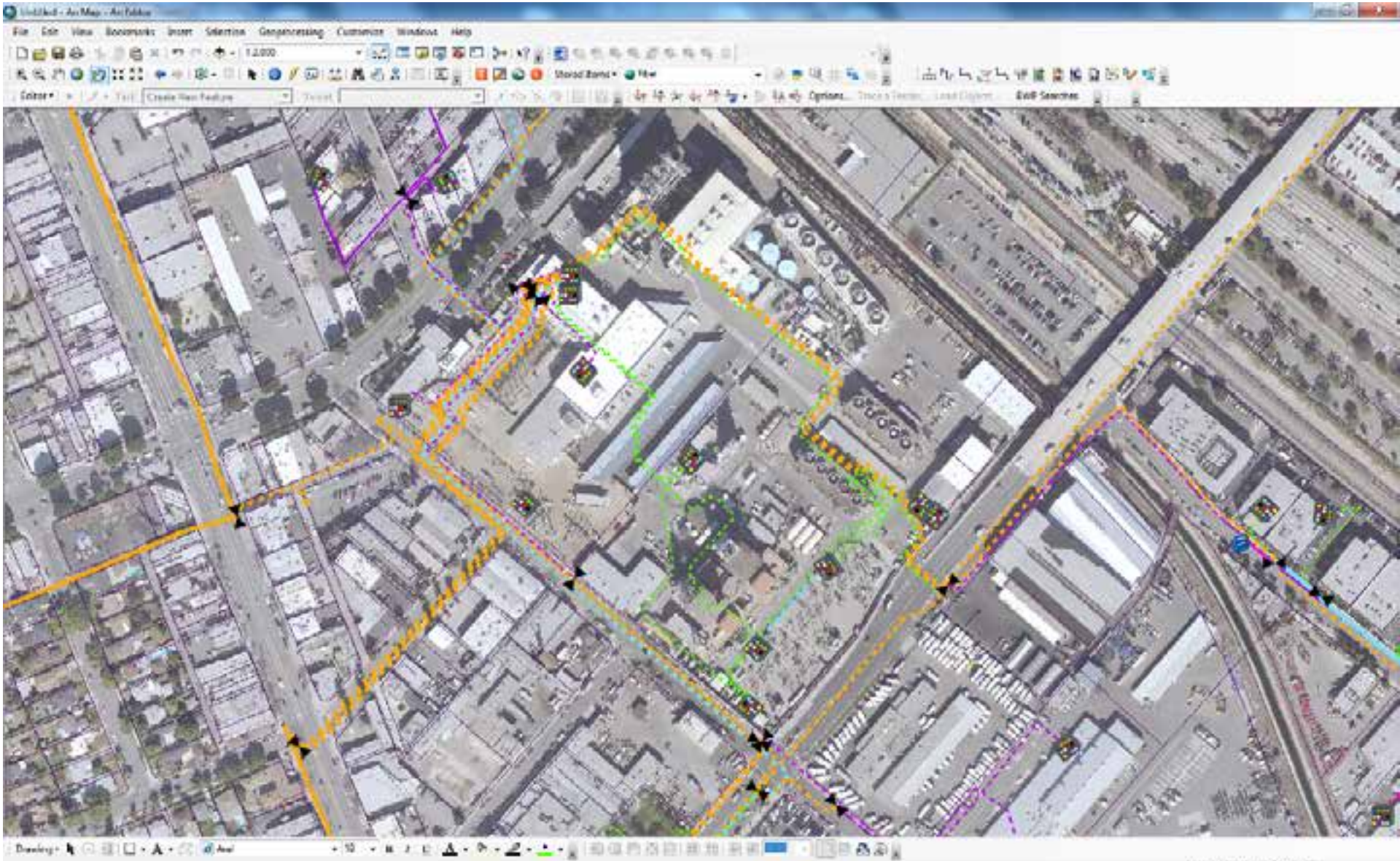
ArcFM with Substation Internals



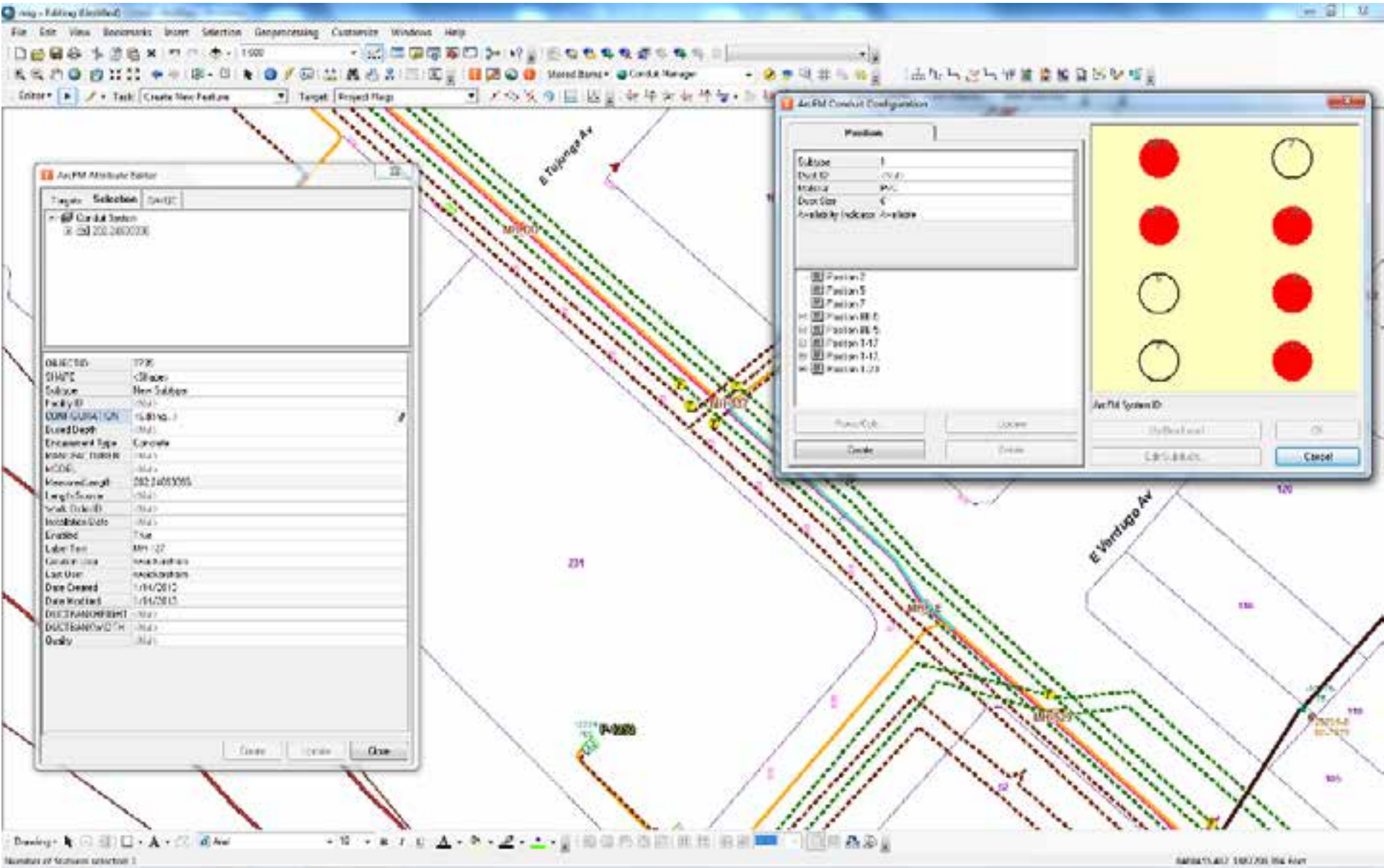
Fiber Manager



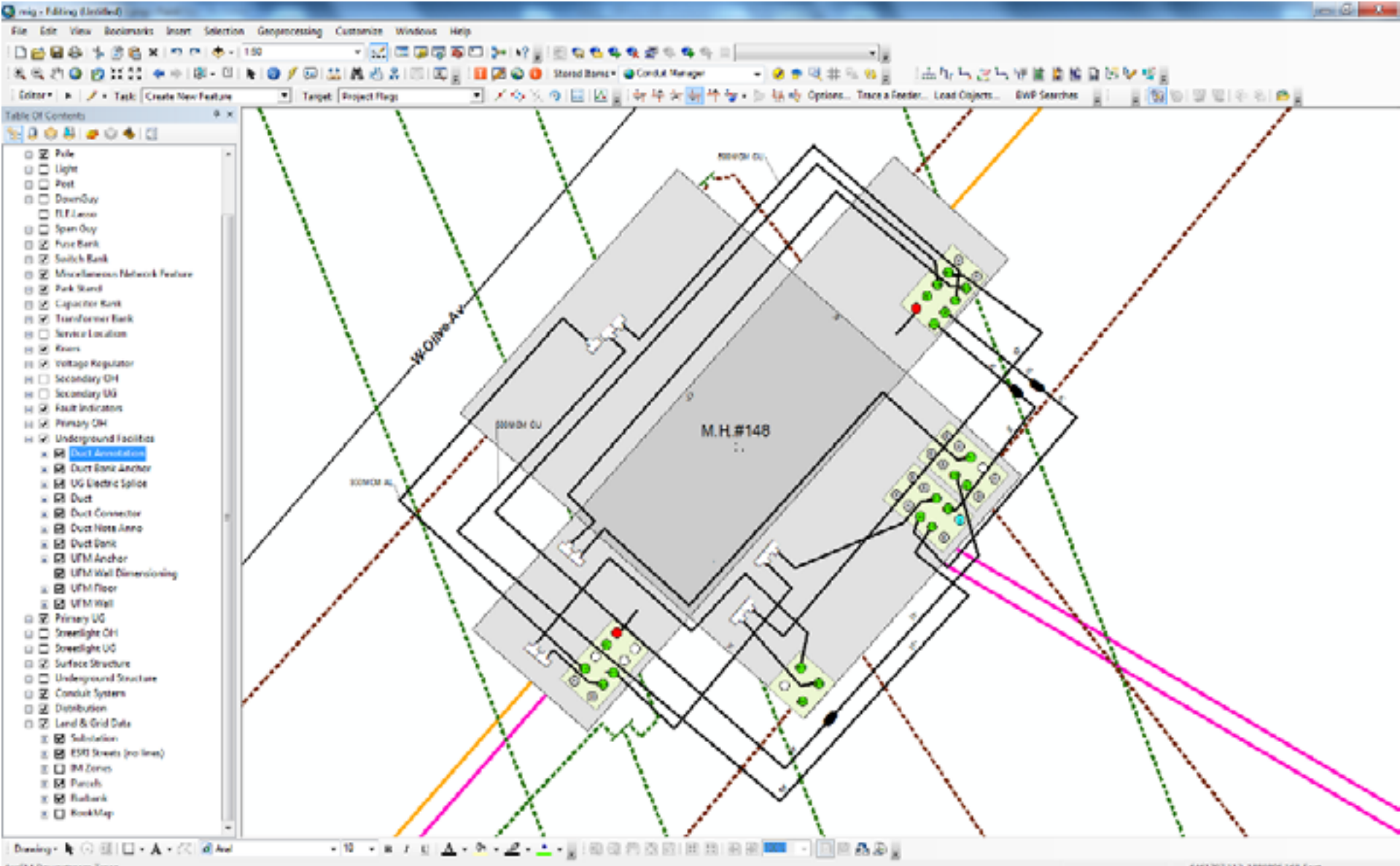
Fiber Manager



Conduit Manager

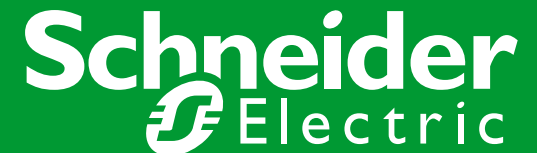


Conduit Manager

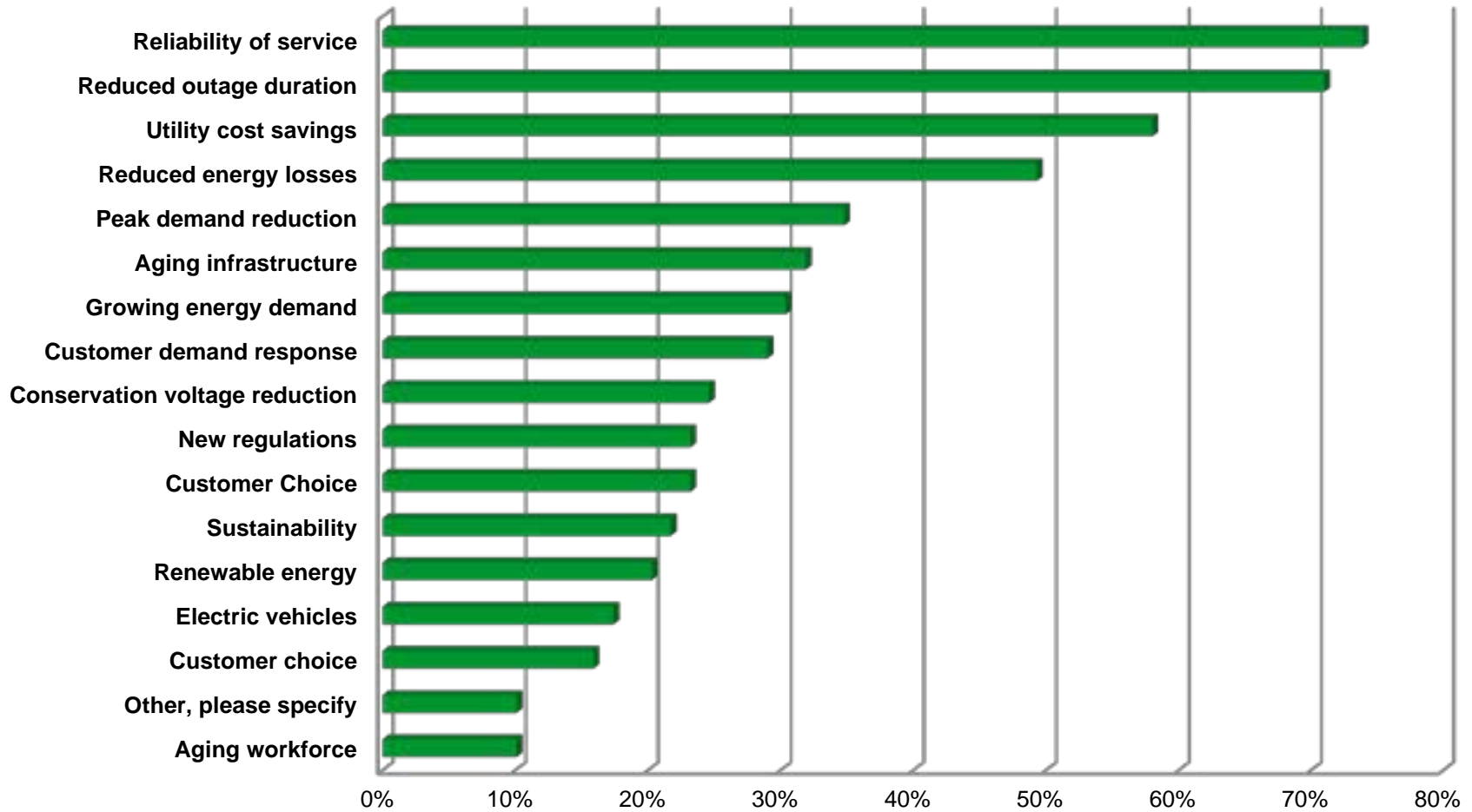


Smart Grid Drivers

Where are you going?



Key Business Problems for Utilities

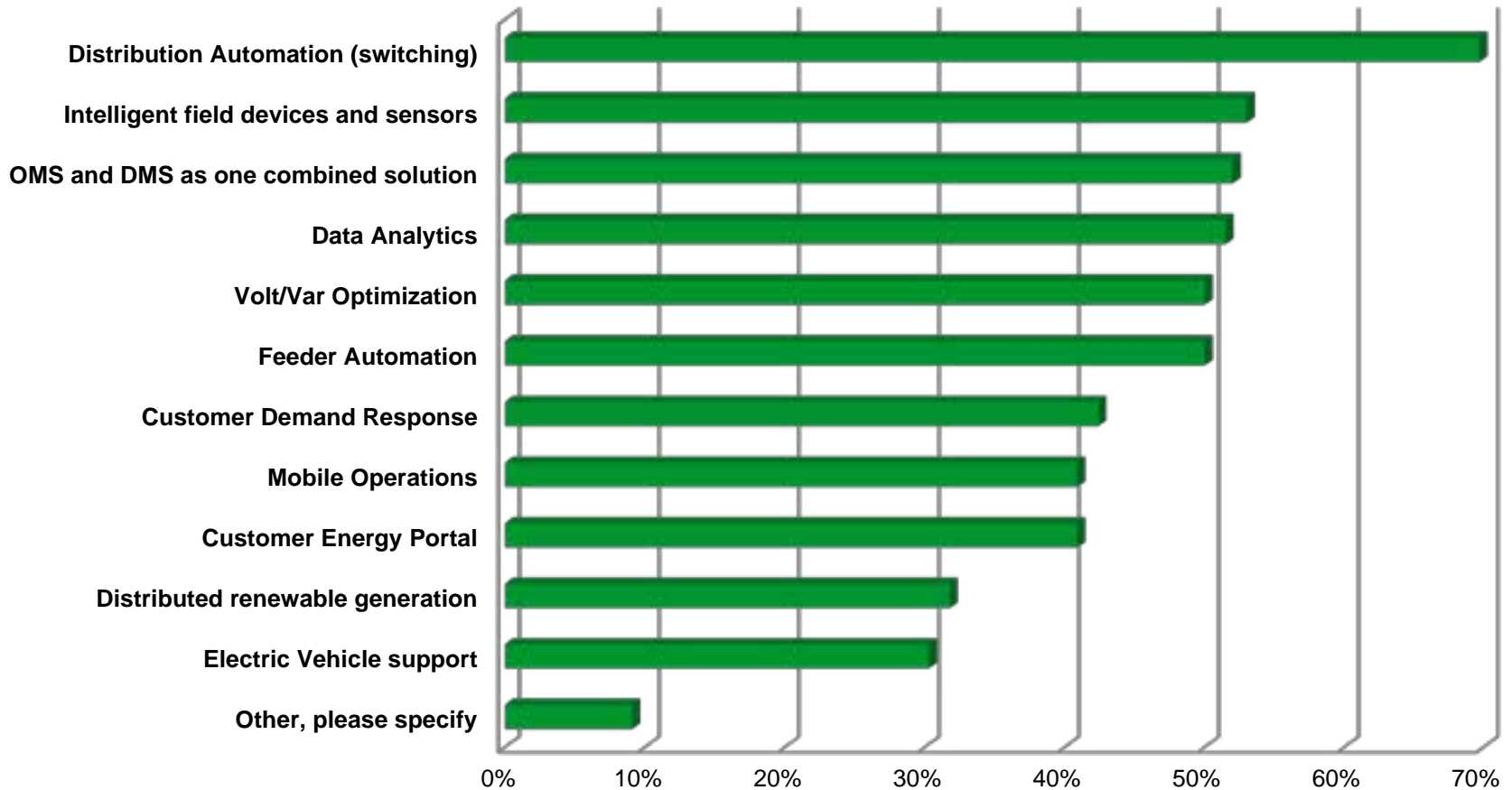


Successful Large Utility Upgrades (PSEG)

Wednesday, 11:30 am - Noon, Room 101 A

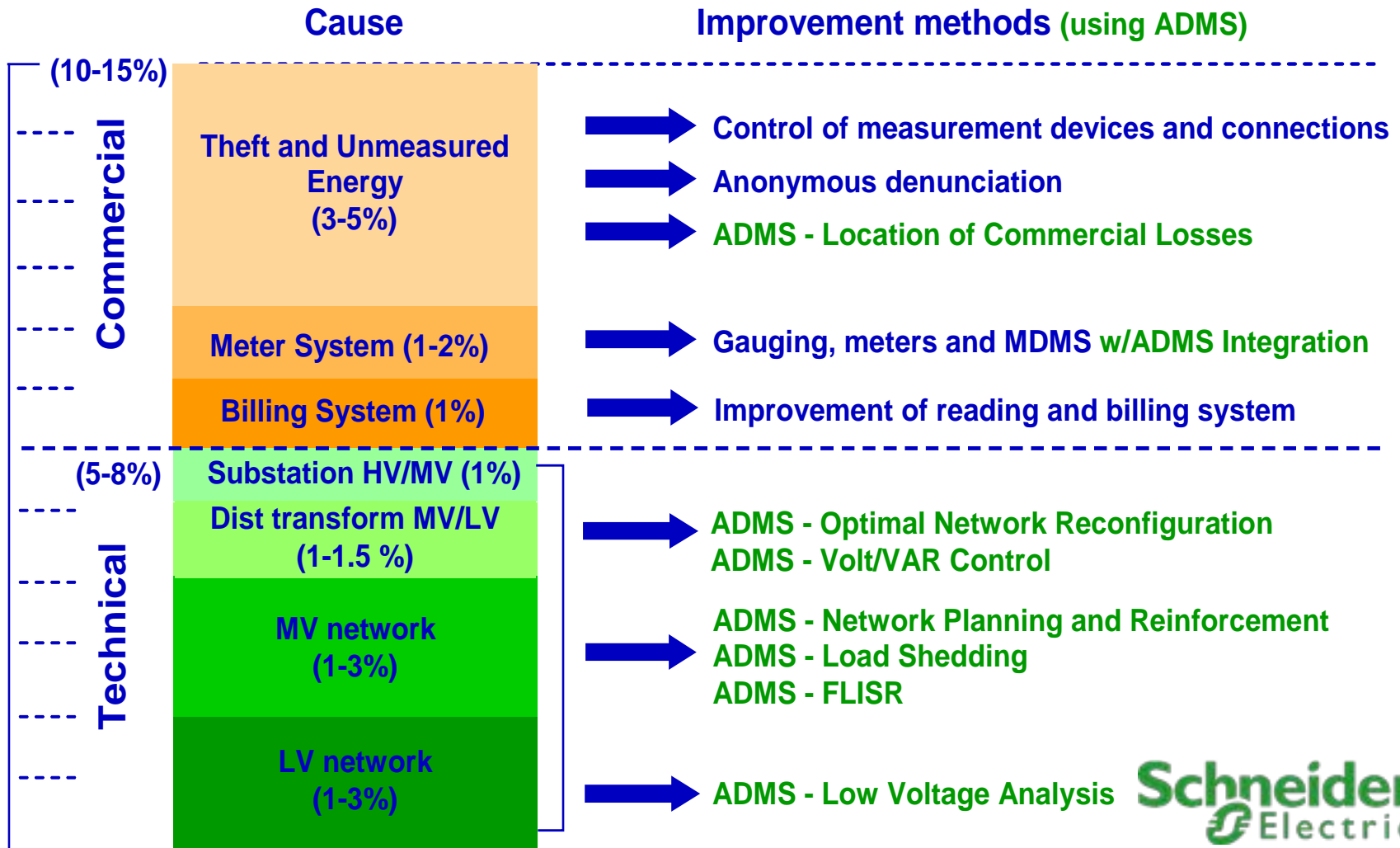


Projects Under Consideration (Solutions)



Source: Link 2012 Survey

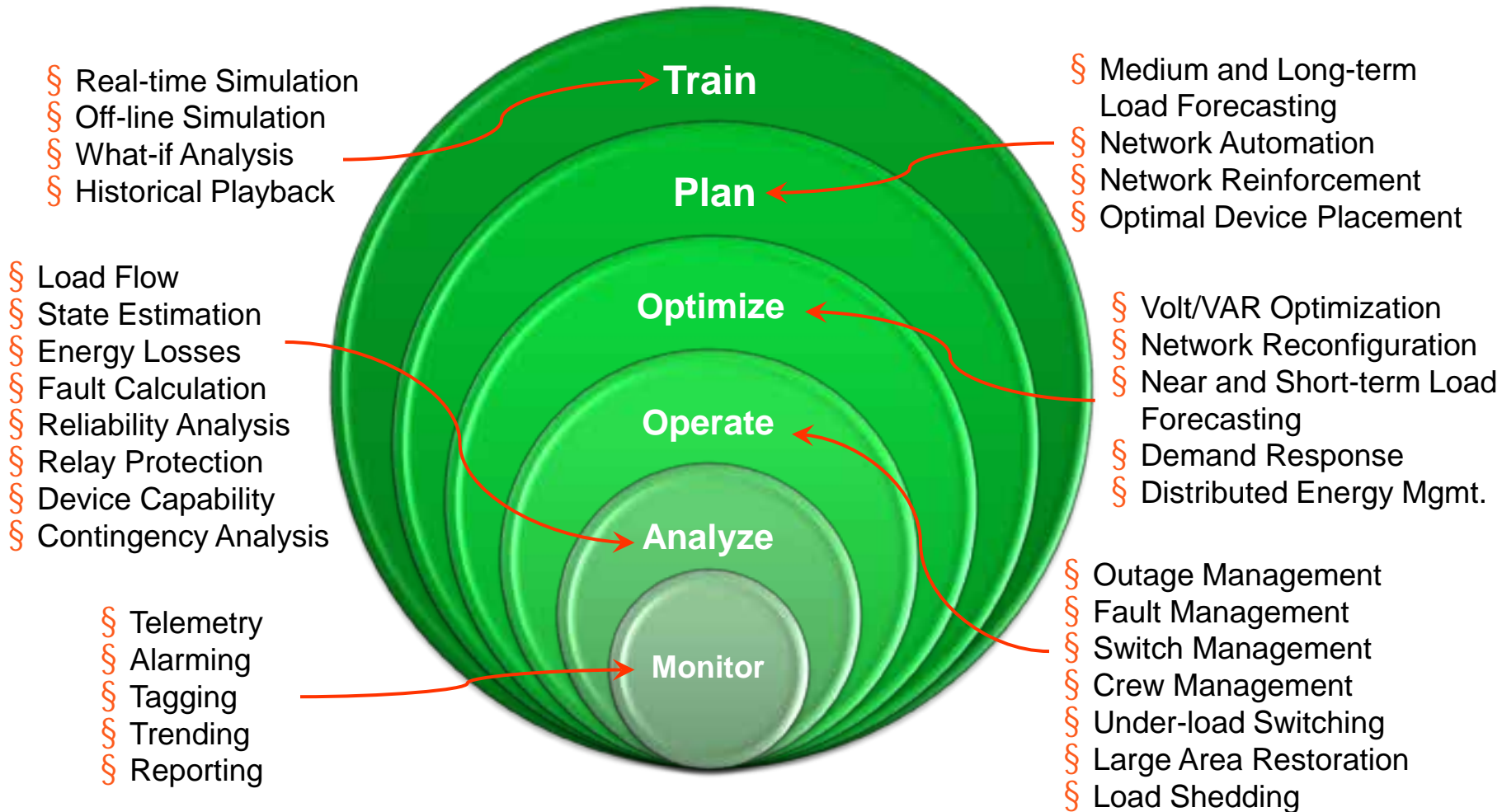
ADMS and SG Benefits



ADMS Functionality

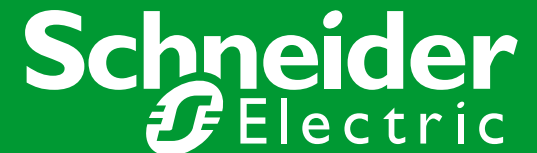
ADMS Benefits

- § Safety
- § Reliability
- § Efficiency
- § Standardized Training
- § Unified Interface
- § Advanced Analytics



Source Data Preparation

How do you get there?



White Paper

- Best Practices for Creating Your Smart Grid Network Model
- Schneider Electric – Electric Utilities White Papers

The screenshot shows the Schneider Electric website's Support page. The top navigation bar includes the Schneider Electric logo, a search bar with a dropdown menu set to 'all the site', and a search button. The main navigation menu has tabs for Solutions, Products and Services, Support (highlighted), Your business, and Company and Careers. The page title is 'Support'. The breadcrumb trail reads: 'You are here: Home > Support > White Papers library > Electric Utilities'. The main content area is titled 'Electric Utilities white papers' and lists 17 white papers with their titles and file sizes. A 'Back to White Papers list' link is at the bottom. The left sidebar contains navigation links for 'Operations around the world', 'Customer Care Centre', 'Cybersecurity', and 'Substitution tool'. The right sidebar features a 'To know more' section with a 'Discover' link to 'Our solutions Overview', a 'Find out more' link to 'EcoStructure', and a 'Schneider Electric TV' section with a video player and a link to 'Customer testimonial, Case study, Product demo... Watch now our videos!'.

Schneider Electric Global [Change country] Home | Site map | Contact | Français

all the site Search

Solutions Products and Services **Support** Your business Company and Careers

Support

> You are here: Home > Support > White Papers library > Electric Utilities

Electric Utilities white papers

- > Best Practices for Creating Your Smart Grid Network Model (pdf, 309 Ko)
- > How Utility Electrical Distribution Networks can Save Energy in the Smart Grid Era (pdf, 609 Kb)
- > Preparing for Distributed Energy Resources (pdf, 650 Kb)
- > Arc Flash Mitigation (pdf, 242 Kb)
- > How the Convergence of IT and OT Enables Smart Grid Development (pdf, 147 Kb)
- > Power quality enhancements for IEC 61850 (pdf, 592 Kb)
- > A high accuracy standard for electricity meters (pdf, 406 Kb)
- > Real experience using power quality data to improve power distribution reliability (pdf, 962 Kb)
- > An Alternative Approach to Improving SAIDI and SAIFI Indicators (pdf, 725 Kb)
- > Improving MV Network Efficiency with Feeder Automation (pdf, 838 Kb)
- > Improving MV Network Efficiency with Feeder Automation - German version (pdf, 1.3 Mb)
- > Local intelligent circuit breakers - a new concept (pdf, 1.3 Mb)
- > Local intelligent circuit breakers - a new concept - German version (pdf, 1.6 Mb)
- > Compact metering solution withstands harsh environments (pdf, 855 Kb)
- > Improving Network Availability with Intelligent Electronic Devices (pdf, 529 Kb)
- > Effect on Substation Engineering Costs of IEC 61850 and System Configuration Tools (PDF file 430 Mo)
- > What will MV switchgear look like in the future (PDF file, 1 Mo)

> Back to White Papers list

Operations around the world

- Local operations

Customer Care Centre

- We care!
- Contact

Cybersecurity

- News
- Report an incident

Substitution tool

Counterfeiting

- Counterfeiting
- Definitions

To know more

Discover

- Our solutions Overview

Find out more

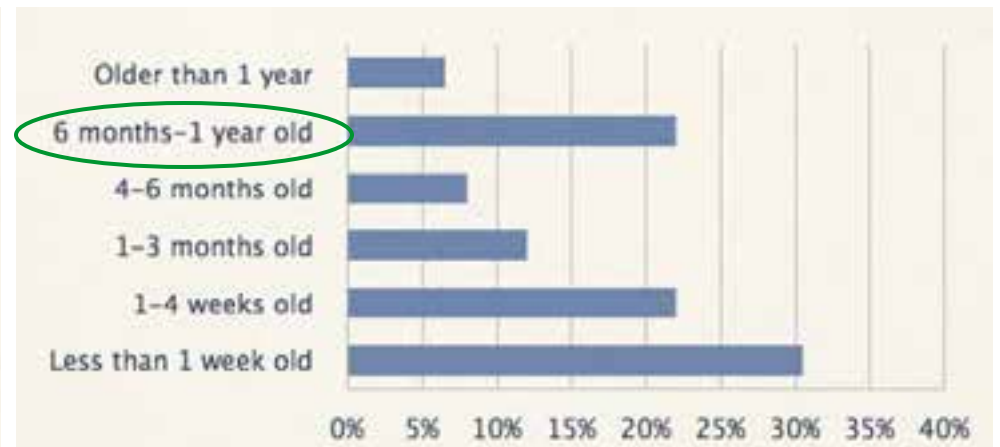
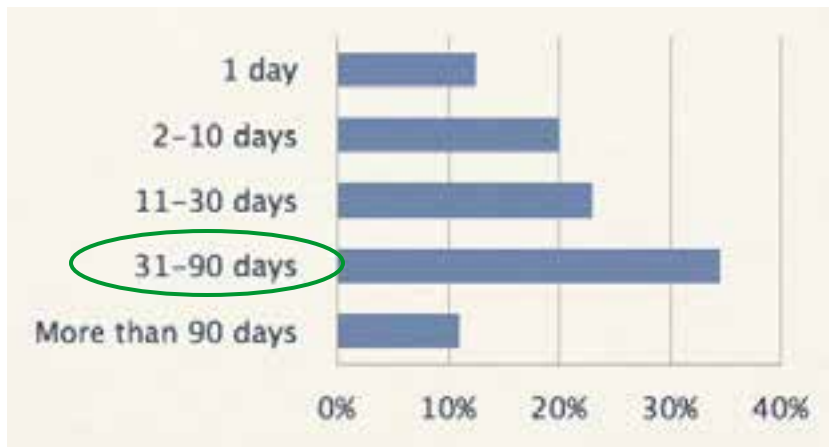
- EcoStructure

Schneider Electric TV

Customer testimonial, Case study, Product demo... Watch now our videos!

GIS Readiness

- ESRI survey of 226 utility companies on Smart Grid Readiness



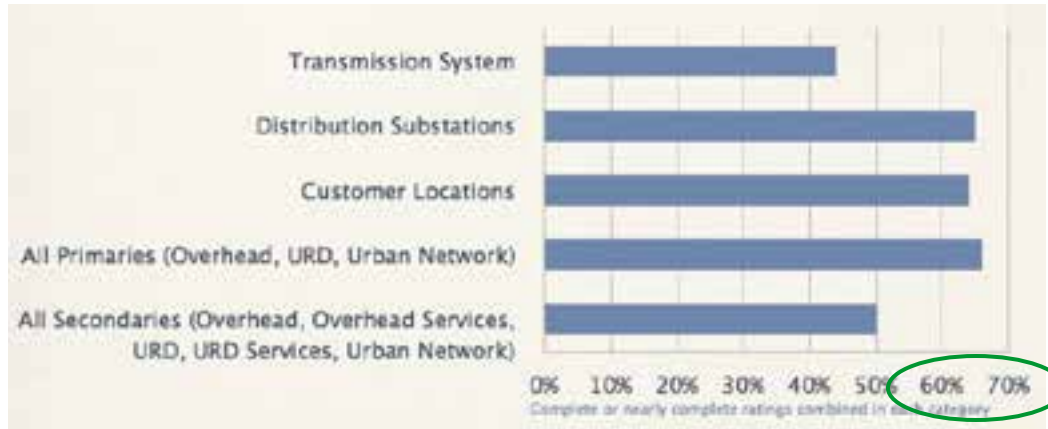
Lag between work completion and GIS

Age of oldest outstanding work order

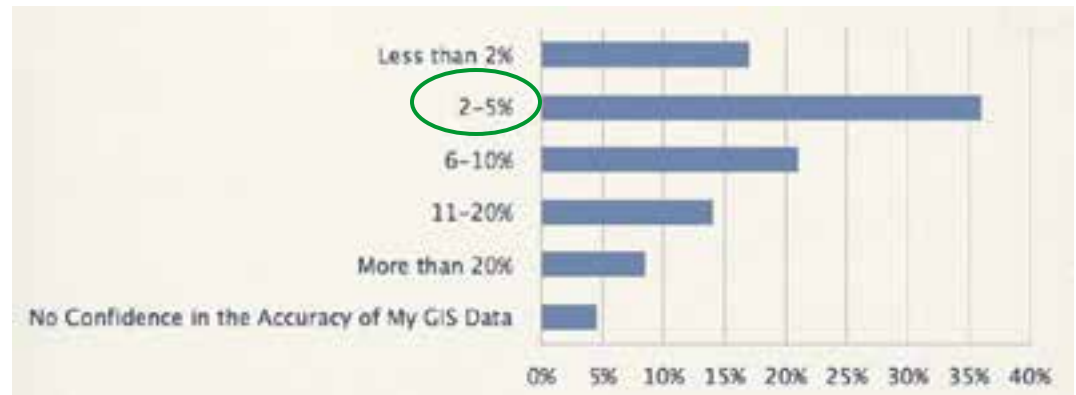
Recommendation: Use GIS-based design and mobile GIS: Designer, Orbit



GIS Readiness



GIS data completeness

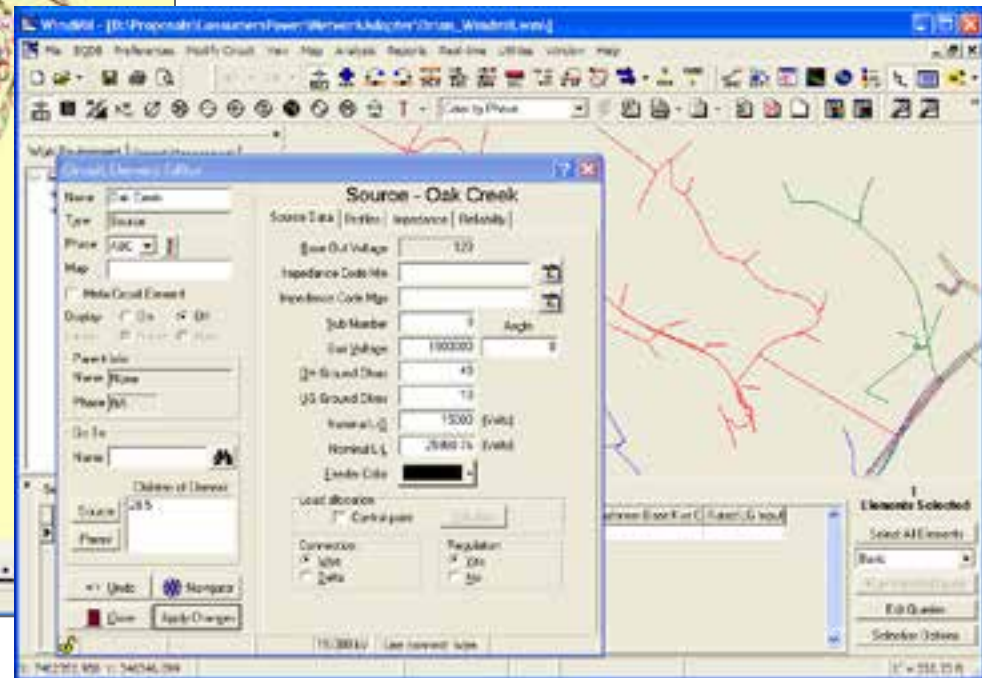
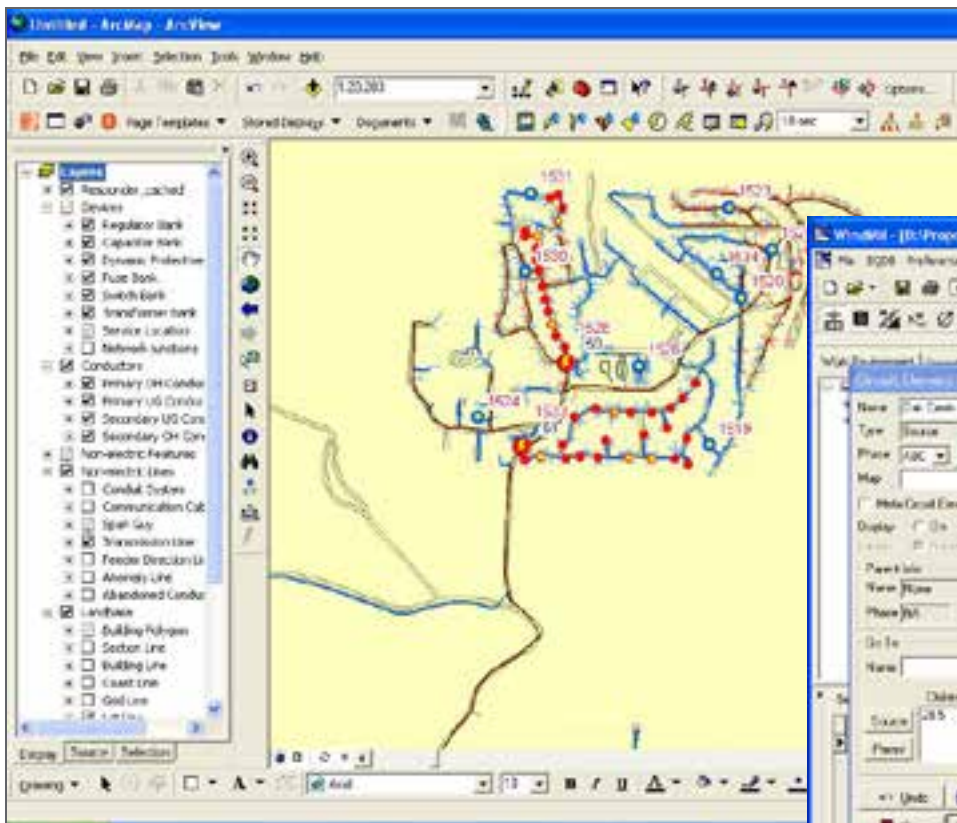


GIS data accuracy

Recommendation: Use a systematic process to improve accuracy and completeness

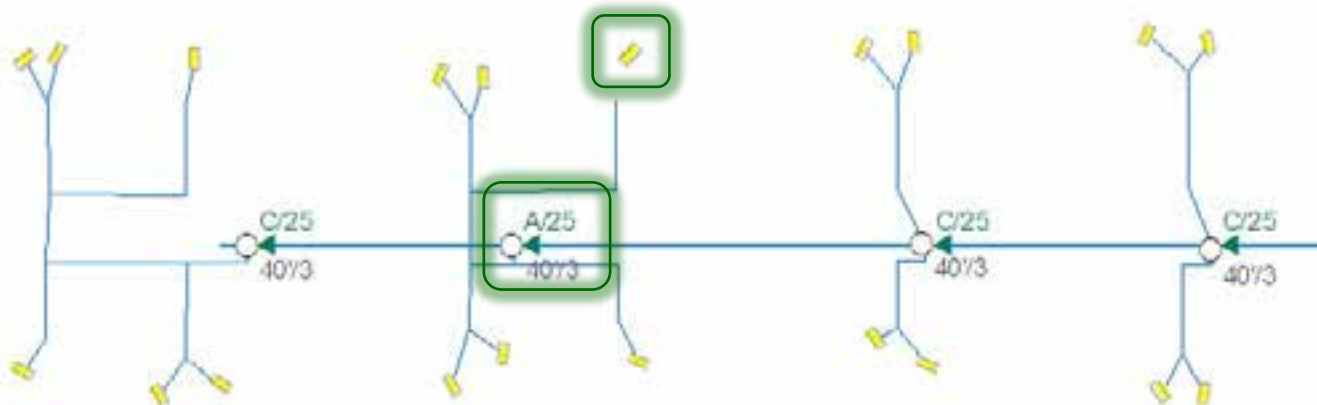
Increased Importance of Quality

- Smart Grid applications assume data from the GIS is complete, correct, and current



GIS Data Quality Problems

1. Transformer/customer connectivity
2. Phase mismatches:
 - a. where phase changes between conductors (e.g. A to B, etc.)
 - b. devices/conductors where phase is null
 - c. devices and conductors that are in unintentional loops or multi-feeds



GIS Data Quality Problems

3. Voltage mismatches:

- a. where conductor voltage changes without a tap or transformer
- b. devices/conductors where voltage is null
- c. devices that have a different voltage than their connected conductors

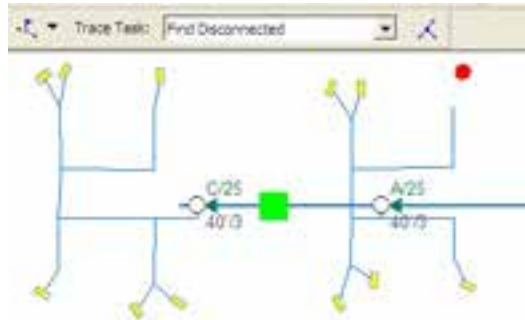
4. Disconnected devices or conductors

5. Devices with null or duplicate ID's

- a. switches, especially for Switch Order Management

GIS Readiness

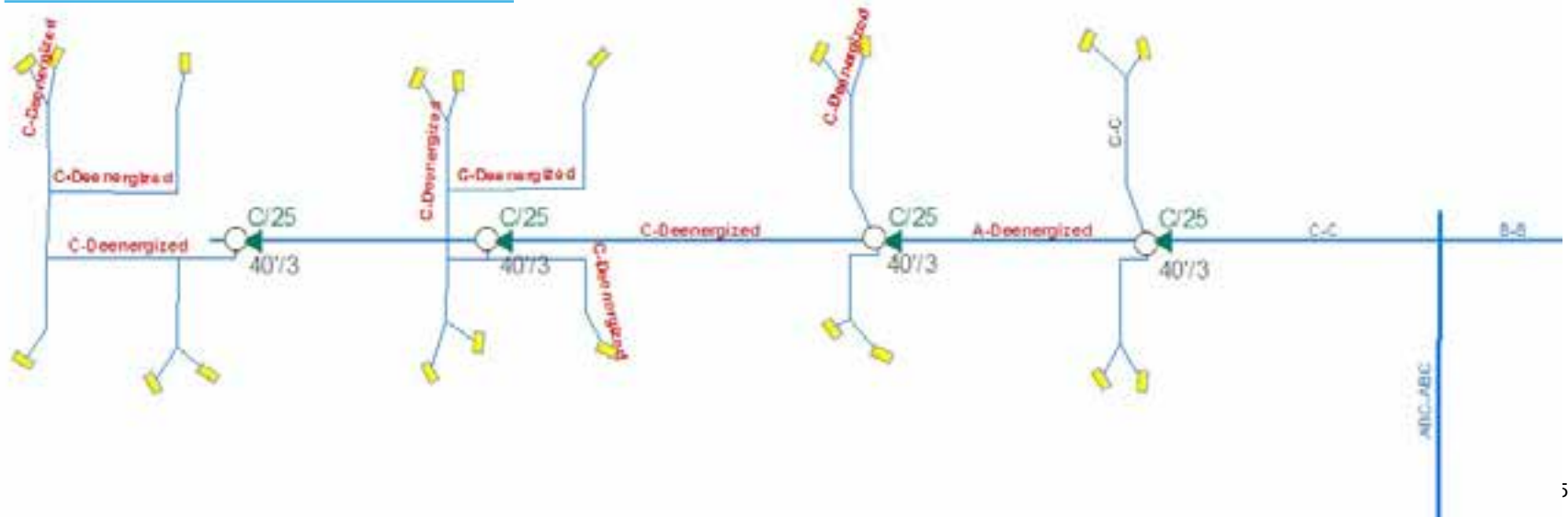
Find
Disconnected
Trace



Feeder Manager Phase Mismatch

LabelText Expression:

<https://infrastructurecommunity.schneider-electric.com>



Cool Tools, Absolutely Free!

created by Kim Despins on Aug 26, 2013 1:36 PM, last modified by Kim Despins on Oct 2, 2013 9:37 AM

This list provides links to free tools that you may find useful.

- Address Management Tool: Simplifies common tasks for managing address data, including connecting point and polygon addresses relate to street centerlines.
- ArcFM for Silverlight Configuration Tool: Simplifies the maintenance of relationships between page.config file when configuring the ArcFM for Silverlight web application. View Read Me
- ArcGIS Diagrammer for 10.1: This productivity tool creates, edits, and analyzes a geodatabase s
- ArcGIS Diagrammer for 10.2: This productivity tool creates, edits, and analyzes a geodatabase s
- ArcSDE User Privileges Report: This tool provides a simple view and report of user permissions.
- Bugzilla: Free, fast, and easy to use web-based software for bug tracking.
- Domain Sort: This tool allows the specified coded value domain to be sorted.
- Geodatabase Designer: Used to create an HTML or XML report of your geodatabase. Includes a
- Geodatabase Diagrammer: Creates a geodatabase diagram in Visio.
- Geodatabase Toolset: Contains excellent tools used to investigate and diagnose geodatabase
- Geometric Network Configuration Manager: When it is necessary to temporarily remove a geo
- Geospatial Modeling Environment: Various free tools to facilitate spatial analysis and modeling
- MXDPERFSTAT for Version 10: A diagnostic tool that identifies and diagnoses MXD and stored d
- MXDPERFSTAT for Version 9: A diagnostic tool that identifies and diagnoses MXD and stored d
- SDEMON GUI: A GUI-based tool with SDEMON functionality: stop, pause, resume, start SDE ins

ArcFM Autoupdaters

- ArcFM Auto Phase Assign

- Returns a phase designation for a point feature when placed within a search tolerance of a conductor or when the point feature is updated.

- ArcFM Length Double

- Updates the Measured Length field with the value in the Shape.Len field.

ArcFM Autoupdaters

- ArcFM Connect Network Feature

- Connects a point feature to the network when it is not currently part of the network and is moved to snap to another network feature.

- ArcFM Inherit Operating Voltage

- Populates the operating voltage field of the incoming object with the value of the feature to which the object is connecting.

- All Feeder Manager Autoupdaters

- ArcFM Phase Swap – can be used to correct phase data

ArcFM Validation Rules

● Electric Connectivity

- This object validation rule ensures that electric features are properly connected. For example, transformers and other devices must be connected to conductors or busbars and service points must be connected to secondary conductors. Conductors should be connected to other conductors.

● Feeder Info and Trace Weight Comparison

- This object validation rule compares the trace weight value to the Feeder Info field setting to verify that both fields have the same phases energized.

● Phase on Transformer Bank

- This field validation rule ensures that the phase value of a transformer is a subset of a connected primary conductor.

ADMS Data Import QA/QC

- Device connectivity
- Voltage inconsistencies
- Phase inconsistencies
- Invalid catalog data
- Zero-length conductors
- Devices at three-way intersections
- Incomplete data - missing required attributes

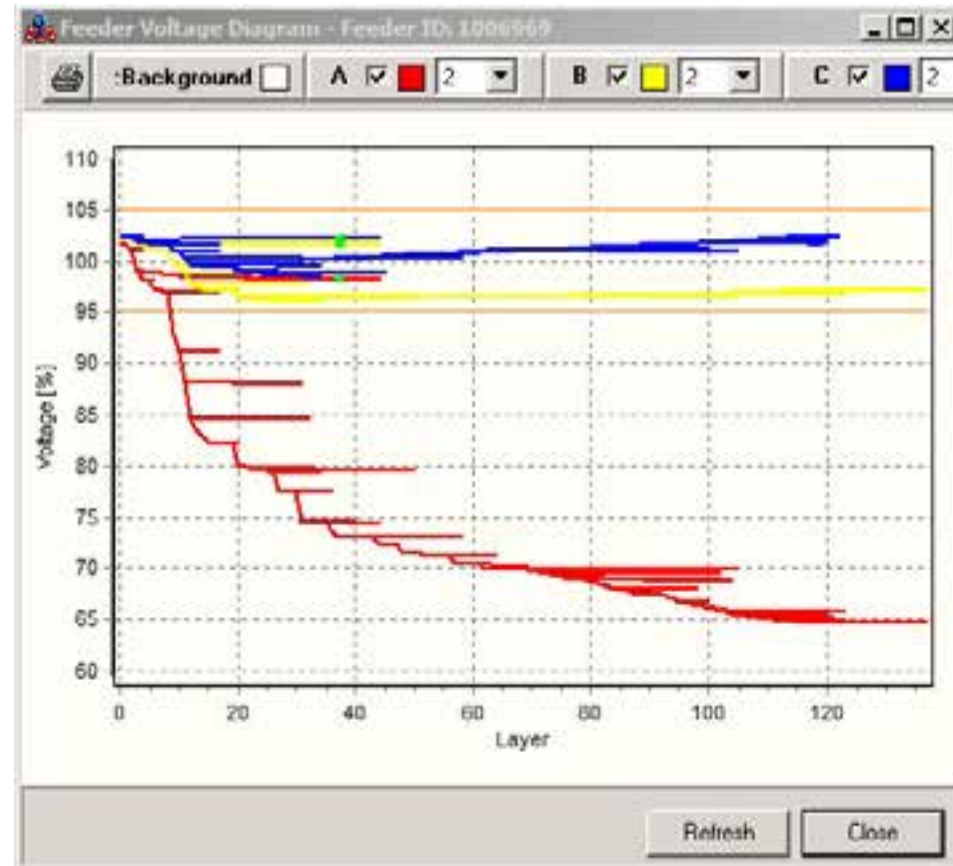
Example error messages:

- “ERROR: Phases of transformer (FacilityID= '520309') are inconsistent with phases of its associated primary lines”
- “ERROR: Equipment is not connected to the network. Equipment: Transformer, FacilityID= '243891'”
- “ERROR: Type of switch (FacilityID= '184103') is null”

ADMS Internal QA/QC

ADMS is then used for further data validation:

- Data within expected ranges
- Overloaded or underloaded devices
- Low voltages
- Errors due to phase imbalance, incorrect connectivity, or incorrect conductor lengths
- Expected results from running ADMS functions



Required ADMS Data

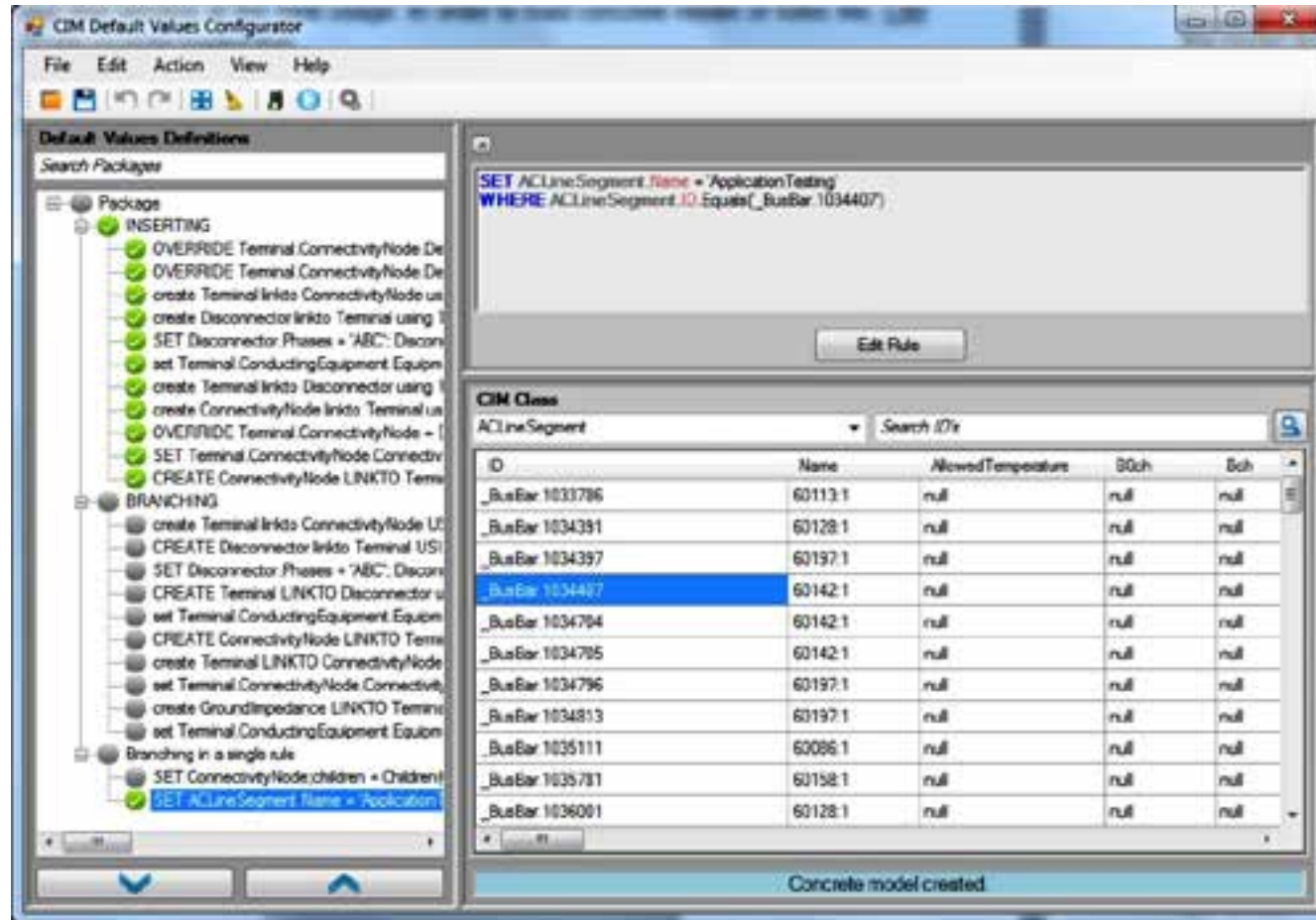
DMS Data Requirements					Importance for DMS application (Key: H=High,M=Medium,L=Low,N=Not Required)																								
Element	Attribute	Unit	Type	Mandatory/Optional	Network Operation												DMS Core Apps & Training Simulator		Network Operation						Optimization of Network Operation			Network Analysis	
					Network Model	Topology Analyzer	State Estimation	Load Flow	Performance Indices	Switching Sequence Management	Return To Normal State	Temporary Elements	Load Flow (Real Time)	Dispatcher Training Simulator	Phase Balancing	Fault Location	Fault Isolation	Supply Restoration	Large Area Restoration	Load Shedding	Voltage Reduction	Voltage Regulation	VAR Regulation (Control)	VoltVar Control	Optimal Network Reconfiguration	Fault Calculation	Security/Contingency Analysis		
Switch (LoadBreakDisconnect,Disconnect,Sectionalizer)																													
Switchgear - Switch	Switchgear type			Mandatory	H	N	L	L	L	H	N	N	L	N	L	H	H	H	H	L	H	L	L	L	L	H	N	L	
	Poles:		phaseCode	Mandatory	H	H	L	L	L	H	N	N	L	N	L	H	H	H	H	L	N	L	L	L	L	H	N	L	
	Rated voltage of switchgear	kV	float	Mandatory	H	L	L	L	L	L	N	N	L	N	L	L	L	L	L	L	N	L	L	L	L	N	L		
	Rated current of switchgear	A	float	Mandatory	L	N	L	L	L	H	N	N	L	N	L	L	H	H	H	L	N	L	L	L	H	N	L		
	Normal status		SwitchStatus:	Mandatory	H	H	L	L	L	H	H	N	L	N	H	N	N	N	N	N	N	N	N	N	H	N	H		
	Gang operated (yes/no)		bool	Mandatory	H	H	H	H	H	H	N	N	H	N	H	H	H	H	H	H	H	L	L	L	H	N	H		
	Utility owned (yes/no)		bool	Mandatory	N	L	H	H	H	H	N	N	H	N	H	H	H	H	H	H	L	L	L	H	N	H			

CIM Default Values Configurator: Missing data, invalid data

Data Workshops and Gap Analysis

- Data Gap Analysis - understand this and use it
- Data Workshops - need a comprehensive cross-section of personnel from front line users and management
- Change Management - including new workflows to collect and maintain new attributes & data
- Support and develop personnel transitions
- Thorough documentation

CIM Default Values Configurator



- Add missing data
- Trap and update invalid data

Catalog Data

- Catalogs
 - Boys
 - Complex Elements
 - HV/MV Transformers
 - MV/LV Transformers
- Sections
- Generators
- Motors
- Impedances
- Capacitors
- Relays
- Current Transformers
- Voltage Transformers
- Fuses
 - Fuser Bottom
- Switchgears
- Reclosers
- Fault Detectors
- Fault Recorders
- Busbars
- Joints
- Polebars
- Reactors
- Surge Arrestors
- RTU
- Tap-changers
- Cells
- Measurement devices
- Range Type
- Automatic Voltage Regulator
- Generic Elements

HV/MV TRANSFORMERS CATALOG


TRVN_CAT1

Browse Details

Transformer type

Mark:

Reliability: >>



Number of windings

 1 2 3

Number of phases

 1 2 3

Symbols

Global	Detail
<input type="checkbox"/>	<input type="checkbox"/>

U_{n1} kV S_{n1} MVA

U_{n2} kV S_{n2} MVA

U_{n3} kV S_{n3} MVA

Voltage Control

Number of taps:

ΔU, % between two successive taps:

Home Load

Not avail Exist

Grounding Resistance: Ω

Grounding Resistance: Ω

Short circuit impedance (voltage)

	Upper	Lower
U_{k10}^{max}	<input type="text" value="15,54"/> %	<input type="text" value="14,06"/> %
U_{k12}	<input type="text" value="10,5"/> %	<input type="text" value="9,5"/> %
U_{k12}^{min}	<input type="text" value="8,4"/> %	<input type="text" value="7,6"/> %
U_{k13}	<input type="text" value="8,82"/> %	<input type="text" value="7,98"/> %
U_{k23}	<input type="text" value="3"/> %	<input type="text" value="2,52"/> %

Connection

Connection of primary winding:

Connection of secondary winding:

Connection of tertiary winding:

Primary/Secondary phase shift:

Primary/Tertiary phase shift:

Isolation/Cooling

Medium Oil Dry

	Upper	Lower
P _{Cu2}	<input type="text" value="137,55"/> kW	<input type="text" value="124,45"/> kW
P _{Cu13}	<input type="text" value="0"/> kW	<input type="text" value="0"/> kW
P _{Cu23}	<input type="text" value="0"/> kW	<input type="text" value="0"/> kW
P _{Fe}	<input type="text" value="42"/> kW	<input type="text" value="38"/> kW
P _{Fe0}	<input type="text" value="42"/> kW	<input type="text" value="38"/> kW
I _o	<input type="text" value="0,42"/> %	<input type="text" value="0,38"/> %
I _{o0}	<input type="text" value="0,42"/> %	<input type="text" value="0,38"/> %

ONAN_{n1} MVA

ONAN_{n2} MVA

ONAN_{n3} MVA

Cu heating: min

Ti heating: min

Ti cooling: min

Shot circuit rated current: A Cost: \$

Connection

Connection of primary winding:

Connection of secondary winding:

Connection of tertiary winding:

Primary/Secondary phase shift:

Primary/Tertiary phase shift:

Isolation/Cooling

Medium Oil Dry

ONAN_{n1} MVA

ONAN_{n2} MVA

ONAN_{n3} MVA

Cu heating: min

Ti heating: min

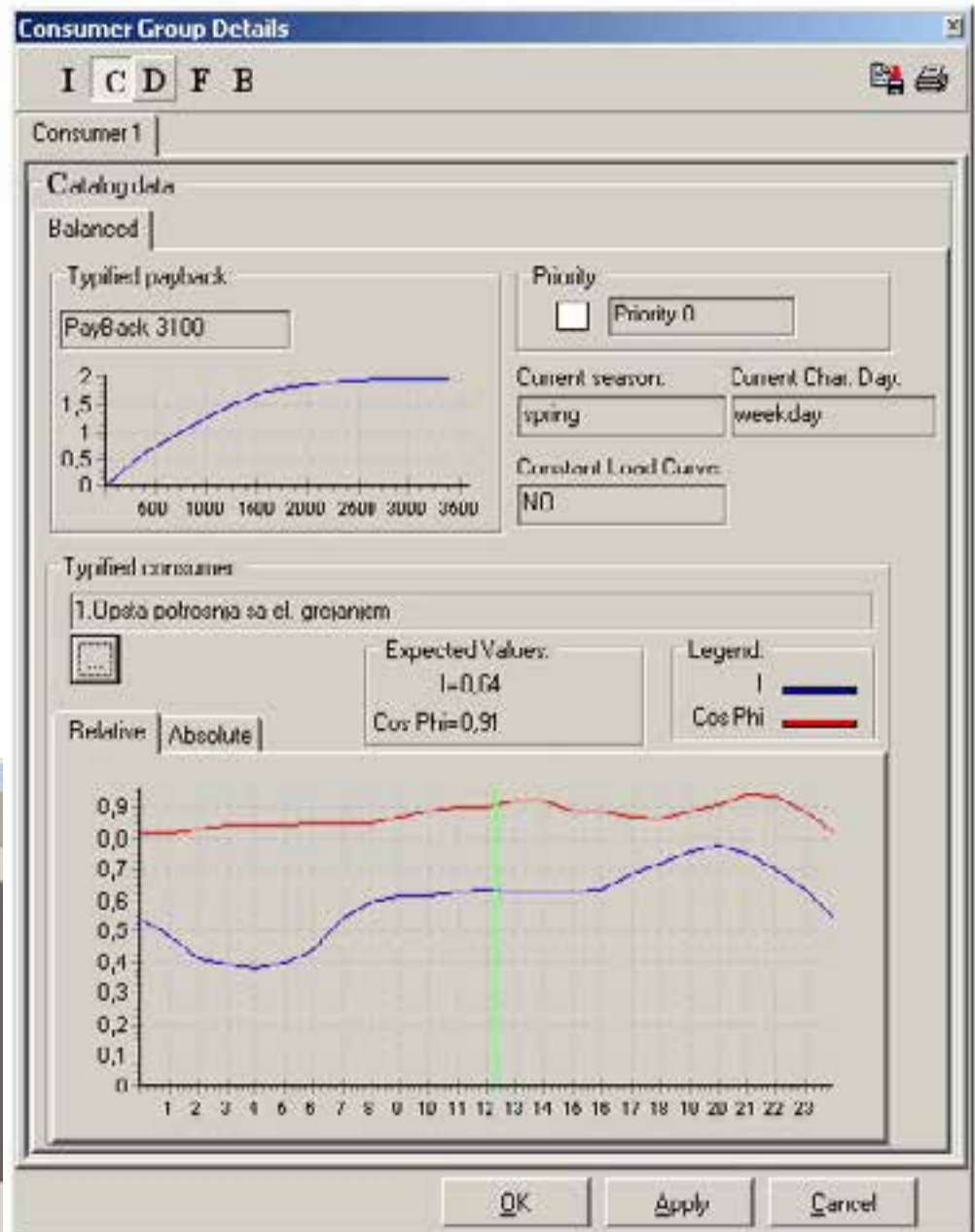
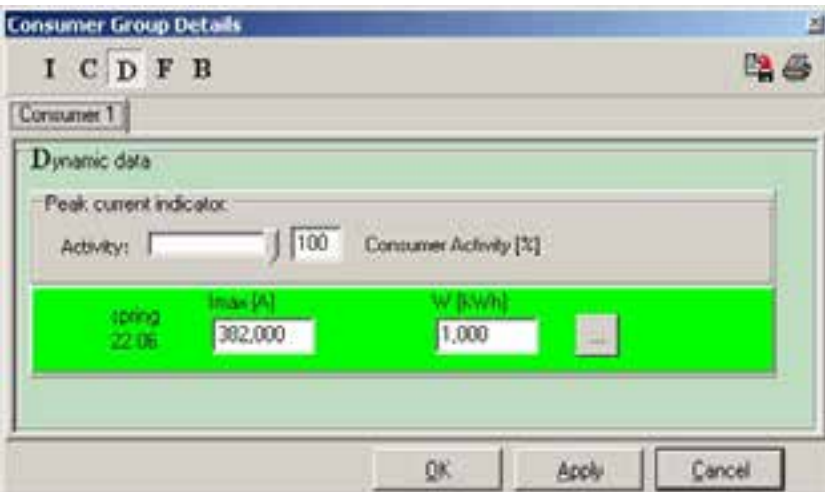
Ti cooling: min

Shot circuit rated current: A Cost: \$

Copy Save Delete Exit

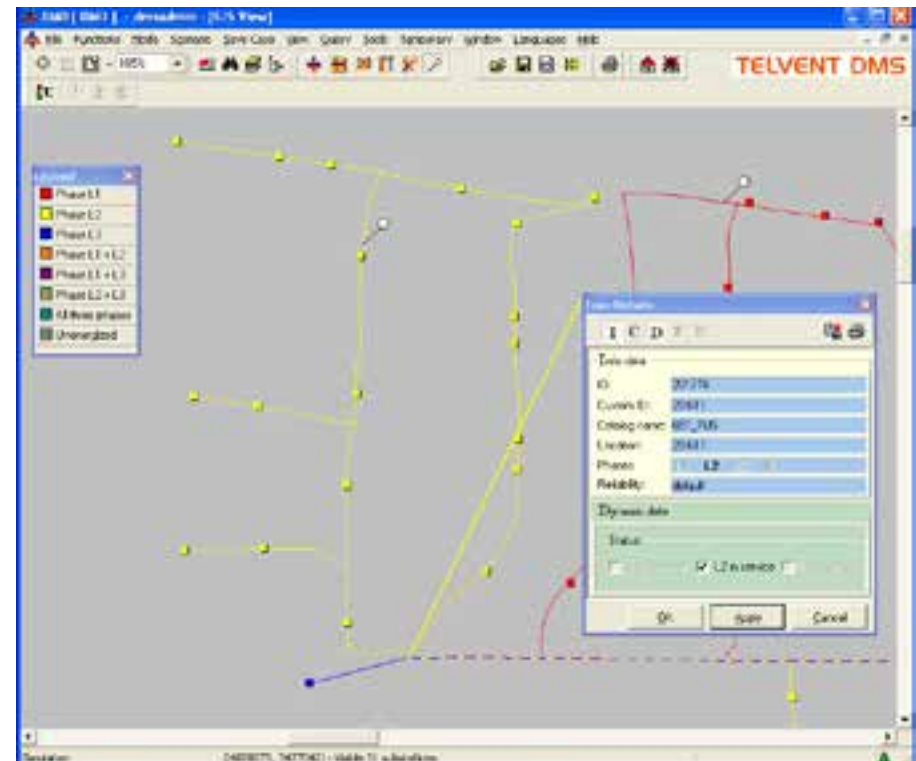
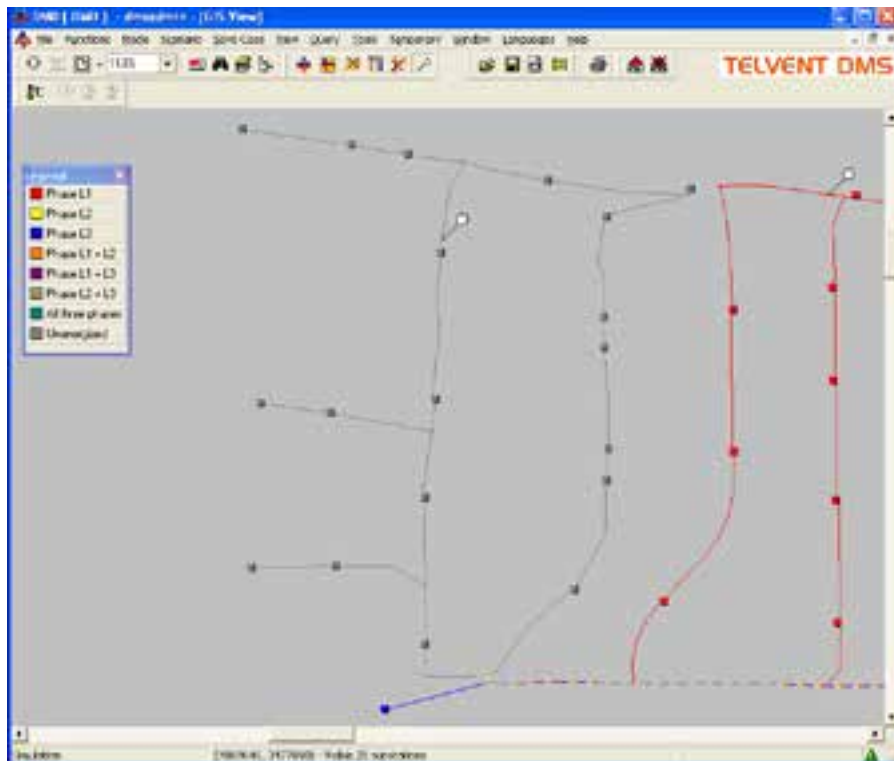
Consumer Groups

- Consumer loads aggregated into groups per transformer
- Groups can be generated from load data or tied to SCADA or AMI

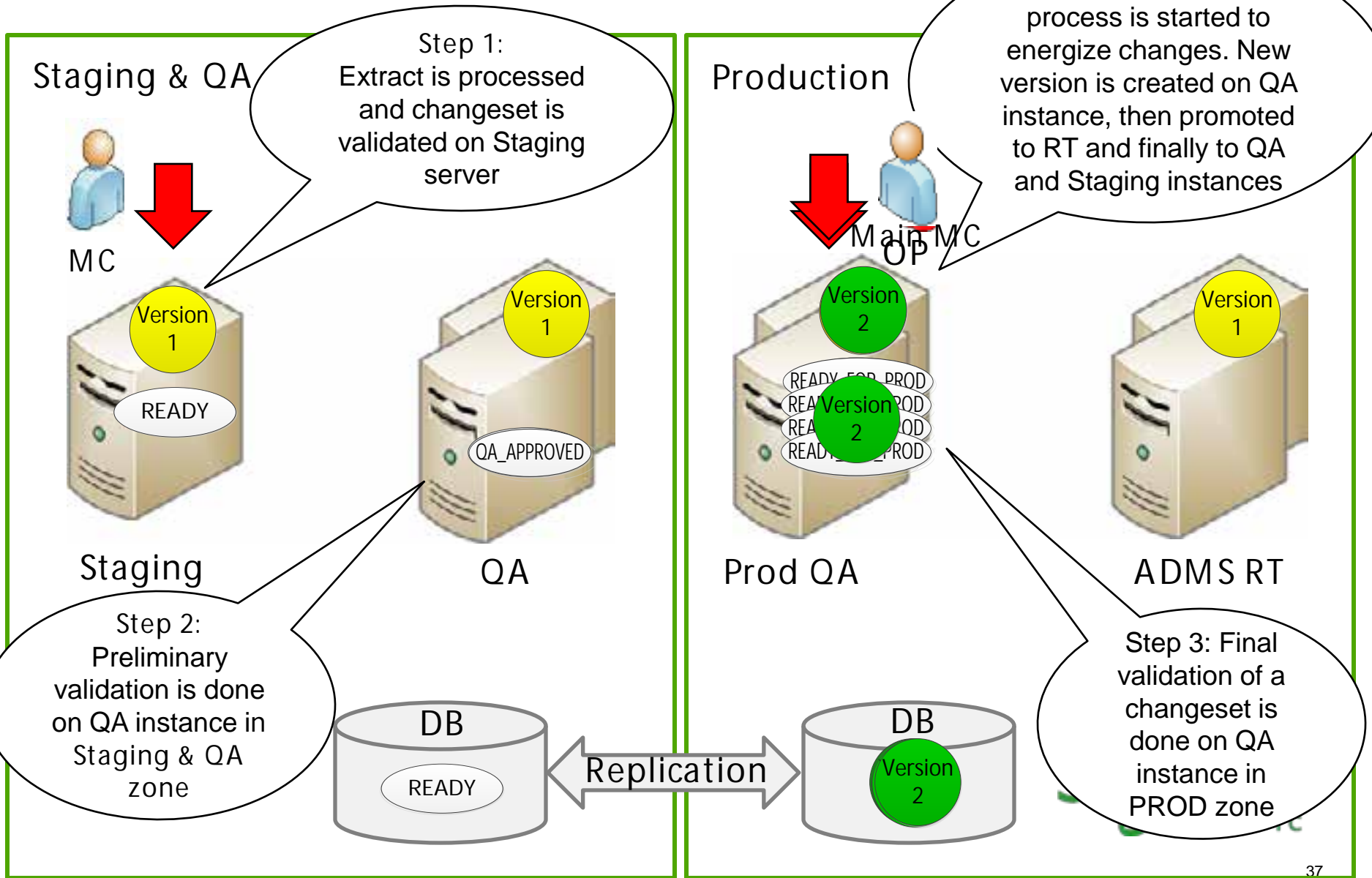


Expectations about States

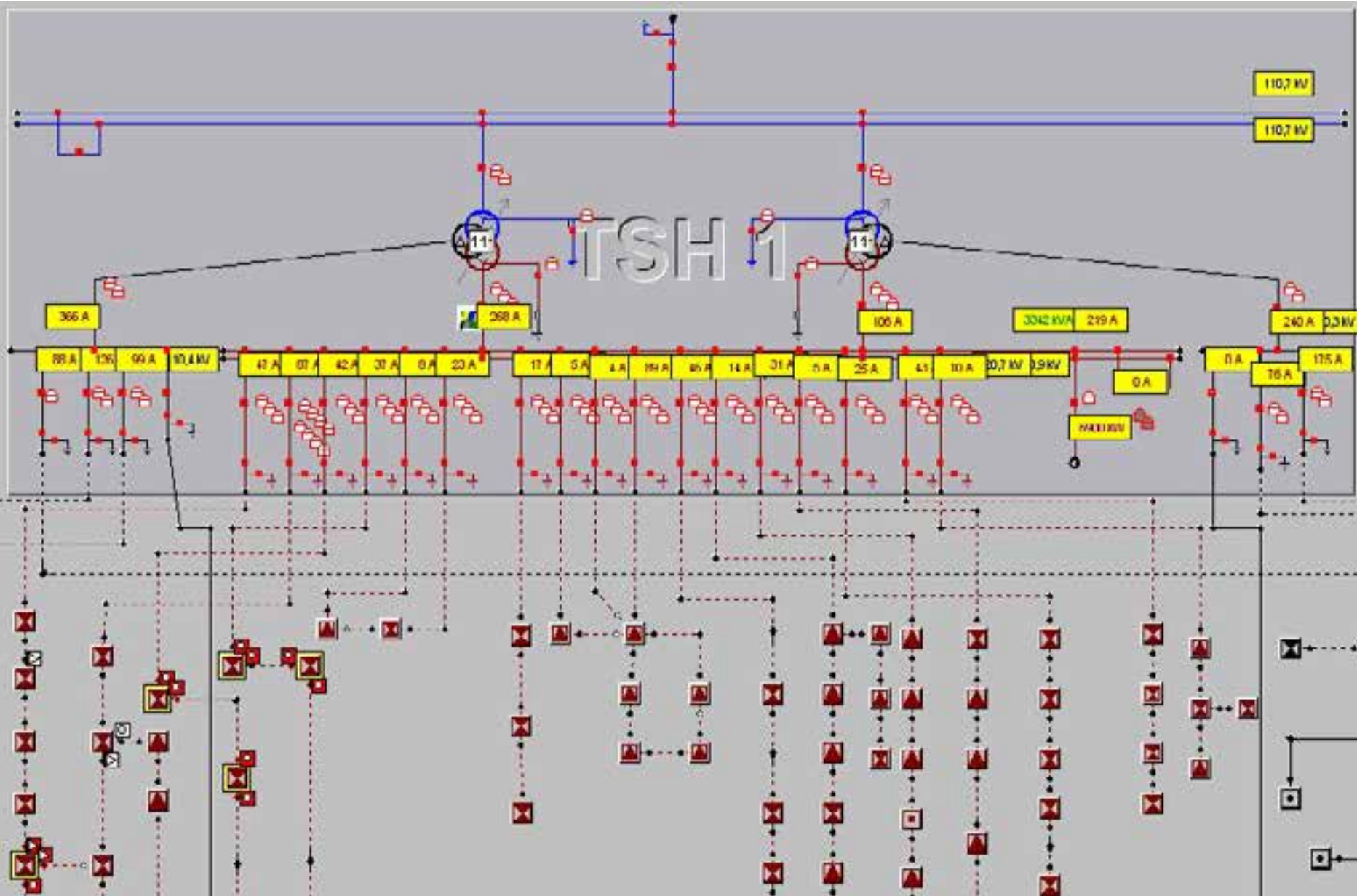
- ADMS will need to track “soon to be constructed/ energized” features
- Energization can occur in ADMS



Model Promotion – Data Flow



Substation Internals



DG/DER/DR Data

- Distributed Generation

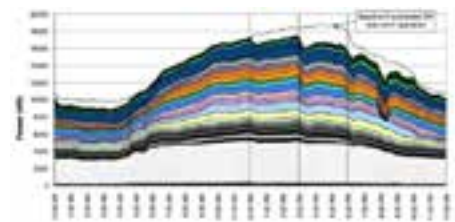
- Photovoltaic Panels
- Wind Turbines
- Generators (supply-side)

- Distributed Energy Resources

- Battery Banks
- Electric Vehicle Charging Stations
- Ice Bears

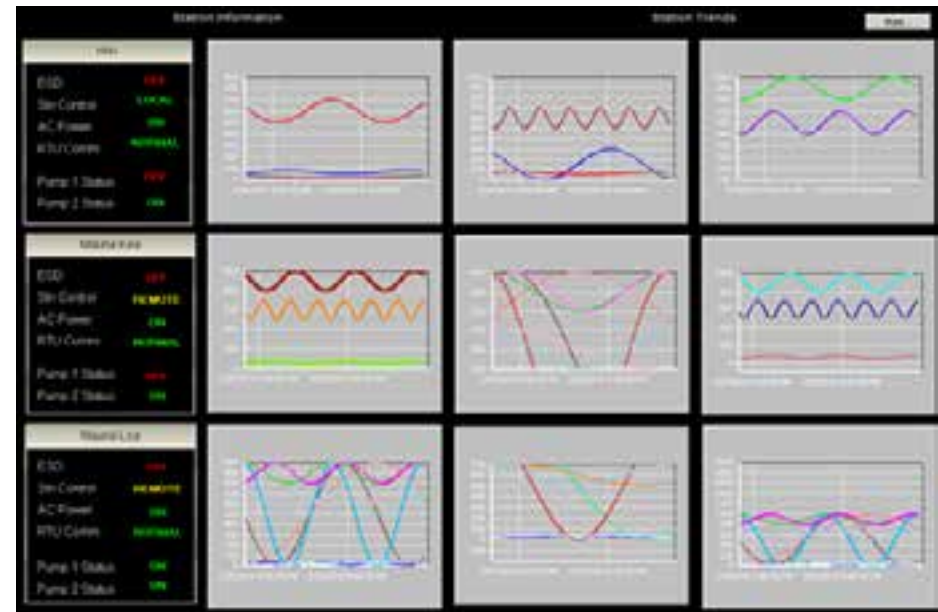
- Demand Response

- Adjustable Thermostats
- Generators (demand-side)
- Smart Appliances and Lighting Systems



SCADA Points

- Monitoring and control points
- Modeled via various Control object classes, related to device feature classes in ArcFM



Summary and Questions

- Determine your Smart Grid and ADMS Business Drivers
- Work to improve quality and timeliness of GIS data
 - Correct, Complete, Current
- Prepare additional data sources
- Enjoy your Smarter Grid
- Questions?

Thank You!

Bill Wickersheim
Facility Technology Coordinator
Burbank Water and Power

John Dirkman, P.E.
Smart Grid Product Manager
Schneider Electric

Esri User Conference
17 July 2014

