GIS Data Preparation for ADMS and Smart Grid Implementation

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Esri User Conference
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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?

Schneider Electric

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

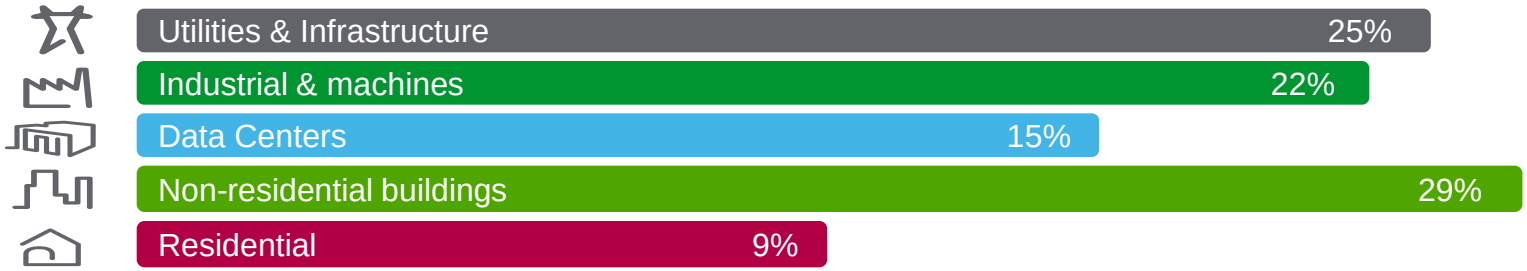
4-5% of sales devoted to R&D

~$1.5 billion devoted to R&D

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

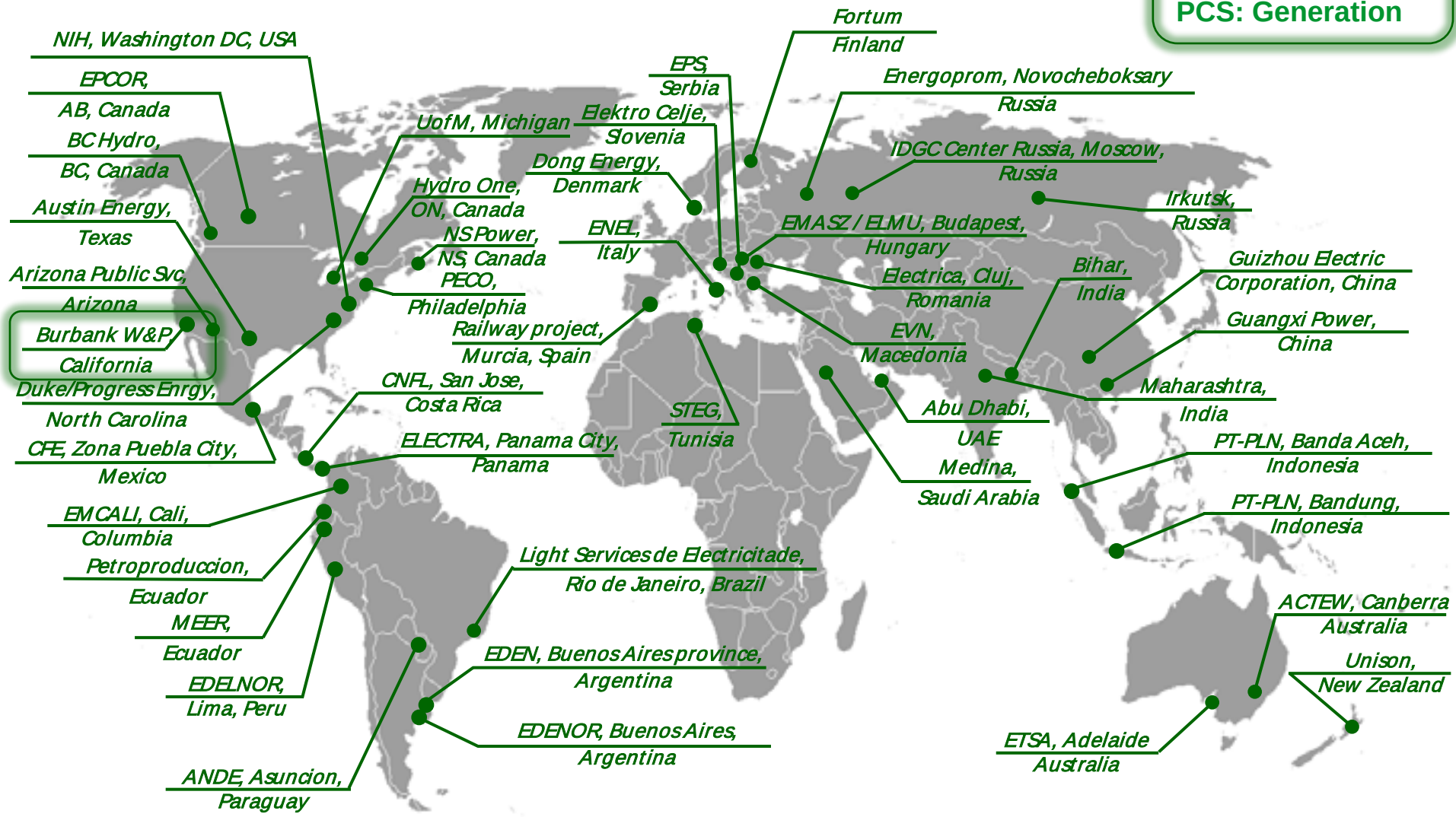
SQUARE D by Schneider Electric
TELVENT
dtn
AREVA
invensys
APC by Schneider Electric
xantrex Smart choice for power
SummitEnergy
PELCO by Schneider Electric
PowerLogic
NU-LEC INDUSTRIES
Modicon

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

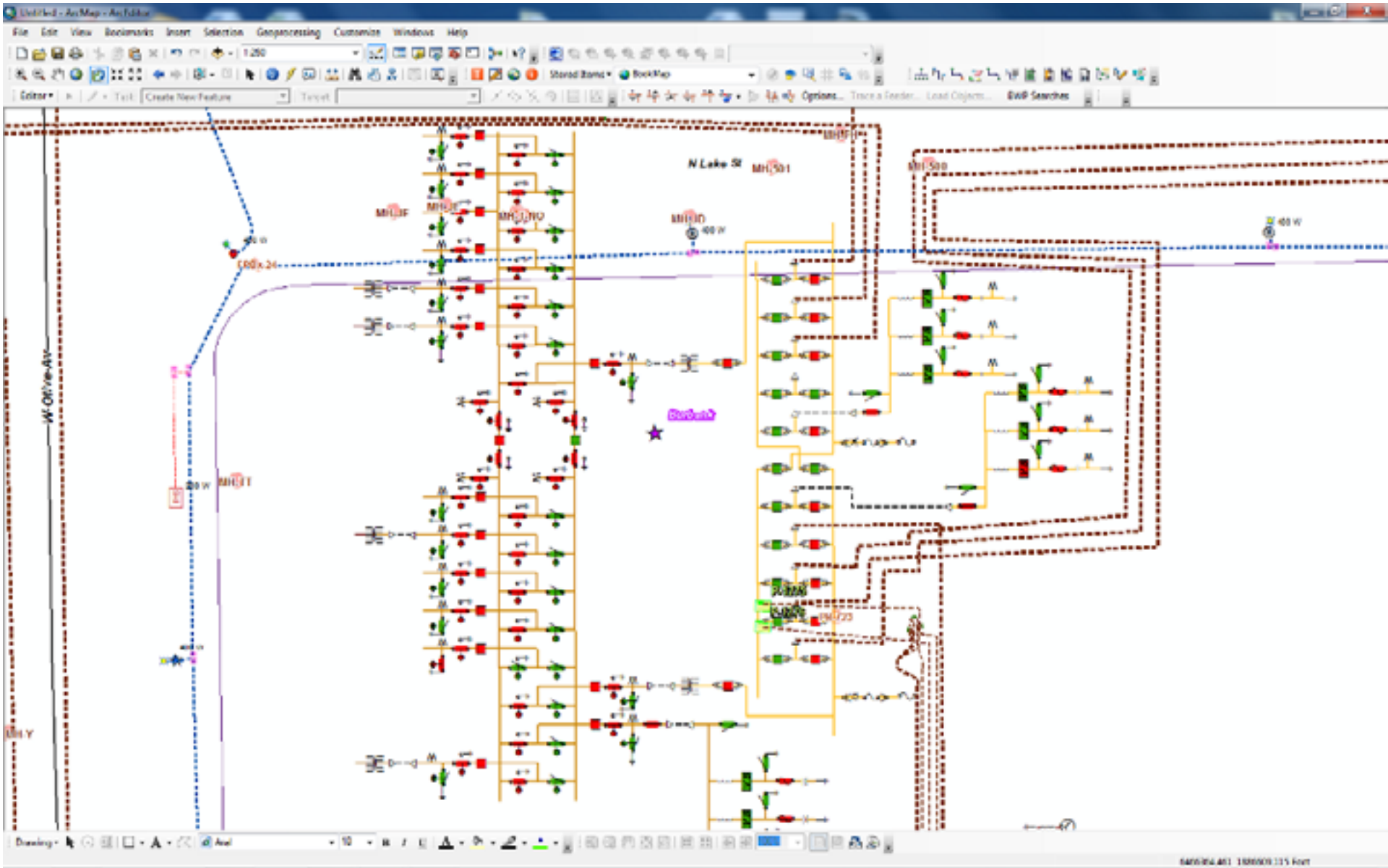
- Services 45,000 households and 7,000 businesses in Burbank, California with water, electricity, and communications
- 20 Substations, 120 feeders, 320MW peak load

Schneider Electric

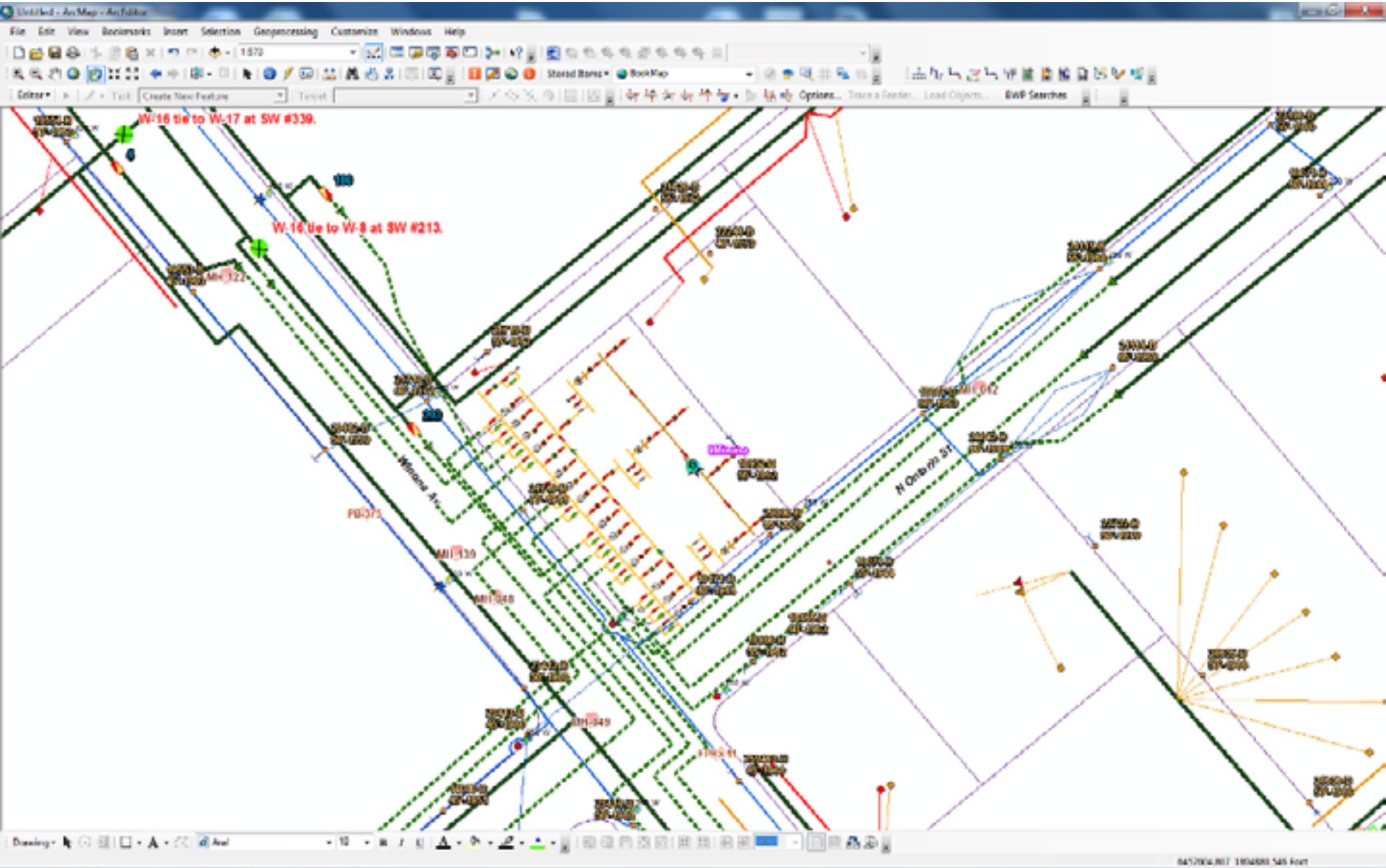
Burbank Water and Power

- 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)

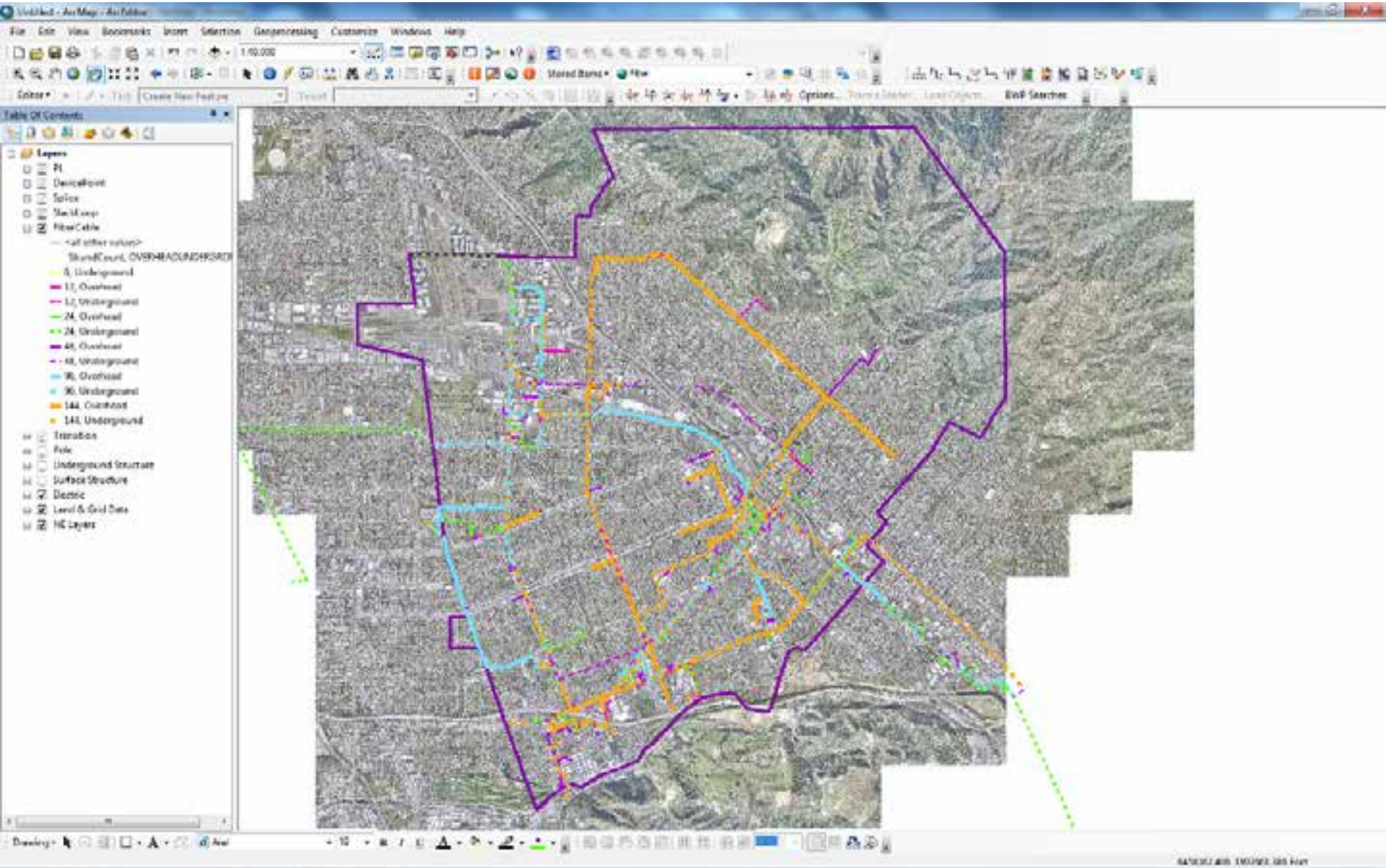
ArcFM with Substation Internals



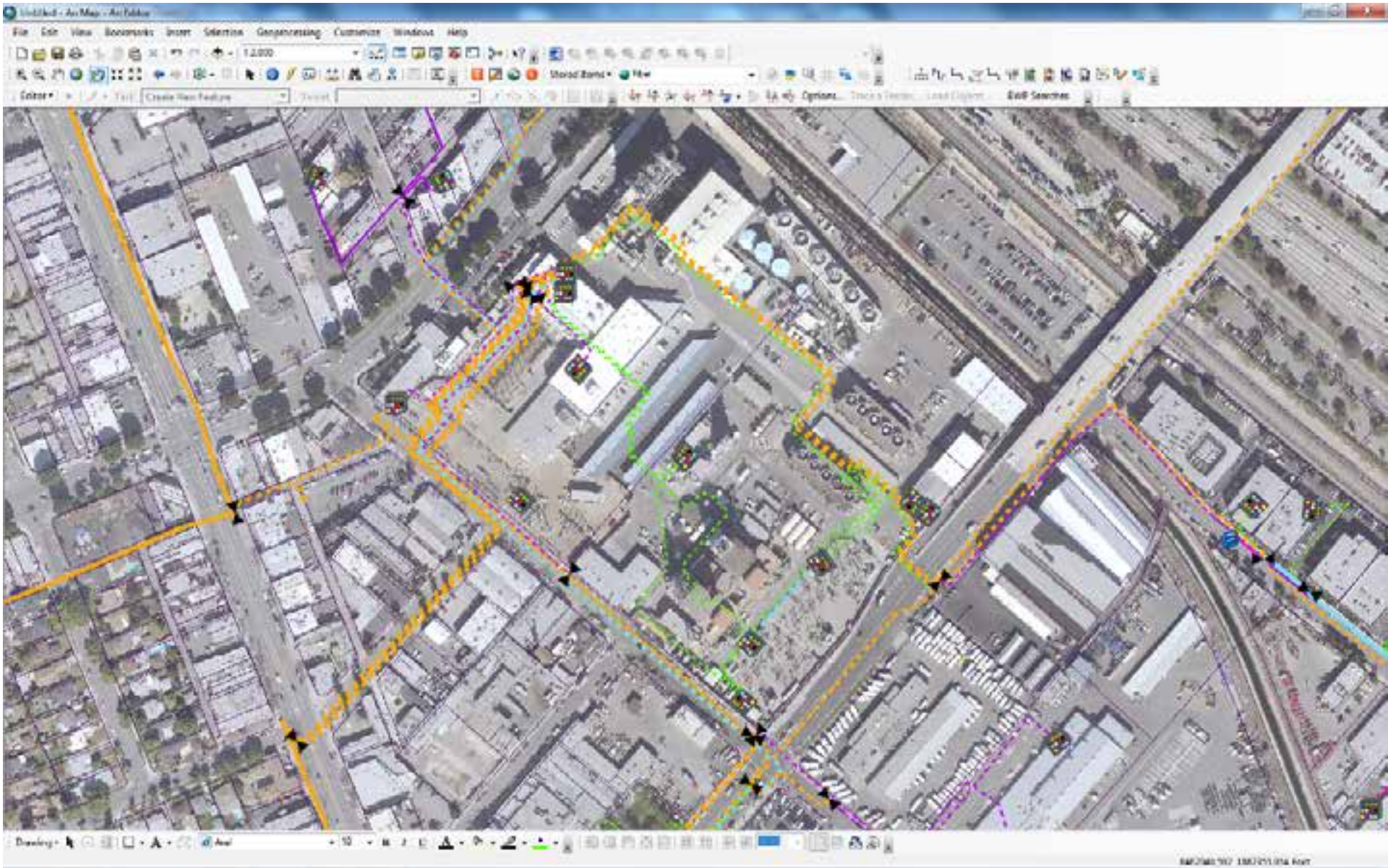
ArcFM with Substation Internals



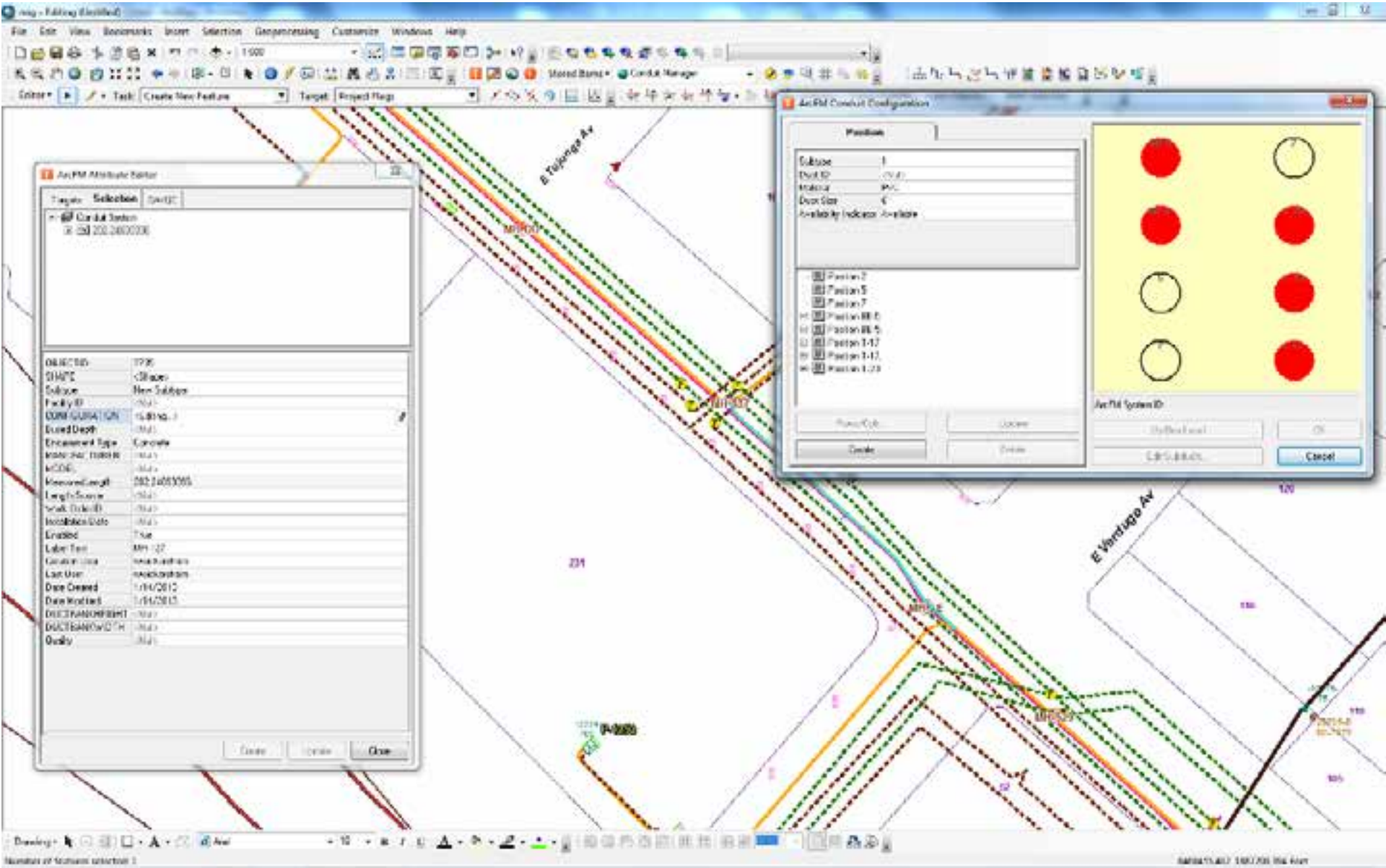
Fiber Manager



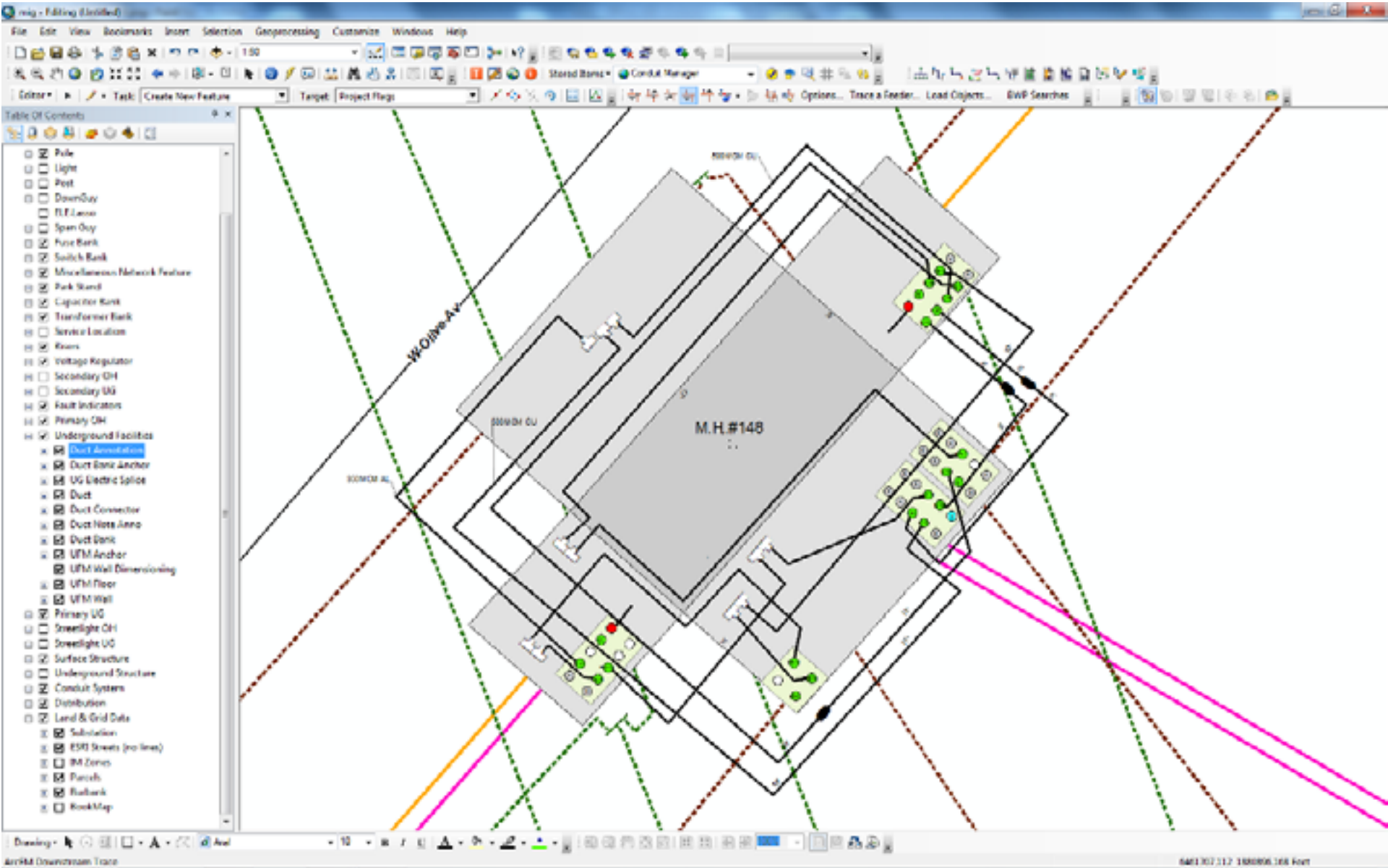
Fiber Manager



Conduit Manager



Conduit Manager



Smart Grid Drivers

Where are you going?

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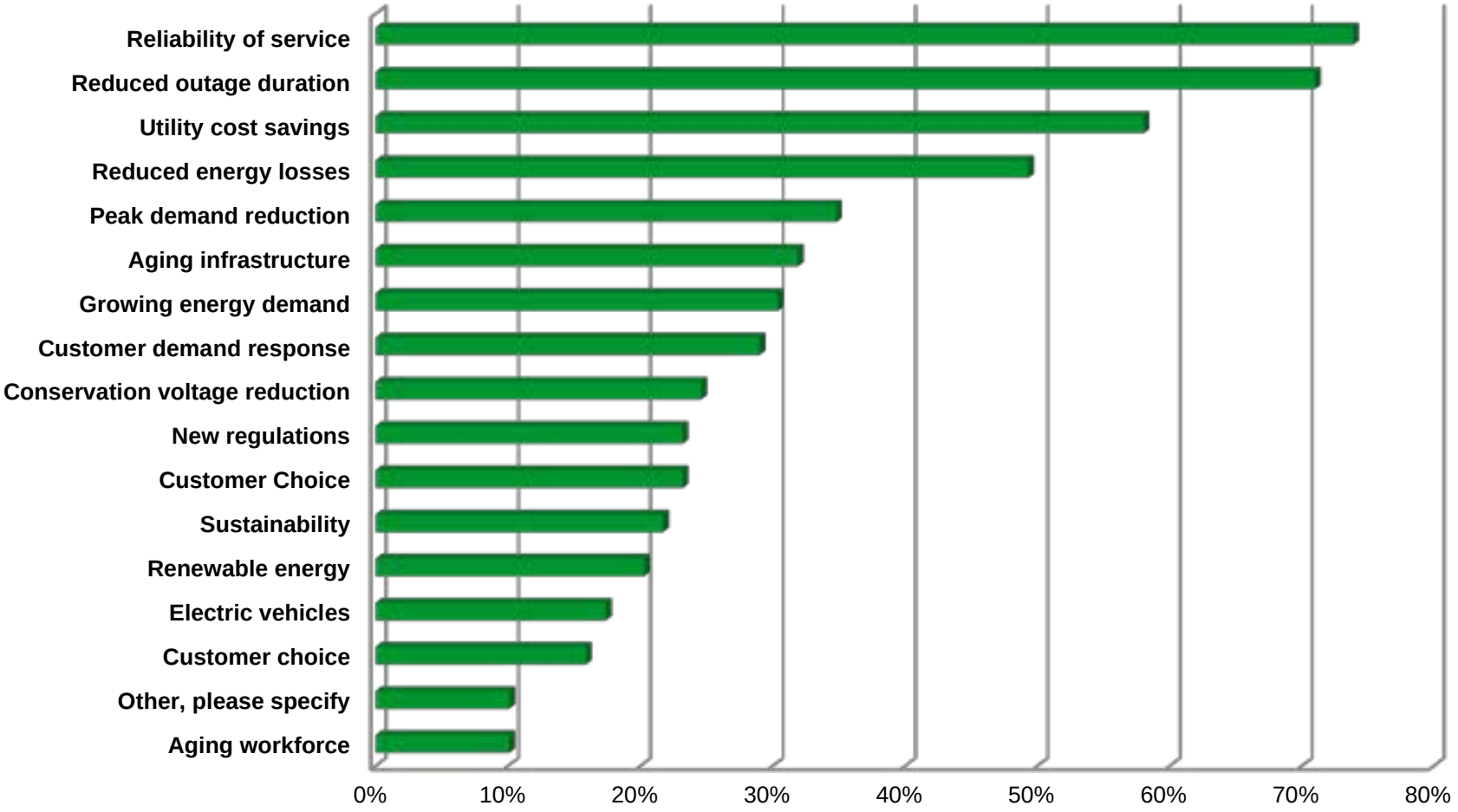
Key Business Problems for Utilities

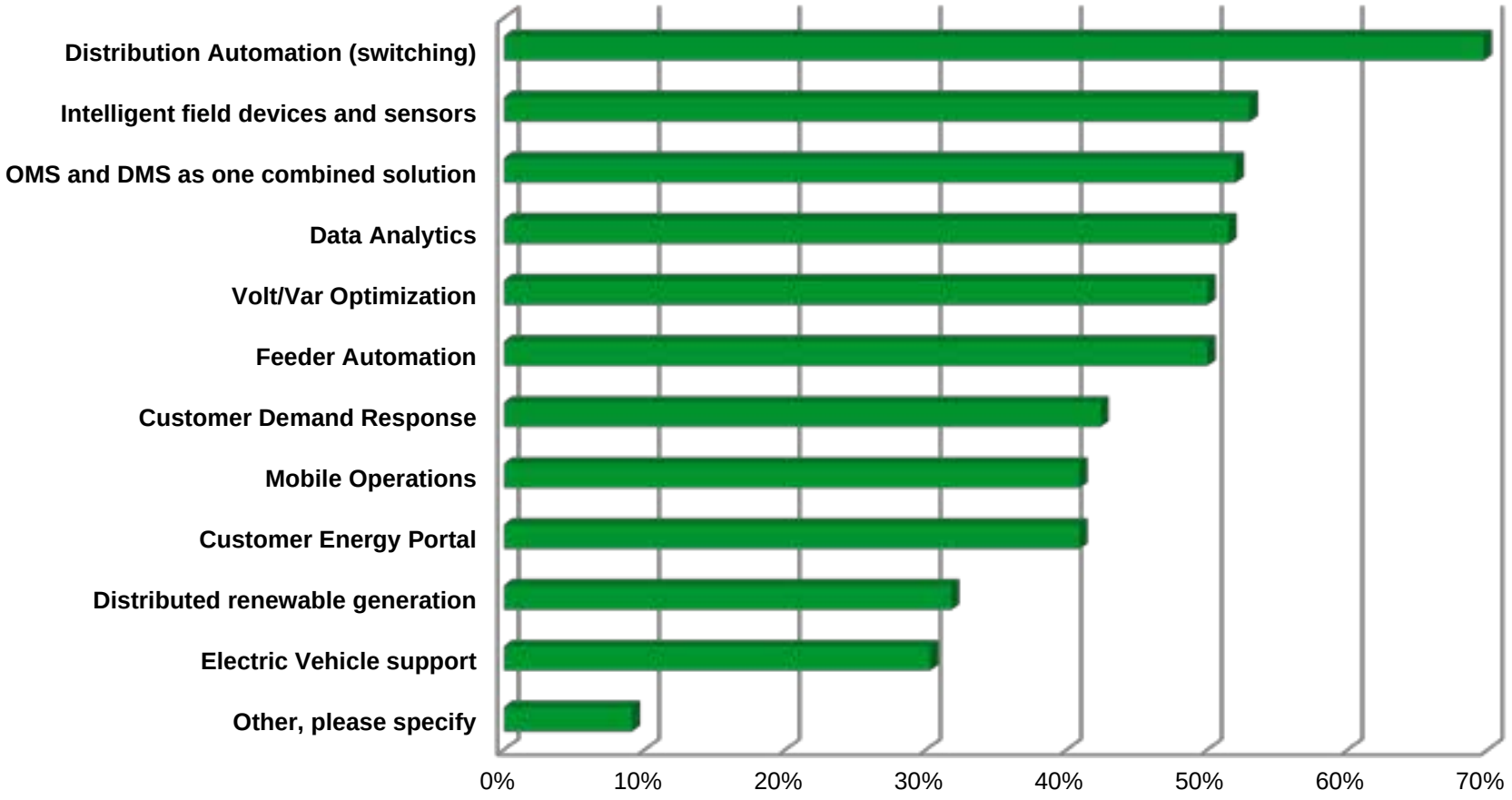


Successful Large Utility Upgrades (PSEG)

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

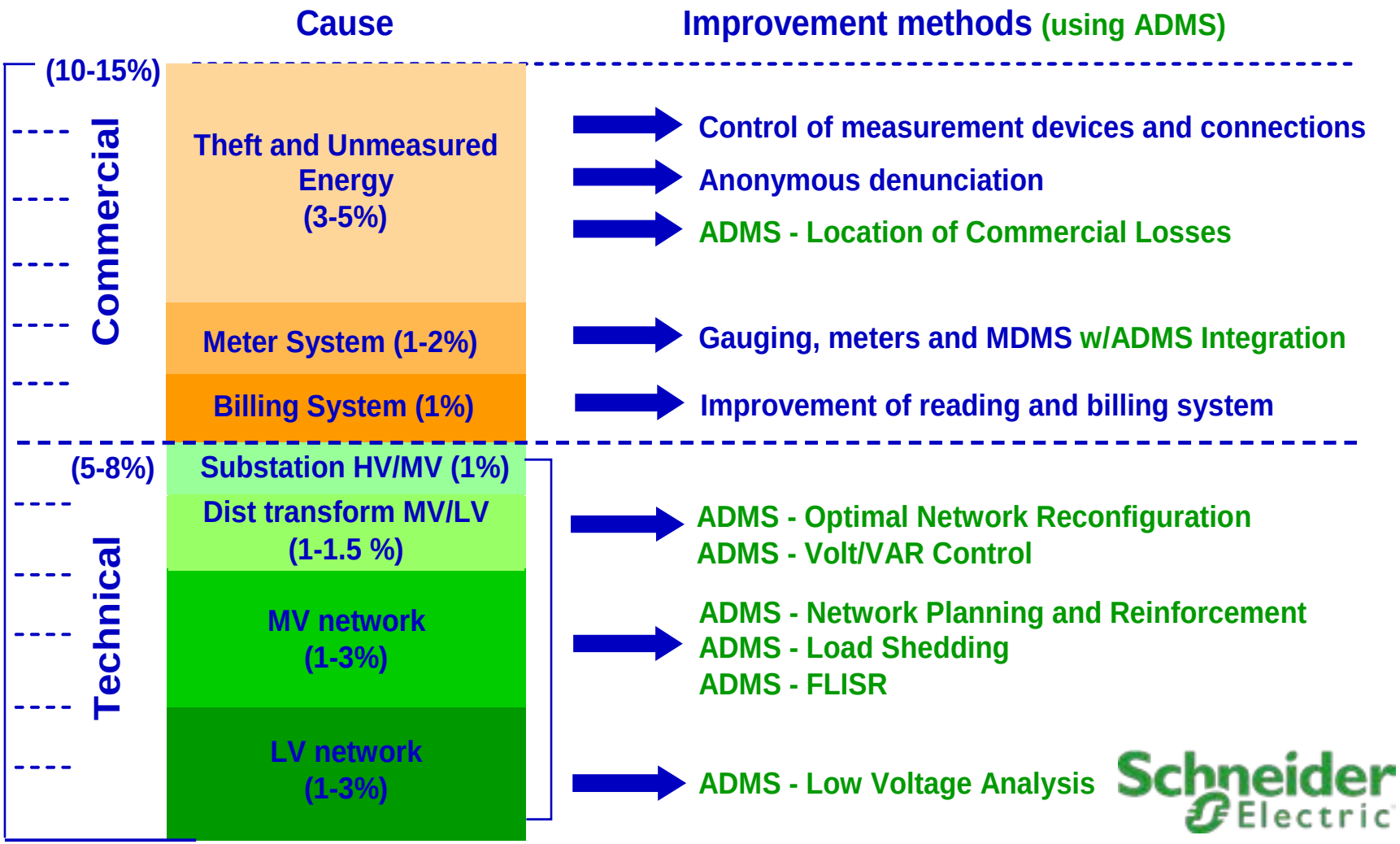
Source: Link 2012 Survey

Projects Under Consideration (Solutions)



Source: Link 2012 Survey

ADMS and SG Benefits



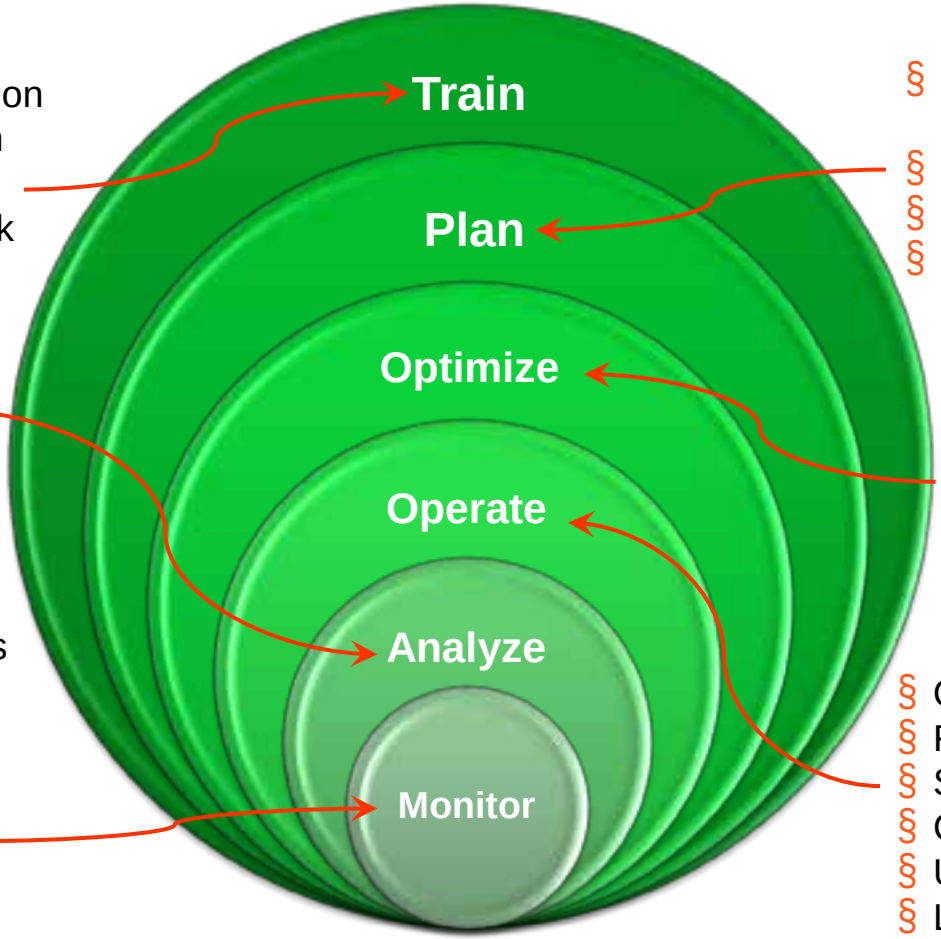
ADMS Functionality

ADMS Benefits
- **Safety**
- **Reliability**
- **Efficiency**
- **Standardized Training**
- **Unified Interface**
- **Advanced Analytics**

- Real-time Simulation
- Off-line Simulation
- What-if Analysis
- Historical Playback

- Load Flow
- State Estimation
- Energy Losses
- Fault Calculation
- Reliability Analysis
- Relay Protection
- Device Capability
- Contingency Analysis

- Telemetry
- Alarming
- Tagging
- Trending
- Reporting



- Medium and Long-term Load Forecasting
- Network Automation
- Network Reinforcement
- Optimal Device Placement

- Volt/VAR Optimization
- Network Reconfiguration
- Near and Short-term Load Forecasting
- Demand Response
- Distributed Energy Mgmt.

- Outage Management
- Fault Management
- Switch Management
- Crew Management
- Under-load Switching
- Large Area Restoration
- Load Shedding

Source Data Preparation

How do you get there?

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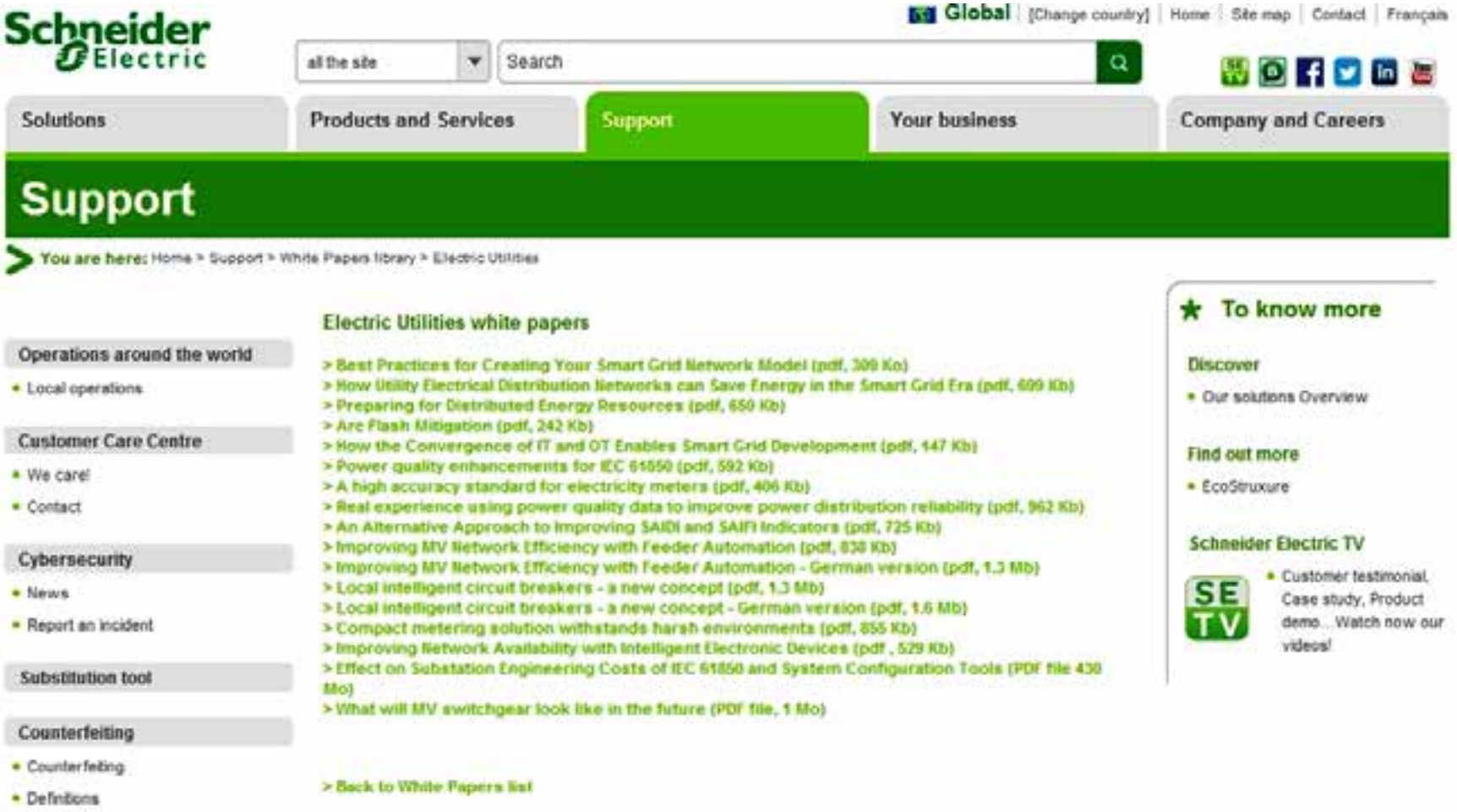
White Paper

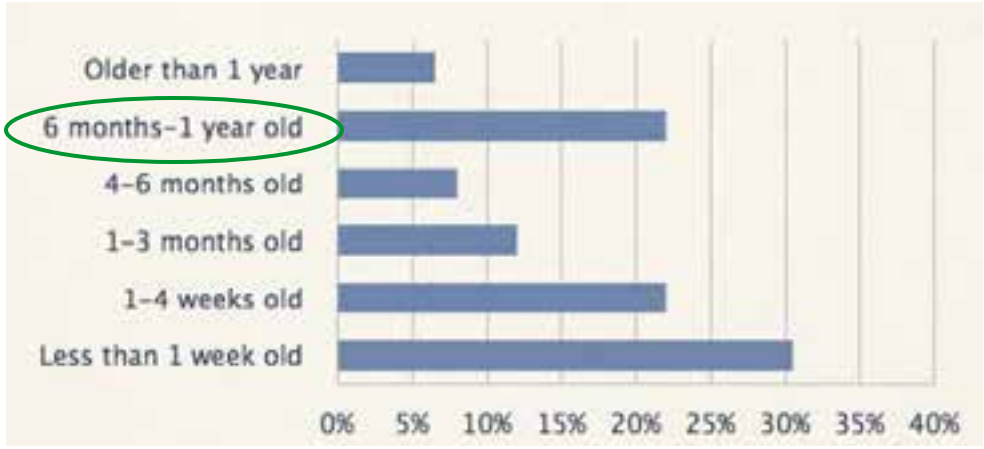
- Best Practices for Creating Your Smart Grid Network Model
- Schneider Electric – Electric Utilities White Papers



GIS Readiness

- ESRI survey of 226 utility companies on Smart Grid Readiness

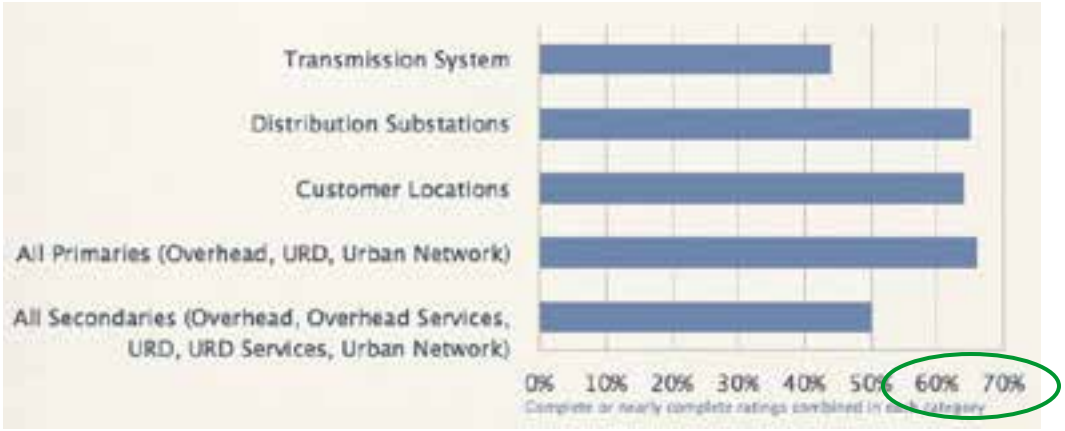
Lag between work completion and GIS



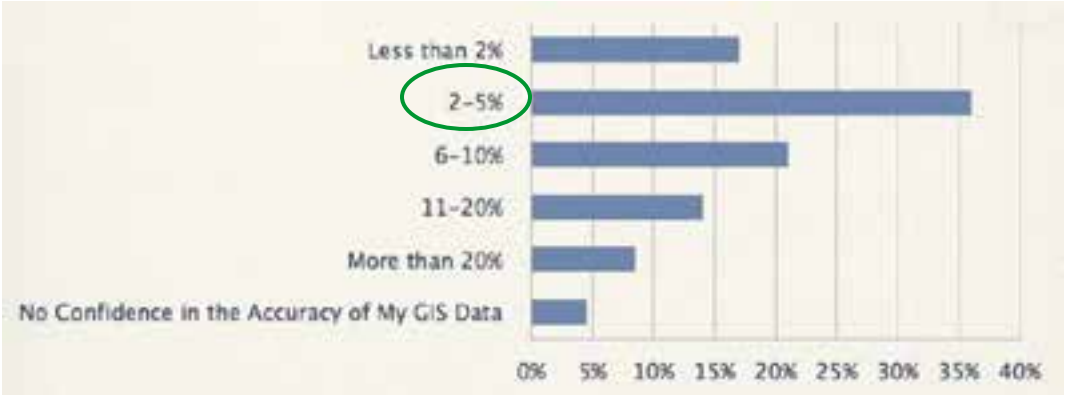
Age of oldest outstanding work order

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

GIS Readiness



GIS data completeness

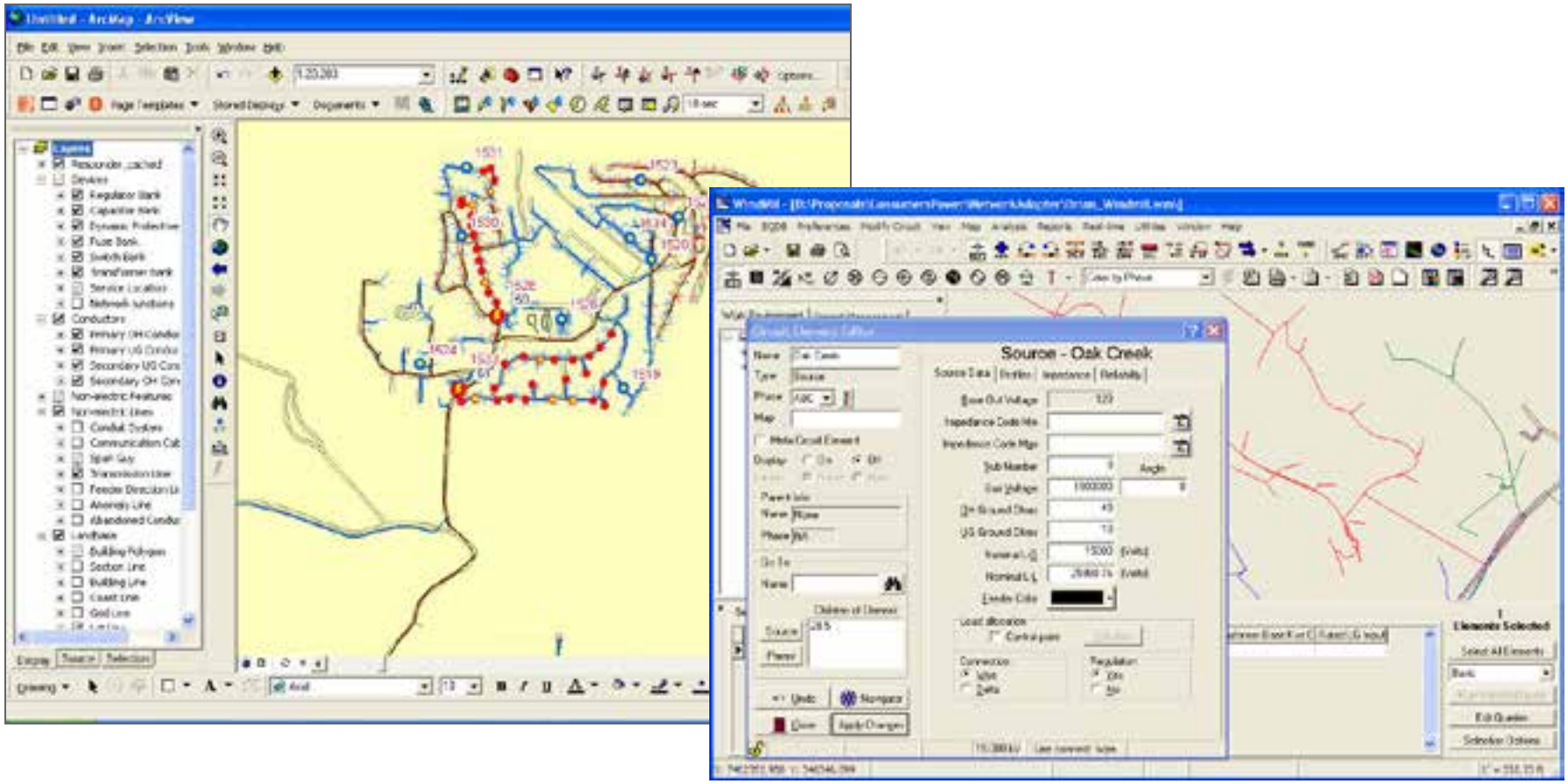


GIS data accuracy

Recommendation: Use a systematic process to improve accuracy and completeness

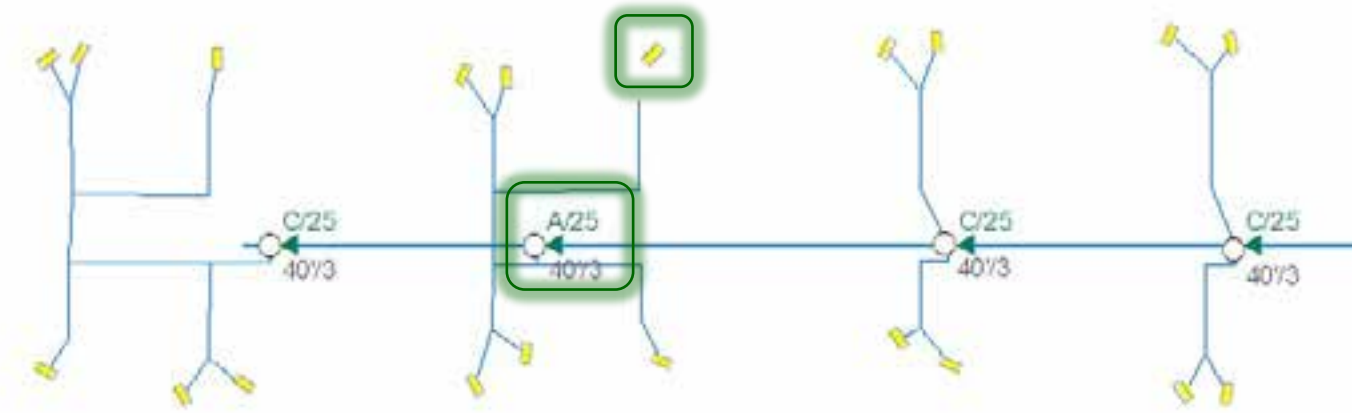
Increased Importance of Quality

- 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



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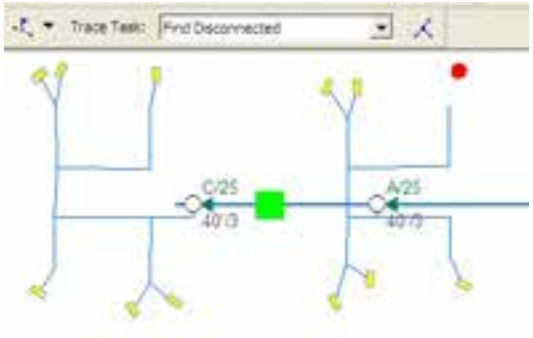
GIS Data Quality Problems

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

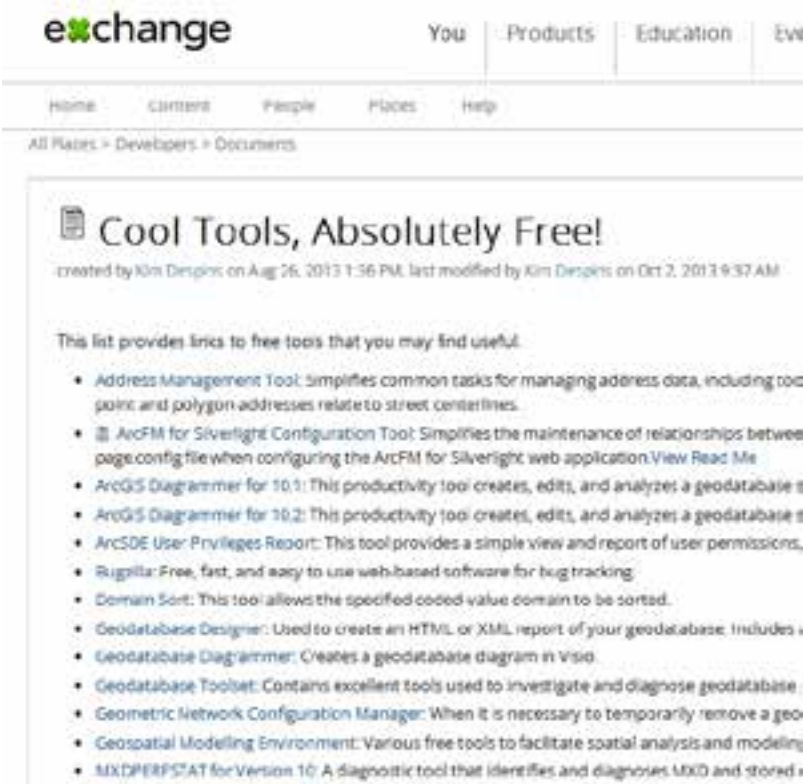
GIS Readiness

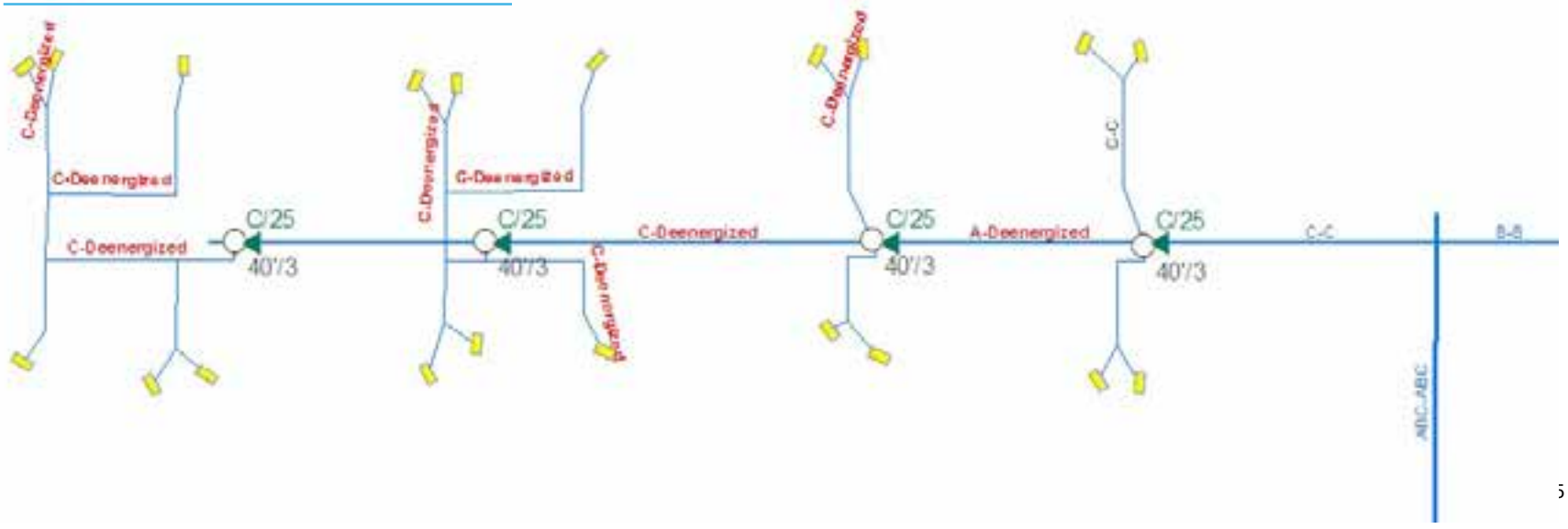
Find Disconnected Trace



Feeder Manager Phase Mismatch Labeltext Expression:

https://infrastructurecommunity.schneider-electric.com





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.

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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”

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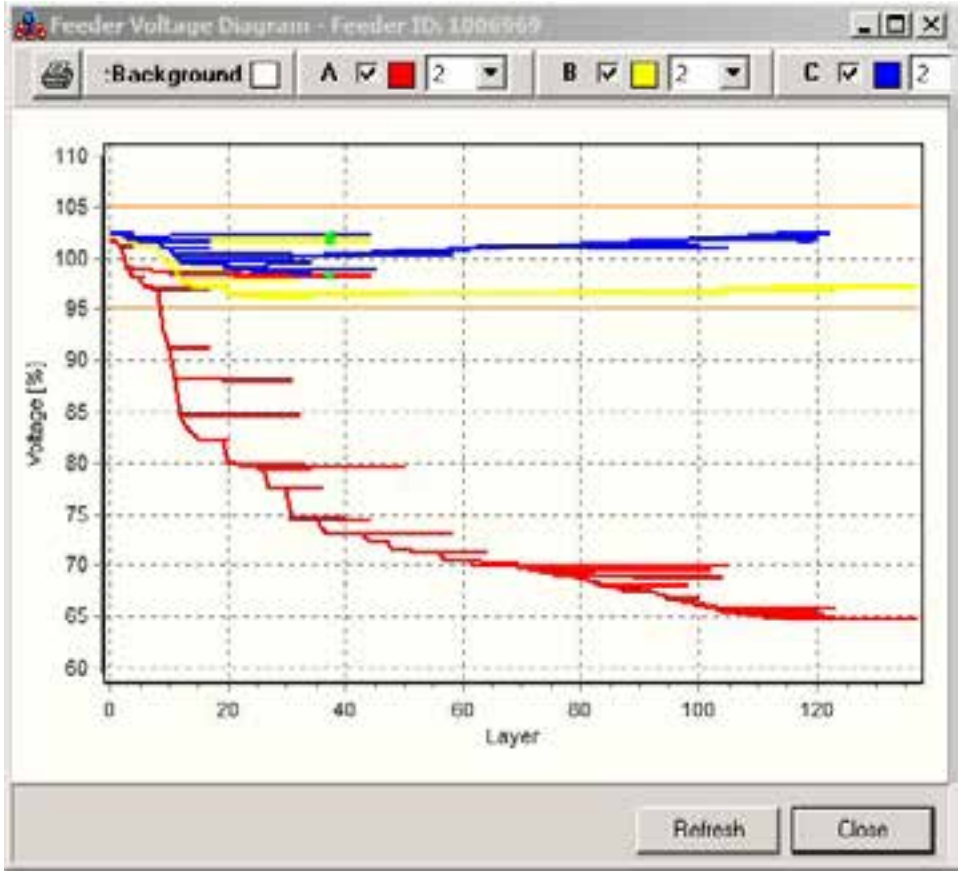
ADMS Internal QA/QC

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)																				
					Network Operation								DMS Core Apps & Training Simulator		Network Operation							Optimization of Network Operation				Network Analysis	
Element	Attribute	Unit	Type	Mandatory/Optional	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)	Volt/Var Control	Optimal Network Reconfiguration	Fault Calculation	Security/Contingency Analysis
Switch (LoadBreakDisconnect,Disconnect,Sectionaliser)																										
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	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	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	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

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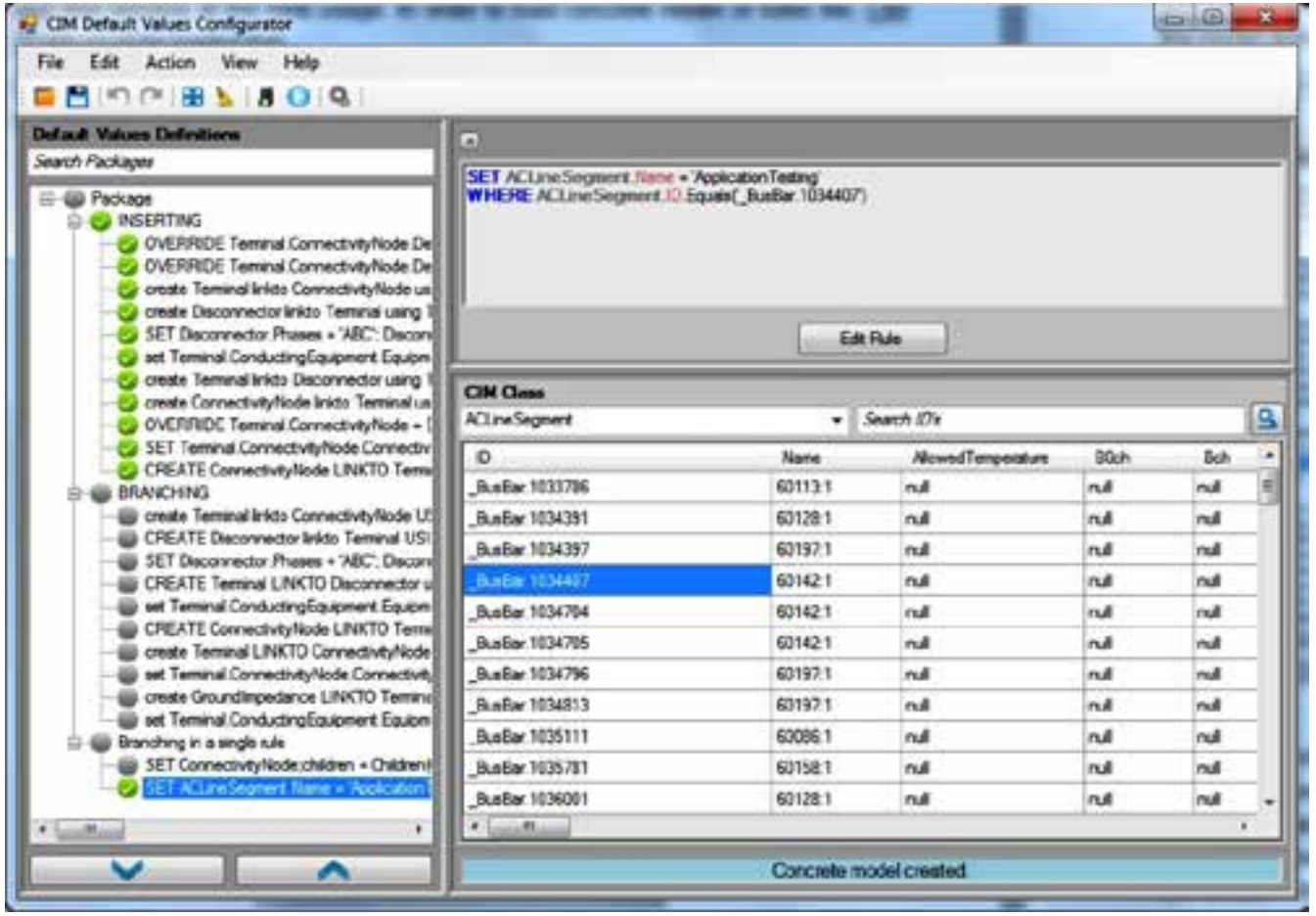
CIM Default Values Configurator



- **Add missing data**
- **Trap and update invalid data**

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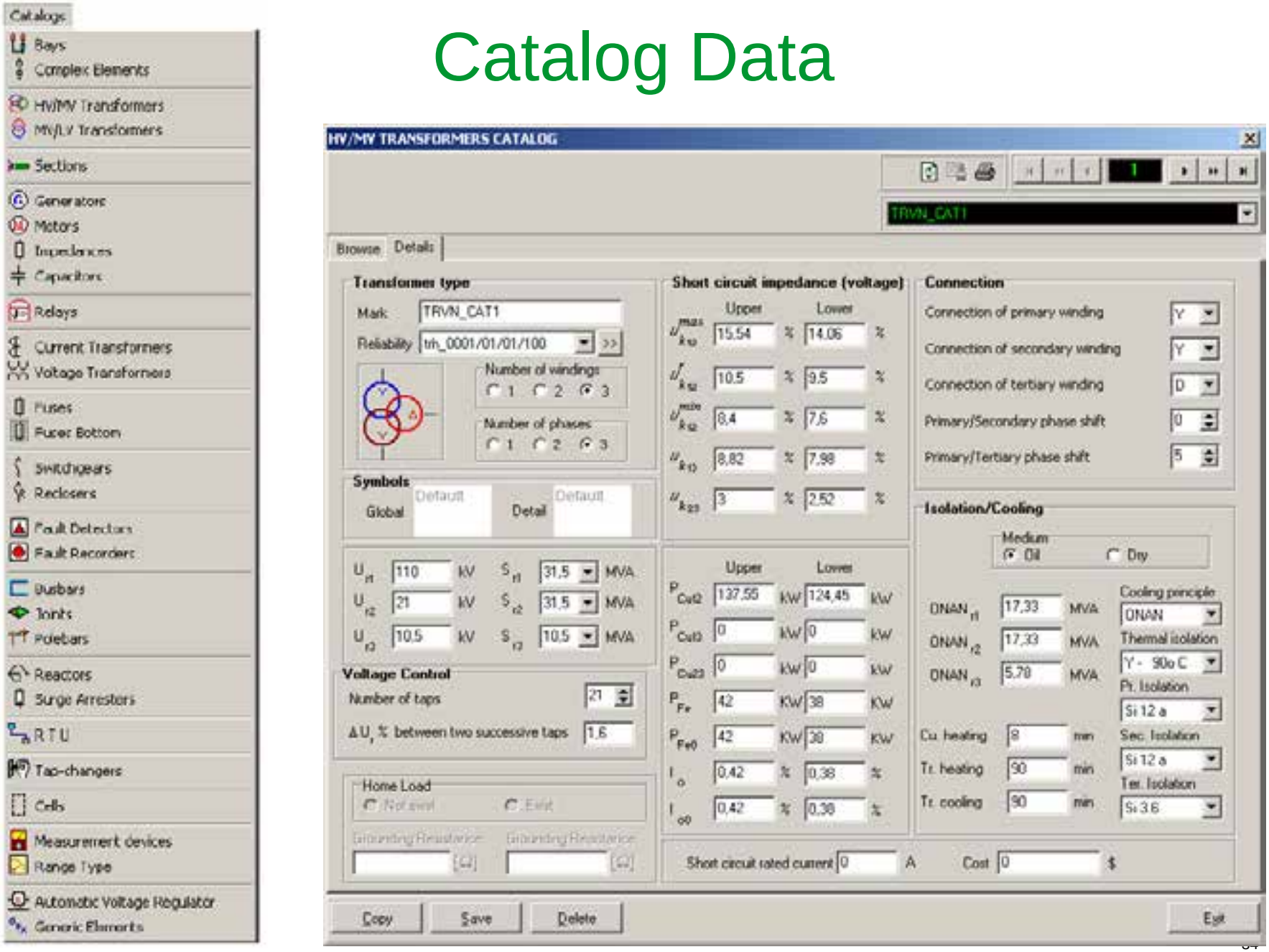
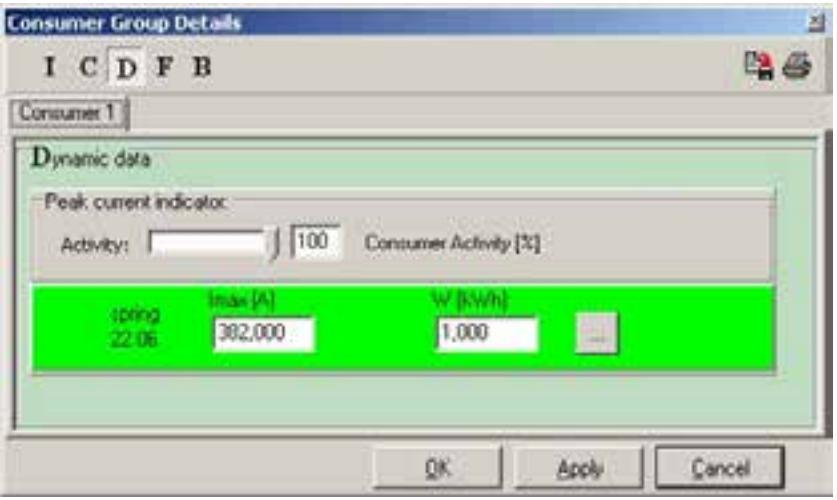
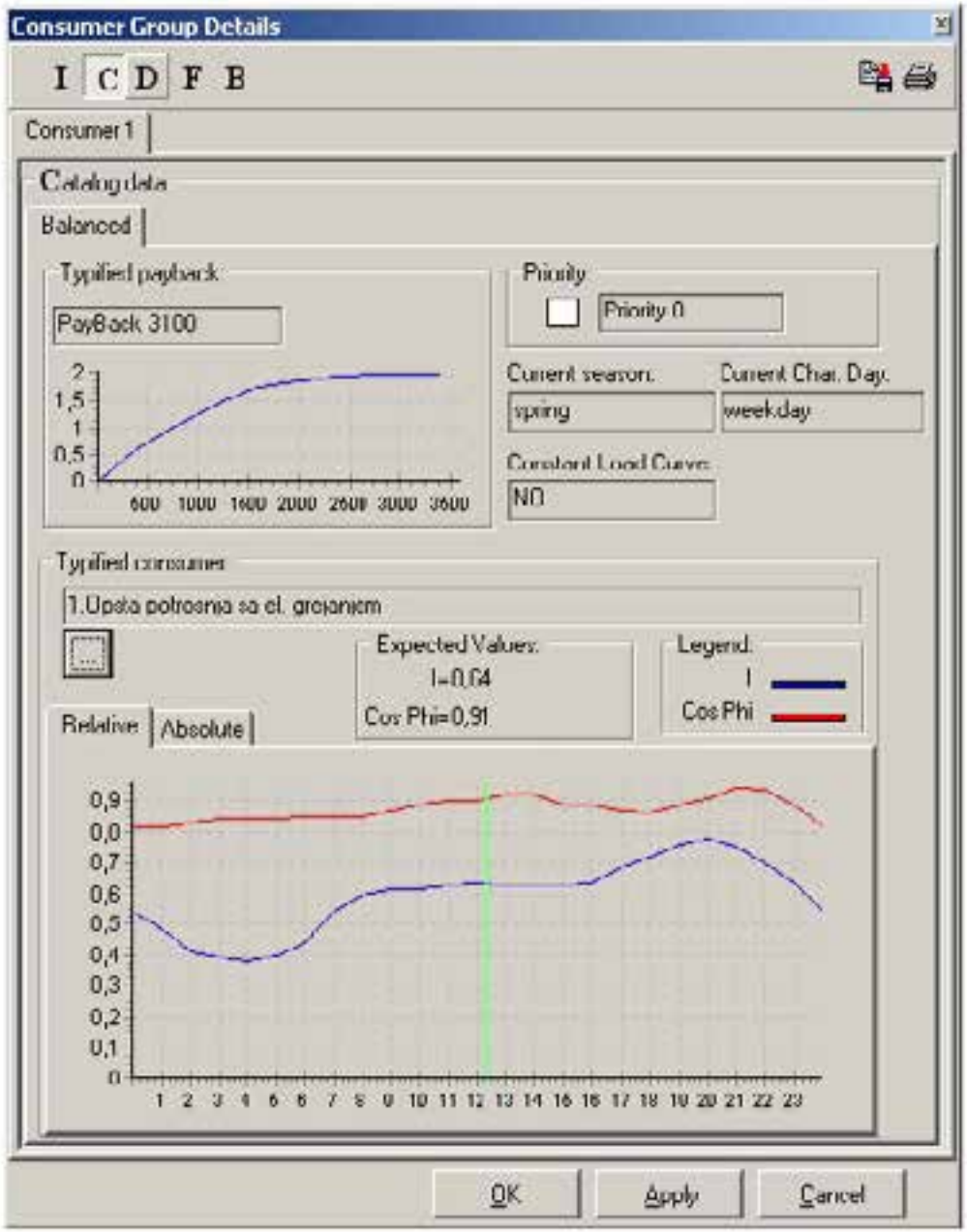
Catalog Data



Consumer Groups

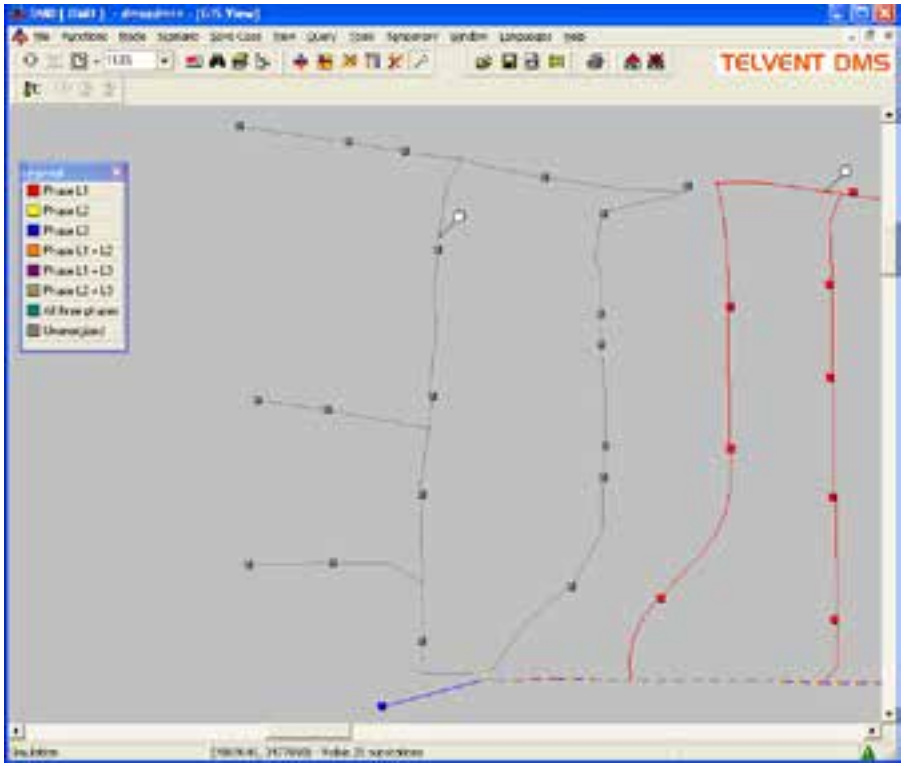
- Consumer loads aggregated into groups per transformer
- Groups can be generated from load data or tied to SCADA or AMI

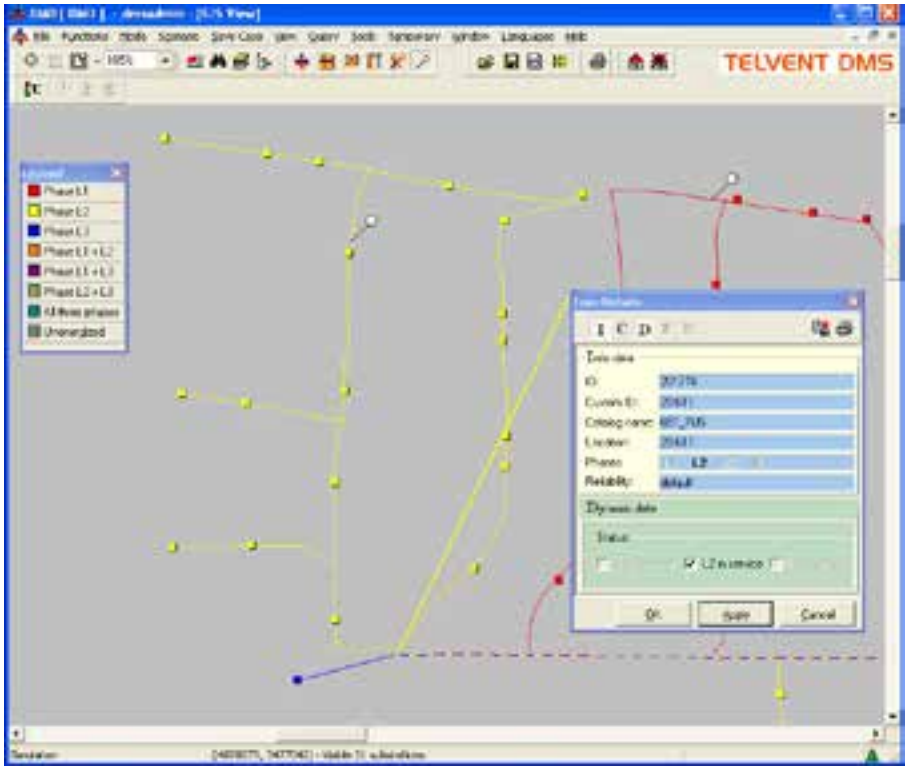




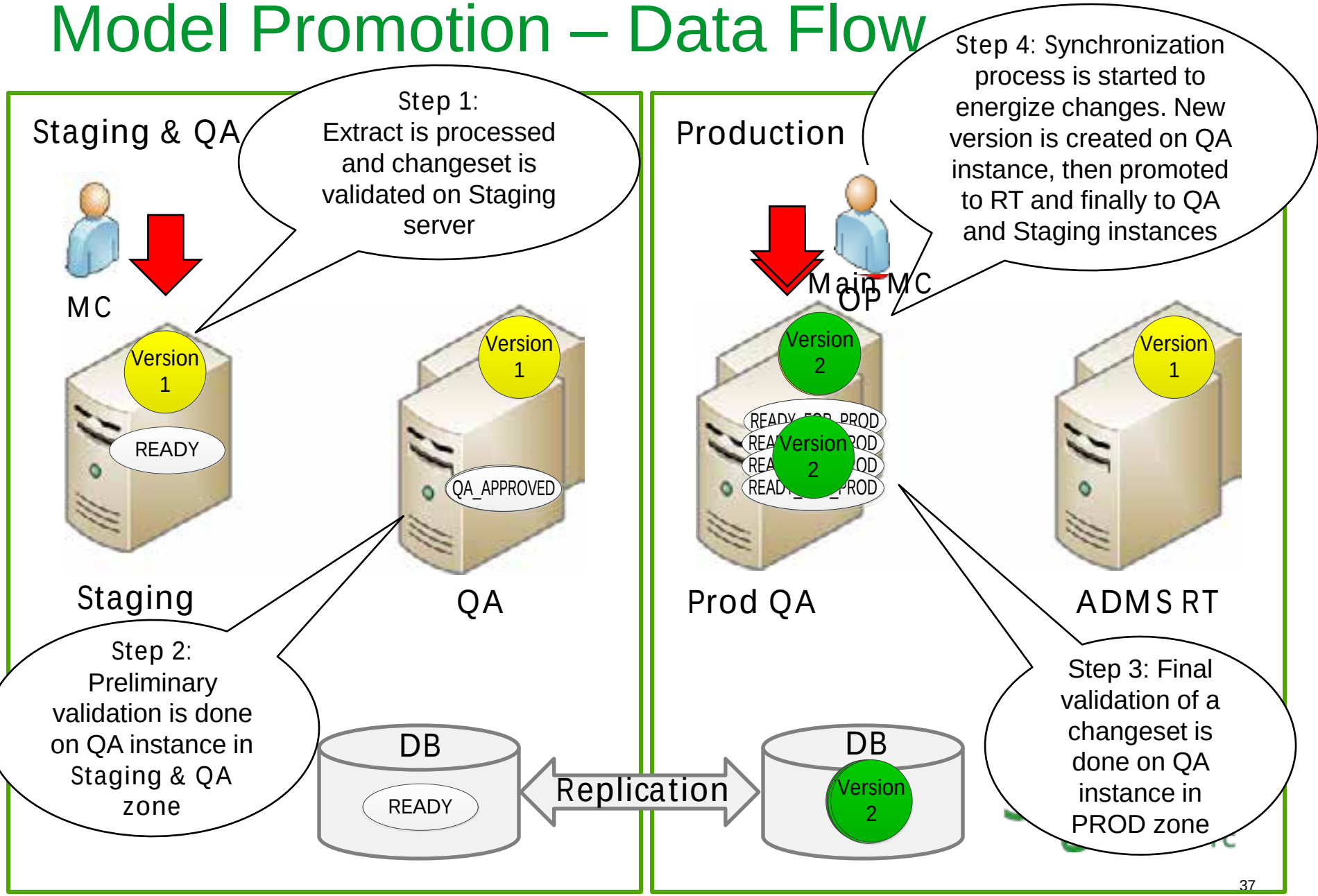
Expectations about States

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

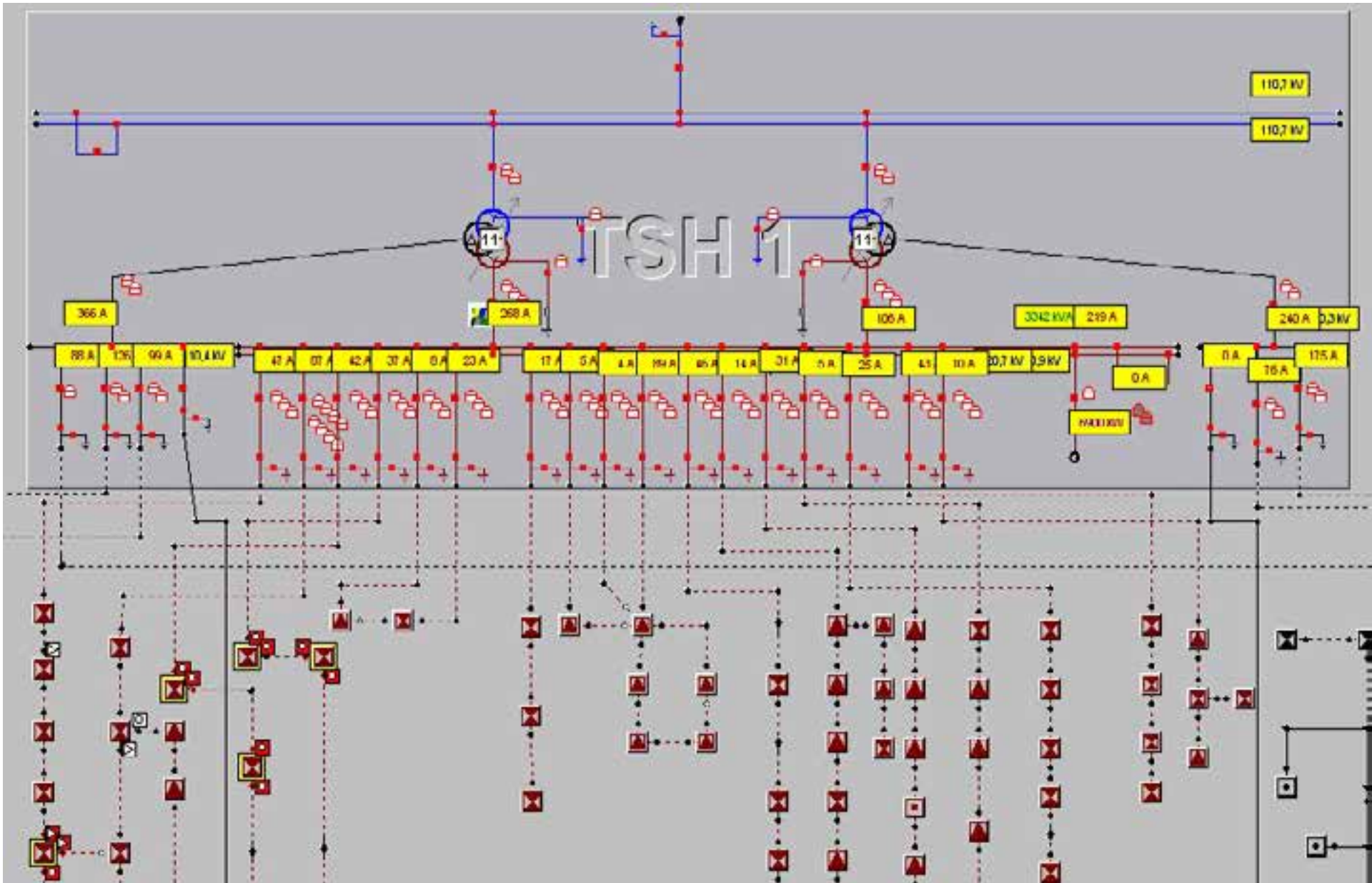




Model Promotion – Data Flow



Substation Internals



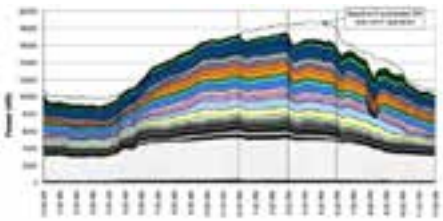
DG/DER/DR Data

- 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









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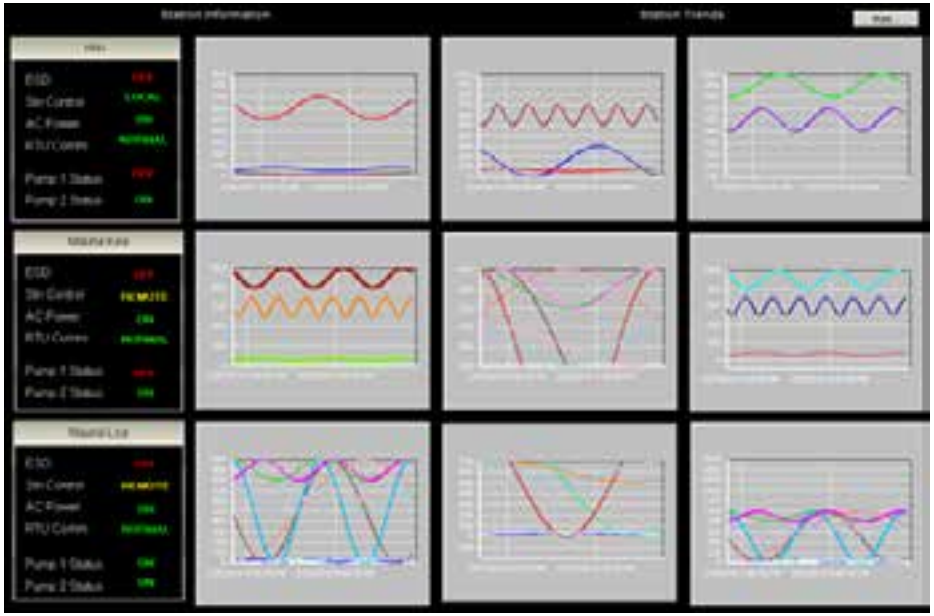
SCADA Points

- 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?

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Thank You!

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