



South Tulsa Switch Automation Pilot

Presented by:

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Abstract for SWEDE, 2010

Title: South Tulsa Distribution Automation Pilot

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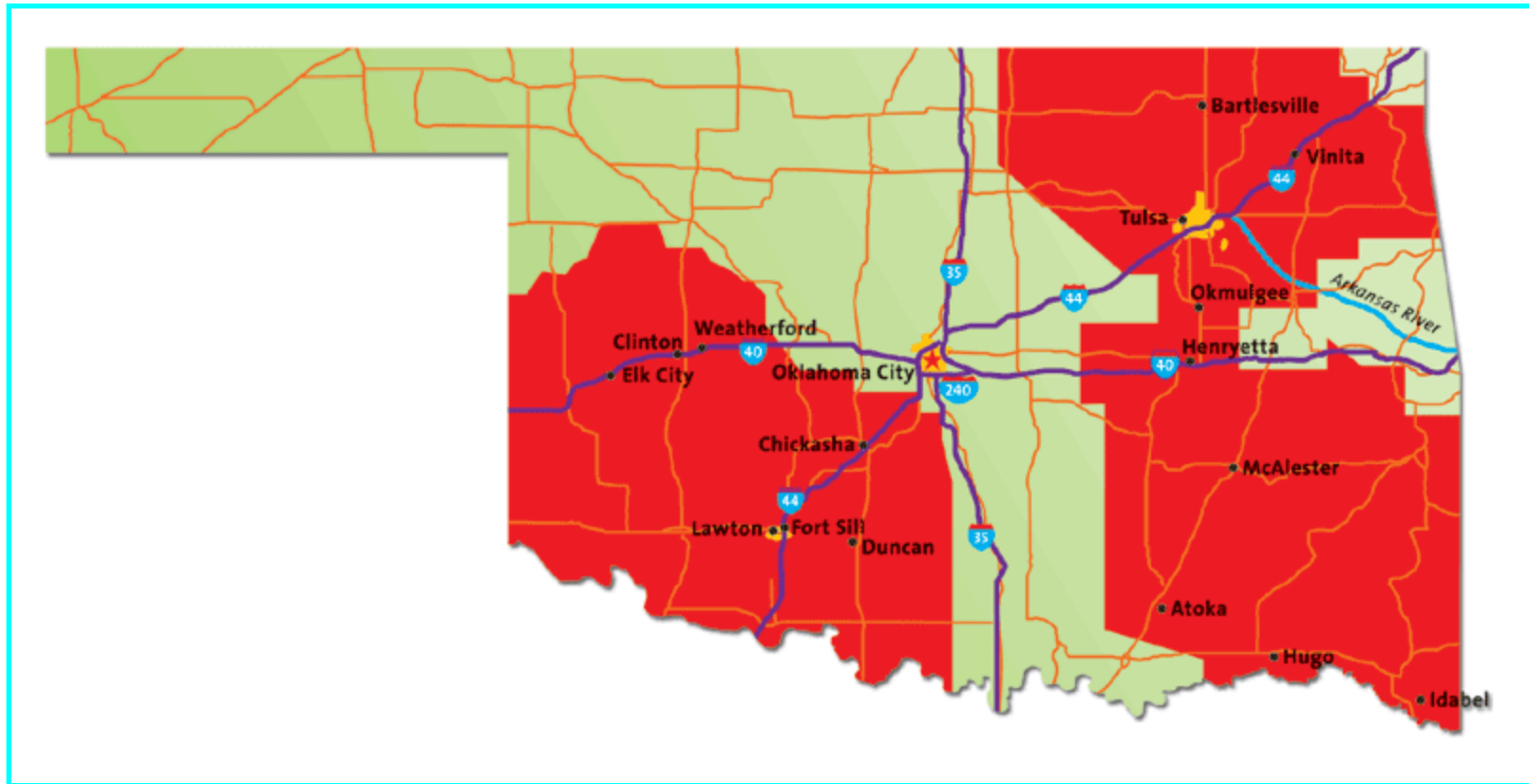
Title: Distribution System Planning Supervisor

Public Service Company of Oklahoma

A Subsidiary of American Electric Power

In 2006, PSO embarked on a multi-year program to implement a large scale distribution automation pilot for major overhead feeders serving the greater Tulsa metropolitan area. The pilot system, which was constructed in three phases, went into operation on July 27, 2009. This presentation highlights pilot area considerations, the Distribution Automation technology deployed, supporting project justification and operational performance issues.

AEP – Public Service Company of Oklahoma

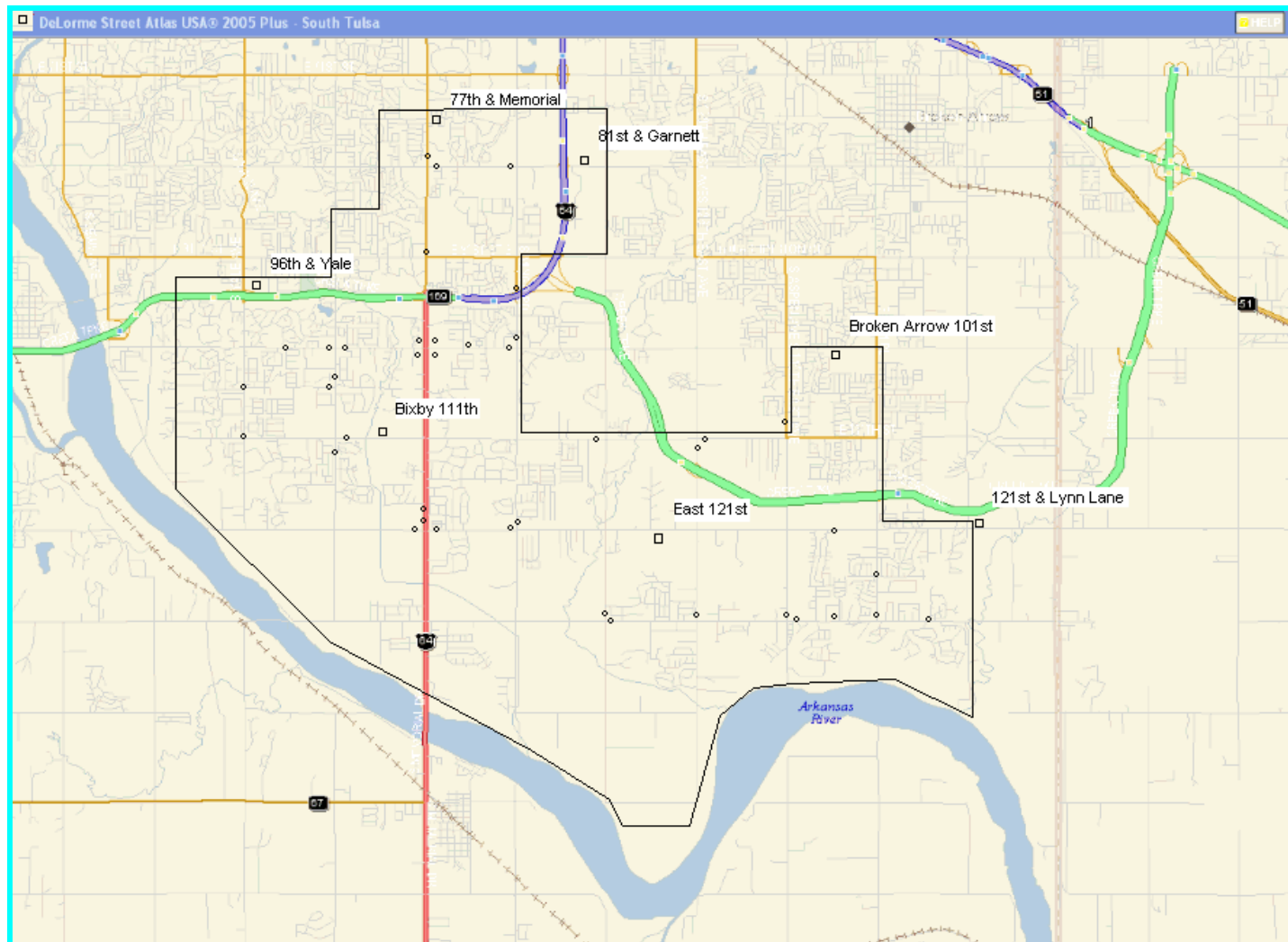


Pilot System Selection Criteria

- *Large footprint*
- *Residential area*
- *Outage history*
- *SCADA availability*
- *Cost control*
- *Supportable*
- *Expandability*
- *Proven technology*



South Tulsa Switch Automation Boundaries



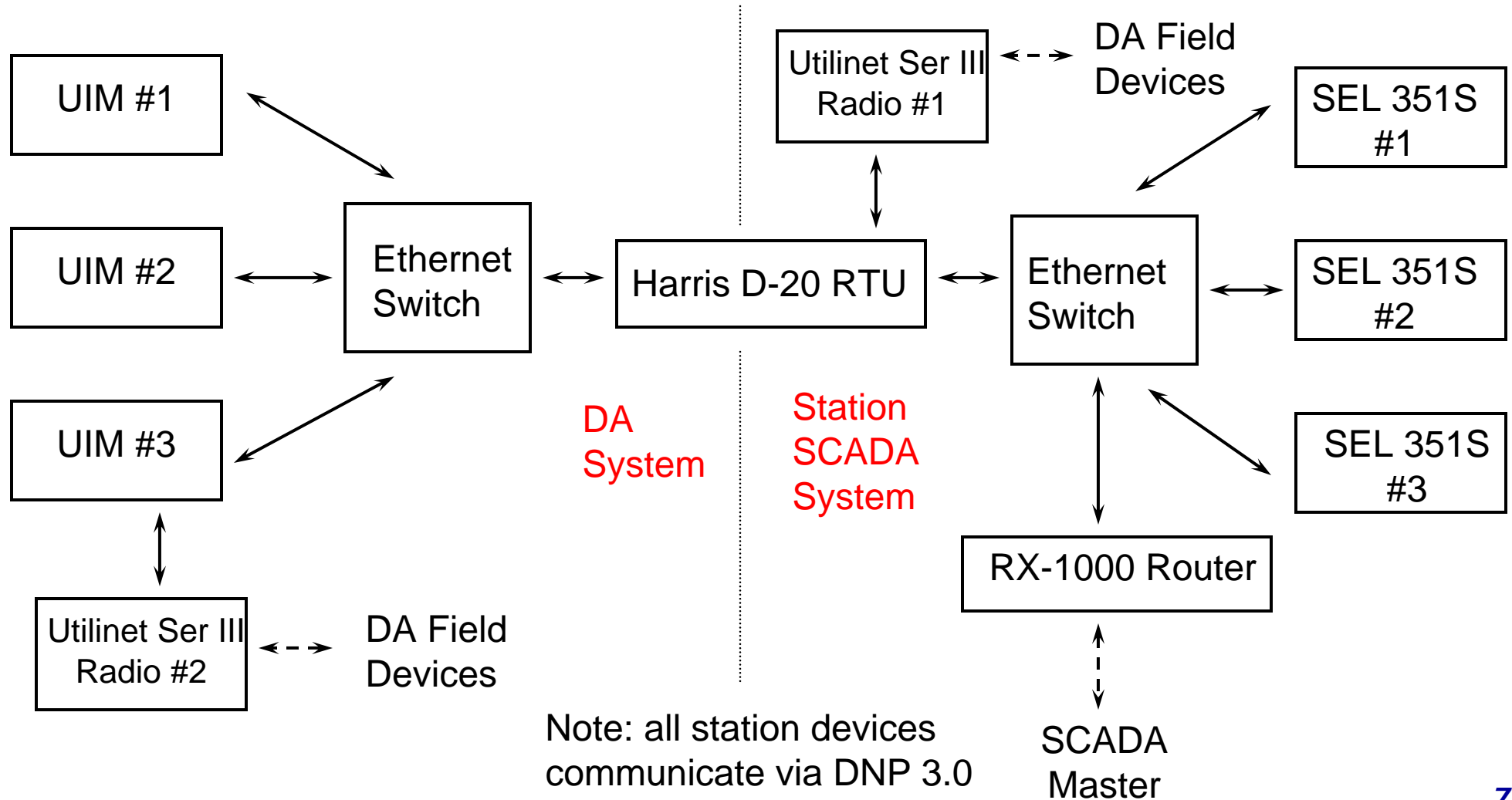
Scope of Project

- ***Forty-one (41) 14.4 kV, 900 A Scada-Mate switches with IntelliTeam II controls***
- ***Twenty-nine (29) repeater radios***
- ***Automates portions of nineteen (19) 13.8 kV circuits in south Tulsa and south BA areas***
- ***Four (4) station SCADA interface points – 96th & Yale, 81st & Garnett, 121st & Lynn Lane, East 121st St***
- ***IntelliLink Remote interface from two (2) stations – 96th & Yale, 81st & Garnett***

Communication

- *Utilinet® Series III IWR radios with 900 MHz spread-spectrum technology in switch controls and 4 stations*
- *29 – Utilinet Series III WanGate radios (repeaters)*
- *3 dBd gain omni-directional antennas at each switch*
- *9 dBd gain omni-directional antennas at station interfaces*
- *DNP 3.0 protocol from switch controls to station RTU*
- *Presently TRW 9550 protocol between station RTU and SCADA master*
- *Conversion to Harris 5000/6000 protocol required*
- *1/4 of switches mapped to each station interface to reduce latency times*

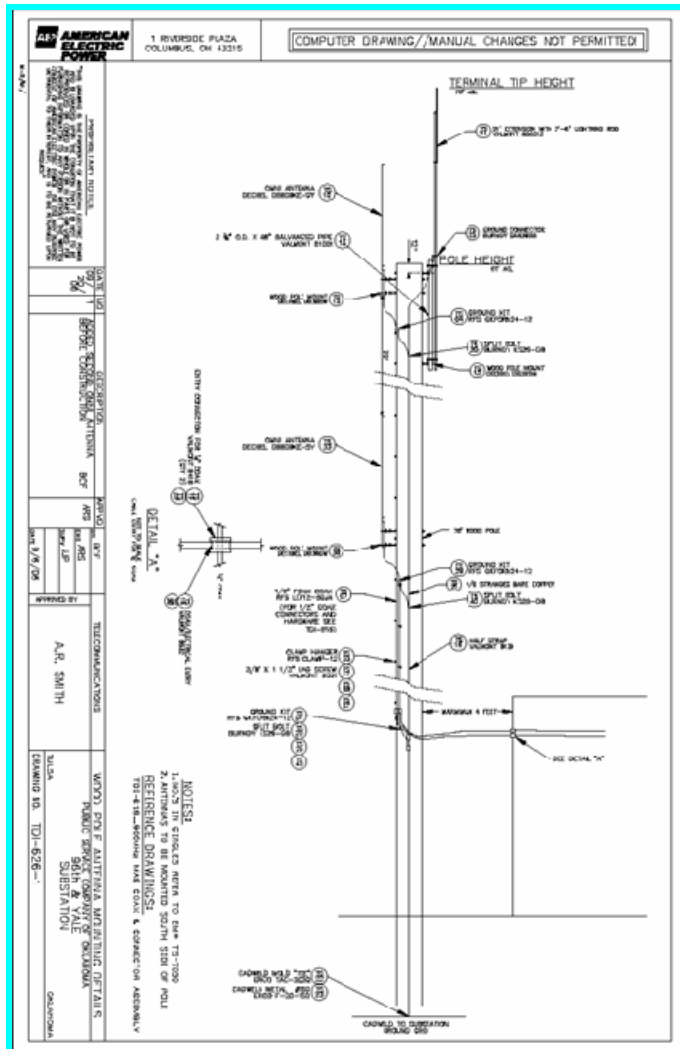
East 121st DA SCADA Interface



East 121st DA SCADA Interface - cont'd



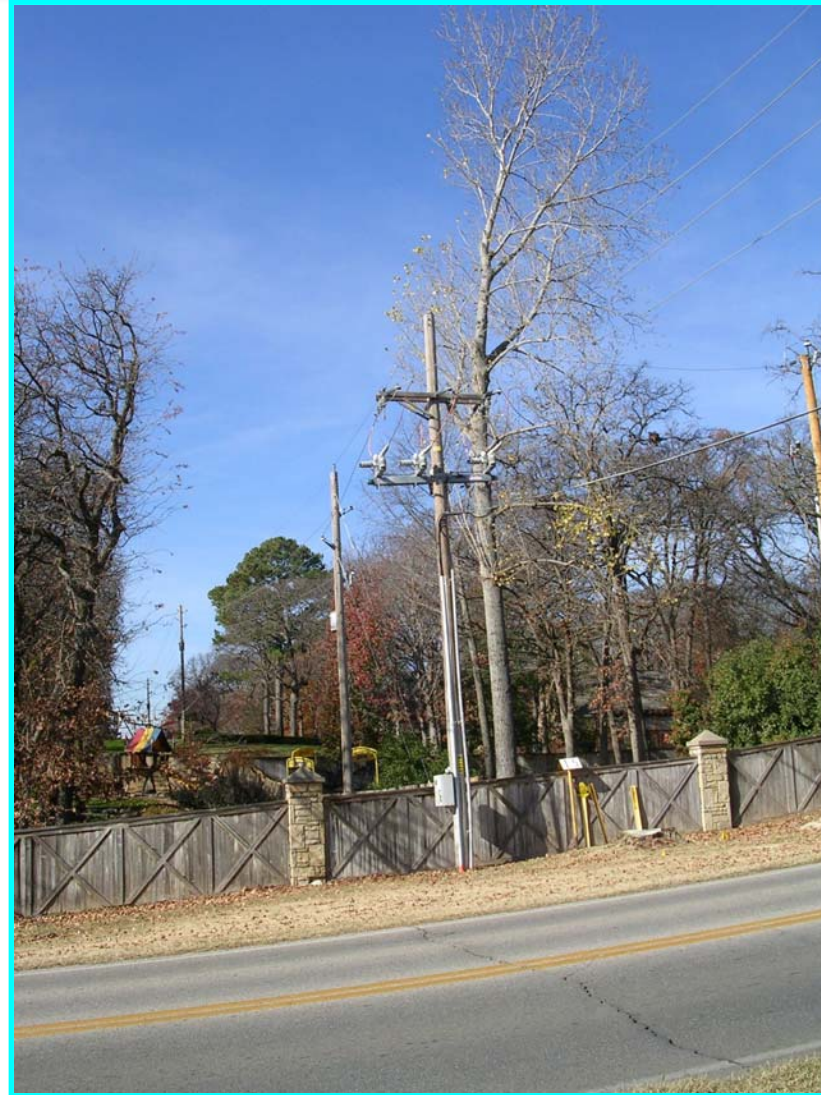
Station Antenna / Scada-Mate (Typical Installation)



South Tulsa Switch Installations



South Tulsa Switch Installations



South Tulsa Switch Installation - Final State & Station Radio Interface



Repeater & Source/Sub Switch Installation



Information Choices

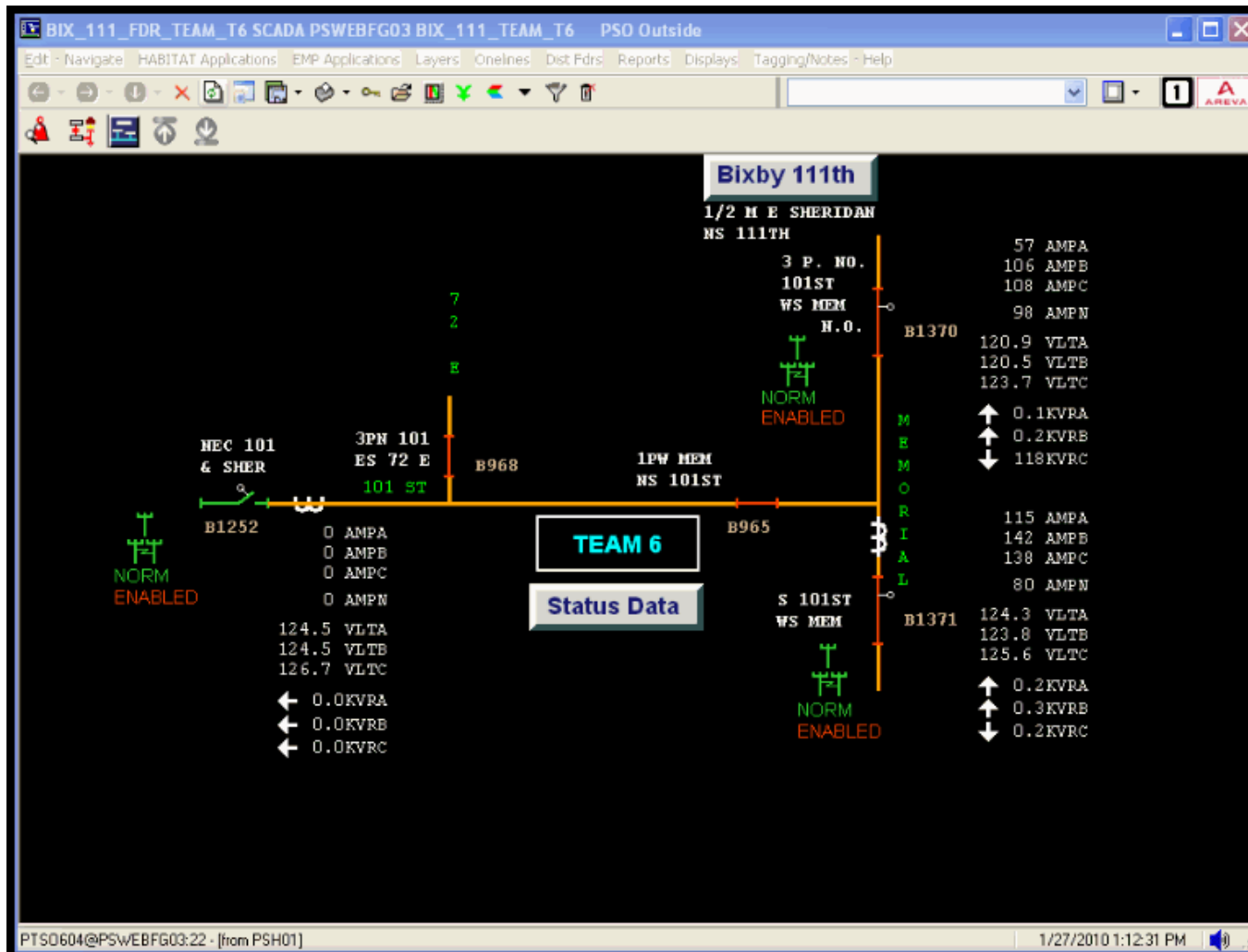
■ **Switch I/O Availability**

- **38 status points (i.e., switch open/close, fault indication, battery status)**
- **26 analog inputs (i.e., measured quantities such as 1ph current/power)**
- **4 analog outputs (i.e., real-time average feeder loading – amps)**
- **1 binary counter (number of switch operations)**
- **1 frozen counter (number of operations prior to freeze)**
- **9 control outputs (i.e., close/open switch, enable/disable automatic operation)**

South Tulsa Automation Pilot SCADA Points

- ***28 SCADA Points per Switch Control***
- ***Analog Input Points – (per phase voltage/current, neutral current, per phase MVAR)***
- ***Status Points – (open switch, closed switch, automatic operation enabled, visual open contact, remote/local, battery low, battery bad, cabinet door opened, per phase overcurrent fault indicator, ground fault indicator, switch control not transfer ready, not all teams transfer ready, real-time load data invalid)***
- ***Control Output Points – (trip/close, auto/manual)***
- ***Analog Output Points – (real-time feeder loading – amps)***

SCADA DA Panels – Team Display

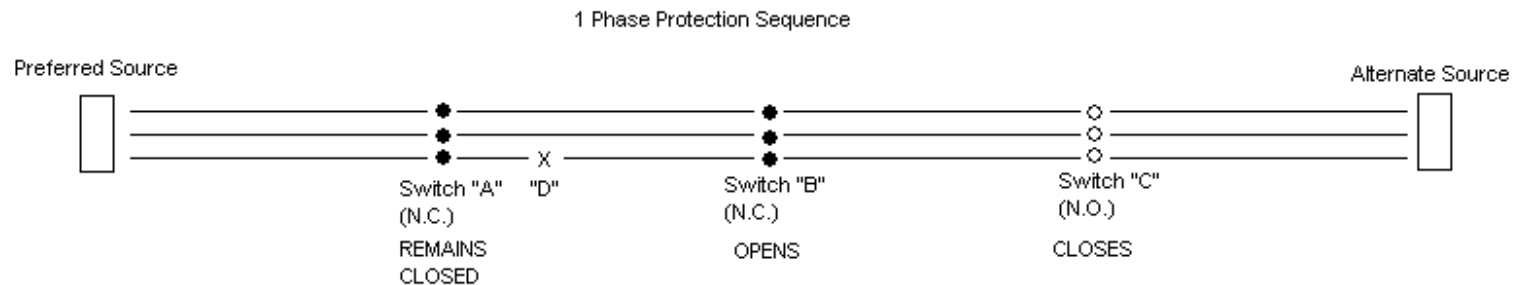


SCADA DA Panels - Status Display

	SW # STATUS ONLY	MEMBER READY	ALL TEAMS READY	AUTO	SUPV CO	BATT LOW	BATT TRBL	SECURITY	PHASE A	OVERCURRENT			FAULT	
										PHASE B	PHASE C	GROUND	WATCHDOG	LOAD VALID
Team 16														
Fdr XK-1														
	B2192	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	ALARM
	B1788	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
	B1326	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
Team 17														
Fdr XK-5														
	B1011	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
	B1788	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
Team 18														
Fdr XK-5														
	B1011	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
	B1010	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
	19A_XK	⊗	⌋	19A LOV ENABLED				19A PROHIBIT REST DISABLED						
Team 19														
Fdr XK-5														
	B851	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
	B1010	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
	B1754	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	ALARM
Team 20														
Fdr ZJ-8														
	B754	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
	B2072	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM
	B1754	⌋	⌋	ENABLED	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	NORM	ALARM

Conditions for Transfer

- **Fault current counts – (open before lockout)**
- **Voltage loss counts – (source-side outage)**
- **Extended loss of voltage – (loss of source)**
- **Single-phasing – (loss of 1 or 2 phases on source side)**

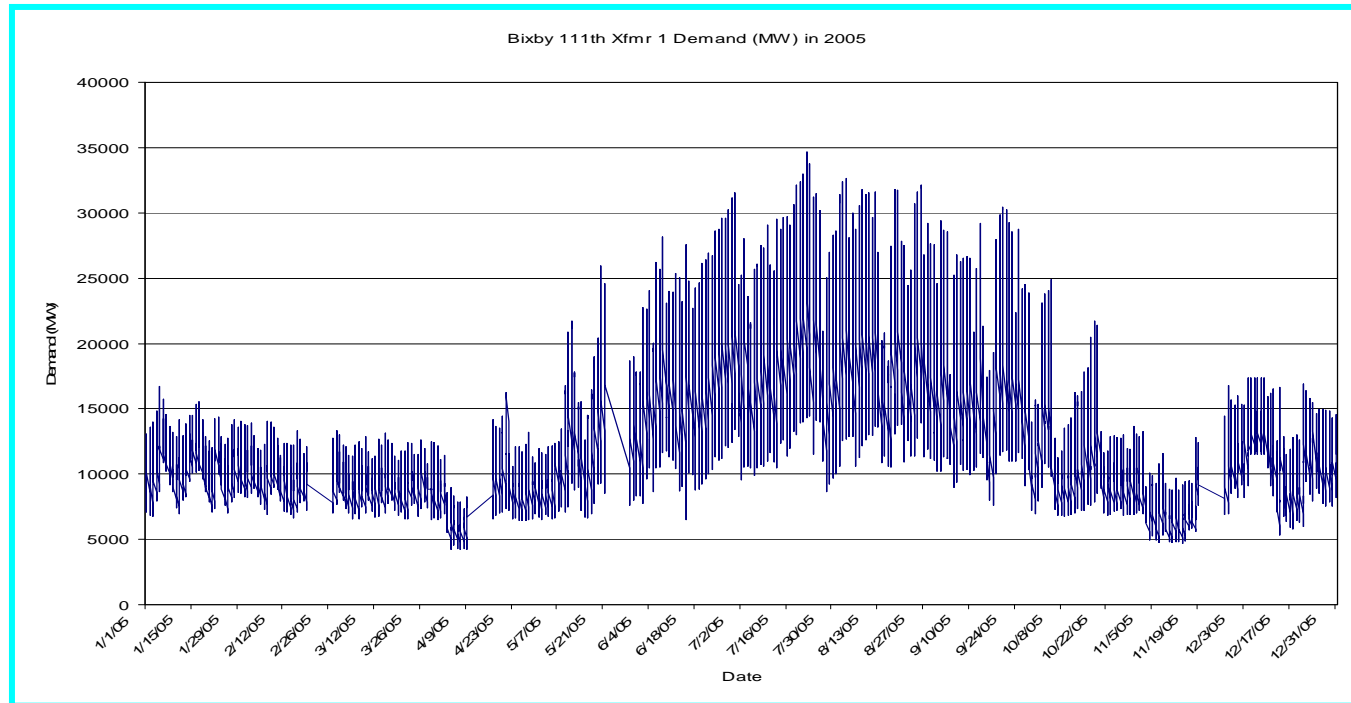


1. fault initiates at point "D" which breaks line in clear
2. at this point 2-ph power from "D" to "C" and 3-ph power from Preferred Source to "D"
3. Switch "B" opens
4. Switch "C" closes restoring maximum amount of 3-ph service area

Why Do It?

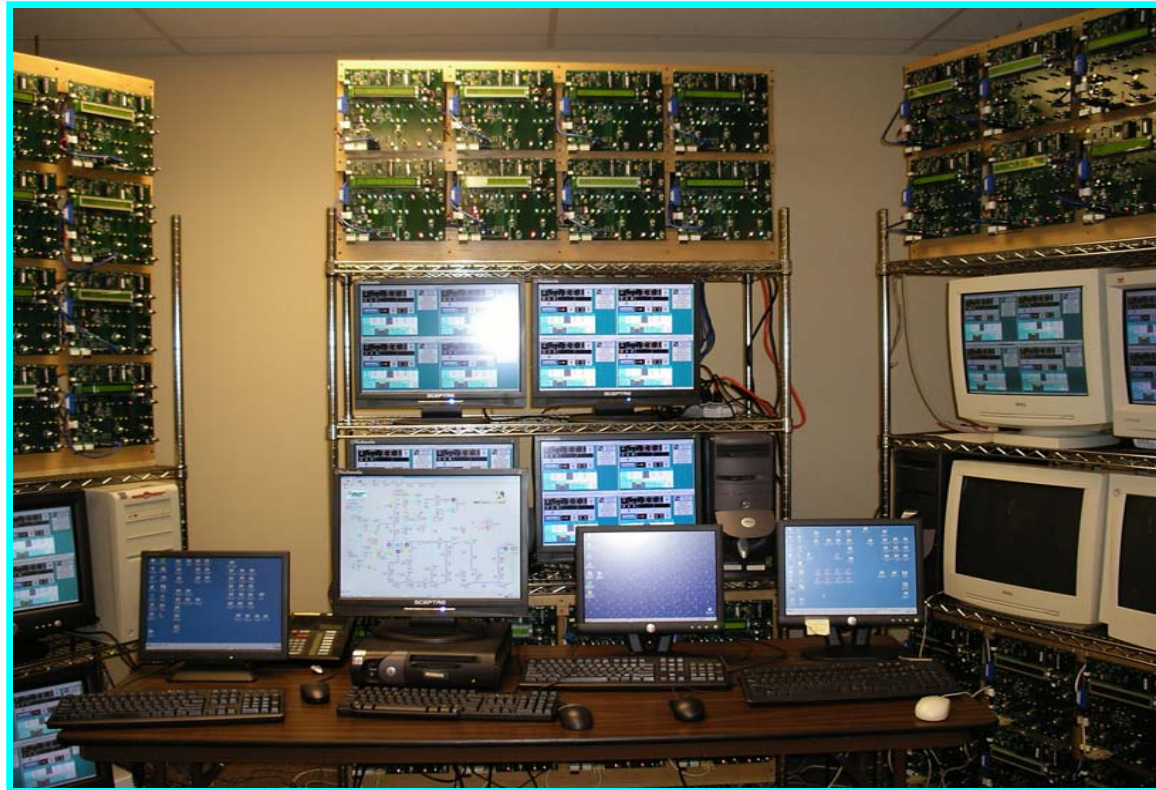
- ***Target circuits on average experienced 0.75 breaker lockouts per year (2002 – 2004)***
- ***15,359 customer outages (breaker lockout)***
- ***Net customer outage reduction of 8294 outages (projected) with automated switch application***
- ***Associated customer outage minute reduction between 497,640 CMI (60 minute switching) and 1,492,920 CMI (180 minute switching)***
- ***\$244 per avoided customer outage***
- ***\$1.35 to \$4.06 per avoided CMI***
- ***Utilization rates on circuit and station level of 60.7% and 67.8%, respectively, in August 2004***

Annual Load Duration



- **No. hrs. at 90% - 100%; 44 of 8088 (0.54%)**
- **No. hrs. at 80% - 89%; 227 (2.81%)**
- **No. hrs. at 70% - 79%; 387 (4.78%)**
- **No. hrs. at 60% - 69%; 480 (5.93%)**
- **No. hrs. at 50% - 59%; 501 (6.19%)**

Simulation of Phase I,II System

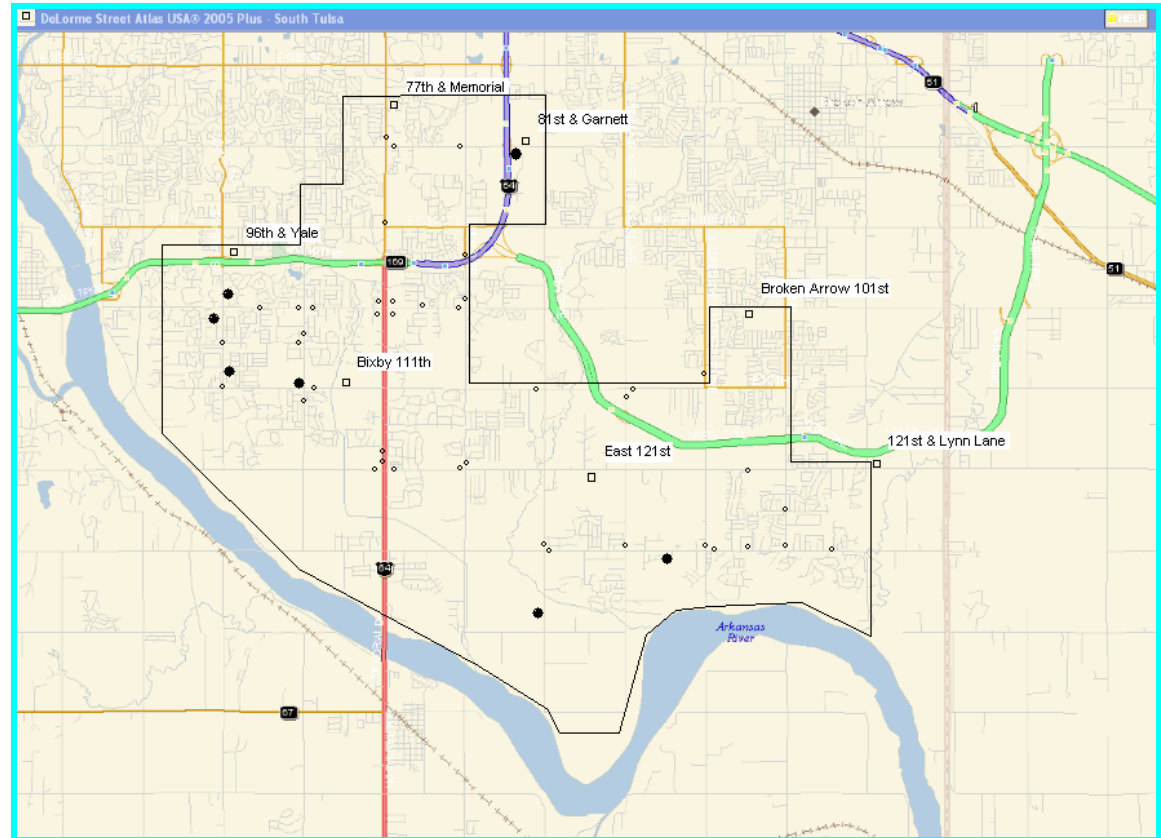


- *Duvall, WA simulation with 40 controls*
- *5801 controls communicate via Utilinet*
- *4 controls per display for viewing action*
- *Wave Form Generator injects analogs, simulates faults, loss of sources, etc.*
- *Instant Replay summarizes results for utility*

Fault Event Locations/Benefits

(7/27/09 – 2/1/10)

- ***Two (2) temporary outage events with restoration***
- ***Five (5) sustained outage events with restoration***
- ***3,898 sustained customer outages avoided –w- DA***
- ***233,880 CMI avoided -w- DA (conservative estimate)***



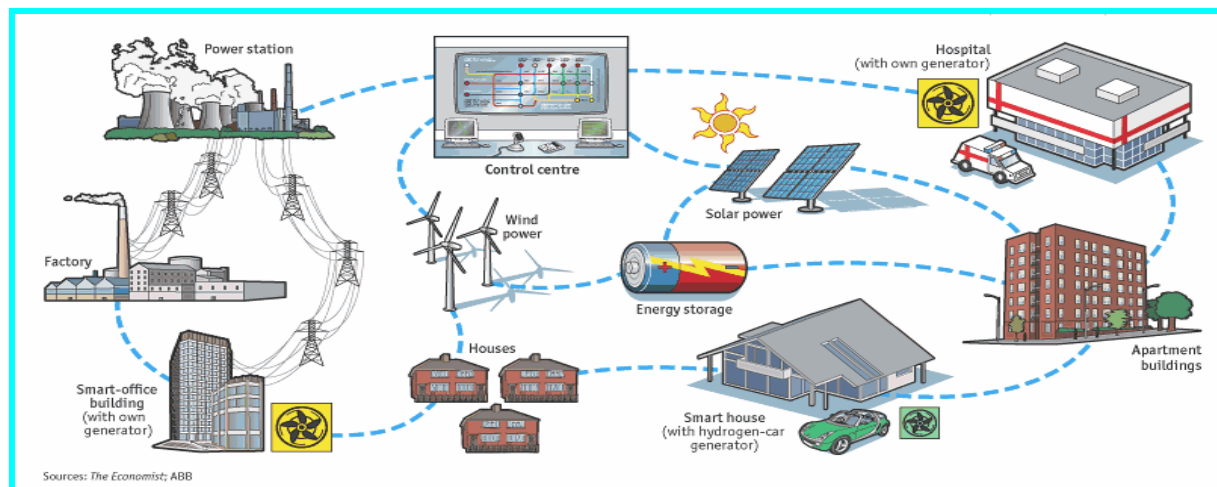
Challenges/Opportunities

- ***Standards/Grounding***
- ***ASP & Control Front processor board failures***
- ***Interrupter failures***
- ***Recognition of delay setting for unsolicited report acknowledgement from RTU***
- ***Unsolicited reporting activation***
- ***Phase translation***
- ***Commissioning***



AEP gridSMARTSM Vision

- **Transforming from Single Source Distribution Circuits to an Interconnected Grid with Multiple Sources, Real Time Visualization, Optimization, Automation, and Control.**
 - **Installation of a distribution management system (SCADA) and the development of a distribution energy management system with visualization tools for “multi-source” distribution operations.**
 - **Control of voltage and Var to maximize grid efficiency from the generator to the customer**
 - **Circuit reconfiguration to improve reliability and optimize circuit performance.**
 - **Accommodate and take full advantage of distributed energy sources including renewables, storage, customer generation, and demand response**
 - **Installation of remote sensors and automated control devices to provide “real time” analysis of the dispatch of multiple sources on a feeder**



Questions, Comments.....

