CITY PUBLIC SERVICE
DISTRIBUTION AUTOMATION PILOT PROJECT (DAPP)

Competition in the electric utility industry has rarely been a consideration in the past. However, changing legislation is now making competition possible. In fact, legislation is encouraging competition by requiring utilities to allow their infrastructure to be used by other entities. Rules are currently being developed by the Public Utility Commission (PUC) to implement a "wholesale wheeling" statute for Texas. Retail competition, the delivery of electricity directly to a customer located within another utility's service area, is also on the horizon. "Retail wheeling" pilot projects are already being implemented in several other states and it appears inevitable that they will also be approved in Texas.

In preparation for competition, City Public Service (CPS) has recognized the need to operate more efficiently and contain costs associated with everyday core business activities. In addition, CPS recognizes the need to customize service to the ratepayer and to provide more options to accommodate the customer's lifestyle. For a utility to maintain its existing customer base in the face of "retail wheeling," customer satisfaction must be enhanced.

New value-added services are continuously being developed and improved by companies as communications infrastructure and technology become more developed. Customers will soon begin to expect these services as standard offerings and will find that the services will be available from more companies than just their traditional electric utility. Not only will customers expect new value-added services, but also more reliable electric service. Customers will expect less frequent electric outages, shorter duration outages, and improved quality of service from the utility.

CPS's recognition of these facts prompted the implementation of a Distribution Automation Pilot Project (DAPP). The DAPP will allow CPS to assess and gain experience with current automation technology in order to prepare for system-wide deployment in the future. Through Distribution Automation, CPS expects to gain several efficiencies in service through improved operational control. These efficiencies will result in significant, long term, economic benefits for CPS. The optimization of existing facilities will allow CPS to defer future construction costs of new feeders, substations, and/or power plants. Customer site automation will also contribute to the deferment of future construction costs. Through implementation of load control and time-of-use pricing programs, CPS will be able to shave its peak load, thus reducing the need for new electric facilities. CPS plans to assess the economic and technological benefits from the DAPP and implement, on a system-wide level, those components that demonstrate positive results. Through optimization of CPS's existing facilities, deferring construction costs, and providing value-added services to customers, CPS will be better positioned for the competitive future.

SYSTEM-WIDE COMMUNICATIONS

CPS is in the process of constructing a system-wide, state-of-the-art, fiber optic network to meet the long-term communications needs of the electric and gas distribution systems. CPS will use this new communications network to link its major distributed computing systems which include the Control System (SCADA), Geographic Information System (GIS), Corporate Mainframe System, Mobile Data Terminal System, and Power Plant Control Systems. CPS will also use the fiber optic network to connect all of the electric substations, which will facilitate the implementation of distribution automation and energy management programs. The network will ultimately replace CPS's existing analog microwave radio and telephone line communications systems, which are not adequate to meet current needs. Furthermore, there is a growing concern that these systems may be unavailable in the future due to a recent trend in the Federal Communications Commission of reallocating radio frequencies. CPS intends to transition from its existing analog communications systems, to a fully digital environment, in order to serve current applications, and strengthen its position to fulfill future needs. The communications network to be implemented will consist of over 330 miles of fiber optic cable. The fiber optic network is currently about 20% complete and it is projected that the entire network will be completed by the end of 1997.

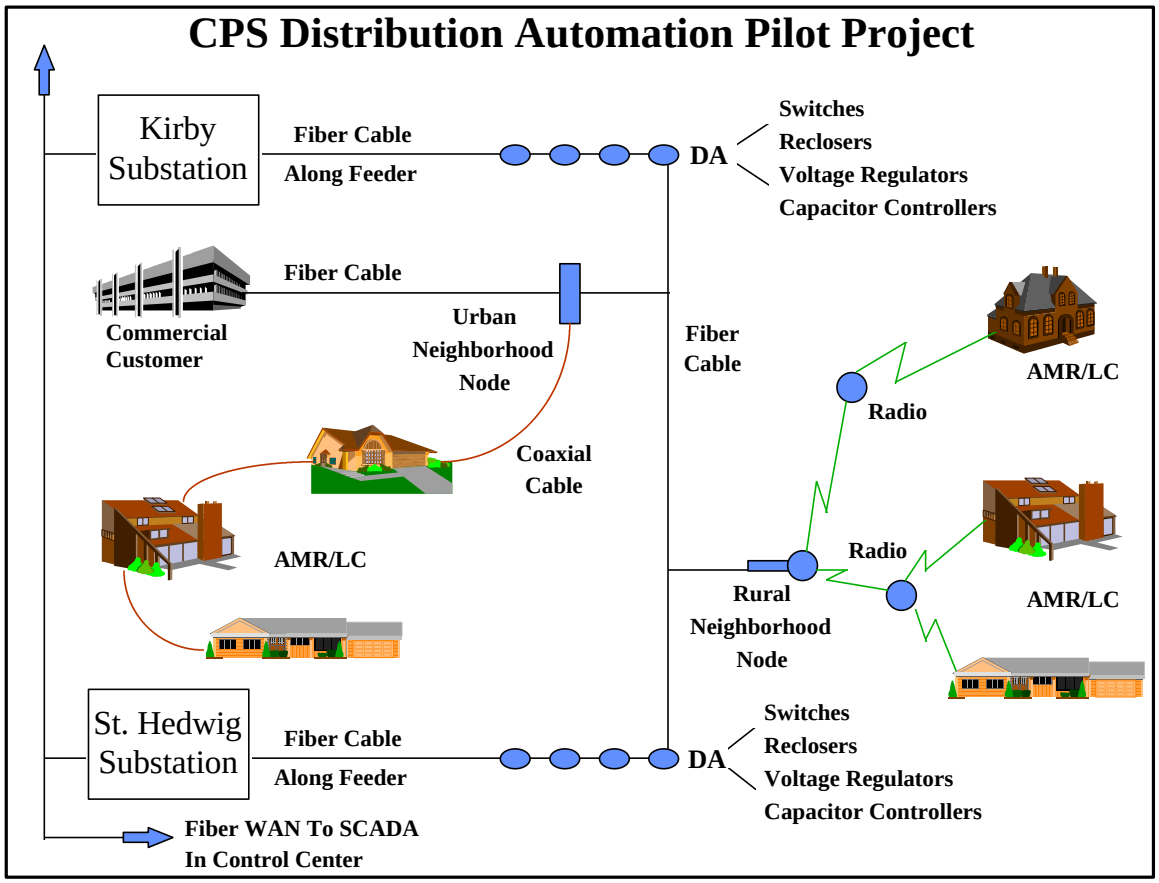
OVERVIEW OF DAPP

CPS's primary objective for the Distribution Automation component of the DAPP is to automate two 13.2 kV distribution feeder lines. One feeder is approximately eight miles long and primarily serves urban areas, and the other is approximately 60 miles long and primarily serves rural areas. CPS plans to automatically monitor and control various field devices on these feeder lines, including capacitor switches, regulators, reclosers, and line switches. In order to perform this automation, CPS will purchase a new Supervisory Control and Data Acquisition (SCADA) system. The communication media selected to support distribution automation will consist of a 12 mile long, 48 count fiber optic cable which will interconnect two substations (Kirby and St. Hedwig) to CPS's Control Center. Two H&L Instruments fiber optic network controllers will be installed in the Kirby substation with one controller actively working and the other acting as a backup. To communicate with the individual field devices on the feeder lines, H&L Instruments fiber optic transceivers will be utilized. Specific benefits that CPS expects to realize from Distribution Automation include:

- *Improved Service Restoration Time*
- *Improved Voltage Control*
- *Enhanced Load Switching & Shedding Capabilities*
- *Efficient Use of Circuit & Substation Transformer Capacity*
- *Automated Retrieval of Customer Data & Service Status*

The customer-oriented objectives of the DAPP are to perform Automatic Meter Reading (AMR) and Demand Side Management (DSM) applications at selected residential and commercial locations on the two feeders. CPS has officially enrolled 136 residential customers and 9 commercial customers to participate in the DAPP. CPS will deploy a state-of-the-art communications system with sufficient bandwidth and capacity to accommodate all potential customer site applications. A Hybrid Fiber Optic/Coaxial Cable (HFC) communications system will serve the urban residential customers. From HFC Node locations on the fiber backbone, coaxial cable will extend into the urban residential neighborhoods. To communicate with the rural residential customers, a packet radio system is being specified. The radio will transmit data back to a point on the fiber optic cable, and the data will then travel over the fiber to the main controller. Different methods will be utilized to communicate with the commercial customers participating in the DAPP. An illustration of CPS's DAPP is shown in Figure I.

Figure I
DAPP Overview Diagram



UTILITY COMMUNICATION ARCHITECTURE

CPS's DAPP is a joint project with the Electric Power Research Institute (EPRI). EPRI's goal in this project is to have Utility Communications Architecture (UCA) implemented for Distribution Automation applications. UCA is a standard, non-proprietary communications protocol that was developed under the direction of EPRI in order to promote and facilitate interoperability between computer systems supplied to the electric utility industry. To assist in the specification and implementation of UCA compliant field equipment, CPS hired Utility Consulting International (UCI), a consultant from Cupertino, California.

In CPS's DAPP, field device vendors will be required to incorporate UCA compliant protocol directly into the field device controllers; gateways will not be acceptable. In addition, vendors will be required to demonstrate that their devices are capable of interoperating with equipment from different vendors. It is a primary goal of the DAPP to demonstrate "Plug & Play" capability between equipment supplied from different vendors. With respect to the customer site equipment, UCA will be implemented only to the extent practical. Since UCA has not been fully defined for communications with customer sites, CPS is not making its implementation a mandatory requirement.

AUTOMATED FIELD DEVICES

Of the equipment available to automate on the two selected circuits, the following quantities of equipment were selected for automation: 13 Line Switches, 7 Reclosers, 2 Regulator Banks, 2 Capacitor Switches, and 2 Substation Load Tap Changers (LTC). CPS received proposals for the DA Field Devices in January, 1996 and evaluated the proposals with respect to several criteria. The equipment had to conform to the high-end technical functional requirements, as well as be compliant with UCA communications. In addition, the manufacturer had to supply a controller for the field device, or partner with a controller manufacturer, and assume responsibility for the integration of the equipment.

The primary challenge to most of the prospective Offerors was making their equipment UCA compliant. This was demonstrated in that CPS received no acceptable bids for the Capacitor Switches or the Reclosers. However, CPS has recently been approached by several Recloser manufacturers who are now willing to provide UCA compliant equipment. For the DAPP, CPS plans on using automated line switches in lieu of the reclosers, but will attempt to acquire UCA compliant reclosers in the future as the DAPP expands.

Several acceptable bids were received for the Automated Line Switches, and since a fundamental goal of the DAPP is to demonstrate interoperability between equipment supplied from different vendors, CPS elected to utilize two different switch manufacturers. The vendors that were awarded bids for the various field devices are shown below.

Field Device	Vendor Selected
Regulators	Siemens
LTCs	Beckwith
Switches	1. Kearney w/ QEI Controller 2. G&W w/ SISCO Controller

SCADA SYSTEM

CPS selected Siemens to supply the new SCADA System for the DAPP and is currently in the negotiation stage of the agreement. In addition to the new SCADA for distribution automation, CPS will purchase a new Transmission SCADA and backup system. In the future, CPS will install Generation and Network Analysis applications in both the main and backup master stations. The SCADA vendor will assume system integration responsibility for the DAPP, including ensuring that all equipment operates correctly with UCA compliant communications. The SCADA system will be capable of being expanded to accommodate system-wide applications.

Initially for the DAPP, the Distribution SCADA system will allow for the monitoring and control of distribution substation equipment, automated field equipment and customer site equipment. Once the SCADA system for Distribution Automation is complete, work will begin to accommodate Distribution Management System (DMS) applications which include:

- *Distribution modeling of the two pilot feeders and the neighboring electrical network*
- *Volt/Var analysis based on real-time information*
- *Outage detection and location*
- *Fault isolation to provide user with switching recommendations for restoring power*
- *Feeder reconfiguration to determine optimal configurations through model-based analysis of loading, voltage, and vars of neighboring feeders*
- *Issuing commands to and retrieving data from customer site equipment for load control and AMR*

CUSTOMER SITE AUTOMATION

RESIDENTIAL CUSTOMERS

CPS initiated a program called "Watt$aver" for the customer site component of the DAPP. The Watt$aver program includes components such as a customer questionnaire, a load survey, and load control. As an incentive, customers who agreed to complete the questionnaire and participate in the load survey component of the program were offered $100. Of approximately 1,800 residential customers that were offered to participate, 136 signed up for the program. Customers who elect to continue with the load control portion of the program will be paid monthly incentives ranging from $6 to $10, depending on which appliances they allow CPS to control. CPS plans to solicit additional customer participation in this portion of the program up to a maximum of 200 customers. The load control portion of the program is scheduled to begin in late 1996.

In addition to the load survey and load control components of the Watt$aver program, CPS will implement additional baseline applications at all customer locations that are in close proximity to the HFC communications system. These applications include Tamper Detection, Outage & Restoration Detection, and AMR for electric, gas, and water meters. The San Antonio Water System company is participating in CPS's DAPP to perform AMR for the water meters as well as other more advanced applications.

CPS also plans on implementing more advanced functions on a small percentage of the DAPP residential participants. CPS intends to demonstrate the technical capabilities that are possible from the customer site equipment and will assess which functions should be implemented as the program expands in the future. CPS would like to determine the customers' long-term commitments to the functions, and determine whether the expansion of these functions is economically justifiable.

- *Single-line Text Messages (One-Way to the Customer)*
- *Local Customer Acknowledgment of Messages*
- *Power Factor Monitoring (Scheduled and "On-Demand")*
- *Power Quality Monitoring*
- *End-Use Appliance Monitoring (Device Energy Profiles for Electric & Gas Appliances)*
- *Current Usage and Billing Information (Electric, Gas & Water)*
- *Historical Bill Information (Up to Previous 13 Months)*
- *Time-of-Use and Real-Time Pricing Information (Electric Only)*
- *Outage Duration Information*
- *Hard Disconnect (Electric Meter Only)*

COMMERCIAL CUSTOMERS

CPS conducted interviews to find commercial customer participants for the DAPP, and enrolled 9 participants through these interviews. The results of the interviews indicated that the customers were primarily concerned with having reliable power and information on outages, when they occur. Commercial customers want real-time information so they can make informed decisions such as sending their employees home during an extended outage. Some customers were also very concerned with power quality since they have sensitive electronic equipment. Since the needs of the commercial customers are unique, CPS has decided to implement a few baseline functions at all of the commercial customer participants and offer special, more advanced applications on a case-by-case basis. The baseline applications that will be implemented at all of the commercial customer locations include:

- *Automatic Meter Reading (Electric, Gas, and Water)*
- *Outage & Restoration Detection*
- *Text Messaging (For Outage Duration Planning)*
- *Billing and Energy Usage Information*