Implementing GPS Equipped Field GIS at Florida Power & Light

After hearing just ten minutes of Kurt Swanson's presentation at the AM/FM International Conference in March, I was convinced that Florida Power and Light Company has one of the most advanced implementations of Field GIS in the utility industry today. In his presentation entitled, "One Thing Leads to Another: A Case Study of Implementing GPS Equipped Field Pen Computers at Florida Power & Light", Kurt described how a Rapid Evolutionary Development (RED) process was used to quickly implement a wide range of Field GIS applications to provide tools and information for re-engineering the methods by which they design, engineer, maintain and measure reliability of their electric transmission system.

RED involves rapid prototyping of new technologies and the ongoing evolutionary process of tweaking and expanding software systems to better meet user needs. The idea, according to Kurt, is to get a new system into the hands of the users quickly. "In our case, the users were the transmission inspection and repair crews. We put a product into the field without a lot of planning that seemed to solve 80% of the problems that we wanted to address. Now we are focusing on enhancing and improving the hardware and software aspects of the product to solve the remaining 20%." This approach allowed FP&L to get new products and processes in the hands of users early and have the benefit of their early feedback. "Its an excellent way to get the users involved early in the development of the new systems and technologies they will be using," remarked Kurt.

In addition to the incorporation of RED, FP&L had the following additional objectives in mind when they designed their transmission information system:

- Re-engineer the process to eliminate unnecessary activities.
- Make data collection a part of the work process.
- Utilize advanced technologies as much as possible to insure the accuracy of collected data and reduce manpower required to compile and analyze this data.
- Encourage an environment where the user feels "ownership" of the systems being developed.

"In early 1991, when we started this project, all of our information was on paper. Most paper from field crews looks like chicken scratch and is difficult to get into the computer. We wanted to make electronic data collection part of our re-engineering efforts," explained Kurt.

With these guidelines as a basis for action, FP&L proceeded to develop pen computer-based applications to address transmission line inventory, transmission inspection and maintenance tracking, and outage analysis. The key components of the new system design are described as follows:

- **Transmission Line Inventory System**—provides information about the makeup of FP&L's transmission system. It maintains the sequence of structures within areas, lines and line sections. It contains the makeup of each structure; that is, the materials and components (arms, insulators, conductors, guys, etc.) of which the structure is composed.

- **Transmission Maintenance Tracking System**—allows for the identification, assignment, scheduling, completion and analysis of transmission structure, underground and right-of-way maintenance. This is a paperless system utilizing field computers from problem identification through resolution. Various tools are provided such as exception reporting, automatic bill-of-material generation, climbing inspection status, and time sheets.

- **Transmission Geographic Information System**—facilitates the integration of geographic information with tabular data and provides query, modeling, and map generation capabilities.

- **Transmission Outage Analysis System**—is a record of all transmission outages and their identifiable causes. This includes fault location, fault magnitude of phase(s) involved, tools to help determine causes, and tools to distribute this information in real-time.

**Distilled Input**

FP&L is currently using 34 field computers manufactured by Tusk Incorporated with 100 more on order. Each unit contains a 180 megabyte hard drive, but it is the sophisticated software programs developed by FP&L that make the units so useful in the field. "We wanted to develop a user
interface that reduced the number of data entry errors and also provided features to help crews make good decisions in the field. Since handwriting recognition was only accepting 20 percent of the text entered, that approach was quickly ruled out,” remarked Kurt. “Wherever possible, our user interface relies on pre-defined buttons and pick lists. As much as possible, we made use of decision tree forms to control the type and flow of information that can be entered for each specific task, thus reducing errors and ‘bad’ choices.” During Kurt’s brief demonstration of FP&L’s pen-based software, it was apparent that the particular pick list triggered depended upon a specific data field entry in the screen form.

**Inspections, Work Tickets, and Repairs**

For field crews, the electronic loop of FP&L’s system begins and ends at the docking station. Kurt recommends that field crews “...have zero interface with the uploading and downloading of information to the host computer. You can’t expect field crews to become data processing experts, so we designed our docking stations for the unattended transfer of data.” An FP&L field crew simply drops the unit into the docking station at the end of the day and goes home. The host computer automatically initiates a communication session with each machine as it is docked. The host will also automatically begin a communication session after 24 hours of being docked to ensure that all information it has downloaded into the field unit is current.

FP&L’s software supports a work flow that starts with the logging of problems from field inspection. “At night, our host computer updates master files with data captured in the field units the previous day, and downloads updated information into the field units that night for the next day’s work tasks,” explained Kurt. “All the information about the lines in a lineman’s area is downloaded into the field unit, including the GPS location of each structure. The lineman goes out and logs problems.” Each field PC unit has its own inspection schedule. Schedules are based on various reliability statistics collected over the years. “As we collect more timely and accurate data using our field PCs, we hope to improve our reliability statistics on potential structure outages and reduce our inspection costs even more.” noted Kurt.

Ground, aerial and climbing inspection tasks are programmed as separate functions in the FP&L field units. The inspection screens have defaults built-in, so if the structure is OK, the user makes a single key entry. Inspectors also can enter recommendation prompts from a list, such as re-inspect next year, and type in remarks with a touch screen keyboard. Once the field PC is in the docking station, the host only uploads exception situations. “Before our digital world we had to search every inspection sheet to find the exceptions. That took a lot of time, and we usually missed a few,” commented Kurt.

**Navigating to the Job Site**

FP&L’s field PCs also generate work order tickets and schedules. The initial work order screen consists of a spreadsheet that lists each field crew/vehicle down the left side and each crew’s assigned workorders across the top. The user picks the work order he wants to complete and the system asks, *Do you want to navigate to the job site?* For units equipped with the GeoLink® software and built-in Trimble GPS receiver, the system will aid the crew in navigating to the job site. FP&L has two people out mapping structures, with over 35,000 structures mapped to date. Since company’s service area contains over 62,000 transmission structures spread out over 25,000 square miles, it will be some time before all transmission structures have assigned GPS coordinates. However, the company has driven all their patrol routes with GPS and wrote their own navigation software, so it is only a matter of time before the system can be used to navigate to any structure in the service area. At this time, about half the structures are supported by the navigation function.

“We use GeoLink, GPS and lasers to map structures at a relative accuracy of less than a foot. We’ve written software that calculates the intersection of two circles from rangefinder measurements to the same structure from two different GPS locations. This intersection is the structure’s coordinate relative to two known GPS points.”  

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**Kurt Swanson**  
FP&L

When an FP&L crew gets to the work site, they start the clock for time reporting using software on the PC and stop the clock when finished. Travel time to and from the job site is also extrapolated. At the end of each job, question prompts appear on the PC screen for the repair crew to answer. The list of answer choices provided are used to diagnose the causes of a component failure, and help management in determining actions to extend the life cycle of feature components. “As we upgrade our system, we plan to add more question prompts to further analyze component failures in the field,” remarked Kurt. “Our focus has been finalizing the automatic work ticket and time sheet generation functions, which now work very well.”

**Mapping Structures Within Inches**

For some time, FP&L has been experiencing great success in using differential GPS and laser rangefinders in concert to accurately locate transmission structures. “We’re using GeoLink, Trimble non-survey grade receivers built into our PCs, a Trimble GPS base station, and Laser-Atlanta laser
guns to map our structures at a relative accuracy of less than a foot,” commented Kurt. “We’ve integrated all of these components, and have written our own triangulation software that calculates the intersection of two circles from rangefinder measurements to the same structure (e.g. pole) from two different GPS locations. This intersection represents the structure’s coordinate relative to the two known GPS points.” The Laser-Atlanta units have a range of about 2,000 feet.

FP&L also makes use of structure location data that they have been collecting to analyze outages caused by lightning. “We had been getting lightning data from the National Lightning Detection Network (see MAPS ALIVE, January 1994, pp. 14-15), but had no way of comparing it to actual outage locations. Now that we have structure locations, we made the comparison, and found that we had 8 to 9 percent fewer outages caused by lightning than we thought,” commented Kurt. “This allowed us to reduce our lightning outage patrols and save $90,000 a year.”

**Remember, You Read It Here First!**
Rumor has it that Tusk Incorporation, the Florida-based manufacturer of the ruggedized field PC units in use at FP&L (see MAPS ALIVE, September 1993, p.2), recently purchased the marketing rights to FP&L’s software, and is planning to form a new division to productize and market the software to other utilities. Good move Tusk! Its nice to see a hardware vendor move into the applications business. However, I offer Tusk a word of advice— selling application solutions is quite different than selling commodities. It takes a different kind of business strategy and marketing approach, and a vastly different brand of employee, so beware. Good luck!

**‘Next Stop’ Bus Announcements to be Triggered by GPS**

Auto-Trac, Incorporated, of Dallas, Texas, was recently awarded a public transit contract by the County of Lackawanna Transit System (COLTS) of Scranton, PA, for the implementation of a customized version of the company’s Fleetservice AVL System. The system will consist of GPS-equipped vehicle tracking units on buses, a communications controller, various mapping computers at the dispatch center, and two-way communications between dispatcher and buses via mobile data terminals.

The Fleetservice controller can accommodate route and timetable information for as many as 1,000 stops. The mobile data terminal in each bus displays time from last GPS, last message from the dispatcher, last message to the dispatcher and appropriate “next stop” announcement information. The driver can change the automated announcement system to manual mode if diverting from the usual route. In manual mode, various announcement and pre-canned messages can be displayed and transmitted to the control center such as driver off bus, driver on bus and emergency.

According to Jacqueline Jones, Auto-Trac’s marketing manager, “Our Fleetservice system offers fleet owners a custom-designed fleet management system that can instantly locate and identify each vehicle in their fleet. As the COLTS system will show, the benefits to transit companies include enhanced vehicle and driver safety, improved customer service through more accurate bus schedules, and Americans with Disabilities Act compliance and service through improved transit management.”

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