APPROACHES TO VEGETATION MANAGEMENT

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ABSTRACT

Vegetation management has long been a critical maintenance issue for utilities. But following the 2003 Blackout in the USA, it is an issue that has received more public regulatory scrutiny. The benefits of GIS-based vegetation management go beyond meeting regulatory reporting though. This paper will present how the New York Power Authority turned to GIS in response to the heighten attention on vegetation management. For a comparison, the paper will also present how Statnett, the transmission utility in Norway, uses GIS a part of it vegetation management program.

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NEW-YORK POWER AUTHORITY – VEGETATION MANAGEMENT SOLUTION FOR HV TRANSMISSION

On August 14, 2003, one of the worst blackout events in history descended upon the Midwestern and northeastern United States and Ontario, Canada. More than 50 million people were affected, and many lost power for up to two days or experienced rolling blackouts for up to a week before pre-blackout conditions were restored. Consequently, the United States and Canadian governments created a bi-national task force to investigate the causes of the blackout and to recommend system changes that would reduce the possibility of future outages. The task force determined that the loss of key transmission lines in Ohio due to contacts with trees was one of the primary causes of the blackout. A variety of other problems enlarged the crisis. The events triggered by the encroachment of trees within the wire security zones highlight the importance of vegetation management along electric transmission lines.

The New York Power Authority (NYPA) vegetation management program maintains approximately 16,000 acres of right-of-way (ROW). The program's principal goal is to provide safe and reliable transmission of electric power in an economical and environmentally compatible manner. Therefore, the authority has designed an Integrated Vegetation Management (IVM) computer application (called the ROW Application) that uses GIS technology.

NYPA is the United States' largest state-owned power organization and one of the largest producers of electricity in New York State. The power is generated at 17 generating facilities and is distributed by approximately 1,400 circuit miles of high-voltage transmission lines. John Wingfield, GIS/Survey manager, explains that the enterprise-wide GIS ROW Application "is linked to the land management, equipment maintenance, and environmental and engineering data, which is necessary to efficiently and effectively manage the authority's facilities and to comply with all relevant regulations."

This technology has provided a focused and coordinated approach to fulfilling the goal of Integrated Vegetation Management, which has become a utility industry standard throughout the United States.

In an effort to enhance and modernize the implementation of its vegetation management program, NYPA partnered with the URS Corporation of Buffalo, New York, to develop and integrate new technologies that would improve its ROW management program. The previous ROW management process had relied on an existing, post-construction plan-profile drawings as basemaps for delineating vegetation inventory data. NYPA's maintenance crews used these drawings to identify the location of treatment sites. Although this system worked, it had its drawbacks.

A major concern was that the drawings used for the inventory process did not reflect current conditions along a ROW. Additionally, there was no effective way to faithfully delineate the actual vegetation configuration within a ROW. This resulted in inaccurate estimates of brush acres or vegetation that actually needed maintenance. Employees manually recorded information about maintenance activities on paper.

The labor intensity of juggling these disparate data sources and the problems and costs associated with their deficiencies led NYPA to seek a better way to achieve its ROW management goals.

In 1999, NYPA aggressively promoted the use of geographic information system technology throughout the company in the areas of right-of-way vegetative and real estate management. Because NYPA has been using GIS technology to support special projects since 1990, it had a realistic idea of the best method for achieving its goals.

The ROW Application development team includes NYPA's consultant, URS Corporation; surveyors; real estate managers; foresters; biologists; transmission maintenance managers; and GIS professionals from the authority. Wingfield believes that inclusive management leads to successful planning. “An effective program is not just a software application, it is using a bottom-up management style that gains an understanding of what people really need so you can fully leverage the system and the database. We had a series of meetings with virtually every member of the proposed user community and asked them to tell us what was needed. They were not bashful. In some cases, this caused us to change direction and get more out of the solution.”

The team created an application that effectively organized a comprehensive data set so end users could easily use the data to support their work. Implementation of the program began by carefully determining all data elements that were necessary to support IVM. Development of the NYPA enterprise GIS ROW Application included two major steps—data collection and user applications.

The first step consisted of compiling existing electronic data. Some of the data was obtained from government sources and included streams, roads, regulated wetlands, and tax maps. The team created some data sets by digitizing data from paper records including real property parcel maps and transmission line plan–profiles. NYPA acquired high-quality digital orthophotos to serve as basemaps. Other data sets were created by recording the company’s corporate memory through interviewing people who have worked for NYPA for years. This data included items such as access road locations and relationships with landowners. To create a consistent data set, all the coverages were normalized and adjusted to match visible features on the digital orthophotographic basemaps.

After NYPA converted existing records, it began collecting field data. A field portable GIS and mapping program facilitated field data collection. Using digital orthophotos as background maps, the field crews traced vegetation sites directly on the computer screen to produce polygons with true spatial coordinates. These vegetation polygons were attributed with information from pull-down menus.

The IVM application provides easy access to data and a simple interface to perform relatively complex tasks such as creation of treatment plans that ensure compliance with all regulatory mandates and landowner agreements. NYPA maintains all vector and tabular data at its central data center, which gives all parties access to the most current information. Image data (digital orthophotos and document scans) is maintained on local servers at each NYPA site. This combination of centralized and distributed data storage provides the best possible response times across NYPA’s widely separated wide area network. Central data access also ensures data security control.

The ROW Application helps ROW managers evaluate current vegetation conditions. It provides access to geographic data sets so vegetation management treatment techniques can be examined in a way that includes factors such as wetlands, landowner’s issues and agreements, site access, regulatory commitments, security, and dangerous tree trimming sites. The application also has a function that serves the treatment plan review process and another function that creates work orders through MAXIMO.

The IVM program incorporates a balance of cultural, physical, biological, and chemical tactics to control the targeted tall growing tree species. It also works to enhance the abundance of all lower growing desirable vegetation. A regular inventory and documentation of maintenance activities allow for analysis, evaluation, and continuous improvement in the overall ROW management program.

The IVM work flow from scheduling treatments to evaluating effectiveness is a smooth process. Field inventories are conducted annually for the ROW scheduled for treatment the following year. NYPA’s system forestry staff reviews the inventories and treatment recommendations, accepting or modifying the recommendations as it deems necessary.
Once the actual fieldwork begins, the treatment plan and related data are downloaded to field computers for use by NYPA inspectors. These inspectors track the actual treatment in the field and then upload the data to the central server for future use. This data supports contract change orders, regulatory reporting, information for seeking bids, and other reporting needs. After the next field inventory of the same ROW is completed, NYPA uses the as-treated data to analyze how well the previous treatment cycle worked.

Says Wingfield, "On the first line where we had a repeated cycle, we saw a 60 percent non-compatible vegetation reduction. Presumably, on the next cycle we will see another significant reduction. Eventually, because of our IVM program, we will be using only a tiny fraction of the herbicides and manual effort we had used in the first cycle. We have already saved a significant amount of money in the first cycle; ultimately, we will have saved money and had an ecologically positive result."

In the aftermath of the 2003 blackout, the Federal Energy Regulatory Commission and other regulatory bodies requested information for follow-up investigations. NYPA’s delivery of comprehensive information was impressive. Federal organizations, such as the Environmental Protection Agency, requested demonstrations of NYPA’s management solutions. Wingfield reports that the officials rated the IVM solution as the most successful they had seen.

STATNETT-VEGETATION MANAGEMENT KEY TO TRANSMISSION ASSET MANAGEMENT

Statnett is the National Transmission System Operator (TSO) for the country of Norway. Established in 1992, Statnett owns and operates approximately 12,000 km of transmission lines. Annual revenue is approximately 600 Million Euro with maintenance expenditures on the order of 28 Million EUR. This paper looks at the role of vegetation management within the overall process of asset management.

Maintenance management as a business process utilizes an integration of the GIS and the Maintenance Management System. The goals for the system are

- Contribute to the Corporation Vision of Statnett being one of Europe's leading and highly efficient TSOs.
- Achieve Best Practices designation in International Benchmarks for Grid Companies
- Improve planning quality and efficiency in the execution of that plan
- Reduce costs
- Improve security for maintenance workers
- Reduce outages and costs incurred through outages

Planners need certain information about conditions that have an impact on maintenance activities. These include

- Current, actual road networks and weight restrictions
- Road tolls, keys and contact personnel
- Environmental restrictions
- Landowners and contract documents (past and present)
- Current maintenance worker information (location and status)
- Current equipment status and location
- Inventory/stores levels
- Helicopter landing sites

These kinds of data strongly suggest that a GIS-based approach is the most logical. Thus the integrated maintenance approach uses GIS as a portal into the MMS system but once in the maintenance system, the user may remain within the MMS. Integration has been accomplished using ABB-developed technology to provide a contextual link between the GIS and the MMS (and also the SCADA System). In operation, the user can select any object using the mouse, perform a 'right-click', and select from a pop-up menu that permits navigation to one of the other systems centered on the object of interest.

For example, on receiving a SCADA event (alarm) notification, a user may right-click on the operated device and navigate to maintenance records in the MMS, or create a work order in the MMS, or view weather data in the GIS, or view the geographic location of the device on a map in the GIS, etc. After making a selection, the GIS or MMS (depending on selection) will provide the display appropriate to the type of selection. The originating window in SCADA will remain active permitting the operator to return to the SCADA system at any time. Interaction may originate in any of the three component systems.

Thus, GIS is used to create failure reports, show or create work orders, report completed work, view historical work orders, review technical data or show fault records and resulting work performed. GIS is also the portal through which documentation is viewed, spare parts are located, operational (e.g., lightning strike) data is viewed, or location of objects in the MMS are viewed. In general, GIS is the portal through which all activities originate.

Because transmission lines are routed mostly through heavily forested areas, vegetation management represents a significant portion of the overall maintenance expenditures. Vegetation management practices are built around predictive maintenance and routine inspection. Integrating available data through GIS provides a system for Right of Way (ROW) maintenance. The data model includes forestry growth models, electrical operations models utilizing safety margins accounting for temperature and maximum load. Both field inspection (ground based) and aerial laser survey techniques provide additional data. Lightning strike data is provided through sensors and arrangements with the Norwegian weather service.

ROW maintenance work is generated by viewing the current conditions, ranking with respect to underlying forestry growth anticipations, optimal times for deforestation operations. Once the timber to be cut has been identified, the application provides best access routes based on the wood type (size and length), physical location and topology. Additional features include notification of landowners if required and estimation of the crew and resources needed for the forestry operations.

In conclusion, the integrated system has provided a tool that is well received by the maintenance users. Overall the work practices are more efficient through easier and faster access to data as well as more relevant data for the maintenance process. Future, but unscheduled plans include additional integration capabilities to provide data synchronization between GIS, MMS and SCADA.

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