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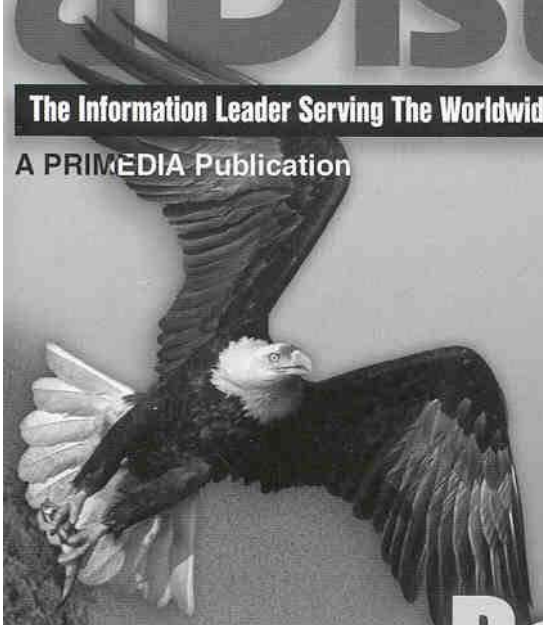

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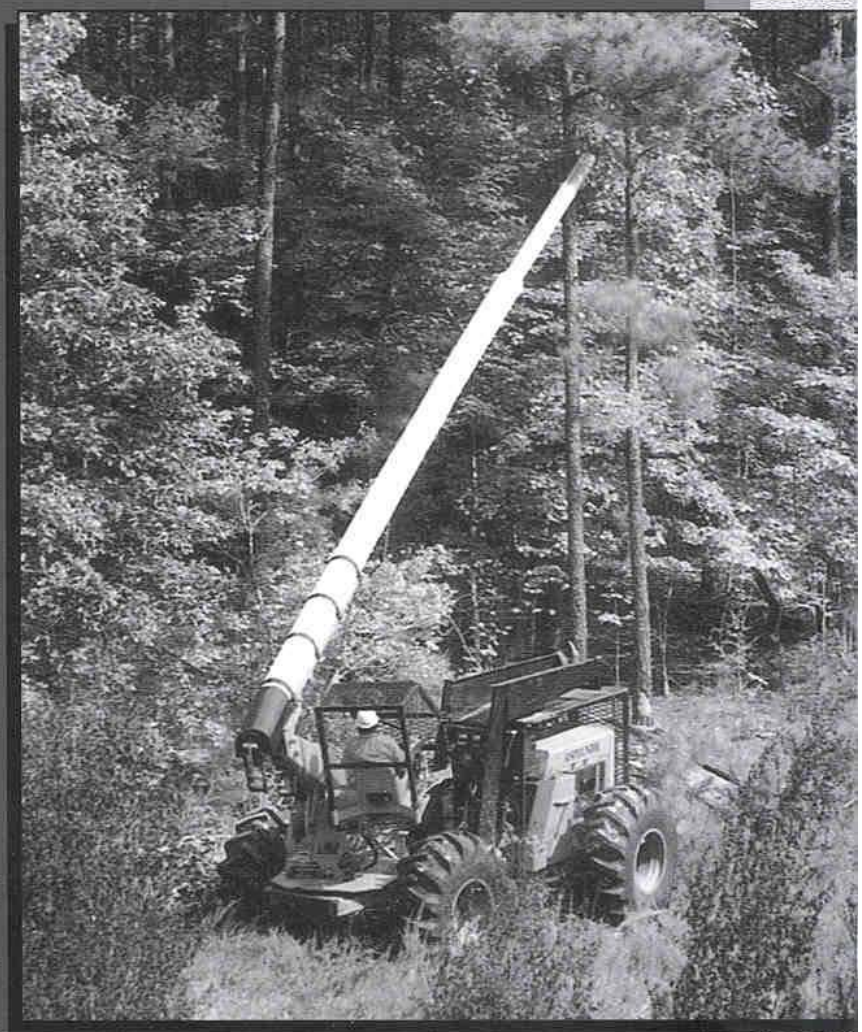
Vegetation Management

In its beginning, vegetation management focused on the tree trimming needed to construct a new overhead line or to maintain line clearances. Nowadays, vegetation management consists of entire right-of-way (R/W) maintenance programs as well as traditional tree trimming. These programs include the selective use of herbicides, computerized tracking and inventory systems, specialized equipment usage and the use of professional foresters and vegetation managers. All of these have one common goal—to maintain or increase the electric utility's system reliability.

Vegetation management activities—tree-trimming and vegetation control—usually are the largest cost element in an electric utility's operating budget (tree-trimming alone is a US$7- to $10-billion business). Combine this with the fact that tree-related causes can be the source of a majority of customer interruptions, and it is plain to see that vegetation management is probably the most costly item to an electric utility.

This vegetation management special section contains articles that focus on some of today's best practices. For example, Chris Asplundh Sr. of Asplundh Tree Experts outlines the past, present and future of vegetation management; Gary O'Neill of American Electric Power (AEP) outlines how vegetation management evolved at AEP; and Gueth Braddock of Dixie Electric Membership Cooperative (DEMCO) showcases the specialized equipment needed to clear R/Ws in the southern United States. No matter how big or small, all electric utilities are looking to maximize the benefit of a successful vegetation management program.



The changes in the electric-utility industry during the past five years far outweigh any seen in the past 50 years. Increased demand for reliability, ever-increasing customer expectations, regulatory scrutiny and cost control will continue to challenge utilities. Business as usual in tree trimming will not meet these increased demands. Best-practice operations in tree trimming combined with technology improvements and new management processes will be essential. Across the electric-utility industry, innovations continue to emerge and shape best practices for the new era.

The editors of Transmission & Distribution World *would like to thank Joyce Steingass, Navigant Consulting Inc., and Peter Simpson, independent consultant, without whose untiring efforts this special section on vegetation management would have never come together.*

Entergy Achieves Significant Savings

By Danny Taylor, Entergy, and Dan O'Neill, Navigant Consulting Inc.

In 1997, Entergy Corp. (New Orleans, Louisiana, U.S.) embarked on a concerted effort to overhaul its vegetation management program. The aim was to improve reliability and cost effectiveness. In 2001, Entergy saw the fruits of its efforts, with vegetation-related customer outages dropping about 50% since 1997. A close look at how this was done reveals valuable lessons for anyone seeking to achieve similar results.

Entergy service territory map.

The location of Entergy's service territory creates a special challenge. In the rich soil of the Mississippi River Delta and Gulf Coast—with near-tropical heat and rain for a good part of the year—the growing conditions are ideal for many trees, shrubs and vines. Added to that are the regular thunderstorms, occasional hurricanes and ice storms that create a utility vegetation manager's worst nightmare.

Entergy initially recognized the need to centralize the vegetation organization if it was to be successful in leveraging the scope of work and standardizing work practices. Therefore, in early 1997, Entergy formed a single vegetation department. Later that year, it commissioned a team to examine the current vegetation management program and practices, as well as to develop recommendations for a new business plan to include standard procedures, practices and contract strategies. In late 1997, the team presented its recommendations to management, which, in turn, implemented them in early 1998.

The typical progression of utility vegetation management practices occurs in three stages:

Transmission trimming must be more aggressive than distribution trimming to the point where, for most utilities, transmission trimming means mowing and spraying a wide right-of-way under the towers, and side trimming plus danger-tree removal.

● *Stage 1: Get on cycle.* Most utilities find it all too easy to defer tree trimming whenever revenue shortfalls or expense overruns cause earnings pressure. Yet tree-trimming specifications usually are designed to achieve a clearance that is likely to be effective in avoiding contact for a fixed number of years (such as a four-year cycle). Some fast-growth species may require more trimming or mid-cycle "hot spotting," but most of the circuit should be relatively trouble-free from normal growth-caused contact for the given cycle. If funds are cut, trimming is deferred for another year and trouble begins. For the circuits experiencing trouble, future trimming will need to not only be restored to the cycle amount, but also increased to catch up what was missed. This, in turn, causes a built-in unevenness to future trimming schedules as well as the inefficiency of varying crews accordingly.

● *Stage 2: Optimize the cycle.* Once a utility achieves consistent performance on a regular trimming cycle, it may try to step up to the next level of vegetation management to optimize the cycle and processes. This includes allowing the cycle to vary by circuit depending on factors that would cause one circuit to need a longer or shorter cycle.

This is not the same as deferring trimming whenever the company needs more earnings. Instead, it is a carefully planned approach to doing a fixed amount of trimming on the system each year. This is similar to an approach that would target the worst-performing circuits first, but it combines it with the discipline of recognizing that there is a certain interval of time—different for different circuits—at which the circuit must be re-addressed.

Typical optimizations include doing the backbone on a different cycle than the laterals because of the larger impact of backbone outages. Transmission trimming must be more aggressive than distribution trimming to the point where, for most utilities, transmission trimming means mowing and spraying a wide right-of-way under the towers, and side trimming plus danger-tree removal. Other adjustments may include trimming lower voltages on a

The key to taking the next step is to carefully target the places where such work is done based upon impact on the system.

longer cycle and trimming urban areas, where easements may be narrower and clearances harder to obtain, on a shorter cycle. Included in this phase may be contracting improvements that typically include a move from time and materials (T&M) to unit price (or at least managing T&M as if it were unit-priced). Other enhancements may include smart use of herbicides to reduce stem growth and better work with communities to integrate utility trimming with urban forest aesthetics.

- *Stage 3: Target broken limb/fallen tree outages.* Once a utility's growth-caused (or contact-caused) outages are less than 50% of its vegetation-caused outages, everyone will start asking the question, "We just trimmed those circuits, so why are they still having outages (especially in storms)?"

Even though most tree-trimming specifications will call for removal of "danger" trees that are dead and likely to hit the line, in practice the costs of such work would break the budget if done extensively. For example, if regular trimming costs US$2000 to US$4000 per mile, heavy removal of overhang above the normal amount or removal of trees or branches that are not dead but are structurally weak and likely to cause outages under stress could easily cost US$10,000 per mile.

The key to taking the next step is to carefully target the places where such work is done based upon impact on the system.

Many of these elements were part of Entergy's successful program, but Entergy did it all in one cycle. It is just finishing the fourth year of its four-year cycle with the satisfying results. Entergy's program included the following familiar elements:

- *Revamp the cycle plan.* All circuits were put on a proactive cycle and have been trimmed accordingly (89% finished as of the end of 2001, and is on target to finish the rest this year and start the next cycle).
- *Switch those areas that were being trimmed* by grid or area to trimming by circuit, so reliability can be monitored and accounted.
- *Vary the cycle by factors:* voltage, species, clearance and impact (Entergy has not yet adopted different cycles for backbone and laterals).
- *Focus cost control* on achieving the desired specification at a controlled cost per mile (in Entergy's case, it switched from T&M to unit pricing in its contracts).
- *Source tree trimming through multiple vendors* in distinct market areas, allowing better vendors to increase their market share.
- *Increase use of the proper equipment* for the work, including high-rise bucket trucks for high overhang and vertical saws where appropriate in rural roadsides.
- *Control reactive trimming* by integrating it with cyclical trimming so cycle busters can be noted and skips can be charged back to the contractor.
- *Inspect* work to ensure compliance and avoid callouts.
- *Continue use of low-volume basal spraying of selective herbicides* to kill woody stems, but leave ground cover to reduce stem density and to reduce future trimming/removal costs.
- *Within the year, prioritize circuits* that are due for trim this year to be trimmed earlier or later based on pre-inspection and determination of need.
- *Begin to target problem-prone overhang and danger trees*, at least on the backbone and where circuits have been prone to broken limb/fallen tree trouble. (Entergy is still refining its efforts in this area, under a program they call Sky-Lining, not to be confused with ground-to-sky clearing, which is done in many transmission corridors at great expense.)

Entergy achieved a 30% reduction in the cost per mile to trim.

If there were a fourth stage in achieving excellence in vegetation management, it would be excelling at the community relations aspect of vegetation management.

If there were a fourth stage in achieving excellence in vegetation management, it would be excelling at the community relations aspect of vegetation management. While some such effort may come during the "optimize the cycle" phase, for many utilities it may be the icing on the cake after all the other steps are taken. Entergy recognized this aspect when a very active tree-conservation group took it to task in the early 1990s for its trimming practices. Entergy quickly decided it was best to work with such groups and, as a result, helped to form a joint utility-community program to work with the community on the issue. In the process, Entergy learned how to make its vegetation practices arboricul-tural-friendly, including:

- Pruning trees instead of trimming them
- Helping customers understand when pruning actually helps a tree
- Offering to replace selected trees with smaller ornamentals, or to plant new trees in suitable locations to offset removals under power lines
- Ensuring that underground construction does not damage roots
- Making wood chips and logs available to those who need them.

Entergy's success can be traced to the way it addressed the full spectrum of what must be done on several different reliability fronts, in its case, virtually simultaneously.

Danny Taylor has the BSEE degree from Mississippi State University and is a registered professional engineer in Mississippi. He has 23 years of experience with Entergy, primarily in distribution operations and engineering. He has been in management since 1986 and has held various positions in Mississippi and Texas.

Dan O'Neill is a director at Navigant Consulting, Inc. with the Electric & Natural Gas Distribution practice area. O'Neill has more than 16 years of industry experience, including four years as a utility financial executive and the remainder with major consulting firms that serve the industry. He has consulted on decision analysis, activity-based budgeting, work management, and information systems planning. He holds the Ph.D. degree in economics from MIT, taught at Georgia Tech's College of Industrial Management, and is a past president of the Atlanta Economics Club and the Atlanta Chapter of The Planning Forum.

LIPA Advances To the Next Level

By Michael Hervey, LIPA, Thomas Spatz, KeySpan Energy, and Charles A. Fijnvandraat, Navigant Consulating Inc.

Long Island Power Authority (LIPA, Long Island, New York, U.S.) was created as a state municipal agency to absorb the debt of the Shoreham Nuclear Power Plant, which is located on Long Island. In 1998, LIPA bought the T&D assets of the Long Island Electric Co. and signed an eight-year outsourcing agreement with a company now called KeySpan Energy (Long Island) to manage these T&D assets. The enabling legislation also involved outsourcing agreements with rights for generation operation and repurchase, and all energy-procurement services.

LIPA's director of T&D faces the many opportunities and challenges of running a 4600 MW, 1.1 million customer-based utility as a total turnkey outsourced model. As the sole individual in LIPA's T&D organization, the director is responsible for the outsourcing agreements that cover operations, maintenance, construction, service restoration and T&D budgets. He also is responsible for balancing the outsourcer's goal to maximize profits and LIPA's goal to reduce rates.

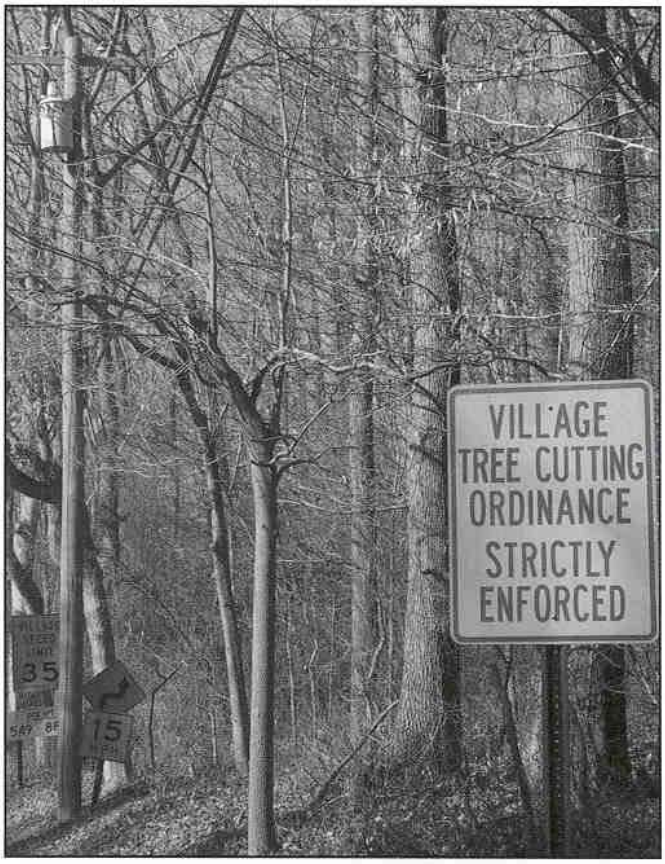
Working together, LIPA's T&D director and KeySpan Energy's outsourcing manager have been able to improve reliability while striving to control costs and to maintain the 20% rate reduction that was the result of the creation of LIPA in 1998.

With a geographical location off the coast of the states of New York and Connecticut, Long Island occasionally is referred to as the first line of defense for any northeasters, hurricanes and other major weather patterns that come barreling up the East Coast off the Atlantic Ocean. Effectively, LIPA takes the brunt, slowing the impact of weather patterns before they hit the mainland, a job other utilities in New York and Connecticut appreciate.

With the high concentration of vegetation, and the compact design and construction of overhead lines in a dense residential setting, vegetation is the leading contributor of storm outages even with the extensive use of covered wire.

When LIPA took over the T&D assets, it engaged Navigant Consulting Inc. (NCI, Chicago, Illinois, U.S.) to assist in managing the outsourcing contract with KeySpan Energy.

The electric-utility environment is changing considerably, in particular there is an increased emphasis on performance, resource constraints, and aging infrastructure as well as increased pressure to identify and manage system risk. As the owner of the assets with specific agreements that place the majority of the risk and incremental costs of storms as its responsibility, LIPA needed a method that supplemented the current planning techniques with a probabilistic approach, coupled with a program tailored toward minimizing vegetation-related storm damage—the largest contributor of storm outages.



Sometimes local regulations hamper a utility's vegetation management efforts.

While LIPA's current planning and maintenance process was consistent with the rest of the industry, its risk was more pronounced using the status quo, operating as a total outsourced utility.

LIPA recently ranked in the top quartile in non-storm reliability indices, as defined by the New York Public Service Commission, due in no small part to the efforts during the past several years on several new initiatives. These initiatives include:

- *Implementing a 3-5-7 year optimized trim cycle.* Based on the lessons learned from getting all circuits under a five-year trim cycle in 1999, LIPA launched the 3-5-7 year optimized trim program in 2000. This program tailored the individual circuit's performance, determining the optimal trim cycle

What we needed was to supplement these existing tools with a probabilistic model that reflects the different parameters that occur during storm events.

based on existing vegetation, expected growth rates and prior success in trimming efforts.

- *Installing more than 61% of the radial overhead circuits* with at least one midpoint and one tie auto switching point, all via supervisory control and data acquisition (SCADA). This has dramatically decreased the amount of customers impacted during an outage, assisted in pinpointing the location of the outage and reduced the number of customers impacted during the fault with the ability to quickly back feed and restore customers.
- *Instituting a circuit-improvement program* in 1994 to target the removal of armless construction, installing additional lightning arrestors and 4-ft (1.2-m) crossarms in hazardous tree locations on the three-phase mainline.

While these initiatives have delivered significant success in minimizing the impact of non-storm outages, they had only a marginal effect on reducing the magnitude of vegetation-related damage during storm events with sustained winds in excess of 50 mph or during heavy icing conditions.

LIPA and KeySpan have done a great job of enhancing the reliability of the system during non-storm operating conditions, which has had some impact on storm performance, but LIPA realized early on it had significant storm-damage exposure, which its traditional engineering planning tools did not reflect.

What LIPA needed was to supplement these existing tools with a probabilistic model that reflected the different parameters that occur during storm events. While the system may be adequately designed for normal day-to-day operation, during a storm event the system could be radically reconfigured such that backups may not be available, equipment called upon to operate may not, and system capacity and equipment may already be too heavily loaded to provide backup capability.

For this reason LIPA and KeySpan launched a pilot program in 2001 to incorporate two new approaches, introducing a probabilistic model to supplement LIPA's existing process along with an enhanced vegetation program intended to minimize storm damage.

For the probabilistic model, the analysis considers the following:

- Vegetation density and species
- Whether the outages were predominately three phase or single phase
- System configuration (ability for switching and backup)
- Historical crew response and restoration
- Historical storm feeder performance
- Weather events and characteristics (ice, lightning, wind direction)
- Overhead construction and non-storm performance
- Detailed field observations.

The output of this analysis determines the relative probability of a feeder's susceptibility to storm damage. These feeders are screened using a cost-per-customer avoided calculation that compares various alternatives such as installing additional isolation devices, reinforcing infrastructure (pole replacements, reconductoring), or pursuing enhanced vegetation trimming and removal.

The analysis confirmed that enhanced vegetation remediation with a focus on minimizing three-phase outages was the right combination.

The enhanced vegetation program, which is in addition to the existing program, is funded primarily from savings achieved through the 3-5-7 year optimized trim cycle. This enhanced program focuses on working with the system arborists to identify and remove the growth most likely to structurally fail during a future storm under the same characteristics that have historically impacted that feeder. Depending on the location and field construction, the key drivers in determining the proper trim and removal technique may be ice loading, wind shear direction, vegetation density and species, soil erosion or a combination. This is different from the technique used in cyclical clearance-based trim or a ground-to-sky approach.

By strategically focusing the efforts on feeders identified with the probabilistic model, LIPA found that pursuing enhanced vegetation trimming and removal is typically the most cost-effective solution.

The analysis confirmed that enhanced vegetation remediation with a focus on minimizing three-phase outages was the right combination. Therefore, targeting vegetation on three-phase mainlines had the greatest impact on minimizing the cost, damage and customer interruptions during a future major storm event.

With the completion of the analysis in late 2001, LIPA and KeySpan have identified several feeders and have begun to bid out the work for enhanced trimming and removal. LIPA continues to strategically apply the techniques of the enhanced vegetation program and to further roll out the probabilistic planning model to supplement present techniques toward system planning and design.

This will be a win-win situation for not only the outsourcer but also for LIPA as it strives to identify and minimize the risks impacting and influencing rates.

Mike Hervey is the director of Transmission and Distribution for the Long Island Power Authority (LIPA). He has nearly 22 years of experience that includes nearly every aspect of T&D. He joined LIPA in 2000 where he is systematically applying a combination of engineering and business processes to T&D asset decisions. **Thomas Spatz** is the director of Electric Service for KeySpan Energy. He has 28 years of experience in the electric-utility business and has held director positions in both the operating and engineering areas of KeySpan. He has earned the BSEE, MSEE and MBA degrees.

Charles A. Fijnvandraat is a senior engagement manager at Navigant Consulting (NCI). He has more than 15 years experience in the electric-utility industry having worked both as a utility manager and as a consultant assisting clients in improving reliability, design optimization, increasing operating efficiencies and maximizing IT/GIS investments. Fijnvandraat also is a member of the IEEE and is a registered professional engineer.

GlobalViewpoint

By Rick Bush, Editor in Chief

Sailing into Big Water

Loose from his moorings and with the wind at his back, Michael Hervey set sail to locate a new job opportunity. After 18 years with ComEd, Hervey was on the receiving end of a management shuffle precipitated by a series of summer blackouts in downtown Chicago, Illinois, in the summer of 1999. Hervey had a nice résumé with stints in protection and control, distribution, transmission and substation maintenance, construction and engineering. Hervey was confident his unplanned exit would not be a career buster. I offered to be a resource for Hervey in his search. In return, he promised to be a resource for *T&D World* when he made dock.

Hervey indeed managed a soft landing. Now the director of T&D at Long Island Power Authority (LIPA, Long Island, New York, U.S.), Hervey even managed to meet one of his personal goals, to live near "big water." Hervey is a deep-water sailing enthusiast who gladly traded Lake Michigan for the Atlantic Ocean.

Hervey invited me up to visit, meeting me at the train station grinning from ear to ear. He just loves working in LIPA's fast-paced entrepreneurial environment. Hervey interacts with customers and tracks industry trends. He also answers his own phone and sends out his own e-mails. He meets regularly with Keyspan staff on network issues and focuses on the special challenge of providing first quartile reliability on an island.

Hervey drove us over to LIPA headquarters to meet his boss. Well, headquarters might be an overstatement. LIPA has only 71 employees with only two working in T&D, yet this organization is responsible for providing power to nearly 1.1 million customers. LIPA manages assets that include 1300 circuit miles (2092 km) of transmission, 56,000 miles (90,123 km) of distribution and 178 substations.

I'd like to step back and provide a little insight into how LIPA came into being. Remember the Long Island Lighting Co. (LILCO)? This investor-owned utility ran into trouble getting Shoreham Nuclear Plant on line. Cost overruns nearly sent LILCO into bankruptcy. With a hostile public paying electric rates of 17 cents per KWh, the scene was not pretty.

The short version is that Gov. George E. Pataki pushed for LIPA to take over LILCO's retail electric business along with the Shoreham debt. LIPA then outsourced operations, maintenance and construction back to newly formed KeySpan Energy, staffed by former LILCO employees.

I chatted with Hervey and his boss, COO Seth Hulkower, over a box lunch. Hulkower shared his experiences in crafting the original 1998 management services agreement with KeySpan to run and maintain the T&D network.

LIPA was pressured to bring down the cost of electricity on Long Island and quick. As a state agency, LIPA was able to reduce the cost of capital from 9.5% to 5% on the $4 billion Shoreham-related debt. As a municipal entity, LIPA was exempt from federal income tax—another major savings. And now, as a not-for-profit municipal utility, LIPA had no shareholders to pay. These moves enabled LIPA to cut rates to around 14 cents per KWh. And get this, KeySpan did not incur any significant layoffs.

Oh, yes, I forgot to mention that LIPA committed to freeze its rates for five years so some hard work remains. LIPA is now four years into its eight-year management services agreement with KeySpan. LIPA is already pre-paring for the expiration of their services agreement with KeySpan. Hulkower acknowledges that the contract is fairly easy to monitor and enforce but that it also limits competition and flexibility, keeping LIPA from taking advantage of best of breed opportunities.

States Hulkower, "We must determine which core elements LIPA needs to own and which functions are best bundled and outsourced." Assisted by Navigant Consulting, LIPA is reviewing the key metrics needed for a successful management services agreement. Hulkower acknowledges there is a limit to the number of agreements LIPA could successfully manage. I expect a steady stream of visitors to call on Hulkower and Hervey in Uniondale, New York, over the next six or seven months pitching packaged services solutions to this overworked but merry band of men and women.

After lunch, Hervey dropped me off to catch the train back to New York City. I was struck again by the pervasive smile that lit up Hervey's face. Here is a man in his element. It's fun to see Hervey, with a full sail, facing the future with anticipation and optimism. I have no doubt that the citizens of Long Island will be the better for it.

Rick Bush

Note: Seth Hulkower will speak at T&D World's annual Outsourcing Summit to be held Nov. 4-6, 2002, at the Renaissance Vinoy Resort and Golf Club in St. Petersburg, Florida, U.S. See page 86 for more information.