A Meeting of the Minds

Community involvement is key to controversial transmission expansion.
Placing transmission in congested areas has never been more difficult. Many utilities have access to eminent domain, but they are justifiably hesitant in using it. More than one utility has spent a decade in futility trying to place new transmission in urban settings.

New times require new strategies. This article describes a cooperative effort between a city utility and its constituents, facilitated by knowledgeable consultants, to develop workable solutions to address a real and pressing need.

In 1990, Nashville Electric Services (NES, Nashville, Tennessee, U.S.) announced plans to build a new 161-kV transmission line through Nashville. The utility faced intense opposition from residents living in neighborhoods near the proposed lines. At the time, NES planned and routed lines like most utilities, engineering studies demonstrated growth patterns and lines were routed based on cost.

Residents in the affected neighborhoods went on the offensive, citing health concerns and property devaluation. Still the major complaint against NES was the lack of opportunity for input from those most affected by the line. Highly organized neighborhood activists took their campaign to local elected officials and the media, and successfully postponed the project.

By 1997 loads on the existing transmission system began to exceed forecasts, and NES was in danger of losing the ability to serve the city’s growing electrical load. NES advised the public that a hot summer might cause significant outages on the transmission system unless the utility added more transmission. The proposed 161-kV system, which became known as the Central Power Loop, would take load off the existing system and dramatically improve capacity and reliability.

NES discovered it had to route the most critical portions of the Central Power Loop through the same neighborhoods that had opposed the 161-kV line seven years earlier. NES hired Burns & McDonnell Engineering Co. (Kansas City, Missouri, U.S.) to assist in the routing, permitting, design and construction management of the Central Power Loop project, which it planned to perform in three phases.

Citizens Involvement
NES management and the appointed five-member NES Power Board wanted to establish community involvement in the line routing and design process. Burns & McDonnell recommended the formation of a Citizens Advisory Committee (CAC) to bridge the gap between citizens, local stakeholders and the utility. NES public relations and design staff teamed with Burns & McDonnell environmentalists, transmission engineers and construction managers to help the community understand the routing, design and construction of major transmission lines through urban corridors. The CAC would enable the public to provide much needed input in the route selection and design process.

Foundation Design and Installation Provide Unique Challenges
The Central Power Loop lines are located in areas above relatively shallow, solid limestone rock, so most structures required drilled-shaft foundations. The most labor-intensive part of the job was preparing foundations, which ranged from 4 to 9 ft (1.2 to 2.7 m) in diameter and 20 to 30 ft (6 to 9 m) deep. Drilling took several days to complete and sometimes continued into the night. NES took great care to limit the disruption to homeowners and businesses during foundation construction. Burns & McDonnell’s construction manager personally notified residences and businesses of when and where work would be done. In some cases, NES offered homeowners the option to stay at a motel at NES expense if the work continued after 6 p.m. Burns & McDonnell’s construction manager and the contractor also worked closely with homeowners when construction access required tree trimming. The self-supporting steel structures ranged from 90 to 140 ft high with diameters at the base ranging from 5 to 8 ft (1.5 to 2.4 m).

Weathering steel was used for structures to help them blend into the neighborhood.
NES staff worked with city- and state-elected officials, neighborhood associations and interest groups to get a broad representation of interests in the study area for each phase. NES invited about 20 people to participate in the CAC process for each phase of the Central Power Loop. Early meetings drew diverse attendees, including university professors, members of local historical societies, an urban forester, members of the city park board, homemakers, business persons and political activists. To guide the overall process, the CAC set clear objectives, which included:

- To work with NES to provide safe, reliable and affordable electric service to all citizens of Nashville.
- To identify opportunities and constraints in local neighborhoods related to a 161-kV transmission line.
- To provide input and feedback from communities regarding the transmission line siting and design.

The CAC held monthly meetings at NES headquarters, starting with Phase I in February 1998, and continuing with Phase II in November 1999 and Phase III in May 2001. The CAC process for each phase lasted about six months with members learning from Burns & McDonnell experts about aesthetics, electrical and magnetic fields (EMF), land use patterns, design options and cost. A large study area encompassing the terminal points of each new 161-kV transmission line was defined during each phase, whereupon the CAC focused attention on possible route segments within the confines of the study area.

**Line Need and Route Selection**

The first major hurdle facing NES and Burns & McDonnell was to convince residents of the need for the new lines. They demonstrated that significant growth had occurred in areas around the residential areas. In addition, residences were consuming additional electricity with the addition of central heat and air conditioning, home computers and a variety of electrical appliances.

NES and Burns & McDonnell provided the CAC with three separate engineering studies showing the need for the line, as well as a computer analysis of the NES system showing cascading power outages that would occur with the loss of a major transmission line.

Once they convinced the CAC members the need was real, the work of choosing the best route for the line began. Burns & McDonnell and NES used land use maps, photographs and prepared visual simulations of critical portions of the new lines to help CAC members understand the impact of a 161-kV transmission line. Burns & McDonnell helped CAC identify route constraints (areas to avoid), opportunities (areas that were acceptable) and route selection criteria. Burns & McDonnell personnel extensively evaluated each study area and collected data for each route using the criteria selected by the CAC. Each CAC member also ranked each criterion based on importance. The summation of these weighted criteria helped the committee identify preferred preliminary routes.

The CAC also dealt with issues relating to the design and construction of the transmission line. These issues included structure types (galvanized steel vs. weathering steel), landscaping and tree trimming, and spotting structures to avoid sensitive areas such as churches and schools.

The CAC held open house meetings for the public to introduce the project and review preliminary routes. NES heavily advertised the public meetings through newspaper advertisements, inserts in bills and informational mailings. The CAC held the meetings in public facilities near the areas the new lines would affect. NES and Burns & McDonnell personnel staffed booths to explain project need, alternative routes, route selection criteria, engineering, construction, right-of-way issues, EMF and tree trimming. The new Central Power Loop crosses Interstate 440.
role of the CAC in seeking the best solution was reviewed. Each open house attendee was invited to complete a survey and asked to rank the most important route selection criteria.

After each open house, the CAC reviewed the public input and made a final route selection. In addition to a preferred route, the CAC also selected an alternate route in the event the preferred route proved to be unfeasible.

Burns & McDonnell prepared a final route study report for the NES Power Board review that included the recommendations of the CAC and the comments of the public. The board, having the final decision on the route selection, tracked the CAC process closely and listened to the residents’ preferences. Ultimately, the board-approved routes for all three phases were those the CAC recommended.

NES kept the CAC and the public informed during the engineering and construction of each

About Nashville Electric Service

Nashville Electric Service (NES) is among the 10 largest public power utilities in the nation, distributing electricity to more than 300,000 customers in middle Tennessee. The NES service area covers 700 sq miles (1813 sq km) in and around Nashville, with utility rates among the lowest in the nation. NES receives bulk power from the Tennessee Valley Authority at 161 kV and distributes the power at 69 kV and below.

The Central Power Loop’s Phase III construction is ongoing.
Design and Construction

To follow the approved routes, all three phases required a large number of angle structures and varying span lengths. On average, the Central Power Loop has 11 angles per mile. In addition, existing 69-kV transmission lines and lower-voltage distribution circuits ran along large portions of the final routes. Project planners improved aesthetics by eliminating all existing wood transmission line structures, installing self-supporting steel structures and repositioning existing 69-kV lines onto new structures. Distribution circuits in some sections were transferred to steel crossarms placed on the new structures to give a cleaner appearance. With the large number of angles and distribution circuits, many of the Central Power Loop structures are unique.

Each phase also required at least one interstate highway crossing, numerous crossings of heavily traveled arterials and residential streets, and railroad crossings. Engineers relocated many structures during design and construction because of underground utility interference. In addition, the typical congestion of an urban corridor caused by buildings, parking lots, streetlights, communication poles and billboards further complicated the design. Along Sharondale Drive, a new 161-kV circuit required the relocation of the a 69-kV circuit, which residents pressed to have underground. With construction costs nearly seven times greater than overhead, NES investigated alternative solutions.

NES and Burns & McDonnell worked with the residents along Sharondale Drive to develop a minimum-impact overhead line design, which included weathering steel structures to limit visual impact, taller structures to limit tree trimming and extensive landscaping around each structure.

The new Central Power Loop structures were equipped with braced post and horizontal post polymer insulators to support the lines on tangent and running angle structures, and to reduce visual impact. Engineers selected the 795 kcmil Drake ACSS conductor (aluminum conductor, steel-supported) for the 161-kV line. The ACSS conductor was selected due to its higher current capacity and operating temperature. In addition, the ACSS conductor has the same diameter and weight as the 795 kcmil ACSR (aluminum conductor, steel reinforced) conductor NES uses on 69-kV lines. This enables engineers to convert eight existing 69-kV self-supporting steel structures to 161-kV.

Transferring existing distribution lines to new structures proved to be challenging and required significant coordination between construction contractor Davis H. Elliot Companies, NES and Burns & McDonnell. The existing distribution lines ranged from 4 kV to 13.8 kV, with the majority being 13.8 kV. The line transfer required precise coordination between construction crews and dispatchers to ensure safe working conditions while minimizing the impact of outages on homes and businesses.

A Look Back

From start to finish, the entire Central Power Loop project will span nearly five years. The final cost of the Central Power Loop will be approximately US$11 million or around $1.1 million per mile. The design, routing and construction of a transmission line in a highly congested urban environment significantly affected the cost of the Central Power Loop. In addition, transferring the existing 69-kV and distribution circuits to the new transmission lines further increased material and construction costs.

Enlisting the help of the CAC to assist in routing, design and construction of the Central Power Loop proved successful. Residents who opposed the project came to understand the need for it and helped find the best solution for the affected neighborhoods and the entire city. With the help of the CAC, NES and Burns & McDonnell were able to accomplish the major goal of this project—to add electrical capacity to serve Nashville’s growing power needs.

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