STRENGTHENING
YOUR TRANSMISSION SYSTEM
Doing more with what you have

BY SARAH BECKMAN, PE

As the United States continues to use more power in more places, utilities are trying to keep up with increased demand and an aging transmission system, parts of which date back to the 1880s. The U.S. has approximately 360,000 miles of transmission lines, 70 percent of which are estimated by the Department of Energy (DOE) to be more than 25 years old. With the increased demand for system reliability and resiliency, utilities are now being asked to strengthen their existing systems.

In many cases, the option to build new transmission lines does not exist. The existing corridors are at capacity, and acquiring the land for a new transmission line route is often not feasible for a variety of reasons. Consequently, utilities are turning to other options to get more out of their existing transmission lines. This can take shape in several ways—simple structure replacements and raises, dynamic line ratings or reconductoring (replacing the wires only) and rebuilding existing lines. All of these will help to push more power through existing facilities, remediate issues like clearance concerns, add extra years to a line's life, along with improving its overall reliability. Smart grid updates are another option for improving operations, maintenance and planning with efficient two-way communication.

Where to Start

In order to effectively address the issue, a clearly defined goal and approach must be set. What needs to be achieved? Is more ground clearance required to reach the current voltage rating? Is a higher line rating needed?

To start, determine the desired facility rating. In essense, this is the maximum current that meets design security and safety criteria of a particular line on which the conductor is used. Next, develop design criteria by which to analyze the existing line. Typically, a utility has predefined design criteria. However, in some instances, criteria may be worth reviewing to determine if there are areas to tweak. For example, maybe a large clearance buffer isn't necessary, or a reduction on allowable swing angles (the mechanical movement of the conductors, due especially to wind) may be appropriate. Making these modifications can allow more flexibility in design and lead to potential cost savings. Finally, construction constraints must be considered. Lead time on materials, difficult terrain, equipment required for construction and land access all play a large role in the engineering and design of any project. Identifying these key items will help ensure a successful project from inception to energization.

Examining Alternatives

The first, and perhaps simplest option for gaining system reliability, is to increase ground clearance. The best way to effectively extend the life of a line is to replace structures on an as-needed basis. This alternative works best if the majority of the line is in good condition. Additionally, replacing structures with taller ones may allow a higher line voltage rating if not already at the conductor's maximum.

Structure material selection depends on how quickly the structure needs to be installed, what is available, and the terrain. Wood is a common material, and even if not available in stock, it usually has a short lead time. However, it is not always the ideal choice. For areas where land access is by foot traffic only, fiberglass structures are becoming more common. They are light and durable, and sections can be carried in and installed quickly. Steel is a great option for helicopter work and for lines that require a longer lifespan, however lead times can be 24 weeks or more. If gaining additional ground clearance is the objective, lattice tower extensions and phase raisers can essentially jack up existing structures if they are in good condition.

To determine a line's true capacity in the field and optimize an existing line, especially at times of peak load, dynamic line rating technologies are a great solution. These devices monitor the conductor over time, for characteristics such as conductor temperature, clearance, load, and weather to provide a reliability-based rating. With this, the maximum capacity of the facility can be determined. They may be moved around to critical spans for monitoring and on several lines to develop a picture of the broader system. Because of this, dynamic line rating is a great option if the goal is to increase the efficient use of an existing line and provide higher asset utilization and reliability.

Reconductoring and Rebuilding

If a line in an existing corridor is relatively new, but a higher voltage rating is needed, reconductoring the existing line is a viable option. Many different types of higher capacity cables are manufactured. Generally, these are high capacity, high temperature, low sag conductors that can often provide the necessary rating while still maintaining the required ground clearance to operate at a higher temperature. In these cases, it is important to recognize that the existing structures must be reanalyzed for heavier cable with different sagging characteristics. It is likely that dead ends will have to be replaced. However, it is still a cost-saving solution when compared to the alternatives.

While not usually the most cost-effective option, rebuilding a line may be the most comprehensive solution for ensuring reliability and increasing a facility rating if the line is nearing the end of its life span. The potential for a higher capacity conductor as well as a taller structure offers more reliability and resiliency. It may also be possible to use existing right of way to mitigate the need for additional permitting, landowner involvement, and access issues that may be confronted when trying to build a new line in a new corridor. The scope of a line rebuild can be as simple as a structure-for-structure replacement with either a new, higher capacity conductor or taller structures, to upgrading to multi-circuit structures for additional capacity, if the easements allow. Ultimately, a line rebuild is the most comprehensive solution, cost permitting.

Conclusion

In order to keep up with the ever-growing demand for power, a more reliable grid, and in an attempt to maximize existing facilities, utilities have several options for strengthening their systems. The life of a line may be extended and the rating increased by replacing a handful of older, at-risk structures, using dynamic line rating to determine the true capacity of the existing line, and reconductoring if it is in good condition and more capacity is needed. Alternatively, the line may be rebuilt entirely to get the most out of the existing utility corridor. In a time when we are trying to do more with what we have, these are all viable options to help save money while providing the increased reliability that is required. ✪

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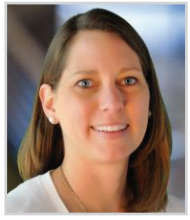

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