

# LAKEVIEW LIGHT AND POWER REBUILDS TYEE SUBSTATION FROM THE GROUND UP

By Terry Elvrom

Lakeview Light and Power in Lakewood, Wash., has been looking to the future since 1922. In the spirit of that slogan, LL&P has taken on its most challenging endeavor to date: the complete demolition, design, and rebuild of its Tyee Substation.



The new foundation contained so much concrete it took 22 days to cure and be ready to support the immense weight of the transformer and switchgear house.



An aerial shot of the finished project.

### Identifying the need

The RTE-ASEA transformer was manufactured in Waukesha, Wisc., in July 1982 and took on its first load in March 1985. The typical lifespan of a transformer is about 30 years, but with a robust maintenance schedule, including regular oil testing and relatively light load, LL&P extended its service period to more than 40 years. Owned by Bonneville Power Administration since installation, and complemented with Lakeview-owned switchgear, LL&P purchased the transformer from BPA in September 1996 at a cost of \$325,000.

Tyee Substation is located in the southeast corner of Lakeview's service area and serves commercial customers on Pacific Highway adjacent to Interstate 5, Springbrook and Nyanza Park neighborhoods, and, perhaps the most important customer, St Clare Hospital. The unique dynamic of serving the Nyanza Park and Springbrook neighborhoods is that they are heavily tree lined, which makes them prone to naturally occurring faults, such as tree limbs falling on service lines, especially during fall and winter in the stormy Northwest.

Numerous fault impacts on a transformer and accompanying switchgear can be quite profound. And, compounded by its advanced age, Tyee was beginning to show signs of wear. Supported by onsite inspection of various components and end-point information collected by the SCADA system, LL&P deduced that relay failure, among other factors, was becoming a more common occurrence. The data was conclusive: it was time to put this substation out to pasture.

"I view our substations as the vital organs within the body of our distribution system. As such, we strive to keep these components healthy through periodic inspections and adhering to regularly scheduled maintenance," said Lakeview Light and Power General Manager John DeVore. "However, we came to the realization that with each of our substations being 40-plus years in service, we were living on borrowed time. Thus, as we assess the long-term reliability of our distribution system, replacing each substation became logical and critical to be included in our five-year capital forecast."



Setting the transformer.



Delivery of the switchgear.

LL&P operations and management teams conveyed the need for a call to action by its board of directors, and the board affirmed its commitment to reliability: an entirely new Tyee Substation would be built.

### Budget and financing

To say that the cost of building a substation would be considered a big-ticket item is a vast understatement. Municipalities and investor-owned utilities can pay for these improvements by way of tax levies or municipal bonds. For LL&P, a non-profit, member-owned utility, raising a large amount of capital for this project without borrowing added a whole new level of complexity.

Forethought by the board of directors and management team in 2017 resulted in the creation of a five-year strategic plan that addressed these needs.

In keeping with its Vision Statement to be fiscally responsible to its members, LL&P partnered with EES Consulting. The result was a cost of service analysis that included calculation of both operational expenses and capital costs to determine revenue requirements, as well as the creation and use of a five-year capital forecast to determine these values. The study also resulted in a way to better cover fixed costs due to growth.

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## COVER STORY

With the restructuring of rates for its commercial customers and a small increase to the base-rate charge for both residential and commercial customers in August 2018, the financing was in place while still adhering to LL&P's core values of providing cost-based service to its members.

After thorough research and due diligence, the budget line item of \$2,000,000 was submitted to the board of directors in November 2019. It was unanimously approved. The project officially had the green light!

"Our board takes the role of governance seriously. We pride ourselves in leading the cooperative, and we work hard to make decisions that are in the best interests of our members and local communities," said Lakeview Light and Power Board President Avery Johnson.

### Design/build

LL&P's electrical engineer, Chang Choi, was tasked with the design of the new substation. Having served in the same capacity with Seattle City Light and Tacoma Power, he was well-versed in the process. The first step was finding a manufacturer to build a transformer that not only fit the needs of today, but one that could serve the needs of an ever-growing market well into the future.

Several bidders from both foreign and domestic firms vied for the LL&P contract, but it came with a very important caveat. The winning bidder had to have a proven track record with a mandatory minimum of 10 years of providing domestic utility companies with reliable, state-of-the-art transformers.

After careful review of the bids, including input from DeVore, Operations Superintendent Mark Hadman, and Substation Operator and SCADA Technician Darren Lawrence, the contract was awarded to the ILGIN Group, a transformer manufacturer based in South Korea.

Key components of the 15/20/25 MVA ILGIN transformer are that it was outfitted with a load tap changer, which eliminated the need for separate, oil-filled voltage regulators. The interior of the transformer frame was made with wood and it features advanced components that contribute to lowering the electrical loss of the transformer.

The interaction between the original transformer and stand-alone voltage regulators led to measurable loss but was rectified with the integration of the load tap changer and improved core material. The result of carefully selected components for

the new Tye transformer was rewarded in the form of an Efficiency of Design credit from BPA in the amount of \$35,000.

The switchgear bid was awarded to Myers Power Products, based in Ontario, Calif. It consists of high-speed tripping breakers, protection relays, and current and potential transformers. It is ready for incoming BPA metering, outgoing Lakeview metering, an advanced SCADA interface, fiber-optic communications connections, and a back-up battery system. Enclosed in a 15-by-32-foot switchgear house, two HVAC units were installed, providing a climate-controlled environment for the advanced electronics. The addition of the HVAC units was definitely an upgrade from the old housing, which operators described in the summer months as "a really expensive sweat lodge."

With the transformer and switchgear ordered, along with the high-side 115-kv breaker from General Electric, the timeline became a concern. With an estimated build time of 12 months for the transformer, and nine months for the switchgear, no one was sure how the effects of the COVID-19 pandemic would impact the manufacture or delivery of the components. Knowing it was a variable that was out of their control, it was time to turn their attention to the next phase of the project.

### Demolition and construction

Tye Substation was de-energized on March 11, 2020, and the load was picked up by LL&P's Roy Miller and Lake Grove substations. Tacoma Power disconnected the transmission line a day later. The next step was to begin the



*The new HVAC-equipped switchgear enclosure is ready for incoming BPA metering, outgoing Lakeview metering, an advanced SCADA interface, fiber-optic communications connections, and a back-up battery system.*



*A new load tap changer eliminated the need for separate, oil-filled voltage regulators.*



*An oil separator unit senses the specific gravity of any potentially remaining oil and reroutes it for safe collection.*

salvage and demolition process. Step one was removal of the dielectric oil—a lot of it. The oil capacity for the transformer was over 4,000 gallons, the three voltage regulators held 700 gallons each, and with the OCB (oil circuit breaker) holding an additional 2,000 gallons, over 8,100 gallons of oil had to be removed very carefully.

Considering that Clover Creek sits just under 300 yards away, the Tye Park Elementary School playground is adjacent to the substation, and there is a high water table, environmental concerns were paramount. With the assistance of Transformer Technologies from Salem, Ore., the oil was vacuumed out safely and was sent to their facility for recycling.

LL&P's meter crew removed relays and test gear from the switchgear housing, while crews from BPA and CenturyLink removed metering and communications components. With all equipment removed for recycling or repurposing, Transformer Technologies crews removed the transformer, voltage regulators, and switchgear housing from their foundations, and hauled them away for salvage.

With a nearly bare substation footprint (only the recently replaced 115-kv SF<sub>6</sub> breaker would remain for integration), it was time to hand the site over to Ground Crew Foreman John Bender. Surveying the old foundations, Bender knew he had to bring in a heavy hitter. He enlisted the help of nearby N C Machinery of Fife to bring the juggernaut: a massive Caterpillar 316 with a six-foot breaker-bar attachment. Excavation was tricky, especially considering that some of the vaults to be removed were over 10 feet below ground level, but in Bender's capable hands, site demolition took only three days.

The ground crew continued to prep the site by digging channels in which power and control conduit would be precisely

laid in advance of the foundation contractor beginning work. The foundation forms were laid in three days and were ready for concrete pouring. The concrete was delivered on April 20 and took all day to pour. The foundations held slightly more than 50 yards of concrete—that's 10 truckloads of concrete! And such a large amount of concrete doesn't dry overnight; it took 22 days to cure and be ready to support the

immense weight of the transformer and switchgear house.

Furthering LL&P's commitment of its stewardship to the environment, an important new feature was built into the substation footprint: an advanced oil containment system. This system consists of a runoff channel surrounding the transformer to collect rainwater or any oil spillage. Through a series of baffles, oil is collected at the base and routed to a separate collector while water passes over the top. Then the remaining water reaches an oil separator unit that senses the specific gravity of any potentially remaining oil and reroutes it for safe collection and the clean water runoff returns to the storm drain system.

With site construction complete, it was now time to move to the next phase of the project.

### Testing, delivery, and more testing

Normally the next step would be to visit the manufacturer to conduct a FAT (factory acceptance test) to ensure the product is up to specs. But due to COVID-19 concerns, ILGIN conducted these tests at their testing facility while Choi observed via Zoom meetings and telephone calls. Fortunately, the transformer was put through its paces and passed with flying colors. Within days, the transformer was loaded onto a cargo ship in Busan, South Korea, to make the three-week trip to the Port of Seattle.

The transformer arrived on May 26 without incident and the LL&P line crew completed the assembly and processing of the transformer in six days. Using specialized equipment, Jim Flynn of Tacoma Power assisted with Doble testing on the de-energized transformer to determine the integrity of bushings and winding in the transformer core. After a few weeks of

delays, the switchgear was finally ready, and Choi and Lawrence were able to attend the FAT in person at the Meyers facility in California. LL&P crews took delivery of the switchgear house on July 6 and set to work on integration between the transformer and switchgear by pulling cable through the conduits and connecting them to the four new feeder busses.

Pat Eckroth from Tacoma Power assisted with completing the relay testing, and a Schweitzer Engineering Laboratories control module complemented the SCADA integration. With over 1,300 data points, it ensures complete control remotely over all aspects of the new substation.

On August 12, the transformer was energized. The next morning, inside the SCADA control room at LL&P, with a few keystrokes, Lawrence enabled Tye to take on load for the first time. "It's alive!" he proclaimed, channeling Mary Shelley's Frankenstein.

### Looking forward

Committed to its culture of safety, LL&P crews gathered for a project debriefing to exchange information on how they could improve safety protocols, crew training, and sub-contractor collaboration. These lessons will be applied as LL&P looks forward to its next project, a rebuild of their Roy Miller #2 Substation.

It's important to note that the Tye project, with the exception of two sub-contractors, was completed entirely in-house. With mindful planning, flawless execution, and LL&P crews providing the bulk of the labor, the final cost of the project was just short of \$1.7 million dollars. That's a savings of over \$300,000 and a great example of LL&P's commitment to fiscal responsibility.

"Occasionally, life provides us with opportunities to accomplish things that have lasting value," said DeVore. "The safe and successful completion of this project allowed us to do just that by providing reliable electrical service to our customers both now and for generations to come." **NWPPA**

*Terry Elvrom is a Lakeview Light & Power customer service representative and contributing editor of LLP's newsletter, Connected. He would like to thank Chang Choi, Darren Lawrence, and Mark Hadman for their help in bringing this story to life; the board of directors; and General Manager John DeVore for his trust and encouragement. Elvrom can be reached at [telvrom@lakeviewlight.com](mailto:telvrom@lakeviewlight.com).*