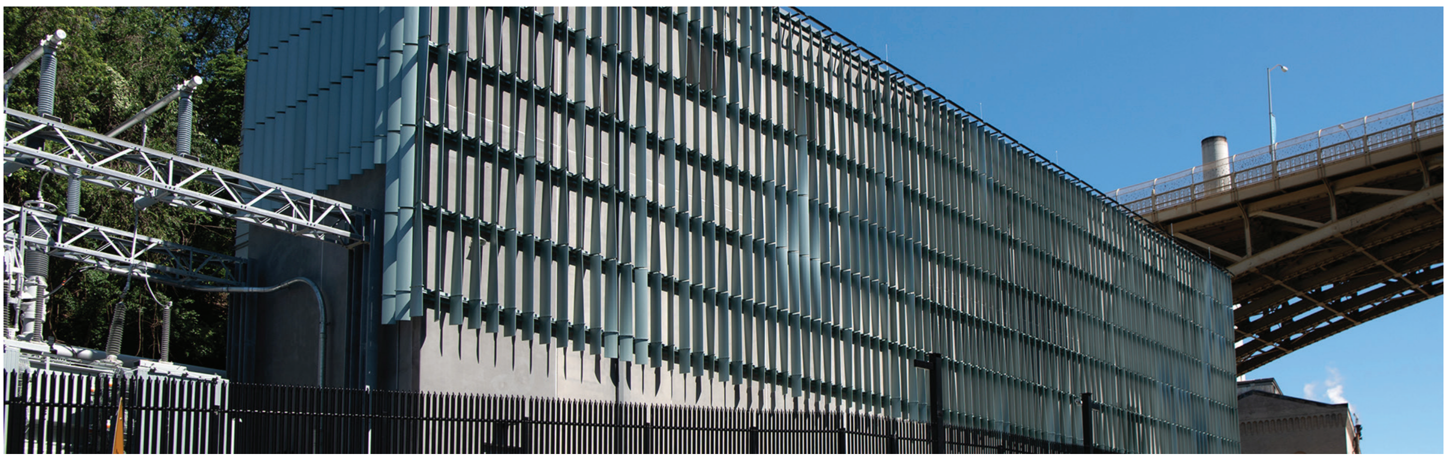
BURNS McDONNELL

CASE STUDY

Riazzi Substation is a Model of How to Overcome Challenging Construction Conditions

In the heart of Pittsburgh, the University of Pittsburgh and Carnegie Mellon University — along with high-tech, finance and medical industries — are growing rapidly and placing new demands on the power network operated by Duquesne Light Company (DLC). The Riazzi Substation is now adding critical resilience to Pittsburgh's power infrastructure.



Challenge

Duquesne Light Company (DLC), the major utility serving Greater Pittsburgh, has launched a major program to upgrade electric reliability and system resilience in response to continuing growth and dynamic changes on its grid. Riazzi Substation, a 138/23-kV gas-insulated substation (GIS) in the historic Panther Hollow neighborhood of Pittsburgh, is one of the central elements of this effort.

Located in a densely populated urban area, the Riazzi Substation was constructed on a difficult project site that demanded engineering innovation and the highest standards of construction quality. The project site was long and rectangular, totaling approximately 1 acre with extreme grade changes and poor soil quality due

Project Stats

Client
Duquesne Light Company

Location
Pittsburgh, Pennsylvania

138/ 23-kV
GIS SUBSTATION

1
4-POSITION 138-kV GAS-INSULATED RING BUS SWITCHGEAR

6
23-kV DISTRIBUTION LINES

to fill material that had been placed there decades earlier. The construction site was further complicated by overhead obstructions from a nearby traffic bridge.

This constrained site also created complications when sequencing and coordinating work crews. Tight schedule requirements exacerbated this issue by requiring that multiple scopes be completed concurrently by 40-plus subcontractors that shared this space. The schedule and space constraints were complicated further because the project was executed during the worst of the COVID-19 pandemic, presenting issues with staffing and availability of material resources.

Neighborhood residents also voiced concerns about the aesthetics related to a substation, power lines, transformers and other electrical gear being prominently visible in the heart of an attractive historic district. These concerns were resolved when DLC agreed to build an enclosed two-story structure to house electrical equipment along with undergrounding power cables.

Solution

The project was strategically located between the Carnegie Mellon and University of Pittsburgh campuses in the Panther Hollow residential area. The project was conceptualized under the principle of being a good neighbor, with a minimized footprint, architectural designs for exterior facades that were consistent with nearby structures, and underground cabling for high-voltage power lines and medium-voltage feeder circuits connecting the substation with the area distribution grid.

Riazzi Substation is 138/23-kV substation with associated 138-kV and 23-kV underground infrastructure. The station consists of a four-position 138-kV gas insulated ring bus switchgear, two 138/23-kV power transformers and 23-kV metal clad switchgear. A two-story structure houses all switchgear and associated protection and control systems, shielding this sensitive equipment from the effects of severe weather. The 138-kV supply is derived by splitting an existing underground 138-kV power line encased in a high-pressure, fluid-filled (HPFF) conduit near the property. Six 23-kV feeder lines originate from the new station in a configuration that is expandable to accommodate at least a dozen additional lines.

Burns & McDonnell managed all aspects of this integrated engineer-procure-construct (EPC) project, including site development, stormwater management and permitting, foundations, above- and below-grade electrical, the GIS building and switchgear, protection and controls, SCADA, the underground 23-kV distribution and underground 138-kV transmission.

Upon commencing construction, site preparation work included installation of a retaining wall along a large portion of the property boundary to stabilize a steep grade adjacent to key electrical equipment.

The two-story substation building was constructed of precast concrete with an exterior designed to closely resemble exteriors of university operations facilities located nearby. The design avoids the typical industrial feel of a conventional substation by incorporating green textural elements running vertically on exterior walls, along with landscaping and revegetation of areas around the site. The structure design reduced the required footprint by a factor of five over the space needed for conventional outdoor substations with equivalent capacity.

Discrete, underground power cables were installed to and from the substation, mitigating neighborhood concerns about the appearance of poles and above-ground lines. The underground cable routes were installed using stainless steel pipe, requiring hundreds of welds and turns, while navigating aging underground utility infrastructure, including a 16-inch water main and a 68-inch storm sewer, both more than 100 years old.

On one of the selected underground cable routes for three distribution circuits exiting the substation, a large steam main running beneath an arterial street posed an obstacle that made installation of manholes and conduit along that portion of the route infeasible. The solution was a new aerial cable installation spanning 20 poles, capped at each end by riser poles where the cable connects back to the underground conduit.

Results

By utilizing an integrated EPC project delivery method, all members of the construction and engineering teams were able to collaborate closely from day one, providing meaningful input that was critical to overcoming design and constructability issues. With such a small project site and challenges navigating aging utilities surrounding the station — combined with an aggressive schedule — precision in scheduling of work packages was key.

Despite the fast pace, protecting safety and health of the workforce was always the utmost priority, with daily temperature and symptom checks as well as thorough cleaning protocols a standard practice. Breaks were also staggered to minimize time employees spent together in relatively close spaces. While certain employees contracted the COVID-19 virus, mitigation measures limited the spread of infections on-site and not a single day of work on-site was missed due to the virus. With over 100,000 construction hours on the job and zero recordables, the project team demonstrated that safety is first on every aspect of the project.

When lead times and materials prices began escalating rapidly due to the pandemic, the owner and all contractors stepped in whenever possible to identify stocked items or alternative sourcing methods. For example, when a commissioning engineer for a key piece of equipment was stuck abroad without a way to get to the site, the owner stepped up and was instrumental in making a case that went all the way to Washington, D.C., to get sign-off of proper approvals.

Though many challenges cascaded and made a difficult coordination effort that much harder, every contractor and employee stepped up and made sacrifices to help each other out. The project met all stringent demands and kept moving ahead of regulator-mandated schedules.

The substation enclosure and undergrounding of transmission and distribution lines reduces outage risks for critical power equipment, while mitigating long-term expenses for operations and maintenance. The project was both a triumph of teamwork and a model that can be used on similar projects needed to support distribution grid demands within dense urban environments.

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