

INFRASTRUCTURE RENEWAL FOR THE NEXT GENERATION

PATCO High Speed Line Power Infrastructure Renewal

This Engineering Excellence Award entry tells the story of how The Burns Group (Burns) helped the Delaware River Port Authority (DRPA) and the Port Authority Transit Corporation (PATCO) High Speed Line:

- Ensure continued, reliable service for PATCO's 50,000 daily passengers
- Preserve PATCO's outstanding record of on-time performance
- Promote clean transportation to support the region's green initiatives
- Utilize public funds for tangible, long-term regional benefits

This award entry tells the story of how Burns' creative and innovative engineering solutions:

- Renewed PATCO's electrical infrastructure, which had outlived its useful life, and was experiencing system failures and lapses in reliability
- Completed construction on a busy, 24-hour a day, 7-day a week (24/7) railroad without impacting operations
- Reimagined and repackaged the project to meet DRPA's funding limits, while saving them a total of \$20 million
- Helped navigate existing conditions and scheduling intricacies while accounting for stakeholders' fluid operating priorities, using collaboration and a detailed construction management framework

ROLE OF ENTRANT

Burns served as the Professional Engineer and Construction Monitor for the PATCO High Speed Line Power Infrastructure Renewal for the DRPA. Burns was responsible for the engineering and design for a state-of-the-art, low-maintenance fiberglass pole line, oversight of the installation of new traction power and signal power cables, and the complete replacement of PATCO's fiber-optic backbone, which allows for increased information capacity, future system expansion, and improvements in security, revenue collection and information dissemination throughout PATCO's system.

Specifically, Burns was responsible for the following:

- Replacement of all traction power cable, signal power cable and telecommunications cable, replacing copper wire with fiber optic cabling, including: 113,000 feet of 26.4 kV cable; 113,000 feet of 2.4 kV cable; 36,000 feet of 27C signal cable, 12,000 feet of communications cable; 59,000 feet of fiber optic cable; 30 2.4 kV to 120 V 100 Hz transformers and 825 fiberglass poles
- Upgrade of telecommunications and signals backbone network using state-of-the-art ATM networking system
- Increasing capacity for DRPA/PATCO telecommunications needs for ongoing and planned projects
- Construction phasing to minimize impact on PATCO operations while providing contractors with adequate construction windows

ROLE OF OTHER CONSULTANTS

Construction Scheduling: Envision Consultants, Ltd.

Construction Inspection: JCMS, Inc.

Railroad Signal Construction Phase Services, Field Testing Oversight, and Support during Signal Cutovers: Hatch Mott Macdonald

BURNS' CONTRIBUTION TO THE PROJECT

PATCO operates a 14.2-mile long, 2-track high-speed, heavy-rail transit system between Philadelphia, PA and Lindenwold, in southern New Jersey. The system is owned by the DRPA and has been in service since February 1969. In the early 2000s, the DRPA realized that PATCO's traction power distribution system infrastructure in the southern New Jersey part of the system was at the end of its useful life, had become unreliable and was subject to outages, and needed to be replaced.

Much of the system infrastructure dated to the late 1960s when the PATCO system was built. The wood poles that served as support for the power lines were rotted at the base or were brittle, and were easily blown over in high winds. The insulation in the power cables had aged and weathered, leading to electrical shorts and system shutdowns. It became crucial for DRPA to update these systems, as reliable traction power and signal power are critical for the safe and efficient operation of the PATCO High-Speed Line.

Included in Burns' infrastructure renewal was the complete replacement of the aging electrification and power distribution system. The project would become one of the largest electrical public works projects ever built in southern New Jersey: construction costs topped \$30 million, of which, \$10 million came from American Recovery and Reinvestment Act of 2009 (ARRA) funds.

1. Uniqueness and/or innovative application of new or existing techniques

This project represents an original application of an existing technology: fiberglass poles used on a railroad. The application of this technology is new due to the fact that it is the first application of fiberglass poles on a U.S. railroad. Utilization of fiberglass poles on this section of PATCO's High Speed Line adds a potential 100 years of life to the system, greatly increasing the system's reliability and durability, and protecting PATCO's investment. In the past, wood poles were used for pole lines because they were inexpensive. However they are also subject to decay and insect infestation. In order to ensure the infrastructure upgrade visually integrated with the natural surroundings, the new fiberglass poles were made brown.

2. Future value to the engineering profession and perception by the public

Future value to the engineering profession

The PATCO Power Infrastructure Renewal provides tremendous value to the engineering profession. It shows that existing technologies can be applied in untraditional ways to help clients meet their technical and operational needs. The use of fiberglass pole lines instead of traditional wood has greatly extended the life and reliability of PATCO's infrastructure, and serves as a model project for future traction power infrastructure upgrades across the country. This project also reinforces how important it is for engineers to support clean transportation initiatives, and is an example of how the engineering profession contributes to making a healthier, cleaner, "greener" environment for the traveling public.

Perception by the public

In a time of increased use of mass transit and regional rail due to high gas prices and increased population in major metropolitan areas, the growing number of riding public needs high reliability, predictability and on-time service. This project demonstrates to the public that mass transit can be upgraded to improve reliability while having minimal impact on daily ridership and schedules. This project was successfully completed with minimal impact on PATCO's 50,000 daily riders, emphasizing a positive image of engineering, and increasing the public's confidence in mass transit. This project also enabled Burns to utilize \$10 million of ARRA funds, allowing DRPA significant savings and demonstrating the ability for public money to provide public good.

3. Complexity

A summary of the engineering complexities associated with this project includes:

- Significant coordination between multiple stakeholder agencies including DRPA/PATCO, NJ TRANSIT and Conrail, was required to keep the project moving smoothly, and without significant impact to the riding public. For example, while working along the right-of-way that PATCO shares with NJ Transit's Atlantic City Line, buses were substituted for late-night NJ TRANSIT trains four nights a week.
- The project's construction phasing was carefully developed to minimize the impact on PATCO operations, while providing the contractor with adequate construction windows.
- A significant portion of the work area was only accessible from the track. Because PATCO does not have a parallel maintenance road along the tracks, and in many locations the track is inaccessible by conventional construction equipment, the installation of new poles and cable, including cable transfers and removal of old poles, was done using a train of hi-rail line equipment.
- 24/7 operations created a significant scheduling challenge for the construction team. Since most of the work was done using on-track construction equipment, the team used single-track outages at night between 9 p.m. and 5 a.m. in order to access the tracks. In a carefully orchestrated manner, the contractor was permitted to work from one track while revenue trains operated on the adjacent track. The team collaborated to carefully manage construction activity and shutdowns around peak travel times and special events.
- Significant safety measures were established and implemented in order to protect workers and equipment from closely passing trains. Look-ahead schedules were closely coordinated several times a week to make sure that all parties were synchronized. While working along the right-of-way that PATCO shares with NJ Transit's Atlantic City Line, buses were substituted for late-night NJ Transit trains four nights a week.

4. Successful fulfillment of client/owner needs

Through the completion of this project, Burns helped DRPA improve the reliability and safety of the PATCO High Speed Line, enabling them to continue providing outstanding on-time service to their 50,000 daily riders. Burns exceeded expectations through:

- In order to capitalize on \$10 million in ARRA funds, the project was quickly and creatively redesigned to become shovel-ready, ultimately saving DRPA nearly \$20 million total. This project facilitated the successful use of ARRA funds to provide tremendous benefit to the region.

- Infrastructure upgrades, including the first fiberglass pole line on a U.S. railroad, extend service life and improve system reliability.
- The complete replacement of the system's fiber optic backbone allows for future increased information capacity, future system expansion, and improvements in security, revenue collection and information dissemination throughout PATCO's system
- All construction was completed on an active railroad without impacting PATCO operations, maintaining their outstanding on-time performance record
- Navigation of complex working conditions and scheduling intricacies and careful phasing minimized impact on daily operations and schedules
- Collaborative problem solving that enabled success even during the most extreme construction restrictions, and while accounting for PATCO's often fluid operating priorities
- Strong on-site resident engineering expertise resolved field issues correctly and in a timely fashion to allow safe, unimpeded construction progress

5. Social, economic and sustainable development considerations

Social considerations

The project reinforces to the general public and local community that PATCO is committed to promoting and providing clean transportation to support the region's green initiatives. The renewal of PATCO's infrastructure increases visibility of electric traction as a clean mode of transportation.

Economic considerations

While DRPA made a significant upfront investment in upgrading this section of PATCO track, the long term economic benefits to them are great. The low-maintenance fiberglass pole line has an anticipated 100 year service life, and requires much less periodic maintenance, providing tremendous long-term economic benefit to DRPA.

Sustainable development considerations

The renewal of PATCO's power infrastructure supports and promotes mass transit as a clean form of transportation, and supports the region's green initiatives. By providing a more reliable system, the PATCO High Speed Line will attract a greater number of riders, reducing the number of cars on the road and decreasing harmful emissions.

SUMMARY

The PATCO High Speed Line Power Infrastructure Renewal for the DRPA is unique and worthy of special recognition. Burns' revitalization of an antiquated traction power distribution system helped DRPA and PATCO:

- Ensure continued, reliable service for PATCO's 50,000 daily passengers
- Preserve PATCO's outstanding record of on-time performance
- Promote clean transportation to support the region's green initiatives
- Utilize public funds for tangible, long-term regional benefits

Burns' creative and innovative engineering solutions:

- Renewed PATCO's electrical infrastructure, which had outlived its useful life, and was experiencing system failures and lapses in reliability
- Completed construction on a busy, 24-hour a day, 7-day a week (24/7) railroad without impacting operations
- Reimagined and repackaged the project to meet DRPA's funding limits, while saving them a total of \$20 million
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Burns' innovative solutions helped DRPA and PATCO achieve social, economic and sustainable design benefits, including:

- The project reinforces to the general public and local community that DRPA, PATCO, The Burns Group and the engineering community are committed to promoting and providing clean transportation to support the region's green initiatives
- The low-maintenance fiberglass pole line has an anticipated 100 year service life, and requires much less periodic maintenance, providing tremendous long-term economic benefit to DRPA