

Washington DC Metro Silver Line Material and Quality Control Issues



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The Washington DC Metro System, the subway that operates throughout the District of Columbia, Virginia and Maryland, is extending one of its branches – the Silver Line. Construction is underway to provide riders with access to the Dulles International Airport and other surrounding areas in Virginia. Numerous technical issues have arisen in the past several years. As the second phase of construction continues, the most recent issue involves out-of-specification concrete rail ties. Additional issues, including cracks in concrete support girders and deficiencies in installed concrete panels, have plagued the project in the past three years causing schedule delays and cost overruns. Clearly, there are quality control and material issues on this massive project. DOE's capital asset large construction projects have experienced similar material issues, found after the equipment has been installed in the field. With proper oversight, quality control testing and inspection, these issues can be eliminated or their effects minimized. This bulletin includes a list of best practices generated by the DOE Office of Enterprise Assessments that are pertinent to these issues.

Discussion:

Background

Washington Metro's Silver Line extension to Dulles airport, currently under construction, is experiencing significant cost overruns and delays to the project schedule. Hundreds of concrete rail ties installed at track crossovers have been found to be out of specification. This problem could further delay the project that is already 13 months behind schedule. Other serious issues identified in the past three years include faulty concrete panels installed at five of six new stations being constructed, and cracks found on girders that support the tracks at the Dulles International Airport.

Discussion

The Silver Line extension is being constructed in two phases. The first phase is complete and operational with service that started on July 24, 2014. This phase provided five new stations in Northern Virginia's Dulles Corridor. Phase 2 began in 2014 and will expand the line by 11.5 miles out to Loudon County via Dulles International Airport, adding six stations to the line. The main objective of the extension is to link Washington DC to Dulles Airport and other suburban areas such as Tysons, Reston, Herndon and Ashburn. The second objective is to reduce reliance on highway traffic in these areas to improve traffic conditions.

In September 2018, Capital Rail Constructors (CRC) discovered the issue with hundreds of concrete rail ties installed at track crossovers. The issue involves approximately 400 ties that support rails in areas where multiple sets of track come together. The affected ties are higher in the middle than at the ends by as much as half an inch. This imperfection could cause the rails and, therefore, the metro railcars to lean slightly towards the outside. Rocla Concrete Tie, the manufacturer, denies that their ties are faulty claiming that they meet specifications. The Project Director for CRC states that the ties passed all quality control testing in house, however fails the testing that can only be performed after the ties are installed. A number of the faulty ties have been replaced. CRC has stated that it will add "shims" on the remaining ties to level out the tracks; however, Metro has rejected this remedy. Metro stated that the proposed fix could potentially cause additional maintenance issues going forward and wants all the affected ties to be replaced¹.

In July 2015, cracks were discovered in six of eight girders that were installed to support the tracks near the Dulles Airport. Work stopped on these installations for several months until the affected girders were replaced. In early 2016, a whistleblower at Universal Concrete Products filed suit stating that he was directed to lie about the results of quality testing on concrete panels used at several metro stations under construction on the Silver Line. About 20% of the 1600 panels delivered were found to have the incorrect water/cement ratio, and out-of-specification rocks were used in the

concrete mixture. A sealant will be applied to protect the affected panels every ten years, keeping water from getting into the panels and providing a resolution to the mixture issues.

The construction of the Silver Line has been hampered by material issues, specifically in the area of concrete products. Some of the issues, like the concrete panels, were caused by fraudulent activities and guilty parties have been identified and penalized. However, other issues were due to inadequate or poor quality control. For the concrete ties, there may be a tolerance build up issue that should have been identified in the design phase, rather than found in testing after the equipment was installed in the field. In any case, if these issues had been identified in a timely fashion, significant re-work and re-testing could have been prevented, and cost and schedule impacts could have been avoided.

Conclusion

There are probably few, if any, large construction projects that have not been plagued with material issues. The DOE's capital asset construction projects, along with large commercial construction projects like the expansion of the Washington DC subway system, are no different. As long as these projects follow best practices in quality assurance and quality control, the risk of issues can be minimized or issues that do arise can be found early and their impact can be limited.

Recommended Actions:

Lessons Learned:

The following is a summation of Best Practices from the DOE Office of Enterprise Assessments in four areas that are pertinent to the issues discussed in this Lessons Learned Bulletin: Quality Control Inspections, Control and Calibration of Measuring and Test Equipment, Concrete Testing and Receiving Inspection Program:

- Quality Control (QC) Inspections
 - Contractors must use qualified personnel with experience to perform effective QC inspections in accordance with industry standards
 - Contractors should use subcontracted inspection organizations to supplement their QC inspection staff when required to perform specialized QC inspections.
 - Qualified and experienced QC inspectors should monitor work in progress and identify potential deficiencies that are easy to correct on the spot.
 - QC inspectors should not be involved in performing the work activities that they inspect. QC inspectors, different from field and construction engineers should maintain objectivity and provide an unbiased assessment of the quality and acceptance of completed work activity
- Control and Calibrations of Measuring and Test Equipment (M&TE)
 - Contractor programs for the control and calibration of M&TE should be controlled by QA requirements and calibration of equipment should be traceable to the National Bureau of Standards.
 - Contractors must check the accuracy of their M&TE at frequent intervals to ensure it is within calibration tolerance when used in the field. These checks can be performed daily, weekly, or monthly, depending on type of M&TE and its usage.
 - Where M&TE is found to be out of calibration or damaged, it is necessary to identify and review all work performed using the equipment since it last was successfully calibrated. This may result in re-testing to verify that equipment was installed properly.
 - Components or systems that had been tested using suspect M&TE also require re-testing in some cases.
 - The advantage of performing frequent accuracy checks is that amount of re-testing required due to inaccurate M&TE is minimized.
- Concrete Testing
 - On projects where substantial amount of concrete is being poured, contractor should have a full-time onsite QC inspector in the field to monitor concrete manufacture and performs QC checks of freshly mixed batches.

- QC inspector should test the first batch of concrete on each shift and as needed to verify that properties comply with specified requirements before releasing to the field. These tests can identify when a change to a concrete batch is needed to compensate for environmental condition changes.
- Use of testing program can reduce the amount of waste (concrete found out of specification) and can thus improve efficiency of concrete placement.
- An independent testing organization should perform the official testing that forms the basis for accepting the concrete.
- Receiving Inspection Program
 - Receiving warehouses should use material testing equipment to perform limited mechanical and physical tests on hardware and components and to verify chemical contents of some hardware and components.
 - Samples of hardware and materials should be sent to an independent entity to verify the equipment complies with specifications. This testing can provide early identification of non-conforming components and hardware before the item is released to the field.
 - Early identification of equipment issues permits time to purchase replacement items without significantly impacting project schedules.

Other Quality Control lessons learned:

- Identify and focus on issues that are critical to the quality of the project
- Select contractors that make quality a core value - don't rely on Quality Control or Quality Assurance to identify issues
- Quality should be proactive, not reactive
- Empower key QA/QC personnel on the team to make decisions on the project using vetted, experienced and verified staff.

Critical Decision(s):	CD-3
Facility Type(s):	Capital Asset Construction
Work Function(s):	Quality Assurance, Project Management, Engineering
Technical Discipline(s):	Engineering

References:

1. Aratani, Lori, "New problems for the Silver Line Phase 2: Officials say rail ties are flawed", The Washington Post, December 12, 2018.
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3. Coblenz, Mark; Szympruch, Scott; Sebastian, Robert; Goocharan, Rocky, "ICC Construction Quality Assurance/Quality Control Panel",
4. Smith, Max, "Silver Line concrete problems flagged a year earlier in whistleblower lawsuit", WTOP Hubbard Radio Washington DC, LLC , May 16, 2018.
5. "Office of Enterprises Assessments Lessons Learned From Review of Construction Quality at U.S. Department of Energy Nuclear Facilities", Office of Nuclear Safety and Health Assessments, Office of Enterprise Assessments, U.S. Department of Energy, November 2016.