



**PHASE I QUALITY ASSURANCE ASSESSMENT  
OF MONONGAHELA INCLINE**

**FOR**

**PITTSBURGH REGIONAL TRANSIT**



**FINAL REPORT DATE: May 15, 2024**

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## EXECUTIVE SUMMARY

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Port Authority of Allegheny County d/b/a Pittsburgh Regional Transit (PRT) retained the professional services of Talson Solutions, LLC (Talsion), an independent capital advisory firm, to conduct a quality assurance assessment of the ongoing electrical work for recent Monongahela Incline (Incline) Rehabilitation activities. Westmoreland Electric Services, LLC (WES) is serving as the electrical contractor through agreement with the PRT, and Mott MacDonald (Mott) is providing design services under an on-call contract with PRT. SAI Consulting Engineers (SAI), Inc., and Advanced Integration Group (AIG) provided full time inspection and construction management and administration services for the project on behalf of PRT.

The objective of the quality assurance assessment, which is the first phase of a multi-phased review of the Incline, was to evaluate and analyze the root causes of the Incline's electrical issues which have led to various operational shutdowns and determine whether the corrective actions implemented sufficiently address the root causes. Additional focus was to assess if a quality assurance program was in-place for adequate inspection, testing and reporting of electrical work activities. This entailed assessing contractual compliance by WES, including adherence to predefined quality standards, as well as the overall project management by PRT's personnel. The assessment included review of project documents and interviews with representatives of PRT, Westmoreland, SAI, AIG, and Mott. PRT's Operations, Engineering and Legal Departments were accessible and provided insight and support.

Talsion noted that the Incline's various operational shutdowns appeared to be a result of a series of non-systematic, sporadic and unpredictable causes. There is evidence that several of the equipment failures (e.g., brake resistors, cabin doors, track lighting) may have been potentially avoided with additional analysis of the full design and related calculations to pre-existing known working conditions and/or existing equipment capacities.

Talsion did note that PRT, WES and Mott were collaborating in implementing the necessary corrective actions to mitigate similar issues from future operational stoppages. As a result of the assessment, Talsion identified the following enhancement opportunities relating to contract administration and documentation and project management practices. They are supported by seven observations (listed in the Detailed Observation and Recommendation Section of this report):

1. Enhance contract language to clarify engineer obligations for design and construction support services.
2. Require that relevant project documents be approved by the designated Engineer of Record.
3. Improve communication amongst PRT departments and its consultants, specifically related to site access, inspections, testing and system modifications.
4. Improve document management by PRT's design and construction consultants.
5. Enhance Incline training, specific to integration of new software and systems.
6. Ensure the activation of "Audit Trail Enhancement" into new operating system software.

As of April 30, 2024, the issuance of the Final Acceptance Certificate for WES contract obligations remains open and full conveyance of warranty to the PRT of the Incline remains incomplete.

## PROJECT BACKGROUND

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The Monongahela Incline is the oldest continuous operating funicular in the United States. Built in 1870, the 154-year old community asset provides a quick and reliable connection from Mt. Washington to Station Square and downtown Pittsburgh. The electrical work is part of the rehabilitation and modern technical integration efforts to upgrade the Incline from a mostly mechanical system to an electrical system. The efforts will extend its service life, reduce long-term maintenance costs and meet passenger safety and operational guidelines. Predominant elements of the scope of work includes the integration of a new SCADA System and Control System Design, the replacement of Incline door signals and operators, installation of new proximity switches, E-stop system and upper station operator workstation redesign, and vehicle power systems.

On December 27, 2021, PRT entered into a \$2.6 million Agreement with WES for the Monongahela Incline Phase II Rehabilitation electrical work. On January 27, 2022, the Notice to Proceed was issued, with substantial completion anticipated to occur 365 days from the notice date. However, the completion of the work was challenged with significant delays and closures due to material and equipment issues. Within Change Order No. 1, PRT extended the completion date to April 15, 2023, in exchange WES provided supplementary spare parts and related credits.

The Incline's operations have been affected by various significant and concerning issues. Most notably through the completion of this report, incidents include the East Car striking the upper station bulkhead at the top of the tract on April 1, 2023, the failure of the Drive Control System on August 11, 2023, which left eight passengers stranded for over an hour, and on November 22, 2023, the Incline experienced a total loss of operations control for several hours due to a software related issue. Additional stoppages to the Incline's operations in 2024 were caused by software deficiencies related to track slowdown devices and brake resistor failures. The brake resistor failure was found to be due to the resistor sizing being underrated by the system integrator, ELCON Technologies (ELCON); however, this may have been avoided if the proposed design review included sizing calculations of the new system design by ELCON against the original in-use resistor sizes. A detailed list of the notable incidents, root cause and corrective actions responses is attached as **Appendix A**.

PRT and SAI have formally notified WES of delinquent completion on multiple occasions, serious incidents impacting the prove-in period completion and delayed issuance of the Final Acceptance Certificate from April 23, 2023 through January 9, 2024. Notification of potential liquidated damages due to required schedule extensions and preservation of rights for future liquidated damages have also been communicated to WES. Initial attempts by WES for inspections by the Pennsylvania Department of Labor and Industry in November 2022 and January 2023 required rescheduling due to required testing not being complete. The Incline ultimately passed the required inspections and recommenced revenue operations in March 2023. As of April 3, 2024, there remain 17 unresolved punch list items.

On April 27, 2024 and subsequent additional design review based on the resistor redesign, the Incline entered into revenue operations and another 60-day proving period, which is required as condition of acceptance of the newly installed equipment warranties and software system ownership by the PRT. Upon acceptance, WES will contractually deliver software codes, databases, licenses, and withdraw all obligations to further manage the system. After the warranty period has lapsed, future software support and remediations may be performed by PRT, ELCON and/ or another third-party integrator (through an ancillary contractor).

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## AUDIT SCOPE

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Talson conducted the quality assurance assessment by utilizing applicable guidance and reporting standards outlined by the International Professional Practices Framework issued by the Institute of Internal Auditors. These standards require quality assurance over adequate planning and performing the assessment to obtain sufficient and appropriate evidence to provide a reasonable basis for observations and conclusions within a detailed assessment plan based on risk-assessed objectives. Talson believes that the evidence obtained provides a reasonable basis for our observations and conclusions based on our assessment's objectives.

The scope of the work included the general assessment of compliance with quality assurance procedures and contract provisions and identifying any risks to planned completion of the contractual obligations, issuance of substantial completion, acceptance of the system, and continuous future operations. Talson assessed the project team's management (e.g., PRT, WES, Mott, SAI and others) and alignment with industry best practices throughout the engagement, facilitated knowledge sharing discussions, and collaborated with the project teams to ensure transparency of the assessment but also maintained independence.

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## WORK PERFORMED

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Talson reviewed various project documents at its Philadelphia office, followed by on-site work activity at PRT's offices from April 8-10, 2024. Fieldwork consisted interviewees conducted in WES offices, site visit to the Monongahela Incline Upper Station, reviewing additional documentation and interviewing personnel involved with the project. The complete list of documents reviewed and personnel interviewed are attached as **Appendices B and C** respectively.

Specific assessment activities included, but were not limited to:

1. **Documentation Review:** Assessed the Agreement between PRT and WES to ascertain that the terms, conditions and deliverables were achieved. RFIs, submittals, meeting minutes and other notable documents were also assessed to identify any potential risk. Talson reviewed Mott's Scope of Contracted Services under its Work Order with PRT.
2. **Analyze Testing:** Reviewed and evaluated testing procedures and results including Factory Acceptance Testing, System Integration Testing and Site Acceptance Testing for approvals and completeness to design and regulatory requirements.
3. **Inspection:** Inspected the newly installed equipment and devices including the SCADA systems and related electrical cabinets for the brake drive system. This also involved reviewing design drawings and inspection reports to confirm installation of redundancy devices and drive controls, as well as reviewing all emergency drills procedures and performing tests on the new devices.
4. **Project Administration:** Evaluated practices by PRT, WES, SAI and Mott to assess whether the identified root causes of issues were resolved timely and sufficiently, and that the control measures to mitigate those issues are working accordingly. This included reviewing submittals, daily inspection reports, general communications and other critical notifications between the various parties.

## **DETAILED OBSERVATIONS AND RECOMMENDATION**

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Talson identified the following seven observations resulting in noted recommendations to enhance the quality assurance process and contract compliance for the current Mon Incline Rehabilitation Project and for consideration for future Incline rehabilitation or enhancement projects.

### **Contract Administration Practices**

- 1.1 Mott was not formally requested to conduct an independent investigation on the root causes (i.e. underrated brake resistors) for the failure of new resistors within the initial design. Evidence was not readily available or confirmable through the formal submission process that Mott had effectively evaluated calculations for the original brake resistor design provided by ELCON), the integration subcontractor to WES against the “then” and “existing” resistors operating the Incline. Subsequent to the March 2024 brake resistor failure, Mott has reviewed through a formal submittal the proposed resistor redesign and related calculations for wattage and OHM sizes.

With additional analysis of the full design and related resistor calculations to pre-existing known working conditions such as slow run, there is the possibility that the failure may have been identified in design prior to impacting revenue operations resulting in a shut-down of the Incline.

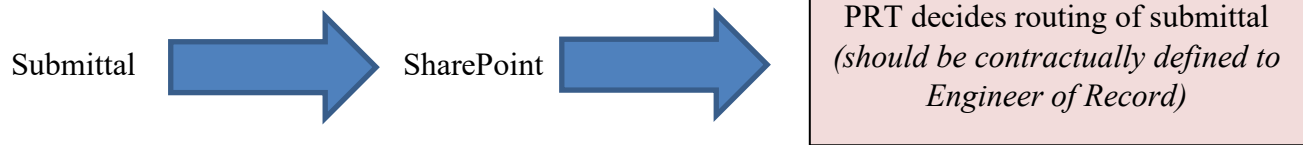
Talson noted that Mott was contractually obligated to prepare a Conceptual Design Report (CDR) which summarizes conceptual design for the new control system. The CDR was to outline the existing and proposed systems including outlining the basis for design, conceptual schematics for the overall control system, and sketches of typical arrangements and details. The overall concept intent was that the proposed changes must not impair the availability of the Incline and the upgraded control system and its components must be sustainable and maintainable. Talson has not assessed the viability of the CDR and its potential lack of pre-identification of potential future failures.

Prior to the preparing the CDR, Mott also was obligated to prepare a Preliminary Hazard Analysis (PHA). Talson’s review of the PHA and CDR are pending. Should any hazard identifications and correlating mitigations be identified as “a current risk”, Talson will note so the PRT in it’s Phase II report.

- 1.2 Though interviews with WES, Mott and PRT and the review of formal submittals, Talson could not ascertain that select project documents were signed and stamped by the designated Engineer of Record. The lack of formal review by Mott at PRT’s directive may have been a result of PRT assuming engineer decisions which, in the future should be more clearly defined and obligated to the designer.

Talson specifically noted informal email communications and approvals in lieu of formal submissions.

**Observed Process:**



Talson discussed during various interviews the potential for a more defined list of obligations and responsibilities for Engineer of Record. At the PRT, the designated Project Manager currently directs submittals to various entities for their further review or disseminates the information for internal review at PRT. Because PRT has qualified engineering staff, this practice may be acceptable, but obligations for approval of critical design and inspection and testing should be assigned to the Engineer of Record.

**Project Administration Practices**

1.3 Talson noted inconsistencies and discrepancies with WES' submittals practices which entail interminable email correspondences to PRT contrary to adhering to the established standard reporting procedures. There appeared to be a lack of formal communications through the submittal process and submissions for technical design, installation, inspection and testing activities. Examples include:

- a. ELCON Site Acceptance Test Results
- b. Complete inventory of Factory Acceptance Test Results

1.4 WES led training for operation and maintenance staff for the Incline have lacked sufficient detail and conveyance of trouble shooting scenarios and materials. The training efforts should be collaboratively approached by WES, ELCON and PRT and include a more robust schedule of activities and knowledge sharing sessions.

PRT has only two Rail Instructors remaining who have training obligations for over 75 Operators, who are included in the operating staff for the Incline. The balance of instructors with knowledge of facility operations appears too minimal and could result in future institutional risk of knowledge sharing.

1.5 The activation of "Audit Trail Enhancement" into the new operating system software has not yet occurred. This will enable PRT to track and monitor any user interface, changes or modifications to the system software. This will allow for transparency and insight into any alterations that could dis-enable safety protocols or warning systems of potential failure of the Incline operations.

Due to previous concerns with accessibility and traceability, access and permission levels to operating the software system have been recently adopted and implemented as noted below:

Levels of Software System	
Operators	Allowed for full operation of the facility
Maintenance	Allowed for changes to/overrides to certain aspects of the operations
Administration	Allowed access to sensors and systems for modifications as needed

1.6 Mott has limited responsibility to provide support services during the construction phase. Mott's primary responsibility is to address questions related to the design and reviews construction submittals as directed by PRT. Mott services are excluded from performing startup and testing, commissioning, as-builts, final inspection, site visitation and participation in meetings unless directed by PRT.

### **Document Management Practices**

1.7 Talson identified a delay in uploading of SAI Inspector Daily Reports into the project document repository, SharePoint. Documents were uploaded in batches several months after inspector activities had concluded and as a result of inquiries from the quality assessment. All project meeting minutes, reporting and other Project communications should be made available to PRT and within SharePoint on a timely basis.

SAI also has contractual obligations to submit a Quality Assurance and Quality Control Plan (QA/QC Plan) that aligns with the Federal Transit Administration (FTA) guidelines, specifically following the 15-elements of quality control described by the FTA. Talson's review of the QA/QC Plan is pending. Should any areas be identified as a notable deficiency or concern to the quality oversight of the Incline, Talson will note so in the Phase II report.

Talson recommends continued compliance verification by PRT of WES and Mott deliverables prior to issuance of the Final Acceptance Certificate for WES and acceptance of Mott's contract obligations. The PRT would benefit from enhanced future design scope and contract terms and conditions relating to specific assignment of responsibilities and obligations for Engineer of Record, including review and responsibility for adherence to pre-existing and proposed design specifications and scope.

PRT consultants should also ensure timely communication and availability of inspection and testing documentation. Additionally, as required in WES contract, further training related to the operations and maintenance of the new system and enhancements to the Incline should be planned, conducted and documented between PRT, WES and ELCON. Any modifications to the existing software made by WES and ELCON need to be communicated and documented to PRT to ensure that any "informal" work arounds are not impactful to the overall operating system of the Incline and do not impact any of the newly installed safety systems.



## APPENDIX A: ROOT CAUSE OF INCIDENTS AND CORRECTIVE ACTIONS RESPONSES

Incident/Failure	Root Cause	Corrective Action Response (CAR)	Responsible Party(s)	Talsol's Assessment
East Car Struck Upper Station	4/1/2023: The car suddenly accelerated just prior to initiating the e-stop and struck the bulkhead.	Implemented speed tolerance gauges. If not going at anticipated speed then an ESTOP happens.	WES identified the root cause. ELCON assisted in the implementation of the CAR. Approved through Submittal No. 61)	Adequate CAR
Drive Control System Failure	8/11/2023: Leaking air conditioning unit on top of the Drive Control System.	Added drip pans and correctly set the AC units to the design settings.	WES implemented the change and Mott agreed with the change.	Adequate CAR
Software Issue	11/22/2023: Incline experienced a total loss of operational control.	Power cycled the whole system.	PRT	Pending Talsol Review <sup>1</sup>
Incline Track Lighting (notable punch list item)	12/14/2023: Housing and gasket design by GVA insufficient in weather conditions resulted in shortages and outages of track lighting	Revised design and manufacturing of new housing fixtures and thicker gaskets. Lighting expected to be fully operational by May 31, 2024	Incline Track Lighting (notable punch list item)	Adequate CAR
West and East Car Collide with Station	1/2/2024: Previous programing modifications changed the safety protocols.	Three levels of clearance were established along with a log of any and all changes made.	WES and ELCON implemented the changes to the software and PRT came up with the different clearance tiers.	Adequate CAR
Brake Resistor Failure	3/12/2024: The operations under an extended slow run caused the resistors to fail.	Conducted calculations and changed the resistors from two 100 OHMS to four 50 OHMS.	Mott and PRT reviewed and approved Submittal No. 77A.	Potentially Adequate CAR (Concern root cause has not fully been explored)
Slow Run	4/27 – 4/28/2024: Due to a track disposition sensor.	Identified the issue and allowed the incline to run with 3 of 4 safety measures.	PRT made the decision to keep the incline running.	Adequate CAR

<sup>1</sup> Talsol has not concluded its review of the submitted CAR.

## **APPENDIX B: DOCUMENTS REVIEWED**

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### **From: Pittsburgh Regional Transit**

- Mon Incline Drawings, dated September 9, 2021
- Executed Contract, dated December 27, 2021
  - Port Authority of Allegheny County Mon Incline Terms and Conditions and Technical Provisions, dated Sept. 17, 2021
  - Contract Addendums No. 1 – 3, dated October 19, 2021 – October 28, 2021
- Capital Budget Request Form, dated March 7, 2017
- Meeting Minutes No. 1 – 40, dated February 8, 2022 – April 18, 2023
- SAI Scope of Contracted Services, undated
- Mott MacDonald Scopes of Contracted Services, undated
- Organizational Charts, dated March 28, 2024
- Mon Incline Operations Investigation, dated February 5, 2014
- Contractor’s Progress Payment, dated May 15, 2023
- PRT Notice of WES Delinquent Completion, dated December 21, 2023
- PRT Notice of Software Nonconformance, dated January 8, 2024
- PRT Incident Report, dated January 9, 2024
- Monongahela Incline Open Punch List, dated April 3, 2024

### **From: Westmoreland Electric Services, LLC**

- FAT SCADA Sign Off Sheet, dated October 5, 2022
- SAT Punch List, dated January 12, 2023
- SAT SCADA Re-Test, dated February 2, 2023
- Resubmittal for SCADA System O & M, dated August 15, 2023
- RFI No. 1 – 34, dated February 28, 2022 - March 20, 2024
- Brake Resistor Calculations No. 102, dated April 4, 2024
- Purchase Order for SCADA, dated January 14, 2022

### **From: SAI Consulting Engineers, Inc.**

- Request for Information E No. 1 – 37, dated March 14, 2022 - March 20, 2024
- Request for Information G No. 1 – 35, dated February 16, 2022 - December 7, 2022
- Request for Information H No. 1 - 7, dated April 4, 2022 – September 26, 2022
- Submittals No. 1 – 79, dated February 22, 2022 - April 30, 2024
- Submittal Reviews No. 1 – 33, dated February 25, 2022 – June 29, 2023
- Letter of Transmittal No.1 – 81, dated February 4, 2022 – March 31, 2023
- Inspection Daily Reports, dated June 6, 2022 – March 15, 2024

## **APPENDIX C: INTERVIEWS CONDUCTED**

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### **Pittsburgh Regional Transit**

- Katharine Kelleman – Chief Executive Officer (*discussion only*)
- Mike Cetra – Chief Legal Officer (*discussion only*)
- Amy Silbermann – Chief Development Officer (*discussion only*)
- Eric Bilsky – Deputy Chief Engineer
- Burt Jennings – Chief Safety Officer
- Charles Reeves – Deputy Chief Operating Officer of Transportation
- Andrew Lukaszewicz – Director of Rail Service Delivery
- Eric Bernstein – Senior Project Engineer of Electrical
- Joshua Banyas – Director of Capital Programs
- Dave Matlin – Manager of Capital Programs of Systems
- Jacob Cherevka – Manager Facilities
- Christopher Jones – Assistant Manager

### **Westmoreland Electric Services, LLC**

- Brian Owens - President
- Michael D. Thomas Sr. – Project Manager
- Phillip Hunt – Purchasing Administrator

### **SAI Consulting Engineers, Inc.**

- Brian Schull – Assistant Department Manager of Construction
- Mike Wissel - RCM

### **Advanced Integration Group**

- Mike Turske - Engineer

### **Mott MacDonald**

- Shem Kobialka – Contract Manager
- Dave Mason – Electrical Engineer
- Kemal Nilksic – Portfolio Manager