Metropolitan Transportation Authority
RFP No. 16098

Technical Proposal for
Energy Consulting Services

February 27, 2025

Prepared by

T U R N E R
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C O R P O R A T I O N

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1 Executive Summary

The Turner Engineering Corporation (Tenco) Team proposes to provide Metropolitan Transportation Authority (MTA) with the selected Energy Consulting Services on an as-needed basis as a firm on the Energy Consulting Panel, per RFP No. 16098.

MTA is procuring Energy Consulting Services to increase energy cost savings and related revenue streams, improve sustainability, and reduce carbon footprint to meet New York State energy policy requirements. Tenco proposes a strong team of deeply experienced companies with skilled NYC area industry leaders and engineers who share MTA's values and commitment to safe, energy-efficient, and cost-effective service and operation.

The Tenco Team proposes services in several energy areas:

1. **Technical and engineering services**
2. **Fleet and other transportation electrification advisory**
3. **Demand Response**
4. **Energy markets, competitive supply management and risk management advisory, and Regulatory, legal, and regulated supply management advisory (Fossil Fuels).**

The Tenco Team is the right team for MTA Energy Services:

Right Prime Contractor: Tenco is an agile, technically sophisticated transit systems engineering company with deep experience in energy and advanced transit projects at NYCT, LIRR, and MNR, and across North America. Our expertise covers transit and energy storage equipment and systems, integration, and analysis, as well as railcars and buses, operations and maintenance, and specification and procurement. We have a deep understanding of energy policy, sustainability, and regulatory environments. Tenco provides transit engineering service at the highest professional, technical, and quality level. We listen, understand the client's problem, and use the right tools and techniques to deliver effective results. We use the strengths and skills of our team members, working closely and communicating fully, to jointly achieve the agreed-upon goals.

Right Team: The Tenco Team includes Tenco and:

- **Nebula Engineering (Nebula) –** Nebula is a cutting edge engineering company based in New York specializing in design and analysis of electrical and traction power systems for public transit agencies in New York, New Jersey, and across the country. NY MBE, DBE.
- **Marine Tiger Technologies (Marine Tiger)** – Marine Tiger is a leading business and technology consulting company delivering solutions for public sector transportation and environmental clients, with advanced expertise in asset management and resiliency for transportation and other critical infrastructure sectors. NY WBE.

- **Granite Data Solutions (GDS)** – GDS is a SDVOB providing expert services in key areas:
  - Advanced, modular battery storage and mobile microgrid solutions for scalable and flexible rollout of energy resources, including architecture and design
  - Advanced data analytics and technology solutions, specializing in asset and life cycle management, including provision of IT and OT equipment on a large scale.
  - Professional engineering solutions and on-site technical support; Cloud Services Platforms for end users and installers.
  - Project Management: Full lifecycle support, including contractor hiring, project management, and ongoing system maintenance.

The Tenco Team meets all requirements for MTA-recognized MBE, WBE, and SDVOB participation.

Right Experience: Tenco Team members work for US transit operators and their consultants and traction power and train control suppliers, for NYCT, LIRR, and MNR, and for Boston MBTA, Chicago Metra, CTA, LA Metro SF BART, Vancouver Skytrain, and WMATA; for railroad authorities; for railcar builders, equipment suppliers including ATC, propulsion, and doors; for subway and rail construction companies; and for government agencies and regulators.

Our hands-on experience covers traction power and energy storage design, integration, implementation, and monitoring services; railcar and bus fleets and their systems and equipment; leadership and design on safety related systems including power, fuel, train control, and communications; transit agency organization and departments, operations and maintenance, staff and procedures; and agency oversight and regulatory compliance reporting.

Key Tenco Team MTA projects related to energy include:

- ABB Smart Battery
- Deloitte Flywheel Energy Storage Study
- Urenco Flywheel Energy Storage System (FESS)
- Hyundai Rotem Loan Agreement with NYCT
- Toyo Denki Battery Energy Storage System (BESS)
- NYCT AC Train EMC Standard.

Right Expertise and Capabilities: The Tenco Team has deep expertise and capabilities to investigate, understand, assess, and resolve energy challenges in the selected topic areas, from extensive relevant projects:

1. **Technical and engineering services:** NYCT ABB Smart Battery; NYCT Kawasaki Gigacell Battery Power System; NYCT Urenco Flywheel ESS; NYCT Toyo Denki ESS; LA Metro WESS; Caltrain Electrification 2x25 kV Traction Power and Utility Impact; NYCT NYPA Regen Energy Improvement Project; Caltrain Electrification Storage Study; Denver 1x25 kV Utility Impact; LA Metro Microgrid; LIRR, NYCT, and MNR train-traction power studies, engineering, and design; Energy storage and resiliency products for commercial, industrial, and utility-scale projects; Electromagnetic compatibility planning, assessment, and testing; Services including design architecture, engineering, site services, remote monitoring, and a robust cloud services platform. Energy management software and battery control modules for end-to-end solutions.

2. **Fleet and other transportation electrification advisory services:** NY Electric Vehicle Rate Modeling; NJ Transit ZEB System Design and Investment Planning Study; PANYNJ Climate Transition Risk and Opportunity Analysis and Strategy; Cupertino Zero Emission Fleet Planning; LA Metro Bus Electrification Planning.

3. **Demand Response:** LA Metro Microgrid; Consulted on distributed energy resources, grid modernization, energy resilience, and decarbonization strategies; developed DER program designs, assessed energy system capability, and investigated modeling energy storage value stacks and demand response technologies.

4. **Energy markets, competitive supply management and risk management advisory, and Regulatory, legal, and regulated supply management advisory (Fossil Fuels):** Executive experience buying/selling 22-25 million gallons of refined fuels per year, about $80-88 million, or about half NY MTA purchases. Authored and executed hedging and risk mitigation strategies, negotiated supply contracts, and directed procurement, closely monitored energy markets, and conducted multivariate financial analyses to enhance ratemaking and distribution outcomes. Handled legal and regulatory compliance for storage and distribution, including spill protection, control, and countermeasure (SPCC) plans and remediated regulatory noncompliance and spills.

Right Leadership: The Tenco Team Engagement Manager is Eli Fernald, a senior NYC-based engineer with deep experience with MTA rail and energy projects. For each topic, the Tenco Team provides a transit expert in that area as Project Manager (PM) to lead Tenco Team work:

- **Technical services and Demand Response PM:** Gary Thompson, Senior Engineer. Expert in energy and microgrid modeling and analysis, utility modeling and simulation, demand response assessment, and electromagnetic compatibility (EMC) testing and analysis. Recently completed the 2x25 kV Caltrain electrification project and analysis.

- **Engineering services PM:** Bruce Huang, P.E., Senior Engineering Executive.
  Expert in design and analysis of AC and DC utility and traction power systems, and battery power systems for transit applications. Experience with all phases of power system projects, from feasibility assessment to installation and commissioning. Based in NY, deep experience with MTA and its agencies.

- **Transportation Electrification PM:** John St. Clair, Senior Consultant.
  Expert in zero emission and electrification assessment, transition planning, and cost analysis. Before joining Marine Tiger, John played a key role in the development of MTA NYCT's Enterprise Asset management program for both the bus and subway fleets.

- **Energy Regulatory and Supply Management PM**: Denley Vennes, Senior Consultant.
  Expert in fuel procurement and analysis, regulatory proceedings, and contract negotiation. Executive Management experience, specializing in wholesale & retail energy distribution. Proven ability to increase profitability and operational efficiency in a leadership role.

Our area leaders understand the technologies new and old that enable efficient and cost-effective service; the constraints and imperatives of policy and government; and the ways to integrate technology and policy safely, on time, and within budget.

Right Commitment: Tenco, Nebula, and Marine Tiger each have long and successful experience on MTA projects related to energy, and on similar projects across North America. In each case, success stems from hard listening followed by hard work, and by commitment to make the team succeed. We understand MTA's mission and vision, as well as the inherent risks and obstacles in providing transit services, and the need to reduce costs and optimize revenue for MTA to continue to provide safe and reliable transit for the public. We are committed to helping MTA deliver safe, efficient transit in line with its mission and vision, with reduced energy use and cost, and better service for passengers.

The Tenco Team is local, flexible, thorough, deeply experienced, responsive and responsible, and proficient. We know MTA and rail division staff and they know us. We listen well, understand what is needed, hit the ground running, and provide the needed solution. Most importantly, we understand the crucial importance of defining, implementing, and verifying the right energy solutions to the challenges of MTA transit operations.

2 Firm Qualifications and Experience

2.1 The Tenco Team

The Turner Engineering Corporation (Tenco) Team has proven experience, capabilities, industry-leading expertise, judgment, depth, and diligence to provide the Metropolitan Transportation Authority (MTA) with productive and efficient professional engineering and advisory services. Our experience and capabilities, and our structure, location, and vision, equip us to deliver impactful energy solutions that are directly applicable to the challenges MTA faces.

Tenco will lead the Tenco Team by overseeing technical tasks and engagement with MTA and other parties. For 30+ years, Tenco has been at the cutting edge of rail and bus transportation solutions development, including strategic analysis; traction power, utility impact, and energy storage systems and solutions for transit; systems and equipment engineering; Safety, RAM, EMC, and Cybersecurity; modeling and technical analysis; and system integration, testing, commissioning, certification, revenue service integration, and operations and maintenance support.

The Tenco Team is deeply experienced and highly agile, with the capacity to lead and support multiple projects (mini-RFPs) as needed by MTA, for: technical and engineering services; transportation electrification advisory; demand response; energy markets, competitive supply management and risk management advisory; and regulatory, legal, and regulated fuel supply management advisory.

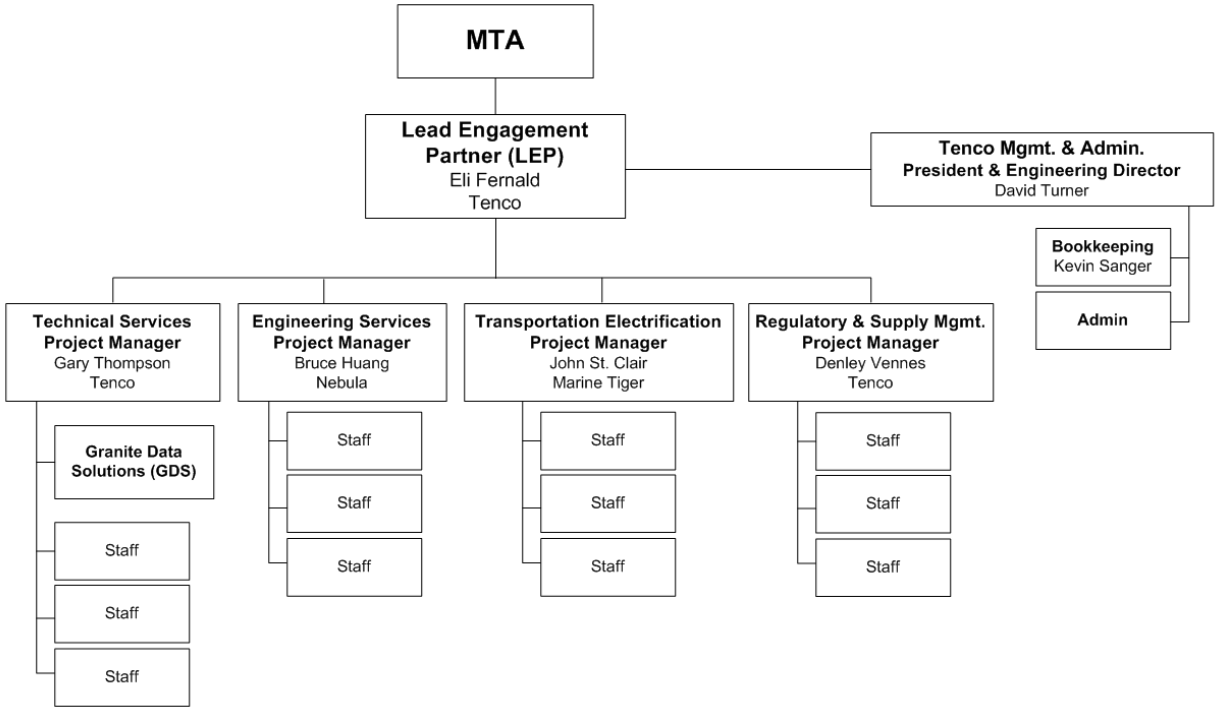
2.2 Team Organizational Structure

Tenco will direct each contract awarded to Tenco through the Energy Consulting Bench, led by:

- Eli Fernald, Lead Engagement Partner and Tenco Team manager. Mr. Fernald will lead communications and engagement with MTA and other parties involved.
- David Turner, President and Engineering Director of Tenco.

Project Managers (PM) will manage projects as assigned and be responsible for completion and delivery of all associated tasks and deliverables. Each PM will oversee their own work, work by other employees from their company, and work by others on the Tenco Team. The Team will organize teams strategically as each mini-RFP is released to provide the most benefit to MTA and the project.

Figure 1-1
Tenco Team Organizational Chart



2.3 Turner Engineering Corporation (Tenco)

2.3.1 About Tenco

Tenco is an agile, technically sophisticated transit systems engineering company with deep experience on energy and advanced transit projects at NYCT, LIRR, and MNR, and across North America. Our expertise covers transit and energy storage equipment and systems, integration, and analysis, as well as railcars and buses, operations and maintenance, and specification and procurement.

Tenco provides transit engineering service at the highest professional, technical, and quality level. We listen, understand the client's problem, and use the right tools and techniques to deliver effective results. We use the strengths and skills of our team members, working closely and communicating fully, to jointly achieve the agreed-upon goals.

Tenco was established 30+ years ago, based in Los Angeles, CA, with staff across the US and Canada, including 30 full-time engineers and analysts, and 50 expert engineering associates.

2.3.2 Qualifications

Below are Tenco's relevant qualifications that exhibit our deep knowledge of the energy sector, and extensive experience providing energy consulting services in transit, for MTA and across the country.

Project:	**NYCT ABB Smart Battery**
Client:	ABB, MTA, NYCT
Contact:	Anaum Afsar, Project Manager ABB Contact No: 365-324-5163 Contact Email: anaum.afsar@ca.abb.com
Dates:	2018 – Ongoing
Value:	$450k
About:	This pilot project deployed an ABB Smart Battery ESS (ASB) through a NYSERDA Grant to MTA, as part of an initiative to provide energy storage and utility grid services for heavily burdened utility power systems and traction power stations. The project demonstrated two major functions: the capture and reuse of regenerative braking energy on the DC side of the TPSS; and available revenue generation by providing AC side grid services.
Tenco Scope:	Tenco developed and continues to perform the ASB Electromagnetic Compatibility (EMC) Program. Attended and provided technical support for EMC factory testing in Montreal, and performed on-site installation, systems integration testing, and qualification testing and analysis at the NYCT Rockaway Test Track, using 10-car R211 train configurations. Work included supporting and performing troubleshooting activities, including ASB and traction power faults, and issues with the ASB and its interfaces with traction power, SCADA, critical communications, and other wayside systems. Tenco continues to be a key technical resource for the project. The ASB provides key functional and economic benefits for NYCT, such as peak demand reduction, regeneration energy savings, and utility demand response programs. Tenco's EMC Program ensures that public transit operates reliably and safely during ASB operation and supports a successful pilot deployment that opens the door to more energy innovation for New York.

Project:	**Flywheel Energy Storage Study**
Client:	Deloitte Consulting, MTA
Contact:	Adrian Rouse, Energy / Power Specialist Lead, Deloitte Services LLP Contact Email: arouse@deloitte.com
Dates:	January 2025 – Ongoing.
Value:	$44k
About:	Deloitte Consulting subcontracted Tenco to conduct a flywheel energy storage study for use of regenerative braking technologies in New York City's subway system.
Role:	Tenco is conducting a comprehensive analysis of subway energy usage and applicable energy storage solutions; a detailed review of the proposed flywheel system design, schematic, and proposed methodology of measuring charging, specifically from regenerative breaking energy; and a load flow study on flywheel wayside energy storage modeling. Tenco is providing assessments of critical integration work to achieve project goals, including correct integration with NYCT operating voltage ranges, with NYCT ripple levels and detection, and with typical amounts of regeneration energy available for capture. Once review and analysis are complete, Tenco will generate a final technology assessment and feasibility analysis, including providing technical recommendations to incorporate the methodology to measure captured energy.

Project:	**Hyundai Rotem Loan Agreement with NYCT**
Client:	Hyundai Rotem, NYCT
Contact:	WooKyoung Yoon, Senior Research Engineer / Energy Solution Development Team, Hyundai Rotem Contact No: +82-31-8090 Contact Email: wkyoon@hyundai-rotem.co.kr
Dates:	November 2024 – Ongoing.
Value:	$500k
About:	Hyundai Rotem entered a Loan Agreement with NYCT to demonstrate the operation of its propulsion and APS systems, with the goal to get those systems qualified for inclusion in procurement offers for NYCT subway cars. Tenco is providing consultation and guidance on requirements and practices at NYCT, and on technical aspects of the systems that must meet NYCT requirements.
Role:	Tenco developed several key project plans, including the EMCP, Smoke Flame Toxicity (SFT) Compliance Plan, and the technical Cybersecurity Plan and Cybersecurity Design Principles document, ensuring all plans were compliant with the NYCT requirements. For propulsion and APS, Tenco established key design requirements for EMI qualification and successful regenerative braking

operation. Tenco developed project RAMS analyses, including reliability analysis and Failure Mode, Effects, and Criticality Analysis (FMECA) for propulsion and APS systems.

Project: **Urenco Flywheel Energy Storage System (FESS)**

Client: MTA, NYCT

Contact: Robert Schmitt, formerly NYCT Assistant Chief Electrical Officer, Power Operations. Now at STV.
Contact No: (917) 418-3691
Contact Email: robert.schmitt@stvinc.com

Dates: 2000 – 2002

Value: $500k

About: New York City Transit (NYCT), the New York Power Authority (NYPA) and Urenco Power Technologies, Ltd. (UPT) implemented a Flywheel Energy Storage System (FESS) Qualification Project to install, demonstrate, evaluate, and qualify a 1 MW FESS at NYCT. The FESS was used to capture regenerative braking energy from subway trains.

Tenco Scope: As an element of the qualification testing, Tenco evaluated and tested the FESS with respect to NYCT's EMC requirements. Tenco established a Pilot FESS Electromagnetic Compatibility Qualification Plan (FEQP) and performed EMC field tests including conducted, inductive, and radiated emission tests. Tenco performed a FESS EMC Design Analysis that included in-depth assessment of the control systems and safety-critical software. Tenco provided the EMC Qualification Test Report that allowed the FESS to enter service on the mainline. Tenco also delivered key safety and performance analysis recommendations for next steps to drive safe and efficient operation of the FESS on a larger scale.

Project: **Toyo Denki Battery Energy Storage System (BESS)**

Client: MTA, NYCT

Contact: Robert Schmitt, formerly NYCT Assistant Chief Electrical Officer, Power Operations. Now at STV.
Contact No: (917) 418-3691
Contact Email: robert.schmitt@stvinc.com

Dates: 2015

Value: $250k

About: Toyo Denki offered its Battery Energy Storage System (BESS) as a product that is in service in Japan to NYCT. However, Toyo Denki had no experience in the US, including with EMI/EMC design and testing. Tenco assisted Toyo Denki in the design, application, and preparation for testing at NYCT.

Tenco Scope: Eli Fernald led the BESS EMC Program. Tenco assessed the electromagnetic environment and project requirements, developed the EMC Plan and associated test procedures. However, Toyo Denki found the process at NYCT too slow and unlikely to meet commercial objectives, so they withdrew from the project.

Project: **M7 Propulsion System Overhaul**

Client: LIRR, MNR, MTA; Tenco is working for Mitsubishi Electric Corporation, supplier to MTA.

Contact: Yuzo Yamamoto, Program Manager, Mitsubishi Electric Itami Works
Contact No: +81-70-7823-8458
Contact Email: Yamamoto.Yuzo@dh.MitsubishiElectric.co.jp

Dates: June 2024 – Ongoing.

Value: $135k

About: The M7 railcars were put into service in 2002 with an expected useful life of 40 years. The Propulsion Inverter Box and High Voltage Distribution Box are at the end of their useful life threshold of 15 years. The propulsion system equipment upgrade will allow the Railroads to maintain the fleet in a State of Good Repair.

Tenco Scope: Tenco developed the EMC Program Plan for the updated M7 railcars. Tenco evaluated emissions limits and developed the qualification test procedures for conductive and inductive emissions testing. Tenco performed formal design reviews, and delivered the Electromagnetic Emissions Safety Analysis (ESA), which included assessment of the EMI risks associated with changes to the design. Tenco assessed functional and EMC impacts of the propulsion system and other system and subsystem equipment interoperability. Once the M7 Pilot Married Pair is ready, Tenco will perform the commissioning EMI field tests and submit a final EMI report with results and recommendations.

Project: **LIRR M9 EMI Footprint Test**

Client: LIRR, MTA; Tenco worked for Kawasaki Rail Car (KRC), supplier to MTA.

Contact: Yuzo Yamamoto, Program Manager, Mitsubishi Electric Itami Works
Contact No: +81-70-7823-8458
Contact Email: Yamamoto.Yuzo@dh.MitsubishiElectric.co.jp

Dates: January 2023 – November 2024.

Value: $60k

About: LIRR contracted KRC and Tenco to perform electromagnetic interference (EMI) Footprint Tests for the LIRR M-9 EMUs.

Tenco Scope: Tenco participated in review sessions during test preparation and development of test procedures. Tenco conducted the EMI Footprint Test at LIRR, which included ATC antenna calibration, and conductive and inductive emissions testing, and provided critical troubleshooting support during testing issues, such as measurement obscuration due to inverter harmonics.

Project: **NYCT AC Train EMC Standard**

Client: MTA, NYCT

Contact: Ken Mooney, NYCT Chief Engineering Officer (Retired)

Dates: 1995 – 2003

Value: $250k

About: MTA required standardization of EMC specifications and requirements to ensure that all aspects of the train system are electromagnetically compatible, and to identify potential issues during factory testing, prior to delivery.

Tenco Scope: Tenco developed a comprehensive EMC Standard document for the NYCT AC Train, to provide clear guidance and baseline requirements to the carbuilder. The EMC Standard provided detailed EMC verification methodology, test procedures, emissions limits, and susceptibility design provisions to ensure the integrated train is electromagnetically compatible: within itself; with other trains in operation at NYCT; with the NYCT signal, CBTC, and communications systems; with other NYCT electronic equipment; and with equipment owned by neighbors.

The work included qualification testing for the experimental AC Trainsets in the R110A and R110B contracts, as well as later tests and separate work on R142, R160, and R211 trainset procurements.

Project: **Humatics Ultrawide Band Train Control Demonstration**

Client: MTA, NYCT

Contact: James Kinsey, Chief Technical Officer
Humatics
Contact No: jkinsey@humatics.com
Contact Email: 410-409-1306

Dates: 2021 – 2023.

Value: $250k

About: Tenco and Humatics installed a full stack UWB rail navigation system for four trains on 8 km of track, using UWB nodes installed on the train to continually range to wayside beacons, to demonstrate the precision and resilience of a UWB system, and the positive effects this can have on adjacent activities, including preventive and corrective maintenance.

Tenco Scope: Hitachi Proposal and Project, including provide technical, project, and safety contributions to Humatics in advancing its integration and demonstration project with Hitachi. New Applications: Help identify and pursue new opportunities, including Transport for London (TfL) CBTC Location Improvement, CRRC/MBTA Cab Signal Program Station Stopping. New Application Project Engineering, as directed, including to provide technical, project, and safety

contributions to Humatics in developing solutions for the item 2 project opportunities. HRNS System Engineering, including follow-up on the NYCT CBTC Simple Siemens system definition work.

Project: **Regeneration Energy Improvement Project (REIP)**

Client: New York Power Authority (NYPA), NYCT

Contact: Robert Schmitt, formerly NYCT Assistant Chief Electrical Officer, Power Operations. Now at STV.
Contact No: (917) 418-3691
Contact Email: robert.schmitt@stvinc.com

Dates: 2006 – 2008.

Value: $750k

About: Tenco led a NYCT, NYPA, and NYSERDA Regeneration Energy Improvement Project (REIP) to quantify train regeneration (regen) energy savings and identify means to increase the savings.

Tenco Scope: Tenco led planning, testing, analysis, and reporting on instrumented ten-car R142 trains on the Rockaway Line, and made railcar modifications in the field, to understand and quantify effects which limit actual NYCT regeneration. Tenco recommendations and modifications of propulsion parameters resulted in a train returning up to 44% of the total propulsion energy in 40 mph regen events, an increase of more than 300%. Tenco analysis showed that the interaction of system constraints at NYCT significantly limited regen capability, and that propulsion parameter modifications can significantly increase regen capture without resulting in third rail overvoltage conditions.

Project: **LA Metro Microgrid Feasibility Study, Phase II, including LA Metro Grid-Integrated Energy Storage & Electric Bus Feasibility Study**

Client: Los Angeles County MTA (LA Metro), sub to TRC Companies

Contact: Katie Wilson
TRC Companies
Contact No: (858) 252-8145
Contact Email: KPWilson@trccompanies.com

Dates: 2018 – Ongoing.

Value: $500k

About: The Phase II study provides further action on the findings of the Microgrid Feasibility Study Phase I, which concluded that Metro may implement a phased and scalable microgrid network of nodes across the Metro system to provide a pathway to microgrid construction.

The Metro Traction Power Substation (TPSS) is the intersection of utilities, the city of Los Angeles, and Metro, and ideal for grid scale storage. Metro is also buying two fleets of electric buses, moving toward the Board goal of a zero-emission bus (ZEB) fleet by 2030. There are significant hurdles and unknowns when transitioning to ZEB, such as charging requirements, impact on the electrical power network, coordination of ZEB charging schedules with peak service schedule, and charging costs.

Tenco Scope: Tenco analyzed LA Metro Green Line train power data to create traction power substation energy and power profiles. Tenco used this analysis to generate a list of the best locations for a microgrid to support LA Metro's Green Line energy, power, sustainability, and resiliency goals. Tenco site analysis considered minimum construction impact while maximizing LA Metro benefits. Tenco helped develop the Measurement and Verification, Regenerative Braking, and Potential System Configuration sections of LA Metro's feasibility study report.

Tenco performed in-depth assessment, planning, and testing for planned energy storage systems on the AC and DC sides of TPSS for heavy rail and light rail, including cost benefits, siting, interconnection, loads, dependability impacts, grid services, and co-development. Tenco evaluated candidate locations for the Pilot grid-integrated energy storage system (GISS) and performed utility network and rail system modeling and analysis to determine the range of energy and cost benefits.

Tenco performed a baseline study of adding grid energy storage to support a ZEB fleet on the Metro Silver and Orange Lines. Tenco analyzed bus line schedules and investigated a bus charging schedule to maintain the current bus operation schedule, and added GES to reduce power costs and peak demand. Tenco staff analyzed, modeled, and estimated costs for ZEB charging requirements.

Project: **Peninsula Corridor Electrification Project (PCEP)**

Client: Peninsula Corridor Joint Powers Board, sub to PGH Wong

Contact: Jeffrey Katz, Executive Vice President
PGH Wong
Contact No: (415) 850-2071
Contact Email: jkatz@pghwong.com

Dates: 2016 – 2024.

Value: $2.9m

About: The PCEP was a key element of the Joint Powers Board (JPB) Caltrain Modernization program that upgraded the performance, operations, capacity, and safety of the commuter rail system between San Francisco and San Jose. Caltrain eventually will operate in a blended system with California High-Speed Rail. The PCEP deployed a 2x25 kV 60 Hz Traction Power System (TPS) and Overhead

Contact System (OCS). Tenco was the EMC Engineer and RAM Engineer for the entire PCEP scope. In September 2024 Caltrain began all-electric service.

Tenco Scope: As the EMC Engineer, Tenco developed the EMC Program for the entire PCEP scope; developed and performed an EMI/RFI Study; and performed energy and power utility modeling to determine potential effects of PCEP emissions and proposed mitigations. Tenco was also the Reliability, Availability, and Maintainability (RAM) Engineer responsible for developing the PCEP RAM Program and requirements, and for performing analysis and demonstrations to satisfy RAM requirements. Tenco modeled the local utility 230 kV, 115 kV, and 60 kV electrical network and analyzed the PCEP single phase load onto the utility electrical network. Tenco used the analysis to demonstrate to the utility that PCEP would not adversely impact their electrical network.

Project: **Wayside Energy Storage System (WESS) for Los Angeles Metro Subway**

Client: Vycon Energy / Calnetix

Contact: Octavio Solis, Director of Industrial Programs
Calnetix Technologies
Contact No: (562) 282-5507
Contact Email: osolis@calnetix.com

Dates: 2013 – 2016

Value: $1m

About: The Los Angeles County Metropolitan Transportation Authority (LA Metro) Red Line provides heavy rail subway service with six-car trains operating at up to 65 mph with short headways. Revenue service measurements show that natural regeneration from braking trains to accelerating trains recoups 34% of the energy provided by nearby braking trains. The remaining 66% of the braking train energy is a candidate for capture and reuse. LA Metro contracted Tenco and Vycon initially to design, build, integrate, and commission a flywheel WESS at the LA Metro Red Line traction power substation, and recently to restart WESS operation revenue service after a period of being offline.

Tenco Scope: The project, funded by a US DOT grant, deployed a 2 MW / 15 s / 8.33 kWh WESS which can charge and discharge continuously at 1.25 min intervals, saving 10-15% of net traction power energy every day. Tenco coordinated project work; provided engineering, management, and technical services, including safety certifications, performance validation, system integration, and quantification of energy savings; designed and built the Real-Time WESS Control System (RTC); performed EMI analysis; and monitored and presented energy savings.

Project:	**Cupertino Sports Center (CSC) EV Charging Report (CSEVR)**
Client:	City of Cupertino
Contact:	Chad Mosley Director of Public Works Contact No: 408-777-7604 Contact Email: ChadM@cupertino.org
Dates:	June 2023 – December 2024.
Value:	$30k
About:	The City of Cupertino plans to deploy electric vehicle (EV) charging to power its on-demand EV transportation service. The EV Charger Project will provide charging at the CSC for the EV fleet. The City contracted Tenco in support of its goal to deploy an EV charging station that can immediately support the initial fleet, with a path to cost-effectively expand charging capacity as the demand grows, the fleet expands, and technology advances.
Tenco Scope:	Tenco investigated and analyzed alternative EV charging configurations that could achieve the City's goals, and delivered a report that provided applicable Hopper EV charger technologies and considerations, and listed EV charger arrangements for installation and service, considering feasibility, cost, time to deploy, and compatibility with expected expansions. This report contained four main sections: general EV charger information, Hopper EV charger project considerations, PG&E interconnection or upgrades, and site EV charger plan alternatives. Tenco created and delivered a final presentation to the city.

2.4 Nebula Engineering

2.4.1 About Nebula

Nebula focuses on electrical design and specializes in traction power. They have extensive experience working with public transit agencies in the New York and New Jersey area, as well as agencies across the country, including MBTA, SEPTA, DART, RTD, VRE, and state DOTs.

Nebula has a strong track record of delivering complex electrical design solutions on time for large-scale transit projects, ensuring system reliability, energy efficiency, and on-schedule commissioning. Their expertise extends to advanced systems such as battery storage and integration of other new and expanding technologies, to support transit agencies in the effort to modernize, reduce costs, and maintain regulatory compliance.

Nebula is a certified DBE and NY MBE.

2.4.2 Qualifications

Below are Nebula's relevant qualifications that highlight their expertise in electrical and traction power design and analysis for crucial New York projects.

Project:	**Design-Build Services for Jamaica Substation Replacement**
Client:	LIRR
Contact:	Michael Mekako, Principal Engineer LIRR Contact Email: memekak@lirr.org
Dates:	January 2023 – Ongoing.
Value:	$300k
About:	The Jamaica Substation provides traction power to critical segments of the LIRR Main Line and Atlantic Branch that currently service dense volumes of train traffic that will be increasing as the East Side Access project enters revenue service. The Project will replace the existing substation, which is already operating beyond its useful life.
Nebula Scope:	Responsible for DC traction power system design and analysis, and construction support for the new substation.

Project:	**Penn Station Access**
Client:	MNR
Contact:	Martin Wong Contact Email: Martin.Wong@jacobs.com
Dates:	February 2022 – Ongoing.
Value:	$400k
About:	The Penn Station Access project includes construction of four new passenger rail stations in the East Bronx, bridge rehabilitations, over 19 miles of new and rehabilitated track work, the reconfiguration of the New Rochelle Yard, new and reconfigured interlockings, and the modernization of signal, power, and communication infrastructure. It will bring Amtrak's Hell Gate Line into a state of good repair and improve reliability and on-time performance for intercity passengers.
Nebula Scope:	Nebula designed the AC power and DC traction power systems for the new line and led the Building Information Modeling (BIM) development.

Project:	**Kawasaki Battery Power System**
Client:	NYCT
Contact:	Willard Francis Kawasaki Rail Car (KRC) Contact Email: francis@kawasakirailcar.com
Dates:	July 2009 – February 2010
Value:	$180k
About:	NYCT continues to explore battery energy storage as a solution to optimize energy efficiency, reduce costs, and improve the reliability of its subway system. NYCT implemented a Kawasaki Battery Power System (BPS) at the Far Rockaway test track as part of this effort. The BPS utilizes Kawasaki's proprietary large nickel-metal hydride (NiMH) GIGACELL batteries.
Nebula Scope:	Nebula developed and delivered a detailed substation design that enabled the BPS to efficiently store and reuse regenerative braking energy from trains, stabilize line voltage in real time, and provide emergency power during outages. Nebula's design work included all associated switchgear, control systems, and interfaces between the BPS and the traction power system. The project, including Nebula, completed the work on time and within the project budget, and Nebula design and analysis was fully implemented.

2.5 Marine Tiger Technologies

2.5.1 About Marine Tiger

Marine Tiger is a business and technology consulting company with advanced expertise in asset management and resiliency for transportation and other critical infrastructure sectors. They develop and deliver transportation-focused solutions to improve operational efficiency, mitigate risks, and reduce carbon emissions to meet climate and energy goals.

Marine Tiger has a wealth of experience providing customized consulting services on behalf of the MTA.

They are a certified NY WBE.

2.5.2 Qualifications

Below are Marine Tiger's relevant qualifications that highlight their deep experience in performing operational assessments and developing strategic plans for complex transportation systems, particularly in the areas of sustainability and organizational optimization.

Project: **Zero Emission Bus System Design and Investment Study**

Client: New Jersey Transit

Contact: Mike Kilcoyne, SVP, Surface Transportation/GM
NJ TRANSIT Bus Operations
Contact No: 973-491-8868
Contact Email: mkilcoyne@njtransit.com

Dates: January 2023 – Ongoing.

Value: $211k

About: NJ TRANSIT deployed eight electric buses and the associated charging infrastructure at its Newton Avenue Garage in Camden, NJ as the first step in a larger, system-wide program to evaluate the feasibility of zero-emissions buses (ZEB) in the next five to 10 years. They are determining the necessary upgrades and modifications that will be necessary at its existing and planned future garages to support and successfully transition to a future electric fleet. NJ TRANSIT intends to develop long-term capital investment and implementation plans while concurrently advancing engineering design for early ZEB deployments.

Marine Tiger Scope: As part of the Zero Emission Bus System Design and Investment Study, Marine Tiger conducted site visits and interviews with operations and maintenance personnel at each of NJT's 16 bus garages. The site visits focused on 'pull-in' and 'pull-out' movements throughout the facilities, the number and types of maintenance bays, servicing, and maintenance staffing levels. Other critical

factors in the assessments were the types of routes run out of each location, including local, express, and commuter, as well as the fleet assigned to meet service demand.

Marine Tiger reviewed and summarized major transportation operations policies at NJ TRANSIT, identifying areas that could be affected by the transition to zero emissions technologies including dispatching, daily fueling operation, charging operation, charge status management, parking, cleaning, and dispatching for route operation. For example, to maximize charging time, Marine Tiger recommended that the service operation should be changed from one that is performed on buses as they line up or pull-in to one that could be executed while the buses are parked. This project was completed on-time and within budget. Marine Tiger did not engage any subconsultants in this work.

Project: **Climate Transition Risk and Opportunity Analysis and Strategy**

Client: Port Authority of New York and New Jersey (PANYNJ)

Contact: Brian DaSilva, Principal
Boston Consulting Group
Contact No: 202-412-0403
Contact Email: DaSilva.Bryann@bcg.com

Dates: October 2023 – November 2023

Value: $35k

About: As a step toward net zero carbon emissions, PANYNJ contracted Marine Tiger to identify climate mitigation and emission reduction measures in five lines of business: aviation; maritime; passenger rail; bridges, tunnels, and bus operations; and commercial real estate.

Marine Tiger Scope: Marine Tiger research and analysis identified transition risks and opportunities for net zero carbon emission strategies in the context of direct GHG emissions, electricity indirect GHG emissions, and other emissions that are a consequence of agency operations, but outside of direct agency control. Marine Tiger conducted expedited research to identify agencies in each line of business and strategies employed by each to reduce carbon and greenhouse gas emissions in complex operations. Results of benchmarking research were then used to identify strategies to support the identification and implementation of emission reduction measures. This project was completed on-time and within budget. Marine Tiger did not engage any subconsultants in this work.

Project: **NYSDOT OTSM Strategic Plan**

Client: NYSDOT Office of Traffic Safety and Mobility (OTSM)

Contact: Robert Limoges, PE
OTSM Director
Contact No: 518-457-0271
Contact Email: Robert.Limoges@dot.ny.gov

Dates: June 2021 – November 2024

Value: $300k

About: NYSDOT OTSM contracted Marine Tiger to provide business consulting, advisory, and analysis services to support realigning its priorities to meet future needs and a rapidly changing transportation landscape.

Marine Tiger Scope: Marine Tiger performed a complete organizational assessment that was key to the successful reorganization of the OTSM, the establishment of a new Traffic Engineering Bureau, and the approval of 39 new staff positions. Marine Tiger's tasks included: identifying challenges and opportunities in the organization; delivering a Gap Analysis that presented key findings and recommendations for strategic direction, resource allocation, management, communications, performance measurement, and technology planning; and designing a streamlined portfolio of business functions and a forward-looking staffing plan. This project was completed on-time and within budget. Marine Tiger did not engage any subconsultants in this work.

Project: **PATH Climate Risk Assessment Initiative, Rail Bundle**

Client: NYSDOT Office of Traffic Safety and Mobility (OTSM)

Contact: Sarah Colasurdo
PANYNJ
Contact Email: scolasurdo@panynj.gov

Dates: March 2023 – March 2024

Value: $160k

About: The Climate Risk Assessment (CRA) was an initiative to identify and cost-effectively mitigate PANYNJ's current and future high-priority climate-related risks. The purpose of the CRA is the development of an optimized risk reduction investment strategy for integration into capital planning. This Task Order is specific to the Port Authority Trans Hudson (PATH) transit system, a 13.8-mile rapid transit system in the northeastern New Jersey cities of Newark, Harrison, Jersey City, and Hoboken, and Lower and Midtown Manhattan in New York City. PANYNJ contracted Marine Tiger to perform the CRA.

Marine Tiger Scope: Marine Tiger evaluated existing Enterprise Asset Management (EAM) data and integrated design and field-collected data into a new master asset data set

called FMAD. Marine Tiger developed PATH's Functional Hierarchy Diagram to collaborate with stakeholders in determining the most critical system assets and functions. Utilized Asset Management best practices to create a Geospatial Database of the PATH Rail Bundle assets consistent with Port Authority hierarchy principles and requirements. Identified the critical "child" assets from the FMAD data and assigned the consequence of failure from a climate event to each child asset to determine how operational key performance indicators are affected. Marine Tiger delivered a technical consequence memo to summarize calculations and findings.

Due to the high level and on-time delivery of the work, Marine Tiger was awarded additional funding to complete a GIS analysis involving asset dependency and redundancy chains that informed the Climate Model and study output. Marine Tiger identified critical assets and the requirements for each to complete its intended operational function, and identified asset redundancies to determine if the asset in question needed mitigation in the case of a climate event. Marine Tiger did not engage any subconsultants in this work.

2.6 Granite Data Solutions (GDS)

2.6.1 About GDS

GDS provides expert services in two areas:

- Advanced, modular battery storage and mobile microgrid solutions for scalable and flexible rollout of energy resources
- Advanced data analytics and technology solutions, specializing in asset and life cycle management, including provision of IT and OT equipment on a large scale.

GDS is a NY and federally certified SDVOB led by industry specific professionals committed to driving innovation and sustainability within the energy storage industry.

2.6.2 Qualifications

Over the past five years, GDS has built a vertical delivering turnkey energy storage and resiliency solutions for commercial, industrial, and utility-scale projects. They offer a comprehensive suite of services, including design, engineering, and site services. Their energy management system software and battery control modules provide end-to-end solutions for various organizations.

GDS combines technical expertise with a visionary approach to address the rapidly growing demand for energy storage and resiliency. GDS provides expert services in:

- **Design and Architecture:** Custom microgrid and energy storage project designs.
- **Engineering Services:** Professional engineering solutions and on-site technical support.
- **Cloud Services Platform:** Real-time system data access for end users and installers.

- **Energy Management System Software:** Advanced tools for monitoring, optimizing, and controlling energy storage systems.
- **Battery Control Modules:** Seamless integration of energy storage hardware and software.
- **Project Management:** Full lifecycle support, including contractor hiring, project management, and ongoing system maintenance.

GDS turnkey solutions include their fixed and mobile battery energy storage systems (BESS). These options offer very dense energy footprints, allowing the system to store large amounts of energy in a small space. Units are modular, can be connected in parallel, and maximize safety through internal fire and gas detection and suppression systems.

Project:	**Off-Grid Generation and Energy Storage for Park Operations**
Client:	California Initiative
Dates:	2023
Value:	$250k
About:	A California park seeks to replace their existing diesel generator with a cleaner, quieter alternative that meets requirements and provides cost savings. The solution needed to provide enough power to run all operations and HVAC simultaneously.
GDS Scope:	Using their turnkey battery energy storage system (BESS), GDS tailored the design and configuration of their storage solution to implement a 336 kWh energy storage system with string inverters and a 75kW backup diesel generator. This solution provides the park with full grid independence for clean and reliable power, with ample redundancy to ensure operations are not impacted by any issues or outages.

Project:	**CDCR Fair Share**
Client:	California Department of Corrections and Rehabilitation (CDCR)
Contact:	Devin Holmes
Dates:	2024 – Ongoing.
Value:	$3m
About:	CDCR contracted GDS to specify, design, and deliver CDCR hardware to 34 institutions.
GDS Scope:	GDS is responsible for imaging, asset tagging, assembly, and distribution of over 3,000 all-in-one client devices to business locations and 34 secure institutions. In addition, GDS supports IT asset disposition (ITAD) services, ensuring seamless device delivery and responsible asset management throughout the entire process.

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3 Staff Qualifications and Management

The Tenco Team is agile, flexible, thorough, responsive and responsible, and proficient. The Tenco Team's proven qualifications, expertise, experience, and structure are well matched to the project requirements. We listen well, understand what is needed, hit the ground running, and provide the needed solution. Most importantly, we understand the crucial importance of defining, implementing, and verifying the right solution to provide the right work product for each Task Order.

The Tenco Team has deeply experienced leadership that understands how to effectively collaborate and manage a team to achieve project goals. Below are the key Tenco Team roles.

Figure 1-1 in Section 2.2 shows the Tenco Team project organization chart. Each box identifies the project role and structure with respect to each applicable scope area.

3.1 Lead Engagement Partner (LEP)

Name: Eli Fernald
Company: Tenco
Title: Rail Systems Engineering Director

Mr. Fernald is a NYC based engineer with deep experience with MTA rail and energy projects. He has extensive experience in rail transit equipment and system engineering, analysis, and with electromagnetic compatibility (EMC) for signals, trains, and communications at NYCT, Boston MBTA, LA Metro, Chicago Metra, and others. He has performed safety assessment for rail transit energy improvement projects, signal systems, and railcars.

3.1.1 LEP Qualifications

Mr. Fernald has deep experience providing energy, EMC, and other engineering consulting services to rail and bus transit agencies, including key New York projects with MTA. He knows the people at MTA and its agencies, and he knows the specific equipment and trains those people oversee and operate. He is a technically adept, hands-on engineering director with a proven record leading diverse teams through complex projects in a range of operating and regulatory environments. He understands how to manage and deliver sustainable, cost-effective energy solutions tailored to transit agency cost and resilience goals.

Below are the five most recent projects for Mr. Fernald.

Project: **NYCT ABB Smart Battery**

Client: ABB, MTA, NYCT

About: This pilot project deployed an ABB Smart Battery ESS (ASB) through a NYSERDA Grant to MTA, as part of an initiative to provide energy storage and utility grid services for heavily burdened utility power systems and traction power stations. The project demonstrated two major functions: the capture and reuse of regenerative braking energy on the DC side of the TPSS; and available revenue generation by providing AC side grid services.

Role: As an expert in transportation electronics, electromagnetic compatibility (EMC), and rail transit systems integration, Mr. Fernald leads the Tenco team in performing the ASB EMC Program, including design, integration, and testing. He works closely with MTA and with NYCT Traction Power, Signal, and Railcar Engineering departments to ensure that the ASB system works safely and reliably with NYCT systems and trains. Tenco provided in-depth review of the ABB design and generated a Regenerative Braking Characteristics Report. Mr. Fernald led key troubleshooting activities, and delivered key results for successful regenerative braking energy capture and ripple generator functionality.

Project: **Flywheel Energy Storage Study**

Client: Deloitte Consulting, MTA

About: Deloitte Consulting subcontracted Tenco to conduct a flywheel energy storage study for use of regenerative braking technologies in New York City's subway system.

Role: Mr. Fernald is the lead Tenco engineer and regenerative braking expert conducting: a comprehensive analysis of subway energy usage and applicable energy storage solutions; a detailed review of the proposed flywheel system design, schematic, and proposed methodology of measuring charging, specifically from regenerative breaking energy; and a load flow study on flywheel wayside energy storage modeling. Once review and analysis are complete, he will lead the final technology assessment and feasibility analysis, providing technical recommendations to incorporate the methodology to measure captured energy.

Project: **Hyundai Rotem Loan Agreement with NYCT**

Client: Hyundai Rotem, NYCT

About: Hyundai Rotem entered a Loan Agreement with NYCT to demonstrate the operation of its propulsion and APS systems, with the goal to get those systems qualified for inclusion in procurement offers for NYCT subway cars. Tenco is providing consultation and guidance on requirements and practices at NYCT, and on technical aspects of the systems that must meet NYCT requirements.

Role: Mr. Fernald led the development of several key project plans, including the EMCP, Smoke Flame Toxicity (SFT) Compliance Plan, and the technical Cybersecurity Plan and Cybersecurity Design Principles document, ensuring all plans were compliant with the NYCT requirements. For propulsion and APS, he led development of EMC test procedures, provided technical support for laboratory testing, and delivered the EMC test report. He developed reliability analysis and Failure Mode, Effects, and Criticality Analysis (FMECA) for both systems. He provided internal project management review and executive review of all propulsion and APS deliverables.

Project: **P2550 LRV Modernization & Overhaul Program**

Client: Kinkisharyo, LA Metro

About: Many critical systems and components on the AnsaldoBreda P2550 LRV fleet were experiencing parts obsolescence issues, lack of vendor support, and outdated technology. These deficiencies diminish the performance and maintainability of the fleet. By overhauling and replacing these critical systems and components, this midlife Modernization Program will maintain the fleet's State of Good Repair (SGR) and ensure the continued safety, reliability, availability, and maintainability of the fleet for revenue service.

Role: Mr. Fernald leads development of the EMC Program Plan (EMCP) and EMC Design Report (EDR). He manages the project team, and leads the team in the field performing EMI field tests. He provides key input and review of the EMI safety analysis and supplier lab testing and documentation. Using Tenco test results, he determined P2550 susceptibility to conducted, inductive, and cab signal emissions, which he used to create emission limits.

Project: **LACMTA HR4000 Heavy Rail Vehicle (HRV) Project**

Client: CRRC, Los Angeles County MTA (LA Metro)

About: CRRC MA Corporation (CRRC) supplied LA Metro with 64 HRV Married Pairs (MPs) for use on the Red and Purple subway lines. LA Metro will operate the HRVs in revenue service in consists of up to six HRVs, or three MPs. CRRC contracted Tenco to develop and perform an EMC Program (EMCP) to fulfill the TS EMC requirements.

Role: Mr. Fernald led the Tenco team in performing and delivering EMC planning, analysis, and testing, including generating the EMCP, EDR, ESA. As part of the EMC Program, Mr. Fernald led several initial EMI field tests at the CRRC Test Track in Changchun, China, followed by final EMI field tests onsite at LA Metro. Testing included HRV radiated, conductive, and inductive emissions, cab signal interference, and radio susceptibility. He facilitated EMC communications between Tenco, LA Metro Operations and Procurement staff, and CRRC engineers and management, to thoroughly and safely complete the required testing within tight non-revenue time windows.

3.1.2 LEP References

Project: NYCT ABB Smart Battery
Client: MTA
Contact: Nora Ostrovskaya, Senior Director, Energy Finance
Contact No: 646-660-1123
Contact Email: nostrovs@mtahq.org

Project: Toyo Denki BESS; Urenco FESS; Regen Energy Improvement Project (REIP)
Client: STV
Contact: Robert Schmitt, Lead Engineer, Traction Power
Contact No: 917-418-3691
Contact Email: robert.schmitt@stvinc.com

Client: Hatch
Contact: Alexander Gutman, Resource Director, Vehicle Electrical Engineering
Contact No: 267-307-3778
Contact Email: alexander.gutman@hatch.com

3.2 Project Managers

3.2.1 Project Manager: Technical Services and Demand Response

Name: Gary Thompson
Company: Tenco
Title: Senior Engineer, Transportation Utility Power Systems

Mr. Thompson has broad experience with rail and energy projects. His work includes rail transit DC energy storage systems analysis, design, integration, installation, test, and post-energization energy and performance analysis; 2x25 kV rail electrification, EMC, integration, and utility grid impact assessment; microgrid and rail transit feasibility analysis and energy and regeneration modeling; utility network modeling, simulation, and analysis; electromagnetic field simulation and analysis for insulation coordination, lightning analysis, magnetic field exposure, and wayside energy storage savings; electromagnetic field surveying for radio frequencies (RF) and radiated emissions; railcar systems reliability availability maintainability and safety (RAMS) analysis; rail transit electromagnetic compatibility (EMC) testing; and railcar CBTC electrical integration.

3.2.1.1 PM Qualifications

Below are the five most recent projects for Mr. Thompson:

Project: **Bay Area Rapid Transit (BART) Train Control Modernization Program**

Client: BART, sub to Systra

About: The BART is updating its signal system to a Communication Based Train Control (CBTC) system. CBTC will enable BART to reduce headway and increase the number of trains per hour. CBTC equipment it being installed on the 131 miles of BART alignment, in a number of existing wayside facilities, and on over 1000 existing BART cars.

Role: Mr. Thompson is BART's Vehicle Electrical Interface lead, the EMC lead, and supports the facilities working group. As the Vehicle Electrical lead, he coordinates the electrical interfaces between the CBTC supplier, BART rolling stock, and the rolling stock supplier to ensure the new CBTC system and equipment will properly function, physically fit in the existing BART vehicles, and meets all BART requirements. He reviews the CBTC supplier design documents, interface control design documents, procedures, and reports to ensure they meet BART and system requirements. As the EMC lead, he ensures the wayside and onboard CBTC equipment meet all the applicable standards and work with the existing BART environment to achieve EMC. As part of the facilities working group, he organized and coordinated the new CBTC heat and power equipment requirements with existing BART facility heat and power capability to identify areas that require upgrades.

Project: **Peninsula Corridor Electrification Project (PCEP)**

Client: Peninsula Corridor Joint Powers Board, sub to PGH Wong

About: The PCEP was a key element of the Joint Powers Board (JPB) Caltrain Modernization program that upgraded the performance, operations, capacity, and safety of the commuter rail system between San Francisco and San Jose. Caltrain eventually will operate in a blended system with California High-Speed Rail. The PCEP deployed a 2x25 kV 60 Hz Traction Power System (TPS) and Overhead Contact System (OCS). Tenco was the EMC Engineer and RAM Engineer for the entire PCEP scope.

Role: Mr. Thompson established, performed, and managed all EMC activities for PCEP, which provides 2x25kV 60 Hz power to the Caltrain line. He modeled the local power utility, PG&E and SVP, transmission network and the Caltrain line in EMTP-RV to meet the strict PG&E and SVP validation. Mr. Thompson used the EMTP-RV model to perform system impact studies, system planning studies, and protection studies to prove to the utilities that Caltrain electrification, connection, and trains regenerating power back into the grid will not have a negative impact on the utility transmission network. In September 2022 PG&E and SVP accepted the San Jose analysis and conclusions and allowed Caltrain to energize the San Jose section. In May 2023 PG&E accepted the San Francisco analysis and conclusions, allowing Caltrain to energize the San Francisco sections. In June 2023 Caltrain began testing the first electric trains. In September 2024 Caltrain began all-electric service.

Project: **Wayside Energy Storage System (WESS) and WESS Restart**

Client: Los Angeles County MTA (LA Metro) and Vycon Calnetix

About: LA Metro B Line heavy rail subway train fleets have DC chopper propulsion and AC propulsion. To capture and reuse train regeneration braking energy, LA Metro contracted with Tenco and Vycon to design, build, and integrate a flywheel WESS at the LA Metro B Line traction power substation. The project deployed a 2 MW / 15 s / 8.33 kWh WESS which can charge and discharge continuously at 1.25 min intervals. The design and installation allow easy expansion to 6 MW. The Federal Transit Administration (FTA) funded the project under the American Recovery and Reinvestment Act (ARRA) TIGGER program.

Role: Mr. Thompson developed detailed system and design documents and performed analytic simulations of energy use to assess alternative configurations and operating scenarios. He created qualification test procedures for WESS equipment for factory and field tests, to qualify the equipment and integrate it into the LA Metro B Line Subway Traction Power Substation. He performed tests to demonstrate that the WESS was EMC-qualified with the LA Metro track circuits. He used the FFT Analyzer to capture and analyze data, analyzed, and presented the WESS performance data, and tuned and optimized the WESS software control process, and reported on WESS performance and energy savings.

Project: **Cupertino Hopper Electric Vehicle Shuttle Charger Project**

Client: City of Cupertino, California

About: The City of Cupertino plans to deploy electric vehicle (EV) charging to power its on-demand EV transportation service. The EV Charger Project will provide charging at the CSC for the EV fleet. The City contracted Tenco in support of its goal to deploy an EV charging station that can immediately support the initial fleet, with a path to cost-effectively expand charging capacity as the demand grows, the fleet expands, and technology advances.

Role: Mr. Thompson led a study of alternative EV charging configurations that evaluated and ranked applicable EV charger technologies and considerations, listed EV charger arrangements for installation and service, considering feasibility, cost, time to deploy, and compatibility with expected expansions. Mr. Thompson provided preliminary fleet transition and operational planning, analyzed availability and impact on City existing infrastructure, projected timing for PG&E interconnection or upgrades, and delivered options for the City to deploy EV chargers on a short timeline to show immediate benefits, while being compatible with expanding service and long term benefits.

Project: **Green Line (C Line) Microgrid Feasibility Study**

Client: Los Angeles County MTA (LA Metro)

About: LA Metro is the principal provider of public transportation in Los Angeles County (the County) and serves as the County‘s transportation planner, coordinator, designer, builder, and operator of heavy rail subway, light rail, and bus service across a 1,433 square-mile service area. The County is prone to many types of natural disasters, and the 2019 Climate Action and Adaptation Plan (CAAP) details LA Metro’s commitment to improving resiliency in preparation for the inevitable changes ahead.

Role: Mr. Thompson reviewed and analyzed Green Line modeled train power data and created traction power substation energy and power profiles. He used the energy and power profiles to find preferred locations for a microgrid that would drive to Green Line energy, power, sustainability, and resilience goals. He recommended microgrid design consideration and system architecture, to minimize construction impact and cost and to maximize benefits to LA Metro.

3.2.1.2 PM References: Technical Services and Demand Response

Below are references for Mr. Thompson.

Project: Bay Area Rapid Transit (BART) Train Control Modernization Program
Client: BART, sub to Systra
Contact: Frederic Bana, Executive Vice President & Chief Operating Officer
Systra
Contact No: (213) 785-5718
Contact Email: fbana@systra.com

Project: Caltrain Peninsula Corridor Electrification Project (PCEP)
Client: Peninsula Corridor Joint Powers Board, sub to PGH Wong
Contact: Jeffrey Katz, Executive Vice President
PGH Wong
Contact No: (415) 850-2071
Contact Email: jkatz@pghwong.com

Project: Wayside Energy Storage System (WESS)
Client: Los Angeles County MTA (LA Metro) and Vycon Calnetix
Contact: Octavio Solis, Director of Industrial Programs
Calnetix Technologies
Contact No: (562) 282-5507
Contact Email: osolis@calnetix.com

3.2.2 Project Manager: Engineering Services

Name: Bruce Huang
Company: Nebula Engineering
Title: President, Senior Electrical and Traction Power Engineer

3.2.2.1 PM Qualifications

As president of Nebula, Mr. Huang is a deeply experienced leader with strong technical capabilities. Based in New York, he has extensive experience providing traction power, electrical, and other energy-related consulting services for New York and New Jersey area public transit agencies. He consistently delivers successful projects in power distribution system design and assessment, and modeling and analysis of electrical systems, including AC/DC traction power substations and energy storage systems. His work demonstrates his understanding of the importance of collaborating closely with stakeholders to modernize infrastructure and integrate industry-leading technologies into transit agency operations.

Below are the five most recent projects for Mr. Huang.

Project: **ECI Asset Evaluation for Port Newark South**

Client: Port Authority of New York and New Jersey (PANYNJ)

About: PANYNJ released its Port Master Plan 2050 (PMP), the 30-year plan for the future of the Port Authority's facilities. The PMP defines the multistep process of implementing Electrical & Communications Infrastructure (ECI) Master Planning, aimed to jointly develop a program for all impacted stakeholders to inventory, assess, and prioritize upgrades of terminal infrastructure and equipment based on future needs and technologies. Port Newark South is a first step to developing a framework across Port facilities. The task included site investigation, electrical infrastructure data collection, identifying electrical loads and stakeholder interviews.

Role: As the project Senior Electrical Engineer, Mr. Huang performed site evaluations, collected critical electrical infrastructure data, and identified electrical loads. He worked directly with impacted stakeholders

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Project: **Traction Power Load Study**

Client: Long Island Rail Road (LIRR)

About: LIRR is experiencing increasing service levels that are expected to continue to rise in the future. To support the anticipated service expansions, LIRR formulated its Future Network Strategy, which includes mainline extensions, such as East Side Access, and the planned deployment of new railcars, such as the M9. These expansions and increased service levels subsequently increase the loads on the traction power system. LIRR contracted Nebula to perform the traction power load study.

Role: Mr. Huang's work included traction power system modeling, simulation results analysis, field measurement, and model validation for both the existing system, and the future expanded system. He delivered results that defined the ability of the existing system, and provided possible improvements to the traction power system to support increased loads.

Project: **Jamaica Capacity Improvements Phase II – Jay Breaker House Conceptual Design**

Client: Long Island Rail Road (LIRR)

About: The Jamaica Capacity Improvements (JCI) Project seeks to modernize critical LIRR infrastructure in and around Jamaica Station. The second phase of JCI includes a full state-of-good-repair of all Jamaica railroad infrastructure. The current breaker configuration at Jay Breaker House emits high fault currents. Jay Breaker House has east and west main buses, each connected to four nearby substations, and a tie-breaker switch. This tie switch was designed to be normally open, and in the event that power to one of the buses fails, the tie can be closed. However, due to the critical nature of power operations and the detrimental consequences of losing power, this tie switch remains closed, thereby increasing the available short circuit current.

Role: Mr. Huang's work included traction power system design, and Jay Breaker House alternative analysis, which includes developing conceptual designs for a new Breaker House, and performing short circuit current analysis and load flow simulations for different scenarios.

Project: **Design-Build Services for Jamaica Substation Replacement**

Client: Long Island Rail Road (LIRR)

About: The Jamaica Substation provides traction power to critical segments of the LIRR Main Line and Atlantic Branch, which currently service dense volumes of train traffic that will increase as the East Side Access and Jamaica Capacity Improvements projects near completion. The work of this contract will replace the Jamaica Substation, which is already operating beyond its useful life.

Role: As the project Lead DC Traction Power Engineer, Mr. Huang was in charge of DC traction power design for the new substation and general construction support.

Project: **Multi-Line Traction Power Study for CBTC Operation**

Client: NYCT

About: The study is to evaluate the ability of the Traction Power System to support Communication Based Train Control (CBTC) operation for Lexington Ave Line, 7th Ave Line, Eastern Parkway Line and Astoria Line. The study also makes recommendations for improvement of the Traction Power System as necessary.

Role: Mr. Huang's work includes data collection and review, defining influence zones and basis of analysis, and QC review of simulation results and reports.

3.2.2.2 PM References: Engineering Services

Below are references for Mr. Huang.

Project: Jamaica Substation Replacement Project
Client: LIRR
Contact: Michael Mekako
Contact Email: memekak@lirr.org

Project: Penn Station Access
Client: MNR
Contact: Martin Wong
Contact Email: Martin.Wong@jacobs.com

Project: Traction Power Load Study
Client: LIRR
Contact: Gordon Yu
Contact Email: jyu@gfnet.com

3.2.3 Project Manager: Transportation Electrification

Name: John St. Clair
Company: Marine Tiger Technologies
Title: Senior Transportation Consultant

Mr. St. Clair has over 35 years of experience across the lifecycle of rail and bus transit vehicles and infrastructure assets. He is an expert in asset management and procurement, with deep experience in climate risk assessment, electrification planning, and fleet transitioning. Before joining Marine Tiger, Mr. St. Clair played a key role in the development of MTA NYCT's Enterprise Asset Management Program for both the bus and subway fleets. He managed oversight of all JFK International Airport's Air Train system assets for the Port Authority of New York and New Jersey.

3.2.3.1 PM Qualifications

Mr. St. Clair's extensive experience in transit system management and fleet assessment provides MTA with a unique resource as the effort to electrify bus fleets ramps up. His asset management experience combined with his deep understanding of MTA enable him to provide valuable advisory services in cost estimation, operational optimization, and identification of cost-effective electrification and procurement solutions.

Below are the five most recent projects for Mr. St. Clair.

Project:	**Zero Emission Bus System Design and Investment Planning Study**
Client:	NJ TRANSIT
About:	NJ TRANSIT contracted Marine Tiger to assess the impact of transitioning to a zero-emission bus fleet.
Role:	Senior Consultant who led the comprehensive evaluation of operational processes to assess the impact of transitioning to a zero-emissions bus fleet. Analyzed key functions, including dispatch, fueling, charging operations, charge status management, parking, cleaning, and route dispatching to facilitate seamless integration of electric vehicles into daily operations. Delivered strategic insights to optimize workflows, reduce operational disruptions, and enhance fleet efficiency during the transition while aligning with sustainability goals and regulatory requirements.

Project:	**ERP/EAM Software Replacement**
Client:	Niagara Frontier Transportation Authority (NFTA)
About:	Project to replace the existing Enterprise Resource Planning (ERP) / Enterprise Asset Management (EAM) system.
Role:	Senior Consultant responsible for evaluating and defining requirements for the business capability model to replace the ERP/EAM system with an updated system to improve efficiency, cost savings, data integration, scalability, and flexibility. Leading workshops on-site with asset managers to identify and develop EAM system requirements. Using deep experience managing transportation assets to develop best-case outcomes for new system procurement and integration.

Project:	**Transit System Quality Management System Development**
Client:	MBTA
About:	MBTA contracted Marine Tiger to develop a compliant Quality Management Plan and System.
Role:	Senior Consultant, responsible for creating an effective Quality Management Plan for the rail transit system assets that complies with FTA and other established quality system requirements. Analyzed current practices, procedures, and organizational structure through interviews with rail asset managers and documented procedures for quality systems in compliance with FTA quality requirements.

Project: **WeGo Nashville Transit System Security Assessment**

Client: WeGo Public Transit

About: WeGo Public Transit aimed to develop and implement a multi-faceted, long-term, proactive and prevention-oriented Public Transportation System Security Plan. Marine Tiger was contracted to assess the transit security system and assist with plan development.

Role: Senior Consultant responsible for assessing existing security practices, operations, and the hazards and security issues for the system of buses, transit centers, central bus, and operations and maintenance facilities to evaluate system security vulnerabilities. Evaluated peer agencies for system security approaches, challenges, and current processes, procedures, and technologies for effectiveness. Proposed risk mitigation for assets and personnel to enhance security across the transit system.

Project: **PATH Climate Risk Assessment Initiative, Rail Bundle**

Client: Port Authority of New York and New Jersey (PANYNJ)

About: The Climate Risk Assessment (CRA) was an initiative to identify and cost-effectively mitigate PANYNJ's current and future high-priority climate-related risks. The purpose of the CRA is the development of an optimized risk reduction investment strategy for integration into capital planning. This Task Order is specific to the Port Authority Trans Hudson (PATH) transit system, a 13.8-mile rapid transit system in the northeastern New Jersey cities of Newark, Harrison, Jersey City, and Hoboken, and Lower and Midtown Manhattan in New York City. PANYNJ contracted Marine Tiger to perform the CRA.

Role: Determined the criticality of PATH rail system assets in support of a Climate Risk Assessment Model. Analyzed asset data set for the relationship of assets to criticality for support of essential functions. Determined asset relationships for criticality, dependencies, and redundancies to identify risks to operational function due to adverse climate events. Developed essential function consequences and relationship to KPIs for revenue and economic impact from asset function disruption. Created presentations and summarized findings in reports.

3.2.3.2 PM References: Transportation Electrification

Below are references for Mr. St. Clair.

Project: Zero Emission Bus System Design and Investment Study
Client: New Jersey Transit
Contact: Mike Kilcoyne, SVP, Surface Transportation/GM
NJ TRANSIT Bus Operations
Contact No: 973-491-8868
Contact Email: mkilcoyne@njtransit.com

Project: New York Electric Vehicle Rate Modeling
Client: MTA
Contact: Pam Anukoolthamchote
Associate Director Mobility Solutions, Guidehouse
Contact Email: Canukoolthamchote@guidehouse.com

Project: Department of Buses, Enterprise Asset Management and RCM for Bus Fleet
Client: MTA NYCT
Contact: Bart Coppola
ACMO Bus Electrification
Contact No: 347-694-1878
Contact Email: BartCoppola@nyct.com

3.2.4 Project Manager: Energy Regulatory and Supply Management

Name: Denley Vennes
Company: Tenco
Title: Senior Consultant

Mr. Vennes has 15 years of executive experience in the energy sector, specializing in wholesale and retail fuel and propane procurement and distribution. He negotiated multi-year energy contracts for $87m / 25m gallons of fuel per year, managed business-to-business and business-to-government contracts, and led initiatives in regulatory compliance, financial analysis, and inventory management to optimize operations and profitability. He achieved superior financial results by short-term and long-term hedging, right-sizing storage and distribution, control of time of delivery and timed discounts, and risk mitigation strategies to stabilize operational costs and increase financial resilience in volatile markets.

3.2.4.1 PM Qualifications

Mr. Vennes' deep experience operating in the energy market provides MTA with key expertise in energy procurement and risk management. He is an expert in energy and fuel procurement and contract negotiation. He can advise and collaborate with MTA to deliver competitive procurement and cost management strategies. His experience with the fuel energy regulatory process will give MTA critical guidance to maintain compliance while increasing cost savings.

Below are five recent projects for Mr. Vennes.

Task:	**Contract Negotiation and Administration**
Company:	Turner Engineering Corporation (Tenco)
About:	Tenco works on many contracts of varying sizes, with tight budgets, stringent requirements, complex risks, and high expectations.
Role:	Mr. Vennes is responsible for and participates in contract and administrative tasks across numerous Tenco transit projects, including: contract negotiation and management; regulatory compliance; risk management; proposal development; cost control; and insurance review.

Task:	**Competitive Energy Procurement for Big Horn**
Company:	Big Horn Cooperative Marketing Association
About:	Big Horn is a diversified $88M cooperative active in energy procurement and distribution, including wholesale and retail propane and refined fuels, and other product sectors including retail and auto repair. Big Horn secures and distributes fuel supplies at competitive prices to their members. Their services aim to help members reduce energy-related costs and improve operational efficiency.
Role:	Mr. Vennes actively led energy procurement analysis, research, negotiations, and contract execution. He regularly negotiated large fuel supply contracts with multiple refiners, intermediate parties, and end users. He closely monitored market conditions and facilitated competitive contracts for clients. As CFO, he performed and maintained periodic cost analysis and financial modeling to provide key insights for active and future agreements, in order to maximize profitability and operational efficiency amid fluctuating markets and logistical costs, such as transportation and storage.

Task: **Regulatory and Safety Advisory for Fuel Supplies**

Company: Tri-Energy Cooperative

About: Tri-Energy is a diversified $100M cooperative specializing in energy procurement and distribution, including wholesale and retail propane, refined fuels, and lubricants. They provide reliable energy solutions and consulting services for fuel procurement, contracts, and overall energy strategy.

Role: Mr. Vennes has deep experience in leading projects through the fuel energy regulatory processes. For numerous contracts, he navigated the cooperative through complex regulatory environments, to ensure compliance with environmental, health and safety, market, quality, and other requirements and standards. He interfaced directly with governing bodies, including the EPA, DOE, and local agencies. He led key activities for compliance, including: establishing tailored inventory management and controls strategies; authoring and maintaining Spill Prevention, Control, and Countermeasure (SPCC) plans; delivering mandatory federal and state reporting for fuel energy storage and transportation; developing program compliance plans; and remediating noncompliance issues with applicable agencies.

Task: **Competitive Procurement Services**

Company: Tri-Energy Cooperative

About: Tri-Energy is a diversified $100M cooperative specializing in energy procurement and distribution, including wholesale and retail propane, refined fuels, and lubricants. They provide reliable energy solutions and consulting services for fuel procurement, contracts, and overall energy strategy.

Role: Mr. Vennes actively negotiated large government fuel contracts, including for state DOT, cities, schools, and other entities of varying size. He worked directly with agencies to assess and improve their procurement bid strategies. He provided competitive procurement services and supply agreements for both the company and customer, optimizing savings for each party based on specific operations and supply needs. As an example, Mr. Vennes spearheaded an initiative to move fuel storage on site for a large construction project, based on his analysis of market, operational, and transportation and logistical costs, and availability issues for the project. His solution improved logistics and significantly increased project cost savings. He led additional aspects of the project, including design, SPCC, environmental and operational impact, safety, electrical supply, and the regulatory process.

He assessed cooperative risk levels, and developed and employed specialized hedging strategies based on unique market conditions and acceptable levels of exposure. He introduced contract management strategies that exploited zero-risk arbitrage opportunities in refined fuels markets, resulting in an additional 6%+ growth in overall profits.

Task:	**Competitive Procurement and Supply Management for Cooperative**
Client:	Farmers Union Oil Company
About:	Farmers Union is a $9.5M cooperative specializing in energy markets, including bulk and retail propane and fuels, and other supply and retail markets.
Role:	As the GM and CEO for 11 years, Mr. Vennes led the cooperative through sustainable growth and long term profitability. He headed negotiations for key brand and fuel supply agreements to provide competitive fuel purchase contracts for the cooperative and the end-user. His deep experience gives him an astute understanding of the position and leverage of all parties involved in negotiations. Mr. Vennes established key cost saving strategies, including working directly with refiners to secure advantageous pricing and minimize markups.

3.2.4.2 PM References: Energy Regulatory and Supply Management

Cooperative: Farmers Union Oil Company
Contact: Wallace Schott, Former Board President
Contact No: (605) 823-4800

Cooperative: Big Horn Cooperative Marketing Association
Contact: Kent Hanson, Interim CEO
Contact No: (218) 434-0664
Contact Email: coopservice@wiktel.com

Client: City of Bismarck
Interface: Client of Tri-Energy Cooperative
Contact: Dean Weber, Fuel Contract Point of Contact
Contact No: 701-355-1700
Contact Email: dweber@bismarcknd.gov

4 Discussion Topics

4.1 Tenco Team Expertise

Tenco has deep experience in providing energy-related technical and engineering services in public transit applications, delivering energy solutions that are directly applicable to the challenges MTA faces today. Tenco understands that as demand increases and systems expand, MTA and its agencies will encounter a more heavily burdened traction power system that must be adapted to improve resilience and increase revenue generation.

MTA knows us and we know them. Tenco has directly led, supported, and collaborated with MTA and its agencies on numerous projects. We understand how MTA operates, communicates, the struggles it faces, and which energy and other financial and engineering solutions are feasible for the Authority. Our history of successfully working with MTA and other transit agencies across the country emphasizes our commitment to delivering tailored, high-impact solutions that align with the agency goals for modernization, sustainability, and operational excellence.

Tenco provides critical resources, knowledge, and services in all phases of energy capture, storage, and optimization projects, from preliminary feasibility studies, to implementation, integration, and commissioning for revenue service. Tenco will provide detailed solutions that address MTA's energy management challenges, reduce operational costs, improve system reliability and predictability, so MTA can make informed plans and decisions. We are experts in EMC/EMI program planning, testing and analysis. Tenco consistently develops and executes EMC programs that mitigate and eliminate disruptions and safety hazards due to EMI and other system and environmental factors.

Tenco's expertise and technical proficiency in energy-related and demand response services as they specifically apply to transportation and transit agency applications distinguish us from competitors. We know how to assess transit energy usage, identify key power profiles, and increase savings through demand response opportunities without negatively impacting system resilience and availability. From conceptual design of battery energy storage, microgrids, and electrification and charging infrastructure, to developing comprehensive EMC and integration programs for advanced transit systems, Tenco is uniquely positioned to support the MTA in both the operational and technological aspects of its transit network.

Tenco's expertise in fuel energy procurement, risk management, and energy compliance aligns with MTA's needs in managing the fuel regulatory process, competitive pricing, and mitigation or elimination of risks. With executive experience buying and selling millions of gallons of refined fuels annually, approximately half of MTA's annual procurement, Tenco has direct experience in managing complex procurement processes for large-scale energy supplies. Our understanding of energy markets positions us to seize key opportunities for energy procurement and risk management. This skillset enables Tenco to provide impactful advisory services to MTA in analyzing fuel purchase options, establishing hedge strategies, and negotiating energy supply contracts. This will help MTA to mitigate market volatility and reduce operational and financial risks.

Tenco understands how to develop and tailor procurement strategies to MTA's specific needs and circumstances. We understand how to analyze available or underutilized properties and facilities as on-site storage opportunities, which can provide significant cost savings with the amount of fuel MTA procures and uses, and we know how to implement inventory and storage on-site. We know how to diversify procurement across multiple supply agreements for competitive pricing that is adequately hedged. Tenco will evaluate every input into the MTA ratemaking process, including fuel types, supply contracts, tax and other financial implications, transportation and delivery, market normalization, and bridging adjustments, and will provide informed opinions to MTA.

Nebula's expertise in energy-related technical engineering services, particularly in the design and analysis of traction power systems, positions the company to significantly assist the MTA in overcoming its current challenges, especially as they pertain to energy efficiency and power system design. With projects like the Jamaica Substation Replacement, where they delivered comprehensive DC traction power system design and construction support, Nebula understands the complex needs of transit power infrastructure. As the MTA continues to expand and modernize its services through projects like East Side Access and Jamaica Capacity Improvements, Nebula will provide crucial engineering solutions to improve system reliability, capacity, and efficiency.

Nebula's work on the Kawasaki Battery Power System for NYCT showcases their ability to integrate advanced energy storage solutions into complex and changing transit systems. This expertise is particularly relevant as the MTA explores battery energy storage to optimize energy use, reduce operational costs, and increase sustainability. Nebula's experience in designing substation systems that implement and interface with regenerative braking energy, stabilize line voltage, and provide backup power during outages is directly applicable to the MTA's ongoing efforts to modernize its infrastructure. With a proven track record in both power system design and energy management, Nebula is uniquely positioned to help the MTA tackle its energy challenges, ensuring a more efficient and resilient transit network for the future.

Marine Tiger's unparalleled expertise in asset management in the transportation sector and deep experience in energy consulting and resilience make them uniquely qualified to support MTA's energy initiatives. Through experience in providing asset management, strategic advisory, and resilience services in the transportation industry, Marine Tiger has a thorough understanding of transportation assets, how each contributes to critical transportation functions, and how to improve their efficiency and effectiveness.

Marine Tiger's expertise includes gap assessments, KPI development, and system implementation — all designed to optimize resource allocation and improve performance. By integrating these capabilities with energy procurement and cost management advisory services, they help clients achieve measurable outcomes in efficiency, sustainability, and compliance with New York State energy policies. Work includes many years of service to MTA in a variety of consulting capacities, making the team very familiar with the full breadth of MTA operations. With an understanding of the MTA, public transit needs, and relevant risk and resilience

parameters, Marine Tiger offers competency in the areas necessary to provide energy consulting services on behalf of the MTA.

GDS's ability to rapidly deploy turnkey energy storage products for large and small scale projects, partnered with Tenco's expertise designing and assessing energy capture and storage for public transit agency applications, positions the Tenco Team to provide impactful energy storage solutions to MTA in a short timeframe. Their fixed and mobile battery energy storage systems (BESS) can provide critical storage to support agency infrastructure, and revenue and non-revenue vehicle fleets, improving resiliency and increasing cost savings.

GDS understands how to address the energy resiliency needs of critical infrastructure for MTA. Partnering MTA property owners with engineering procurement and construction firms, they support the global transition to renewable energy with scalable and reliable storage solutions. They enhance these technologies with operational efficiency improvements through live system data and predictive analytics, while providing end-user access to valuable real-time data from anywhere in the world.

4.2 Tenco Team Approach

The Tenco Team is ready and qualified to provide MTA with superior energy-related services using skilled, qualified, and experienced staff that are experts in the requirements and practice of transit energy engineering and policy.

The Tenco Team understands the requirements, the context, and the business, legal, technical, and human implications of energy and cost efficiency for MTA transit services. Tenco's approach is to understand the risks, impacts, severity, and likelihood; to identify benefits, limitations, costs, opportunities, and effects; to define risk protections, mitigations, and effects; to lay out practical plans; and when needed, adjust the plans and actions.

The Tenco Team is highly agile, seamlessly adapting to both intermittent and continuous project workflows. Whether managing projects that evolve with the availability of information and resources, or handling intensive, ongoing tasks, we ensure smooth progress and efficient execution at every stage for both remote and on-site responsibilities.

Tenco knows how to efficiently collaborate and communicate with MTA and its agencies, requesting information, utilizing project resources, and performing tasks at the right time to ensure the Tenco Team operates efficiently and cost-effectively.

4.2.1 Task Approach

In general, for each Work Assignment Contract, Tenco will:

- Work with MTA and the specific agency or agencies requesting service to define the task scope, objectives, deliverables, and timeframes
- Identify project characteristics and risks unique to the particular agency and departments requesting services
- Set a plan that is right-sized to the task, that addresses project obstacles and risks, and that prioritizes and ranks subtask work to focus on the elements of risk and impact, recognizing the requirements of safety, operations, and maintenance
- Present the plan to MTA and adjust as required
- Hold a project kickoff meeting to bring the team together, ensuring each member fully understands the Task Order scope and goals, assigning clear responsibilities, and defining the final deliverable content
- Perform the work, coordinating with MTA. Focus the work on the most significant elements of the problem, and on finding the best-fit solutions and mitigations considering all impacts on MTA, including passenger service, maintenance, staff, schedule, cost, etc.
- Provide MTA with progress reports and brief MTA to ensure work progresses to meet Task Order goals
- In the report and presentation of work, highlight results, conclusions, and required actions for each group or party involved
- Perform a quality assurance review of each document before submitting to MTA, including an internal review and sign-off of technical quality and consistency
- Submit the task results to MTA, and respond to comments, guidance, and next steps.

4.2.2 Quality Management

We provide clients with the highest level of quality service and deliverables. Our quality management program covers:

- *Project Kickoff* – We bring the team together, make sure each member fully understands the Task Order scope and goals, assign clear responsibilities, and define the final deliverable content
- *Project Status and MTA Briefings* – We provide MTA periodic progress reports on open Task Orders and brief MTA as required to ensure work is progressing to Task Order goals
- *Quality Review* – We perform a quality assurance review of each document submitted to MTA. This includes internal review and sign-off of technical quality and consistency.

4.2.3 Cybersecurity

The Tenco cybersecurity program supports all MTA cybersecurity activities. Upon contract award, Tenco will submit a program that meets all MTA security and privacy requirements.

Security and Privacy Plan: Within 30 days after award of a contract, we will update and adapt our existing Tenco security program as needed to generate an MTA-compliant project Security and Privacy Plan for: Data Security; Network Security; Application Security; and Threat, Vulnerability, and Risk Assessment. The Plan will comply with all authority, state, and federal requirements. Tenco will update the Plan annually, and additionally as required by MTA.

Data Security: The Tenco plan will incorporate a data security solution that aligns with MTA's security model, and provides easy, efficient role-based access control for Tenco staff and subconsultants.

Network Security: Tenco will provide a network infrastructure solution that includes a secure network perimeter with compliant firewalls, safeguard mechanisms, intrusion detection, secure communication paths, and all other required functions to comply with NY State ITS security policies and standards.

Application Security: Tenco security policy applies across all applications, for all staff and subconsultants. Access will be permitted only as needed for staff to complete project tasks.

In addition to the overarching Security and Privacy Plan, upon award of a contract, Tenco will update and submit, or provide evidence of, the following:

- Incident Management Plan
- Cybersecurity Incident Response Team
- Cybersecurity training documentation
- Cybersecurity insurance
- System Security Plan, based on NIST 800-53 security and privacy controls
- Patch and Vulnerability Management Plan
- Project specific plans and procedures, including authentication and identity management.

4.2.4 Delivery of Work

The Tenco Team will deliver all work products electronically, and in paper copies as needed.

If work product consists of equipment or systems, Tenco will deliver the equipment and will instruct the recipients in the proper use of the equipment. For training of MTA or agency staff in the use of equipment or systems, Tenco Team staff will deliver and present the training materials in person, using training materials and presentations, and where appropriate, training videos and other media. The training session will introduce Operating and Maintenance Manual documentation and equipment design documentation, as appropriate.

5 General Information

The Tenco Team has offices in New York, California, and across the country. All offices listed below will be assigned to MTA as applicable for specific tasks and mini-RFPs.

Office locations:

1. **Turner Engineering Corporation (Tenco)**
   Headquarters
   2006 Glyndon Ave
   Venice, CA 90291

2. **Turner Engineering Corporation (Tenco)**
   Regional Office
   161 Clifton Place
   Brooklyn NY 11238

3. **Nebula Engineering**
   Headquarters
   28 Maple Pl #6
   Manhasset, NY 11030

4. **Marine Tiger Technologies**
   Headquarters
   515 Madison Avenue
   New York, New York 10022

6 MTA Forms to Be Reviewed and Completed

Tenco uploaded the RFP contract documents and attachments to the Conductiv Platform via the "CONTRACTING FORMS" upload link. The table below summarizes these forms with clarifying comments. Note that the RFP attachment table skips Att. No. 3 and No. 4.

For Att. No. 2, Tenco uploaded the Cost Proposal to the Conductiv Platform via the "COST PROPOSAL" upload link.

The RFP Letter instructs the Proposer to:

> *"Complete and sign all applicable documents. Completed forms must be included with the Proposal…"*

Tenco completed, signed, and included all documents from the MTA Contract Documents .zip folder, except for those explicitly called out in Addendum No. 5. Forms specific to a mini-RFP or contract award will be updated and submitted for that specific proposal.

Table 6-1
RFP Attachments

RFP Att. No.	Name of Document	Submitted with Proposal?	Comments
1	Scope of Work	Yes	Tenco reviewed, added note and date on form.
2	Cost Proposal Template	Yes	Tenco uploaded the completed Cost Proposal via the "COST PROPOSAL" upload link.
3	N/A – RFP Table skips Att. No. 3		
4	N/A – RFP Table skips Att. No. 4		
5	Vendor Responsibility Form	Yes	Completed and signed.
6	MTA Personal Service Agreement (PSA) – Long Form*	Yes*	Per PSA form, to be submitted after MTA Purchase Order received. *For this proposal submittal, Tenco included this form with only proposed changes to the agreement.
7	Compensation Provisions	Yes	Tenco reviewed, added note and date on form. Tenco will update this document once MTA Purchase Order received, and negotiated rates are established.
8	EEO-1 Information Report Form	Yes	Completed forms for Consultant and each Subconsultant.
9	EEO-1 Requirements Provision v2	Yes	Tenco reviewed, added note and date on form.
10	MWBE EEO Policy Statement	No	Per RFP Add. No. 5, proposer shall exclude from Proposal Submission all documents named and referenced under Add. No. 3 attachment, including this document.

Table 6-1
RFP Attachments

RFP Att. No.	Name of Document	Submitted with Proposal?	Comments
11	Staffing Plan v2	No	Per RFP Add. No. 5, proposer shall exclude from Proposal Submission all documents named and referenced under Add. No. 3 attachment, including this document.
12	Work Force Utilization Report	No	Per RFP Add. No. 5, proposer shall exclude from Proposal Submission all documents named and referenced under Add. No. 3 attachment, including this document.
13	Insurance Requirements	Yes	Tenco reviewed, added note and date on form.
14	SDVOB Utilization Plan + SDVOB 100 Form	No	Per RFP Add. No. 5, proposer shall exclude from Proposal Submission all documents named and referenced under Add. No. 3 attachment, including this document.
14.1	Utilization Form 15A.1	No	Per RFP Add. No. 5, proposer shall exclude from Proposal Submission all documents named and referenced under Add. No. 3 attachment, including this document.
14.2	Utilization Form 15A.4	No	Per RFP Add. No. 5, proposer shall exclude from Proposal Submission all documents named and referenced under Add. No. 3 attachment, including this document.
15	SDVOB Provisions No Goals	Yes	Tenco reviewed, added note and date on form.
16	MBE & WBE Requirements	No	Per RFP Add. No. 5, proposer shall exclude from Proposal Submission all documents named and referenced under Add. No. 3 attachment, including this document.
17	Financial Interest Disclosure Instructions	Yes	Tenco reviewed, added note and date on form.
18	Financial Interest Disclosure Form	Yes	Tenco reviewed, added note and date on form. As instructed in RFP Att. No. 17 Instructions, Tenco will submit a completed form upon entering into a contract with MTA, at which time Tenco will have identified specific employees and subconsultants for the specific mini-RFP task.
19	EO 177 Compliance Form	Yes	Completed and signed.
20	Sexual Harassment Compliance Form	Yes	Completed and signed.
21	Omnibus Procurement Act Form	Yes	Tenco reviewed and checked applicable box.
22	Prompt Payment Regulations Letter	Yes	Tenco reviewed, added note and date on form.
23	NYS Lobbying Law Instructions	Yes	Tenco reviewed, added note and date on form.
24	NYS Lobbying Law (Non-Responsibility Determinations)	Yes	Completed and signed.
25	NYS Lobbying Law (Affirmation & Certification)	Yes	Completed and signed.
26	Vendor Code of Ethics (VCoE) Form	Yes	Completed and signed.

Table 6-1
RFP Attachments

RFP Att. No.	Name of Document	Submitted with Proposal?	Comments
27	Iran Divestment Act Form	Yes	Completed and signed.
28	Vendor Diversity Practices Questionnaire Form	Yes	Completed and signed.
29	MTA Cyber Security Terms and Conditions	Yes	Tenco reviewed, added note and date on form.
30	MTA Cyber Security Requirements	Yes	Tenco reviewed, added note and date on form. Cybersecurity items added to the proposal as required by this document.
31	Vendor Certification of Compliance with MTA Cybersecurity Provisions	Yes	Completed and signed.
32	Executive Order No. 16 Prohibiting State Agencies and Authorities from Contracting with Businesses Conducting Business in Russia	Yes	Completed and signed.
33	MTA IT Mutual NDA Cyber	Yes	Completed and signed.
N/A	MBE/WBE/SDVOB Goal Commitment for RFP No. 0000016098	No	Provided in RFP Add. No. 3, and specified in Add. No. 5 that proposer shall exclude from Proposal Submission.

7 Appendices

Appendix A: Tenco Team Resumes

- As directed in the RFP Letter, Tenco affixed as an appendix the resumes for the proposed Engagement Partner and lead Project Managers.
- Per Addendum No. 2, MTA Response to Vendor Questions, Item 56, Tenco provided resumes of lead employees in the energy consulting area, in addition to the Lead Engagement Partner and defined Project Manager roles.

Appendix B: Tenco Team Case Studies

- **Tenco Case Study:** Saving Money Every Day: LA Metro Subway Wayside Energy Storage Substation (2016)

- **Tenco Case Study:** Peninsula Corridor Electrification Program (PCEP) Single Phase Study (2022)

- **Marine Tiger Case Study:** Zero Emission Bus System Design and Investment Study (1/2023 – 6/2025)

- **GDS Case Study:** Microgrid as a Grid Alternative Solution (2024)

Note: Tenco uploaded the RFP Forms to the Conductiv Platform via the "CONTRACTING FORMS" upload link. These are not included in the Technical Proposal appendices.

Appendix A:

Tenco Team Resumes

Eli Fernald

Mr. Fernald is a senior transportation electronics, system, and software engineer with extensive experience in rail transit equipment and system engineering; safety analysis; including integration of and electromagnetic compatibility for signals, trains, energy storage, and communications at Boston MBTA, LA Metro, NYCT, SF Bay Area Caltrain, Long Island Rail Road, Metro North, Philadelphia SEPTA, Denver Eagle P3, Edmonton, and Chicago Metra. He has worked for Tenco for 20 years, and currently works out of Tenco's regional New York office.

For Los Angeles County Metropolitan Transportation Authority (LACMTA), Mr. Fernald performed complete assessments of all signal equipment in use on the LACMTA Green, Blue, and Gold Line light rail signal lines and on the Red and Purple Subway lines. The assessments determined electromagnetic interference (EMI) susceptibility to LRV conducted and inductive emissions for each line. He used these measured susceptibility curves to create conducted and inductive emission limits for these operating light rail and heavy rail lines as well as limits that cover all future lines. The LACMTA light rail lines use a broad range of supplier circuits, including Electrified Electrode, AFTAC, PSOIIs, AF 900 coded circuits, and power frequency circuits. The LA subway lines used Alstom / GRS audio frequency and power frequency circuits. Each project determined immunity to train conducted, inductive, and cab signal emissions, for each line.

Mr. Fernald provided technical direction to develop and apply measured susceptibility curves to create conducted and inductive emission limits for these lines to ensure safe and dependable operation of AC propulsion railcars on the existing track circuits.

For New York City Transit's (NYCT) Regeneration Energy Improvement Project (REIP) which quantified train regeneration energy savings and identifying means to increase the savings, Mr. Fernald performed embedded controller, software assessment, testing and extensive data analysis. The REIP project demonstrated the capability to more than triple the amount of regenerated energy by straightforward train modifications engineered by Mr. Fernald. His analysis of hundreds of test events showed limited train regeneration, and indicated that the R142 implementation of the 690 VDC regeneration voltage clamp is restricting energy savings. NYCT is implementing recommended equipment modifications to implement improved regeneration.

For ABB, Mr. Fernald is leading the technical work to integrate a new Smart Battery Energy Storage System into the NYCT subway traction power system. Mr. Fernald is leading the Electromagnetic Compatibility (EMC) design, integration, and test, working closely with MTA and with NYCT Traction Power, Signal, and Railcar Engineering departments to ensure that the Smart Battery system works safely and reliably with NYCT systems and trains. The Smart Battery project includes the design, testing, supply, installation and operation of an energy storage system with lithium-ion batteries which will capture train braking energy, and will reduce peak utility power system demand, and participate in the utility power demand response market. In this pilot project, the MTA will capture this regenerative braking energy through a sophisticated battery energy storage system and release this energy during peak demand hours. Instead of drawing power exclusively from Con Edison network, during peak times, NYCT will smooth peak energy usage by drawing power from the battery, thus helping to balance power supply with energy demand.

For Edmonton Transit Systems (ETS) Light Rail Transit (LRT), Mr. Fernald defined equipment types and sensitivity limits in terms of inductive, conductive and radiated emissions from the LRV for medical facilities located near the LRT line; measured LRV radiated emissions, inductive emissions, and magnetic fields; determined impact on nearby medical equipment, signaling system, wayside power, and Canadian RF guidelines; and provided a final report.

Mr. Fernald has performed safety assessment for rail transit signal systems and railcars, and for rail transit energy improvement projects. He is expert in with Euronorm and US transit industry standards. For LA Metro and MBTA new AC propulsion subway car projects, Eli Fernald was the Technical Director for each project to set the emission limits to protect the existing track circuits from the emissions of the new trains.

Mr. Fernald led the carbuilder EMC system integration and test work for railcar electronic and power systems, for the MBTA Red and Orange Line and for the LA Metro HR4000 Railcar procurement projects. He led, performed, supervised, and guided extensive factory and field tests of conducted, inductive, and cab signal interference; investigated problems and presented design solutions to reduce emissions. He provided and reviewed test reports; and led and performed in-depth assessment of the mechanical, electrical, thermal, and magnetic characteristics of propulsion components including inductors, brake resistors, inverters, and traction motors.

For Mitsubishi Electric Corporation projects for New York City Transit, Long Island Rail Road, Metro North Railroad, Philadelphia SEPTA, Denver Eagle P3, MBTA Red, Orange, and Green Line, Mr. Fernald has and is performing extensive simulations and electromagnetic emissions and susceptibility tests of train propulsion equipment and of railway signal equipment including audio frequency overlay track signals for grade crossings. For this work, Mr. Fernald is using and integrating an extended suite of software tools, including Pspice, PSIM, Ansys Maxwell, Labview, Java, and scripting tools. The work is integrated with a system safety program, and includes fault tree, FMECA, and subsystem hazard analysis. He performed extensive factory and field tests of conducted, inductive, and cab signal interference; investigated problems and presented design solutions to reduce emissions; and provided test reports; and performed in-depth assessment of the mechanical, electrical, thermal, and magnetic characteristics of propulsion components including inductors, brake resistors, inverters, and traction motors.

As a designer of high performance communications electronics, he was Technical/Project lead for Applied Micro Circuits Corporation on experimental 10 Gbps and 4 Gbps CMOS Serializer/Deserializer transceivers, both of which achieved first silicon success. He created, refined, or reviewed architecture of all functional blocks; created design documents and schedules and managed a 10 person design/layout team; created a Mathcad model of the low jitter 10GHz phase locked loop (PLL) used in the transceiver; and provided analog/system design support for multi-million gate mixed-signal ASICs in 0.13u CMOS process with embedded RAM and 2.5 Gbps serial links.

For Lawrence Livermore National Laboratory, he wrote LabVIEW real-time data acquisition and display software, added functionality to an existing piece of Linux imaging software, developed a SPICE device model for a 200ps step recovery diode, and evaluated a RF positioner for use with a hand-held radar.

He is adept at high-performance electronic integrated circuit design, embedded and web software development, instrumentation hardware and software, design and integration of communications circuits and equipment, and use of computer modeling tools for complex design and verification projects.

He has a BS Magna Cum Laude in Electrical Engineering from UC San Diego, and received several top academic awards. He is a member of the IEEE. His technical skills include C/C++, Synopsis ASIC design flow including synthesis, static timing analysis, Cadence IC design suite, Matlab, Mathcad, HSPICE, Agilent multi-GHz / Gbps scopes & Bit Error Rate Testers (BERTs), HP spectrum and logic analyzers, Verilog, P&R, formal verification, Mentor DRC/LVS. Mr. Fernald is located in Brooklyn, NY.

Gary Thompson

Mr. Thompson is a transportation systems engineer with broad experience in design, analysis, and commissioning of rail systems, trains, and equipment. His work includes utility network modeling and simulation and analysis; energy, regeneration, and microgrid modeling and analysis; electromagnetic field simulation and analysis for insulation coordination, lightning analysis, magnetic field exposure, and wayside energy storage savings; electromagnetic field surveying for radio frequencies (RF) and radiated emissions; rail transit DC energy storage systems design, integration, installation, and test; railcar systems reliability availability maintainability and safety (RAMS) analysis; and rail transit electromagnetic compatibility (EMC) testing. He is experienced in industrial installation, electrical and electronic integration, RAMS analysis, technical report writing, research and development in photovoltaic sensors, project planning, and small scale manufacturing. He is certified with the Electromagnetic Transients Program modeling tool EMTP-RV. Mr. Thompson is a supervising engineer at Tenco, where he has worked for over 10 years. He currently works out of Tenco's Davis, CA regional office.

He established, performed, and managed all EMC activities for the Caltrain Peninsula Corridor Electrification Project, which will provide 2x25 kV 60 Hz power to the Caltrain line. He modeled the local power utility, PG&E and SVP, transmission network and the Caltrain line in EMTP-RV to meet the strict PG&E and SVP validation. Mr. Thompson used the EMTP-RV model to perform system impact studies, system planning studies, and protection studies to prove to the utilities that Caltrain electrification, connection, and trains regenerating power back into the grid will not have a negative impact on the utility transmission network. In September 2022 PG&E and SVP accepted the San Jose analysis and conclusions and allowed Caltrain to energize the San Jose section. In May 2023, PG&E accepted the San Francisco analysis and conclusions, allowing Caltrain to energize the San Francisco sections. In June 2023, Caltrain began testing the first electric trains.

For the LA Metro Green Line Microgrid, Mr. Thompson reviewed and analyzed Green Line modeled train power data and created traction power substation energy and power profiles. He used the energy and power profiles to find preferred locations for a microgrid that would drive to Green Line energy, power, sustainability, and resilience goals. He also recommended microgrid design consideration and system architecture to minimize construction impact and cost and to maximum benefits to LA Metro.

Mr. Thompson analyzed, modeled, and estimated costs for the charging requirements for the planned LA Metro zero emission electric buses. He compared the benefits, modeled bus schedule, and charging schedule for on-route charging and at the station charging, highlighting potential hurdles that LA Metro had not considered when purchasing eBuses. The analysis incorporated a Grid Integrated Energy Storage System with the bus yard charging system as a way to offset the eBus charging costs and as a way to generate revenue LA Metro authority through ancillary services.

For the Los Angeles Metro flywheel Wayside Energy Storage Substation (WESS) project, Mr. Thompson developed system and detailed design documents and performed analytic simulations of energy use to assess alternative configurations and operating scenarios. He created qualification test procedures for WESS equipment for factory and field tests, to qualify the equipment and integrate it into the LA Metro Red Line Subway Traction Power Substation. He performed tests to demonstrate that the WESS was EMC-qualified with the LA Metro track circuits. He used the FFT Analyzer to capture and analyze data, analyzed and presented the WESS performance data, and tuned and optimized the WESS software control process, and reported on WESS performance and energy savings.

For the California High-Speed Rail (CHSR), Mr. Thompson helped create the Traction Return Current Study using EMTP-RV to model the CHSR return current's effect on adjacent structures such as adjacent rails and buried and above ground pipes. He analyzed large data sets of EMTP-RV results, producing clear graphic results for use by CHSR Authority.

For the Bay Area Rapid Transit District (BART) Train Control Modernization Program, Mr. Thompson is the EMC lead and member of the facilities working group. He reviews contractor design documents, survey procedures, and reports to ensure they meet BART and system requirements. He organized and coordinated the

new Communication Based Train Control (CBTC) heat and power equipment requirements with existing BART facility heat and power capability to identify areas that require upgrades.

He was the deputy engineering manager of Tenco's Strategic Technical Advisory (STA) group for the Santa Clara VTA Silicon Valley Phase II Extension (SVXII). He lead the group in providing technical guidance to VTA so the SVXII will fulfill BART's operating and maintenance requirements for safety, performance, quality, and dependability. He directed and integrated the reviews of the emerging VTA's draft project design criteria manual; Fire Life Safety criteria, design assessments, regulatory compliance evaluation, and egress calculations; technical design input for infrastructure elements; cost and feasibility evaluation of alternative tunnel and station concepts; constructability assessment; Safety and RAM; and program and project technical management issues. He ensured that the Tenco STA group represented BART's interests in its actions and reports, and coordinated with Tenco team members, industry experts, and the VTA engineers and consultants. He was an engineering assistant and document control for BART's internal review of the emerging VTA's draft project design criteria manual. He coordinated with BART staff and STA members to ensure that all stake holders review and comment on document; documents are tracked and organized; and comments are transmitted to VTA in a timely manner.

Mr. Thompson was the assistant manager for BART's Structural Technical Advisory Panel (TAP) that provided independent review of BART's Structural Design Criteria Manual major revision to be consistent with the latest structural and seismic requirements and regulations. He organized and led meetings, kept meeting minutes, edited submittal document for clarity, and resolved conflicting professional opinions between TAP members to provide a unified TAP opinion for BART.
For BART, he also managed technical and Tenco staff activities for the Traction Power System renewal project. The work included performing and documenting surveys at traction power substations, 115 kV / 34 kV switching stations, and DC tie stations in preparation for replacement of these facilities.

For the Denver North Metro Rail Line (NMRL) project, Mr. Thompson created an electrical model of the 18.5 mi line in EMTP-RV to simulate the effects of lightning strokes to the 25 kV overhead centenary system (OCS) for the insulation coordination study. The insulation coordination study determines cost effective placement of surge arresters on the OCS so the NMRL meets program availability goals and protects passengers from harmful step and touch potentials at passenger stations caused by lighting strokes. For the same project, he wrote the procedure and performed an electromagnetic survey of the RF and magnetic field conditions at strategic locations along the line, to determine conditions for potential sensitive RF and magnetic field sensitive receptors and characterize the RF and magnetic fields before the 25 kV OCS is turned on.

For the Denver South East Rail Extension (SERE) project, Mr. Thomson performed a survey of the SERE line and identified potential sensitive receptors to RF and magnetic fields generated by the planned SERE, including the Sky Ridge Medical Center. He created an electrical model of the line in EMTP-RV to current distribution in the SERE OCS and the rails. He then used the current distribution to calculate the worst case magnetic field generated by the SERE at the medical center and showed the magnetic fields would not adversely affect the medical center. For the Denver Eagle P3 project, Mr. Thompson created an electrical model of the line in EMTP-RV to calculate the currents induced on adjacent signal and communication cables and circuits from the 25 kV OCS. The model used as-built design documents to account for real world canceling such as non-design specified cable twist and cable buried depth and accounted for inductive coupling and capacitive coupling.

Mr. Thompson developed and performed safety analysis for the new Siemens Charger Diesel-Electric Locomotive. He developed a Safety System Program Plan with Preliminary Hazard Analysis (PHA), Hazard Tracking Log (HTL), Failure Mode Effects, Criticality, and Effects (FMECA) analysis, and Hazard Analysis Report. He developed the PHA from intermediate design to final design, and transformed the PHA to a HTL. The HTL tracks category I, II, and III hazards, per MIL-STD-882C, and ensures they are properly mitigated through design or procedures. Mr. Thompson led the FMECA effort that analyses all Siemens interfaces for locomotive drive, brake, and cab and car controls. Mr. Thompson used the HTL to track hazard mitigations and wrote the Hazard Analysis Report documents that all the hazards are properly mitigated.

Mr. Thompson is a graduate of the University of California, Davis, with a Bachelors degree in Mechanical Engineering.

Nebula Engineering

Buxuan (Bruce) Huang, PE

Electrical/Traction Power

EDUCATION
Master of Science,
Mathematics,
New York University

Master of Science,
Electrical Engineering,
Polytechnic University

Bachelor of Science,
Electrical Engineering,
Zhengzhou University

REGISTRATIONS
Professional Engineer
NY, NJ

PROFESSIONAL MEMBERSHIPS
Institute of Electrical and Electronic Engineers

YEARS IN PRACTICE
16 Years

Mr. Huang is an experienced engineer to apply electrical engineering principles and technology to the design and construction for public and railroad infrastructure projects. His areas of expertise include power distribution, DC/AC traction power substations, third rail, overhead contact system (OCS), load flow study, electrical system modelling and analysis, data/telecommunications and security design, construction, system deployment/integration and lighting system.

ENGINEERING EXPERIENCE

PANYNJ, ECI Asset Evaluation for Port Newark South, Newark, NY
Sr. Electrical Engineer. PANYNJ released Port Master Plan 2050 (PMP) the 30-year plan for the future of the Port Authority's Port facilities. As identified in the PMP, implementation of Electrical & Communications Infrastructure (ECI) Master Planning is envisioned as a multistep process involving several studies and planning forums aimed at aligning the impacted stakeholders to jointly develop a program to inventory, assess, and prioritize upgrades of terminal infrastructure and equipment based on future needs and incorporating industry leading technologies. This project is to use Port Newark South as a first step to develop a framework across Port facilities. The task included site investigation, electrical infrastructure data collection, identifying electrical loads and stakeholder interviews.

LIRR, Traction Power Load Study, Jamaica, NY
Traction Power Engineer. LIRR desires to perform a new traction power load study on the electrified system to assess the ability of the system, and possible improvements that are needed, to support the increased loads. This study consists of existing system analysis and future system analysis. Mr. Huang's works include traction power system modeling, simulation results analysis, field measurement and model validation.

LIRR, Design-Build Services for Jamaica Substation Replacement, Jamaica, NY
Lead DC Traction Power Engineer. The Jamaica Substation provides traction power to critical segments of the LIRR Main Line and Atlantic Branch that currently service dense volumes of train traffic that will be increasing as the East Side Access project enters revenue service. The Project will replace the existing substation, which is already operating beyond its useful life. Mr. Huang was in charge of DC traction power design for the new substation.

LIRR, Jamaica Capacity Improvements Phase II, Jamaica, NY
Traction Power Engineer. The Jamaica Capacity Improvements (JCI) Project seeks to modernize critical LIRR infrastructure in and around Jamaica Station. The second phase of JCI includes a full state-of-good-repair of all Jamaica railroad infrastructure. Mr. Huang's works include traction power system design, and Jay Breaker House alternative analysis, which includes developing conceptual designs for a new Breaker House and performing short circuit current analysis and load flow simulations for different scenarios.

NYCT, Multi-Line Traction Power Study for CBTC Operation, New York, NY
Traction Power Engineer. The study is to evaluate the ability of the Traction Power System to support Communication Based Train Control (CBTC) operation for

Lexington Ave Line, 7th Ave Line, Eastern Parkway Line and Astoria Line. The study also makes recommendations for improvement of the Traction Power System as necessary. Mr. Huang's work includes data gathering and review, defining influence zones and basis of analysis, QC review of simulation results and reports.

NYCT, Rail Control Center Electrical System Study, New York, NY
Electrical Engineer. The Rail Control Center (RCC) is one of New York City Transit's (NYCT) most critical facilities. The purpose of this study is to analyze the existing RCC power distribution system and the operation of its protective devices, and to make recommendations for system improvements in worker safety and operation. The study includes modelling existing electrical system, protective device coordination and arc flash analysis using SKM Power Tools.

NYCT, Study to Improve Electrical Service and Grounding for NYCT Signal Power, New York, NY
Sr. Electrical Engineer. The scope of this project was to prepare a study on how to best implement the recommendations made by the New York State Department of Public Services (NYS DPS) Task Force for improving reliability of signal power to support CPM Signals Engineering and MOW Engineering groups. The study made recommendations for improvements of the Electrical system and developed various types of Grounding schemes in different NYCT transit environments. A comprehensive selective coordinated design of a number of NYCT signal power facilities was also included in this study.

NYCT, Kawasaki Battery Power System for New York Transit Authority, NY
Traction Power Engineer. The project is to provide a detailed substation design for Kawasaki Battery Powered System (BPS), including associated switchgear, control system and interface between BPS and traction power system control center. Mr. Huang's work involved designing the control and monitor cabinet, internal wiring diagram, equipment layout, cable and conduit schedule, and reviewing switchgear shop drawings from the manufacturer.

MNR, Penn Station Access, New York, NY
Sr. Traction Power Engineer. This project is to bring Metro-North trains to Penn Station via Amtrak's Hell Gate Line. It includes four new passenger stations, bridge rehabilitations, track work, the reconfiguration of Metro-North's New Rochelle Yard, new and reconfigured interlockings, and the modernization of signal, power and communication infrastructure. Mr. Huang provides traction power design for DC system.

MNR, Hudson Line Track #1 Electrification, Hudson Valley, NY
Sr. Traction Power Engineer. Metro-North's Hudson Line extends 74 miles from Grand Central Terminal to Poughkeepsie. This project is to electrify two segments of Track #1, which is approximately 11.5 miles in length. The design includes new aluminum-stainless steel 3rd rail and associated components, such as traction power cables, sectionalizing switches and negative reactors.

MARINE TIGER TECHNOLOGIES

John St. Clair, CRL

Senior Consultant

General Qualifications

John St. Clair brings more than 35 years of experience across the lifecycle of rail and bus transit vehicles and infrastructure assets. His expertise includes Asset Management system implementation, reliability-centered maintenance, rail car and bus procurement, and testing. He has worked with buses, rail, and automated people movers and brings a wealth of experience in IT systems integration and operations. Before joining Marine Tiger, John played a key role in the development of MTA New York City Transit's enterprise asset management program for both the bus and subway fleets and managed the oversight of all JFK International Airport's Air Train system assets for the Port Authority of New York and New Jersey.

Credentials

Years of Experience: 38

Education

Advanced Graduate Certificate, Transportation Management, New York University-Tandon School of Engineering, 2016

BS, Economics, concentration in Industrial Management, City University of New York, College of Staten Island, 1995

AAS, Electrical Engineering Technology, City University of New York, 1984

Certifications

Completed Asset Management Principles, Institute of Asset Management

Asset Management Principles, Institute of Asset Management, 2018

Project Experience

Niagara Frontier Transportation Authority (NFTA) ERP/EAM Software Replacement. Senior Consultant, responsible for evaluating and defining requirements for the business capability model to replace the existing ERP/EAM system. Leading workshops on-site with asset managers to identify and develop the EAM system requirements. Focused on bringing to bear experience managing transportation assets to develop best-case outcomes for new system procurement and integration. (06/2024 – Present)

MBTA Transit System Quality Management System Development, Massachusetts. Senior Consultant, responsible for creating an effective Quality Management Plan for the rail transit system assets that comply with FTA quality system requirements. Analyzed current practices, procedures, and organizational structure through interviews with rail asset managers and documented procedures for quality systems in compliance with FTA quality requirements (5/2024 - Present)

WeGo Nashville Transit System Security Assessment, Nashville, TN. Senior Consultant, responsible for assessing existing security practices, operations, and the hazards and security issues for the system of buses, transit centers, central bus , and operations and maintenance facilities to evaluate system security vulnerabilities. Evaluated peer agencies for system security

approaches, challenges, and current processes, procedures, and technologies for effectiveness. Proposed risk mitigation for assets and personnel to enhance security across the transit system. (11/2023 – 6/2024)

Port Authority of New York and New Jersey (PANYNJ), Climate Risk Assessment, PATH Rail System, New York, NY. Assistant General Manager, tasked with determining the criticality of PATH rail system assets in support of a Climate Risk Assessment Model. Analyzed asset data set for the relationship of assets to criticality for support of essential functions. Determined asset relationships for criticality, dependencies, and redundancies to identify risks to operational function due to adverse climate events. Developed essential function consequences and relationship to KPIs for revenue and economic impact from asset function disruption. Created presentations and summarized findings in reports. (11/2023 – 2/2024)

NJ TRANSIT, Zero Emission Bus System Design and Investment Planning Study, Newark, NJ. Senior Consultant who led a comprehensive evaluation of operational processes to assess the impact of transitioning to a zero-emissions bus fleet. Analyzed key functions, including dispatch, fueling, charging operations, charge status management, parking, cleaning, and route dispatching to facilitate seamless integration of electric vehicles into daily operations. Delivered strategic insights to optimize workflows, reduce operational disruptions, and enhance fleet efficiency during the transition while aligning with sustainability goals and regulatory requirements. (4/2023 – 11/2024)

Port Authority of New York and New Jersey (PANYNJ), Climate Change Assessment - SEA, New York, NY. Senior Consultant who led the development of a comprehensive Climate Risk Assessment Model to evaluate the criticality of Port Facilities' assets. Utilized asset management best practices to establish a functional hierarchy for each port, facilitating alignment with operational priorities. Conducted in-depth analysis of asset inventory data, identifying critical dependencies, redundancies, and potential vulnerabilities that could impact essential operations during adverse climate events. Engaged with stakeholders to gather insights on critical assets and historical climate-related risks, producing actionable recommendations. Delivered clear, data-driven presentations and reports to guide strategic planning and enhance resilience against future climate challenges. (3/2023 – 10/2023)

MTA, New York Electric Vehicle Rate Modeling. As Senior Consultant, performed and supported a comprehensive analysis of the New York MTA bus operations and power needs to identify optimal solutions for electric bus garage power requirements. Delivered strategic insights into alternative power options, focusing on capital and operational expenditures (CapEx and OpEx) to support informed decision-making. Provided actionable recommendations that enabled the MTA to optimize its transition to electric buses while minimizing long-term costs. (8/2023 – 11/2023)

New Jersey Transit Zero Emission Bus System Design and Investment Planning Study. Senior consultant evaluating all aspects of operations for the impact of the transition to zero emissions bus fleet, including dispatching, daily fueling operation, charging operation, charge status management, parking, cleaning, and dispatching for route operation. As a result of the analysis NJT gained an understanding of the need for a yard management and charge management system to optimize service for the ZEB transition. NJT also gained an understanding of the need for integration of plans for emergency response throughout the NJT operating area where the ZEB buses would operate. (6/2023 – 11/2023)

Port Authority of New York and New Jersey Climate Change Assessment. As Senior Consultant, was tasked with determining the criticality of Port Facilities' assets to support the Climate Risk Assessment Model. Responsibilities include creating a functional hierarchy for each port using asset management best practices and analyzing asset inventory data. Analyzed all assets to determine the relationship to criticality to support essential functions. Determined asset relationships for criticality, dependencies, and redundancies to identify risks to operational function due to adverse climate events. Interview stakeholders to identify critical assets supporting essential functions and historical risks from climate events. Create presentations and summarize findings in reports. (3/2023 – 12/2023)

Experience Prior to Marine Tiger

Port Authority of New York and New Jersey (PANYNJ), Air Train, JFK International Airport, New York, NY. As Assistant General Manager, oversaw all maintenance and renewal activities and strategies for all fully automated JFK Air Train system assets. Was responsible for maintenance strategies for all system assets, including rail vehicles, power systems, automated control systems, elevators, escalators, track, and guideways. Introduced condition-based maintenance strategies and evaluated and approved all renewal work. Provided oversight of contracted system operator, Bombardier/Alstom, and all maintenance, repair, and renewal work. Introduced and applied condition-based asset management maintenance strategies and worked to improve the system operators' use of CMMS. Participated in system operator selection process and contract negotiations and approved all renewal work scopes and costs. (6/2019 – 5/2021)

Metropolitan Transportation Authority New York City Transit (MTA NYCT), Department of Buses, Enterprise Asset Management and RCM for Bus Fleet, New York, NY. Project Manager for the Enterprise Asset Management implementation and reliability-based maintenance for the bus rolling stock fleet. Led a project team using the Computerized Maintenance Management System (CMMS) data to evaluate and validate maintenance strategies. Developed more effective maintenance strategies based on system data using the principles of reliability-centered maintenance. Led the initiative to develop a condition assessment program for the bus fleet in conformance with FTA guidelines for condition

assessment. Led project to use artificial intelligence to analyze bus system data to predict and address potential failures of the bus emissions system. (2/2015 – 5/2019)

MTA New York City Transit (NYCT), Department of Buses, New Bus Project, New York, NY. Served as the NYCT Senior Director, directing new bus qualification and evaluation testing, including in-service evaluations to qualify buses and systems for NYCT procurement. Achievements included. enabling the qualification of two new bus builders to qualify alternative models of express coach, local bus, and articulated bus that were successfully purchased and integrated into the fleet; identifying and tracking functional and reliability issues for corrective action and improved design for future procurements; and directing the development of bus technical specifications for new bus procurements. (5/2008 – 2/2016)

MTA Department of Subways, Division of Car Equipment, New Car Warranty and Reliability, New York, NY. Served as the Department of Subways Project Manager for reliability and warranty on capital projects for over 2,500 new rail cars in five contracts worth over $2B. Integrated a new CMMS system to track rail car performance and identify reliability and performance issues for corrective action implementation. Conducted review meetings with NYCT Project Management and FTA Oversight to review progress on modifications and develop resolutions for reliability issues. Developed and managed the post-acceptance modification program to control the progress, quality, configuration, and effectiveness of modifications. (4/1998 – 5/2008)

MTA New York City Transit, Scheduled Maintenance System, New York, NY. As the NYCT Manager, developed and managed annual plans to provide scheduled maintenance for approximately 1,000 subway cars annually. Developed work scopes, material forecasts, labor forecasts, budget allocation, and shop loading. Managed project milestone completion and addressed material, quality, and shop loading issues to facilitate adherence to schedule and milestones. (11/1991 – 3/1998)

Denley Vennes

15+ years of Executive Management experience, specializing in wholesale & retail energy distribution and retail operations. Proven ability to drive complex strategic initiatives, M&A activities, and financial operations. Special focus on achieving business results that increase profitability, operational efficiency, communications, and best practices in member-owner cooperatives.

Contact

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3119 Clairmont Road
Bismarck, ND 58503

Expertise

- Strategic Planning & Execution
- Financial Modeling & Forecasting
- Project Management
- Process Improvement
- Mergers & Acquisitions
- Post-Merger Integration
- Cooperative Equity Management
- Cooperative Finance
- Communications
- Back Office Operations
- Continuity Plan Design
- Change Management

Experience

April 2024 - Current
Turner Engineering Corporation l 2006 Glyndon Ave, Venice, CA

Business Administrator

- Provide strategic consulting, focusing on business development, operations optimization, and risk management.
- Support contract negotiations, proposal development, and compliance for major engineering, transit, and energy projects.
- Advise clients on inventory management, accounting, supply procurement, and marketing strategies to improve operational efficiency.
- Lead efforts in streamlining back-office processes, integrating technology, and enhancing staff development.

March 2023 - April 2024
Big Horn Cooperative Marketing Association l 4784 Hwy 310, Greybull, WY

CFO

- Provided financial planning and analysis for a diversified $88MM cooperative active in Energy Distribution (Wholesale & Retail Propane, Refined Fuels, & Lubricants), Agronomy (Inputs & Application), Grain, Farm Supply, Auto Repair and Retail Stores
- Oversaw overall financial management of the cooperative
- Directed all Accounting, IT and Human Resource departments and functions
- Led energy procurement analysis, research, negotiations, and contract execution
- Negotiated large fuel supply contracts with refiners, intermediate parties, and end users
- Advised Division VP's on operations according to prior industry experience

Key Accomplishments:

- *Delivered detailed differential analyses that identified targets for strategic divestiture as well as unrealized market potential in profitable business segments, for which I provided detailed strategies for growth*
- *Created a detailed business plan with conservative financial modeling to return the cooperative back to profitability after consecutive years of operational inefficiency and local net losses*
- *Standardized and optimized most HR and Payroll functions by implementing right-sized software and procedural solutions*
- *Significantly improved timeliness and accuracy of financial reporting by overhauling the chart of accounts and internal accounting procedures as well as automating key processes*
- *Created and audited workflows for staff to maintain their own continuity plans*
- *Developed direct reports through 1-on-1 training, accountable goal setting, and targeted institutional education*

Education

2000 - 2004
B.A. History
Northwestern College

Additional Coursework:
2016 - 2017
Executive Education Program
- ***Mergers & Acquisitions***
- ***CHS Future 40***
- ***MBA Essentials***

University of Minnesota, Carlson School of Management

Certifications

CETP:

- Basic Principles & Practices
- Propane Cylinder Filling
- Plant Operations
- Bobtail Delivery Operations
- DOT Hazardous Materials
- Designing & Installing Vapor Distribution Systems

Experience *(continued)*

November 2020 - February 2023
Tri-Energy Cooperative I 219 N 20th St., Bismarck, ND

CEO

- Directed a $100MM cooperative specializing in Energy Distribution (Wholesale & Retail Propane, Refined Fuels, & Lubricants) with 12 company-owned retail convenience stores in North Dakota and franchise branding for 3rd parties
- Provided leadership, training and support to department heads
- Established and executed equity management strategies aimed at securing the cooperative's relevance and competitive edge
- Ensured sustainable growth and long term profitability of the cooperative through strategic planning initiatives

Key Accomplishments:

- *Renegotiated key supply and brand agreements with multiple suppliers, resulting in 10%+ growth in overall profits.*
- *Introduced contract management strategies that exploited zero-risk arbitrage opportunities in refined fuels markets, resulting in an additional 6%+ growth in overall profits.*
- *Increased gross revenues by 33% through organic growth (both in depth and diversification), targeted M&A, and expanding wholesale and franchise contracts with 3rd parties, resulting in record earnings that exceeded profitability targets.*
- *Restructured internal distribution methods while consolidating and strengthening vendor relationships to increase sales & efficiency.*
- *Established a partnership program ("Gallons of Gratitude") with 3 local public school districts to fund classroom supply budgets by $140 per educator, per year, amounting to $250,000 in donations each year. The resulting retail growth in these markets made this initiative cash neutral to the cooperative (est. 2.5%+ growth) and served to significantly bolster company image and presence.*

https://bpsfoundation.com/partners/gallons-of-gratitude/

February 2009 - October 2020
Farmers Union Oil Company I 101 N Main St., McLaughlin, SD

GM / CEO

- Directed a $**10**MM cooperative specializing in Energy (Propane, Bulk & Retail Fuels) with Parts (NAPA), Farm Supply and Convenience Stores serving **4** counties in South Dakota and North Dakota
- Provided leadership, training and support to department heads
- Implemented accounting controls and conduct regular audits to ensure lean back office operations and compliance with GAAP
- Authored and executed equity management strategies
- Led energy procurement and negotiations, diversified supply chains and introduced hedging strategies to increase cost savings for the cooperative and end users
- Increased operational efficiency through expanding and right-sizing energy storage
- Established environmental regulatory compliance and remediation plans

David B. Turner

Mr. Turner manages and directs development, integration, and certification of cutting edge transportation systems, equipment, and vehicles, including advanced energy, traction power, and propulsion; safety critical train control; and communications, control, and information systems applications. Mr. Turner is President and CEO of Turner Engineering Corporation (Tenco).

He has deep knowledge of rail transit system design, development, integration, construction, installation, test and certification technologies, methods, and systems. His teams lead in:

- Application of energy storage systems for more efficient and cost-effective rail and electric bus lines
- Development of cloud based information and control systems to speed Bus Rapid Transit (BRT) and Light Rail in shared urban corridors
- Design, integration, and certification of new generations of autonomous vehicle transit systems.

He is expert in rail systems electromagnetic compatibility (EMC) methods and programs; in high-tech and safety-critical software development and hardware structured design practices; and in transportation reliability, maintainability, and safety (RAMS) programs and techniques. He leads design, EMC, OnTime Arrival, and Safety programs for rail and bus energy storage projects, automatic train control, railcars, subsystems, involving requirements and specifications, system and subsystem design, integration, system assurance, and test for rail systems across the US, Canada, and Asia.

He directs teams of engineers and analysts to design, integrate, and perform railcar-level Safety and RAM analysis on railcar, locomotive, LRV and APM projects, and for all major systems and components. Railcar builders include CRRC, Nippon Sharyo, and Siemens. APM builders include Woojin and Glydways. Systems suppliers include Siemens, Alstom, Bombardier, Mitsubishi Electric (MELCO), and Wabtec. Systems include Propulsion, Auxiliary Power Supply, Vehicle Monitoring Systems, ATC, ATP, PTC, CBTC, Doors, HVAC, Wheelchair Lifts, Lighting, Brakes, Couplers, and Current Collectors. Railcar projects include MBTA Red and Orange Line Heavy Rail Vehicles, the Los Angeles Metro Heavy Rail HR4000 and A650 Overhauls, and the LA Metro Light Rail P2000, P2550, P2550 Overhaul, and P3010 projects; LIRR M7, M8, and M9 railcars; SEPTA Silverliner Vs; BART A, B, C and FOTF cars; locomotives for Amtrak, MARC, and VIA; and cab and gallery cars for commuter lines across North America.

Mr. Turner led and managed the Utility Interconnect, Train-Track Circuit EMC, RAM, and safety analysis activities for the Caltrain Peninsula Corridor Electrification Project (PCEP), which has successfully enabled energization of the PCEP line. He led the application of PCEP design documents to create an EMTP-RV model of the 50+ mi Caltrain system and the entire 230 kV, 115 kV, and 60 kV connected utility networks of PG&E and Silicon Valley Power, and to demonstrate that the impacts of PCEP on the utilities complies with all applicable requirements. The EMTP-RV is used for PCEP studies including utility power system impact, electromagnetic interference (EMI) studies and power quality studies. The same model determined EMI on existing cables, short circuit calculations, insulation coordination studies, and power quality studies. He also leads the PCEP team work with signaling suppliers to ensure the new signaling system will achieve EMC with the new electric multiple unit (EMUs) being provided to Caltrain.

Mr. Turner leads system design, integration, and assurance projects for advanced train control systems, including train-borne, wayside, and central equipment implementing Automatic Train Control (ATC), Positive Train Control (PTC), and Communications Based Train Control (CBTC) systems. He has worked on CBTC systems for San Francisco Airport, New York City Transit, SF MUNI, SF BART rail transit systems; mainline railroad ATCS and PTC applications including for the CHSR Project; automated people movers for Houston Intercontinental Airport, Newark, Singapore; and conventional signal systems from New York to LA.

For BART's train Control Modernization Program, Mr. Turner is leading the consultant team work to work closely with BART and Hitachi to ensure that the new Communications Based Train Control (CBTC) system meets BART's crucial requirements for on-time performance, reliability, and maintenance, and to ensure electromagnetic compatibility; and to ensure integration with the existing BART facilities. Other BART projects include traction power improvement strategic directions and alternative energy solutions; EMC and RAMS tasks for major subsystem for new BART railcars; design improvements to the first generation onboard and wayside ATC systems for the BART Reliability Taskforce; qualification of the first microprocessor onboard ATC systems; safety assessment and design improvement of hardware and software for the BART SFO wayside extension; and railcar RAM and safety tasks including on trainlines, propulsion, brakes, auxiliary, and door systems; and measurements of train regeneration performance in mainline and test track conditions.

He led the BART team providing strategic technical engineering assessments and direction for the $5b BART Silicon Valley Extension to downtown San Jose. For LA Metro, he is leading the application of new big data and machine learning techniques to improving traffic flow and Bus Rapid Transit performance in the densest urban corridors. For LA Metro and NYCT, he led teams in the design, integration, and commissioning of wayside energy storage systems, and in assessing and developing microgrid and grid storage solutions. For the California High-Speed Rail (CHSR) Project, Mr. Turner was responsible for the technical, program, and task management of the EMC and RAM programs. His work in those programs involved all systems, rolling stock, interfaces to civil and stations; Environmental Impacts; relationships with neighbor railroads, utilities, and neighbors; and integration between disciplines.

He led EMC teams and projects for Alstom, Bombardier, China CNR Corporation, CAF, Mitsubishi, Nippon Sharyo, and Siemens for wayside signal systems, railcars, and advanced propulsion systems; for NYCT and other subways; for Denver Eagle P3, Long Island Rail Road, Metro-North Railroad, SEPTA, and Taiwan Railway Administration commuter railroads; for light rail vehicles (LRVs) for Edmonton, Los Angeles, Pittsburgh, Portland, and Sacramento; and for the California High Speed Train project. To achieve EMC, he identifies, quantifies, and integrates constraints from wayside track circuits, traction power, third rail and OCS, track, and alignment; and synthesizes train propulsion, auxiliary, failure monitoring, and train effects to demonstrate and document compliance with the wayside constraints.

For railcars, he leads teams and performs work to integrate propulsion, friction brake, trainline and unit networks, doors, automatic train control, train operator display, vehicle maintenance system, passenger communications, railcar control and trainline circuits, event recorder, lighting, and HVAC. In these projects, he works with the carbuilder, subsystem suppliers, the transit authority, and the consultant to synthesize robust, cost-effective, specification-compliant solutions to challenging interface issues.

He leads system assurance programs which guide all railcar subsystem suppliers to coordinate design efforts and analyses, so the completed railcar provides critical multi-vendor functions with required levels of performance, safety, reliability, and maintainability.

He has performed railcar system and subsystem design, system assurance, and test projects for Chicago Metra, Los Angeles, New York, Portland, San Francisco BART, San Juan PR, Seattle, and Washington DC area. He leads teams and solves safety-critical design problems in integrating ATC, propulsion, friction brake, trainline and unit networks, doors, train operator display, vehicle maintenance system, passenger communications, railcar control and trainline circuits, event recorder, lighting, and HVAC. He works with the carbuilder, subsystem suppliers, the transit authority, and the consultant to synthesize robust, cost-effective, specification-compliant solutions to challenging interface issues.

For NYCT and the New York Power Authority, Mr. Turner performed a Regeneration Energy Improvement Project (REIP). NYCT's expanding fleet of AC propulsion trains have not yet delivered the expected energy savings. The REIP project identified and resolved unexamined interactions of NYCT AC train propulsion, train controls, traction power, signals, and track. Tenco demonstrated a tripling of regenerated energy by straightforward train propulsion system modifications engineered by his project team.

For Sacramento Regional Transit (RT), Mr. Turner resolved a complex interaction of LRVs with the audio frequency overlay track circuits at quad gate protected highway crossings. RT observed that under certain conditions, crossing control would malfunction, bringing gates down in the wrong sequence. He led a data collection, analysis, test, and design task that showed that one fleet of RT LRVs disturbed the normal operation of the gate crossing traffic loop detector circuits. His analysis revealed that the LRV Auxiliary Inverter line inductor was not effective at the 30 kHz operating range of the traffic loops. He led the design of a replacement inductor, and performed a demonstration test that showed that the modified LRV did not disturb the normal operation of the traffic loop.

Mr. Turner is a senior member of the IEEE, and a member of the SAE, IRSE, and the AAR. He holds Bachelor degrees in Electronics Engineering and English from the University of California, Berkeley and Columbia University. He has published twenty-six papers in APTA, Transportation Research Board, IEEE, UMTA, and Nuclear Science journals, and was a member of the IEEE standards committees for software V&V guidelines and wireless networks.

Jesse Holland

Mr. Holland is a Los Angeles-based transportation systems engineer with experience in integration, electrification, analysis, and safety assessment on light rail vehicle, autonomous vehicle, and wayside systems. His work includes analysis, testing, and project management of EV charging systems; energy storage systems; rail and transit reliability, availability, maintainability, and safety (RAMS) analysis for Safety Certification; inspecting, testing, and integrating active rail transit projects as a representative of LA Metro Fire Life Safety; and electromagnetic and radio frequency interference (EMI/RFI) analysis for rail applications.

For the City of Cupertino, Mr. Holland performed an assessment of alternative electric vehicle fleet charging provisions for the City's on-demand EV transportation service. He investigated alternative configurations which could achieve the City's goals, and evaluated these configurations using weighted measures covering usage compatibility, site compatibility, initial cost consisting of procurement cost and installation cost, procurement issues, installation steps, operations and maintenance (O&M) impacts, 10 year total cost, PG&E involvement, and readiness for future use.

Mr. Holland has prepared RAM and Safety Certification plans for regulatory compliance for a new Automated Transit Network (ATN) employing autonomous vehicles, and rail systems including Siemens Metro-North Dual Power, and RTM Double-Decker Cab Cars and Coaches. He performed and prepared: Fault Tree Analyses (FTA) using PTC Windchill; Preliminary Hazard Analyses (PHA); Hazard Tracking Logs (HTL); Failure Modes, Effects, and Criticality Analyses (FMECA); Sub-system Hazard Analyses (SSHA); System Safety Program Plans (SSPP); and Safety Certification Plans (SCP). For the new ATN, he continues to work directly with the client's design and engineering team to provide safety engineering and analysis, including the SSPP, SCP, PHA, FTA, and project requirements. For Siemens Metro-North Dual Power, Mr. Holland performed safety analysis on the penalty and emergency braking systems for new rolling stock to assess worst-case scenarios for both lite and tandem pair locomotives.

Mr. Holland is performing an evaluation of life cycle costs of a battery light rail vehicle (LRV) to provide on-wire Overhead Catenary System (OCS) service and off-wire (battery only) service on a new LRV line. He evaluated the cost and timeline differences between on-wire and off-wire configurations for utility conflicts and relocation, SCADA, communications, and safety certification. He works directly with the transit agency's Operations, Maintenance, and Rail Fleet departments to incorporate the agency's requirements and goals into the assessment.

As a Program Manager, Mr. Holland manages the maintenance, repair, and reimplementation of LA Metro energy storage systems for transit, including the restart programs for the LA Gold Line Energy Storage system at Avenue 61 in Highland Park, and the Red Line WESS at the Westlake/MacArthur. Work includes field checks of functionality and troubleshooting for: the ESS flywheels and ancillary equipment; and traction power SCADA alarms, indications, and controls, coordinated with ROC. He works extensively with LA Metro Rail Operations and LA Metro Traction Power Department.

For the Caltrain Peninsula Corridor Electrification Project, which will provide 2x25 kV 60 Hz power to the Caltrain line, Mr. Holland performed analysis of Electric Multiple Unit (EMU) EMI/RFI test data related to track circuit immunity limits. He made FFT analyses of background noise and train emissions for various acceleration and braking scenarios. For these studies, he

used software to analyze worst-case EMU emissions to investigate whether the trains would interfere with new signal system equipment. He provided client-facing technical reports.

For the LA Metro Regional Connector Project (RC), Mr. Holland represents and provides coordination of Metro's FLS team, including for SCADA and EMP function, alarms and logging, field device connectivity, scenario triggering and execution, and troubleshooting. The RC 1.9 mi light rail line connects the west side A and E light rail lines to the east side L light rail line and the subway and commuter hub at Union Station. The RC will deliver seamless journeys from Azusa to Long Beach, and from East LA to Santa Monica.

For the LA Metro Crenshaw-LAX (CLAX) Transit Corridor Project, Mr. Holland represented and provided coordination of Metro's FLS team, including for SCADA and EMP. CLAX is an 8.5 mi light rail line extending Metro's operations to the Los Angeles International Airport (LAX). The line features 8 new stations, 5.5 mi of at-grade track with 16 at-grade crossings, 3,600 ft of bridge, 4,600 ft of U-wall, 4,700 ft of cut & cover trench and 6,000 ft of bored tunnel.

For Metro Corporate Safety for both CLAX and RC, Mr. Holland verifies project compliance with contract documents; FLS design criteria; local, state, and national safety codes, including fire protection; and all applicable requirements. Compliance verification tasks include: conducting field inspections of facilities and equipment; managing the team witnessing Local Field Acceptance Tests (LFATs) and Systems Integration Tests (SITs); reviewing project submittals such as LFAT and SIT test procedures and reports, requests for information (RFIs), design deviation requests (DDRs), and other contractor related submittals; conducting research on technical issues to support project needs; providing technical evaluations of FLS related systems; supporting drills and training for Metro and first responders, including LAFD and LAPD; and preparing reports on FLS project activities and status for Corporate Safety.

Mr. Holland has extensive experience in design, construction, and test / approval of alternative energy systems. For the Advanced Structures and Composites Center, Mr. Holland worked at the Alfond Wind-Wave Ocean Engineering Lab in Orono, ME, where he was part of a team that developed and tested wind turbines and wave energy converters in the lab's wind-wave basin (1:50 scale). Using SolidWorks, he helped design and perform computational fatigue tests for testing equipment for the lab, including the wind tunnel that was built atop the wave basin, and equipment to test the moments of inertia of models to be tested.

He has extensive experience in: evaluating safety and reliability using PTC Windchill FTA; analyzing worst-case EMU EMI/RFI emissions using DewesoftX; two-dimensional modeling using AutoCAD; and two- and three-dimensional modeling using SolidWorks. His past work in AutoCAD has included designing permits, schematics, and detail drawings for fiber expansion. His work in SolidWorks has primarily been in designing fluid dynamics equipment and models (wind tunnel, wave energy generator, airlocks), and using the fatigue analysis and CFD components of the program to test these under varying conditions. He is also proficient in NDS Geographic Information System (GIS) programs.

Mr. Holland is a graduate of the University of Maine with a Bachelor's degree in Mechanical Engineering, where he focused on ocean and marine engineering, and wind and wave energy. Mr. Holland is located in Los Angeles, CA.

Appendix B:

Tenco Team Case Studies

Tenco Case Study:

Saving Money Every Day: LA Metro Subway Wayside Energy Storage Substation (2016)

Saving Money Every Day: LA Metro Subway Wayside Energy Storage Substation

Gary Thompson & David Turner
Turner Engineering Corporation | Venice, CA

Agenda

- LA Metro Red Line – WESS Project
- About WESS
- WESS Flywheel Energy Savings Results
- WESS Predicted Savings

LA Metro Red Line WESS Project

WESS Project Overview

- **Grant:** Federal Transit Administration (FTA) grant from the ARRA Transit Investments for Greenhouse Gas and Energy Reduction (TIGGER) Program
- **Objective:** Save energy by capturing train regen energy
- **Scope:** 2MW / 8.2 kWh flywheel WESS at the Red Line Westlake/MacArthur Park Traction Power Substation
  - Ready for expansion to 6MW/24.6 kWh capacity
- **Additional Benefits**
  - Reduce peak power demand and electricity bill
  - Provide voltage support with potential to reduce the number of substations in a new or expanded line

Team Responsibilities

LA METRO

- Project Management and Systems Engineering
- Construction and Installation
- Support for Testing, Commissioning, and Monitoring of Operation

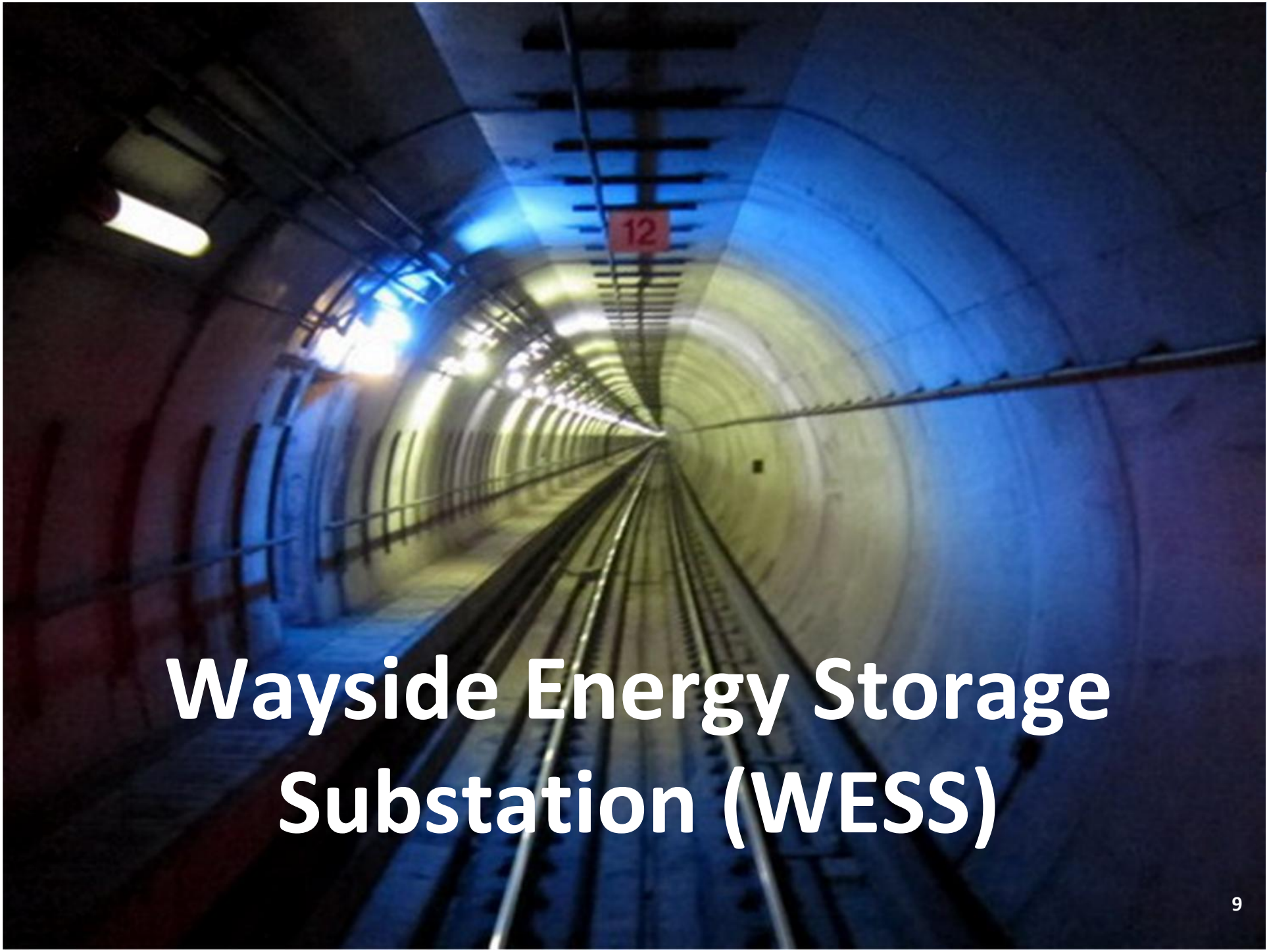
Team Responsibilities

- **VYCON**
  - Supply and Deliver 16 Flywheel Units in 4 modular cabinets of 500 kW each, with total capacity of 2MW
  - Supply a DC circuit breaker switchgear, a DC negative switch, and an EMI Filter
- **Turner Engineering Corporation**
  - Develop the conceptual and functional design of the system.
  - Design and supply a Real Time Controller (RTC) and control software
  - Provide test and monitoring procedures
  - Analyze/Report the obtained data reflecting the performance of the system
- **Elcon**
  - Design the installation of the equipment integrated into the existing Traction Power Substation

Milestones

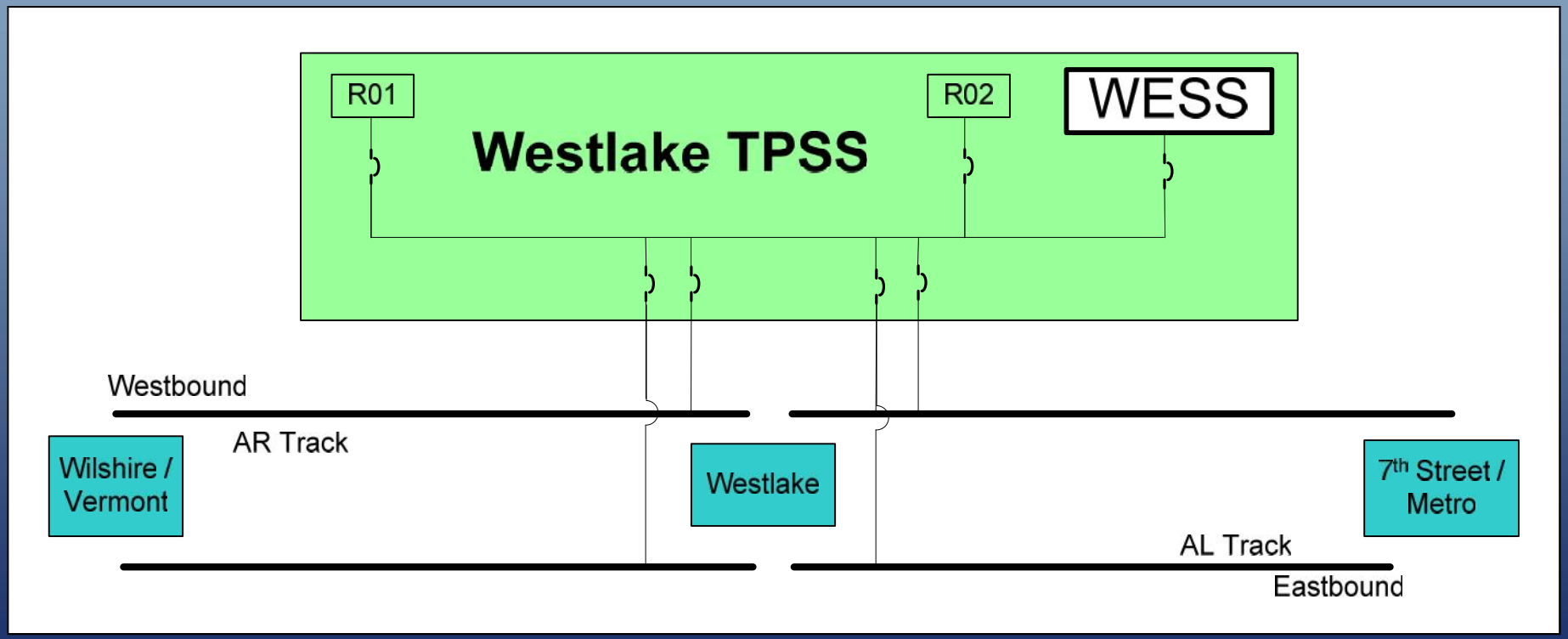
- Kickoff: December 2012
- Equipment Delivery: January 2014
- Powerup: March 2014
- Regular Service: August 2014
- **Complete Performance Monitoring: July 2015**

Metro Red Line

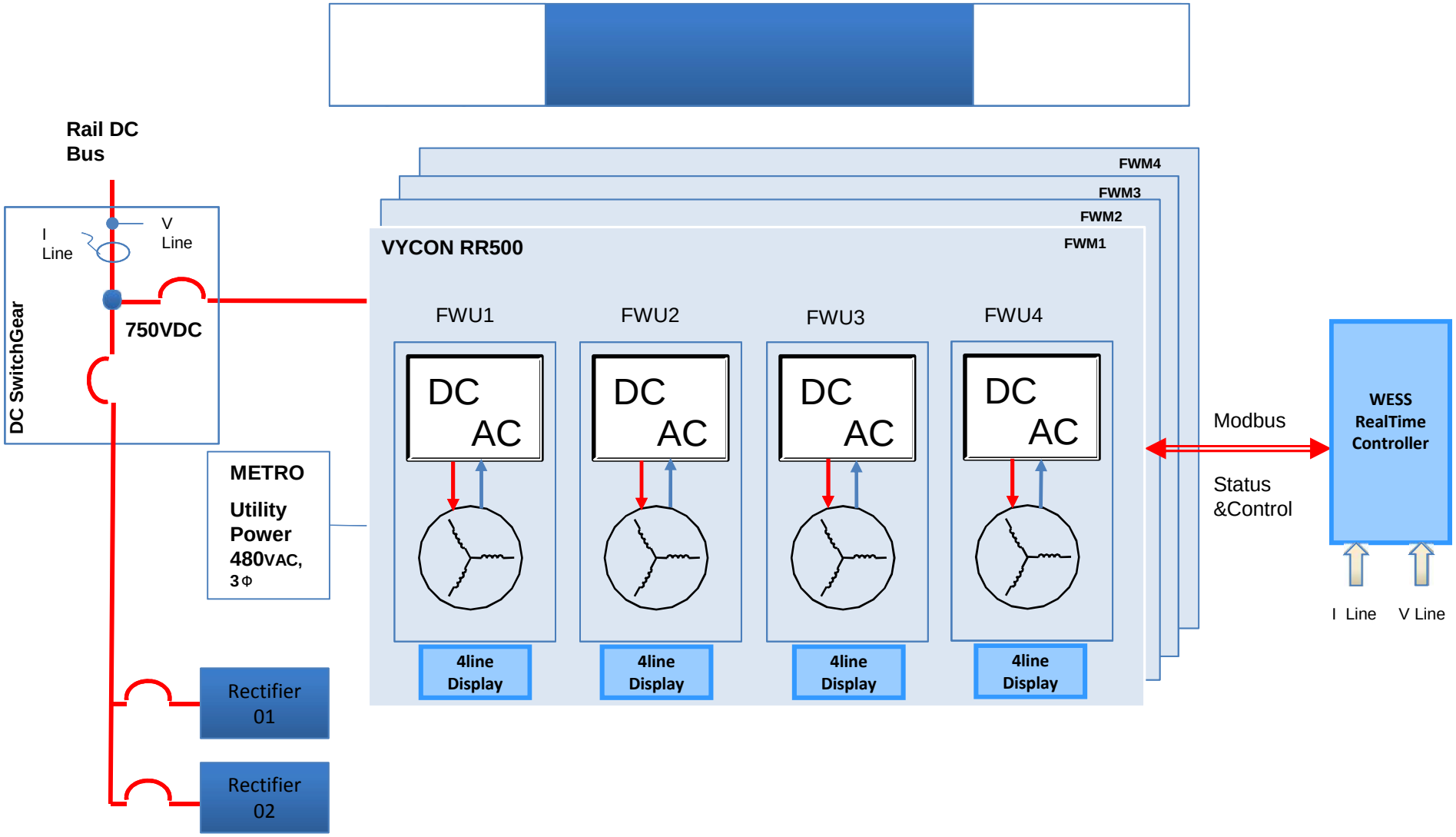


Wayside Energy Storage Substation (WESS)

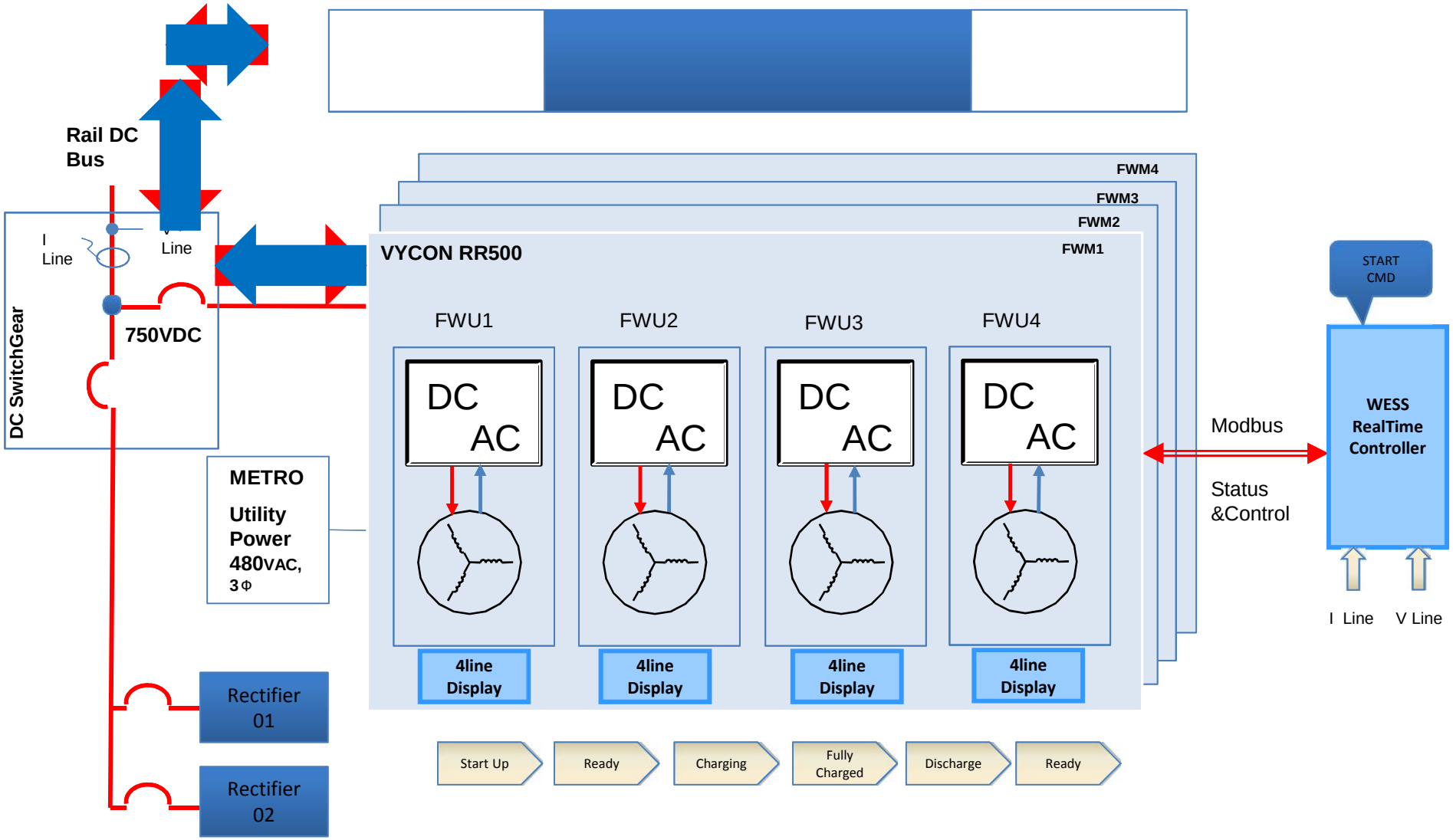
About WESS


R01
R02
WESS
Westlake TPSS
Westbound
AR Track
Wilshire / Vermont
Westlake
7th Street / Metro
AL Track
Eastbound

Basic Operational Sequence



Basic Operational Sequence

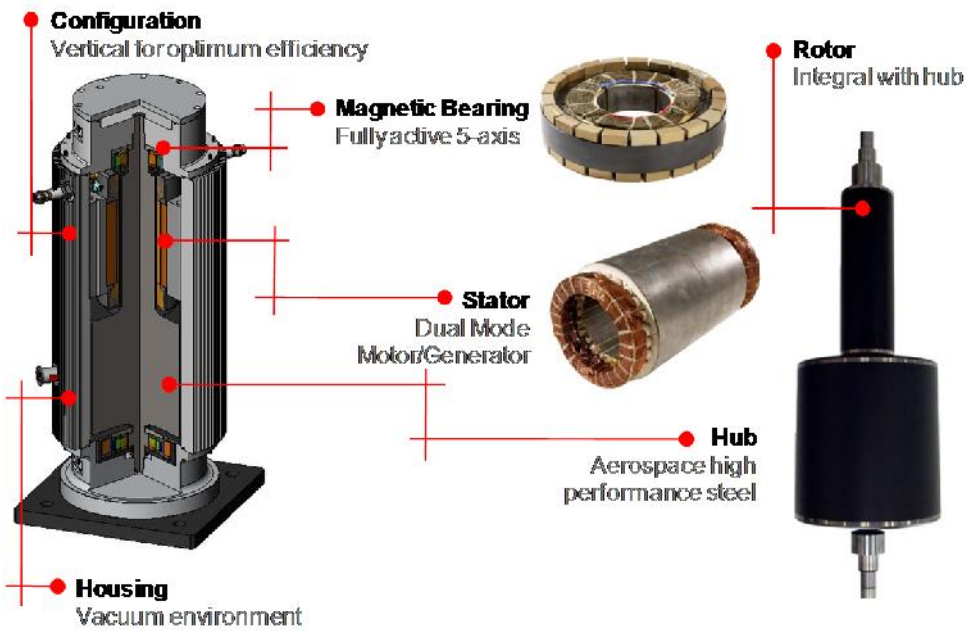


WESS Equipment

- **Major Elements**
  - Flywheel Module: 500 kW, 15 sec. capacity; 4 each
  - Real Time Controller
  - DC Circuit Breaker
  - EMI Filter
  - Aux Power
  - Protection Devices

VYCON Flywheel Technology Overview

Flywheel Technology Overview

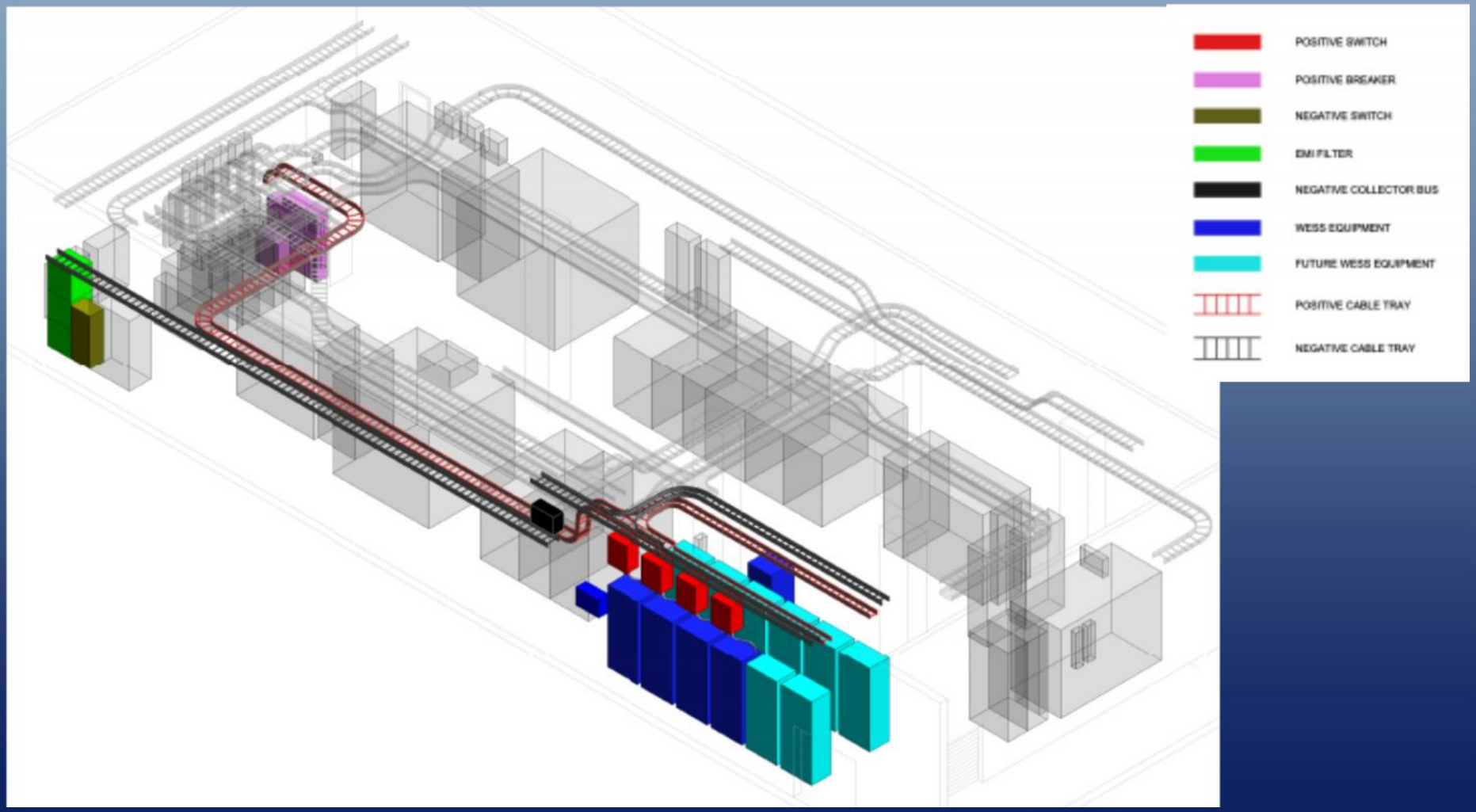


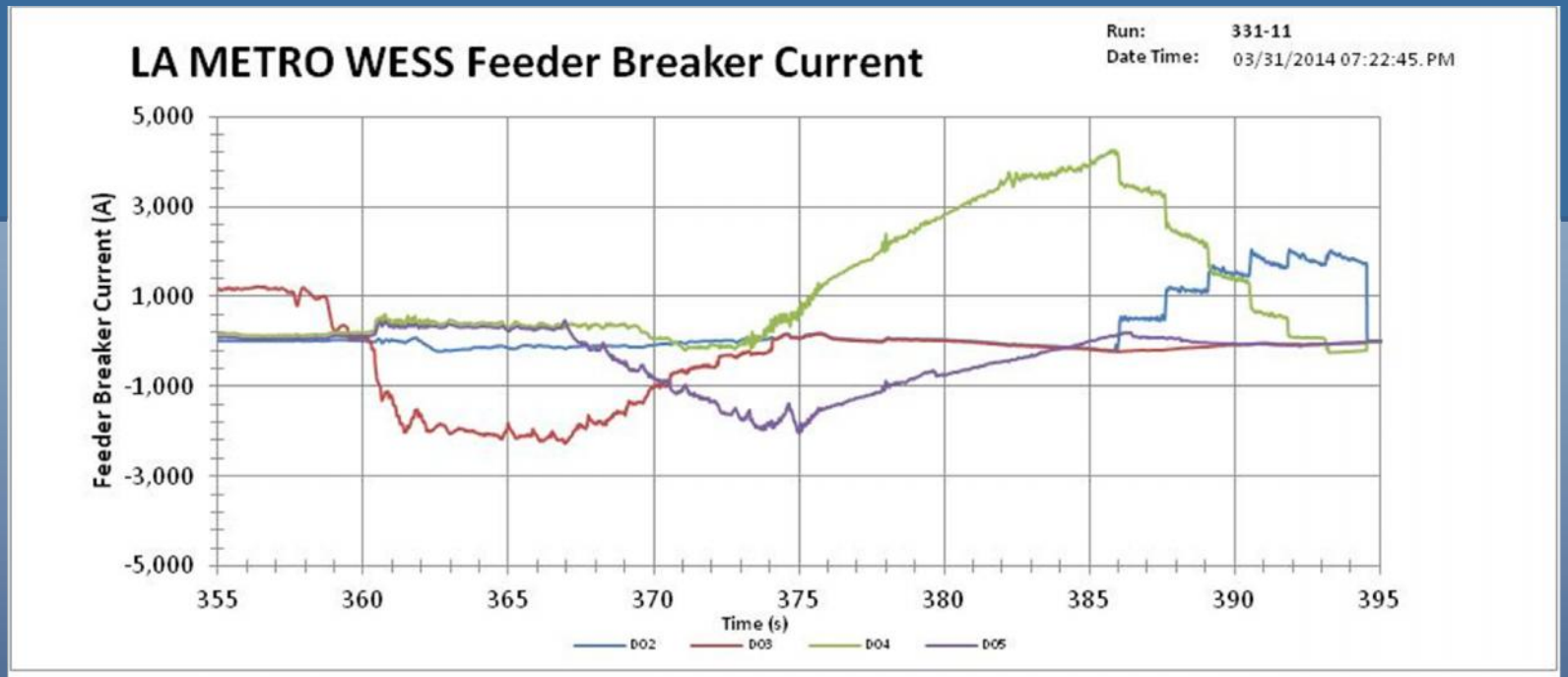
- "Mechanical battery" – stores energy by spinning a mass, produces high power output for short durations
- Dual Mode Motor / Generator – converts kinetic energy into electricity when needed, quickly charges (converts electricity into kinetic energy) to be ready for next event
- Five-axis magnetic levitation – eliminates any bearing maintenance, no friction losses
- Efficient – high speed permanent magnet motor/generator in a low friction environment
- Key Benefit – 20 year operating life with no flywheel maintenance

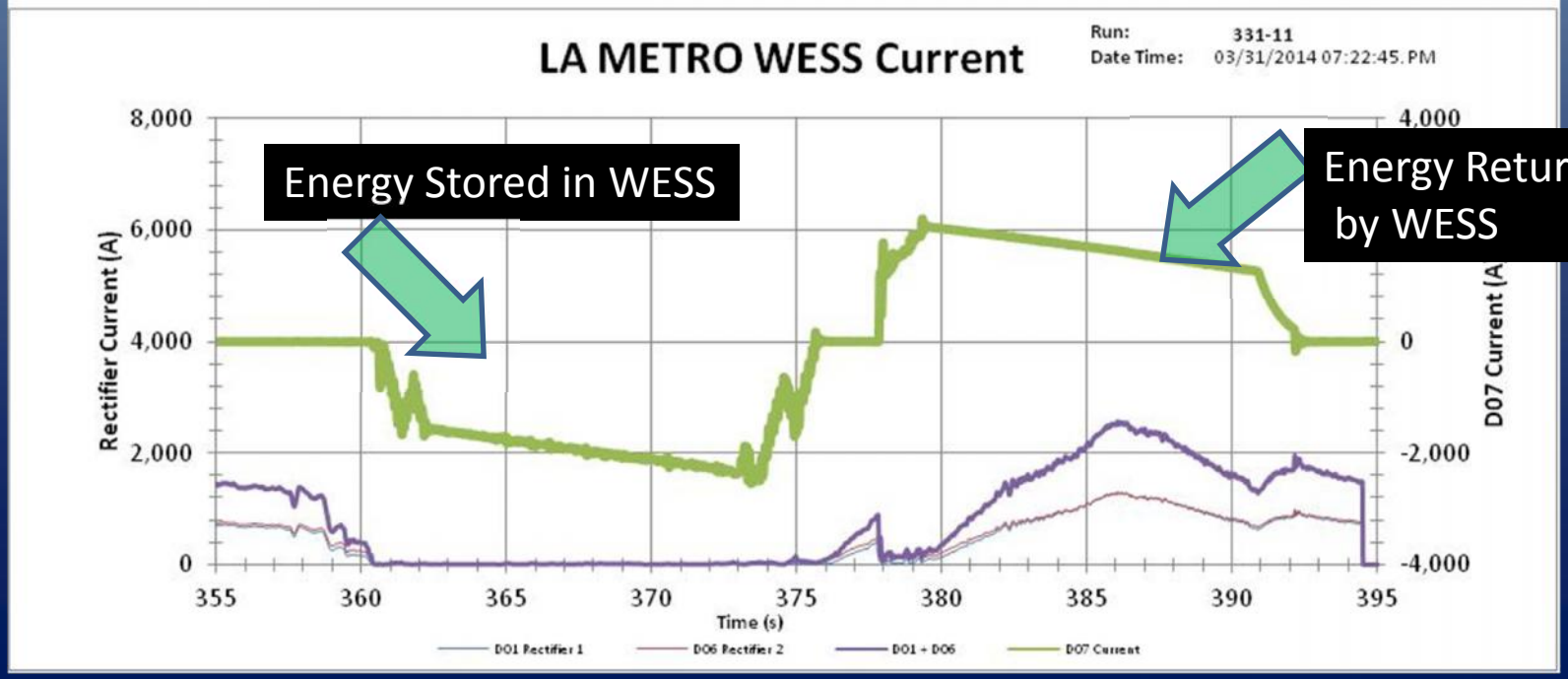
Optimized Integration of Core Technology Provides a Cost Effective, Reliable and Long Life System

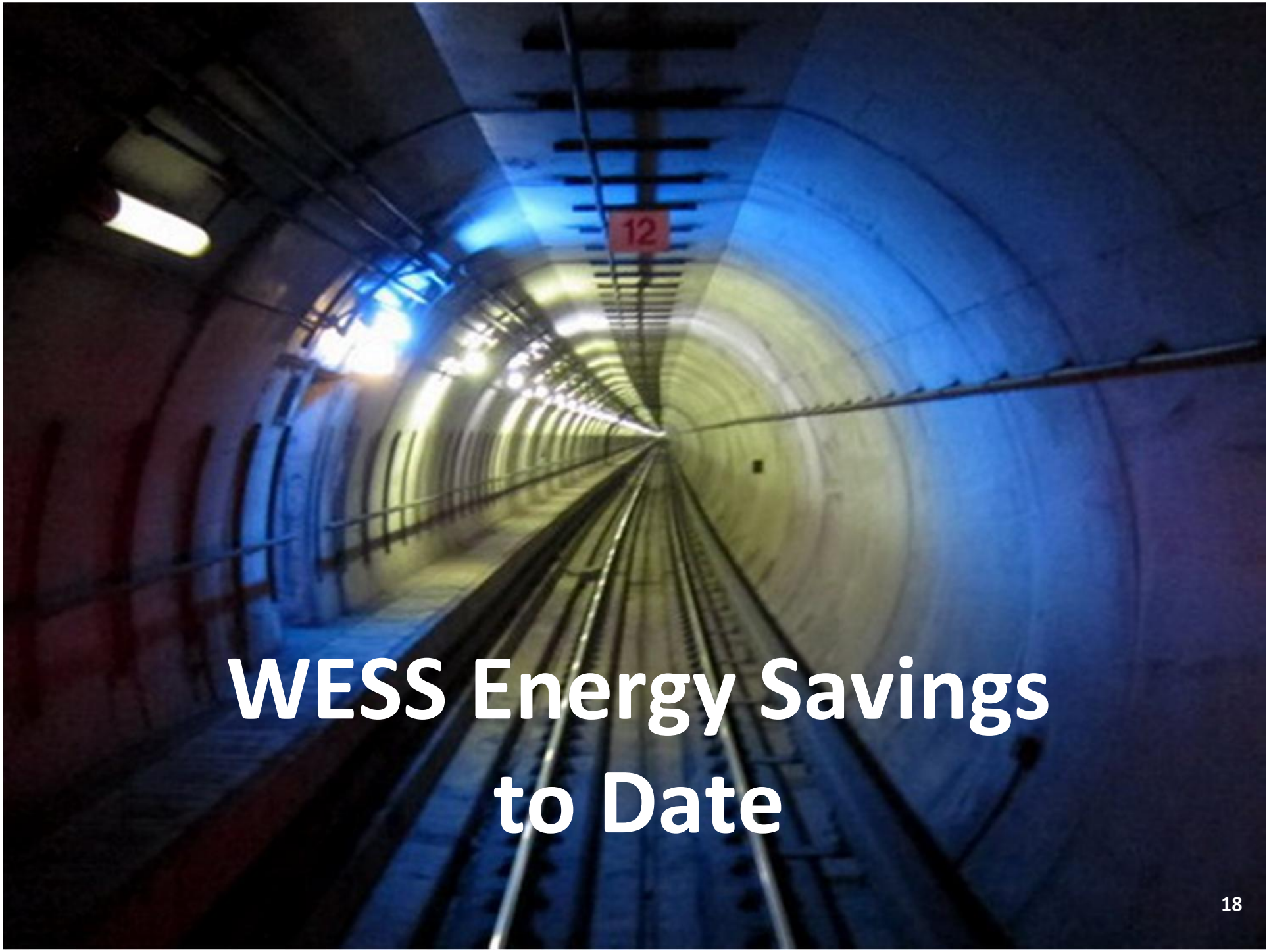
Vycon Flywheel Module

WESS Installation Details




LA METRO WESS Feeder Breaker Current
Run: 331-11
Date Time: 03/31/2014 07:22:45.PM
Feeder Breaker Current (A)
5,000
3,000
1,000
-1,000
-3,000
-5,000
355
360
365
370
375
380
385
390
395
Time (s)
D02
D03
D04
D05


LA METRO WESS Current
Run: 331-11
Date Time: 03/31/2014 07:22:45.PM
Energy Stored in WESS
Energy Returned by WESS
Rectifier Current (A)
8,000
6,000
4,000
2,000
0
4,000
0
-2,000
-4,000
D07 Current (A
355
360
365
370
375
380
385
390
395
Time (s)
D01 Rectifier 1
D06 Rectifier 2
D01 + D06
D07 Current



WESS Energy Savings to Date

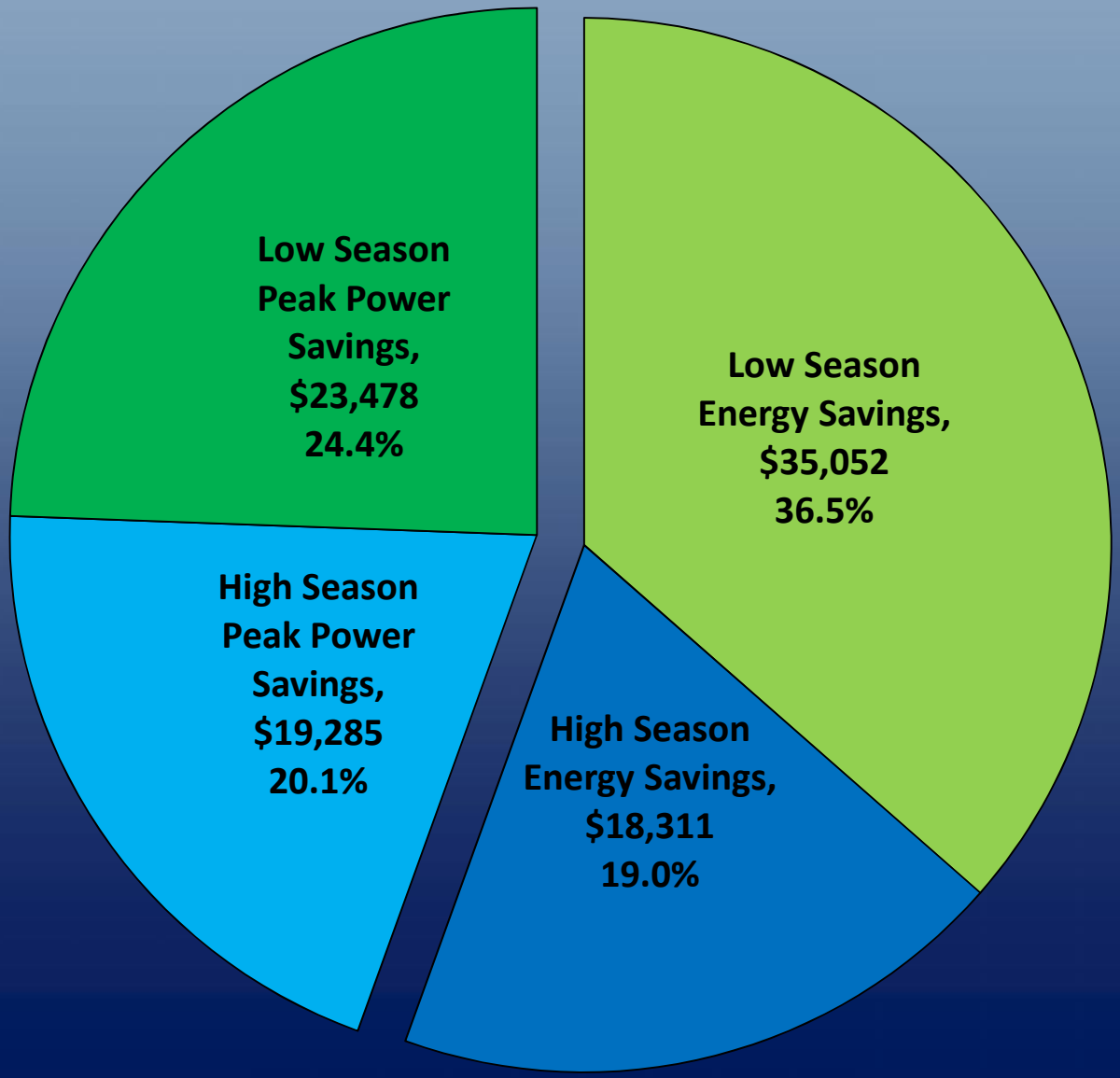
Definitions

- WESS Energy Saved = WESS Energy returned to line
- Rectifier Energy = Traction Energy from Power Utility
- % Energy Saved:

$$\frac{WESS\ Energy\ returned\ to\ line}{Rectifier\ Energy\ + WESS\ Energy\ returned\ to\ line}$$

- % Energy Saved is the additional energy Metro would buy if WESS were offline

Estimate WESS Annual Savings $96,126



Main Screen

Wayside Energy Storage System - Performance

RTC Comm OK

Total
Today
Week
Month
Daily Avg

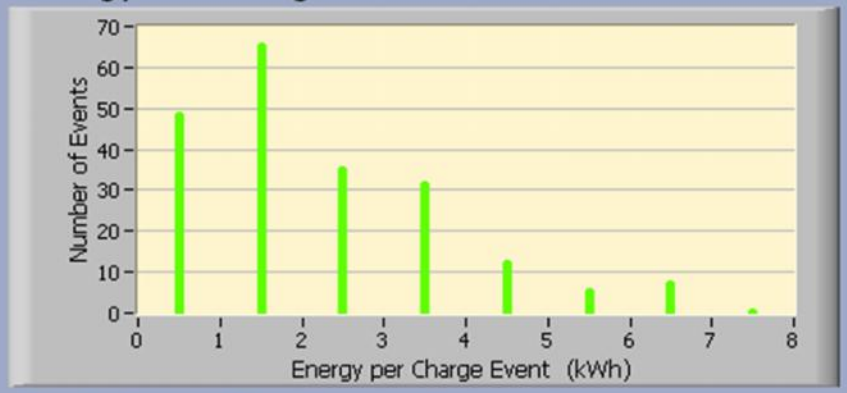
Charge/Discharge Cycles: 402

Hours In Service: 3.9

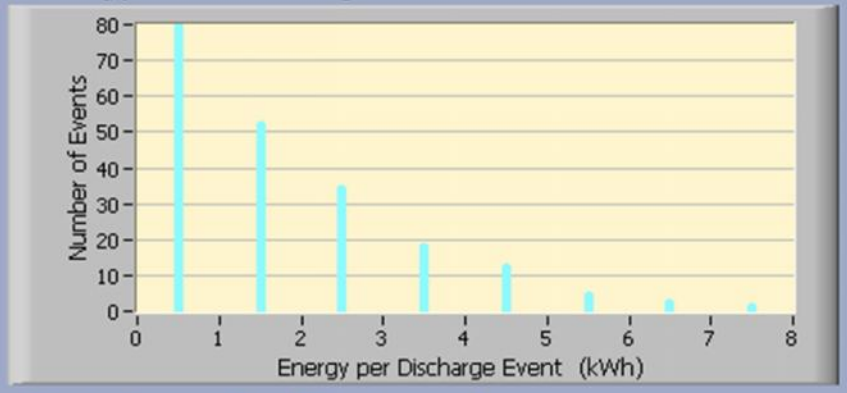
	In	Out
Energy (kWh)	527.1	404.5
Rectifier Energy Out (kWh)		1816.8
Energy Saved (%)		18.2

Histogram Min Event Time (secs): 6

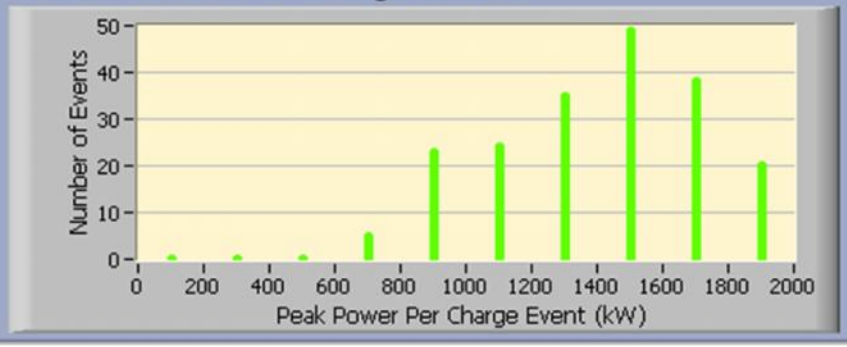
Energy Per Charge Event



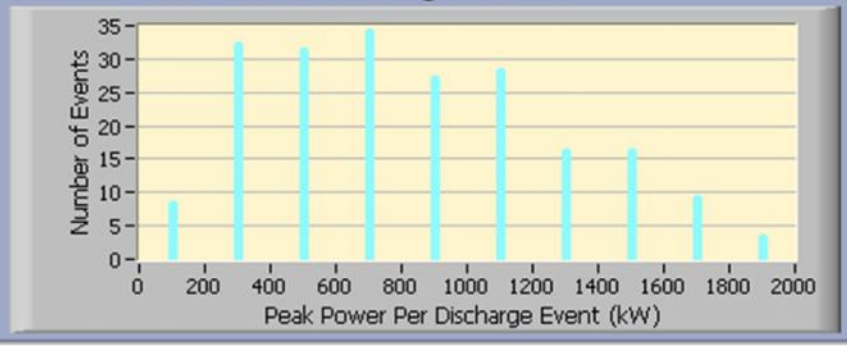
Energy Per Discharge Event



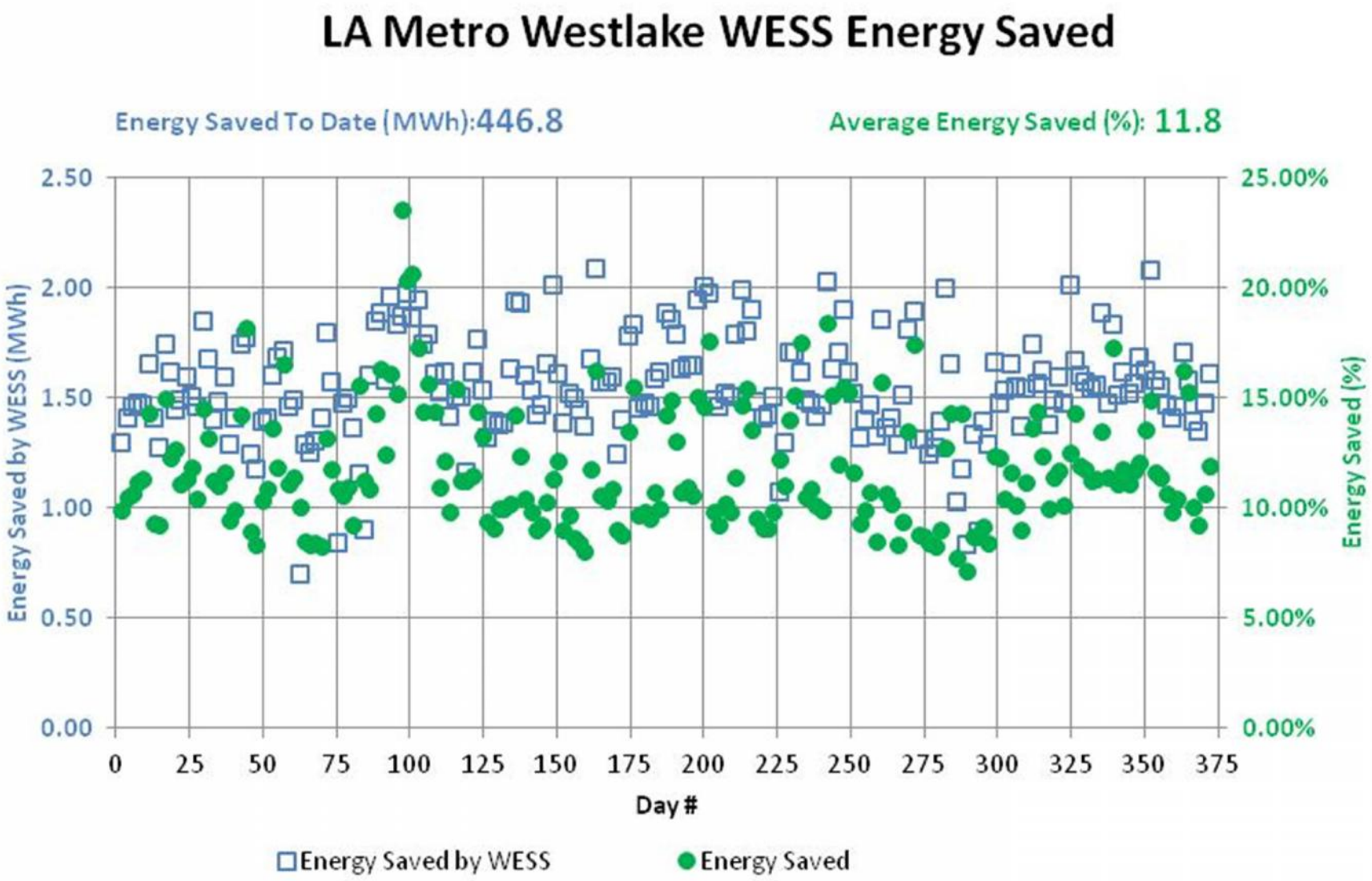
Peak Power Per Charge Event



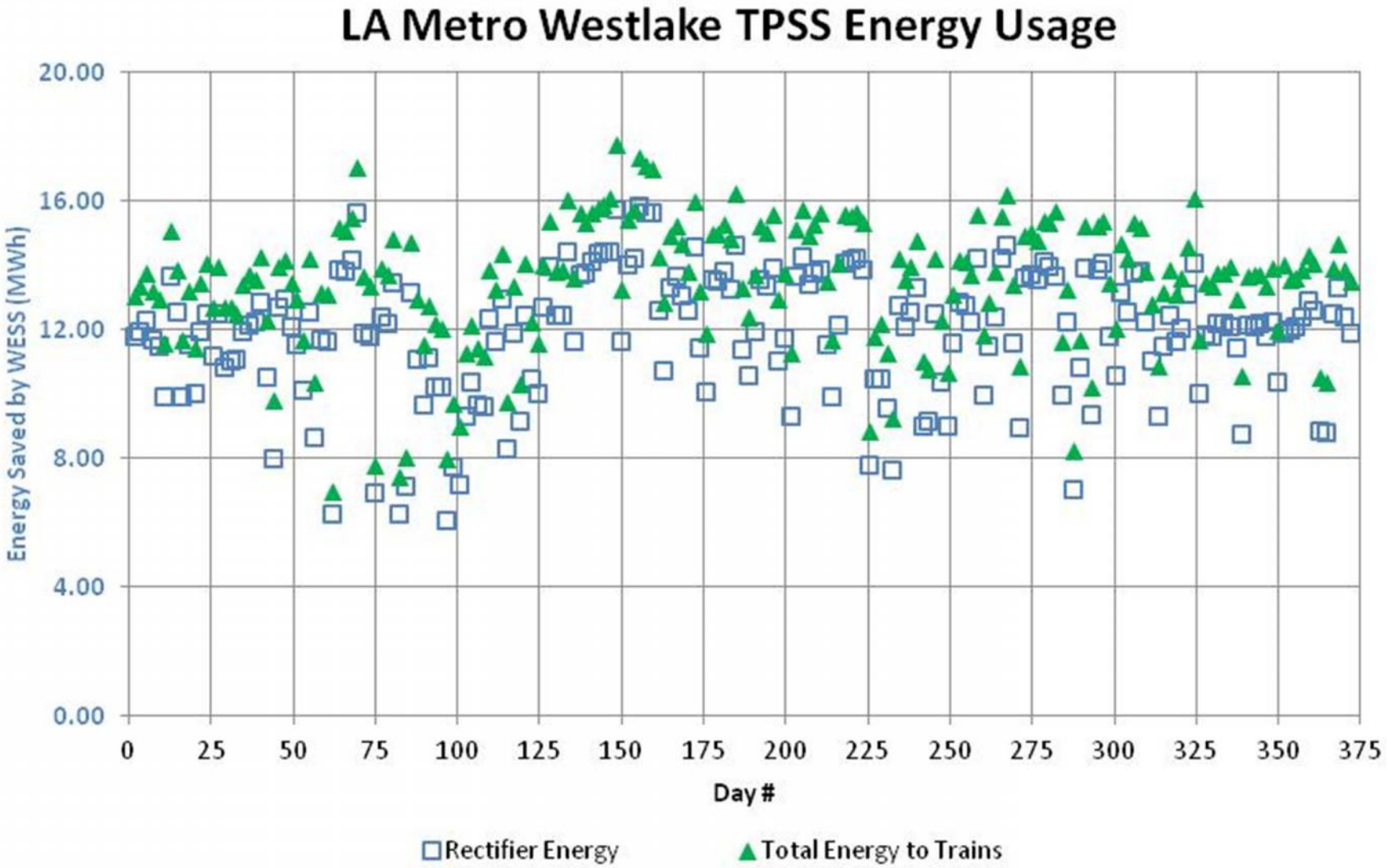
Peak Power Per Discharge Event



WESS Energy Saved



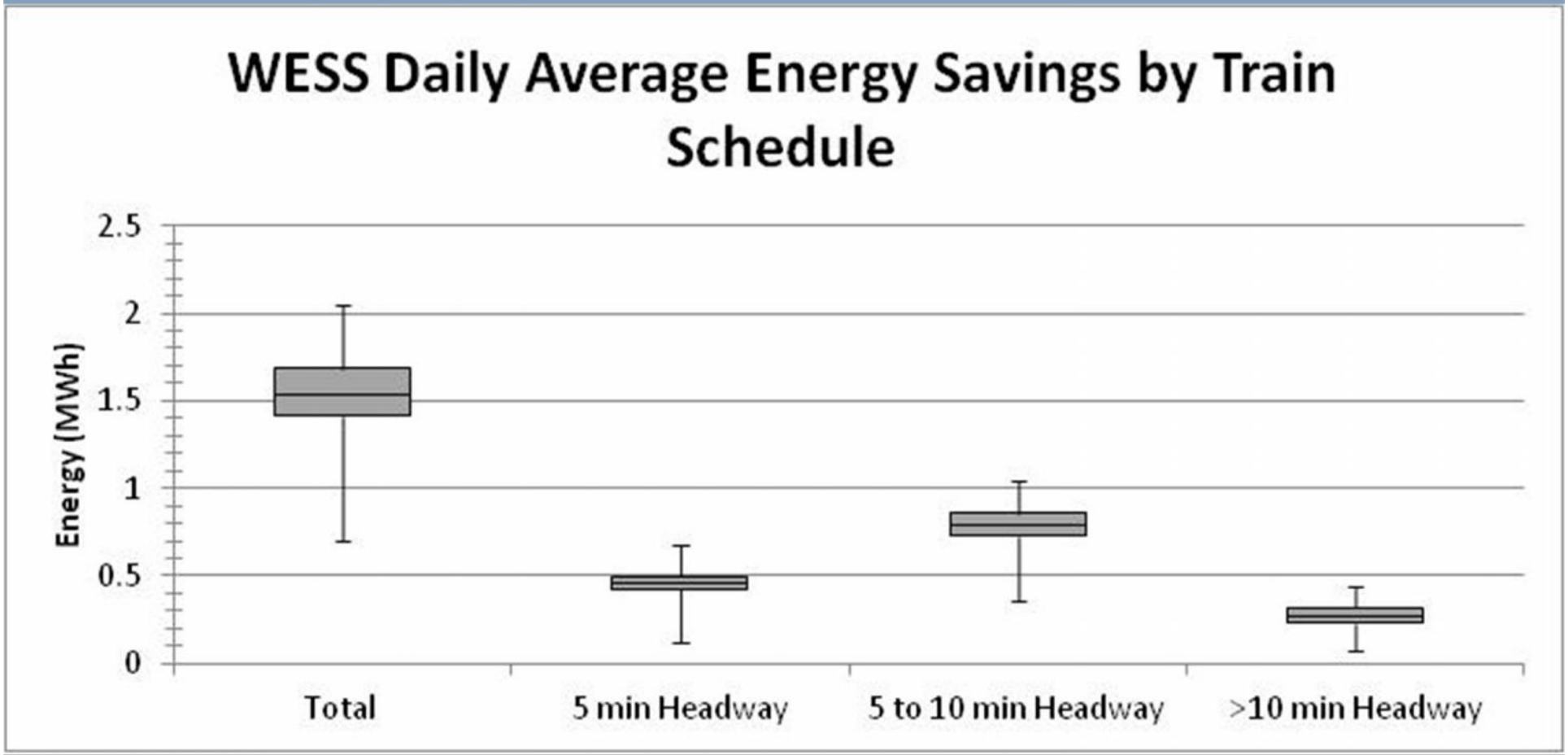
Westlake TPSS Energy Usage



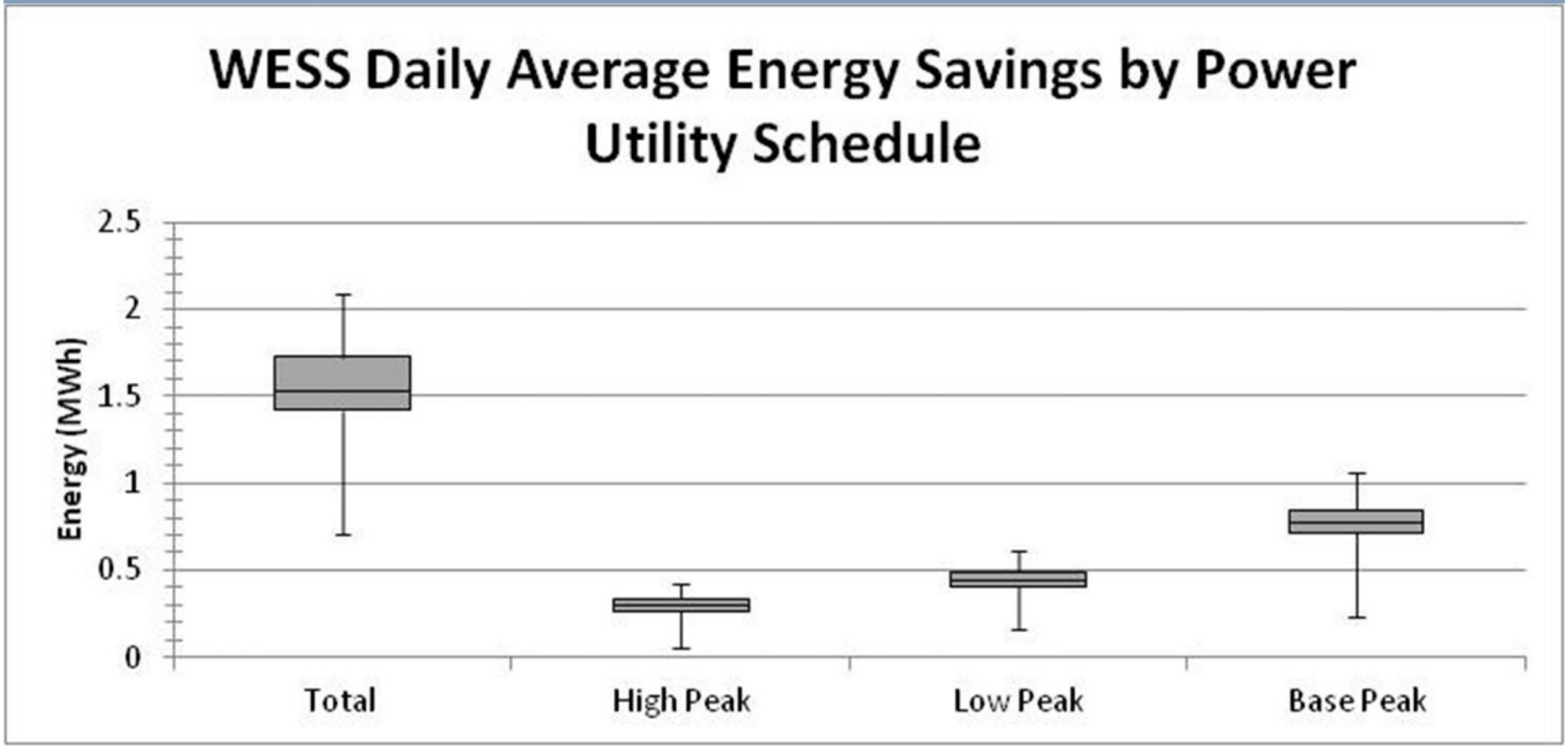
WESS Energy Saved

- Each 24 hrs, WESS saves and average of:
  - 11.5% Energy Saved
  - 1.6 MWh
- Maximum Energy Saved: 31%
- Average Weekday Energy Saved: 11% / 1.5 MWh
- Average Weekend Energy Saved: 14% / 1.7 MWh

WESS Energy Saved by Train Schedule



WESS Energy Saved by Power Utility Schedule



WESS Peak Power Savings

WESS Peak Power Savings by Power Utility Billing Schedule			
Description	**High Peak (kW)**	**Low Peak (kW)**	**Base (kW)**
Peak Power Demand with WESS[1]	1028	1113	1165
Peak Power Demand without WESS[2]	1260	1305	1455
Peak Power Reduction	232	192	290
% Peak Power Reduction	18.4%	14.7%	19.9%

Note:[1] Calculated from WESS measurements
[2] Calculated from Power Utility bills

WESS Energy Saved

- The Metro train schedule and Utility peak billing schedule don’t align by time of day
- WESS saves the most energy with 5-10 min headway; but most of this savings is during the Base billing period
- WESS percentage energy savings is greatest with > 10 min headway, which is also during the Base billing period
- WESS energy savings with 5 min headway varies from 7% to 18% of traction power, with an average of 11%.

WESS Predicted Savings

Predicted Savings

- Each 24 hrs, WESS saves an average of 1.6 MWh
- Each 30 days, WESS saves an average of 48 MWh
- Each year, WESS saves an estimated 566 MWh
- 566 MWh savings a year equals about $96,000 a year

WESS Costs

- LA WESS carried significant costs for integration with Metro systems and for application of WESS to transit environment
  - New application and package of VYCON flywheel units
  - First WESS deployment at LA Metro
  - Safety, training, performance tuning
- Provided for 6 MW capacity, but only deployed 2 MW, so high costs for possible expansion capacity
- WESS expansion or next WESS will cost much less

Next Steps

- Continue to monitor WESS
- Expansion of WESS at LA Metro

Tenco Case Study:

Peninsula Corridor Electrification Program (PCEP) Single Phase Study (2022)

Peninsula Corridor Electrification Program

Single Phase Study

TURNER
ENGINEERING
CORPORATION

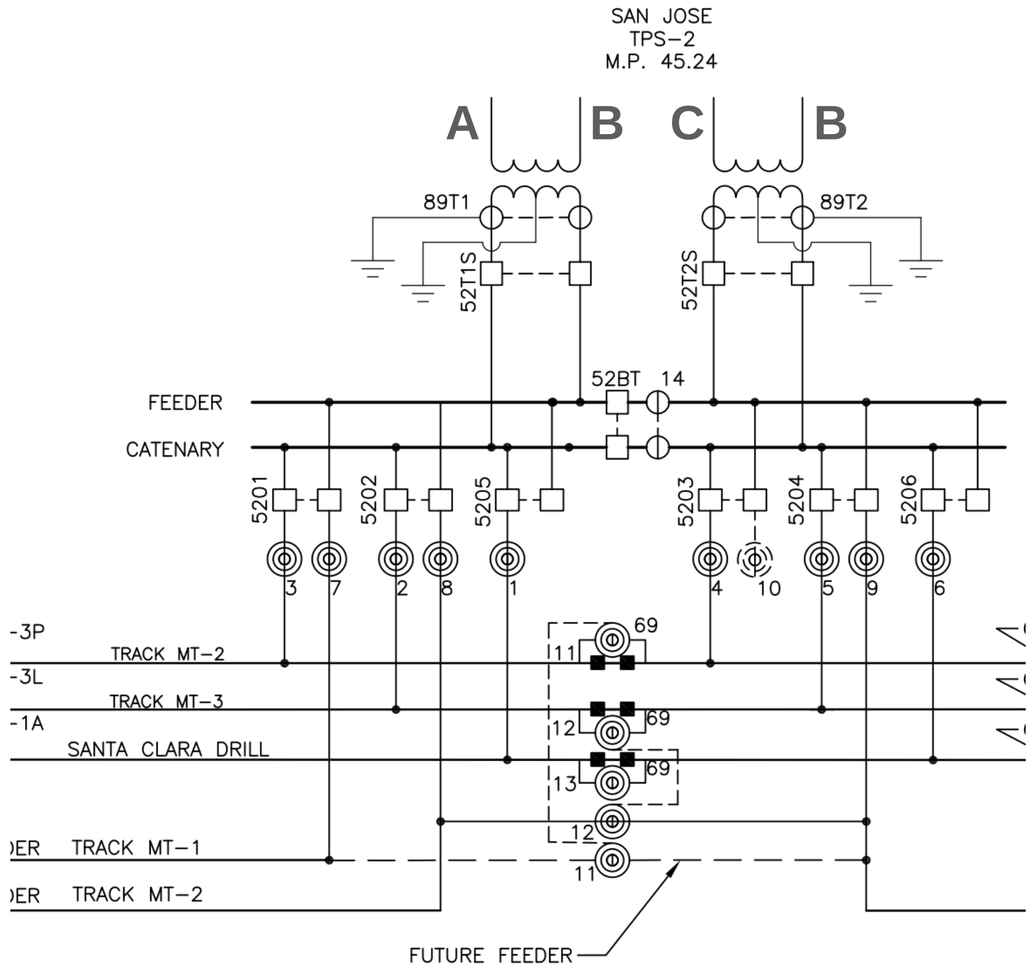
November 2022

Agenda

- Caltrain PCEP Single Phase Study
- Results

Single Phase Study

Caltrain San Jose Traction Power Station Connection to PG&E

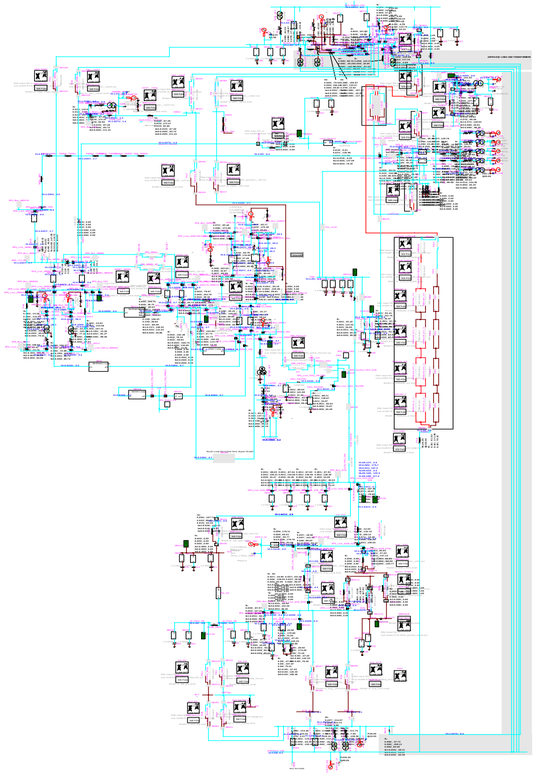


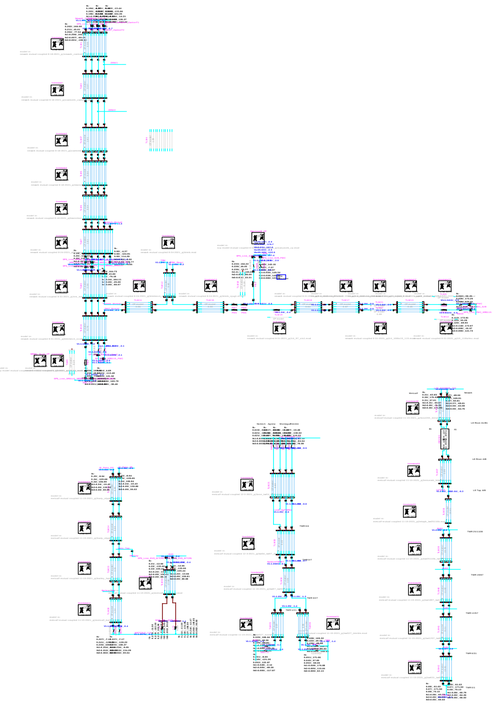
Requirements

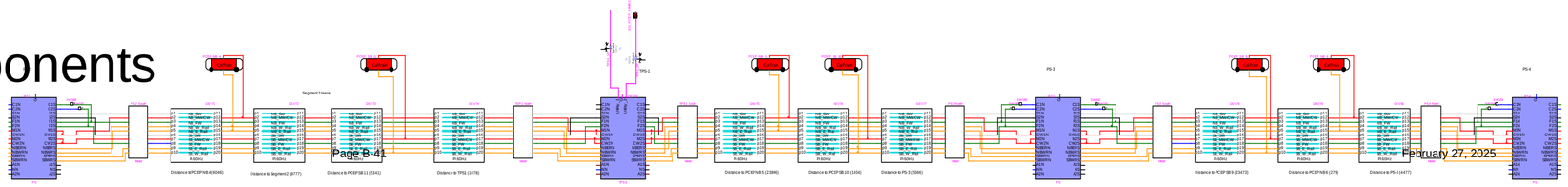
- Studies required by the contract and AREMA Chapter 33, Section 6.5:
  - Voltage Flicker Study
  - Phase Unbalance Study
  - Harmonic Distortion and System Resonance Study …
- Also, supplying utilities PG&E and SVP required a Protection Study for impacts onto their:
  - Protective relays
  - Environmental Leadership

EMTP-RV Model

- Tenco used EMTP-RV for modeling and simulations.
- EMTP-RV handles:
  - Both 3-phase utility network and Caltrain 2x25 kV single phase loads.
  - Frequency dependent impedances, harmonics and transients
- Modeled:
  - PG&E and SVP utility network 115 kV, 230 kV, and 60 kV
  - Caltrain OCS and TPS
  - EMU loads and harmonic components





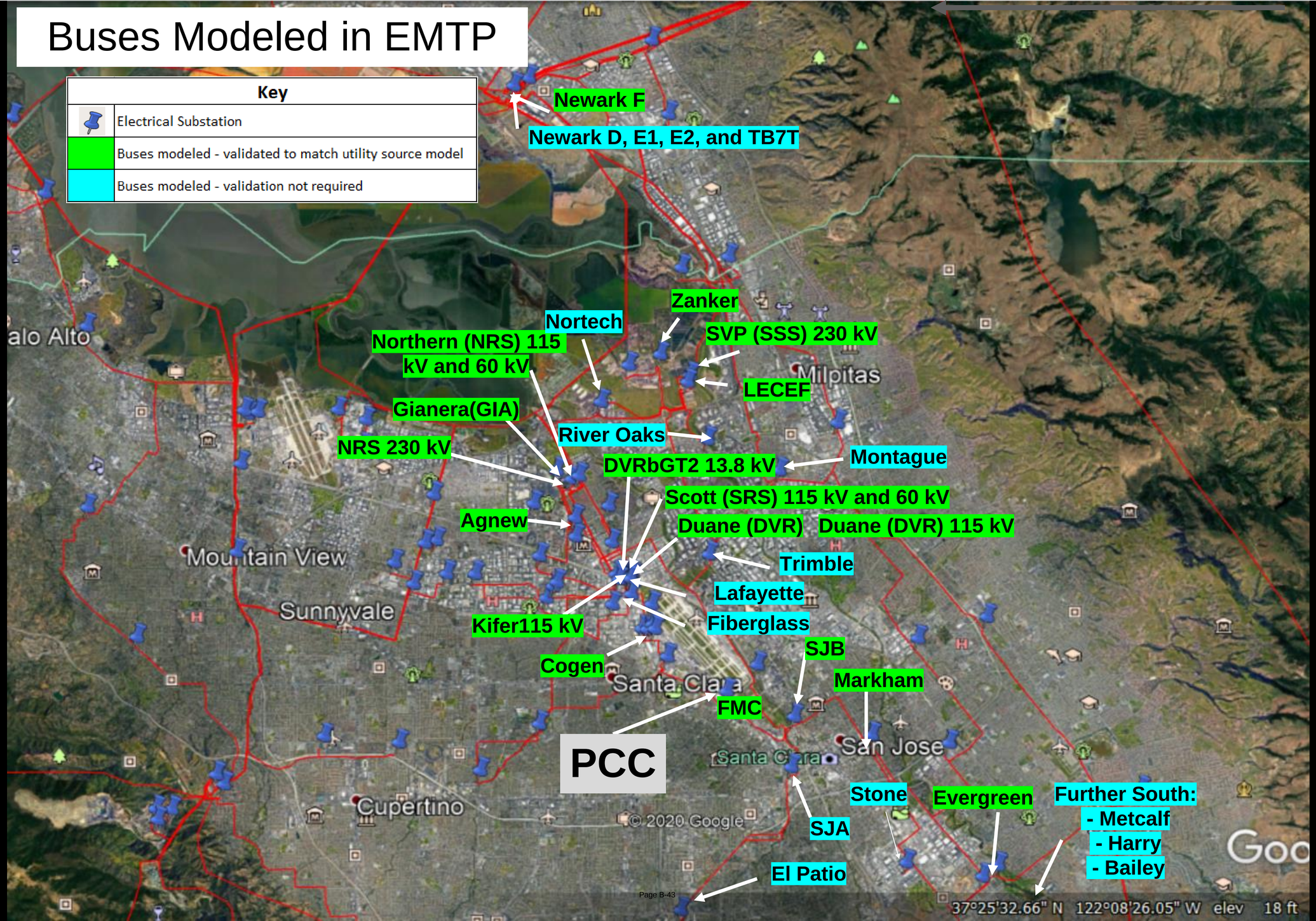


EMTP-RV Model

Tenco simulated:

- Normal conditions
- Many N-1 and N-2 contingency conditions
- Faults on the Caltrain network
- Faults on the PG&E/SVP network, including phase-to-phase and phase-to-ground

Buses Modeled in EMTP



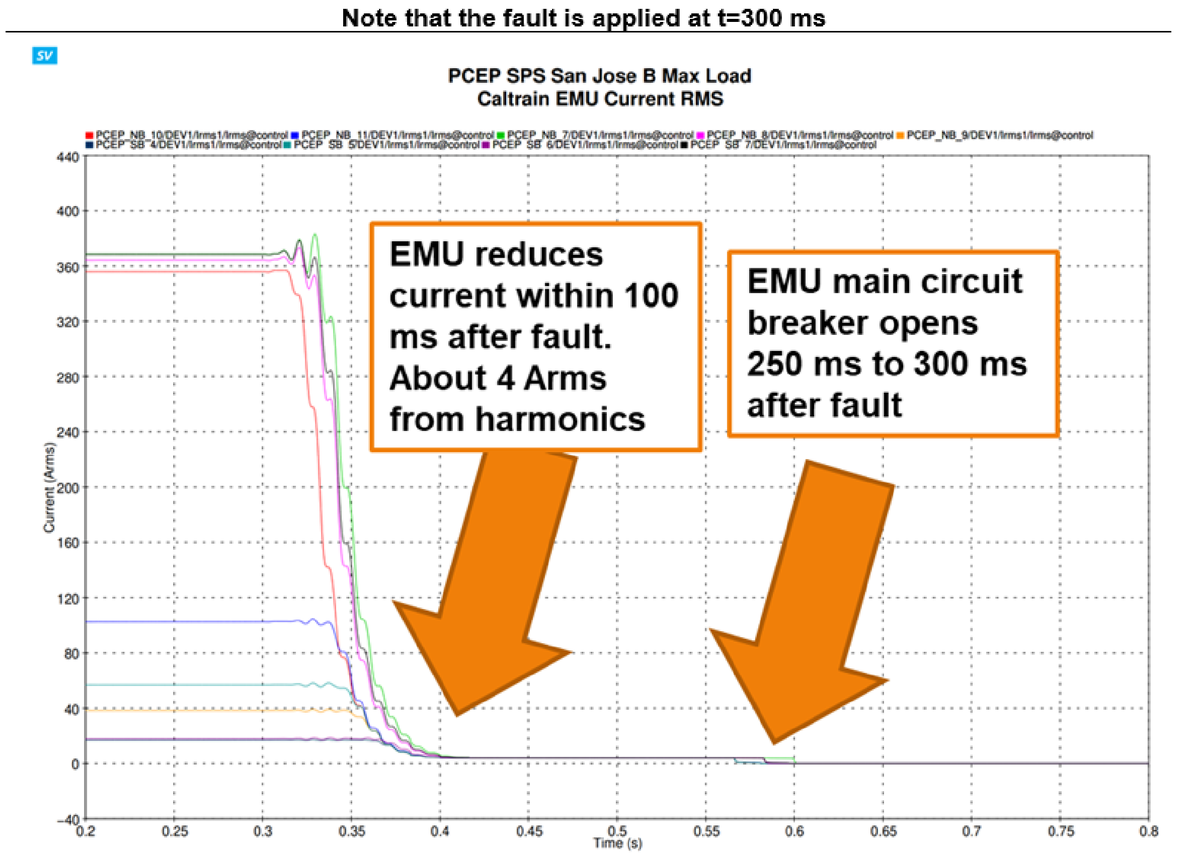
Protection Study Results

- Fault Studies show no significant impact on PG&E or SVP
  - Normal conditions - Train load on 115 kV lines: 300 to 400 A rms at 60 Hz
  - Fault conditions
    - Train impact on 115 kV line: 300 A
    - 115 kV line fault current: 17 to 33 kA

  Train contribution to fault is quite small
- Train max negative sequence impact: 250 A during 115 kV line faults
- Minor impacts on PG&E distance relays during PG&E contingency conditions.
  - PG&E must update line relay settings and relay firmware to add fault detector supervision

Protection Results

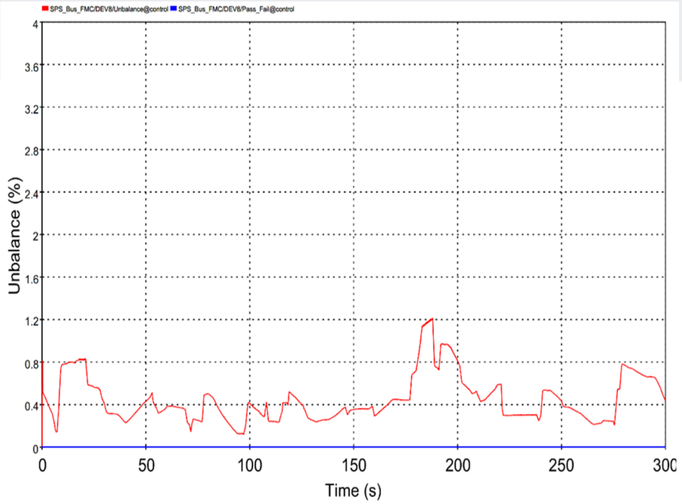
- During utility fault, the OCS voltage collapses within 100 ms
- EMUs reduce current load and current injection and shut down within 300 ms after fault
- EMUs cannot synthesize 60 Hz waveforms and do not significantly inject current into the grid and feed a fault



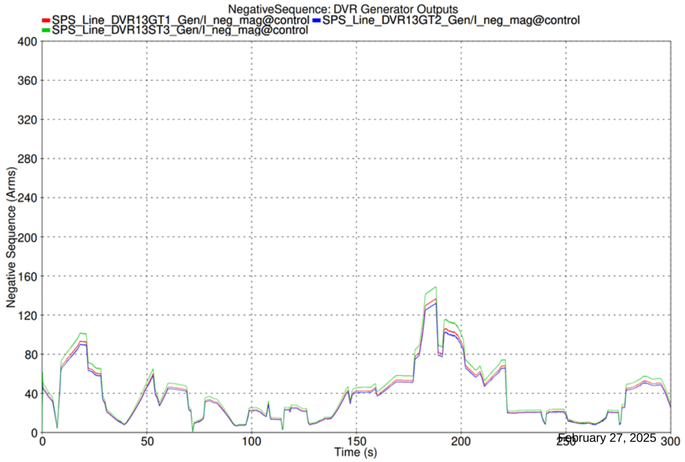
Voltage Unbalance Results

- Voltage unbalance and negative sequence current continuously vary, reflecting train loads, running schedule, and train timing
- Unbalance stays below the 2.5% PG&E Phase Unbalance target.
  - Under certain utility N-1/N-2 conditions Voltage Phase Unbalance may momentarily exceed the target
  - Rules allow brief exceedences
- Negative sequence current inside SVP generators is less than 15% of the generator limits

Voltage Unbalance at PCC

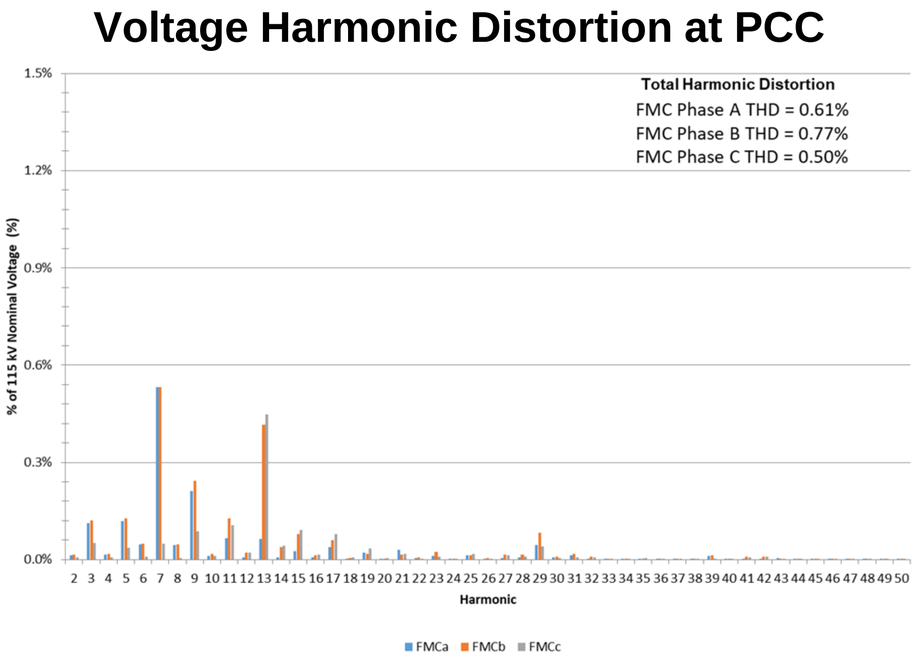


Negative Sequence Current at SVP Generator



Harmonic Distortion Results

- Harmonic Distortion from Caltrain onto the utility is below the recommended limits in IEEE Std 519-2014, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
- Modeled the EMU harmonics, using measured harmonics from EMU testing at Pueblo CO
- Will verify Harmonic Distortion onto PG&E during EMU testing and commissioning at Caltrain



Voltage Flicker Results

- Below limits in IEEE Std 1453-2015, Recommended Practice for the Analysis of Fluctuating Installations on Power Systems

Lessons Learned

- The Utility has a different perspective, constraints, and mindset than the transit agency, contractor, contact, and AREMA requirements.
  - Must recognize the utilities concerns and constraints
- Get an early start working with the Utility on System Impact / Power Quality issues
  - Negotiate and agree the scope and commercial aspects
  - Be fluid, leave room for expansion and changes as the studies progress
  - Be ready to educate the Utility on transportation equipment technology. Their deep expertise is related, but different.
  - Meet regularly with technical peers

Marine Tiger Case Study:

Zero Emission Bus System Design and Investment Study (1/2023 – 6/2025)

MARINE TIGER
TECHNOLOGIES

Case Study: Zero Emission Bus System Design and Investment Study (1/2023 - 6/2025)

a. Client Contact Information:

NJ TRANSIT
Mike Kilcoyne
SVP, Surface Transportation/GM
NJ TRANSIT Bus Operations
973-491-8868
mkilcoyne@njtransit.com

b. Description of Complexity and Stakeholders:

Beginning and End dates: 1/2023 – 6/2025
Contract Value: $210,778

Context: NJ TRANSIT deployed eight electric buses and the associated charging infrastructure at its Newton Avenue Garage in Camden, NJ as the first step in a larger, system-wide program to evaluate the feasibility of zero-emissions buses (ZEB) in the next five to 10 years. They are determining the necessary upgrades and modifications that will be necessary at its existing and planned future garages to support and successfully transition to a future electric fleet. NJ TRANSIT intends to develop long-term capital investment and implementation plans while concurrently advancing engineering design for the early ZEB deployments.

Approach: As part of the Zero Emission Bus (ZEB) System Design and Investment Study, Marine Tiger conducted site visits and interviews with operations and maintenance personnel at each of NJT's 16 bus garages. The site visits focused on 'pull-in' and 'pull-out' movements throughout the facilities, the number and types of maintenance bays, servicing, and maintenance staffing levels. Other critical factors in the assessments were the types of routes run out of each location, including local, express, and commuter, as well as the fleet assigned to meet service demand. Marine Tiger reviewed and summarized major transportation operations policies at NJ TRANSIT, identifying areas that could be affected by the transition to zero emissions technologies including dispatching, daily fueling operation, charging operation, charge status management, parking, cleaning, and dispatching for route operation. For example, to maximize charging time, Marine Tiger recommended that the service operation should be changed from one that is performed on buses as they line up or pull-in to one that could be executed while the buses are parked.

c. Recommendations offered to the client and the results of the implementation of those recommendations (including any post-implementation success measurements):

Analysis is ongoing; however, initial assessment and recommendations address:

1. Modifications to existing infrastructure to support an electric fleet;
2. Modifications to operational procedures, such as changes in parking to accommodate charging, to support transition to an electric fleet (i.e., service operations require

modification from a bus line-up scenario to one that can be executed while buses are parked);
3. Infrastructure additions to maintain regulatory compliance and support environmental stewardship as the transition is complete;
4. Design criteria for bus infrastructure to support effective operations and asset management;
5. Bus deployment management protocol to facilitate effective transition and bus operator training; and
6. Phasing options, timeline, and business case for ZEB transition.

d. Specific questions:

1. **Project Completed on time and within estimated budget?** Yes
2. **How were efficiencies achieved?** A combination of on-site and desktop analysis was used to gather necessary data and support collaboration while minimizing on-site time.
3. **Did the client or the proposer implement the recommendations?** The client is in the process of implementing recommendations with ongoing input from the project team.
4. **Did the client encounter any problems (i.e., legislative, political, organizational, process, etc.) in attempting to implement the changes? If so, describe the issue and how your company assisted the client in working through it in attempting to implement the changes?** The client has not encountered any substantial challenges.
5. **Did the proposer engage with any sub consultants? If yes, describe the specific scope of services:** Marine Tiger Technologies (MTT) is a sub consultant on this project and conducted much of the on-site data collection regarding current operations and identified necessary modifications to infrastructure and operations to support ZEB transition (the prime partner led development of specifications for ZEB transition based on needs identified by MTT).

e. Any other information regarding the project that would assist the MTA in determining the success experienced by the client: The client has been able to quickly implement ZEB transition measures based on recommendations provided by the project team. MTT team members' direct experience in bus operations allowed expedited and valid identification of infrastructure and operational changes necessary to support ZEB transition.

f. How would this experience translate to the public sector environment? New Jersey Transit is a public sector client; this project is directly applicable to MTA needs.

Granite Data Solutions (GDS) Case Study:

Microgrid as a Grid Alternative Solution (2024)

CASE STUDY

REQUIREMENTS

1. Replace the generator with a grid alternative solution that was cleaner, quieter, had fewer operating and maintenance demands, with a total lower cost of operation year over year.

2. Meet the statutory, renewable mandate from Congress while staying in budget.

3. Provide an uptime SLA (service level agreement) of “five nines” or better (99.999%).

Could it be done?

Did a solution exist that would have the capacity to deliver over 5x the existing power output in a reliable, renewable, affordable design, and in a form factor that didn’t come with a footprint that wasn’t devastating to this fragile, and protected landscape within this National Treasure?

Our engineering team was ready to accept the challenge. And accept the challenge we did. We began with a holistic understanding of the current situation:

Emissions – Carbon Dioxide, carbon monoxide, hydrocarbons, NOx particulate emissions, and soot.

Fuel – Cost per gallon, cost to transport, respiratory exposure to cancer causing vapors, skin exposure to cancer causing fuel, fire hazards associated with fuel handling

Backup – Firing up a backup generator to run the essential/critical compound operations when the primary generator is offline.

Noise – In a pristine, protected landscape, there is zero tolerance for unwarranted or intrusive noise. A diesel generator running around the clock provided that very noise, disturbing the natural serenity in the compound.

Reliability – The power generated by a diesel generator is only as good as the source of fuel, available servicing, maintenance, and weather conditions. The power had to be interrupted for all the above, at regular intervals.

Longevity – Diesel generators have a lifespan based on hours of operation and maintenance intervals.

Once we had the data on the current infrastructure, we went to work understanding the needs, wants, and demands of the client for this compound.

THE WANT

The solution needed to be able to provide enough power to run all the operations simultaneously and provide HVAC for the living quarters for on-site Personnel.

THE WASTE

Emissions GHG – A 50KW, Diesel Generator, running at 50% load, 20 hours per day is provides 400MWh of power annually, while emitting over 300 Metric Tons of GHG.

Fuel – A 50KW, Diesel Generator, running at 50% load, consumes 4.5 gallons of fuel per hour (GPH), and running 20 hours per day, consumes 90 gallons of fuel per day. 90 gallons of fuel per day at an average cost of $5.00/gallon is equal to $450/day on average.

Fuel Transportation – 90 gallons of fuel per day being trucked from 20+ miles away has an average delivery cost of $2.50/mile.

CASE STUDY

Noise Pollution – A 50KW, Diesel Generator, running at 50% load, produces 85dB of noise at 100' which is the equivalent of city traffic.

Reliability/Servicing – A 50KW, Diesel Generator needs to be serviced routinely, every 500 hours of operation. Operating 20 hours per day, a 50KW, Diesel Generator would need to be serviced every 25 days which was an added expense of roughly $150 and half a day down, in which the backup generator would have to run to power the park.

Longevity – A 50KW, Diesel Generator, running at 50% load has a lifespan of 25,000 hours of operation. Operating 20 hours per day, the generator would be End of Life (EOL) at 41 months. At an average cost of $30,000 (including shipping, installation, and set-up), in 20 years, it would stand to reason that the purchase of five generators would be required to fulfill the need for powering this facility.

With a thorough understanding of the situation and the data to support it, we now had enough information to develop the perfect solution.

THE SOLUTION

We proposed a 336KWh storage solution. With 336KWh of storage to run the compound**.** and a **200**KW solar array to charge the storage, the compound would now have enough power to run all operations simultaneously, and to add HVAC without over burdening the infrastructure.

Why not all solar?

We considered all grid alternatives, and in an environmentally sensitive location, solar did not scale as a power source as it would have taken between four to six acres, and there would have been no power available after sunset.

The 336KWh PowerPack 336 was the perfect answer to a complex problem.

We were able to provide clean, reliable, conditioned power, 24 x 7 x 365 without a single ounce of GHG, without a single decibel of noise, without a single acre of protected land, without a single drop of fuel, and with a solution that will last 20+ years.

Based on a 20-year lifespan, here are the Total Cost of Ownership (TCO) metrics:

- Over 20 years, the storage solution and solar charging array average $11,900 annually with ZERO metric tons of CO2, and NET Zero emissions.
- Over 20 years, the diesel generation solution would have averaged $175,000 annually with over 8,000 metric tons of CO2 and immeasurable amounts of poisonous GHG emissions in at least four other categories.

Now, with a year of data to support our initial analysis, research, engineering, design, and implementation, we have the results we had predicted:

With our case study, we conclusively proved that our solution is the answer to all the power problems the federal and state governments are facing today.