AECOM
30 Knightsbridge Road, Suite 520
Piscataway, NJ 08854
www.aecom.com

732 564 3600 tel
732 369 0122 fax

October 14, 2015

NJ TRANSIT Corporation, Procurement Department
One Penn Plaza East, 6th Floor
Newark, New Jersey 07105-2246
Attn: Thomas J. Fusco

Re: RFP No. 16-001 – Design, Engineering, Construction Assistance and Other Technical Services for the NJ TRANSITGRID Project – Distributed Generation

Dear Mr. Fusco:

AECOM strongly supports NJ TRANSIT's objective to create a sustainable, resilient energy option for assets throughout the system. As one of New Jersey's leading full-service consultants in energy, transit, security and resiliency, AECOM has the depth of resources throughout New Jersey, the directly-related project experience, and the advanced expertise to perform this distributed generation project to NJ TRANSIT's complete satisfaction.

NJ TRANSIT has identified two elements critical to the success of this program: a strong understanding of advanced energy options and a thorough understanding of transit and transit systems. This combination is exactly what the AECOM team offers with our management team of Ayokunle (Kunle) Kafi, PE, as project manager, and Ed Hrinewski, PE as deputy project manager.

Kunle has 30 years professional experience and has managed the planning, design and delivery of more than $2.5 billion in the Energy and Power Transmission projects, primarily in the NJ/NY metropolitan region. Ed has over 40 years of experience in transit systems engineering and integration and a long-term association with NJ TRANSIT that includes successful delivery of the Hudson Bergen Light Rail project.

Kunle and Ed are joined by an impressive cadre of discipline leaders and technical specialists who will be instrumental in delivering the 20 percent design in 10 months. Rounding our management and technical team, AECOM is bringing on world renowned experts in cybersecurity, microgrid technology, systems integration, environmental interface and compliance, and state-of-the-art security systems.

An important aspect of the AECOM team's expertise is our demonstrated ability to coordinate and integrate with the key stakeholders, including PSE&G, JCP&L, FTA, Hudson County, and a myriad of municipalities and interest groups. No one team has had the success of moving major programs forward in this region than AECOM has. Moreover, our subconsulting team includes pre-eminent firms in their fields of expertise — bringing the most advanced technology and innovation in the industry for microgrid and distributed generation facilities.

In Section 6 of this proposal, we also propose an alternative management structure to combine the REF No 15-031 Project and RFP No. 16-001 Project management teams. We are confident that this approach would achieve a 20 to 25 percent economy of scale, while ensuring consistency in the approach to the deployment of the microgrid.

AECOM

The AECOM team appreciates your review of this proposal. We look forward to working in a collaborative partnership with NJ TRANSIT to create and deliver this first of a kind Microgrid system, safeguarding the economic vitality and resiliency of one of our region's most essential transit systems.

Please contact us for further information.

Sincerely yours,

Frederick W. Werner, PE
Project Executive
Corporate Executive Vice President

Julie D'Orazio, PE
Senior Vice President
Senior Region Transit/Rail Sector Manager

02 Qualifications of Consultant

The AECOM team brings an organizational structure proven by experience to manage the NJ TRANSITGRID project to its successful completion and to maximize value for NJ TRANSIT and the citizens of New Jersey.



The NJ TRANSITGRID project is a first-of-its-kind project and involves the busiest rail transit line in North America. The operational sensitivities and public visibility mean that there are no second chances to get it right. NJ TRANSIT and Amtrak need a consultant who is known and trusted to deliver the project safely, without disruption to operations, on time and within budget. AECOM is the right consultant for this mission.

As you review our qualifications we ask that you consider the following characteristics of our team:

Proven – We are a local team with the right expertise, experience and resources in New Jersey.

Collaborative – We have demonstrated our ability to work collaboratively with NJ TRANSIT, regulators, reviewers and stakeholders.

Driven – As residents/employers in the NY/NJ region we are invested in the region's infrastructure and committed to deliver the NJ TRANSITGRID within schedule and budget.

WHY AECOM

We understand the uniqueness of this project and have structured the team to deliver these critical success factors:

THE RIGHT EXPERIENCE

- Smart grid technology experience in New Jersey and worldwide
- Global experience in risk and terrorism threat assessments
- Over 25 years of history working with NJ TRANSIT, including 17 years running the Hudson Bergen Line

TECHNICAL INNOVATION

- A proven cybersecure microgrid approach
- Leaders in climate adaptation and resiliency solutions to mitigate cyber and physical security risks
- A global technical practice network for renewable energy and sustainability

PROVEN LEADERSHIP AND MANAGEMENT PRACTICES

- A PM and task leaders with credentials that exceed the criteria
- Systematic project controls
- A proven risk management process from conceptual design through construction

DEPTH AND VALUE OF RESOURCES

- Unparalleled resources in the region
- Teaming partners chose for their expertise, added value and relationships
- Working relationships with the involved power, rail transit, and federal regulators/reviewers

AN ORGANIZATION STRUCTURED FOR SUCCESS

Our entire team shares a common vision: *our success is dependent on how well we collaborate, share lessons learned, and discuss concepts and issues early in the process when decisions have the greatest impact.*

Team members were chosen for their directly relevant experience and proven performance. They are proficient, easy to work with, and bring special talents. We will draw upon their depth of expertise, including team member synergies on previous projects to exceed expectations and deliver the project to NJ TRANSIT's expectations.

THE AECOM ADVANTAGE

AECOM was created to design, build, finance, and operate the world's infrastructure. Whether we serve clients at one phase of the project lifecycle or throughout it, our role is to apply creative vision, technical expertise, interdisciplinary insight, and local experience to address complex challenges in new and better ways. We help our clients deliver critical resources and services, improve the places where people live and work, and sustain a world in which we can all flourish.

AECOM is a premier, fully integrated professional and technical services firm whose global staff — including architects, engineers, designers, planners, scientists, and management and construction services professionals — serves clients in over 150 countries around the world. AECOM is ranked as the #1 engineering design firm by revenue in *Engineering News-Record* magazine's annual industry rankings, and has been recognized by *Fortune* magazine as a World's Most Admired Company. The firm is a leader in all of the key markets that it serves, including transportation, energy, facilities, environmental, oil and gas, water, high-rise buildings, and government. AECOM provides a blend of global reach, local knowledge, innovation, and technical excellence in delivering customized and creative solutions that meet the needs of clients' projects. A Fortune 500 firm, AECOM companies, including URS Corporation and Hunt Construction Group, had revenue of approximately $19 billion during the 12 months ended June 30, 2015.

AECOM will serve as prime consultant for the team, providing project management and controls, as well as leading various technical disciplines.

A Leader in Both Energy and Rail/Transit

AECOM's Energy Practice

In the United States and Canada, AECOM is a single and comprehensive source for planning and energy solutions for a new sustainable future. We offer expertise in planning, environmental and economics, energy efficiency and carbon management, hydropower and dams, thermal, geothermal and nuclear, wind and solar, and transmission and distribution.

AECOM is a leader in providing fully integrated design, engineering, procurement and construction services. We partner with public and non-profit facilities to replace their inefficient equipment, improve operating conditions and lower operating expenses. We provide a full array of services for electric power, liquefied natural gas, repowering, greenfield, cogeneration, waste-to-energy, micro-turbine and fuel cell projects.

Our support services span the entire life of a project, from planning and permitting, through engineering and design development, preparation of bid documents and specifications, procurement, testing and commissioning. Our network of talented professionals design and implement energy efficient projects that are timely, safe, economical and environmentally friendly.

With more than 100 years of experience and the strength of global resources, we provide our clients with the resources to develop innovative energy strategies, solutions and services, so they can focus on their core missions.

Microgrids

AECOM believes the future of the electrical power infrastructure is moving toward a constellation of microgrids, operating at different scales and with different missions, networked together and supported by a modernized transmission and distribution system.

Design. AECOM offers a team organized to provide functional integration and foster innovation for each aspect of design. Our deep bench of engineers forms an in-house team with the organizational integrity and processes to optimize the microgrid design solution.

Construction. Our team includes professionals from AECOM's energy services group, which has a reputation for delivering energy projects to government and private industry via many procurement methods. Our project management team is constituted to manage the risk inherent in a complex, unprecedented project such as this.



Optimization and Expandability. Our teammates offer an open-architecture, distributed-network solution to microgrid design that is more flexible and better suited to expansion than constrained, products-based approaches. Our strategy for optimization encompasses security (reliability, stability, power quality–in all operations modes), sustainability (GHG reduction), and economy (efficiency, conservation, market participation).

Interconnection and Stakeholders. AECOM recognizes that microgrids are a key enabler of the private and federal energy strategy. Leaders know that the success of their microgrid programs is dependent, in part, on support from their utility partners. Long-term interests will only benefit from properly engaging the utilities. To support this imperative, AECOM has built its team with professionals to address safety, interconnect and market participation, and military-utility precedents for microgrid advancement.

2021

Through the formation of this team of experts, AECOM's microgrid design solution will provide of flexibility to support the changing mission, and the ability to upgrade and scale the microgrid in the future.

AECOM's Rail/Transit Practice

AECOM is a leader in rail/transit program management, planning, design and construction. Ranked #1 in rail/transit among ENR's Top 100 Design Firms in 2015 and for the past 12 years. AECOM has a wealth of experience working on the regional rail infrastructure of the NY/NJ Metro area and the Northeast Corridor.





We have demonstrated our knowledge and expertise on numerous NJ TRANSIT projects, including the **Hudson-Bergen Light Rail** (at left), the Trans Hudson Express Tunnel, **the Frank R. Lautenberg Station at Secaucus** (above), and the Newark Subway, to name a few. Our work on the Northeast Corridor is extensive, including the FRA's Northeast Corridor (NEC) Passenger Rail Corridor Investment Plan, NY Penn Station Vision, Amtrak's Gateway Tunnel, and many other projects for Amtrak, the Port Authority, and the Metropolitan Transportation Authority (MTA).

2021

We have the experts that will make sure the selected solutions are properly, efficiently and safely integrated into this transportation network that is so critical to the region.

AECOM's Resources for the Project

The AECOM team brings a combination of the required expertise, the depth of resources and added value to achieve the challenging schedule for this project.

Required Personnel/Anticipated Workload

AECOM offers a team of industry leaders in the management, analysis, planning, design and delivery of power grids and energy systems for complex public infrastructure, most notably transit rail systems. The credentials and qualifications of our proposed staff are discussed in Section 3 of this proposal. An evaluation of our current project workload, taking into account resources involved with existing proposals and active projects, indicates that the designated key personnel, all full-time employees, will be available for this project. AECOM commits to providing additional personnel as needed to properly staff and support the NJ TRANSITGRID project. This allocation of staff resources will enable us to meet NJ TRANSIT's specified deadlines. The anticipated workload for the duration of this project of our key proposed staff is presented in the table on page 6.

In conjunction with our leadership team, our extensive local resources enable our team to deliver this project efficiently, on time and to NJ TRANSIT's satisfaction. The graphic below is a snapshot of our team's available resources that can be mobilized as needed.

Project Office

AECOM will co-locate key staff and maintain an office near the project area and NJ TRANSIT for the duration of the project. Our project manager and core management team will be reachable through that office during regular working hours. Moreover, we offer NJ TRANSIT the option of placing agency staff in AECOM's project office to enhance communications and collaboration.

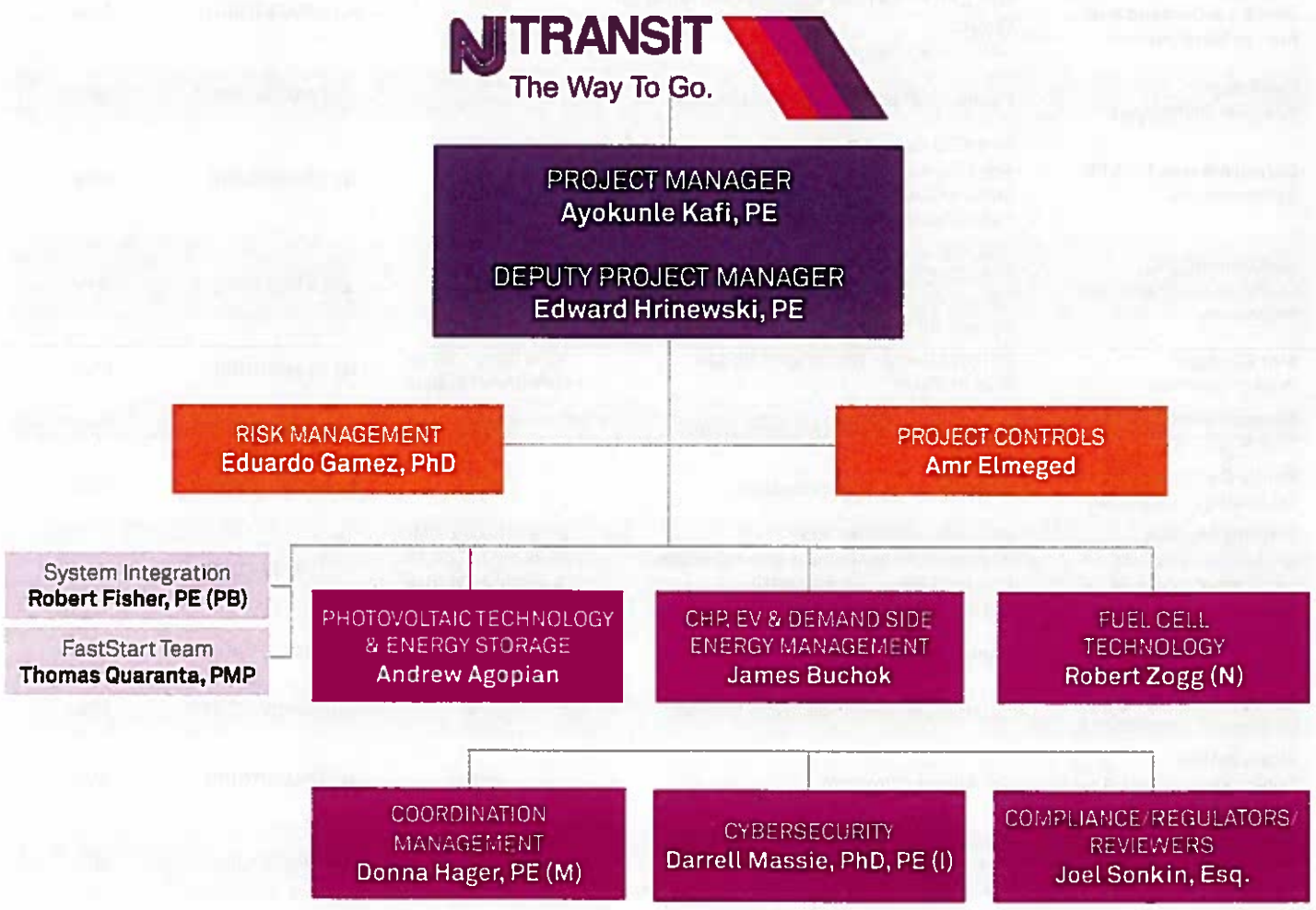
Combined team resources of **3,264** *in the NJ/NY metro area*

AECOM Team Staff by Discipline	NY/NJ	Firm-wide
BIM 3D/4D/5D Modelers	12	59
Civil Engineers	372	4268
Construction and Procurement Services	347	1794
Environmental and Permitting Services	312	2904
Geotechnical Engineers	66	410
Power and Energy Specialists	49	687
Project Managers	227	2023
Public Involvement Specialists	5	159
Quality Professionals	12	78
Risk Professionals	10	80
Safety and Security Specialists	23	211
Schedulers and Cost Estimators	139	641
Structural Engineers	213	1267
Surveyors/ROW/Property Acq. Specialists	15	138
Traction Power and Systems Engineers	140	422
Transportation Engineers	76	1281
Value Engineers	1	10
Others	1245	12384

A Dedicated Project Team

AECOM offers key personnel who have worked together to develop our organizatino, management approach and work plan. Our team is introduced further in Section 3, which provides biographies of our core leadership team members and resumes of our full management and production staff.

As requested by the RFP we have developed a table showing the current and projected workload of the key personnel in our core leadership team, which is shown in the following management organization diagram. The members of our team are strongly and personally committed to the success of this project. Our complete organization chart appears in Section 6.



AVAILABILITY OF KEY STAFF/ANTICIPATED WORKLOAD

Key Team Member/Role	Current Workload		Forecasted Workload	
	Projects	Commitment	Projects	Commitment to NJ TRANSIT
Ayokunle Kafi, PE Project Manager	Champlain Hudson Power Express Con Edison Phase 2 Reliability Program AECOM Miscellaneous	20% 10% 20%	NJ TRANSITGRID	100%
Edward Hrinewski, PE Deputy Project Manager	Atlanta Streetcar Project Closeout	100% through Sept 2015	NJ TRANSITGRID	100%
Donna Hager, PE Coordination management	Miscellaneous Project Support	10%	NJ TRANSITGRID	25%
Andrew Agopian PV Technology/Energy Storage	County of Ventura, Solar Projects Beaumont Unified School District Solar Project Confidential Projects	10% 15% 40%	NJ TRANSITGRID Confidential Projects	60% 40%
James Buchok CHP, EV & Demand Side Energy Management	Riker's Island CHP Close-out NYC DEP North River Cogen & Electrification Project National Grid Newtown Creek	5% 40% 40%	NJ TRANSITGRID	75%
Bob Zogg Fuel Cell Technology	Confidential project/confidential client	20%	NJ TRANSITGRID	50%
Darrell Massie, PhD, PE Cybersecurity	SPIDERS Camp Smith Army Research Lab Cooperative Agreement Vehicle Communication Module Fuel Efficient Forward Operating Base	10% 15% 5% 5%	NJ TRANSITGRID	45%
Joel Sonkin, Esq. Compliance/Regulators/ Reviewers	SIEDC BOA NYCEDC CAM GE/AECOM Various BD pursuits	25% 10% 15% 50%	NJ TRANSITGRID	50%
Amr Elmeged Project Controls	PANYNJ George Washington Bridge Riyadh Metro	90% (thru 1/2016) 10% (thru 12/2015)	NJ TRANSITGRID	60%
Eduardo Gamez, PhD Risk Management	Manage AECOM Risk Advisory group	50%	NJ TRANSITGRID	50%
Phillip Castellano, PE Technology Integration	Miscellaneous Project Support	10%	NJ TRANSITGRID	50%
Timothy McClive Analysis of Ancillary Services and Market Revenue Opportunities	New England Green RFP Virginia/Dominion Power Solar impacts PJM load forecasting analysis Assorted engagements	30% Jan-Mar 2016 10% thru 12/2015 15% thru 11/2015 35%	NJ TRANSITGRID	40%
Elizabeth Carter, System Safety and Security	Confidential Projects	50%	NJ TRANSITGRID	50%
Nicholas Tomizawa, AICP Concept of Operations	Capital Area Transit Authority BRT TVA	50%	NJ TRANSITGRID	50%
Adam Zellner Public Involvement/Agency Coordination	Confidential Projects	75%	NJ TRANSITGRID	25%
Ruby Siegel FTA Funding Reviews and Compliance	Federal Railroad Administration NEC FUTURE LIRR Network Strategy Study	50% 25%	NJ TRANSITGRID	20%
Michael Pacy, PE Coordination with Phase 1	Miscellaneous Project Support	10%	NJ TRANSITGRID	50%
Robert Fisher, PE System Integration	Amtrak NJHSRIP, Monmouth County Reinforcement, Minneapolis SWLRT	60%	NJ TRANSITGRID	100%

THE AECOM CONSULTING TEAM

The AECOM team consists of firms in fields required for the successful completion of the TRANSITGRID project. The following table summarizes key selection factors for each team member.

Firm	Role	Key Selection Factors
Intelligent Power & Energy Research Corporation (IPERC)	Cybersecurity	• Cybersecurity experts for microgrid installations • Developed microgrid control networks for DOD/DOE • Has adapted this technology for cities and industries
Navigant Consulting Inc.	Economic analysis; fuel cell/energy storage	• Energy technology engineers and analysts • Economic modeling for power grids • Specialists in business and market strategies
Climate Change Mitigation Technologies	Electric vehicles; photovoltaic/ energy solutions	• Renewable energy and microgrid development • Experts in wayside energy storage systems • Consulted for NJ TRANSIT and Amtrak
Parsons Brinckerhoff	CHP; systems integration	• Industry leaders in power generation and transit • Numerous successful partnerships with AECOM • Extensive NJ TRANSIT facilities experience
Greener by Design	Public involvement; stakeholder coordination	• At the forefront of intelligent microgrid projects • Public outreach for Hoboken's microgrid program • Energy Surety Design Methodology
The Chertoff Group	Security	• Founded by Michael Chertoff, former DHS Secretary • A global leader in security and risk management • Assists agencies in the review of critical infrastructure
A.G. Consulting Engineering	Mechanical, electrical, plumbing	• MEP firm specializing in rail/transit programs • Experts in traction power, security, telecommunications, lighting, ventilation
GTS Consultants	Surveying	• Surveying and mapping for NJ TRANSIT projects • Projects related to Hurricane Sandy recovery
ILC Dover	Resiliency and cybersecure regulations	• Resiliency specialists for federal, state and city clients • Experts in flood control systems for transit facilities
JCMS, Inc.	Cost estimating	• Cost and schedule specialty firm with projects completed up to $5 billion in construction value
Macan Deve	Coordination management, technology integration, document control	• Renewable technologies, greenhouse gas reduction • Microgrids, energy resilience and independence projects in association with AECOM
PMA Consultants	Scheduling, value engineering	• VE experts using 3D/4D BIM technology • Assessed risks for 150 projects in 20 countries
Radin Consulting	Environmental support	• VE experts using 3D/4D BIM technology • Has assessed risks for 150 projects in 20 countries
Robinson Aerial Surveys, Inc.	Aerial Surveys	• 20,000 surveying projects for governmental agencies • NJ TRANSIT, PANYNJ, NJTA, NJDOT projects

Key Teaming Partners that Bring Added Value

AECOM's subconsultants have worked with on directly relevant projects. They represent ***the most innovative talent in the emerging fields related to microgrids, power and transit rail technologies*** *as well as leading-edge project control systems.*

IPERC

Intelligent Power & Energy Research Corporation (IPERC) is a Service-Disabled Veteran-Owned Small Business (SDVOSB) specializing in providing cybersecure energy control solutions for microgrids. IPERC has extensive project history in the cybersecure microgrid space, particularly with the federal government and Department of Defense (DoD), most recently as the prime contractor and microgrid controls network designer for all three phases of the DoD/DoE SPIDERS (Smart Power Infrastructure Demonstration for Energy Reliability and Security). Through the SPIDERS program, IPERC has successfully installed and received type accreditation for, the first operational cybersecure microgrids within the DoD.

IPERC has transitioned this technology to the commercial, utility, and municipal markets for communities, transit systems, hospitals, and utility-scale microgrid projects. IPERC's vast experience with cybersecure controls technologies positions them as subject matter experts in assessing critical continuity of operations requirements for our customers, identifying critical loads, optimizing distributed energy resources, and implementing a cybersecure architecture for all microgrid installations. IPERC's cybersecure, collaborative intelligence software and compact field-tested hardware form a complete distributed controls solution that is inherently more robust, more adaptable, and more reliable than any alternative on the market. The IPERC team is comprised of experts in control systems, cybersecurity and essential microgrid elements, including generators, fuel cells, solar power, and energy storage.

As a member of the team, IPERC will work exclusively to ensure that the microgrid technology designed is both proven and cybersecure while considering innovative solutions.

NAVIGANT

Navigant Consulting, Inc. (Navigant) is a specialized independent consulting firm that assists clients in addressing the critical challenges of regulation, risk, business model change, and disputes. Navigant's energy professionals combine market insights and business strategy knowledge with exceptional energy operational experience to deliver technically and financially viable solutions. Navigant's staff has, on average, 15 years of experience and includes strategy and organizational change experts, technology experts, mechanical and electrical engineers, project managers, project developers, economists, regulatory strategists, and research analysts, each combining first-hand industry experience with consulting expertise. Many of its consultants have held staff or management positions in utilities, oil and gas companies, and other diversified energy companies. This enables Navigant to quickly assemble an interdisciplinary team capable of identifying strategic options and efficient solutions that will bring immediate and sustainable value to NJ TRANSIT.

Navigant's energy practice has extensive experience working on projects comparable to the NJ TRANSITGRID project, including the economic modeling and commercial arrangements for developing the project and integrating it into the grid. Navigant has a team of professionals experienced in safety and security analyses, including: threat and vulnerability analysis, failure modes and effects analysis, and software safety and security analysis.

Navigant will perform market assessments and economic analysis for the energy market, capacity market, and ancillary services market as appropriate, and will also lead the study of the fuel cell technology option for this program.

Climate Change Mitigation Technologies LLC (CCMT) is a renewable energy, energy efficiency, and microgrid project development company that operates exclusively in New York and New Jersey. The members of CCMT have been in the renewable energy, energy efficiency, and microgrid project development business for over a decade. CCMT has an expertise in battery storage systems, including wayside energy storage systems ("WESS") for rail transit systems. CCMT was a founding member of the New York State Battery and Energy Storage Technology Consortium (NY-BEST).

CCMT has consulted with senior staff of both NJ TRANSIT and Amtrak on the application of battery storage and other DG technologies for rail infrastructure resiliency and microgrid purposes. At Amtrak's request, CCMT evaluated battery storage and microgrid applications on the Keystone and Hell Gate lines and for construction of a new power injection point/ microgrid at the Sunnyside Yards in Woodside, NY.

CCMT will work with key technology vendors — Power Analytics Corporation, Advanced Solar Products LLC and Transpower — to evalute and provide solutions for energy storage and integration.

- **Transpower Inc.** – TransPower has been working on light, medium, and heavy duty on and off-road vehicles, subsystems and charging stations dating back to the 1990s. TransPower has experience in designing, developing, building and supporting hundreds of vehicles over the past 20 years. This includes electric, hybrid and fuel cell buses and trucks, ranging in gross vehicle weight ratings from 14,000 pounds to 80,000+ pounds and included various fuels such as electric, gasoline, diesel, CNG, LNG, propane and hydrogen. Dating back to those 1990s projects, TransPower's team has been working on every pre-standard AC and DC on and off-board charging systems, and worked with the Society of Automotive Engineers (SAE) and the Electric Power Research Institute (EPRI) to create the standards widely used today by all plug-in vehicles. TransPower is the first in North America to demonstrate heavy duty all-electric trucks for 80,000 pound class vehicles operating at or near the ports of California and Texas. TransPower's system architecture of using on-board, bi-directional chargers at up to 70 kW of power is driving the new standards of SAE's J3068 heavy duty vehicle development programs, as well as updates to the SAE J1772 light duty charge standards for AC and DC charging. TransPower is working with the University of Delaware, the National Renewable Energy Laboratories, and major utilities to test bi-directional, vehicle-to-grid capable trucks and buses using their on-board charger technology and upcoming grid interface standards such as OpenADR and SEP2.0b. TransPower was involved in the recently patented 500 kW overhead DC fast charging system used for dozens of transit buses throughout the U.S. TransPower has demonstrated a 1MW bi-directional grid tied energy storage system in partnership with the California Energy Commission and the Department of Energy's Sandia National Labs.
- **Power Analytics Corporation (PAC)** – With over 25 years' experience in the power industry, PAC provides software and services for electrical system planning and operations for energy intensive, mission-critical facilities and microgrids world-wide. PAC's software currently protects and manages more than $120 billion in customer assets. In a recent merger, PAC added substantial capability in telecommunications, analytics and financial settlements. Dr. Jose Vivas, PAC's Vice President of Power Engineering Services, has direct experience with the New Jersey power market. Dr. Vivas worked at PSE&G in New Jersey for ten years (1996-2006), managing interconnection studies and contingency analysis for PSE&G, and understands New Jersey's "critical hot spots" for transmission constraints, substation vulnerabilities, and locational marginal pricing.
- **Advanced Solar Products, Inc.** (ASP) – ASP has been a leading New Jersey company in solar energy and related sustainable technologies since its formation in 1991, which makes it one of the oldest and most trusted solar installers in the Northeast. ASP provides a turnkey service and has been involved with the installation of over 250 photovoltaic systems totaling over 55 MW for a wide variety of public entities and private clients throughout the Mid-Atlantic and New England, including one of the largest, privately-owned, net metered solar systems in the western hemisphere. ASP has a proven record of bringing large scale, complex solar energy projects to completion as the firm has installed 23.297 MW of photovoltaic systems for utilities, including New Jersey Resources (NJR) and PSE&G.

PARSONS BRINCKERHOFF

Parsons Brinckerhoff (PB) is experienced in types of power generation, including a wide range of fuels and plant types. PB has engineered over 75,000 MW of generating capacity on over 200 sites around the globe in the past 25 years. Over the past decade, PB's focus has moved with client needs such that experience in combined cycle plants has become one of the company's strongest assets. PB Power has delivered a large number of combined cycle, cogeneration, and simple cycle projects, in EPC or engineering roles from conceptual studies to EPC projects. PB's involvement encompasses all phases of projects, including development, financial analysis, evaluation, planning, engineering, design, construction support, performance testing and start-up.

PB's combined cycle experience includes the world's largest combined cycle plant at the time of commissioning, the 1,875 MW Teeside (UK) plant, the Los Angeles Department of Water and Power's 550 MW plants at the Haynes and Valley sites, and the first gas-fired CCGT project in the Philippines, the 1,000 MW Santa Rita Power Station in Batangas. PB has experience with a number of "new technology" CCGT plants, such as Taranaki (360 MW Alstom KA 26), Rocksavage (750 MW) and Seabank (755 MW Siemens SGT-400F).

PB will collaborate with AECOM in the evaluation and design of CHP solutions, as well as provide expertise in system integration based on its extensive NJ TRANSIT facilities experience.

Greener by Design

Greener by Design (GbD) is at the forefront of intelligent microgrid development, to provide power to vital facilities and critical infrastructure, and to protect public health and welfare. Its multidisciplinary team brings a comprehensive understanding of the economic and policy underpinnings of a rapidly changing environmental and energy landscape, and a fresh perspective on how technology, innovation, and policy will influence markets in years to come.

GbD is working extensively with the City of Hoboken and Sandia National Laboratories. Their design, developed following Superstorm Sandy, uses the Energy Surety Design Methodology to envision an extensive Microgrid solution to avoid the widespread devastation and power outages which resulted from the storm. The ability to control large numbers of nodes in a microgrid presents optimization and communications challenges for a city as complex as the City of Hoboken. GbD has been deeply involved in developing and executing strategies for the extensive outreach to, and coordination with, the myriad of public and private interests across the City, as well as with such other stakeholders as the NJ Board of Public Utilities, PSE&G, NJ TRANSIT, Amtrak, and County officials.

GbD will be responsible for public involvement and stakeholder coordination.

CHERTOFF GROUP

The Chertoff Group (TCG) is a specialized consulting firm established by former Secretary of Homeland Security Michael Chertoff in 2009. TCG provides clients with security advisory and risk management services that help them respond to myriad security and safety challenges. TCG includes individuals from the highest levels of government and industry in the U.S. and U.K., including former leaders from the Departments of Justice, Homeland Security and Defense; the National Security Agency; the Central Intelligence Agency; the White House; the New York City and New York State Offices of Emergency Management (OEM); and Scotland Yard. They have been involved in conducting security assessments, incident investigations and reviews for almost every critical infrastructure sector. Starting with the establishment of DHS, TCG personnel played crucial roles in the development of the coordinating counsels and information sharing organizations.

TCG will be responsible for system safety and security assessments.

Proven Specialty and DBE Subconsultants

*Rounding out our team is a group of specialty and Disadvantaged Business Enterprise (DBE) partners. **AECOM is committed to meet the minimum 19% DBE participation** in the NJ TRANSITGRID project.*

A.G. Consulting Engineering, P.C. Role: MEP. AG was founded in 1994 and specializes in the design of electrical and mechanical systems for new construction, as well as for existing facilities for renovation and rehabilitation. AG's services include power, lighting controls, plumbing, fire protection, air conditioning, heating and ventilation, telecommunication, security systems, utilities, cost estimating, and code compliance. AG specializes in the design of traction power systems for transit and recently completed (2014) the NYCT Cranberry Tube project, which has been awarded for construction, for which they designed a new substation and renovated many CBHs (Circuit Breaker Houses). AG is a NJ-certified DBE.

Role: Surveying. **GTS** provides surveying, mapping, and right-of-way support services for public infrastructure projects. GTS has provided survey, mapping and utilities for several NJ TRANSIT projects, including several related to recovery from Hurricane Sandy — County Yard survey, mapping, right of way for 5 miles of the NEC; MMC Yard survey, mapping, utilities for 190 acres of rail yard area; and Hoboken Yard mapping, survey, and utilities for 150 acres if rail yard area. GTS has also provided the survey control for mapping, as-build drainage, localized detailed topographic survey, and construction baseline and benchmarks for the Improvements to the Garden State Parkway Interchange 142/Route 1-78 as a subconsultant to the New Jersey Turnpike Authority. GTS is a NJ-certified DBE.

Role: Resiliency. **ILC** is a provider of engineered solutions designed to save space, withstand extreme conditions, and save lives as well as critical assets. ILC Dover is the only supplier of flood protection systems with the capabilities to test full scale systems to extreme water levels. ILC has been developing solutions for flood mitigation and other deployable barriers for infrastructure protection needs for many years. In the 1990s they designed and manufactured Stream-Saver™ inflatable pipe plugs to prevent accidental discharges from chemical plants, and Vapor Guard™ flexible covers for wastewater treatment facilities. They developed the Resilient Tunnel Plug for the Department of Homeland Security Science and Technology Directorate, Flex-Gate™ solutions for New York's MTA, as well as the Flex-Wall™ and Flex-Cover™ for multiple transit authorities.

Role: Cost Estimating. **JCMS, Inc.** has provided PM/CM, cost estimating, CPM scheduling, delay claim analysis, and web-based document control on a large number of infrastructure projects ranging in size from $1M to over $5B. JCMS is the only SBE/DBE firm that has provided cost estimating, scheduling and construction management services to NJ TRANSIT on many projects through Term Contract Assignments for over 18 years, 12 of them as a prime consultant. JCMS also provided services at PSE&G's Salem Nuclear Power Plant facility and developed a project control system to monitor all engineering and construction projects. JCMS is a NJ-certified DBE.

Role: Coordination Management, Technology Integration, Document Control. **Macan Deve Engineers, DPC (MDE)** delivers projects focused on renewable technologies, energy efficiency, green-house gas reduction, micro-grids, energy resiliency and energy independence. MDE offers a broad range of professional technical services as well as project and construction management services (PMCM). The technical services provided have saved clients millions of dollars on their annual energy bills and are tailored to create more resilient infrastructure for energy independence. MDE staff have worked with AECOM on several energy efficiency projects including the design and construction of a 13.5MW Cogeneration Plant for NYC Department of Corrections (NYCDOC) at Rikers Island. MDE staff has also managed several energy efficiency programs with AECOM for the NYC

Housing Authority (NYCHA), which total close to 100M in Design and Construction cost. MDE is a NJ-certified DBE.

PMA Consultants

Role: Scheduling, Value Engineering.

PMA Consultants, LLC is a nationally recognized program, project, and construction management consulting firm founded in 1971 with origins in the transportation and power industries. The firm has provided consulting services on projects involving rail, subways, transmission/distribution, electricity/steam, and nuclear and fossil fuel (natural gas, coal, and oil) power plants for more than 40 years. The firm's professionals have provided scheduling, value engineering (VE), risk management, and 3D/4D BIM services to the Port Authority of New York and New Jersey, MTA Capital Construction, PSE&G Con Edison, BP, ExxonMobil, and Amoco.

PMA's services include schedule development, cost and schedule integration, schedule monitoring and reviews, and preparing monthly progress and schedule analysis reports. PMA has conducted qualitative and quantitative risk assessments on more than 150 projects in more than 20 countries, ranging from under $10 million to over $1 billion. PMA's project managers have also been involved in the implementation of Oracle Primavera Unifier for large transportation clients. Clients have also benefitted from PMA's 4D BIM modeling.

Radin Consulting, Inc.

Role: Environmental Support.

RCI provides planning and engineering services to the transportation market. Since its inception in 1998, RCI manages transportation projects that involve facilitation to meet federal and state regulatory requirements and strategizing and streamlining opportunities to expedite project funding. For more than a decade, RCI has helped to manage and review capital projects for NJ TRANSIT and New York City's MTA. RCI's NEPA EIS experience includes numerous projects for NJ TRANSIT, including Access to the Region's Core, Portal Bridge Rehabilitation/Replacement, and Newark-Elizabeth Rail Link.RCI is currently involved in the preparation of a NEPA Environmental Assessment for the Lehigh Line Third Track Enhancement Project. In 2012, RCI was selected to prepare a NEPA Categorical Exclusion document for Amtrak's High-Speed Rail Project on the Northeast Corridor, extending from New Brunswick to Trenton, NJ.

Role: Aerial Surveys.

Robinson Aerial Surveys, Inc. has worked on over 20,000 projects for state, county and government agencies, major engineering firms, and private developers. The firm performs all facets of land surveying and specializes in construction lay-out and geotechnical instrumentation monitoring. Robinson currently employs three certified photogrammetrists, a licensed land surveyor, two CADD and one LIDAR specialists, among others. Robinson has worked on projects for NJ TRANSIT, the Port Authority of New York and New Jersey, NJDOT, NJ Highway Authority, NJ Turnpike Authority, NYC MTA, LIRR, and counties, including Hudson, Bergen, Morris, Warren, Essex, Passaic, Sussex, Middlesex and Monmouth.



AECOM has established relationships with all of these firms and anticipates a collaborative, productive working environment that will facilitate the delivery of a successful project.

RELEVANT PROJECT EXPERIENCE

The NJ TRANSITGRID project is unique as it requires broad experience across multiple technologies and disciplines with many stakeholders and facilities. ***The AECOM team brings leading expertise and directly related project experience*** *in every aspect of performance required to deliver this project successfully.*

The following brief sketches provide a snapshot of recent projects our team has completed and demonstrate our experience in each element of critical technology.

Combined Heat and Power

RIKER'S ISLAND COGENERATION FACILITY

2015 AECOM



Working with the New York Power Authority, designed and constructed a 5MW natural gas plant, a 15 kV medium voltage electrical distribution system, a control room and a new microgrid controls system, while revamping the existing island 26.5 kV feeder systems and loads. Also includes the installation of two modular 7.5 MW gas turbine generators that will provide the prime source of electrical and thermal energy to the island.

Electric Vehicles

COMMUNITY READINESS AND PLANNING FOR ELECTRIC VEHICLES AND CHARGING INFRASTRUCTURE

2013 AECOM



Developed a plan for electric vehicles in Columbus, Cleveland, and along I-71, integrating Ohio's current EV activities and produced a replicable, ready-to-implement plan for plug-in vehicles and charging infrastructure.

Photo Voltaic (PV)

PSE&G SOLAR 4 ALL PROGRAM

2015 AECOM



The program consisted of two segments—distributed pole-mounted solar and centralized solar— each 40 MW in size, connected to the PSE&G distribution system, doubling New Jersey's solar capacity.

Battery Storage

ADVANCED SOLAR PRODUCTS PV/BATTERY HYBRID PROJECTS

2015 CCMT



Constructed a 400 kW PV/battery hybrid system for Franklin Township School, Hunterdon County, NJ, providing battery backup for selected emergency circuits, while also participating in the PJM frequency regulation market.

Fuel Cell

NASA AMES RESEARCH CENTER

2014 AECOM



This design-build project was performed through a Utility Energy Services contract (UESC), in partnership with Pacific Gas & Electric (PG&E). Along with upgrades and expansion of energy management and efficiency controls, the project included a rooftop PV system and a bio-gas fuel cell.

Cybersecurity

CYBERSECURE SMART MICROGRID MANAGEMENT SYSTEMS (SPIDERS III)

2015 IPERC



The final of three phases, the microgrid utilizes two existing government-furnished 1 MW generators and two new 750 kW generators, plus two 250 kW battery devices called Integrated Storage and Inverter Modules (ISIMs).

Resiliency

NJ TRANSIT HURRICANE RESPONSE STRATEGY DEVELOPMENT

2014 **AECOM**



Developed protective measures to protect rail operations, light rail, and bus facilities, designed to shelter over 700 rail vehicles and protect assets from storm damage at various e Hoboken Terminal, and the Oradell Bus Garage.

Security

PORT AUTHORITY OF NEW YORK AND NEW JERSEY SECURITY ASSESSMENT

2013 **The Chertoff Group**

A review of the PANYNJ's public safety and security procedures including an executive-level security prioritization plan based on its assessment; with recommendations for improvement which were adopted.

Hardening

CON EDISON STORM HARDENING

2014 **AECOM**



Prepared conceptual design reports to develop storm hardening measures at six generating stations and five substations to provide long-term protection from flooding to allow certain generating stations and substations to remain operable prior to, during, and after a Superstorm Sandy type event.

Rail/Transit Systems

HUDSON-BERGEN LIGHT RAIL TRANSIT SYSTEM (HBLR)

Ongoing **AECOM (legacy URS)**



An AECOM-led special purpose company designed, built and currently operates and maintains HBLR, an 18.5-mile alignment with 24 stations serving one of the more densely populated areas in North America.

Regulatory Compliance

GENERATION ASSET VALUATIONS AND DISPATCH FORECAST

2014 **Navigant**

Provided independent consultant market assessments of 15 generation assets for Topaz Power Management, LP., (including plants in northern and central New Jersey); developed 20-year forecasts of energy, capacity and ancillary service power markets and prices as applicable.

Funding

HUDSON COUNTY ENERGY PLANNING AND FUNDING ACTIVITIES

Ongoing **Greener By Design**



Reviewing energy efficiency and renewable energy plans and projects relative to sustainability objectives and funding sources, and prepared an application to the US EPA's Climate Showcase Communities Grant program.



A Wealth of Successful Relevant Experience

*At the end of this section, include descriptions of past performances of our team that demonstrate the **extent and depth of our team's experience and qualifications** to perform the required services.*

Project	Page
CHP/EV	
Rikers Island Cogeneration Facility	18
Lahey Clinic CHP Plant	19
New York Presbyterian Hospital	20
City College of New York Central Plant Upgrade	21
LIVEWIRE Program – Power, Self Generation, and Cooling System Service Provider	22
Northport Medical Center (VAMC)	22
VA Medical Centers in Georgia	23
High Sierra Cogeneration Plant	24
Wayside Energy Storage System for MTA-NYCT Power Traction Substation, 53rd Street and Sixth Avenue	25
TransPower Transportation Products & Services	25
Community Readiness and Planning for Electric Vehicles and Charging Infrastructure	26
PV/Battery Storage	
California State University, Fullerton 1.16MW Rooftop/Canopy PV System	27
LADWP Pine Tree Solar Solar PV Project	28
PSE&G Solar 4 All Program	28
CSU San Bernardino Energy Efficiency and Infrastructure Upgrade	29
WMATA Solar Development Potential	30
Austin, TX Solar PV System	30
Advanced Solar Products PV/Battery Hybrid Projects	31
Fuel Cell	
ConnDOT Bus Maintenance Facilities Fuel Cell Feasibility Study	32
Ames Research Center	33
Fuel Cell Installation at Austin Energy Medical Clinic	33
SRP/ASU East Fuel Cell Project	34
Community-Based Distributed Generation, Heating, and Cooling Using SOFC	34

Project	Page
Cybersecurity	
Integrated Smart Power Infrastructure Demonstration for Energy Reliability and Security (SPIDERS I)	35
Fort Carson SPIDERS II	35
Cybersecure Smart Microgrid Management System (SPIDERS III)	36
Information Assurance (IA) and Information System Security Engineering (ISSE) Support for the Army Central Meter Program	36
Resiliency/Security/Hardening	
PANYNJ Security Assessment	37
Bloomberg LP Security Advisory Services	37
MetLife Security Advisory Services	37
MTA Capital Security Program Design and Construction Services	37
Rehabilitation of South Ferry Terminal Complex	38
Super Bowl 48 – Temporary Emergency Power System	38
Long Slip Canal Fill	38
Superstorm Sandy Recovery Program	39
Flood Mitigation – 8 Station Project, CM1410	39
Con Edison Storm Hardening	39
Rail/Transit Systems	
Hudson-Bergen Light Rail Transit System (HBLR)	40
THE Trans Hudson Express Tunnel (ARC)	40
Amtrak Gateway Program	41
PATH Multiple Tasks	41
PATH WTC Transportation Hub	41
Regulatory/Funding Compliance	
Reliability Standards Compliance	42
NERC/NPCC Standards Compliance Services	42
Generation Asset Valuations and Dispatch Forecast	42
Hudson County Energy Planning and Funding Activities	43
Maher Terminals Energy Retrofit	43

Relevant Project Experience

Combined Heat and Power

Rikers Island Cogeneration Facility
Owner: New York Power Authority

The New York City Department of Corrections (NYCDOC) retained the services of NYPA/**AECOM** to evaluate building a reliable, energy-efficient cogeneration facility on Rikers Island. The Rikers Island project includes a Natural Gas Power Plant of over 5 MW, 15 kV medium voltage electrical distribution system, and a controls room as well as controls experience including integration of controls with an existing ICS, and implementation of a new **microgrid** controls system. AECOM completed this project as both the prime contractor and lead design/engineering firm under two separate contracts. The electrical **microgrid** scope consisted of revamping the existing island 26.5 kV feeder systems and loads. Utility grade feeder isolation devices were installed and the entire system complies with all utility required mandates. The project also includes the installation of two modular 7.5 MW gas turbine generators that will provide the prime source of electrical and thermal energy to the island, while maintaining a synchronized connection to the utility grid so that the utility can pick up 100% of the island's electrical load.

The combined cycle efficiency of this plant is significantly higher than the individual efficiencies of the existing energy sources currently serving the island. The operation of this plant also produced a significant reduction in CO2 and NOx emissions to the environment. The project integrates **microgrid** controls with diverse energy generation sources, such as intermittent renewable energy with diesel and natural gas generators. In addition to the true "island" mode of operation, the plant operates in parallel with the utility and can produce approximately 16.5 MW during cold weather. Island loads range from 12 to 24 MW seasonally. When island loads are less than the rated output of the turbines, individual substation loads (11 in total) are wirelessly transmitted to the CHP control room import/export controller and turbine output(s) are reduced accordingly. At no time is power exported to the utility.





RELEVANCE TO NJ TRANSITGRID:

- Microgrid design and controls
- Combined heat and power
- Gas-powered
- Planning and scoping
- Alternatives analysis
- Design and construction

Combined Heat and Power

Lahey Clinic CHP Plant

Owner: Lahey Clinic, Burlington, MA

AECOM and PB teamed with Bond Brothers to design, procure and construct a new, three-megawatt combined heat and power (CHP) plant at Lahey Clinic, a seven-story, 317-bed hospital and medical center in Burlington, Massachusetts. This cogeneration project was executed using proceeds from tax-exempt bonds issued by MassDevelopment — Massachusetts' finance and development agency — and an Energy Efficiency incentive Grant through Mass Save, a utility-led energy savings program. The goal of the project is to reduce operating expense and enhance facility reliability during day-to-day operations and during critical emergency periods. The 4,600-square-foot plant, which is contained in a new building adjacent to the existing boiler plant, is now being commissioned. It will supply electrical power and heat to Lahey's medical facility.

The new CHP system has been designed and installed to meet NStar's — Lahey's local utility company — interconnection standards and requirements and operate in parallel with either of the electrical power systems' (EPS) dual feeders, or in an isolated "island Mode" to provide standby power in an emergency. During island Mode operation, the CHP will be coordinated with Lahey's existing emergency generation system to provide Lahey with virtually all its power requirements during an EPS outage. The new CHP system will also supply a considerable portion of the hospital's energy throughout the year by providing both steam and heating hot water.



The AECOM team's scope included the sourcing, selection, and procurement of the CHP system; the design engineering to install, piping and wiring of the systems, equipment; and the startup, commissioning and testing of the system. For this project, AECOM recommended unique solutions that recognize and incorporate the physical alignment to existing boilers; site conditions, including topography and buried services; preservation of site aesthetics; configuration of existing electrical service; coordination with existing emergency power generation; delivery of hot water thermal energy; and the opportunity to cost effectively receive fuel gas from the local gas supply system.

Initial challenges included identifying and connecting with the building systems to utilize hot water heat, revamping existing utility feeders to interconnect with and protect generators and feeders, and routing the exhaust system several hundred feet to discharge above the roof from the basement.

RELEVANCE TO NJ TRANSITGRID:

- Combined heat and power
- Planning and scoping
- Feasibility studies
- Alternatives analysis
- Design and construction

Combined Heat and Power

New York Presbyterian Hospital

Owner: New York Presbyterian Hospital, NY, NY

The New York Presbyterian Hospital (NYPH) is a premier, private, not-for-profit Health Care Provider located primarily on two campuses in New York. **AECOM** was selected to perform a project development investment grade audit, and construction and project management to provide a new cogeneration plant at the hospital. The cogeneration project is located on York Avenue, between 68th Street and 72nd street.

The campus has a central boiler plant that generates steam all year round. It has a stable base load of electricity and steam, and as such was a perfect candidate for a CHP installation to cut energy costs. The cogneration project provides up to 7.5 MW/hr of electric power and a significant portion of the hospitals base steam requirement.

The construction of the cogeneration project consists of the following equipment: combustion turbine package, duct burner, heat recovery steam generator, gas compressor skid, medium voltage switchgear. Along with miscellaneous pumps, fabrication and installation of cooling water piping, boiler feedwater piping, gas piping, a new Gas Meter room, electrical gear and all electrical and mechanical appurtenances and hookups. Dunnage steel and housekeeping pads were installed to support the new equipment.

The client gave the contractor one year from the date of the NTP for substantial completion of this project. Ninety percent of all the work occurred in the Dynamo Room with the rest occurring on the roof and sub-basement. The Dynamo Room is within the existing central plant facility. Heat recovery steam generator (HRSG) was also installed to recovers heat from the turbine, used to run building heating system and steam absorption chillers.





RELEVANCE TO NJ TRANSITGRID:

- Combined heat and power
- Project development investment grade audit
- Construction and project management
- Commissioning savings guarantee

Combined Heat and Power

City College of New York Central Plant Upgrade

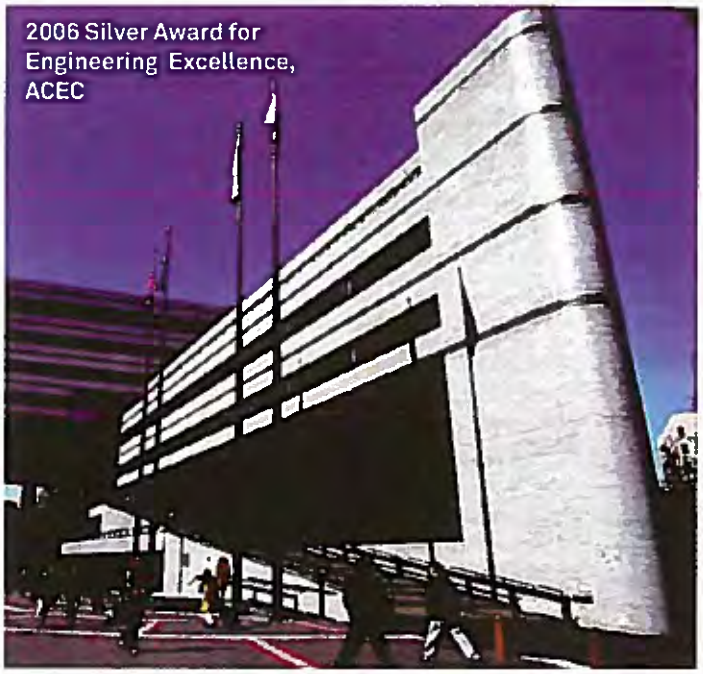
Client: Dormitory Authority, State of New York

The rapid growth of the City College campus combined with its unique urban setting resulted in a central plant far behind its required capacity. Facing budget cuts, while requiring new campus buildings to meet their academic mission and compete for bright students, the administration was hard-pressed to find the capital to upgrade the central plant to the level that was required.

Through a unique energy performance contract between DASNY and **AECOM**, CCNY was able to secure funding for their project while expediting the implementation of the upgrades. Under the contract, AECOM served as the implementation contractor, working with DASNY, CUNY and CCNY to develop the design, and acting as the general contractor for the project's execution. The result is that the campus infrastructure needs have been met, and the construction was completed on time and within budget, for one of the largest central plants ever built in New York City.

The first component of the CCNY program involved determining improvements for the central chiller and boiler plant for the campus. AECOM installed a new 10,000 ton capacity hybrid chiller plant consisting of two 2000 ton each steam turbines and two 2000 ton each electric centrifugal chillers, one of which was equipped with parallel VFD drive, rated 1000 ton. The chilled water distribution to the campus was designed as primary and secondary systems, allowing variable control of the flow based on the buildings chilled water demand. The pumping system for chilled water and condenser water was equipped with VFD motors for control and balancing of the system. The boiler plant received one 50,000 lb/h and 20,000lb/h high pressure boilers. The project also included installation of the new BMS system that provides monitoring of the chilled water distribution to satellite campus buildings and control/monitoring of the central chiller and boiler plant. This BMS system is utilizing an existing campus-wide ethernet connection. Overall, this project provided the installation of state-of-the-art high efficiency equipment and systems.

The second component of the CCNY project focused on energy efficiency upgrades at Steinman Hall. The assessment identified energy efficiency improvement opportunities and measures that would resolve outstanding HVAC problems that have plagued the building for many years. The project identified eight energy conservation measures: 1. Air Handling





Units, 2. Fan Coil Units, 3. VAV Terminal Boxes, 4. Radiation System, 5. Modular Chiller Bypass and Airedale Units, 6. Fume Hoods Controls and Exhaust Fans, 7. Building Control System, 8. Window Seal and Shading.

RELEVANCE TO NJ TRANSITGRID:

- ASHRAE Level II Energy Audit
- Planning and scoping
- detailed A/E design
- feasibility studies
- equipment procurement
- budget and schedule control

Combined Heat and Power

LIVEWIRE Program – Power, Self Generation, and Cooling System Service Provider

Owner: Maryland Procurement Office

AECOM is providing services to support and assist the Government in the development, management and execution of LIVEWIRE—the program to restore and modernize an intelligence community (IC) agency's electrical and mechanical infrastructure. Facilities under this agency's auspice worldwide possess an enormous electric power and mechanical infrastructure which, because of its vital role supporting our national security, require the most skilled maintenance and minimized exposure to local hazards. Power outages (local and remote) would adversely impact the agency's mission. The intelligence community agency's objective for LIVEWIRE is, ultimately, a flexible power system, and microgrid to meet power demand, achieve required availability under changing mission requirements and self-sufficient from dependence on emergency power generation.

The scope of our services and support includes program management, studies and architectural/engineering design services, systems engineering, risk management, strategic planning, master planning, reliability and availability analysis, and construction implementation services at intelligence community agency locations worldwide. These functions are performed and managed by AECOM. Some of them are in collaboration with specialty subcontractors that include small businesses.

RELEVANCE TO NJ TRANSITGRID:

- Microgrid
- Risk management
- Reliability analysis
- Planning and scoping
- Design
- Systems engineering

Northport Medical Center (VAMC)

Client: Department of Veteran Affairs



AECOM conducted a study and is performing the design for a new CHP Plant to augment steam generation and reduce energy consumption and cost for the Northport Medical Center (VAMC) in Northport, NY. The project includes steam recovery to the campus boiler plant and power generation to peak shave electrical demand from PSE&G.

Based on a completed VA Feasibility Study for adding a CHP to the Northport campus, the VA has requested one 800kW to 1000kW natural gas fueled CHP system be investigated for installation at the existing boiler plant. AECOM has analyzed two CHP technology options for installation at the plant. The two options include a Reciprocating engine natural gas CHP with exhaust steam and jacket heat recovery and a natural gas microturbine with steam heat recovery.

The two technology options have been proposed in two installation configurations; Installed within a building addition to the north side of the existing boiler plant and in a pre-packaged outdoor pad mounted configuration. An addition was selected in lieu of an independent building, in order to take advantage of the existing boiler plant spaces to satisfy the programmatic requirements of the VA design guidelines for boiler plants.

AECOM's services include CHP technology review, CHP design, campus controls and monitoring design, life cycle cost analysis, environmental permitting research, site grading and utility relocation, steam and condensate connections, HRSG design, protective relaying modifications, and arc flash analysis.

RELEVANCE TO NJ TRANSITGRID:

- CHP planning and design
- Feasibility studies
- Permitting
- Life cycle cost analysis

Combined Heat and Power

VA Medical Centers in Georgia

Client: Department of Veteran Affairs

AECOM was selected to design three CHP and new steam generation plants at VA Medical Center in Augusta, Dublin and Atlanta, Georgia. AECOM provided all space programs, conceptual design, schematic design, design development, construction documents, interconnection agreement support, construction administration services, technical specifications, and cost estimates for this project.

AECOM studied electrical power, natural gas, chilled water, steam, heating hot water, and domestic hot water demand on campus to develop trending charts which were used to examine energy balances for combined heating and power concepts. AECOM modeled scenarios that include different technologies in order to optimize equipment selection and operation to match annual trends and maximize heat recovery. Cost estimates and life cycle cost analyses were employed to test variable solutions.



Charlie Norwood VA Medical Center in Augusta – The new plant will include one 1,155 kW megawatt (MW) reciprocating generator set, and the associated distribution and heat recovery equipment. Waste heat will be used to generate 120 tons of chilled water and heating hot water. The size of the absorption chiller was determined based on the site load profiles. The design solutions optimize the central plant operations and reduce electrical energy consumption by base loading the abortion chiller during peak cooling seasons. The project includes the replacement two 36-year old 600HP boilers with five 250 HP boilers. Overall CHP plant is designed to operate at an overall efficiency of 78%. Construction Documents are complete and the contract is in the award stage now.



Carl Vinson VA Medical Center in Dublin – new 846 kW CHP Plant and new steam generation plant. The VA will be able to significantly reducing the overall carbon footprint as related to source power and realize an annual savings of over $450k in operating costs. Overall CHP plant is designed to operate at an overall efficiency of 80%. The project design and implementation was closely coordinated with the utility companies and carefully planned and presented to minimize interruptions to this fully occupied critical care healthcare facility. Construction documents were completed in May, 2015. Construction is slated to be completed by December, 2016.



Atlanta VA Medical Center (VAMC) in Decatur – a four-story CHP Plant building to house three 2.6 megawatt (MW) generator sets, and associated switch gear, air emission control equipment, HVAC systems and heat recovery boilers. Waste heat from the CHP plant will be used to generate 7,000 lb/hr. to 14,000 lb/hr. of 110 psig steam throughout the year. The CHP plant is designed to provide 100% of the electrical power needed for the hospital. Design is complete and construction will be completed in 2016.

RELEVANCE TO NJ TRANSITGRID:

- CHP planning and design
- Feasibility studies
- Life cycle cost analyses
- Coordination with utilities

Combined Heat and Power

High Sierra Cogeneration Plant

Client: Plumas-Sierra Rural Electric Cooperative

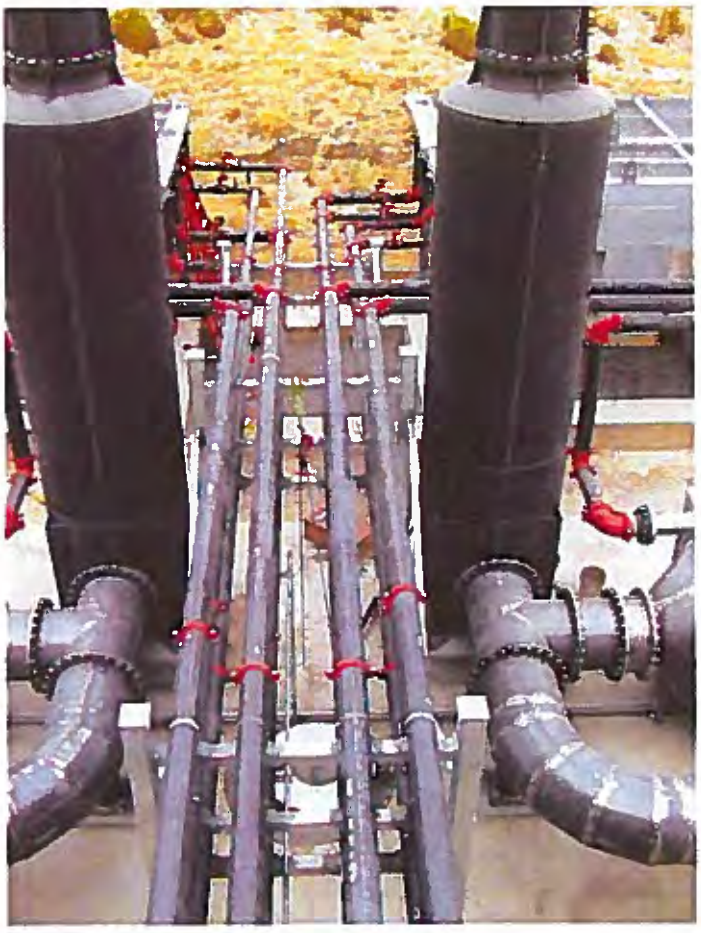
PB Power, in conjunction with EMCOR Energy Services, was responsible for the design, procurement, and construction of a new 6.0 MW combined heat and power plant (CHP). This project provides electrical power to support the distribution system of the Plumas Sierra Rural Electrical Cooperative (PSREC), and provides hot water for heating to the California Correctional Center (CCC) and High Desert Prison (HDP).

The electrical capacity of the cogeneration plant, at design conditions, is 6.0 MW at 4160 volts. The generators also provide kW and voltage support to the grid, operating over the range of 0.9 power factor (PF) lagging to 0.9 PF leading. Thermal energy from each engine generators is recovered in the form of high temperature hot water (HTHW) and transferred into a closed loop heating system to distribute the heat, up to 20.4 MMBtu/hr, to the CCC and HDP.

Heat to the CCC and HDP is individually measured, in the CHP, as hot water goes from and returns to the CHP facility. At the design conditions, the overall gross system efficiency when operating at full load in the CHP mode is approximately 84.9%, a combination of electric efficiency of 41.7% (nominal 8185 BTU/kW-hr LHV basis (not a guaranteed value)) and thermal efficiency of 43.2%. The net efficiency after parasitic loads and thermal losses is approximately 82.8%.

The electric generation is accomplished via two gas-fired engine generator sets located within a concrete masonry building. The cogeneration plant is sited on the CCC campus with access being provided from the site boundary. The site plan is laid out such that the building can be expanded to accommodate a third and fourth engine generator system. The thermal distribution system is designed to deliver the thermal output of the two engine generator sets to either the CCC or HDP.

The project design is based upon the installation of two Jenbacher JMS 620 gas-fired engine generator sets with on-skid heat recovery from the engine. The power produced is fed into a 5 kV switchgear system that is complete with necessary generator breakers, auxiliary breakers, main breaker, relaying controls and SCADA.



The plant is designed to normally operate parallel with the Plumas-Sierra's distribution system, to which it is connected through a new switchyard to be built by the Owner, which includes a new step up transformer. The plant is able to operate either one or both engines in "island" mode.

RELEVANCE TO NJ TRANSITGRID:

- CHP planning and design
- Permitting
- Procurement
- Construction

Electric Vehicles/Energy Storage

Wayside Energy Storage System for MTA-NYCT Power Traction Substation, 53rd Street and Sixth Avenue

Client: MTA New York City Transit





The **Transpower Inc./Climate Change Mitigation Technologies LLC** team was responsible for manufacture, delivery, and installation of a 1 MW/733 kwh lithium ion battery used to capture regenerative braking power of subway cars and then release stored energy to accelerating trains at nearby stations, resulting in 10% - 20% elimination of baseload power consumption. Other benefits include correction for voltage sag and voltage instability.

Construction and Commissioning: Construction is underway, and delivery will be in the fall of 2015, after testing at NY-BEST Rochester, NY battery testing laboratory.

Safety: Climate controlled cabinets are used. Safety is in accordance with New York City Department of Buildings, International Building Code, and manufacturer specifications.

Operational Success: Similar battery and inverter technology was successfully deployed in numerous heavy-duty Class 8 full battery electric off-road yard tractors and on-road 18 wheeler tractors at Ports of Los Angeles and Long Beach. Transpower 1 MW battery was successfully tested at Sandia National Laboratories, 2014 - 2015.

RELEVANCE TO NJ TRANSITGRID:

- Metro area transit facilities
- Battery energy storage
- Design, installation, commissioning

TransPower Transportation Products & Services

Since its establishment in 2010, TransPower has established itself as a market leader in adapting battery-electric technologies to large vehicles, and is on its way to demonstrating similar success in the stationary energy storage market.

TransPower offers the ElecTruck™ system, an industry-leading high power electric drive system developed for locally-driven, short-duty-cycle trucks and buses garaged each night (or day) at the same location. A variant of the ElecTruck™ system is custom designed for each individual truck or bus model, then installed into the vehicle either at TransPower's integration facility or the vehicle manufacturer's own factory.

Electric drive motors are used to propel these vehicles, with all of their energy obtained from onboard batteries. This completely eliminates the need for internal combustion engines or fuel. Such vehicles are simpler and more reliable than conventional internal combustion engine or hybrid vehicles.

TransPower's ElecTruck™ Energy Storage Subsystems (ESS) employ many technological advances to safely accommodate the large quantities of batteries required for large electric vehicles. Each ESS is custom-designed for its intended vehicle application, utilizing battery cells and packaging concepts tailored to vehicle operating needs and space constraints. Methods used to protect, monitor, and maintain batteries are among the most advanced in the industry.





Other vehicles that can be equipped with TransPower's ElecTruck™ components include construction vehicles, mining vehicles, oil well drilling equipment, rail car movers, trams, and airport tow tractors.

RELEVANCE TO NJ TRANSITGRID:

- Available, proven technology
- Fuel and maintenance cost saings

Electric Vehicles

Community Readiness and Planning for Electric Vehicles and Charging Infrastructure

Client: Clean Fuels Ohio

AECOM has been engaged by Clean Fuels Ohio, a statewide non-profit organization, to develop an implementation plan for electric vehicles in Columbus, Cleveland, and along the I-71 corridor. The project is designed to seamlessly integrate all of Ohio's current EV readiness activities and stakeholders and produce a replicable, ready-to-implement deployment plan for plug-in electric vehicles, charging infrastructure, safety trainings, consumer education, marketing, and associated policy solutions, including zoning, code, permitting, inspection, and other incentives.

As the project lead, AECOM was also tasked with integrating information from more than 20 project partners, including local utilities, educational and research institutions, local units of government, state agencies, and metropolitan planning councils. Concurrent with the technical analysis of demand, implementation best practices and team coordination were needed to support the development of an effective marketing program.

As part of the team effort, AECOM developed long-term forecasts for EV demand upon which to base the need for EV infrastructure. The effort required the analysis of demographic, economic, and socioeconomic patterns across a broad region. It focused on the following key items:

- Potential early adopter populations, the geographic locations, concentration, and behavior characteristics to determine where best to locate early infrastructure to support their acceptance and adoption of the technology.
- Assessment of the economic incentives, barriers and conditions needed for EV adoption to move from the Early Adopters to general consumer usage and support.
- Demand characteristics for specific zoning and land use types in order to better understand the impact of EV adoption on local governments, employers, retail, and utilities.
- The economic and fiscal impacts of EV adoption and infrastructure implementation was examined to determine the potential impact upon various levels of government, individuals, and interested stakeholders in EV development such as local industries and utilities.



- Specific opportunities and challenges posed by EV adoption related to utilities, the electrical grid, and the deployment of new technologies to improve environmental sustainability, grid resilience, and infrastructure demands caused by EVs was examined.

To provide Clean Fuels Ohio and the stakeholder organizations with a clear path for supporting the adoption of electric vehicles, AECOM developed a comprehensive understanding of best practices, policies, codes, and case studies of EV supporting communities. The final goal of this process was to develop a set of templates for municipalities, regional and state organizations, as well as private sector stakeholders interested in supporting EV deployment.

RELEVANCE TO NJ TRANSITGRID:

- Electric vehicle implementation
- Best practices
- Stakeholder coordination
- Infrastructure planning

Photovoltaic Technology & Energy Storage

California State University, Fullerton 1.16MW Rooftop/Canopy PV System

Client: California State University, Fullerton



AECOM was selected to perform the design-build implementation of an energy efficiency and infrastructure upgrade allowing for campus growth while reducing energy consumption and providing for renewable energy. Included in this program was the design and installation of a 1.16 Megawatt photovoltaic (PV) system divided equally on two rooftops and an elevated parking structure.

The AECOM team conducted detailed facilities surveys and made recommendations for the installation of solar photovoltaic arrays on the Performing Arts (PA) building, Kinesiology, Health, and Science (KHS) building, and the newly constructed Parking Structure 4 (PS4). The two rooftop PV systems were designed and built utilizing a ballasted solution with minimal attachment to overcome wind loading and seismic conditions.

AECOM designed and integrated a seamless T framed solar canopy providing much needed covered parking on the top deck. The entire structure, including the canopy, uses high efficiency LED lighting. The campus will receive approximately $2.3 million in utility performance based incentives over the next five years based on actual energy production from the PV system.

In addition, AECOM incorporated numerous green technologies such as energy efficient lighting, water conservation measures, and installation of a 4.5MW combined heat and power cogeneration facility. CO2 demand ventilation controls in conjunction with VFD's were included yielding substantial electrical, cooling, and heating savings.

The PV system is owned and operated by the University facilities maintenance group.

RELEVANCE TO NJ TRANSITGRID:

- Design-build of PV system
- Site and condition assessment;
- Conceptual, preliminary, and final design
- Complete procurement, construction/ installation of solar PV arrays
- Start-up, testing and commissioning

Photovoltaic Technology & Energy Storage

LADWP Pine Tree Solar Solar PV Project

Client: Los Angeles Department of Water and Power (LADWP)

On May 22, 2015, the LADWP started up a new utility-built solar PV array located within the utility's Pine Tree Wind Farm on the Tehachapi Mountains. With help from **AECOM**, the new array will generate 8.5-megawatt (MWac) of power to help power the City of Los Angeles. Using 35,160 ground-mounted Suntech solar modules, 7,405 steel posts, and 17 inverters converting DC to AC power and is expected to produce an average of 18-gigawatt hours of energy per year over the next 25 years. The project is helping the LADWP reach its state mandate of having 33 percent of their power from renewable energy sources by 2020.

AECOM began work on the LADWP Pine Tree Solar Project in late 2010, and the site offered several challenges, including constructing the project on land that was not flat terrain and is sloping in different directions — mass grading of the site was not an option. The design team came up with a creative solution to efficiently fit all of solar PV array by using multiple tilt angles to avoid shading of the panels upon themselves and still produce the maximum amount of power necessary. During construction, AECOM also provided a resident field engineer on-site which greatly facilitated LADWP's labor force in constructing the project.

The project involved 'in filling' an existing LADWP-owned wind farm with the new 9.75-MWdc solar PV project. This is often talked about in the industry since PV produces power during the day, and typically wind turbines produce more power at night, so they are very compatible technologies. This rarely comes to fruition; however, this is one of those great examples of a model of a sustainable future.

RELEVANCE TO NJ TRANSITGRID:

- PV planning and design
- Innovative, sustainable solutions
- Construction monitoring

PSE&G Solar 4 All Program



The PSE&G "Solar 4 All" program consisted of two segments— distributed pole-mounted solar and centralized solar— each 40 MW in size, for a total capacity of 80 MW connected to the PSE&G distribution system. **AECOM** (legacy URS) served as the program manager for this project, which doubled New Jersey's solar capacity and created many new "green" jobs.

Program management activities included assisting with preparation of RFPs and bid evaluations of EPC contractors, detailing engineering specifications, addressing system monitoring, metering, and reporting requirements for Renewable energy credits, evaluating and selecting construction sites, reviewing engineering packages, and providing construction management. In order to meet the funding requirements of the federal stimulus program, strict reporting controls on spending and physical progress were implemented throughout the project duration.

The first program segment included the installation of 40 MW of individual solar PV units on 200,000 PSE&G utility poles in New Jersey's six largest cities and 300 rural and suburban communities. The solar PV units range in size from 200 to 240 watts and are connected directly into PSE&G's electric distribution system. The individual units each contain a digital cellular communications package to continuously transmit availability and energy production data to PSE&G's central control facility. The project is currently the world's largest pole-attached solar installation.

The program's second segment included an additional 40 MW of centralized solar generation plants at various sites throughout New Jersey. This segment involved projects of 500 kilowatts to 4.5MW per site. AECOM monitored the adequacy of the technical design and construction activities, and inspected and certified compliance of all installations with national electric code requirements on behalf of PSE&G.

RELEVANCE TO NJ TRANSITGRID:

- PV project management
- Federal stimulus program controls
- Technical design/construction oversight
- Compliance monitoring

Photovoltaic Technology & Energy Storage

CSU San Bernardino Energy Efficiency and Infrastructure Upgrade

Client: California State University

With three new buildings — the Science Building, the Student Union Addition, and the College of Education — in various phases of design or construction, California State University San Bernardino (CSUSB) was faced with the challenge of meeting additional cooling needs with their existing central chiller plant and limited capital funds.

As a qualified energy services company (ESCO), **AECOM** was selected by CSUSB to execute an energy performance contract which included auditing, development, life cycle costing, design-build implementation, and verification of guaranteed savings for energy efficiency and infrastructure upgrade projects. The $13.8 million project delivers needed equipment and systems upgrades to allow for continued campus growth while allowing the campus to deliver on the state's aggressive energy reduction goals.

AECOM completed the Investment Grade Assessment (IGA) for this campus and signed a design-build contract for the implementation of the project. The project includes the expansion of the existing central chiller plant to include two new 1200-ton efficient electric centrifugal chillers, a new 1-million-gallon thermal energy storage (TES) tank, new cooling towers and required ancillary equipment. In conjunction with the physical plant staff, AECOM revised the plant sequence of operations for system optimization of the existing chiller plant in conjunction with the planned expansion. For instance, the chillers are set up in series, rather than in parallel as the existing chillers are, increasing the overall energy efficiency of the system because now only one chiller is producing water at low temperatures.

This project also includes the addition of 350kW of solar photovoltaic panels to generate electricity. Energy efficient lighting and water conservation measures were also included within the scope of this project. Lastly, the project includes the installation of an irrigation well, which eliminated the use of city water to irrigate soccer fields and as makeup water to the central plant cooling towers.

Under this turnkey energy savings performance contract, AECOM was responsible for engineering, procurement, start-up and commissioning of the equipment. Once commissioned, AECOM demonstrated that the equipment



performs as calculated during the IGA through execution of our measurement and verification (M&V) plan. This project reduces the campus's annual energy costs by over $500,000. In addition, the campus received approximately $1.1 million in incentives to complete this work.

Recommended Energy Conservation Measures

- New chillers set up in series rather than in parallel which increases the overall energy efficiency of the system as only one chiller is producing water at low temperatures
- Solar photovoltaic energy
- Energy efficient lighting
- Water conservation measures

The PV system is owned and operated by a third party under a Power Purchase Agreement (PPA), so all Operations and Maintenance (O & M) is handled by a the owner under a separate agreement.

Awards

- 2010 Merit Award for Engineering Excellence, ACEC, California
- 2009 Energy Project of the Year - National Award, Association of Energy Engineers (AEE)
- Innovative and Effective Practices Award, American Public Power Association (APPA)
- 2007 Award for Excellence, Association of Physical Plant Administrators (APPA)

RELEVANCE TO NJ TRANSITGRID:

- Design-build of CHP and PV system
- Site and condition assessment;
- Conceptual, preliminary, and final design
- Complete procurement, construction/ installation
- Start-up, testing and commissioning

Photovoltaic Technology & Energy Storage

WMATA Solar Development Potential

Client: Washington Metropolitan Area Transit Authority

AECOM used Geographic Information Systems (GIS) data provided by WMATA to evaluate multiple photovoltaic (PV) solutions on Metro's usable assets. The PV system design effort focused on providing the right solution using proven technology and available real estate. The design of a PV system in a given envelope of space requires industry experience and in-depth knowledge in order to minimize shading, maximize energy production, and simplify construction. AECOM's PV design specialists analyzed Metro's rooftops, parking lots, parking structures, train yards, and open spaces to estimate potential power that would achieve a balance of maximized energy production while avoiding existing conditions. Existing rooftop mechanical equipment, trees, surrounding buildings and structures, and potential for damage from vehicular traffic in staff/bus parking areas were considered and avoided based on standard practice and guidance from WMATA.

WMATA provided multiple GIS data files of their more than 350 assets that were sorted and organized into a master list of potential PV sites. Using satellite imagery each GIS area was evaluated for potential photovoltaic use and organized into categories. The categories for PV potential are Rooftops, which includes buildings and existing shade structures, ground mount for open spaces and areas, parking lots and parking structure roofs using canopy structures, service and inspection yard rail coverings, and rail covering using a canopy type structure. Each application uses a calculation of either a typical racking system or canopy configuration, with a standard format photovoltaic module and a method of estimation that represents typical installed PV system sizing.

AECOM provided a technical analysis of the potential for PV at WMATA assets, including definition, typologies, and technical solar development potential, as well as cost, potential installed kilowatts of power for the given area, and potential GHG Savings.

RELEVANCE TO NJ TRANSITGRID:

- PV studies for rail system assets
- Technical analysis
- Cost benefit analysis

Austin, TX Solar PV System

Client: Austin Energy



Under a three-year solar design contract, **AECOM** (legacy URS) was selected to provide professional solar engineering and consulting services to Austin Energy on a task order basis. AECOM services performed include site assessments, technology evaluations, feasibility studies, performance modeling, full service engineering, detailed design, procurement consultation, bid package development, and construction oversight.

Since the commencement of the City's Solar PV System Design Program, AECOM has performed work on task orders for roof and ground mount solar PV projects ranging from 50kW to 1MW. Solar PV technologies including thin-film, crystalline silicon, and CPV technologies have been evaluated by AECOM on behalf of Austin Energy on a project-by-project basis.

RELEVANCE TO NJ TRANSITGRID:

- Technology evaluation
- Planning assessment
- Permitting support
- Detailed design
- Construction oversight,
- System commissioning/acceptance testing

Photovoltaic Technology & Energy Storage

Advanced Solar Products PV/Battery Hybrid Projects

CCMT subconsultant **ASP** has extensive experience engineering and constructing large scale hybrid photovoltaic systems which use batteries to support "smart" inverter operation and is a leader in the movement to provide such renewable energy storage systems for public facilities that suffer power outages due to storms and natural disasters.



Bayonne Midtown School – In 2008, **ASP** partnered with SMA America, LLC to achieve the first automated integration of a commercial PV system and inverter with a backup generator to provide emergency power at Midtown Community School in Bayonne, NJ. Bayonne Midtown School is a Bayonne town emergency shelter. ASP's PV-emergency power system functioned as designed after Superstorm Sandy, extending the generator's fuel stores through the first days of the aftermath when diesel deliveries were difficult, and supporting the use of the school's gym to shelter approximately 75 people.



WP Properties – In 2012-2013 **ASP**, partnering with Solar Grid Storage, Inc. ("SGS"), designed and constructed a 500 KW PV/battery hybrid project for WP Properties in Hackettstown and Denville, NJ (divided into two 250 KW systems serving two buildings). The primary purpose of these systems was to allow participation in the PJM frequency regulation market providing the owner of the system with significant financial benefits. These systems were also constructed with the capability to add emergency power.



Franklin Township School – In April of 2015, **ASP**, partnering with SGS, completed construction of a 400 kW PV/battery hybrid system for Franklin Township School, Hunterdon County, NJ. This is the first school building in the state which will provide battery backup for selected emergency circuits, while also participating in the PJM frequency regulation market.

PSE&G's Solar-4-All Grid Security Pilot Program – **ASP** has been awarded two PV/battery hybrid projects under PSE&G's Solar-4-All Grid Security Pilot Program. The first project is a 658.44 kW PV canopy and a 223.82 kW rooftop PV/battery hybrid system which is currently being installed at the Hopewell Township Central High School in Hopewell Township, Mercer County, NJ. Construction of these systems is expected to be completed by the end of 2015. The second project is a 912 kW ground mounted PV/battery hybrid system that will be installed at the Borough of Caldwell Sewage Treatment Facility located in West Caldwell, NJ. These systems will provide power directly to the PSE&G grid under normal operating conditions, but during a power outage, both systems will isolate from the grid and provide emergency power to selected emergency circuits.

RELEVANCE TO NJ TRANSITGRID:

- PV/battery storage
- Design and installation
- PJM integration

Fuel Cell Technology

ConnDOT Bus Maintenance Facilities Fuel Cell Feasibility Study

Client: Connecticut Department of Transportation (ConnDOT)

In its continuing efforts to enhance public transportation and positively contribute to Connecticut's green initiatives, ConnDOT retained **AECOM** to review the feasibility of and provide a conceptual design for integrating fuel cell technology into existing HVAC and electrical systems at three bus maintenance facilities, operated by CT Transit, in the towns of Hartford, New Haven, and Stamford.

AECOM visited and surveyed the Stamford, Hartford, and New Haven divisions of the CTTransit bus system in order to gather technical information and understand how the facilities are operated. The information gathered helped assess the facilities potential to handle the fuel cell footprint, including architectural and structural modifications, as well as, to understand buildings' mechanical, electrical, and various utility requirements. Each of the facilities provided detailed information on their monthly electrical load capacities, consumption and total cost for fuel and electricity.

The feasibility report provided information and recommendation on the type and size of fuel cell best suited for installation at each of the facilities and identifies the most appropriate locations within the facilities to cost effectively install the fuel cells. Site specific design schematics were developed and included within the report.

This feasibility study yielded several conclusions which led CT Transit and ConnDOT to again employ the technical expertise of AECOM for the production of Performance Specifications for an RFP, which went out to bid to a select group of design-build firms, who used the basis of design developed by AECOM to develop proposals for implementation of fuel cell plants at the Hartford and New Haven bus maintenance facilities. These plants will each consist of a single UTC PureCell 400 Fuel Cell Plant, which will consume utility-supplied natural gas in an electro-chemical reaction resulting in the generation of electricity and thermal energy. The electricity will be used by existing on-site electric loads, while the thermal energy will be harnessed through existing HVAC equipment.



With the single, 400kW fuel cell plant operating throughout the year, these two facilities will realize greatly reduced annual energy consumption levels from a renewable, zero-emissions technology.

Recommended Measures:

- Installation of a single UTC model PureCell 400 Fuel Cell Plant
- Integration of fuel cell plant with existing hydronic heating systems
- Operation of the fuel cell plant in "grid connect" mode, allowing it to provide electricity only when facility loads are less than or equal to the fuel cell plant's output.
- Implementation of a long-term service agreement, allowing CT Transit to receive the benefits of the installation with little to no increase in existing maintenance activities

RELEVANCE TO NJ TRANSITGRID:

- Fuel cell plants for transit facilities
- Feasibility study and conceptual design
- Design-build procurement

Fuel Cell Technology

Ames Research Center

Client: US National Aeronautics and Space Administration (NASA)

AECOM, in partnership with Pacific Gas & Electric (PG&E), provided upgrades to lighting, heating and cooling systems; as well as upgrades and expansion of energy management and efficiency controls and systems at NASA Ames Research Center (NARC). This comprehensive design-build project was performed through a Utility Energy Services contract (UESC).

NARC receives electricity at a very low cost — typically less than $0.06/kWh — through an agreement with the Western Area Power Administration (WAPA). While this power agreement has significantly reduced NARC's utility costs, it has also created a challenging environment for NARC to develop financially viable energy projects that are necessary for NARC to meet federally mandated energy efficiency goals. To help NARC with the dilemma, the team provided:

- Facility-wide indoor lighting upgrades including fluorescent and LED technologies
- Facility-wide outdoor lighting upgrades
- Facility-wide hot water boiler upgrades
- Replacement and upgrade of inefficient chillers with high-efficiency, longer life water-cooled chillers
- Conversion of steam heating systems to HHW systems
- Facility-wide, water conservation upgrades including bathroom equipment, kitchen equipment and cooling tower systems
- Facility-wide retro- commissioning and Energy Management and Control System (EMCS) upgrades
- Rooftop PV system at new building N232
- Expansion and upgrade of the EMCS for improved control and visibility of energy consuming and mission critical systems across the facility
- Installation of a bio-gas, fuel cell

RELEVANCE TO NJ TRANSITGRID:

- Energy management
- Technology assessment, including fuel cell and PV systems
- Coordination with utilities
- Design-build delivery

Fuel Cell Installation at Austin Energy Medical Clinic

Client: Austin Texas Medical Clinic



The project goal was to install a 200 kW natural gas fueled packaged fuel cell to provide electrical energy and heated water (for sterilization) at an Austin, Texas Medical Clinic.

AECOM provided design, construction and construction management (EPC) services for installation of standard IFC fuel cell package in an outdoor location adjacent to the clinic.

- Design and construction scope includes:
- Modification of existing parking lot and landscaping
- Site preparation and fencing of area
- Foundations for fuel cell and fin-fan (water-to-air closed loop) cooling module
- Underground utility piping between gas meter and fuel cell, and water main and fuel cell
- Interconnecting piping between fuel cell and fin-fan cooling module
- High temperature heated water piping between fuel cell and client autoclaves
- Medium temperature heated water piping between fuel cell and client domestic hot water system
- Electrical and controls wiring and cabling
- Installation, testing and commissioning of all equipment

AECOM was engaged as a subcontractor to International Fuel Cells, Inc. to provide interface engineering, design, construction management and construction (EPC) services.

RELEVANCE TO NJ TRANSITGRID:

- Fuel cell technology
- Design and installation
- Start-up, testing and commissioning

Fuel Cell Technology

SRP/ASU East Fuel Cell Project

Client: Arizona State University (ASU)

Salt River Project (SRP) executed an agreement with ASU, stating that SRP would develop a Feasibility Study for a combined heat and power fuel cell project at the ASU East Campus SRP retained **AECOM** to conduct the Study as the result of a competitive procurement.

The Study was guided by four goals:

- Support SRP's "Renewable/Sustainable Portfolio" Program;
- Demonstrate "State-of-the Art" Fuel Cell Technology at ASU East;
- Develop & Demonstrate Combined Heat, Cooling, & Power (CHCP) Cogeneration Opportunities; and
- Develop information for Bid Packages.

Project Concept. A high temperature fuel cell power plant would supply electricity to the SRP gird. Fuel cell operations would result in exhaust gases principally formed of water vapor and carbon dioxide (CO2). The operating fuel cell also would be used to produce a heat medium. The exhaust gas could be used to produce hot water or steam, or the exhaust gas itself could be used as the heat medium. The heat medium would be transported to an absorption chiller, which would be capable of providing on demand chilled or hot water to the renovated NCO Building's heating, ventilating, and air conditioning (HVAC) system. Alternatively, the heat medium could be transported to a heat exchanger. Water circulating through the heat exchanger from the swimming pool would be heated and returned to the swimming pool.

Study Approach. The project was conceived and designed as an initial effort to provide SRP and ASU with a conceptual engineering assessment suitable for determining project feasibility. Alternative CHCP Fuel Cell Systems were identified for evaluation. Conceptual engineering then was conducted to develop flow process diagrams for each system to support assessment of system characteristics and performance. Conceptual engineering and alternatives analysis served to support selection of a preferred fuel cell system.

RELEVANCE TO NJ TRANSITGRID:

- Fuel cell technology
- Feasibility study and conceptual design
- Alternatives analysis

Community-Based Distributed Generation, Heating, and Cooling Using SOFC

Client: U.S. Department of Energy, National Energy Technology Laboratory

Staff now employed at **Navigant** led the conceptual design and assessment of a community-based distributed-generation (DG) system using a solid-oxide fuel cell (SOFC). The community, a Southpointe development near Pittsburgh, PA, consists of a variety of industrial, commercial, and residential end users. The conceptual design/assessment included:

- Evaluation of simple-cycle and hybrid (SOFC and turbine) plants
- Hourly performance modeling based on detailed load profiles and various utility rate structures
- Two system architectures—one using a large, central generation plant and the other using several generation plants distributed within the community
- For each system architecture, evaluation of distribution systems to utilize waste heat to serve building heating and cooling loads (utilizing absorption cooling systems for cooling).

The results showed that:

- A SOFC DG system can reduce community energy use by 35% to 45%
- Adding distributed heating can reduce community natural-gas consumption for heating loads by 40% to 45%
- Adding distributed cooling can improve the reduction in community peak electric demand associated with the DG system.

RELEVANCE TO NJ TRANSITGRID:

- Distributed generation using fuel cell
- Conceptual design and assessment

Cybersecurity

Integrated Smart Power Infrastructure Demonstration for Energy Reliability and Security (SPIDERS I)

Owner: U.S. NAVFAC



The SPIDERS Joint Capabilities Technology Demonstration (JCTD) Phase I effort was the first of three phases—all of which feature **IPERC** control systems—demonstrating a cyber secure microgrid architecture with integration of smart grid technologies, distributed and renewable generation on military installations for enhanced mission assurance. Phase I, conducted at Joint Base Pearl Harbor Hickam (JBPHH), Hawaii, was a design-build project and was verified through a successful operational demonstration in December 2012, followed by an approved operational utility assessment in January 2013. Demonstrations included microgrid black start capabilities, optimum generator dispatch, and optimal renewable resource integration. IPERC was responsible for the design, development and implementation of the controls system for the SPIDERS microgrid. IPERC served as a member of the design, simulation modeling, construction commissioning, operator training, and testing teams. IPERC's power control management system successfully executed a 72-hour demonstration, with results including a 30% fuel reduction while in microgrid mode and the grid's two diesel generators could independently island or operate in parallel with N+1 redundancy.

RELEVANCE TO NJ TRANSITGRID:

- Microgrid controls
- Cybersecurity
- Smart grid technologies
- Design and construction
- System commissioning and testing

Fort Carson SPIDERS II

Owner: U.S. NORTHCOM



The SPIDERS JCTD Phase II was a design-build project. The Fort Carson, CO microgrid incorporated seven buildings with prioritized loads, three generators (3.5 MVA), 1 MW solar array, three distribution feeders, and five bi-directionally charging electric vehicles. For the operational demonstration, all microgrid resources were brought online. During demonstration one of the generators was unexpectedly unavailable due to a mechanical failure. The **IPERC** control system dynamically recognized this issue and automatically reconfigured the grid for power. This issue illuminated the need for the control system to mark equipment as unavailable. This change was made within the software and graphical user interface, providing information to the operator and preventing future issues. IPERC provided the detailed design, commissioning, testing, training, monitoring, and reporting of the microgrid control system. IPERC performed cybersecurity and risk management of each component and layer in the microgrid communications architecture. The control system provided an advanced technology designed to operate in conjunction with the existing aging infrastructure. IPERC's power control management system successfully executed a 72-hour demonstration. Cybersecurity was verified with a high level of DOD compliance, and withstanding a subsequent Red Team attack on a similar configuration, as well as controller cybersecurity testing.

RELEVANCE TO NJ TRANSITGRID:

- Microgrid controls
- Cybersecurity
- Smart grid technologies
- Design and construction
- System commissioning and testing

Cybersecurity

Cybersecure Smart Microgrid Management System (SPIDERS III)

Owner: U.S. NAVFAC



SPIDERS Phase III was the final of three phases. The microgrid utilizes two existing government-furnished 1 MW generators and two new 750 kW generators, plus two 250 kW battery devices called Integrated Storage and Inverter Modules (ISIMs). **IPERC** provided the detailed design, construction, system commissioning, testing, training, monitoring, and reporting of the microgrid control system. Building on the knowledge gathered from Phases I and II, updates were made to the GridMaster system. The IPERC GridMaster control system operates the electrical infrastructure at Camp Smith (Cortlandt, NY) to optimize generation and consumption of power at 11.5 kV. IPERC led the effort on cybersecurity and risk management of each component and layer within the microgrid communications architecture. The system was vetted through third-party Red Team Attacks conducted prior to installation. The microgrid control system has been granted an Authority to Operate based on cybersecurity accreditation processes. System commissioning and testing is underway as of May 2015, with final demonstration to be completed in summer 2015.

RELEVANCE TO NJ TRANSITGRID:

- Microgrid controls
- Cybersecurity
- Smart grid technologies
- Design and construction
- Risk management
- System commissioning and testing

Information Assurance (IA) and Information System Security Engineering (ISSE) Support for the Army Central Meter Program

Owner: U.S. Army Corps of Engineers

The IA and ISSE contract exists to provide support to the U.S. Army Corps of Engineers for industrial control system components deployed in support of the Army Central Metering program (AMP). This includes system security validation, systems analysis and system risk assessment of the Enterprise Energy Data Reporting System (EEDRS). Additionally, **AECOM** performs information system security engineering tasks to assist in the integration of EEDRS components into the overall unified Utility Monitoring Control System (UMCS) across Army and Army National Guard systems around the world. AECOM has performed SEVs (Security Engineering Visits) primarily for Army Reserve and National Guard sites. This requires us to validate site-specific EEDRS installations and configurations by performing physical and cybersecurity risk assessments. AECOM coordinated the design, test, integration, and implementation of specific program requirements. Our team serves as subject matter experts in Optical, Terrestrial and IP engineering disciplines and delivers recommended changes to policies, procedures, designs, and technologies that f oster continuous enhancement of enterprise capabilities.

RELEVANCE TO NJ TRANSITGRID:

- Systems analysis
- System security validation
- Risk assessments
- Information system security

Resiliency/Security/Hardening

PANYNJ Security Assessment

Owner: Port Authority of New York and New Jersey

The PANYNJ retained TCG to conduct a review of the PANYNJ's public safety and security procedures. **The Chertoff Group (TCG)** provided an executive-level security prioritization plan based on its assessment, and offered concrete recommendations for improvement, which were adopted by the PANYN

Bloomberg LP Security Advisory Services

Owner: Bloomberg LP

TCG was retained to provide security advisory services and risk analysis with respect to the potential vulnerabilities on and in the vicinity of the client's building complexes, its satellite offices in a number of sensitive international locations, as well as its data centers in the United States, and provided strategic advice and risk analysis regarding terrorist threats and other hazards for the corporation's critical facilities. TCG performed a physical site assessment and a comprehensive threat and risk assessment (TARA) of the facilities in question, including evaluations of each site's vulnerabilities.

MetLife Security Advisory Services

Owner: MetLife

TCG was retained to provide strategic risk management advisory services as well as tactical security design criteria for new facilities under construction in the U.S. southeast region. TCG designed a comprehensive security program for each facility, integrating people, process and technology. It also provided direct support for the design and construction of a world-class security operations center.

RELEVANCE TO NJ TRANSITGRID:

- Threat and risk assessment
- Physical security

MTA Capital Security Program Design and Construction Services

Owner: Metropolitan Transportation Authority

AECOM (legacy URS) is providing A/E services on an on-call basis for the design of security solutions for MTA assets and infrastructure under contracts CM-1279, CM-1287 and CM-1535. Assignments have addressed subways, commuter rail, bridges, tunnels, stations/terminals, maintenance facilities, and administrative buildings.



AECOM's services have included tasks similar to those required under RFP 15125, including Policies and Controls, Vulnerability Assessment of ICS/SCADA Network, Vulnerability Assessment of Major ICS/SCADA Facilities and Assets, and End-of-Life Systems .

Specific task orders include:

- Feasibility Study for Floodgates at Underwater Tunnels
- Consequence Management in Underwater Tunnels
- Design of access control and intrusion detection system for all communication rooms at 468 NYCT train stations
- Design of electronic security system for Roosevelt Avenue/74th Street, Chambers Street and Lexington Avenue/51st Street subway stations

RELEVANCE TO NJ TRANSITGRID:

- Metro region rail/transit facilities
- Threat and risk assessment
- Physical security

Resiliency/Security/Hardening

Rehabilitation of South Ferry Terminal Complex

Owner: MTA New York City Transit

NYC Transit implemented an ambitious rehabilitation and resiliency program at South Ferry Terminal to address the devastating effects of Superstorm Sandy.





AECOM managed the post Hurricane Sandy rehabilitation of the terminal. The goal was to restore South Ferry to pre-hurricane performance and strengthen it against future events. AECOM coordinated the interdisciplinary rehabilitation work effort, which includes instrumentation and control, fire protection, elevators and escalators; station areas; station HVAC equipment; plumbing and sewage ejector systems; and equipment including all power cable. Work also included signal, track and traction power coordination work in the station and tunnel with the signal contractor.

RELEVANCE TO NJ TRANSITGRID:

- Resiliency
- Program management
- Multidiscipline coordination

Super Bowl 48 – Temporary Emergency Power System

Owner: NJ TRANSIT

A.G. Consulting (AG) evaluated the existing electrical systems configuration and sizing at both Secaucus Junction station and Henderson Street substation in Hoboken Yard to identify the rating of proposed supplemental generators that were necessary to maintain continuous and unimpeded operations in the event of a local or regional power outage during Super Bowl 48. Tasks included field investigation of existing conditions. AG reviewed past utility records for power usage, identified any additional loads to be imposed by increased operations related to the Super Bowl, and developed projected loads for the Super Bowl weekend. These investigations and surveys provided the data to enable NJ TRANSIT to identify the ratings and operating characteristics of emergency power generation equipment.

RELEVANCE TO NJ TRANSITGRID:

- NJ TRANSIT project
- Electrical system assessment

Long Slip Canal Fill

Owner: NJ TRANSIT

Superstorm Sandy caused significant damage to NJ TRANSIT facilities in Hoboken. NJ TRANSIT engaged **AECOM** to assist with a re-evaluation of the previous canal fill design, enhancements to improve future resiliency, and technical support associated with the FTA grant application process to support project development. We are currently assisting NJ TRANSIT with alternatives analysis, project development and stakeholder coordination, preliminary civil design, geotechnical engineering, access and utility design, constructability assessment, preliminary cost estimating, and coordination of future rail systems and operational enhancements.

RELEVANCE TO NJ TRANSITGRID:

- Alternatives evaluation
- Conceptual design
- Engineering
- Resiliency
- Cost estimating
- Stakeholder coordination

Resiliency/Security/Hardening

Superstorm Sandy Recovery Program

Owner: NJ TRANSIT



As part of the program management team, **JCMS** provided programmatic support necessary to implement, track and report on the projects to ensure they meet NJ TRANSIT's operating requirements, as well as all federal and State regulations and guidance. JCMS also developed the master and baseline schedules in P6 along with independent cost estimates. All projects are funded by FEMA/FTA and the program includes over 11 separate projects.

RELEVANCE TO NJ TRANSITGRID:

- Project controls
- Federal compliance
- Scheduling
- Cost estimating

Flood Mitigation – 8 Station Project, CM1410

Owner: MTA New York City Transit

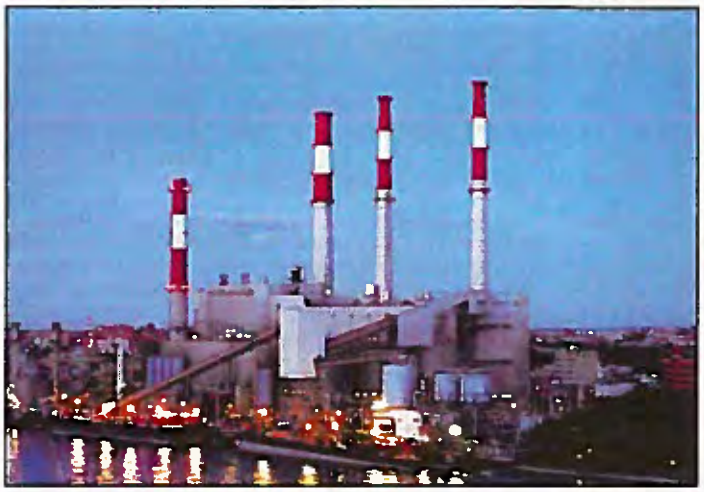
ILC Dover, as a subconsultant, completed the development and installation of a flood mitigation cover for a stand-alone, single stairwell entrance on the Canal Street Subway line. The system is a horizontal fabric door that is stowed in a small container and deployed like a window-shade to seal an entrance from significant water pressure. It is a self-contained system that resides at the point of use, and requires no special tools or training to operate. The system is manually deployed, protects against flooding from Category 2 Hurricanes plus slosh, can be deployed in 30 knot winds, actuated in under 10 minutes once the direction to close the system is issued, and is scalable to protect larger openings and higher water levels.

RELEVANCE TO NJ TRANSITGRID:

- Resiliency solutions

Con Edison Storm Hardening

Owner: Consolidated Edison Company of New York, Inc.



The purpose of this project was to prepare Conceptual Design Reports to develop storm hardening measures at six generating stations and five substations. As a subconsultant, **AECOM**'s scope of work comprised risk assessments for generating stations and substations, determination of critical equipment for the generating stations, development of mitigation measures for the generating stations, cost estimating for the generating stations and substations, development of cost-benefit curves, and preparation of the reports. After the current (pre-mitigation risk) was determined, a minimum of three conceptual design mitigation options were determined to provide long-term protection from the design flood elevation. The intent of these mitigations is to allow certain generating stations and substations to remain operable prior to, during, and after a Superstorm Sandy type event. Other generating stations and substations would not necessarily have to remain operable, but would be capable of being brought back online almost immediately following the storm.

RELEVANCE TO NJ TRANSITGRID:

- Conceptual design
- Resiliency
- Threat, risk, and vulnerability assessment
- Physical security

Rail/Transit Systems

Hudson-Bergen Light Rail Transit System (HBLR)

Owner: NJ TRANSIT



An **AECOM**-led special purpose company designed, built and currently operates and maintains HBLR, an 18.5-mile alignment with 24 stations. HBLR operates on dedicated right-of-way, bridges, viaducts, adjacent to a freight corridor, in a tunnel and in the streets of Jersey City—one of the more densely populated cities in North America. Since the inaugural opening of the first segment in April 2000, AECOM has continuously operated HBLR and maintained the infrastructure, systems, stations, and facilities.

AECOM met and surpassed several schedule milestones. The first 7.5-mile portion (Segment 1) was constructed, tested, and commissioned in just 42 months after Notice-to-Proceed. During that time, the light rail vehicle design was completed, two prototypes were manufactured and tested, and 43 additional vehicles were manufactured, shipped to the U.S., and assembled, tested and commissioned. Passenger safety, scheduling, light rail vehicle turn-around, and other issues were successfully addressed as construction was still ongoing. AECOM, together with the client, addressed all the issues prior to start-up and have continued to improve upon the solutions throughout the operational life of the system.

RELEVANCE TO NJ TRANSITGRID:

- NJ TRANSIT experience
- Design and Construction
- Maintenance
- Operations

THE Trans Hudson Express Tunnel (ARC)

Owner: NJ TRANSIT/Port Authority of New York and New Jersey



AECOM and PB, in a joint venture known as THE Partnership, provided NJ TRANSIT with preliminary engineering and final design services for the $8.7 billion access to the Region's Core (ARC) Tunnel. Formerly known as the Trans-Hudson Express Tunnel, the facility was projected to more than double commuter rail capacity between New Jersey and New York.

PMA developed an integrated program schedule to analyze the impact of ROW/property easement schedules on the overall program. PMA also reviewed a 6,000 activity Oracle Primavera schedule and boiled it down to a Level 2 program schedule that the management team could then use to conduct what-if analyses at the program level. With that schedule tool, the management team could easily understand and communicate how changes in one contract would ripple through the program. Matrix was responsible for performing all environmental investigation activities along the entire alignment corridor. Specific activities include the performance of preliminary assessments and site investigations and preparation of property acquisition environmental cost estimating report.

RELEVANCE TO NJ TRANSITGRID:

- NJ TRANSIT experience
- Planning, design and engineering
- Risk management/project controls
- ROW acquisition
- Permitting

Rail/Transit Systems

Amtrak Gateway Program

Owner: Amtrak



AECOM, in a joint venture with PB, is advancing the Gateway Program from its current feasibility phase to a thorough examination of key operational and rail system design issues focused on capacity, reliability, flexibility, resiliency, and safety. The Gateway Program is a visionary series of projects that will provide infrastructure improvements necessary to meet projected growth in Northeast Corridor rail traffic.

The objectives of the System Level Study are to: Define a feasible systems plan for improving passenger service through the area of the Northeast Corridor (NEC) between Newark, New Jersey, and the connection to the New Haven Line in New Rochelle, New York; Identify course of action for bringing the project through the environmental phase of study; and Establish a business plan for the development and implementation of the Program in a manner that optimizes the use of the funding received for the project.

The joint venture will explore operational functions and associated potential benefits of advancing new tunnels under the Hudson River, including developing a concept of operations (ConOps) that is integrated with rail system designs to generate additional Trans-Hudson capacity. The joint venture will also provide recommendations for signal design, rail vehicle integration, investigate and recommend feasible conceptual traction power system design alternatives that support operational concepts, integration with tunnel design, cost estimating and development of a phased deployment plan.

RELEVANCE TO NJ TRANSITGRID:

- AMTRAK experience
- Concept of operations
- Conceptual traction power system design alternatives
- Northeast Corridor passenger rail

PATH Multiple Tasks

Owner: Port Authority of New York and New Jersey

The objective of this project is to replace all traction power feeders, signal power feeders, the blue light emergency stations and the associated cabling, 480 V/277 power and lighting feeders, 480 V receptacles, tunnel lighting panels and light fixtures, trackbed, running rail and third rail, and associated power equipment that were compromised by exposure to saltwater during the flood resulting from Superstorm Sandy, in an expeditious manner, without any interruptions to PATH services. **JCMS** has provided construction cost estimate and scheduling services, JCMS is providing cost and schedule services for the replacement of various distribution equipment and the replacement of three escalators with 77 feet of vertical travel. All replacement work is to be off-hours and weekend work, with a return to revenue service after each outage.

RELEVANCE TO NJ TRANSITGRID:

- Region rail/transit experience
- Scheduling
- Cost estimating

PATH WTC Transportation Hub

Owner: Port Authority of New York and New Jersey

The **AECOM** team is responsible for final engineering of site preparation, site stabilization, PATH facilities, including tracks, platforms and mezzanine, as well as preliminary through final design for the terminal building, pedestrian connections, security, vertical transportation and conveyances, and public wayfinding systems.

Under a separate contract for the Lower Manhattan Construction Command Center PMA provided ongoing cost/risk analysis support to the value planning exercises and risk management program of the WTC site. A detailed 3D model of the WTC site was developed and linked to a Primavera Risk Analysis-derived schedule.

RELEVANCE TO NJ TRANSITGRID:

- Region rail/transit experience
- Concept, preliminary and final design
- Project controls
- Risk management

Regulatory/Funding Compliance

Reliability Standards Compliance

Owner: Transmission Agency of Northern California

Navigant is presently assisting with TANC's CIP Version 5 and CIP-014 Physical Security transition efforts. Assisted with NERC registration, including determination of functional TO, TSP, and TP designations. Developed and managed full implementation of Reliability Standards compliance program. Navigant served as client representative to WECC during formal off-site audit, which resulted in no violations. Coordinated with third parties in the development of formal delegation agreements and processes for ongoing compliance monitoring activities. Annually conducts internal compliance reviews of all applicable standards. Navigant prepared and submitted audit, Spot-Check, and self-certification materials to WECC. They submitted formal comments and letters to FERC, NERC, and WECC regarding reliability standards development and enforcement activities. Navigant represented client at events hosted by FERC, NERC, WECC, and industry stakeholder events. With regard to operational success, the last audit resulted in no violation findings.

NERC/NPCC Standards Compliance Services

Owner: New York Power Authority

Navigant is assisting with NYPA's CIP Version 5 and CIP-014 Physical Security transition efforts:

- Oversight of cybersecurity implementation.
- In-depth gap analysis on all requirements for TO, GO (Generator Owner), GOP, LSE, and PSE (Purchase Selling Entity) functions.
- On-side pre-audits for the TO, GO, GOP, LSE, and PSE functions in advance of Northeast Power Coordinator Council audits of Order 693 and 705 standards, without violations.
- Assistance with self-certification to NPCC.
- Training of responsible staff members and development of compliance certifications and management process.
- Support of the use of compliance management software.
- Completion of successful audit in 2011 with no violation findings.

RELEVANCE TO NJ TRANSITGRID:

- Cybersecurity
- FERC and NERC coordination

Generation Asset Valuations and Dispatch Forecast

Owner: Topaz Power Management, LP, a portfolio company of Riverstone Holdings

Navigant provided independent consultant market assessments of 15 generation assets. They included existing gas-fired combination cycle cogeneration plants in northern and central New Jersey; existing gas-fired combination cycle plants in northern and central New Jersey and Pennsylvania; existing gas-fired combustion turbine plant in Massachusetts; and existing steam coal plant in Maryland. Services Navigant provided included developing 20-year forecasts of energy market (LMP), capacity market, and ancillary service market prices, as applicable. Navigant forecasted and analyzed each plant's probable dispatch, fuel use, and emissions by category, gross revenue, net revenue, and EBIDTA. They also performed in-depth sensitivity analyses to reflect impacts of various alternative views of plant dispatch protocols, fuel prices, regional demand, and other market drivers. Navigant prepared independent consultant market reports for use in board decisions and/or financing outreach.

RELEVANCE TO NJ TRANSITGRID:

- Market assessment of excess generation

Rail/Transit Systems

Hudson County Energy Planning and Funding Activities

Owner: Hudson County Improvement Authority



Greener by Design (GbD) is assisting HCIA in a wide range of energy planning and funding activities. These services include reviewing energy efficiency and renewable energy plans and projects relative to project-specific and overall energy management and sustainability objectives, funding sources, amounts, status, execution schedule, status, and results. GbD facilitated discussion among stakeholders in planning and implementing efficiency and renewable energy projects. It also prepared an application to the U.S. EPA's Climate Showcase Communities Grant program for wind energy installations, natural ventilation shafts, and an automated energy monitoring and control system for a Silver LEED-certified adaptive building redevelopment program on the Kearny waterfront. GbD is also assisting in environmental compliance and economic feasibility inquiries for emergency backup generators to be used in peak-sharing or demand response scenarios.

RELEVANCE TO NJ TRANSITGRID:

- Planning
- Stakeholder coordination
- Environmental compliance
- Economic feasibility

Maher Terminals Energy Retrofit

Owner: Maher Terminals



The project involved comprehensive energy master plan and implementation of facility-wide energy upgrades. **GbD** conducted a comprehensive analysis of energy use and environmental impacts from operations at this large intermodal facility. GbD's tasks include technical and financial assessments for all energy related systems, including roof-top solar installations; sustainability/energy audio services for on-site buildings; providing energy policy advisory services for the large fleet of specialized vehicles used to move containers at one of the nation's busiest ports; and installation of solar system, energy efficiency projects, and major infrastructure replacement at the facility.

RELEVANCE TO NJ TRANSITGRID:

- Planning
- Technical and financial assessments
- Policy advisory services
- Sustainability/energy audit services


2021
With our combined experience, knowledge of the system and lessons learned, NJ TRANSIT can be confident that the AECOM team will deliver a successfull NJ TRANSITGRID-DG project.

03 Qualifications of Individuals

The AECOM organization maximizes value to NJ TRANSIT by focusing technical resources in the appropriate groups, with strong project management, analysis, engineering and specialty resources support.

The quality of the professionals who perform the work is what matters most. We have structured our team to ensure that NJ TRANSIT has the best management and technical professionals for this project. The AECOM team is a who's who of the top professionals in the energy, security and transit industries — forming a proven team that also has extensive NJ TRANSIT project experience.

Our proposed organization is depicted in Section 6 of this proposal, in accordance with the RFP and identifies subconsultants and key individuals, their proposed role/function, task responsibility and reporting relationships. A brief summary of the qualifications of our management and leadership staff is presented below, followed by the resumes of our key staff shown on the chart.

PROJECT MANAGEMENT



Ayokunle (Kunle) Kafi, PE, CEM is our team's project manager. Kunle has over 26 years of hands-on experience as a dynamic industry manager with demonstrated expertise, diversified skill sets based on profitable and effective management of over $2.5 billion of construction projects within various business segments in the Energy and Power Transmission industry. He has led the development and implementation of power transmission, energy efficiency, and carbon management projects for organizations. He has been instrumental in the implementation of over $750 million in energy efficiency programs for public and private entities in the New Jersey/New York metropolitan area and the Eastern seaboard.



Supporting Kunle is **Edward Hrinewski, PE,** as deputy project manager. Ed has 42 years of extensive project and construction management experience in the rail transportation, power generation, and heavy industrial fields. He has spent the last 18 years managing major design-build transit projects including oversight of multidisciplined engineering teams, procurement, construction, quality, safety, and startup. Ed has achieved increasingly responsible levels of corporate and project management assignments on design-build-operate-maintain (DBOM) projects, such as the Hudson-Bergen light rail project for NJ TRANSIT and design-build projects such as the Atlanta Streetcar project for MARTA/City of Atlanta. His project management responsibilities have included all elements of management, including successfully planning, organizing, and controlling engineering, procurement, construction, and startup of large-scale projects. He is a member of the Project Management Institute and has received numerous corporate awards for outstanding management of design-build projects.



Fred Werner, PE, as project executive, will make sure that our team has the resources required to deliver in a manner satisfactory to NJ TRANSIT, within schedule and budget. Fred is AECOM's global director for design and consulting services. He has 38 years of experience and a record of successful delivery of major projects worldwide. His background includes extensive experience with NJ TRANSIT and other projects in New Jersey.



With the combined experience and expertise of Kunle Kafi and Ed Hrinewski, and the corporate backing represented by Fred Werner, we are confident of our leadership team's ability to steward this project to a successful end — delivery of the most reliable, sustainable power solutions for New Jersey's critical transportation infrastructure.

TECHNICAL LEADS

Our technical work will be organized around the discipline leads as shown in our organization chart. All of the discipline leads and their staffs have the experience and expertise needed for this project.



Donna Hager, PE
Coordination Management

Donna has 25 years of experience in a variety of engineering projects in the areas of project management, risk management, and construction management for energy efficiency, co-generation, drinking water, wastewater, environmental planning, solid waste, industrial waste, and hazardous waste. After 25 years working as an engineering consultant, Donna has launched a woman-owned business, Macan Deve Engineers DPC, which is a new venture into the engineering and construction industry in the New York City metropolitan area. The company is focused on the energy, water, and wastewater business sectors, in addition to alternative methods of project delivery, such as design-build opportunities. Donna is very active in professional societies, has served on the NY Water Environment Association Program and Public Outreach committees for over 20 years, and is a Board Certified Environmental Engineer.



Andrew Agopian
Photovoltaic Technology & Energy Storage

Andrew is a project manager, general contractor, production manager, and technical expert in for photovoltaic systems, energy storage facilities, and other advanced-technology projects and operations. His primary focus for the past 15 years has been on solar energy. His expertise encompasses the specification, procurement, installation and integration of photovoltaic and storage facilities for major infrastructure clients and programs. Before joining AECOM, he was a project manager for a photovoltaic solar electric manufacturer and system integrator for commercial, municipal, and industrial applications with over 100 MW of installed systems worldwide. He also co-owned a general building contracting firm specializing in the integration and installation of cogeneration photovoltaic solar electrical systems with more than 50 completed projects for commercial, residential, and remote locations.



James Buchok, CEM
CHP, EV & Demand Side Management

James Buchok is a certified energy manager and distributed generation certified professional with 40 years of progressively responsible experience in all aspects of power generation, combined heat and power (CHP), industrial process cooling, refrigeration, piping, HVAC, energy management, temperature control/instrumentation and general building construction industry. He has managed major energy projects and portfolios with individual contract values in excess of $120 million, requiring complex coordination across multiple systems and processes. James has extensive relevant experience, including projects in the region such as the Rikers Island Cogeneration Facility, among other projects for the New York Power Aauthority.



Robert Zogg
Fuel Cell Technology

Bob Zogg is associate director in the energy practice of Navigant Consulting, Inc. He has more than 25 years of engineering experience, primarily in commercial and residential energy end use. His expertise includes the evaluation of distributed generation, combined heat and power (including thermally activated cooling), and energy storage systems; technology/market assessment of appliances and other building equipment; and the development and testing of heat-pump water heaters and other specialized vapor-compression cooling/refrigeration equipment. Before joining Navigant, he worked at TIAX LLC, Arthur D. Little, Inc., and United Technologies/Carrier Corporation. He has led numerous evaluations of on-site power systems (distributed generation, CHP, and distributed electric energy storage) for residential, commercial, and light-industrial buildings.



Darrell Massie, PhD, PE
Cybersecurity

Darrell is the founder and CEO of Intelligent Power and Energy Research Corporation (IPERC), a producer of intelligent controls for power generation equipment. He has extensive experience in distributed energy technology, neural network modeling, fuel cell applications, and advanced control for energy systems. Prior to founding IPERC, he served for over 20 years as a commissioned officer in the U.S. Army Corps of Engineers and taught for 15 years as an Associate Professor at the United States Military Academy, West Point, New York. During his time at West Point, he actively pursued research opportunities in the field of intelligent controls using artificial neural networks. It was upon this base that he founded IPERC. He has authored or co-authored over 90 technical papers and reports and has two U.S. patents.



Joel Sonkin, Esq.
Compliance/Regulators/Reviewers

Joel joined AECOM with a specialty in resiliency planning and project management. Prior to this, Joel spent nine years working for or on behalf of governmental entities engaged in resiliency and sustainability policy and project implementation. He served as Chief of Energy and Environment under now Senator, then Mayor Cory Booker, where he led a department responsible for integrating sustainability and resiliency principles into municipal decision-making around operations, capital investments, and asset management and land use policy and coordinating such activities with other governmental entities and regional stakeholders, such as NJ TRANSIT, PSE&G, N.J. Board of Public Utilities (BPU), the Governor's Office, N.J. Department of Environmental Protection (DEP), U.S. Environmental Protection Agency (EPA), U.S. Department of Transportation (DOT), U.S. Department of Energy (DOE), and the U.S. Army Corp of Engineers (USACE).



Amr Elmeged
Project Controls

Amr is a highly experienced senior project controls manager with leading expertise in the delivery and control of complex design and construction/program management projects worldwide, particularly in the transportation and rail/transit industry. He is proficient in the financial and schedule management, subcontract management, and client relations for all phases of planning, design, program and construction management. His managerial experience is extensive and is demonstrated on complex, multi-billion dollar projects such as the Champlain Hudson Power Express, the Second Avenue Subway in New York and the Tren Urbano Rail System in Puerto Rico.

OTHER KEY SPECIALISTS



Timothy McClive
Analysis of Ancillary Services and Market Revenue Opportunities

Tim McClive manages the power markets modeling team at Navigant's Energy Practice. He is a resource economist and project manager with 30 years of experience in government, utilities, and consulting. At Navigant, Tim has been actively engaged in over 40 power sector analyses, spanning areas in SPP, MISO, PJM, NYISO, ISO-NE, Ontario, SERC Reliability Corporation (SERC), Electric Reliability Council of Texas (ERCOT), California Independent System Operator (CAISO), Pacific Northwest, Arizona, Nevada, Colorado, and British Columbia. He previously worked at the New York State Energy Office, Conectiv, Niagara Mohawk, the Edison Electric Institute, and consulting firms.



Elizabeth Carter
System Safety and Security

Elizabeth joined the Chertoff Group after serving as the plan manager for Weapons of Mass Destruction (WMD) for New York City Emergency Management, where she developed hazard-specific emergency plans to respond to chemical, biological, radiological and nuclear (CBRN) incidents. She worked with the City, the Port Authority of New York and New Jersey and other municipalities to foster interagency coordination and develop WMD protocols. She also served as an interagency task force liaison and health and medical emergency support function coordinator during emergency operations center activations, including severe weather events and multiple fatality incidents. She has managed security assessment initiatives for the Port Authority and developed recommendations for World Trade Center security.



Nicholas Tomizawa, Esq., AICP, CEM, Concept of Operations:

Nick has 12 years of experience conducting transportation system safety and security assessments and audits; writing and critiquing numerous FTA system safety program plans, security and emergency preparedness plans, security and EM concepts of operations, safety/security certification plans, safety and security management plans, emergency operations plans, and continuity of operations plans; preparing departments of transportation and transportation systems for state safety and security audits; and conducting regulatory and policy research for various government agencies and industry organizations. He is also a certified emergency manager and a certified urban planner, was a senior planner for the New York City Office of Emergency Management, and was the city's Emergency Support Function 1 (Transportation) coordinator for activations of the City's Emergency Operations Center. For NJ TRANSIT, Nick served as the project manager to develop a Hurricane Response Strategy (HRS) for the various operational modes.



Adam Zellner
Public Involvement/Agency Coordination

Adam Zellner is President of Greener by Design and is the company's lead on government and finance-related work. Prior to joining Greener by Design, Adam served as policy director to a former Governor of New Jersey, overseeing the development of a variety of policies, including those relating to energy, land use, and environment. Before this he served as the Deputy Commissioner of the New Jersey Department of Environmental Protection and as the Executive Director of the New Jersey Office of Smart Growth. He has also served in Washington and New Jersey for several members of Congress.



Ruby Siegel
FTA Funding Reviews and Compliance

Ruby has over 30 years of management and planning experience in the transportation field. She has worked with transportation agencies on long-range and strategic plans, corridor and major investment studies, feasibility studies and alternatives analyses and is an expert at leading large projects through alternatives analyses and environmental reviews. Ruby serves as the deputy project manager for the FRA NEC Passenger Rail Corridor Investment Plan (PRCIP) NEPA compliant EIS that will result in an integrated rail transportation solution for Northeast Corridor. Ruby has also led other federally-sponsored studies in the Northeast Corridor, including NJ TRANSIT's Access to the Region's Core EIS; the Penn Station 5-Year Strategic Business Plan; and the Vermont Agency of Transportation, Rail Corridor Major Investment Study, among others.



Michael Pacy, PE
Coordination with Phase 1

A licensed mechanical engineer, Mike Pacy has extensive experience in project management, construction management, and engineering and design management for power stations (fossil, combined cycle and nuclear, wind), chemical plants, sewage treatment plants, transmission and distribution engineering and construction, and natural gas transmission and distribution. His experience includes design, construction management and operation of power stations; engineering; project management; and oversight of design and installation consultants for mechanical systems, piping, pressure vessels, and structural design. As a chief engineer for AECOM Energy, Mike has had management and oversight responsibility for engineering and design of power and energy projects, and he has managed teams of electrical transmission and distribution and natural gas transmission and distribution engineers.



Bob Fisher, PE
System Integration

For more than 40 years, Bob Fisher held engineering and management positions for the design, construction, testing, and startup of electrified railroad and mass transit systems. These assignments include management of major transit renovation projects involving signal, communications, and traction power components in both the public and private sector. Recently, Bob served as the project manager for NJ TRANSIT's Electric Traction Power Grid Analysis and led the railroad systems engineering for the $8.7 billion Trans-Hudson Express (THE) Tunnel project. He also served as the traction power, OCS and signals and communication systems integration manager for Amtrak's New Jersey High Speed Rail Improvements project.



Eduardo Gamez, PhD
Risk Management

Eduardo Gamez is the deputy director of risk management for AECOM's program and construction management practice. He directs and provides support to major design, construction and program management projects in risk management for a wide range of infrastructure facilities. His expertise includes evaluation of project delivery methods, such as P3 advisory and the applied project controls in support to managing project risks. As part of AECOM's knowledge leadership center, Eduardo provides leadership to the standardization of the program risk management practice for AECOM globally. His accomplishments include leading the risk management for Second Avenue Subway project that resulted in no change in the anticipated cost since FFGA approval, for the NYCDEP Wastewater Resiliency Program, and for the Champlain-Hudson Power Express transmission project, among many others.



Phillip Castellano, PE
Technology Integration

Phil Castellano has more than 40 years of experience in project management and engineering management from planning through detailed design and construction of major projects. He has a record of successful project completion, business development, personnel management, and development of work methods and tools for monitoring and establishing project performance matrices. His project experience includes fossil fuel and nuclear utility power plants, industrial cogeneration, waste-to-energy, waste water treatment, central heating and chilled water plants, energy savings, infrastructure, transportation, nuclear and fossil power plant retrofit projects, and balance-of-plant design modifications. Previously, as engineering manager, Phil guided the MEP and Vertical Structures Departments that supported AECOM Energy's northeast regional operations. He is well versed in alternate project delivery methods such as construction management at risk and design-build.



Peter Gregory
Safety Management

Peter Gregory is currently AECOM's Safety, Health and Environmental (SH&E) manager. With 15 years of experience in SH&E compliance, Peter has hands-on experience managing risks, conducting comprehensive site inspections, developing new and improving upon existing procedures, providing various trainings, tracking both leading and lagging safety metric indicators, communicating with all levels of personnel and clientele, managing incident investigation and reporting, site investigation/remediation strategies, exposure assessments, and due diligence environmental investigations. Prior to this position, Peter served as the superintendent of operational safety for the Hudson-Bergen Light Rail System Operations and Maintenance. He prepared and reviewed site-specific Construction Health and Safety Plans and other safety-related documents in compliance with OSHA and corporate standards.

Peer Review/Constructability Review/Value Engineering



Frank Russo

Frank is a senior transit industry program and project manager and an accomplished engineer with extensive public and private sector experience on major NJ TRANSIT projects and initiatives. He is a pioneer in developing risk management strategies for major transit rail projects and he has extensive experience in traditional project development and alternative delivery methods such as design-build, design-build-operate-maintain (DBOM), design-build-operate-maintain-finance (DBOMF), CM at Risk and Public-Private Partnerships (P3). In the past 10 years he has directed the development and implementation of four world class transportation projects with a combined value of over $8 billion, including the first DBOM public transportation contract in the United States — the Hudson Bergen Light Rail project. He provides advisory services, including the development of business plans, finance plans, technical and performance guidelines, contracts, procurement, and program level budgets and schedules.



Richard Falcon, PE

Richard Falcon is a professional electrical engineer and an accomplished electrical department manager and project manager with extensive experience for NJ TRANSIT, where among other accomplishments, he directed an engineering department responsible for planning, design, engineering, construction, operation, and maintenance of electrified railroads. He led project management, coordination, design, and facility modifications; coordinated the development of rail operational rules and guidelines; was an integral part of project management; and has been a key participant in overhead electrification projects throughout New Jersey. Richard has comprehensive knowledge of NJ TRANSIT system elements such as signals, communications, operations, vehicles and electrification, including experience in coordinating services and departments for several major new systems such as the Hudson-Bergen Light Rail project, as well as improvement and renovation projects.



Robert Wood, PE

Robert Wood has more than 40 years of professional experience in power generation, storage, and distribution projects encompassing a total scope of development and delivery, including planning, design engineering, procurement, construction, start-up and commissioning, operation, maintenance, and inspection. His experience includes power stations of various types and sizes, high voltage (HV) transmission lines and stations, cement manufacturing plants, infrastructure, and oil pipelines. He has worked on several projects in New Jersey. He has performed extensively for public and private sector clients. He played a key leadership role in AECOM's contract for the U.S. Army Corps of Engineers for the reconstruction and rehabilitation of the power grid and energy sector throughout Iraq.

Advisory Committee



James Peterson

Jim is a Director in Navigant's energy practice, where he has primarily been involved with utility resource procurements and the drafting and negotiation of related power purchase agreements and firm transmission capacity purchase agreements on behalf of utilities and other market participants. Prior to Navigant, he was employed by New York State agencies (Long Island Power Authority, New York Power Authority and New York State Department of Public Service) for 35 years. His experience includes overseeing the planning, power and transmission contracts, project management, fuel supply, and energy scheduling functions of LIPA. Prior to LIPA, Jim oversaw the power and transmission contracts and billing functions of NYPA. Previously, he worked for American Electric Power Service Corporation, where he was involved in power contract negotiations and the development of retail and wholesale electric rate filings with regulatory agencies. Jim began his career at NYS DPS, where he worked in the Office of Administrative Law Judges preparing Decisions.



Lyle Rawlings, PE

Lyle is one of the nation's most respected professionals in solar energy, with more than 30 years experience in research and development, design and policy work in renewable energy. He is the founder and president of Advanced Solar Products, Inc., one of the leading solar photovoltaic integrators in the mid-Atlantic region. Lyle holds one patent in photovoltaic module design and has another patent for an improved module mounting system. He also has extensive experience and expertise in hydrogen, fuel cells, energy storage, zero-emission vehicle design, synfuels and waste-to-energy conversion. Lyle has served on New Jersey's Clean Energy Council since its inception and as Chair of its Renewable Energy Committee for three years. He served on the Governor's Renewable Energy Task Force in 2003 to structure New Jersey's RPS, and to fight for a solar share of the RPS (and succeeded, despite some internal opposition from within the PV industry). He also initiated a working group among PSE&G and the solar industry, leading to the $100 million PSE&G loan program pilot – the first securitized Solar Renewable Energy Certificate (SREC) program in the country.

PERSONNEL CERTIFICATION

AECOM certifies that our key personnel are either employed by team members or will be on board and assigned to the project in the manner prescribed.

RESUMES OF KEY PERSONNEL

RESUMES OF THE AECOM TEAM

Name/Role	Page
Fred Werner, PE Project Executive	1
Ayokunle (Kunle) Kafi, PE, CEM Project Manager	3
Edward Hrinewski, PE Deputy Project Manager	5
Peter Gregory, CSP Safety Manager	7
Peter Totten, PE Quality Manager	9
Eduardo A. Gamez, PhD Risk Management	11
Phillip F. Castellano, PE Technology Integration	13
Donna Hager, PE Coordination Management Lead	15
Riad Habib Coordination of Bid Packages/Bid Documents	17
Robert Brownstein Recommendations for Future Procurements	19
Daniel Z. Gold Ongoing Commissioning and O&M	21
Kenny Pimenta, PE Ongoing Commissioning and O&M	23
Lauri Hack DBE and Subcontracts Management	25
Andrew Agopian PV Technology & Energy Storage Lead	27
John Hoffner, PE Photovoltaic	29
Samuel Monger Photovoltaic	31
James Sherman, Esq. Energy Storage/Integration	33
Jose L. Vivas, PhD, PE Energy Storage/Integration	35
James Buchok, PMP, DGCP, CEM CHP, EV and Demand Side Energy Management Lead	37
Jeffrey Brier Combined Heat & Power	39
Paul Yallouris, PE Combined Heat and Power	41
Roger J. Lemos Combined Heat and Power	43
Michael C. Simon Electric Vehicles	45
Leah Milcarek, PE Demand Side Energy Management	47
Damee Choi, PE, CEM, LEED AP Demand Side Energy Management	49
Robert Zogg Fuel Cell Technology Lead	51
Lisa Jerram Fuel Cell Technology Assessment/Verification	53
Colette Lamontagne Fuel Cell Technology Assessment/ Verification	55
Jonathan D. Thompson Fuel Cell Technology Incentives/ Economic Analyses	57
Darrell Massie, PhD, PE Cybersecurity Lead	59
Aura Lee Keating System Architecture/Operating Protocols	61
Peter Curtiss, PhD, PE Communications/Control Center	63

Name/Role	Page
Octavian Cana, PE, PMP Security	65
Scott Roberts Cybersecurity System Startup	67
Joel Sonkin, Esq. Compliance/Regulators/Reviewers Lead	69
Steve McEvoy Rail Force Account/Rail Ops Coordinator	71
Tom McDermott Power/Utility Regulators	73
Jeffrey Roushey, PE Resliency and Cybersecure Regulations	75
Ray Hinkle, CWB Environmental Impact Statement	77
Leslie Roche, AICP NEPA Coordination	79
Mark Gander, AICP Real Estate/Property Acquisitions	81
Timothy Hand, AICP Permitting Support	83
Amr Elmeged Project Controls Lead	85
Tunc Gundogdu Cost Control	87
Dane McBlaine, PMP, LEED AP Schedule	89
Jay Bayersdorfer, PE Cost Estimating	91
Kevin Meehan Cost Estimating	93
Dave Collett, PE Configuration Management	95
Katie Donahue Document Control	97
Timothy E. McClive Analysis of Ancillary Services and Market Revenue Opportunities	99
Elizabeth Carter System Safety, Security and Resiliency	101
Carlos Campillo System Safety, Security and Resiliency	103
Nick Tomizawa, Esq., AICP, CEM Concept of Operations	105
Adam Zellner Public Involvement and Stakeholder Coordination	107
Ruby Siegel FTA Funding Reviews and Compliance	109
Michael Pacy, PE Coordination with Phase 1	111
Bob Fisher, PE Traction Power and Grid Controls	113
Tom Quaranta, FCMAA FastStart Team	115
Frank Russo, PE Peer Review/Constructability Review/ Value Engineering	117
Richard A. Falcon, PE Peer Review/Constructability Review/Value Engineering	119
Robert Wood, PE Peer Review/Constructability Review/ Value Engineering	121
James J. Peterson Advisory Committee	123
Lyle Rawlings, PE Advisory Committee	125
Specialty Resources	127

Fred Werner, PE

Project Executive

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ Senior AECOM executive with 38 years of experience
+ Global director for design and consulting services at AECOM
+ Oversaw the successful delivery of major projects worldwide
+ Strong record of success meeting clients' needs on major infrastructure programs
+ Extensive project experience for NJ TRANSIT

Years of Experience

With AECOM: 38

With Other Firms: 0

Education

MS, Civil Engineering, Rutgers University, 1977

BS, Civil Engineering, Manhattan College, 1975

Professional Licenses/Certifications

Professional Engineer: New York

Work History

Group President, Design and Consulting Services, AECOM

President, DMJM Harris, Inc. (an AECOM company)

Chief Operating Officer, DMJM Harris, Inc. (an AECOM company)

Senior Vice President and Manager of New York Operations, Frederic R. Harris, Inc. (an AECOM company)

Vice President and Manager of New Jersey Operations, Frederic R. Harris, Inc.

About Fred

Fred Werner is Group President, Design and Consulting Services, for AECOM (NYSE: ACM), a $19 billion, fully integrated infrastructure and support services firm with the ability to design, build, finance and operate infrastructure assets globally. In this role, he leads the group's technical services practice areas, including architecture, cost consultancy, design, economics, energy, engineering, environmental, planning and program management.

Previously, Fred served as President, Corporate Development, and has also led AECOM's U.S. Infrastructure Group, which brought together the company's business throughout the U.S. in the fields of transportation, energy, water and development. He also served as Chief Executive Officer of AECOM's Americas Transportation Group, part of the firm's U.S. Infrastructure Group. He was promoted to that position following a successful stint as President of AECOM's legacy DMJM Harris operation.

During his time as DMJM Harris President, major projects included the design of the new Second Avenue Subway and the Permanent World Trade Center PATH Terminal projects in Manhattan; program management of the $2.5-billion Alameda Corridor rail expressway for the ports of Los Angeles and Long Beach; program management of the $2.5-billion Tren Urbano transit system serving San Juan, Puerto Rico; general engineering consultancy for the $5-billion Phoenix, Arizona, freeway system; LaGuardia Airport modernization program; improvements to 17 New York City Transit stations; rehabilitation of the Tappan Zee Bridge; final cover and closure of the Fresh Kills Landfill; and energy efficiency upgrades to schools, courthouses, hospitals, and office buildings for the New York Power Authority and the New York School Construction Authority.

Fred oversaw the company's operations in New Jersey and served as officer in charge or project manager for major transportation projects that included widening of the New Jersey Turnpike, Route 92 and US Route 1

Fred Werner, PE
continued

EIS and corridor studies, two New Jersey Transit bus maintenance facilities, Atlantic City International Airport master plan update, improvements to 10 New Jersey Transit stations; and the Delaware and Raritan canal dredging program for the Army Corps of Engineers.

Relevant Project Experience

NJ TRANSIT, Meadowlands Bus Maintenance Facility, North Bergen. Project officer for permitting, design and construction design services of a 266,000-squarefoot, 220-coach facility for new construction. Work was performed as part of a design-build operation with a General Contractor. Project featured poor soils improved by dynamic compaction, demolition of existing structures and hazardous waste removal and "fast-track" design with foundation and steel frame construction concurrent with remainder of final building design.

NJ TRANSIT, Oradell Bus Maintenance Facility. Project officer responsible for design and construction services for a 190-coach facility including renovation, expansion, and modernization of the existing facility without interruption to operations.

NJ TRANSIT, Red Bank Station. Project officer responsible for the conceptual design, environmental assessment and preparation of final design/contract drawings for the addition of 400 to 600 new spaces and new high level platforms at the Red Bank facility. Work tasks included drainage design (including elimination of existing retention basin), traffic studies, environmental assessment as well as origin and destination surveys and filing of the project permits, and participation in public information program.

NJ TRANSIT, Station Improvement Program. Project officer responsible for preparing feasibility studies and environmental assessment and design of 10 park and ride facilities. Services included drainage, site lighting, landscaping, utilities and parking garage design.

NJDOT, Route US 1 Corridor Study. Officer in charge of the alternatives analysis, DEIS, public participation and permitting aspects of the preparation of technical environmental studies and cultural resource subcontract administration for $180 million of improvements to an 18-mile-long, intensely developed corridor from Trenton to New Brunswick. Project included road widening and improvements and seven interchange structures, and technical environmental studies completed for noise, socioeconomic and land use and natural ecosystems (soil, geology, groundwater, floodplains, wetlands, aquatics, vegetation and wildlife) and the administration of five cultural resource subcontracts.

New Jersey Turnpike Authority, Route 92 Corridor, Middlesex and Somerset Counties. Office in charge for the EIS, public participation and permitting aspects of the planning and construction of a new ten-mile, limited access roadway in Middlesex and Somerset Counties, New Jersey.

NJDOT, Routes 1 and 9 Tonnelle Avenue, Jersey City. Officer in charge for the preparation of technical environmental study reports and the Draft Environmental Impact Statement (DEIS) for the rehabilitation of three mile roadway in a densely developed area. Technical studies included air, noise, socioeconomic and land use, and the administration of cultural resource subcontracts. Follow up work will include the preparation of the FEIS for NJDOT.

New Jersey Turnpike Authority, New Jersey Turnpike Widening, Woodbridge. Officer in charge for field investigation, laboratory testing and design for the widening and bridge replacement for over two miles of the New Jersey Turnpike. Geotechnical tasks included embankment stability and settlement analyses, soil improvement techniques, widening of railroad and highway bridges, and investigation of wetland mitigation schemes.

Ayokunle (Kunle) Kafi, PE, CEM

Project Manager

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 27 years of experience in the energy/power industry
+ Energy efficiency market segment technical leader
+ Demonstrated management of $2.5 billion+ in construction projects
+ Instrumental in implementation of $750 million + in energy efficiency programs
+ Licensed professional engineer and certified energy manager

Years of Experience

With AECOM: 8

With Other Firms: 19

Education

MS, Energy Management, New York Institute of Technology, 1988

BS, Chemical Engineering, University of Ile-Ife, Nigeria, 1985

Professional Licenses/Certifications

Professional Engineer: New York

Certified Energy Manager

Work History

2010 to Present, AECOM, Energy Efficiency & Carbon Management Market Segment Leader/Associate Vice President

2008, SourceOne Inc. (a Veolia Energy Company), Director of Development

2006 to 2007, Select Energy Services, Inc. (An Ameresco Company), Regional Manager

1991 to 2006, Select Energy Services, Inc. (A Northeast Utilities Company), Regional Manager

1988 to 1991, A & C Enercom, Project Manager

1987 to 1988, DMC Energy Services, Senior Project Engineer

About Kunle

Kunle Kafi has more than 27 years of hands-on experience as a dynamic energy and power transmission industry manager and technical expert. He is an accomplished project manager and people leader and a client-oriented, cost conscious executive with a solid record of technical and management performance. In particular, Kunle has managed more than $2.5 billion in energy construction projects. He has led the development and implementation of power transmission, energy efficiency, and carbon management initiatives and project for numerous public and private sector organizations and has been instrumental in the implementation of more than $750 million in energy efficiency programs in United States and abroad.

In his role as energy efficiency market segment technical leader, Kunle provided technical leadership, process development, thought leadership, and client interface management for integrated teams in phases of project development from consultant planning and design services through to turnkey implementation of power generation, energy efficiency, and carbon management (EECM) solutions. He is a collaborative and trusted advisor for his clients and possesses a high degree of dedication and a total commitment to ethical performance and safety, health and environmental stewardship.

Relevant Project Experience

New York Power Authority, Statewide Energy Program. Performed engineering and program management for a $250 million, 15-year energy savings program. AECOM provided turnkey energy efficiency solutions to various state agencies to meet their energy efficiency targets as outlined by the New York State Executive Order for Energy Efficiency. Oversaw deployment of integrated energy efficiency measures such as chiller plants, boiler plants, comprehensive energy management systems, cogeneration system, and fuel cells. The assignment also included a $15 million project for the State University of New York at Stony Brook, a $12 million district-wide energy efficiency upgrade project for Sachem Central School District, and an $18

Ayokunle (Kunle) Kafi, PE, CEM
continued

million HVAC system upgrade for Goodyear at the State University of New York at Buffalo.

Champlain Hudson Power Express Project, (CHPE), NY. Project engineering manager leading team development; engineering and project delivery for AECOM as Owner's Engineer on this $2 billion project. Provided full-time oversight of the development support efforts for AECOM's team to secure permits, EPC contract and financial close-out for the proposed 1,000 MW high voltage direct current underground transmission cable project. Activities included daily interaction with the client while supervising backroom activities of more than 125 people to deliver timely service and high quality outcomes.

China ESCO, Program Development Program, Shanghai. Worked with AECOM Shanghai PRC to develop a comprehensive market research and analysis for the deployment of energy performance contracting services to various markets in central China. Worked to defined segments of the Chinese market to support the implementation of short- and long-term performance-based energy improvements. The market sectors studied included hospitals, industrial facilities, government offices, and hospitality facilities. The effort culminated in the development of a pilot Comprehensive Energy Efficiency Master Plan (CEEMP) for one of China's leading hospitals, Renji Hospital in Shanghai. The result of the study identified approximately $8 million in energy efficiency improvements that can be implemented by the hospital over a 15-year term.

New York City Economic Development Corporation/ New York City Mayor's Office, Operations and Maintenance Study. Led a team of engineers assessing the City's current operations and maintenance (O&M) standards and protocols. A cost benefit analysis was performed and a subsequent pilot program was implemented in three of the New York City's largest agencies. The City continues to use AECOM engineers to expand this program and plans to improve O&M standards and protocols across the City's building inventory of 4,500 buildings.

New York State Office of Mental Health, Comprehensive Energy Efficiency Management Program. Project manager and technical leader of a team of eight energy engineers tasked with recommending and deploying a comprehensive energy efficiency program for psychiatric facilities statewide. The scope of services included management of a $50 million annual energy budget for 20 psychiatric facilities throughout the State of New York. Provided strategic planning and oversight for the deployment of energy efficiency practices at the central chiller and boiler plants to promote cost-effective operation. Recommended and deployed system and operation improvements for the agency that resulted in a 22 percent reduction in annual energy consumption. Also responsible for annual management of a $5 million service contract for heating, ventilation and air conditioning system infrastructure.

New York Power Authority, Wards Island Wastewater Treatment Plant. Project director leading the project development and visioning. AECOM produced a comprehensive heating alternative feasibility study for the New York City Department of Environmental Protection (DEP) - Wards Island WWTP. Led the analysis of various options for a new heating plant to be constructed on the Wards Island property. The $80 million plant will use the available digester gas as fuel with natural gas as a secondary fuel. The plant will consist of a newly centralized low pressure steam facility as well as new low pressure heating distribution and condensate return systems. The scope of work also included new natural gas service to the island as well as the complete restoration of an historic building to house the new plant.

Dormitory Authority of the State of New York, City College of New York - Energy Performance Contract. Managed team of energy engineers responsible for the development of feasibility studies targeting $200 million in energy savings. Implemented energy conservation measures at CCNY Steinman Hall, reviewed engineering energy audits, supervised energy savings calculations for the upgrade of HVAC systems in the building, and prepared the final report with findings and recommendations.

Edward Hrinewski, PE

Deputy Project Manager

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 40+ years of experience — 23 in power, 20 in transit
+ Accomplished project manager and engineering expert for complex rail transit programs
+ Technical expert in all phases of project development from planning and conceptual engineering through construction
+ 14-year involvement in HBLRT, from Project Controls Manager to Senior Project Director – led design-build of various components
+ Project Controls Manager for various cogeneration projects worldwide

Years of Experience

With AECOM: 42

With Other Firms: 0

Education

BS, Civil Engineering, Stevens Institute of Technology, 1973

Specialized Training

Safety Trained Supervisor/Council on Certification of Health, Environmental and Safety Technologists

Work History

2012 to Present, AECOM, Project Director– Atlanta Streetcar design-build project

2002 to 2012, AECOM, Senior Project Director- HBLRT, Houston Metro

2000 to 2002, AECOM Project Manager, HBLRT

1996 to 2000, AECOM, Supervising Project Controls Manager, HBLRT

1994 to 1996 AECOM, Regional Project Controls Manger

1973 to 1994 AECOM, Asst. Field Engineer through Project Controls Manager

About Ed

Ed Hrinewski has more than 40 years of project management experience on large-scale, highly-visible, fast-track projects. His career includes 23 years in power generation and 20 years in rail transit. He brings a wealth of experience with NJ TRANSIT, having served for 14 years in various management roles, primarily on the NJ TRANSIT's Hudson-Bergen Light Rail Transit (HBLRT) program. He brings lessons learned from major transit programs. He served as project director for the Atlanta Streetcar Project and as senior project director for Houston's Metro Guided Rapid Transit Systems. Ed has managed and coordinated with all of the key disciplines that will be required for the Transitgrid project, including system safety, security, public involvement, agency coordination, FTA funding reviews, coordination management traction power, rail force account, project controls, and specialty resources such as civil, structural, MEP, and environmental services.

Relevant Project Experience

NJ TRANSIT, Hudson-Bergen Light Rail Transit System (HBLRT), Jersey City. The $2.25 billion HBLRT program is an FTA-funded, 15.9-mile transit system delivered as a design-build-operate-maintain project that consists of electrified double track, an overhead catenary system, traction power supply substations, ATP train signal system, 54 light rail vehicles, 25 passenger stations, five park-and-ride lots, 25 interlockings, and a maintenance and storage yard complex with a control center. The maintenance complex contains nine storage tracks and five maintenance tracks, a 100,000-square-foot maintenance shop, a 75,000-square-foot light rail vehicle storage building, and a 40-acre storage yard. The shop includes a car wash, paint shop, maintenance pits, and machine shop. The system operates on a dedicated right-of-way adjacent to a Class 1 freight corridor, on elevated structures and in the streets of Jersey City. HBLRT is the only rail transit system to receive VPP status.

Served in various positions with increasing responsibility including:

Edward Hrinewski, PE
continued

- **MOS-3/8th Street Bayonne Extension** – Senior project director for the design-build contract for a one-mile extension to a new terminal station on the south end of the system. The scope included new track, civil construction TPSS, catenary system, and train signal extension. Coordinated with NJ TRANSIT staff and AECOM operations staff during construction, including the cut-in to operating territory.
- **Danforth Interlocking** – Senior project director for the design-build contract for civil works and track, including double diamond and a new siding, track, catenary system, and train signal scope for new CIH on a new interlocking on the existing operating system. Coordinated with the HBLRTS operations staff. The work was largely performed on scheduled weekend track outages and off-hour single track operations.
- **MOS-2** – Project director for the design-build contract for the $600 million second phase of the HBLRTS through revenue service. This phase was put into service as five segments with overlapping design, construction, startup, and commissioning schedules. The major element of this phase of the program was construction and commissioning of the 4800-foot Weehawken Tunnel facility.
- **MOS-1** – Project manager for the design-build second segment of the HBLRTS first phase. This included elevated structures and a terminal station incorporated into the Hoboken NJ Commuter Terminal. Completed $120 million worth of construction three months ahead of schedule.

Metropolitan Transit Authority of Harris County, Houston Metro, Phase 1, TX. Senior project director for the preliminary engineering for a design-build project to add 19.8 miles of light rail and 26 new stations in four corridors and an intermodal facility. The program value was $1.5 billion. Responsible for preliminary engineering to 30 percent using four civil engineering teams; oversaw constructability review; estimated the installed capital cost; developed an extensive community relations program, and developed a detailed project schedule.

Metropolitan Atlanta Regional Transportation Authority (MARTA) and the City of Atlanta, Atlanta Streetcar Project, GA. Project director for this $59 million project, a cooperative effort if the City of Atlanta, the Atlanta Downtown Improvement District, and MARTA. Responsible for the overall project management for design-build, including coordination with the project sponsors. The 2.7 mile streetcar runs through the heart of Atlanta's business, tourism, and convention corridor. AECOM has the design-build contract encompassing design, safety, quality assurance/control, subcontracting, construction and startup/commissioning, through revenue service. The firm is managing community relations and the extensive public utility relocations and is coordinating with private utilities. AECOM performed technical and design-to-budget reviews throughout the design phases with construction management staff and construction subcontractors.

AECOM Power Cogeneration Projects, Various Locations. Regional project controls manager for domestic and international projects. Responsibilities included staffing, training, and supervising global project control operations for large-scale, lump-sum, date-certain EPC projects ranging from $100 million to $800 million. He managed the project controls tasks throughout the project cycle, including proposal development through project initiation, engineering, procurement, construction, and startup on multiple projects. Projects include the PP9 power project in Saudi Arabia; Uch power project in Pakistan; Puerto Plata barge mount power plant in the Dominican Republic; Tang Shan power project in China; Gordonsville cogeneration project in Virginia; DuPont cogeneration project in Texas; and the Independence cogeneration project in New York, a 1,000 MW combined cycle plant constructed in 26 months.

Peter Gregory, CSP

Safety Manager

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 15 years of experience in safety, environmental and health compliance for transit and energy projects
+ Certified Safety Professional
+ Progressively increasing responsibility for leadership of SH&E initiatives and project interface
+ Superintendent of Operational Safety for HBLRT, experienced interfacing with clients, system operators, designers, and contractors
+ Environmental coodination for PSE&G throughout the State

Years of Experience

With AECOM: 8

With Other Firms: 7

Education

Master of Public Health, School of Public Health, University of Medicine and Dentistry of New Jersey, New Brunswick, NJ, 2004

BS, Biology, Boston College, Chestnut Hill, MA, 2000

Professional Licenses/Certifications

Certified Safety Professional (CSP)

Specialized Training

Safety Trained Supervisor (STS)

OSHA 30-Hour Construction

OSHA HAZWOPER

OSHA Site Supervisor

AHA First Aid-CPR-AED Trainer

Fall Protection – Competent Person

Work History

2008 to Present, AECOM, Safety, Health and Environment Manager

2004 to 2008, EcolSciences, Inc., Construction EH&S Manager

2001 to 2003, Bristol- Meyers Squibb, EH&S Specialist

About Peter

Peter Gregory is a safety, health and environmental (SH&E) professional with 15 years of experience in compliance, including managing risks, conducting comprehensive site inspections, developing new and improving upon existing procedures, conducting training courses, tracking leading and lagging safety metric indicators, communicating with all levels of personnel, managing incident investigation and reporting, implementing site investigation/remediation strategies, performing exposure assessments, and completing due diligence environmental investigations. Peter served as the superintentent of operational safety on the Hudson-Bergen LRT System O&M contract and as enviornmental coordination for PSE&G at various site throughout New Jersey, and is therefore very familiar with the agency and area regulations and best practices.

Relevant Project Experience

Hudson Bergen Light Rail Transit System Operations and Maintenance, New Jersey. As the Superintendent of Operational Safety:

- Worked with and reported to senior management team corporate-wide and for individual sites
- Prepared and reviewed site-specific construction health and safety plans and other safety-related documents in compliance with OSHA and corporate standards
- Reviewed contractor construction work plans to ensure safety and environmental compliance
- Ensured all field activities received formal health and safety review
- Provided safety training and field oversight to employees and contractors. Training was conducted in classrooms and in the field and covered AHA first aid-CPR-AED; hazard communication globally harmonized system; electrical safe work practices; confined space entry; fall protection; bloodborne pathogens; forklift operator training; OSHA HAZWOPER; and MoveSMART–strength and control.

Peter Gregory, CSP
continued

- Tracked leading indicators (best practices) monthly to develop a positive safety culture and reduce incidents and injuries. Examples of leading indicators he developed and tracked include:
  - an active STS certification program
  - employee wellness activities
  - an active safety committee with diverse involvement
  - a leading indicator safety incentive program (Hazard Recognition Program)
  - an active safety awareness poster and banner program
  - an active Stretch and Flex program;
  - a safety prequalification process required for subcontractors
  - documented table-top drills and simulation exercises
- Performed accident investigations and root cause analyses, OSHA recordability determinations; oversee injury management and worker's compensation claims.

NY Metro Area SH&E Manager, New York & New Jersey. As the NY Metro Area SH&E Manager, he was responsible for:

- Protecting AECOM employees and AECOM contractor employees
- Safeguarding AECOM from liabilities incurred from regulatory compliance shortfalls, exposure due to a failure to meet expected levels of diligence appropriate for the applicable industry or activity, and civil suits from the public, subcontractor, or other parties affected by AECOM activities
- Assuring compliance with the safety and environmental management standards at the operating units within the assigned NY Metro Area
- Meeting the expectations of and providing services directed by the area manager
- Providing support to the NY Metro Area providing HAZWOPER and field safety training for employees; technical support; audits related to the SH&E program; reporting findings to operations and safety managers; advice supporting operational needs and changes; and representing AECOM with OSHA, EPA, and the State Department of Labor.
- Supporting AECOM's management of risks related to SH&E

Public Service Electric and Gas (PSE&G), Various Sites throughout New Jersey. Environmental project coordinator responsible for regulatory compliance management for the Resource Recovery/Waste Management Program at PSE&G substations and switchyards throughout New Jersey. Oversight and management responsibilities included writing scopes of work and cost estimates for various PSE&G construction projects; development of comprehensive environmental compliance plans; coordination with PSE&G project personnel and subcontractors; and on-site inspections of storage areas, oil containment devices, and associated spill prevention measures.

New York Power Authority (NYPA) St. Lawrence, NY. Environmental, Health & Safety auditor and team member for environmental, health and safety audit of a hydroelectric plant and four associated facilities. Evaluated each facility for compliance with federal, state and local environmental regulations and OSHA requirements. Developed summary of findings for each facility audit as part of closeout meeting discussions.

Peter Totten, PE

Quality Manager

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ Quality Management System senior manager at AECOM
+ NJ TRANSIT project experience including on the Hudson-Bergen Light Rail project
+ Develops and implements project-specific design quality management systems for complex projects
+ Thoroughly well versed in ISO 9001:2008

Years of Experience

With AECOM: 45

With Other Firms: 2

Education

MS, Nuclear Engineering, Polytechnic Institute of NY, 1976

BE, Mechanical Engineering, Manhattan College, 1968

Professional Licenses/Certifications

Professional Engineer: New York, New Jersey, Connecticut, Pennsylvania, Florida, Massachusetts, Virginia, Texas, Georgia

AECOM Certified Project Manager

Specialized Training

Contractor Trainer – PATH On-Track Safety Training (Roadway Worker Protection)

AECOM – Field Safety Trainer

Safety Trained Supervisor

Work History

1970 to Present, AECOM, Vice President, NY Metro Area Quality Manager

1969 to October 1970, Grumman Aerospace Corporation, Acoustics Engineer

1968 to June 1969, Pratt & Whitney, Acoustics Engineer

About Peter

Peter Totten is a senior quality manager with a background in project management and design. He is responsible for the quality of engineering and design on transit/rail and security projects involving architecture, civil, structural, mechanical, electrical, and plumbing (MEP) engineering design. His project experience includes design engineering for the Hudson-Bergen Light Rail Transit System project and for numerous infrastructure security projects in the New York and New Jersey metropolitan region. He has participated in the preparation and revision of AECOM's Quality Assurance Manual Corporate Standards and is one of AECOM's leading quality management system (QMS) experts. He is thoroughly familiar with ISO 9001:2008 requirements and in tailoring quality systems for project-specific requirements to meet client-specified standards and program goals.

Relevant Project Experience

Area Quality Manager, New York Metro Area. As AECOM's area quality manager, responsible for project QMS implementation, including:

- Participating in area-wide initiatives and supporting the regional quality manager and Americas director of quality as required to improve the QMS
- Providing input to the continual improvement process, verifying that regional factors are considered
- Leading a team of office quality officers within their area and providing guidance regarding QMS implementation
- Requiring that quality orientation is provided to new employees, including guidance to the LMS curriculum on the QMS
- Evaluating and reporting on effectiveness of the QMS
- Tracking performance of the area relative to one or more key performance indicators for the QMS, communicating results to the regional quality manager, regional manager, office managers, and office quality officers

Peter Totten, PE
continued

- Working with office quality officers to verify the level of implementation of the QMS and that corrections and corrective actions emanating from audits or other sources have been addressed, implemented and are effective; works with quality officers, project managers, office managers and senior management to rectify nonconforming work
- Facilitating project reviews for high risk/high reward projects so that they receive the proper level of management oversight and support
- Confirming that client feedback is received and acted upon
- Developing and sharing case studies and lessons learned to foster continual improvement
- Issuing quarterly quality management summary report
- Participating in area or regional conference calls on quality management

NJ TRANSIT, Hudson-Bergen Light Rail Transit System. Supervised engineering and design of mechanical systems (fire protection, HVAC, plumbing and drainage, compressed air) for service and maintenance shops, storage buildings, and passenger terminals for HBLRT, the first public-private partnership design-build-operate-maintain (DBOM) project in the United States. Work included preparation of equipment specifications for rail car wash system, spray paint booth, wheel truing machine, rail vehicle car lift system, cranes, package boilers, and oil/water separators. Revenue service for the initial operating segment was initiated 44 months after Notice to Proceed. Project manager for the engineering for additional upgrades and modifications to the system, including Danbury Interlocking and the Weehawken Pedestrian Bridge East Tower project.

Tappan Zee Hudson River Crossing, Tarrytown, NY. Led the Accident, Threat, Vulnerability and Risk Assessment (ATVRA) of the new Tappan Zee Bridge (Tappan Zee Hudson River Crossing). Risks included accidental and man-made events. This work was in support of the design and construction of the new bridge, a three-mile span crossing the Hudson River approximately 30 miles north of New York City, and joining Westchester and Rockland Counties. The $3+ billion project will replace the current bridge with a modern span, including a cable-stayed section.

MTA Capital Security Program, New York, NY. Project manager and manager of engineering for confidential security projects under a contract to provide design of security solutions and related technical and construction services for MTA facilities throughout New York City, which include rail transit, commuter rail, bridges, buses, stations/terminals, maintenance facilities, and office buildings. Active participant in all task orders for this program and reviewed design bases prepared by the design teams. Participated in threat, vulnerability and risk (TVR) workshops and reviewed all TVR reports. Task orders included major facilities including the overbuild of commercial properties and the potential interrelationships and consequences of an event in a facility and its effects on the nearby facilities and structures.

Transbay Joint Powers Commission, San Francisco, CA. Led the update of the Risk and Vulnerability Analysis (RVA) of the bus bridge/ramp (including cable-stayed bridge), and led the new RVA for the Downtown Extension (DTX) train box and train platform, and DTX tunnel. Risks included accidental, man-made, and natural events. This work was in support of the Transbay Transit Center Project, a transportation and housing project in downtown San Francisco. The $4 billion project will replace the current Transbay Terminal at First and Mission streets in San Francisco.

NJDOT, Delaware River Infrastructure Protection Project (DRIPP), New Jersey and Pennsylvania. Project manager for the design and deployment for NJDOT and NJ Office of Homeland Security to complete DRIPP. The project included the analysis of Maritime Domain Awareness gaps, and the development of a coordinated Security Regional Network with detection and assessment systems to link all landside and marine public and private critical infrastructure and assets along 120 miles of the Delaware River and within the Delaware Bay.

Eduardo A. Gamez, PhD

Risk Management

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ Deputy director of risk management at AECOM
+ Risk management program development and implementation for complex power and transit mega projects
+ Expert in alternate delivery methods
+ Led the risk management for Second Avenue Subway project that resulted in no change in the anticipated cost since FFGA approval

Years of Experience

With AECOM: 6
With Other Firms: 12

Education

PhD, Civil Engineering, Northeastern University, 2009
MS, Construction Management, Northeastern University, 2003
BS, Civil Engineering, Universidad Central de Venezuela, 1999

Professional Associations

Construction Management Association of America (CMAA)
American Society of Civil Engineers (ASCE)
Society of Hispanic Professional Engineers (SHPE)
Boston Society of Civil Engineers (BSCE)

Work History

2009 to Present, AECOM Risk Manager
2003 to 2008, Shawmut Design and Construction, Project Manager
2001 to 2002, Consorcio Vypaco, Assistant Project Manager
1997 to 2000, Constructora Vialpa, Project Manager

About Eduardo

Eduardo Gamez is the deputy director of risk management for AECOM's program and construction-management practice group. He directs and provides support to major design, construction and program management projects in risk management for a wide range of infrastructure facilities. His expertise also includes evaluation of project delivery methods, such as P3 advisory and the applied project controls in support to managing project risks. He is experienced in assessing project shortfalls to establish measures to ensure implementation is predictable and controls are in place for mitigating risks.

As part of the knowledge leadership center, Eduardo provides leadership to the standardization of the program risk management practice for AECOM globally. Over his 18 years of professional experience, he has been part of numerous engineering and construction projects ranging from transportation and development mega-projects on international grounds to building commercial projects for private owners. He is a recognized published author in the subject of risk, and is part of the subject matter experts for publication review on a number of international technical journals. In 2015, he was named by ENR magazine among the top 20 young professionals influencing the engineering and construction industry.

Relevant Project Experience

New York City Department of Environmental Protection, NYC Wastewater Resiliency Program. Risk management director as part of the Program and Construction Management team for the resiliency program, responsible for developing and implementing risk-based processes to quantify project and program risks and define proactive approaches to respond to them. Integrated a prioritization model, focused on increasing the level of resiliency, with the program constrains (funding, operations) to develop a procurement/ packaging strategy for the program. Also, incorporating a sophisticated probabilistic forecasting cash-flow process to isolate and inform decision makers. Developed project contingency controls for a community sensitive program. Created a change management

Eduardo A. Gamez, PhD
continued

control tool that tracked and managed risk causes and triggers.

Transmission Developers Inc. (TDI), Champlain-Hudson Power Express, Quebec-New York. Risk management consultant. Conducted a Risk Assessment and contingency validation model, which included an in-depth review of the contractor's proposal and stipulations to finally map the allocation of project risks and quantify the cost exposure for each party. Supported the technical, financial and legal groups for negotiations with the contractor. Developed risk-based processes to enhance project management and delivery of the $1.1 billion of capital expenditures direct power supply line between the Champlain region and New York City. Designed processes to interface with project controls including: contingency drawdown control, contingency forecast, risk-based decision making on program and project-specific material decisions, risk mitigation monthly meetings, project management plan and register updates. Worked with engineering lead to create awareness on risk areas and to prioritize definition of project elements based on project risk exposure.

Metropolitan Transportation Authority, Second Avenue Subway, New York, NY. Risk management consultant for $17 billion new subway line. Interfaced with FTA and PMOC as agent of the project manager to meet funding agency requirements and the enterprise level project execution plan. Developed processes and implemented the application of risk-based tools, including contingency drawdown control, contingency forecast, risk-based decision making on program and project-specific material decisions, retained risk analysis, risk mitigation monthly meetings, program wide risk assessment and register updates, project management plan and subplans update, and process to initiate continuous revisions.

Maryland Transit Authority, Purple Line Project, Baltimore. Risk management consultant. Developed and implemented risk-based processes to evaluate project delivery of the new subway line in Maryland with $2.5 billion of capital expenditures. Evaluated risks to the MTA on each project delivery alternative and assisted in the decision making that turned the project from traditional delivery to a Public Private Partnership. Interfaced with FTA and PMOC as agent of the project management office to meet funding agency requirements and the enterprise level execution plan. Developed processes and implemented the application of risk-based tools, including contingency drawdown control, contingency forecast, risk mitigation monthly meetings, program wide risk assessment and register updates, and change management.

Chicago Transit Authority, Red and Purple Line Modernization, Illinois. As risk management director, developed and implemented a risk management plan for the delivery of CTA's largest modernization to date, the $2.4 billion north transit rail lines. Interface with FTA and PMOC as agent of the project management office to meet funding agency requirements. Execute risk assessments to coincide with major project milestones to assist material decisions. Developed processes and implemented the application of risk-based tools, including risk-based decision making on program and project-specific material decisions, retained risk analysis, risk mitigation monthly meetings, program wide risk assessment and register updates.

Massachusetts Bay Transportation Authority, Green Line Extension, Boston. Director of project controls responsible for developing and implementing integrated project control processes to enhance project management evaluation and delivery of the final design for the extension of the Green Line light rail from Cambridge to Medford with $1.4 billion of capital expenditures on a heavily urbanized alignment. Developed processes and implemented the application of project controls and risk-based tools, including change management processes, cost loaded detail schedules, earned value measures and monthly reports, contingency management controls, forecasting mechanisms, dashboard reports based on performance measurements that can drill-down or roll-up based on various needs for senior management. Worked with design leads to create awareness on control areas and to prioritize design elements based on project risk exposure.

Phillip F. Castellano, PE

Technology Integration

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 40+ years of experience in power/energy industry
+ Expert in design/construction for cogeneration and energy management projects
+ Engineering Manager for NYPA's Rikers Island Cogeneration Project
+ Extensive NYPA and NY/NJ Metro area energy project experience

Years of Experience

With Macan Deve Engineers: 1

With Other Firms: 44

Education

BME, Mechanical Engineering, Manhattan College, 1965

Professional Registration

Professional Engineer: New York

Awards

Brooklyn Engineer of the year 2005

Work History

2014 to Present, Macan Deve Engineers, DPC, Technical Director

2010 to 2014, Castellano Consulting Engineering, PLLC, Principal

1999 to 2010, AECOM, Vice President Engineering Department Manager [Energy and Power projects] – Retired

About Phillip

Phil Castellano has extensive experience in project management and engineering management from planning through detailed design and construction of major projects. He has a record of successful project completion, business development, personnel management, and development of work methods and tools for monitoring and establishing project performance matrices. His project experience includes fossil fuel and nuclear utility power plants, industrial cogeneration, waste-to-energy, waste water treatment, central heating and chilled water plants, energy savings, infrastructure, transportation, nuclear and fossil power plant retrofit projects, and balance-of-plant design modifications.

Previously, as engineering manager, Phil guided the MEP and Vertical Structures Departments that supported AECOM Energy's northeast regional operations. Reporting directly to the northeast regional operations manager, he was responsible for these departments' overall technical execution. His duties include quality assurance of work products and deliverables, which are generated through a variety of project delivery methods. His extensive engineering and project management experience has been applied to overall project execution in a variety of project delivery methods including construction management and implementation, more recently focusing on the Design Build and Implementation Contracting[IC] project delivery.

Relevant Project Experience

Department of Corrections and New York Power Authority, Rikers Island Cogeneration Plant. Engineering manager with overall responsibility for staffing, project execution, and methods for 15 MW Cogeneration Project.

New York Power Authority, In-City Generation Program, Various Locations. Officer in charge for this $275 million program. AECOM was selected by the New York Power Authority to perform program and construction management for the in-city generation program. At the direction of Governor Pataki, the NYPA undertook the installation of 11 LM6000 gas turbine generators

Phillip F. Castellano, PE
continued

on seven locations situated throughout New York City, and on Long Island. The objective of this project was to provide much needed support to the power grid in the area, where diminishing capacity margins had raised the threat of power outages.

Covanta, 1000 TPD Expansion, Hillsboro Resource Recovery Facility, Hillsborough County, FL. Engineering manager with overall responsibility for staffing, project execution, and methods.

New York Power Authority, North River Waste Water Treatment Plant. Providing overall technical direction for a major central boiler plant replacement and pipe replacement program for this major DEP waste water treatment facility.

New York Power Authority, Poletti Power Plant, Queens. Officer in charge for this $250 million project. AECOM was selected by NYPA as the program manager/ construction manager for its new 500 MW combined-cycle power plant

New York City School Construction Authority, Task Order for Engineering Services, Clean Air for Schools Program (CASP), Brooklyn. Senior mechanical engineer and job engineer for the task order boiler conversion and climate control upgrades for 25 Schools.

New York City School Construction Authority, Task Order for Architectural MEP Services. Senior mechanical engineer/job engineer for task order infrastructure projects for Various Schools within New York City.

MTA New York City Transit, 100th Street Bus Depot. Design-build contract for a 40 percent design development package.

New York Power Authority, Brooklyn Supreme Court. Boiler/chiller replacement and systems upgrade.

New York Power Authority, NYC Police Headquarters. Chiller replacement.

New York Power Authority, Clean Air for Schools Program (CASP). Phase III replacement of coal-fired boilers at various schools in New York City.

1800 TPD Pinellas County Resource Recovery Facility, FL. Project management for major retrofit and upgrade of air pollution control technology.

University of Connecticut (UCONN), Storrs Campus Plant Expansion. Project manager for major expansion of the central heating and chilled water plant for the campus at Storrs.

Westinghouse Power Systems, 300-Megawatt Gas Turbine Combined Cycle Standard Plant, Orlando, FL. Provided standard plant design development. In addition to standard plant design drawings, deliverables included site-specific design modules, cost estimates, and schedule analysis to support business development of the Westinghouse standard plant designs concept.

New York City Department of Environmental Protection, Sludge Dewatering Facility Upgrades. Management of the design and construction management personnel involved in a very aggressive program for volume reduction at eight wastewater treatment plants undertaken by the NYCDEP.

PSEG Salem Generating Station, Service Water Piping Replacement project, Units 1 and 2, NY. This project involved extensive large bore welded piping in safety-related areas of the plant during plant outages and operation. The piping materials were developed for a severely corrosive atmosphere and involved all aspects of the piping and pipe support replacement from the initial plant corrosion testing to product form manufacture, including both shop and field welding. In addition to the pipe fabrication and pipe support modifications, detailed construction planning and spooling of the replacement was required to minimize any impacts on plant operations and plant outage extensions. The program also included the replacement of a number of system auxiliaries, including containment fan coil unit tubing materials.

MTA New York City Transit, Grand Avenue Bus Depot. Project manager for the MEP engineering and design deliverables for this design-build project, which is currently in the final stages of commissioning.

Donna Hager, PE

Coordination Management Lead

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 25 years of diverse engineering experience including energy efficiency and cogeneration
+ Proven leadership of energy efficiency/cogeneration projects: Rikers Island Cogen Plant, Owls Head Cogeneration Plan Optimization, NYCHA Castle Hill Boiler Replacement
+ President & CEO of Macan Deve Engineers (WBE)

Years of Experience

With Macan Deve Engineers: 1

With Other Firms: 24

Education

MS, Environmental Engineering, Manhattan College, 1996

BS, Mechanical Engineering, Manhattan College, 1992

UCLA Anderson, School of Management, Leadership Development Program, 2013

Professional Registration

Professional Engineer: New York

Professional Associations

American Academy of Environmental Engineers & Scientists - Board Certified Member

New York Water Environment Association - Program Committee, Public Outreach Committee

Work History

2014 to Present, Macan Deve Engineers, DPC, President & CEO

2006 to 2015: AECOM, Vice President, Program Manager, Director

1992 to 2006, CDM, Principal, Associate Vice President, Program Manager

About Donna

Donna Hager has 25 years of experience in a variety of engineering projects in the areas of project management, risk management, and construction management for energy efficiency, co-generation, drinking water, wastewater, environmental planning, solid waste, industrial waste, and hazardous waste. She has held several leadership positions such as: client account manager, business operations manager, program manager, project director, risk manager, project manager, project engineer, and construction manager.

After 25 years working as an engineering consultant, Donna has launched a woman-owned business, Macan Deve Engineers DPC, which is a new venture into the engineering and construction industry in the New York City metropolitan area. The company is focused on the energy, water, and wastewater business sectors, in addition to alternative methods of project delivery, such as design-build opportunities.

Donna is very active in professional societies, has served on the NY Water Environment Association Program and Public Outreach committees for over 20 years, and is a Board Certified Environmental Engineer. As an advisory board member of the Manhattan College Mentoring Program, Donna enjoys working with Manhattan College engineering students to help them identify and take advantage of the many career and professional development opportunities available within the engineering and construction industry.

Relevant Project Experience

New York Power Authority/NYC Department of Corrections, Rikers Island Co-generation Facility. Client executive and project director during construction of a $125M combined heat and power facility with two 7.5MW gas turbine generators. Responsible for oversight of turnkey services (feasibility study, design, build and commissioning), including mitigating potential project risk.

New York Power Authority/NYC Department of Environmental Protection, Co-generation Plant Optimization, Owls Head WWTP. Client executive and project director during a $15M upgrade of three 6MW

Donna Hager, PE
continued

prime duty engines. Scope includes energy audit, optimization plan, design, and turnkey implementation. Projected savings are $1.3M annually.

New York City Housing Authority, Castle Hill Boiler Replacement, Climate Control and Lighting Upgrade, NYPA City-wide On-call Energy Savings Program. As program manager of a $24M program, managed the design of new boilers to reduce carbon emissions, in addition to the design of a climate control system and replacement of inefficient lighting throughout a campus-style housing development and community center. Coordinated construction work with owner and public relations team to maintain continuous domestic water supply and heating to over 5,000 residents during construction and equipment retrofits. Also managed project risk and maintained Risk Register to identify and quantify risk elements to the project and their potential impact, and managed the mitigation plan. This project won the 2011 ACEC NY Diamond Award, the Association of Energy Engineers 2011 Region I Project of the Year award, and was recognized by Mayor Bloomberg who visited the project site to celebrate its success and to congratulate NYCHA and the project team on their example to other New York City agencies.

New York City Department of Environmental Protection, On-call Design and CM Services During Construction of Various Projects. As project manager and construction manager, managed $13M of task assignments to provide design services, studies, and CM services to DEP for various projects and initiatives. Responsible for understanding of task scope and needs, quick deployment of resources, and execution in accordance with DEPs Standard Operating Procedures and maintenance of Risk Register. Upstate Projects include: Hudson River Drainage Chamber Upgrade Planning/ Design, Amawalk Dam Ogee Spillway Replacement, CAT 392 Energy Conservation Measures at West of Hudson WWTPs (Tannersville, Grand Gorge, and Pine Hill), and CM Services for DEL-150 Pepacton, Cannonsville and Rondout Watersheds Bridges and Culvert Reconstruction.

New York City Department of Environmental Protection, Croton Water Filtration Plant Design Services During Construction. AECOM's project director of design services during construction for the $3B underground 290-mgd Croton Water Filtration Plant, which includes upgrades to the 100-year-old New Croton Aqueduct and the 800-million- gallon Jerome Park Reservoir in order to connect the water filtration plant to the existing facilities. Responsible for AECOM resource management, budget, and schedule, in addition to daily coordination with the Design Joint Venture partner to ensure overall project performance and client satisfaction.

New York City Housing Authority, Hot Water Storage Tank Replacement Program, NYPA City-wide On-call Energy Savings Program. As manager of a $63M energy management program that contributes to PlaNYC's goal of reducing New York City's greenhouse gas emissions, responsible for the overall coordination between the owner, client, engineering design team, construction managers, field inspectors and contractors during the installation of over 500 instantaneous hot water heaters in housing developments throughout the City's five boroughs. Also maintained Risk Register. The energy efficient heaters replaced inefficient domestic hot water storage tanks that reached their useful life; and provided considerable annual savings as well as social and environmental benefits to the owner and residents.

New York City Housing Authority, Computerized Heating Automated System (CHAS) Evaluation, NYPA City-wide On-call Energy Savings Program. As program manager, responsible for an evaluation of the NYCHA CHAS infrastructure, which makes automated boiler-room / building control panels from multiple manufacturers accessible through a web-based software tool. Services included: engineering oversight of data collection, management of field investigation crews, schedule coordination with NYCHA, and review of surveys collected at over 75 developments. Survey templates were designed to assemble various instrumentation information associated with CHAS work completed under a separate NYCHA contract. The survey work identified typical locations of communication wiring, alarms, and controls inside the boiler plants and hot water storage tank rooms.

Riad Habib

Coordination of Bid Packages/Bid Documents Coordination Support

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 12 years of experience with energy efficiency and renewable projects
+ Procurement project manager for PSE&G NGRP transmission and power generation project
+ Expertise with transmission and distribution projects

Years of Experience

With AECOM: 12

With Other Firms: 0

Education

MA, International Business Finance, Touro College 2010

BS, Mechanical Engineering, University of Hartford, 2003

Work History

2003 to Present, AECOM, Project Manager

About Riad

Riad is a project manager with significant experience in the management of design-build energy efficiency and renewable projects on the local, state, and federal levels, as well as within the private sector. His experience includes auditing, design, and construction management; project controls; and procurement. In addition, he has been involved in leading roles for transmission and distribution (T&D) projects.

Relevant Project Experience

PSE&G Northeast Grid Reliability Project (NGRP), NJ. Procurement project manager for the PSE&G NGRP transmission and power generation project, which includes soliciting bids for major T&D equipment, engineering, construction, and environmental EPC services, leading CO negotiations and logistical construction sequencing along with outage planning. The NGRP scope includes the upgrade of 8 substations, upgrade of 29 miles of overhead transmission line from 138 kV to 230 kV along with replacing approximately 20 miles of underground lines from 138 kV to 230 kV within New Jersey's Northeast region. To date, managed $550 million in project spending.

Norfolk Southern, Juniata Locomotive Shop, Altoona, PA. Project manager for the Norfolk Southern Juniata design-bid-build project located in Altoona, PA. Responsible for leading the design and construction management effort of a multi-phased approach, energy and electrical upgrade project which will enhance the site's electrical infrastructure, generate energy and maintenance savings, and streamline the Juniata site operational processes. The project includes heating decentralization, decommissioning of the existing coal plant, installation of a new 1.5 MW combined heat and power (CHP) engine, upgrades of existing electrical infrastructure, and a variety of building roofing upgrades throughout 16 buildings.

Naval Facilities Engineering Command, ACC NAVFAC Solar Construction, United States; Southeastern States, United States; and Various Locations. Project manager supervising 11 field personnel for installation of PV systems in four states. The various systems totaled 7

Riad Habib
continued

MW and ranged from rooftop PV systems to carport and ground-mounted systems. The PV project was executed through Atlantic Contingency Constructors, LLC (ACC), a joint venture between AECOM and Shaw Environmental & Infrastructure. The project was the recipient of the *Key West Public Works Department Safety Award*.

New York City College of Technology, NAMM Facility HVAC Upgrade, Brooklyn. Project manager for management and oversight of the HVAC upgrade at the facility. The $47 million construction effort involved installation of a new central 900-hp boiler plant in addition to a new 3600-ton chiller plant to meet the facility's future loads. To supplement the new central plants, a new electric and gas service was brought in as part of the construction. Other project energy conservation measures involved lighting upgrades, replacement of 42 AHUs, and implementation of a new backnet building management system. Upon completion, the project generated approximately $1 million in energy and O&M savings annually.

Central University of New York, College of Optometry. Project manager for design development of the new installation of the new building management system (BMS) at the college. The scope of this $2.5 million project also entails implementation of a coil-to-coil heat recovery system on the laboratory floors, which will enable the facility to recapture and re-use normally discharged heat while maintaining 100% fresh air.

Central University of New York, Brooklyn College. Project manager for design development and construction of the climate control upgrade at the campus. The project entails the replacement of over 1,300 steam traps throughout seven buildings, zone control installation, and demolition of existing chillers.

Robert Brownstein

Recommendations for Future Procurements

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 40 years experience in procurement for transportation projects
+ Expertise with procurement, project development, altrernative project delivery, IT, asset management and logistics
+ Former leader of procurement, financial, and capital programs with NJ TRANSIT
+ Guided procurement process for $4 billion Tappan Zee Bridge Replacement project

Years of Experience

With AECOM: 4

With Other Firms: 38

Education

BA, Richmond College, 1972

Work History

2007 to Present, AECOM, Senior Consulting Manager

2001 to 2007, Parsons Brinckerhoff, Principal Consultant

2000 to 2001, Booz Allen & Hamilton, Dir. of Transportation

1995 to 2000, Spear Technologies/TENERA, General Manager

1978 to 1995, NJ TRANSIT, various positions including Director of Procurement

1977 to 1978 , NYC Office of the Mayor, Federal State Aid Coordinator for Economic Development

1972 to 1977, NYC Department of Planning, Transportation Planner

About Bob

Bob has over 40 years of experience, primarily in infrastructure related industries, with particular expertise in procurement, project development, alternative project delivery, organizational development, information technology, asset management, and logistics. He is a frequent speaker at conferences throughout the world.

Bob has assisted numerous public agencies with complex, time-sensitive, high visible procurements. Most recently, he directed the conduct of a "best value" procurement of the design-build contractor for the $4 billion project to replace the Tappan Zee Bridge. In this capacity, he designed the procurement process and guided the process through to award. This highly competitive procurement was fast-tracked and resulted in a contact award that was $800 million below the nearest proposal.

Prior to joining the private sector, Bob was a senior official with NJ TRANSIT, where, in addition to procurement, financial, and capital program related leadership positions, he was the Senior Director of Materials for both the bus and rail divisions.

Relevant Project Experience

NJ TRANSIT Financial and capital Programs. Director of Procurement for the Bus division, and the Senior Director of Materials for both the Bus and Rail divisions. Responsible for identifying outside sources of funds, packaging projects for funding, and serving as the principal liaison with funding sources. Negotiated the federal approval of hundreds of millions of dollars of construction contracts for two major rail electrification projects. One of the architects of the Transpac Program, a federally funded program of projects designed to upgrade the passenger rail network in New Jersey. Some of the projects in the program included new rolling stock, new rail maintenance facility, track replacement, electrification, signal system upgrade, new stations, new rail services, and station rehabilitation. Increased funding to three times the previous funding levels.

Robert Brownstein
continued

New York State Thruway Authority, Program Management Services the Tappan Zee Bridge. Directed the project team in the development and conduct of a "best value" procurement of the design-build contractor for the $4 billion project to replace the Tappan Zee Bridge. In this capacity, managed the development of the solicitation documents, the procurement process through selection, negotiations, and award. This highly competitive procurement was fast-tracked and resulted in a contact award that was $800 million below the nearest proposal.

Maryland Transit Administration, Program Management Services, Purple Line Light Rail Project. Leading the program management team assisting the MTA in the development, procurement of the concessionaire, construction, and startup of the $2.4 billion,16.2-mile Purple Line P3 Light Rail Project.

Port Authority of New York and New Jersey, Tenant Improvements Process Manual. Directed a project to develop a consolidated process and manual for tenant improvements at Port Authority-owned facilities, including the Hudson River port facilities, airports, Hudson River bridges and tunnels, the PATH rail service, and the Port Authority Bus Terminal. The project was a consolidation of the process for tenant improvements to the Port Authority-owned facilities and the development of a single manual to guide both the tenants and the Port Authority.

Chicago Transit Authority, Passenger Rail Car Procurement, IL. Managed the development of all aspects of a value-based procurement for over 700 passenger rail cars, including the development of the solicitation documents, the procurement process through selection, negotiations, and award.

Metropolitan Atlanta Rapid Transit Authority (MARTA), Business Process Study, GA. Managed the upgrade of MARTA's materials and purchasing processes. This project included the use of workshops and interviews, and the development of recommendations to improve processes and procedures, as well as plans to leverage technological advances.

Training, National Transit Institute (NTI), New Brunswick, NJ. The Federal Transit Administration (FTA) provides funding to NTI to provide training for transit professionals in the United States. Served as an instructor for the NTI training programs for transit professionals. Among the courses taught were: Introduction to Asset Management, Orientation to Procurement, Contract Administration, RFPs and Competitive Contract Negotiations, and Quality Assurance and Quality Control.

Washington Metropolitan Area Transit Authority (WMATA), Business Process Study, Washington, DC. Project manager for a business process analysis project for WMATA's materials and purchasing division. This project included the use of workshops and interviews, and the development of recommendations to improve processes and procedures, as well as plans to leverage technological advances.

Dallas Area Rapid Transit (DART), Procurement Business Process Study, TX. Project manager for a business process analysis project for DART's Procurement division. This project included the use of workshops and interviews, and the development of recommendations to improve processes and procedures, as well as plans to leverage technological advances.

City of Phoenix Public Transit Department, Program Management Services for Software Acquisition, AZ. Managed the development of the solicitation documents, the procurement process through selection, negotiations, and award, followed by the implementation of the maintenance and materials management software.

Chicago Transit Authority, Airport Express Service Feasibility Study, IL. Directed the conduct of an economic and operational feasibility study for a proposed public-private partnership for an airport express service that would service the two airports in the City of Chicago. It was designed to be financed with both public and private funds.

Daniel Z. Gold

Ongoing Commissioning and Maintenance & Operation

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 10 years of experience in the energy/power industry
+ Local professional with global power industry experience
+ Extensive experience with solar photovoltaic systems design, procurement, commission and O&M worldwide

Years of Experience
With AECOM: 5
With Other Firms: 6

Education
MS, Wind Energy, Technical University of Denmark, 2009
BS, Mechanical Engineering, University of California - Berkeley, 2004

Professional Licenses/Certifications
Engineer in Training

Work History
2011 to Present, AECOM, Project Engineer
2010 to 2011, OwnEnergy, Project Developer & Wind Analyst
2009 to 2010, European Energy Systems Engineer, Solar/Wind Farm Due Diligence
2008, Siemens, Advanced Engineering Department
2007, PowerLight Corp. (now SunPower Corp), Construction Manager
2004 to 2006, India Power Corp. Project Manager/Product Development

About Daniel
Daniel Gold has more than ten years of experience in project development, management, construction, and engineering of wind and solar photovoltaic (PV) power projects and products. His experience includes wind turbine component design, renewable resource assessment/meteorology, energy calculations, PV system electrical design, wind farm design, energy economic financial modeling, electrical interconnection, environmental permit coordination, construction management, and technical troubleshooting for wind farms and PV systems.

Relevant Project Experience
Los Angeles Department of Water and Power, 9.75MW Solar Photovoltaic System Design, CA. Project engineer responsible for system design, materials budgeting and procurement, value engineering and optimization. Also performed electrical engineering calculations and documentation.

Operations and Maintenance of Photovoltaic System Various Clients, CA. Operations and maintenance and technical troubleshooting on multiple roof mounted 100-1000 kW PV systems. Responsibilities included liaising with a large Asian engineering team from a PV manufacturer and with multiple clients for expedited site visits, inspecting and remediation of underperforming or faulty panels and systems.

U.S. Army Reserve Center, Solar Photovoltaic System Design, Saipan, Northern Mariana Islands. Project engineer responsible for conceptual design for solar photovoltaic system and rain water harvesting as part of a Site Survey Report for NET-ZERO goals. Conceptual design included financial modeling as well as narrative report. Solar photovoltaic system design was roof mounted, rated at approximately 150 kW and supplies roughly 85% of on-site load. Rain water harvesting system was design to provide 100% of potable on-site water requirements integrating with the existing building rain gutters.

Daniel Z. Gold
continued

New York City Department of Environmental Protection, Wind/Solar feasibility Studies on Landfills. Project engineer responsible for wind turbine/solar PV siting and feasibility analysis including, electrical engineering/interconnection analysis, fatal flaw and levelized cost of energy analyses, land/siting evaluation, market/power price analyses.

Federal Aviation Administration, Air Route Traffic Control Centers, Solar Photovoltaic System Design, Freemont, CA. Project engineer responsible for preliminary design for a 700 kW solar photovoltaic carport system.

City of Beaumont, Solar Project Development, Beaumont, CA. Project engineer responsible for development assistance to City of Beaumont in identifying suitable areas for solar project development. GIS prospecting activities lead this effort.

Hartsfield-Jackson Atlanta International Airport, Photovoltaic Feasibility Study, Atlanta, GA. Project lead responsible for seven megawatt solar photovoltaic feasibility study at the Consolidated Rental Car Facility (CONRAC), including utility data analysis, electric system analysis, solar glare analysis for FAA purposes, energy production estimates and financial analysis. Also Project Lead responsible for geothermal heat pump test wells and feasibility study.

CBS Studios, Solar Photovoltaic System Permitting, Studio City, CA. Project engineer responsible for complete solar PV system electrical design building permit package.

Soitec CPV Projects, 200+ Megawatts, Various Locations, CA. Project engineer responsible for system design, layout and value engineering of multiple concentrator solar PV projects totaling over 200 Megawatts, site engineering including various Geographic Information Systems (GIS) analyses.

US Department of State, Bureau of Oversees Buildings Operations, Wind Energy System Study and Design. Project Engineer for feasibility study and system design for 100 kW of wind energy at a US Embassy. Market survey of medium and small wind turbine manufacturers. Energy modeling and economic analysis using in-site wind data for various turbines.

City of Corona Waste Water Treatment Plant, CA. Owners engineer responsible for assisting client in RFP for 200kW system, as well troubleshooting issues with ARRA compliant modules and mixing multiple solar PV modules on a single inverter.

Wind/Solar Hybrid System, Karnataka, India. Project, construction management, and engineering coordination for pilot installation of a small wind/solar hybrid system from Japan for residential applications in rural India. Involved material procurement, meteorological tower construction, wind resource analysis, site assessment and local labor coordination.

Various Clients, Megawatt Wind Energy, US. Project manager responsible for developing wind projects and implementation strategies. Responsibilities included: review of studies on electrical interconnection including power flow modeling; economic/revenue modeling including time of use value of energy; meteorology and resource analysis; land lease negotiation and conducting community outreach programs; permitting coordination with state and federal entities, as well as private third-party consultants; and working with utilities and distributed generation customers on power purchase agreements (PPA).

Various Clients, Megawatt Wind and Solar Systems, Spain and Germany. Energy monitoring, assessment, and troubleshooting of MWs of wind and solar PV systems. Included identifying from a remote desktop in Denmark errors codes in PV inverters and wind turbine SCADA systems, and coordinating with local support staff for maintenance and remediation.

Wastewater Treatment Plant, Photovoltaic System Construction Management, Thousand Oaks, CA. Construction management for a 500kW ground-mounted PV tracker system, including day-to-day site management and preparation and delivery of management reports.

Kenny Pimenta, PE

Ongoing Commissioning and Maintenance & Operation

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ Extensive experience in mechanical engineering for energy projects
+ Local professional with design and construction experience
+ Oversaw Rikers Island Cogeneration Plant construction of mechanical elements to successful completion

Years of Experience
With AECOM: 8
With Other Firms: 0

Education
BS, Mechanical Engineering, NJ Institute of Technology, 2009

Professional Licenses/Certifications
Professional Engineer: New York
Engineer in Training: New Jersey

Work History
205 to Present, AECOM, Senior Mechanical Engineer

About Daniel
Kenny Pimenta is a project manager and an experienced mechanical engineer whose practice has involved mechanical systems of all types. His experience spans the range of small terminal unit replacement, to full PreK school design, and to large central plant designs in campus style setting. Kenny has been responsible for generating field reports, condition assessments, scope reports, conceptual designs, detailed contract documents, specifications, project management, and construction administration. Throughout his career he has experienced all phases of construction, which allows him to anticipate engineering problems and solve them quickly.

Relevant Project Experience
New York Power Authority, Rikers Island Cogeneration Plant. Led the mechanical (process and HVAC) effort during the construction phase of the project. Responsible for the review of all mechanical submittals and RFIs and ensured that all submittals were reviewed appropriately and within the required turnaround time for this cogeneration power plant. Led the design for any revisions to the construction documents necessary as the construction progressed, which included calculations and drawing modifications. This facility installed two gas turbine systems that would provide heating and power to the island's penitentiary. The new plant will have a maximum generating capacity of 15 megawatts.

New York Power Authority, City College of New York. Lead mechanical engineer for the replacement of 70 chilled water control valves located throughout 9 different buildings. The facility has been suffering from faulty valves and controls resulting in severe Low Delta T Syndrome. The design encompasses the replacement of the aging and dysfunctional control valves with modern electronic pressure independent control valves. The intent of the project was to reign in the facility's energy consumption and maximize the system's efficiency. To ensure that savings are met, the existing BMS was expanded by introducing all of these

Kenny Pimenta, PE
continued

control valves and each of their respective air handlers. At the completion of this project the campus will be able to monitor each and every air handler and control valve. The facility will also have the capability to monitor the heat transfer of each coil, the flow of each coil, and the total flow and heat transfer for each building. These enhancements will allow the facility to not only comply with their mandate, enhance their troubleshooting capabilities, but also provide a realistic baseline of the actual cooling load at each of the existing coils. The scope of work also includes the replacement of three failed tertiary chilled water pumps and their VFDs at the facility's most hydraulically remote building. He performed calculations for each of the control valves and the new tertiary pumps such that they would be of adequate size based on the central plant's 14F design temperature differential.

Dormitory Authority, State of NY/CUNY, City College of New York. Mechanical engineer for the expansion of an existing 8,000-ton chiller plant to a maximum capacity of 10,000 tons. The design consists of an installation of a new 2,000-ton steam driven turbine chiller. The scope of the project entailed the design of a steam turbine chiller, three cooling tower cells, a 200 Hp condenser water pump, a 100 Hp primary chilled water pump, a 400 Hp secondary chilled water pump, and a sand filtration system for the condenser water. Responsible for computing pressure drop in the primary chilled and condenser water loops. To ensure that cavitation would not occur he also performed a net positive suction head available calculation to ensure that the condenser water pumps could handle the additional pressure drop in the loop. Computed the pressure drop in the steam lines to ensure that the steam chiller would function utilizing the existing boiler plant as a steam source. During the design assumed the role as project manager and was tasked with ensuring that the project was done correctly, on time, and to the client's satisfaction. Responsible for hiring all the subcontractors and subconsultants necessary to complete the scope of work. Ensured that the design was properly coordinated with all disciplines and that any and all concerns/design related issues were addressed.

Port Authority of New York and New Jersey, World Trade Center, NY. Lead mechanical engineer responsible for the design of providing high pressure steam to three new users at the WTC site. The design consisted of conveying steam from the existing Con Edison high pressure steam main to the three users. The design ensured that the piping, its components, and the housing all meet the requirements of Con Edison. The piping was also designed in the most efficient manner such that no user would have to endure a pressure drop greater than 2psi during peak demand. Performed steam pressure drop calculations to properly size the distribution piping.

New York Power Authority, City College of New York. Lead mechanical engineer in the analysis of the facility's primary and secondary chilled water distribution system. Scope of work required that the existing campus distribution sized for 8,000 tons be analyzed to ensure that it could accommodate the future 10,000 ton load. During the analysis the system was also checked to determine what caused the extremely low temperature difference that was experienced at the central plant, compared to the 14F design. Upon completion of the analysis a report was generated documenting what the trended data for the existing system meant and where the client should investigate to determine the failure. The report also provided with the results of the analysis and how their system could expect to operate under the future conditions. Completed this analysis using Pipeflo Professional 2009, generating a detailed report and performed a presentation to the client discussing the results and recommended modifications.

NYPA/NYCDEP, Wards Island Wastewater Treatment Plant. Lead mechanical engineer in charge of three (3) designers in the replacement of the facility's entire steam (4,000 ft of pipe with sizes up to 24") and condensate (3,300 ft of pipe) distribution system. The design consisted of the replacement of the existing high pressure steam and condensate piping such that the new piping would be able to adequately provide low pressure steam to all terminal devices.

Lauri Hack

DBE and Subcontracts Management

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 22 years of experience in energy/power industry
+ Expertise with procurement, subcontracts, estimating and materials management
+ Experience with PSE&G large-scale substation, transmission, and distribution projects

Years of Experience

With AECOM: 8

With Other Firms: 14

Education

BS, Business, Johnson & Wales University, 1987

Work History

2007 to Present, AECOM, Procurement Manager

2006 to 2007, Bechtel Power Corporation, Senior Purchasing Specialist

1994 to 2006, Wilson Supply/VanLeeuwen, Capitol Procurement, Project Manager

About Lauri

Lauri has 22 years of procurement, estimating, subcontracts, and materials management experience, throughout which she has drawn upon extensive planning, persuasion, and problem-solving skills. Her most recent experience has been supporting PSE&G on the North Central Reliability and Burlington Camden projects, involving large-scale substation and transmission line projects. Her experience also includes working as part of a project team in Europe to support profitability, meet construction schedule, and guide accomplishment of all technical and T&C requirements. Lauri's management abilities have enabled cost avoidance and savings in commodity management, contributing to successful projects both within and under budget. She is experienced in procurement, estimating, and materials management in all areas of transmission and distribution projects.

Relevant Project Experience

PSE&G, Burlington-Camden and North Central Reliability Project Upgrades, Various Locations, NJ. Project procurement and subcontracts manager responsible for overall procurement in addition to subcontract management support for North Central Project with approximately 30 miles of 138 kV transmission line with new 230 kV monopole transmission lines, and the associated 230 kV upgrade of nine switching stations and substations. The $399 million Burlington-Camden program consisted of the installation/modernization of 28 circuit miles of transmission assets as well as six substation upgrades from 138 kV to 230 kV and modifications to two 138 kV facilities. Responsibilities included quote solicitation, order placement and materials management, contract management, reporting to owner, and stakeholder interface. Additional responsibilities included subcontracts and modifications.

PSE&G, Marion Substation, Jersey City, NJ. Project procurement manager. Total procurement support inclusive of inquiry activity, order placement, and expediting of material to job site for equipment replacement at the Marion switchyard. Deliveries were

Lauri Hack
continued

critical to meet the turnaround schedule set forth by our on-site subcontractor and project personnel. All structural materials and miscellaneous hardware was delivered as required to meet project schedule.

PSE&G, Saddlebrook Substation Facility, NJ. Project procurement manager. Supplied procurement support to meet equipment replacement requirements at the Saddlebrook Substation facility. Activity included quote solicitation, order placement, and expediting of materials, working closely with project personnel to meet a tight window of construction as set forth by our site subcontractor. Materials included miscellaneous hardware as well as fabricated insulator spacers, both of which were received within project schedule.

PSE&G, Bennetts Lane Project, Franklin Township, NJ. Procurement manager responsible for providing the necessary procurement support to delivery to this job site of the required structural steel and control house and panels for the expansion of the Bennetts Lane Substation. Both requirements are in the inquiry review and approval stage prior to order commitment. Orders to be negotiated and then expedited through delivery and commissioning at the job site.

Wisconsin Power & Light Company, Nelson Dewey Generating Station Units 1, 2 & 3, Cassville. Responsibilities include preparing purchase orders, reviewing and maintaining forecast, and maintaining information systems for two 120 MW net coal plants that were installing a dry and baghouse system along with Mercury control, and a 300 MW circulating fluidized bed unit that included a dry scrubber and baghouse system along with Mercury control.

RRI Energy, Cheswick Power Plant, Springdale, PA. Managed purchase orders for equipment and materials to meet project requirements. Single-unit, coal-fired generation station located on a 332,000-square-meter (82-acre) site in the borough of Springdale, approximately 29 kilometers (18 miles) northeast of Pittsburgh.

Tennessee Valley Authority, Lagoon Creek Combined Cycle Project, 520 MW, Brownsville. Responsibilities included preparing purchase orders, reviewing and maintaining forecast, and maintaining information systems for this 520 MW combined cycle project.

Tennessee Valley Authority, John Sevier Combined Cycle Plant, Rogersville. Responsibilities included preparing purchase orders, reviewing and maintaining forecasts, and maintaining information systems for a plant that is located within the site boundary of an existing operating facility that contains four 200 MW coal-fired units. AECOM provided engineering and procurement services, field engineering and commissioning support, and materials management.

Andrew Agopian

Photovoltaic Technology & Energy Storage Lead

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 25 years experience, last 15 focused on solar energy
+ Expert in solar energy planning, design, construction, installation, and operations
+ Project manager and design team leader for a wide range of energy infrastructure and facilities projects
+ Licensed contractor with extensive experience in system installation and integration

Years of Experience

With AECOM: 5

With Other Firms: 20

Education

BS, Manufacturing Engineering Technology, Northrop University, Inglewood, CA, 1991

Siemens Solar Earthsafe Training Course, April 2001

Los Angeles Department of Water and Power "LADWP" Solar Photovoltaic Installation Workshop, 2001

SunWize Technologies Dealer Training Conference, 2002

Xantrex Technology, Application, Installation, and Maintenance of Xantrex PV Series Inverters, 2003

RWE Schott Solar SunRoof FS Technical Training Program, 2004

SMA America PV Technical Training May 2005

SunPower Fundamentals of Commercial Rooftop Design, 2010

Construction Management, UCLA Extension, 1997

Lean Enterprise Fundamentals Training, Encompassing the Methodology of Lean Enterprise, Six Sigma and Total Quality, Honeywell, 2000

Professional Associations

Power to the People, non-profit organization working to bring solar electricity to communities in rural areas of developing countries

Work History

2009 to Present, AECOM, Solar PV Project Manager

2007 to 2009, Regenesis Power LLC, Senior Program Manager, PV Solar Electric Systems

2006 to 2007, PowerLight Corporation (subsidiary of SunPower Corporation), Project Manager, Southern California

2001 to 2006, A&M Energy Solutions (now Martifer Solar USA), Founder and Co-Owner

1999 to 2001, Brice Manufacturing Company (A division of TIMCO), Production Manager/Program Planner

1997 to 1999, Flightways Manufacturing, Inc., Facility Manager

About Andrew

Andrew Agopian is a project manager, general contractor, production manager, and technical expert in for photovoltaic systems, energy storage facilities, and other advanced-technology projects and operations. His primary focus for the past 15 years has been on solar energy. His expertise encompasses the specification, procurement, installation and integration of photovoltaic and storage facilities for major infrastructure clients and programs.

Andrew is experienced in operational training, client and stakeholder relations, consensus building, governmental compliance, quality management, and asset management. Before joining AECOM, he was a project manager for a photovoltaic solar electric manufacturer and system integrator for commercial, municipal, and industrial applications with over 100 MW of installed systems worldwide. He also co-owned a general building contracting firm specializing in the integration and installation of cogeneration photovoltaic solar electrical systems with more than 50 completed projects for commercial, residential, and remote locations.

Relevant Project Experience

Los Angeles Department of Water and Power, Pine Tree Solar Project, CA. Design manager for a 9.75 MW photovoltaic project installed at LADWP's Pine Tree wind farm. This is one of the largest PV projects in the United States and forms the cornerstone of LADWP's 400 MW utility-owned PV program. Responsible for technical design including module, inverter, and racking selection, string sizing, tilt angle, and optimizing system layout in a space-constrained site.

California State University, Fullerton Solar Project. Design manager for the design and installation of a 1.16 Megawatt photovoltaic (PV) system divided equally on two rooftops and an elevated parking structure. The two rooftop PV systems were designed and built utilizing a ballasted solution with minimal attachment to overcome wind loading and seismic conditions. The PV canopy structure was designed and seamlessly integrated providing much needed covered parking

Andrew Agopian
continued

on the top deck. The canopy uses high efficiency LED lighting.

County of Ventura, General Services Administration, Todd Road Jail, Santa Paula, CA. Project engineer for Ventura County to develop a 1.16 MW photovoltaic fixed tilt, ground mounted system installed in a field adjacent. Led the feasibility analysis, RFQ/RFP solicitation administration, cost benefit analysis, California Solar Initiative (CSI) documentation, design review, and construction assistance.

County of Ventura, Waterworks District No.1, Moorpark Water Reclamation Facility (WRF), Moorpark, CA. Project Engineer on behalf of the County for a 1.14 MW photovoltaic tracking system installed at the WRF. Services included feasibility analysis, RFQ/RFP solicitation administration, costs benefit analysis, California Solar Initiative (CSI) documentation, design review, and construction assistance.

Naval Facilities Engineering Command (NAVFAC), Atlantic, Solar and Energy Efficiency Projects, Eastern US. As part of an AECOM joint venture, Atlantic Contingency Constructors (ACC) was awarded a multi-phase design build contract to evaluate, design, and construct PV systems over 60 identified locations spanning US Naval facilities in the District of Columbia, Virginia, Maryland, Florida, Mississippi, and Texas. As QC manager for design for ACC, led design quality control for PV systems on rooftop and carport canopy sites totaling 9 MW. As part of the second phase, developed the scope of work (SOW) for the build and subcontract solicitation process, evaluated installers, and reviewed testing and commissioning documentation for the installed PV systems.

U.S. Marine Corps, Camp Pendleton Landfill PV Project, CA. Design manager for a 1.4 MW photovoltaic facility installed on a closed landfill. The project posed unique challenges, as the landfill will continue to settle over the life of the project, and is covered by a specially designed evapotranspiration cover that cannot be altered. Incorporated numerous design elements to address the unique challenges of the project, including height adjustable racking, and a non-penetrating self-ballasted foundation system. Additionally, the modules are laid out in a manner to limit the sheeting of water, which could cause erosion of the landfill cover.

Bolthouse Farms, LA County, CA. Senior project manager for 1.8 MW of solar installations. The system is used to power water wells located on two adjacent farms. Over four miles of underground medium-voltage distribution was installed to replace 11 large direct-drive diesel pumps, helping to offset 1,700 tons of carbon dioxide and one ton of nitrous oxide emissions annually. Managed installation operations, including site analysis, design and engineering, plan check and permitting, cost accounting, scheduling, supervision of construction and installation subcontractors, and customer relations.

Hill Canyon Wastewater Treatment facility, City of Thousand Oaks, CA. Project manager for a solar system developed under one of the first power purchase agreements (PPA), which provided the City of Thousand Oaks the opportunity to achieve clean energy cogeneration without the upfront costs of construction and ownership. The single axis flat tracker, 584 kW, system is installed elevated over a retention basin, allowing the city usage of the basin for overflow. Managed installation operations, site analysis, design and engineering review, cost accounting, scheduling, construction supervision, and customer relations.

Asian Pacific Healthcare, Los Angeles, CA. Performed the site analysis, design and engineering, installation operations, cost accounting, scheduling, and customer relations for this turnkey design build project. The facility provides healthcare services to the surrounding community and was motivated to have a portion of the facility's power generated by a 60 kW rooftop solar system.

Santa Monica Public Library, City of Santa Monica, CA. Performed site analysis, design, engineering, cost accounting, scheduling, installation, operations and customer relations for a 10kW rooftop photovoltaic system installed seamlessly and in a publically visible area on the newly constructed public library.

John Hoffner, PE

Photovoltaic

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 20 years of experience in distributed renewable energy systems
+ Recognized expert in PV industry
+ Leadership role in local, state, and national organizations to develop renewable energy codes and standards, and policies
+ Technical Director State of New Jersey incentive program (CORE) for renewable energy services and programs

Years of Experience

With AECOM: <1

With Other Firms: 25

Education

MS, Engineering Science, Trinity University

BS, Civil Engineering, Tufts University

Professional Licenses/Certifications

Professional Engineer: Texas

North American Board of Certified Energy Practitioners (NABCEP)

Teaching

Co-authored and implemented solar PV training program at Austin Community College (ACC) for North American Board of Certified Energy Practitioners (NABCEP) certification. Received State funding, wrote and taught curriculum (2004 – 2009) for hands-on training and certification of solar PV installers and designers. Course prepares students to sit for nationally recognized NABCEP certification and is regularly offered at ACC and local IBEW in Austin. Member of advisory board for training center Imagine Solar.

Work History

February 2015 to Present, AECOM, Senior Solar PV Lead

2007 to 2014, CH2M HILL, Solar PV Program Manager

1996 to 2007, Conservation Services Group (CSG), formerly Planergy, Director of Technical Services

1983 to 1996, Austin Energy, Manager, Renewable Energy Division

1981 to 1983, Trinity University, Graduate Research Fellowship

1980 to 1981, RG Vanderweil Engineers, Energy Engineer

About John

John Hoffner is an accomplished engineer and manager with expertise in designing, building, commissioning, and operating utility-scale and distributed renewable energy systems. He is acknowledged in the industry for leading teams related to utility-scale photovoltaic (PV) power plants and PV on commercial buildings, and recognized in the renewable industry for technical understanding of cutting-edge PV systems and working with clients to develop high-quality and competitively priced installations in the U.S., Middle East, and Canada. He has conducted financial due diligence for clients investing in utility-scale PV plants. John has held leadership roles in local, state, and national organizations to develop renewable energy codes and standards, and policies. He has 20 years of electric utility experience regarding interconnection, building energy efficiency, and solar modeling.

Relevant Project Experience

New Jersey Solar Program (CORE). Director of technical services responsible for managing technical delivery for renewable energy services and programs, including: PV design support, quality assurance procedures for PV programs, training programs for staff, contractors and allies, technical aspects of public and consumer education activities for State of New Jersey incentive program (CORE). CSG was the subcontractor to Honeywell for initiating and implementing the New Jersey incentive program in 2007. Technical director responsible for training inspectors, setting up technical policies, and approving incentive funds for developers and installers of PV and wind systems. Designed and installed 2 MW+ of distributed renewable electric power plants for CSG and other clients. Oversaw implementation of renewable energy education and outreach programs, training, and policy development in Texas and New Jersey. Implemented "Infinite Power of Texas" education campaign for state of Texas, including a video featuring Dan Rather. Helped build Texas renewable market and drove renewable portfolio standard.

John Hoffner, PE
continued

Austin Independent School District, 1- 2 MW Roof PV Solar on Multiple Buildings, TX. Senior solar PV lead responsible for designing and overseeing construction for six to eight roof top PV systems on schools in Austin. The systems will be installed in late 2015 or early 2016.

Utility-Scale PV Plants, Recurrent Energy, Ontario, Canada. Solar PV program manager responsible for leading a team to write technical specifications and support plant commissioning for 19 solar PV projects each up to 10 MW. Enabled Recurrent Energy to sell $600M of solar assets by March 2014.

1 MW PV System Design, Silver Peak Mine, NV. Directed development of design and construction plan for 1 MW PV plant with a battery storage system to shift solar production; a cutting edge design.

200 MW SOLAR PV PLANT, Laughlin, NV. Drove development of preliminary designs, layouts, electrical one-line diagrams, PVsyst modeling, cost estimates for 200 MW solar PV plant near Mojave Substation. Client bid into San Diego market for between 5 and 6 cents/kWh, a record low price for utility-scale PV.

2 MW Solar PV Plants, PacifiCorp, OR and UT. Solar PV program manager responsible for the team who wrote technical specifications for client to hire contractors and build PV plants. Reviewed drawings and construction submittals. PacifiCorp was able procure and build plants on time and under budget.

Masdar City Development, Abu Dhabi, United Arab Emirates. Managed team providing technical design, procurement, installation, and commissioning for 10 MW PV system. The plant was completed and commissioned in 2009, the first large-scale plant in the Middle East. The project included energy efficiency measures and biomass analyses.

Due Diligence, Marubeni, 150 MW Solar PV Plant, Australia/TransCanada for a $400M investment in a PV in Ontario. Led team to conduct technical due diligence: Marubeni, was considering investing in the Australian Queensland project, and our team worked with TransCanada for a full year evaluating an opportunity that allowed them to invest in a PV plants worth $400M.

Renewable Energy Implementation. Manager, Renewable Energy Division responsible for directing implementation of solar PV, wind, and biomass plants as part of Austin Energy's overall generation plan. Worked with key stakeholders to develop utility specifications and standards for renewable plants including large-scale and distributed generation. Led installation of two 300 kW photovoltaic plants and several small systems on City buildings. Negotiated purchase power agreement for 10 MW landfill gas power plant and 10 MW share of Culberson County wind plant built in partnership with Lower Colorado River Authority (LCRA); the first utility-scale wind farm in Texas. Worked on committees for Texas Public Utility Commission to write state interconnection standards for state.

Recent Publications with Co-authors

Proposed Photovoltaic Module Form Factor to Reduce Levelized Cost of Energy, Proceedings of 40th IEEE PV Specialist Conference, Denver, CO, June 8-13, 2014

Creating a Balance of Cost, Reliability, and Maintainability for Utility-Scale PV Power Plants, Proceedings of 39th IEEE PV Specialist Conference, Tampa, FL, June 19, 2013

Solar PV Project Due Diligence for Ontario, Canada Climates, Proceedings of the World Renewable Energy Forum (WREF), Denver, CO, May 2012

San Jose, California Identifies up to 40 MW of PV for Municipal Facilities through the Solar America Cities Program, Proceedings of the American Solar Energy Society, May 2010

Sun Power For the Town of Westwood, Massachusetts, Proceedings of the American Solar Energy Society, July 2004

Renewable Energy; The Infinite Power of Texas, Proceedings of the American Solar Energy Society, June, 2002

Facilitating Solar Electric Plant Construction, an Innovative Model in Long Island, New York, Proceedings of the American Solar Energy Society, Austin, Texas June 2003

Samuel Monger

Photovoltaic

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ Detailed solar design, data analysis, and energy assessment experience
+ Experienced with boiler MACT and facility energy assessments

Years of Experience

With AECOM: <1
With Other Firms: 1

Education

MS, Mechanical Engineering, Northern Arizona University, 2014
BS, Civil Engineering, New Mexico State University, 2012

Professional Licenses/Certifications

Engineer-in-Training: NM

Professional Associations

ASES

Work History

May 2015 to Present, AECOM Corporation
2014 to 2015, Green Earth Energy & Environmental
2014 to 2015, TSERI-University of Texas at San Antonio

About Sam

Sam Monger has a broad background from research and design in civil, mechanical, and electrical engineering with a particular skillset in detailed solar design, data analysis, and energy assessment. He has worked with a variety of clients including school districts, private corporations, and residential owners. Sam currently serves as solar engineer for the AECOM Solar Practice and mechanical engineer for the AECOM Energy and Sustainability Practice. He provides DC and low voltage AC electrical design, solar array design for rooftop and ground-mounted (fixed and tracking) systems, interconnection identification, solar site assessments, construction oversight, solar energy production modeling, data analysis, energy audits, and data quality review. Sam is also involved with Boiler MACT and facility energy assessments.

Relevant Project Experience

Austin Independent School District, 800 kW Solar Arrays, TX. Solar electrical engineer, assisting in the evaluation of AISD facilities to select rooftops ideal for solar project development. Upon selection of the schools and under the guidance of a senior engineer, identified interconnections and is in the process of completing the solar design for each project.

Williams-Transco Northeast Natural Gas Compressor Stations, Lexington and Reidsville, NC and Unionville, VA. Provided a boiler MACT energy assessment and report for three natural gas fired Boilers that serve as supplemental heat producers in the natural gas compressor stations.

Ft. Sill – Boiler Energy Assessment, Lawton, OK. Performed an energy assessment of the heating system of the Ft. Sill Army Base. Under the guidance of a senior engineer, he inspected and assessed the on-site boilers in order to determine what capital improvements should be made to improve performance, resulting in energy conservation and reduced air emission. The assessment included a comprehensive site visit by AECOM staff to observe and evaluate the boiler operations. AECOM developed a financial feasibility model to evaluate the energy cost savings under various scenarios where the existing boilers were replaced with new high-efficiency condensing boilers.

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James Sherman, Esq.

Energy Storage/Integration

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 20+ years of experience in the renewable energy field
+ Co-founder of CCMT — a renewable energy, energy efficiency and microgrid project development company
+ Oversight of battery storage and electric vehicle projects in NY region
+ Coordination with specialty subcontractors for renewable energy solutions/products: Advanced Solar Products, TransPower, Power Analytics

Years of Experience

With CCMT: 2

With Other Firms: 19

Education

JD, Brooklyn Law School, 1991

BA cum laude, Urban Economics and Geography, Queens College, City University of New York, 1986

Professional Licenses and Certifications

Juris Doctorate, 1991. Admitted to practice of law in New York and New Jersey

Work History

2013 to Present, Change Mitigation Technologies LLC, Co-founder and Member

2009 to 2013, Northeast Transportation Electrification Alliance, Director

2004 to 2009, American Wind Power & Hydrogen, Inc., Project Manager

1994 to 1998, New York City Department of Environmental Protection, Assistant Counsel

About James

James Sherman is Co-founder and Member of Climate Change Mitigation Technologies LLC, a renewable energy, energy efficiency, and microgrid project development company that operates exclusively in New York and New Jersey. James' duties include project creation and development, project finance, governmental relations, and commercialization of stationary grid-tied battery storage systems for utilities, railroads, and industrial, institutional, and governmental entities and battery electric heavy duty Class 8 on and off-road tractors for port facilities and commercial fleet operators.

Relevant Project Experience

MTA New York City Transit, Wayside Energy Storage System Project. Project support and commercialization duties relating to first commercial installation of 1 MW / 733 kwh lithium ion wayside energy storage system (WESS) at traction power sub-station at 53rd Street and 6th Avenue in mid-town Manhattan. Duties also include arranging and overseeing testing of WESS at NY-BEST laboratory in Rochester, NY and in-field testing.

Albany International Airport Hydrogen Fueling Station and Hydrogen-Powered Vehicles Project, NY. Project manager supporting various logistical and program management duties relating to delivery of 700 bar hydrogen fueling station and four hydrogen-powered internal combustion engines with project partners Air Liquide, eTec (now Ecotality), and Quantum Engineering

Northeast Transportation Electrification Alliance. Director (2009 – 2013) responsible for project creation and development, project finance, governmental relations, and commercialization of battery electric light, medium, and heavy duty trucks including preparation of ARRA TIGER grant application on behalf of New York City and Newark, New Jersey for fleet of Proterra Inc. battery electric transit buses. Preparation of 2011 DOE FOA 451 Clean Cities Community Readiness and Planning for Plug-In Electric Vehicles and Charging Infrastructure grant for Essex County, New Jersey Electric Vehicle Initiative

James Sherman, Esq.
continued

American Wind Power & Hydrogen, Inc. Project manager (2004 – 2009) responsible for coordination of various logistical aspects of delivery of four hydrogen-powered internal combustion engines vehicles and 700 bar hydrogen fueling station at Albany International airport, Albany, NY under $1.5MM NYSERDA funding grant

New York City Department of Environmental Protection. Assistant Counsel (1994 – 1998) responsible for advising DEP Commissioner, General Counsel, and chiefs of various operating units on compliance with federal Clean Air Act and Clean Water Act for NYCDEP's fourteen wastewater pollution controls plants; development of regulatory rulemakings; development of specialty air permits for industrial sources; NYCDEP representative to New York State Department of Environmental Conservation's air toxics rulemaking advisory board

Jose L. Vivas, PhD, PE

Energy Storage/Integration

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 30+ years of experience in power generation and distribution
+ Expert in power system analysis and in developing international and electrical utilities
+ Formerly PSE&G Transmission and Distribution Manager
+ Has represented PSE&G before NESC (National Electric Safety Code) and the Board of Public Utilities

Years of Experience

With Power Analytics (Subcontractor to CCMT): 2
With Other Firms: 32

Education

PhD, Electric Power Systems, Moscow Power Institute, 1989
ME, Power Systems, Rensselaer Polytechnic Institute, 1978
BE, Electric Power Systems, Central University of Venezuela, Caracas, 1974

Professional Licenses and Certifications

Professional Engineer: New Jersey

Specialized Training

Training in Automation in Electric Power Plants and Industries, Arles, France

Work History

2013 to Present, Power Analytics, VP of Power Engineering Services
2012 to 2013, Samsung C&T Engineering and Construction Americas, Sr. Manager of Power and Transmission Lines
2012, Altran Solutions, Chief/Manager of Electrical Engineering
2010 to 2011, DOOSAN Engineering and Services, Manager of Electrical Engineering
2006 to 2010, QEI Inc., New Jersey, Director of Latin American Business Development
1996 to 2006, PSE&G New Jersey, Transmission and Distribution Manager

About Jose

Jose's experience in engineering and project management dates to 1974. His work includes management of business development, design and engineering, construction, start-up and operations of interconnections, power generation, transmission lines, substations and distribution facilities. Jose is an expert in power system analysis and in developing international and electrical utilities marketing and business development, as well as in positioning ECA organizations, utilities, developers, products and brands in the USA and Latin American power markets. Currently, Jose is the VP of Power Engineering Services for Power Analytics Corporation, where he provides consulting engineering and power system analysis, smart microgrid design and transmission planning for several large projects.

PSE&G assignments directly related to the NJ Transit Project. He worked at PSE&G in New Jersey for ten years (1996-2006). His work included many projects and studies for the Port Authority and Amtrak. Jose was in charge of interconnection studies and contingency analysis for PSE&G, and has a deep and broad perspective about New Jersey's "critical hot spots" for transmission constraints, substation vulnerabilities, and locational marginal pricing.

Jose thoroughly understands PSE&G's interconnection with the New York power system, and how interdependent these systems are during emergency situations. For example, after the costly multi-billion dollar 2003 blackout which took out a significant portion of the Northeastern grids, the Federal Energy Regulatory Commission (FERC), NYISO, PJM, and the NY/NJ state regulators and legislators decided that the New Jersey power system must be configured to provide firm backup capability for New York City and as many critical services as possible, such as local hospitals, fire stations, gas stations, tunnels, trains, subways, bridges, and ferry ports. During this time, he represented PSE&G before NESC (National Electric Safety Code) and the Board of Public Utilities. While much of this RTO/ISO and utility interconnection work has been done since 2003, there remains a tremendous need for an off-

Jose L. Vivas, PhD, PE
continued

grid emergency power system that the NJTA microgrid project would fulfill. His expertise would enable the NJTA to meet this need with the Power Analytics microgrid power management system.

Enabling such emergency power service requires expert engineering and planning skills, and a thorough understanding of all relevant power parties — PSE&G, Commonwealth Edison, Exelon, Amtrak, the Port Authority of New York and New Jersey, PJM, NYISO, etc. Jose knows that the critical points of interconnection between New Jersey and New York are: Secaucus Junction, Hoboken and Newark Station—all of which were identified in the NJTA's Scope of Work.

Other Projects

ABENGOA, Mojave Solar Power Plant, Hinkley, CA. Lead engineer and project manager for optimization of power electrical studies, electrical model, lightning protection and interconnection to the grid. Updated the electrical studies (load flow, short circuit, relay coordination, arc flash and lightning protection) and optimized the electrical performance, stability and reliability of the 250 MW Solar Power Plant and the interconnection with the 230kV grid.

Huntsman Petrochemical Corp, The Woodlands, TX. Update, quality control and optimization of power electrical studies, update of electrical model, and special protection of new substation. Updated the electrical studies (load flow, short circuit, relay coordination and arc flash) and optimized the electrical performance, and reliability of the 52 substation and 1,300 buses Huntsman's electrical system and the interconnection with the 69kV grid.

James Buchok, PMP, DGCP, CEM

CHP, EV and Demand Side Energy Management Lead

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 40+ years of energy/distributed generation experience
+ Certified energy manager and distributed generation professional
+ Expert in all aspects of energy management systems, and combined heat and power projects
+ Has managed projects individually valued up to $120 million

Years of Experience

With AECOM: 3

With Other Firms: 38

Education

BA, Corporate and Organizational Management, University of Connecticut, Storrs

AS, Engineering Technology, Northwestern Connecticut Community Technical College

Professional Licenses/Certifications

Project Management Professional (PMP)

Distributed Generation Certified Professional (DGCP)

Certified Energy Manager (CEM)

Work History

2012 to Present, AECOM, Senior Manager, Major Projects, Energy

2008 to 2012, Emcor Energy Services Senior Project Manager

1997 to 2008, United Technologies-Carrier/UTC Power, Senior Project Manager

1993 to 1997, Carrier Corporation/United Technologies, Service Manager

1980 to 1993, Carrier Corporation/United Technologies, Service Technician

1978 to 1980, Peterson Co., Service Technician

1974 to 1978, E.S. Mull & Co., Service Technician

About James

James Buchok is a certified energy manager and distributed generation certified professional with 40 years of progressively responsible experience in all aspects of power generation, combined heat and power (CHP), industrial process cooling, refrigeration, piping, HVAC, energy management, temperature control/ instrumentation and general building construction industry. His experience encompasses project management, engineering, estimating, sales, project development, business management, procurement, construction, installation, and commissioning of projects. He combines in-depth technical knowledge and sound business/project management practices to focus on complete client satisfaction. He is a certified Project Management Professional with a thorough understanding of the Project Management Institute's (PMI) project management means and methods.

James manages major energy projects and portfolios requiring complex coordination across multiple systems and processes. He solves problems in areas of risk, financial, contract and resource management as well as construction management. He develops strategies, negotiates contracts, and acts as single point of contact with clients. He manages internal project teams of 15 or more members representing multiple disciplines, and he manages multiple contracts and construction subcontractors.

Relevant Project Experience

New York Power Authority, Rikers Island 15 MW Combined Heat & Power Project, NY. Led a project for the construction of new power plant building, extensive underground 27.5 kV electrical distribution systems, two solar 7.5 MW combustion gas turbines, two Rentech heat recovery steam generators, two Enerflex gas compression systems, and all balance of plant control systems.

St. Francis Hospital, Hartford, CT. Managed complete chiller plant renovation, including piping, electrical, new chillers, heat exchangers and building automation system.

James Buchok, PMP, DGCP, CEM
continued

University of New Hampshire, 4.5 MW Gas Turbine Co-generation Project, Durham, NH. Designed the project to operate on landfill gas. It included gas compression and natural gas blending stations, 5kV & 34.5 kV electrical installation and tri-fuel modifications to an existing 8.0 MW Siemens/Alstom gas turbine

Pratt & Whitney, Combined Heat & Power 7.5 MW Gas Turbine Co-Generation, Middletown, CT. Led project consisting of new building construction, boiler plant including heat recovery and new packaged boilers, and 115 kV electrical infrastructure improvements.

Fordham University, Bronx, N.Y. Designed the university's Rose Hill Gym HVAC and controls installation.

Fairfield University, CT. Led the design and installation of a 4.5 MW combined heat and power with solar gas turbine generator set. This included a high temperature HW absorption chilled water plant.

New York Medical College, Valhalla. Led the development and delivery of a complete campus-wide HVAC renovation, including new chilled water and boiler plant, electrical infrastructure upgrades, and energy management system

The Energy Network/Hartford Steam Co., District Heating/Cooling Plant, CT. On-site construction and retrofit of 3000-ton steam turbine drive chiller. Refrigerant conversions and steam turbine replacements on two 1500-ton chillers.

Capital District Co-Generation Energy Center. Managed and performed the design of a 4,000-ton central cooling plant start-up and commissioning.

Pratt & Whitney Aircraft-Southington, CT. Led the design of a chiller plant replacement project and DDC building automation installation.

Pratt & Whitney Aircraft, East Hartford, CT. Managed a powerhouse process cooling control project and Wilgoos test lab chiller plant modifications.

Carrier World Headquarters, Farmington, CT. Presidential office suite renovation.

Hartford Hospital, CT. Managed the conversion of three nuclear duty 1,500-ton chillers for comfort cooling use including R-134A conversions, micro-processor controls and heat exchanger re-tube

Sikorsky Aircraft, CT. Delivered a 10 MW combined heat and power plant that uses a solar gas turbine gen set.

University of Connecticut Health Center, Farmington. Led a campus-wide DDC building automation retrofit.

Johnson & Johnson Pharmaceutical Research Facility, Spring House, PA. Designed a 4.0 MW combined heat and power plant-project consisted of construction of new power plant building, installation of 4.0 MW MWM reciprocating gas engine generator, heat recovery steam generator, 5 kV and 34.5 kV electrical gear and wiring, and all balance of plant control systems.

New York Power Authority, Wards Island Wastewater Treatment Plant. Managed the installation and commissioning of high pressure steam boiler plant.

Jeffrey Brier

Combined Heat & Power

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 44 years of experience in the energy/power industry
+ Expert in CHP and renewable fuels and the assessment of energy solutions
+ Extensive CHP project planning, design and procurement experience: Rikers Island Cogeneration Facility, Lahey Clinic, NYCDEP North River

Years of Experience

With AECOM: 3
With Other Firms: 41

Education

MBA, New York University, 1974
BS, Chemical Engineering, The Cooper Union, 1970

Work History

2012 to Present, AECOM, Vice President, Technical Services
1997 to 2012, EMCOR Group, Inc., Vice President, Technical Services
1986 to 1991, Vanderbilt Industrial Contracting/Centrig Industrial Contracting, Industrial Mechanical Construction Manager
1991 to 1997, National Energy Production Corporation, Manager Purchasing/Estimating
1973 to 1986, Dart Industries - Chemicals and Plastics Division Economic Engineer, Project Manager - Engineering and Construction, Program Coordinator - Research, Semi-works Plant Manager, and Director of Engineering and Construction
1970 to 1973, E I Dupont, Industrial Chemicals Plant Process Engineer

About Jeff

Jeff Brier has an extensive background in combined heat and power, cogeneration and bio mass fueled power facilities, using reciprocating internal combustion engines, gas turbines, steam turbines, boilers, and chillers. In renewable fuels, Jeff has expertise in the conversion of bio gas's into pipeline quality gas.

Jeff supports clients through assessment of their requirements to provide proposed solutions to their electrical and thermal energy needs. With the support of project teams these solutions are expanded into first Schematic and then Detailed designs As a project moves forward, Jeff provides leadership to the engineering design process, the procurement of major equipment systems, and supports field construction and commissioning/startup.

Relevant Project Experience

New York Power Authority, Rikers Island Combined Heat and Power - 15 MW. Project includes 2 – Solar Taurus 70 Combustion Turbines with duct fired HRSGs. Electrical system design and interconnect provides for black start and island mode operations. Providing design review and RFI support to project design and construction team to resolve vendor and contractor questions.

National Grid, Newtown Creek Conversion of Digester Gas to Pipe Line Gas, New York, NY. Develop and implement a 1600 SCFM digester gas purification system on an Engineer, Procure, Construct basis to purify digester gas at New York City's Newton Creek Waste Water Treatment facility to produce pipeline quality gas and inject in local utility gas distribution system. Due to proximity to a residential property line project design incorporates both extensive noise control measures and "aesthetic" finishes.

Lahey Clinic, Combined Heat and Power - 3MW, Burlington, MA. Examined and modeled facilities electric energy and thermal energy consumption profiles to develop a solution which provided the opportunity for more than 65% (HHV basis) system efficiency and identified that the preferred solution would be a 3 mW – Caterpillar 260-12 (previous model no. MWM 2032-12) reciprocating internal combustion

Jeffrey Brier
continued

engine CHP solution based upon analysis of clients energy requirements. Solution provides a substantial portion of facility electric energy needs for normal operation and steam and hot water for various building services. System design includes islanded operation for non-life safety electric loads. Responsible for system design and procurement and providing mechanical and electrical construction support.

New York City Department of Environmental Protectino, North River Combined Heat and Power. Provide owner's engineers services to review engineers proposed designs and vendors submissions for a 5 x 3 MW combined heat and power facility fueled by a combination of digester gas and natural gas. Includes digester gas purification system.

Radford Army Arsenal, Combined Heat and Power Plant, VA. Prepared design-build bid package. Led the engineering team responsible for preparing the preliminary design and specifications for a combined heat and power plant, with black start capabilities, capable of producing at least 16 MW of electric power at 69 kV and more than 500,000 lbs/hr of superheated steam. This work is being performed for the US Army Corps of Engineers who will use the AECOM prepared preliminary design documents to solicit for a design-build contractor.

Norfolk Southern, Juniata Locomotive Repair Center – Boiler House Revisions and CHP, Altoona, PA. Evaluate existing site operations to identify means to discontinue existing coal fired boiler operations, enhance existing gas fired boiler operations and investigate potential for CHP opportunity. Providing team leadership in the investigation of existing energy consumption patterns to identify locations to supply with recovered thermal energy followed by the development of project life cycle models used in evaluating alternative CHP solutions (microturbine, combustion gas turbine, reciprocating gas engine) and then for the engineering and construction management for implementation of the program. CHP will be an ~1.6 MW internal combustion engine – generator set with black start capability, steam and hot water heat recovery, and upgraded controls for existing gas fueled boilers

Johnson & Johnson, Combined Heat and Power - 4MW, Spring House PA. Phased project included studying, engineering, procurement, and construction of a 4 MW – MWM 2032-16 reciprocating internal combustion engine CHP solution. Initial phase was study of existing and projected energy consumption patterns as they might be served with varying system solutions (reciprocating engine vs. turbine) to evaluate the site's suitability for an economically successful CHP project. Responsible for system design and procurement and providing mechanical and electrical construction support. This project was successful in obtaining a capital cost reduction grant through Penelec.

University of New Hampshire Phillbrook Chiller Expansion, Durham NH. Responsible for system design and procurement of a 800 ton absorption chiller addition, with revised PLC controls for the 2000 ton central chiller node. Providing mechanical and electrical construction support.

Sierra Plumas Rural Electric Cooperative Combine Heat and Power - 6MW, Susanville, CA. Developed a cost effective reciprocating internal combustion engine solution to deliver 6 MW (2 x 3 MW GE Jennbacher 620) to the local utility and provide hot water to host facility. Normal operation is in parallel with other utility generation assets with black start and islanded operation capabilities incorporated as transmission lines were frequently lost due to snow storms. Responsible for system design, procurement, and mechanical and electrical construction support.

Ortho Clinical Devices Combined Heat and Power - 2MW, Raritan NJ. Developed a 2 MW CHP project incorporating a Kawasaki combustion turbine with steam heat recovery project. Responsible for system design, procurement and providing mechanical and electrical construction support .

Midtown Thermal District Energy, Atlantic City, NJ. District energy facility providing 140,000 lbs per hour of steam and 17,000 tons per hour of chilled water to eight hotels along the Atlantic City Boardwalk. Responsible for all major equipment procurement, construction subcontracts, and field construction support.

Paul Yallouris, PE

Combined Heat and Power

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 30+ years of CHP, cogeneration and WTE experience
+ Experience in the design and procurement for plant energy systems, including CHP projects
+ Lead Mechanical Engineer for NYPA's Rikers Island Cogeneration Facility project

Years of Experience

With Macan Deve Engineers: 1
With AECOM: 9
With Other Firms: 27

Education

MS, Mechanical Engineering, Columbia University
BME, Mechanical Engineering, City College of New York

Professional Registration

Professional Engineer: New York, Florida

Work History

January 2015 – Present: Macan Deve Engineers, DPC, Senior Technical Consultant
2012 to 2015, New York Power Authority, Project Engineer – Contract Employee Power Generation Group
2003 to 2012, AECOM, Project Manager/Project Engineer/Lead Engineer - Diverse Projects [Energy and Power]
1999 to 2003, Duke Engineering and Services, Senior Engineer
1989 to 1999, Stone and Webster Engineering Corporation, Project Engineer
1979 to 1989, Gibbs & Hill, Mechanical Engineer

About Paul

Paul Yallouris has extensive experience in engineering and design of combined cycle, cogeneration, and waste-to-energy (WTE) plants. He is responsible for detail design and conceptual studies, equipment specification and selection, preparation of material and heat balances, piping and instrument diagrams, proposals, schedules and manpower forecasts. Paul serves as lead mechanical engineer on combustion turbine simple and combined cycle, cogeneration and WTE projects. He was the project engineer on a major EPC (Engineer, Procure and Construct) WTE Project and on APC retrofit projects. Paul is experienced in plant energy systems, including CHP projects, central plant design of chilled water and boiler systems.

Relevant Project Experience

Rikers Island cogeneration, CHP project, (15mw), NY. Project engineer/lead engineer performing and supervising all system related, and specification work for the design of two (2) gas turbine HRSG modules, each generating a nominal 7.5 MW and 70k lbs/hr saturated steam at 150psig.

Jailolo Geothermal Power Station (2-20MW), Indonesia. Lead engineer for feasibility study.

MWRA Deer Island, Combustion Turbine and Steam Turbine, Boston, MA. Project manager/project engineer for plant upgrades (50MW/20MW), gas turbine black start upgrades and steam turbine cycle efficiency upgrades.

Hillsborough County RRF Expansion Project (20MW), FL. Project engineer providing design, engineering, scheduling, and procurement services for the implementation of this 600 tons-per-day expansion to this waste-to-energy plant. The project involved the addition of a new boiler, APC system, turbine generator, switchyard expansion, and all ancillary equipment and systems needed for the expansion.

Old Dominion Electric Cooperative, Marsh Run Simple Cycle Generation Project. Performed design review of the consisting of three GE 7FA gas turbines.

Paul Yallouris, PE
continued

Thums Simple Cycle, LM6000, Combustion Turbine Power Plant. Lead mechanical engineer for the detail design of the plant. Special features include an SCR, inlet air chilling, water treatment system for NOx Control and power enhancement, cooling systems and miscellaneous balance of plant systems.

Mirant Chalk Point Power Station. Developed conceptual designs for adding additional capacity of 4 simple cycle GE 7EA's combustion turbines as peaking units. In addition made plant layout provisions and developed all necessary permitting support engineering documents to convert the Siemens Kraftwerk 84.2 units to combined cycle.

Mirant Corporation Dickerson Station. Lead Mechanical engineer for combined cycle conversion and expansion project.

Allegheny, Acadia Bay. 500MW combined cycle and 88MW (2 LM 6000) Peaking Plants .

Trigen, Millenium Cogeneration Project. Lead mechanical engineer and performed all detail design functions in the mechanical engineering field.

Resource Recovery Facility (RRF) APC Retrofit Project, Pinellas County, FL. Lead mechanical project engineer for three boiler trains at 1050 TPD each.

1800 TPD and 70 MW Resource Recovery Facility (RRF), Montgomery County, MD. Joint Venture EPC Contract with Kiewit Construction. Project engineer responsible for the project's civil, structural, architectural, electrical, instrumentation and control (I&C), mechanical, and facilities engineering and design.

1440 TPD and 45 MW Resource Recovery Facility (RRF), Union County, NJ. Design-build contract with Walsh Construction. Project engineer responsible for the project's civil, structural, architectural, electrical, instrumentation and control (I&C), mechanical, and facilities engineering and design.

300 MW Combined Cycle Reference Plant Design, Westinghouse Power Projects Division. Project engineer for design services. Developed multiple powerhouse and plot plan configurations with 501-D5 combustion turbines and associated HRSGs coupled with several steam turbine cycle arrangements. Performed optimization and cost comparison studies.

50 MW Combined Cycle and Cogeneration Projects, Carthage and South Glen Falls, NY. Lead engineer for mechanical engineering and piping design work, which included conceptual plant arrangement, drawing production, equipment delivery and plant construction activities. Main components included aeroderivative gas turbines, supplementary-fired HRSGs, steam turbines and auxiliaries, and once-through and CT circulating water systems.

1080 TPD and 30 MW Resource Recovery Facility (RRF), Pasco County, FL. Lead mechanical engineer responsible for supervising the production of all mechanical drawings and specifications for steam, water, air, oil and gas systems. Also supervised materials handling for fly ash and bottom ash; heating, ventilating and air conditioning (HVAC); plumbing; and fire protection work.

Miscellaneous Projects. Mechanical engineer responsible for performeing systems engineering and design work, and selected refuse handling, combustion, power cycle, and residue handling systems equipment for the projects delineated below:

- 2250 TPD and Two 35 MW Turbine Islands with ACC, Essex County Resource Recovery Facility (RRF)
- 500 TPD and 13 MW Facility, Portland, Maine
- General Electric (GE) and BBC Gas Turbines and Dual-Pressure HRSGs, Tungshisiao Combined Cycle Plant, Three 300 MW Units
- 600 MW Combined Cycle Facility, Guddu, Pakistan
- 600 MW Coal-Fired Facility, Hsinta Units 1 & 2, Taiwan

Roger J. Lemos

Combined Heat and Power

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 40+ years of experience in MEP design
+ Expertise in utility system design, power plant design, thermal distribution systems, fire protection, regulatory consulting and integrated MEP systems
+ Responsible for facility modifications and master planning for projects throughout the U.S.

Years of Experience

With WSP/Parsons Brinckerhoff: 21
With Other Firms: 17

Education

BS, Civil Engineering, Worcester Polytechnic Institute, 1977

Work History

1994 to Present, WSP/Parsons Brinckerhoff, Vice President

About Roger

Roger Lemos has an extensive background in engineering project management and consulting. His areas of expertise include utility system design, power plant design, thermal distribution systems, facility modifications, facility master planning, fire protection, regulatory consulting, and integrated mechanical and electrical system design, start-up, and testing. As a project manager for WSP | Parsons Brinckerhoff, Roger is responsible for project management, technical direction, and client interface for mechanical and electrical engineering projects. Before joining WSP | Parsons Brinckerhoff, Roger served in several key management positions, including engineering division manager for another engineering consulting firm in Framingham, Massachusetts. In addition to his project management functions, which included supervising 50 electrical, mechanical, civil, and fire protection engineers on complex multi-million-dollar projects for utilities and industrial clients, he led marketing and sales initiatives and interacted with clients.

Relevant Project Experience

Beacon Generating, Greentree Landfill Gas to Pipeline Quality Gas-processing Project, Kersey, PA. Project manager for engineering, procurement assistance and design required to install a gas processing facility including gas processing building and prefabricated electrical switchgear building at an existing landfill located on Toby Road in Kersey, Pennsylvania.

Beacon Generating, Imperial Landfill Gas to Pipeline Quality-processing Project, Pittsburgh, PA. Project manager for engineering, procurement assistance and design required to install a gas processing facility including gas processing building and prefabricated electrical switchgear building at an existing landfill located on Boggs Road, near Pittsburgh, Pennsylvania.

100 MW Power Plant, Paducah Power Systems, Paducah, KY. Project manager for the detailed engineering and design of a plant consisting of two Pratt & Whitney Twin Pack combustion turbine generator sets operating in simple cycle configuration.

Roger J. Lemos
continued

120 MW Thomas A. Watson Generating Plant, Braintree Electric Light Department, MA. Project manager for the detailed engineering and design of a plant consisting of two Rolls-Royce Trent 60 WLE (wet low emissions) combustion turbine generator sets operating in simple cycle configuration, plus a variety of auxiliary equipment to support the complete plant.

Sawyer Passway Project, Fitchburg, MA. Project manager for the initial design and permitting of a 50 megawatt (MW) power plant on the site of the former Sawyer Passway power plant. The scope of work included an initial feasibility study, evaluation of equipment alternatives, project permitting, and development of an integrated project schedule.

Chelsea Energy Project, MA. Project manager for the initial design and permitting of a 240 MW power plant in Chelsea Massachusetts. Responsible for initial site investigation, site survey, geotechnical investigation, development of a site plan, determination of plant performance, and support of project permitting.

6 MW High Sierra Cogeneration Plant, Susanville, CA. Project manager leading the detailed engineering and design of a plant consisting of 2 x Jenbacher JMS 620 NG engine generator systems with heat recovery. Scope of work included the design, procure, and construction of a new combined heat and power plant (CHP)

Kleen Energy Systems Project, Middletown, CT. Project manager for engineering support of project conceptual design and project permitting. The Kleen Energy Systems project is a nominal 520 MW combined cycle power project using GE 7FA combustion gas turbines and a D-11 steam turbine. Engineering in support of project development required dealing with an extremely challenging site containing an abandoned feldspar quarry and steep topography. Engineering responsibilities included site civil design, equipment layout, heat balances, emissions projections, water balance, drainage studies, and evaluation of electrical interconnection. WSP | Parsons Brinckerhoff was also tasked with developing a detailed design basis document for the project to support development of construction cost estimates.

Wallingford Energy Project, CT. Principal in charge of financial analysis, environmental permitting, and preliminary engineering for this 240 MW simple cycle peaking plant. Coordinated preliminary design activities of environmental consultants and various engineering disciplines in development of a technically sound and environmentally acceptable plant configuration to support the permitting process.

Lordsburg Power Project, NM. Project manager for the initial feasibility study for a 120 MW combined cycle power plant using General Electric LM-6000 gas turbine generators. Other engineering responsibilities included developing and implementing an environmental investigation and cleanup of the Lordsburg site and API-653 inspection of on-site fuel oil storage tanks.

Genetics Institute, Andover, MA. Deputy project manager for the design of a 6 MW dual-fuel cogeneration facility that supplies steam and electricity to this bio-engineering facility. Responsible for the relocation of civil utilities, design of the building that houses the gas turbines and heat recovery steam generators, and the diesel fuel backup system.

Freeport Municipal Power Company, Village of Freeport, NY. Performed an evaluation of the feasibility of converting the existing power plant in the Village of Freeport to a 94 MW simple cycle gas-fired peaking plant. Scope of work entailed investigation of existing site constraints, conceptual sizing of equipment for new plant, evaluation of environmental constraints, and preliminary construction cost estimate.

Brown University, Providence, RI. Project manager for the development of a consolidated mechanical and electrical utility system master plan for the Brown University campus.

Rhode Island Hospital, Providence. Project manager for a comprehensive assessment of the hospital's cogeneration facility and electrical distribution system.

Michael C. Simon

Electric Vehicles

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 20+ years of experience in the renewable energy field
+ Founder of TransPower — a company committed to providing zero-emission transportation solutions for heavy-duty trucks and other vehicles
+ Technical and economic expertise with focus on transportation and energy technologies
+ Successful commercialization of new technologies, including electric drive and storage systems for trucks, buses and other vehicles

Years of Experience

With TransPower (subcontractor to CCMT): 5

With Other Firms: 29

Education

BS, Political Science/Social Science, Stanford University, 1980

ME, Economic Systems, Stanford University, 1981

Work History

2010 to Present, Transportation Power, Inc., Founder, President, and CEO

2006 to 2010, General Atomics, Director, Commercial Business Development for Electromagnetic Systems Division

1993 to 2005, ISE Corporation, Co-founder and Co-CEO

1982 to 1993, General Dynamics, Program Manager, Advanced Space Transportation Systems (1988-1993), Business Planning Administrator (1986-1987)

1981 to 1982, NASA Headquarters, Research fellow on assignment from Stanford University

About Michael

Michael Simon, who has 35 years of professional experience, is TranPower's founder, President & CEO. Under his leadership, TransPower has grown from a company that generated less than $1 million in 2011 to one that is projected to generate nearly $6 million in revenue in 2015 and more than $12 million in 2016. Michael's unique blend of technical and economic expertise, along with his lifelong focus on transportation and energy technologies, has enabled him to achieve numerous successes in commercialization of new technologies.

Prior to founding TransPower, Mike was Director of Commercial Business Development for the Electromagnetic Systems Division of General Atomics (GA), where he led the company's marketing of transportation and renewable energy technologies from 2006 until early 2010. In this capacity, Simon led the marketing of GA's maglev and linear motor systems, and helped originate concepts such as "LIM-Rail," "MagneRail," and "MagneTruck." He also led GA's marketing of high-power inverters for wind turbines, utility-scale solar systems, and other renewable energy applications. Mike's primary focus at GA was to develop a maglev business for moving containers at the Ports of Los Angeles and Long Beach, based on a GA maglev technology called the Electromagnetic Cargo Conveyor (ECCO). However, the high cost of maglev prompted Simon to investigate lower cost means of applying electric technology to the problem of goods movement, such as via electric drayage trucks.

Before joining GA, Mike was Chairman and Co-CEO of ISE Corporation, a company he co-founded in 1995 with colleague David Mazaika. From 1995 until 2005, Mike directed all company financial, business development, and administrative matters. ISE achieved ten consecutive years of revenue growth over this period, and grew from a start-up operation to a fast-growing high-tech firm with 60 employees and more than $20 million in revenues by the time Mike departed in 2005. While at ISE, Mike also played a leading role in conceiving and designing ISE's industry-leading products, co-inventing ISE's gasoline hybrid and fuel cell hybrid drive systems.

Leah Milcarek, PE
continued

Allegheny County, Virtual Energy Savings Performance Contract, Feasibility and Scoping Assessment, Pittsburgh, PA. Project manager (for first phase) to evaluate upgrading the Allegheny County Health Department's Clack Health Center from aging 1930's era buildings to LEED Silver, energy efficient office buildings. Oversaw development of project scoping and execution for multi-disciplinary, multi-geography team and subconsultants. Responsible for successfully development of a project that meets client needs, budget, and could be executed as a performance contract.

Private Client, Locomotive Shop - Energy System Site Assessment, Altoona, PA. Project manager responsible for managing the schedule, budget, and coordinating team resources for a rapid two-month energy audit. The audit will result in recommendations that the client intends to carry through to design and construction.

Naval Facilities Engineering Command - Midwest, Navy Region Midwest Energy Plan, IL, IN, TN. Project manager responsible for coordinating the technical efforts of four task leaders across multiple geographies and disciplines to accomplish two fiber optic investigations, a thermal optimization assessment, and photovoltaic and net-zero assessments. These four tasks are spread across three Navy installations, and building on a high-level planning study that AECOM completed for the Navy in 2013. Responsible for schedule, budget, client communication, and team coordination.

U.S. Army Corps of Engineers, USACE Sustainable Infrastructure Assessments, Malmstrom AFB, MT. Energy product line lead and energy auditor for energy audit at Malmstrom Air Force Base. The project includes liaising with the base energy manager and AECOM site coordinator, organizing and managing a team of energy auditors, completing energy audits while on-site, and overseeing the development and packaging of the client deliverables for integration into the larger AECOM report to the base.

City of Philadelphia, Philadelphia International Airport - IGA Evaluation and Cost Estimate, PA. Project manager overseeing a team of engineers and cost estimators for preliminary and final review of energy conservation measures (ECMs) and development of an independent cost estimate of those ECMs as proposed by an energy services company for the Philadelphia International Airport.

Allegheny County, Guaranteed Energy Savings Phase II, Pittsburgh, PA. Project manager responsible for coordinating client, energy services company, and subconsultants; client representation; and resolving any project issues. Also responsible for managing other client directed tasks including the design of a new 500-gallon domestic water tank, a cooling assessment of a historic courthouse, air permitting at regional care facilities, architectural specification development, condition assessments of multiple facilities, and a new cooling tower maintenance access structure.

Town of Hempstead, Energy and Sustainability Master Plan, Hempstead, NY. Project manager for the collaboration of the energy and planning, design, and development groups within AECOM for the creation of a master plan that will provide a comprehensive, integrated, and innovative framework for the town. Coordinating all tasks and deliverables, maintaining project schedule and budget, and providing the primary point of contact for the client. Specific aspects of these responsibilities include bi-monthly meeting agendas and minutes, monthly invoicing, and reporting for the American Recovery and Reinvestment Act of 2009.

Allegheny County, Guaranteed Energy Savings Project (GESP), PA. Project manager for the GESP technical advisory team. Provided coordination among the client, energy service company, AECOM project team, and subconsultants. The technical advisory role has included assisting the county in all aspects of executing the Phase I project, from initial project scoping and RFP development, to selection of an ESCO for execution of the GESP contract, review of the ESCO investment grade audit, construction coordination during project implementation, and review of measurement and verification and closeout documentation. Provided monthly client and ARRA reporting as well as ongoing client support for various meetings and facility coordination.

Damee Choi, PE, CEM, LEED AP

Demand Side Energy Management

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 15 years of experience in the energy/power industry
+ Expertise in energy audits, energy measures identification, energy savings analysis for projects in the NY/NJ Metro area
+ Assessment and conceptual design of CHP solutions
+ Licensed PE, Certified Energy Manager, and LEED Accredited Professional

Years of Experience

With AECOM: 6
With Other Firms: 9

Education

BE, Mechanical Engineering, The Cooper Union, 2000

Professional Licenses/Certifications

Professional Engineer: New York
Certified Energy Manager
LEED Accredited Professional

Professional Associations

American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): Associate Member, Member

Work History

2009 to Present, AECOM, Energy Engineer
2000 to 2009, PB Power, Inc., Energy Engineer

About Damee

Damee Choi is an energy engineer responsible for tasks including but not limited to, performing energy audits, identifying energy savings opportunities, performing energy savings analysis, developing complex energy models, developing cost estimates, and establishing greenhouse gas emissions inventory. She has been involved in technical roles, such as drawing and document review for codes and standards compliance, and contract review in building energy service line of work. For these energy projects, Damee has been engaged with construction administration/construction bidding where she has prepared bid packages, requests for proposals (RFPs), evaluated contractors' bids, and negotiated costs. On power projects, she has developed water balances, energy balances, construction manpower estimates, project cost estimates, and preliminary site layout plans. Damee has been instrumental in client liaison and coordination with sub-consultants, vendors, and contractors.

Relevant Project Experience

New York City Department of Environmental Protection, Wastewater Treatment Plant Energy Audits. Energy engineer responsible for energy audit, energy measures identification, energy savings calculations, construction cost estimates and QA/QC numerous spreadsheets containing calculations from different disciplines. Worked on four different wastewater treatment plants.

New York City Department of Environmental Protection, Landfill Renewable Energy Generation Prefeasibility Study. Energy engineer responsible for coordinating multidisciplinary study effort. Also performed an energy analysis of the landfill gas power generation. The study evaluated the viability of deploying solar PV based on renewable energy generation technology at three landfill sites owned by DEP. Economic, regulatory, procurement, and community impact were reviewed and discussed in the report. The landfill gas generation profile and the ability for power generation were also evaluated as part of the study.

Damee Choi, PE, CEM, LEED AP
continued

New York Power Authority, Statewide Energy Program - Energy Audit, Auburn City. Involved in preparing an energy audit report focused on methods of reducing existing power demand and electric power consumption, and promoting the use of alternate power sources for various facilities and buildings. The report specified using energy efficient light fixtures, new light controls with sensors, modifications to processes at the water filtering and wastewater treatment plants, using high efficiency motors and upgrading power.

U.S. Department of Veterans Affairs, Northport CHP Feasibility, Northport, NY. Energy engineer responsible for developing an hourly energy model development for CHP application. Also conducted a site visit to collect data necessary for the energy model. The model estimated the overall CHP system efficiency and energy savings. Investigated potential grant and incentive opportunities. Worked with design team to prepare a conceptual design package and feasibility report.

Norfolk Southern, Juniata Locomotive Shop CHP Feasibility, Altoona, PA. Energy engineer responsible for developing an hourly energy model development for CHP application. The model estimated the overall CHP system efficiency and energy savings. Worked with design team to prepare a preliminary feasibility report. Identified $2.5M grant and incentive opportunities and worked with agencies to develop applications.

Air Force Civil Engineer Support Agency (AFCESA), Sustainability Infrastructure Assessment, Various Locations, US. Energy engineer responsible for energy audit, energy savings calculations, construction cost estimates, and QA/QC. She worked on six different air force bases over two years period.

County of San Louis Obispo Energy Report, CA. Energy engineer responsible for energy model development simulating county's complex central plant system and associated buildings. Energy model was developed by using the Carrier HAP software. Successfully calibrated the model to the actual utility bills and predicated energy savings for various energy conservation measures at building and central plant levels.

New York State Office of General Services, Eleanor Roosevelt State Office Building Energy Conservation Feasibility Study, Poughkeepsie. Mechanical engineer on the team engaged to analyze and recommend options for replacing the aging boiler plant serving the building. NYSOGS turned to New York Power Authority for an engineered solution for upgrading its existing 22,500-ton chiller plant and reducing its operating costs. The team developed a model to represent and evaluate four options based upon reliability, heating loads, energy consumption, and capital and life cycle costs. Installation of modular condensing boilers was the preferred choice. The conservation study also addressed the needs to connect heating system to the existing emergency generator and add instrumentation to the generator systems. NYSOGS accepted study recommendations and commissioned the team to provide design and construction management for the project. The project included retubing of two chillers and installation of a side stream compressor. In addition to boiler replacement, the team addressed other needs of the facility, including replacement of the air handling unit coils and upgrades to building fire alarm system.

U.S. Customs and Border Protection, Real Property Assessment, Various Locations. Energy engineer responsible for reviewing the energy data collected from various sites and populating facility reports. AECOM assessed 2.4 million square feet of CBP-owned, leased, and operated facilities along the southern and eastern borders of the United States. Teams of architects and engineers used tablets to collect information in the field, and the data was transmitted to the home office for review and creation of reports.

Implementation Framework Technical Assistance for Sino-Singapore Tianjin Eco-City Project, Tianjin, China. Energy expert responsible for reviewing existing energy policies at national and provincial levels and recommending new/additional policies to the city in line with city's vision. Also provided estimated greenhouse gas emissions for major activities in the city. GHG tracking tool and manual were developed and provided to the client based on World Bank's beta tool. Provided several energy workshops to the employees of the city.

Robert Zogg

Fuel Cell Technology Lead

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 25+ years of experience in energy practice
+ Distributed generation, combined heat and power and solid oxide fuel cell technology expert
+ Extensive project experience for the US DOE and private sector energy clients
+ Author of numerous technical papers and articles

Years of Experience

With Navigant Consulting: 7
With Other Firms: 27

Education

MS, Mechanical Engineering, University of California, Berkeley
BS, Mechanical Engineering, Clarkson University

Work History

2008 to Present, Navigant, Associate Director
2002 to 2008, TIAX LLC, Associate Principal
1988 to 2002, Arthur D. Little, Inc., Senior Consultant
1987 to 1988, Thermal Dynamics Corporation, Senior Engineer
1986 to 1987, Struthers Wells Corporation, Sales Applications Engineer
1981 to 1986, Carrier Corporation, Senior Engineer

About Robert

Robert Zogg is Associate Director in the energy practice of Navigant Consulting, Inc. He has more than 25 years of engineering experience, primarily in commercial and residential energy end use. His expertise includes the evaluation of distributed generation, combined heat and power (including thermally activated cooling), and energy storage systems; technology/market assessment of appliances and other building equipment; and the development/testing of heat-pump water heaters and other specialized vapor-compression cooling/refrigeration equipment. Before joining Navigant, he worked at TIAX LLC, Arthur D. Little, Inc., and United Technologies/Carrier Corporation. He has led numerous evaluations of on-site power systems (distributed generation, combined heat and power, and distributed electric energy storage) for residential, commercial, and light-industrial buildings.

Relevant Project Experience

U.S. Department of Energy, CHP Systems Technology Assessment. Led a technology and market assessment for combined heat and power (CHP) systems suitable for residential and small-commercial buildings, including detailed energy savings and end-user economics, national energy savings potentials, a market overview, and a summary of the U.S. policy/regulatory environment.

U.S. Department of Energy, Building-based Photovoltaic (PV) Generation Systems. Led an initial evaluation of the benefits associated with combining electric energy storage with building-based photovoltaic (PV) generation systems. The evaluation, which focused on advanced battery technologies, shows that energy storage can enhance the energy and economic benefits of building-based PV, and that these benefits will become more important as PV use increases.

U.S. Department of Energy, Combined Heat and Power (Micro-CHP) System. Led an assignment to develop a conceptual design for a residential-scale Micro-CHP system. The conceptual Micro-CHP system, which uses TIAX's free-piston Stirling engine, provides back-up power for critical household loads while reducing total

Robert Zogg
continued

household energy costs by over 10 percent without the benefit of net metering.

U.S. Department of Energy, Packaged CHP Systems for Supermarket Applications. Led an analysis of packaged CHP systems for supermarket applications, including detailed modeling of energy savings and economics, identification of non-energy-saving benefits, and projection of national impacts.

Electric Power Research Institute. Led a review and assessment of distributed generation and distributed energy storage in residential, commercial, and light-industrial applications, which benchmarked the prospects for significant market impacts over the next five to seven years.

U.S. Department of Energy, Air-cooled LiBr-water Absorption Chillers. Led an investigation to summarize the development status of air-cooled LiBr-water absorption chillers. The purpose of the summary is to guide future efforts to develop waste-heat-fired chillers for CHP applications in light-commercial buildings.

Manufacturer of Micro-CHP Systems. Led an initial assessment of the key product features needed for the U.S. market. The assessment included three Micro-Generation product configurations: emergency power only, self-powered furnace, and Micro-CHP.

U.S. Department of Energy, National Energy Technology Laboratory. Led the conceptual design and assessment of a community-based distributed generation system using a solid-oxide fuel cell. The community, a Southpointe development near Pittsburgh, PA, includes a variety of industrial, commercial, and residential end users.

U.S. Department of Energy Efficiency Definitions for CHP Systems. Led an evaluation of efficiency definitions for CHP systems, culminating in recommending two definitions, depending on audience. The recommended definitions should reduce confusion about the energy-savings potential of CHP.

Fuel-cell manufacturer. Led a global market assessment for solid-oxide fuel cells in light-commercial-building applications.

U.S. Department of Energy, National Energy Technology Laboratory, Utility-Grid-Independent, Solid-Oxide Fuel Cells. Led the development of a conceptual design and estimate the manufactured cost for a utility-grid-independent, solid-oxide fuel cell for a single-family residence. This assignment included detailed cost and performance modeling of the fuel-cell system and electric loads. The conceptual design included the fuel cell system, power electronics, both short- and long-term energy storage, a load-management system, and co-generation.

Electric Power Research Institute, Residential Power Systems for DG Markets. Co-authored a report entitled Update on Technology Assessment of Residential Power Systems for Distributed Generation Markets. His contributions include overviews of a) electric and thermal load characteristics of residences, b) DG and CHP system configurations, and c) installation-cost estimates.

U.S. Department of Energy, Office of Power Technologies CHP for Buildings. Led an analysis of the benefits of Cooling, Heating and Power for Buildings (CHP for Buildings). CHP for Buildings expands upon Distributed Generation (DG) and Combined Heat and Power by using the waste heat from a DG system to drive thermally activated cooling systems (absorption and/or desiccant-based systems), in addition to supplying heating loads. Robert's team used a detailed, hour-by-hour computer simulation to illustrate the energy savings, emissions reductions, and economics associated with using CHP for Buildings in selected commercial building applications.

Electric Power Research Institute (EPRI). Assessed the technology status, commercialization schedules, developmental issues, and economics associated with energy storage systems for buildings (primarily battery energy storage).

Lisa Jerram

Fuel Cell Technology Assessment/Verification

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 20+ years emerging technology experience
+ Expert in analysis of emerging markets, including fuel cells for all applications
+ Presented at the 2015 FC Expo on the Global Outlook on Fuel Cell Market: Stationary Applications & Distributed Power Systems
+ Formerly senior market analyst at Fuel Cell Today

Years of Experience

With Navigant Consulting: 8
With Other Firms: 17

Education

BA, History, University of Virginia

Work History

Navigant Consulting, Inc., Associate Director
Pike Research, Senior Research Analyst
Fuel Cell Today, Senior Market Analyst

About Lisa

Lisa Jerram is an Associate Director in Navigant's Energy Practice. She analyzes emerging markets for new technologies, including fuel cells for all applications; electric, hybrid and fuel cell vehicles; hydrogen infrastructure; and electric vehicle charging equipment. Lisa has more than has 20 years of experience analyzing new technologies and markets. She is a frequent speaker and most recently presented at the 2015 FC Expo on the Global Outlook on Fuel Cell Market: Stationary Applications & Distributed Power Systems.

Previously, Lisa was a Senior Analyst at Pike Research and a senior market analyst at Fuel Cell Today, where she authored research reports and led consulting engagements.

Relevant Project Experience

Analysis of Fuel Cells for Mining Applications, Technology Developer. Led a project to assess the potential for fuel cells to be used in mining applications. The project included an evaluation of the potential mining applications where fuel cells would offer a cost or emissions benefit over incumbent technologies and an analysis of the drivers and barriers to fuel cell adoption in mining.

Analysis of Distributed Generation Opportunity and SOFCs in North America. Led a project to assess the potential for SOFCs in distributed generation in the United States for a custom client. The project included a forecasting model based on cost analysis against forecasted grid prices and a written analysis of the market drivers and barriers.

U.S. Department of Energy (DOE), Global Fuel Cell Market Analysis. Led project to analyze the state of the global fuel cell market for DOE, including development of a dataset of global fuel cell shipment, broken out by application and region; forecasts of fuel cell markets; and analysis of the transportation, stationary, and portable sectors.

Lisa Jerram
continued

Industry Association, Fuel Cell and Hydrogen Market Opportunity Assessment. Analyzed opportunities and challenges for small- and mid-sized companies in the fuel cell and hydrogen sector in six geographic markets. Evaluated the total market opportunity, drivers or barriers to market entry, competitor landscape, and the potential for partnerships. Ranked each market opportunity and provided actionable market entry strategy suggestions.

Major Japanese Lithium Ion Battery Developer, U.S. Lithium Ion Battery Market Analysis. Analyzed the potential uptake of lithium ion batteries in the U.S. materials-handling market. Analyzed the U.S. forklift market, the demand drivers for alternative technologies, and a forecast of lithium ion battery uptake.

Fuel Cell R&D Center, Low-Power Fuel Cell Applications. Led project to analyze potential low-power polymer electrolyte membrane (PEM) and direct methanol fuel cell (DMFC) fuel cell applications for the client. Analyzed fuel cell forklifts, backup power, off-grid power, auxiliary power units for refrigerated trucks, and remote monitoring. The analysis is intended to guide the client in determining which application to pursue for market development.

Foreign Trade Organization, Cleantech Company Identification. Led project to vet and analyze cleantech companies in the U.S. Provided profiles of ten cleantech companies for client, whose goal was to use the analysis to facilitate business relationships, develop the presence of North American cleantech companies in Japan, and strengthen Japanese cleantech markets and energy infrastructure.

Sample Publications

Fuel Cells Annual Report, Author, Navigant Research, 2014

Hybrid & Electric Trucks, Author, Navigant Research, 2013

Fuel Cell Vehicles, Author, Navigant Research, 2013

Electric Vehicle Charging Infrastructure, Author, Navigant Research, 2015

Advanced Electric Forklift Technologies in North America, Author, Navigant Research, 2013

Total Cost of Ownership of Alternative Fuel Vehicles (AFVs) for Fleet Operators, Market Analysis, Author, Navigant Research, 2012

Colette Lamontagne

Fuel Cell Technology Assessment/Verification

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 25 years emerging technology experience
+ Leads Navigant's Business and Technology Strategy group, working on R&D related to energy storage
+ Conducted assessments, strategic planning, demonstration oversight, and procurement support for utilities, developers and government agencies

Years of Experience

With Navigant Consulting: 8
With Other Firms: 17

Education

MS, Civil/Environmental Engineering, Tufts University, 1998
BS, Biology and Environmental Studies, Tufts University, 1991

Work History

2007 to Present, Navigant Consulting, Director
2005 to 2007, SAIC, Environmental Engineer
2002 to 2005, FOCIS Associates, Environmental Engineer
1991 to 2002, Arthur D. Little, Inc., Environmental Engineer
1990 to 1991, Tellus Institute, Intern

About Colette

Colette Lamontagne is a Director in Navigant's Global Energy Practice. She leads Navigant's Business and Technology Strategy group and works on research and development related to emerging energy technologies such as energy storage and smart grid. Colette is currently serving as Immediate Past Chair on the Energy Storage Association Board of Directors and has 25 years of consulting experience focusing primarily on emerging technology demonstrations. She has conducted numerous studies for utilities, technology providers, and government agencies including market research, opportunity assessments, strategic planning, demonstration oversight, and procurement support. She has also conducted and provided oversight for numerous lab-, bench-, and pilot-scale technology R&D programs.

Relevant Project Experience

Utility, Northeast US, Strategic Plan. Assessed opportunities for energy storage deployment on their system and to develop a strategic plan for the future.

Utility, Southeast US, Opportunity Assessment. Identified opportunities for cost-effective energy storage deployment in their system.

Developer, Opportunity Assessment. As project developer worked with an energy storage project developer to identify opportunities for transmission upgrade deferral.

Southern California Public Power Authority, Energy Storage Procurement Plan. Led a project for five member utilities to provide a framework, guidance, and an excel based tool to identify opportunities for energy storage deployments. The analysis was used by the utilities to propose energy storage procurement targets.

Sacramento Municipal Utility District (SMUD), Energy Storage Procurement Plan. Supported SMUD with development of their energy storage procurement plan. This plan will be submitted to the California Energy Commission to identify SMUD's energy storage targets in the coming years in response to the requirements of AB2514.

Colette Lamontagne
continued

Technology Provider, Energy Storage Procurement Support. Supported an energy storage technology provider in their response to a request for proposal from the Hawaiian Electric Company (HECO). Supported the technology provider team with coordination and preparation of the Executive Summary and description of the team's value.

Canadian Municipal Utility, Energy Storage Procurement Support. Supported the utility in their response to a request for proposal from the Ontario Independent Electricity System Operator (IESO). Reviewed technical and operating assumptions to ensure the proposed system was viable and realistic.

Energy Storage Association, Survey of Models and Tools. Conducted a survey of existing models and tools for electric system planning, real-time grid operation, and energy storage system design and operation. Characterized how these tools incorporate energy storage, if at all. Survey industry stakeholder needs and identify gaps in model and tool capabilities.

Energy Storage Developer, Market Entry Strategy. Worked with a PV and energy storage project developer to understand the market for their product and prioritize regions and customers.

Sacramento Municipal Utility District (SMUD), Technology Demonstration and Strategic Planning Support. Supported SMUD in their demonstration program designed to test distributed energy storage systems in conjunction with photovoltaic systems in communities and in residences. Navigant analyzed the data collected to understand the impact of energy storage on shifting, smoothing, and firming solar energy. Then helped SMUD develop a strategic plan for incorporating energy storage and PV into their system.

National Association of Regulatory Utility Commissioners (NARUC) / Eastern Interconnection States' Planning Council (EISPC), Assessment of Demand Side Resources in the Eastern Interconnection. Led a study for the NARUC/EISPC to assess the demand side resources in the eastern interconnection which involved identifying and quantifying the existing, planned, and likely future penetration of six resource categories (demand response, energy efficiency, smart grid, energy storage, distributed fossil generation and renewables).

Energy Storage Developer, Opportunity Assessment. Investigated opportunities for implementing energy storage in utility applications in an island grid for an independent power producer. This analysis considered renewable energy integration (i.e., shifting, ramping, smoothing, firming), load leveling, and grid operational support (e.g., frequency regulation, voltage and VAR support). For each of the eight relevant applications, identified and monetized potential benefits. Combined appropriate applications into value streams to optimize the value. This high level analysis provided the client with a prioritized list of opportunities that are worthy of additional research and may be pursued for deployment.

Energy Storage Vendor, Global Market Study for Stationary Energy Storage Technologies. Led a project to identify the top markets for stationary energy storage applications around the world. Evaluation factors included ease of doing business, political stability, gross domestic product, population, utility market structure and the percentage of intermittent renewable energy resources.

National Academy of Science Transportation Research Board, Energy Storage Cost Benefit Analysis. Led a project to identify and model the benefits of a wayside energy storage system (WESS) in rail transit applications. This study involved identifying appropriate WESS technologies and conducting an analysis to understand the business case in hypothetical scenarios as well as in two case studies using data from the Denver Regional Transportation District (RTD) and the Greater Cleveland Regional Transit Authority (GCRTA).

Department of Energy (DOE), Smart Grid Demonstration Program Support. Provided technical assistance to DOE in the collection and analysis of data and metrics to monetize the benefits associated with energy storage demonstration projects funded by the American Recovery and Reinvestment Act (ARRA).

Jonathan D. Thompson

Fuel Cell Technology Incentives/Economic Analyses

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 15 years of experience in energy efficiency
+ Expertise in technology feasibility and economic analysis and optimization
+ Research experience as a former research coordinator for Earth Institute at Columbia University

Years of Experience

With AECOM: 11

With Other Firms: 4

Education

MEng, Sustainable Energy, Columbia University, 2010

MS, Environmental Planning, Pratt Institute, 2006

BS, Environmental Geoscience, Stony Brook University, 2003

Work History

2012 to Present, AECOM, Energy Project Engineer

2010 to 2012, Research Coordinator, The Earth Institute - Columbia University

2004 to 2011, AECOM, Scientist/Engineer

About Jonathan

Jonathan Thompson is a member of the Energy Efficiency Group within AECOM Energy. His background includes energy analysis and optimization, primary pollutant and greenhouse gas emissions analysis and inventorying, wastewater treatment process design, air emissions and odor control design, environmental impact analysis, regulatory compliance determinations, and data analysis utilizing GIS. He brings research experience from academia as a former research coordinator for the Earth Institute at Columbia University in the lab of Vijay Modi, specializing in spatial energy modeling of urban areas.

Relevant Project Experience

U.S. Department of Veterans Affairs (VA), Northport CHP Feasibility. Technology analyst providing technical feasibility and economic analysis of various technologies considered for CHP application at the Northport VA in order to decrease current peak electric demand and offset steam boiler usage.

Air Force Civil Engineer Support Agency (AFCESA), Various Locations, US. Project manager for Sustainable Infrastructure Assessments (SIA) for AFCESA at four bases across the US. The SIAs comprise energy and water Level III audits, building condition assessments, and the development of programmable projects for both energy and water conservation and asset management. The SIAs cover 9M square feet with a staff of over 30 people assigned to the project.

World Bank, Energy Efficiency Toolkit for Developing Cities. Technical leader, as part of a team, responsible for developing an energy master-planning tool for cities in developing nations to reduce energy consumption and GHG emissions, and providing energy modeling and cost estimation for the building sector of the tool.

PlaNYC 80 x 50 Sustainability Plan. The PlaNYC 80 x 50 project was an ambitious sustainability master plan project that aimed to reduce New York City's greenhouse gas (GHG) emissions levels 80 percent of the 2005 levels by 2050. As project manager for Task 3, responsible for the GHG inventory expansion involving an audit of the current NYC GHG inventory, a review of

Jonathan D. Thompson
continued

emerging community based inventorying protocols, and an expansion of the inventory to model data to the neighborhood level for the targeting of specific policies and mitigation strategies where their effectiveness would become evident with this more granular data.

Long Island Cleaner Greener Communities Sustainability Plan, NY. This regional plan helped establish a statewide sustainability planning framework amongst the 10 regional economic development councils in New York State. AECOM provided technical oversight to the Planning Team from Long Island, helping create a plan to reduce greenhouse gas emissions 80 percent by 2050. As lead analyst, responsibilities included the development of the greenhouse gas inventory in accordance with the modified protocol developed specifically for this statewide program and producing Business As Usual projections as well as revised projections that incorporate mitigation strategies. As part of the Energy Working Group, also provided advisement on energy technology implementation and assessment of energy conservation measures.

Town of Hempstead Energy & Greenhouse Gas Inventory, NY. Lead analyst responsible for the development of GHG emissions and mitigation strategies that fed into the Town's overall Energy and Sustainability Master Plan.

New York City Department of Environmental Protection, Greenhouse Gas Inventorying Task Order Contract. Project engineer for this task order that provided the NYCDEP with validation of inventories included in the New York City Mayor's Office PlaNYC 2030 inventory and delineated capital and operational improvements for NYCDEP to meet required reductions in GHG emissions by the 2017 city facility deadline.

New York City Department of Environmental Protection, Owls Head WPCP Greenhouse Gas Reduction Feasibility Study. Lead analyst for this project that was initiated in response to the NYC Mayor's plan to reduce city wide GHG emissions by 30% by the year 2017. The report provided a baseline inventory of GHG emissions and projections for GHG emissions after project implementation showing 72% reduction in non-biogenic emissions and 42% reduction in total emissions.

Hartsfield Jackson Atlanta International Airport (HJAIA), Climate Action Plan, GA. HJAIA asked AECOM to further develop the sustainability initiatives identified in their Sustainable Master Plan (SMP) by creating a strategy for reaching their emissions reduction goals with a Climate Action Plan (CAP). As lead analyst for the HJAIA CAP, responsible for preparing the comprehensive GHG emissions inventory and the evaluation of emissions reduction measures for their reduction potential and cost effectiveness.

Hartsfield Jackson Atlanta International Airport - ISO 50001 Certification. AECOM brought the airport's Energy Management System (EnMS) into compliance with the certification requirements of ISO 50001. As lead analyst, He was responsible for the evaluation of energy consumption data collection against the requirements of ISO 50001.

U.S. Customs and Border Protection, Real Property Assessment. AECOM assessed 2.4 million square feet of CBP-owned, leased, and operated facilities along the southern and eastern borders of the United States. As a project engineer, used tablets to collect information in the field, and the data was transmitted to the home office for review and creation of reports. AECOM also conducted energy assessments.

Earth Institute, Columbia University, Spatial Energy Modeling. As Research Coordinator for the Urban Energy Research Group at Columbian University, led a research team in developing a spatial energy model and optimization tool for siting distributed generation in urban areas (Specifically NYC). Lead researcher in developing the energy model but also responsible for facilitating academic and industry relationships for potential collaborations and grant-funding opportunities. The first publication findings were developed into an online map that displayed energy use by building for all 880,000 tax lots of NYC. http://modi.mech.columbia.edu/nycenergy/

Darrell Massie, PhD, PE

Cybersecurity Lead

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 36 years of professional experience in cybersecurity
+ Founder and CEO of IPERC
+ Leading expert in cybersecure microgrid architecture, distributed energy technology, neural network modeling, fuel cell applications, and advanced control for energy systems
+ One of the U.S. Army's leading experts in strategic power and energy management

Years of Experience

With IPERC: 11
With Other Firms: 25

Education

PhD, Civil Engineering, University of Colorado, Boulder, 1998
MS, Civil Engineering, University of Colorado, Boulder, 1988
BS, Civil Engineering, Colorado State University, 1978

Professional Licenses/Certifications

Professional Engineer: New York, Colorado

Work History

2004 to Present, IPERC, Founder and CEO
1979 to 2005, U.S. Army Officer, Corps of Engineers; Professor of Mechanical Engineering, United States Military Academy

About Darrell

Darrell Massie is the founder and CEO of Intelligent Power and Energy Research Corporation (IPERC), a producer of intelligent controls for power generation equipment. He has extensive experience in distributed energy technology, neural network modeling, fuel cell applications, and advanced control for energy systems. Prior to founding IPERC, he served for over 20 years as a commissioned officer in the U.S. Army Corps of Engineers and taught for 15 years as an Associate Professor of Mechanical Engineering at the United States Military Academy, West Point, New York. During his time at West Point, he pursued research opportunities in the field of intelligent controls using artificial neural networks. It was upon this base he founded IPERC.

Darrell is IPERC's principal investigator for all phases of the US Department of Defense, Department of Energy and Department of Homeland Security- sponsored cybersecure controls system for the Smart power Infrastructure Demonstration for Energy Reliability & Security (SPIDERS) Phase I, II and III projects. He has consulted extensively with the US Army Research Laboratories and serves in a variety of positions as one of the Army's primary experts in the areas of power and energy management and strategic planning. He has authored or co-authored over 90 technical papers and reports, has two U.S. patents and is a registered Professional Engineer in Colorado and New York.

Relevant Project Experience

SPIDERS Phase I, Joint Base Pearl Harbor, Hickam, HI. Principal investigator for the SPIDERS Joint Capabilities Technology Demonstration (JCTD) Phase I effort was the first of three phases—all of which feature IPERC control systems— demonstrating a cybersecure microgrid architecture with integration of smart grid technologies, distributed and renewable generation on military installations for enhanced mission assurance. Phase I was a design-build project and was verified through a successful operational demonstration, including microgrid black start capabilities, optimum generator

Darrell Massie, PhD, PE
continued

dispatch and optimal renewable resource integration. The 2.5 MW cybersecure microgrid incorporated one distribution feeder; two electrically isolated loads; two isolated diesel generators; and an isolated photovoltaic (PV) array.

U.S. Army Corps of Engineers, ERDC-CERL, Energy Security Assessments for Next Generation Microgrid Controllers, Champaign, IL. Lead investigator for the development of the IPC and Department of Defense-specific interfaces, security layers, and Information Assurance (IA). The project further developed plug-and-play software for use on DoD installations and Forward Operating Bases. DOD-compliant Information Assurance measures and documentation were incorporated to facilitate attainment of an Approval to Operate (ATO) and Certificate of Networthiness (CTO).

SPIDERS Phase II, Fort Carson, CO. Principal investigator for the SPIDERS Joint Capabilities Technology Demonstration (JCTD) Phase II effort was the second of three phases—all of which feature IPERC control systems—demonstrating a cybersecure microgrid architecture with integration of smart grid technologies, distributed and renewable generation and energy storage on military installations for enhanced mission assurance. Phase II, conducted at Fort Carson, Colorado, was a design-build project. The Fort Carson microgrid incorporated seven buildings with prioritized loads, three generators (3.5 MVA), 1 MW solar array, three distribution feeders, and five bidirectionally charging electric vehicles.

Marine Corps Systems Command, Universal Controls with Intelligent Power Distribution Expeditionary Power Systems. Principal investigator for the design, development, and demonstration of an intelligent power distribution (IPD) control system for a tactical microgrid. This is a highly reconfigurable supervisory control system, built off of previous technologies. The IPD control system coordinates multiple generators, loads, power distribution units, and load banks to provide increased reliability and fuel efficiency. Included in this effort were several new technologies which were integrated into a management retrofit kit. This improved control system enables systems to automatically reconfigure and optimize, thus reducing fuel consumption, machine run time, and maintenance requirements, while providing advancing monitoring and diagnostics. This effort concluded with an operational demonstration in Fall 2014.

SPIDERS Phase III, Camp Smith, HI. Principal investigator for the SPIDERS Joint Capabilities Technology Demonstration (JCTD) Phase III effort was the final of three phases—all of which feature IPERC control systems—demonstrating a cybersecure microgrid architecture with integration of smart grid technologies, distributed and renewable generation and energy storage on military installations for enhanced mission assurance. As designed for the microgrid at Camp Smith, there are two distinct modes of operation: grid-tied (normal) mode and microgrid mode. The microgrid uses two existing government furnished 1 MW generators and two new 750 kW generators, plus two 250 kW battery devices called Integrated Storage and Inverter Modules (ISIMs). As part of the overall microgrid integration, the generators will be controlled by Woodward governors, while the switchgear, breakers, and switches will be controlled by a network of Schweitzer relays. The GridMaster® system will coordinate this communication and instruct the relays.

Aura Lee Keating

System Architecture/Operating Protocols

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 25 years of experience in the energy/security industry
+ Expertise with critical infrastructure and energy delivery systems
+ Extensive knowledge of cybersecurity specific to ICS, with a focus on Microgrids
+ Achieved first DoD accreditation of a microgrid system

Years of Experience
With IPERC: 7
With Other Firms: 18

Education
BS, Information Systems University of Phoenix, Colorado Springs, CO, 2005

Professional Licenses/Certifications
CompTIA Security+
CompTIA Network+

Work History
2008 to Present, IPERC, Cyber and Information Assurance Manager
2006 to 2008, U.S. Army, United States Military Academy, Information Assurance Security Officer
2004 to 2006, U.S. Army, Joint Military Training Command, Grafenwoehr, Information Assurance Security Officer
2002 to 2004, U.S. Army, Directorate of Logistics, Grafenwoehr, Information Assurance Security Officer
1997 to 2001, *The Gazette*, Database Administrator

About Aura Lee
Aura Lee brings a wealth of cyber and information assurance expertise to microgrids and industrial controls. Her experience includes security and reliability for critical infrastructure and energy delivery systems, information assurance, cybersecurity innovation, and consulting for energy system owners, operators, and security administrators on best practices for secure ICS. She has served as the Lead Information Security Officer (ISO) for Smart Power Infrastructure Demonstration for Energy Reliability and Security (SPIDERS) Joint Capability Technology Demonstrations (JCTD). Her work focuses on the field of cybersecurity specific to Industrial Control Systems (ICS) with a focus on Microgrids, recently leading the charge to achieve the first Department of Defense (DoD) accreditation of a microgrid system during the SPIDERS JCTD (http://energy.gov/eere/femp/spiders-jctd-smart-cyber-secure-microgrids).

Relevant Project Experience
SPIDERS Phase I, Joint Base Pearl Harbor Hickam, HI. Lead information security officer (ISO) for the SPIDERS Joint Capabilities Technology Demonstration (JCTD) Phase I effort, the first of three phases—all of which feature IPERC control systems—demonstrating a cybersecure microgrid architecture with integration of smart grid technologies, distributed and renewable generation on military installations for enhanced mission assurance. Phase I was a design-build project and was verified through a successful operational demonstration, including microgrid black start capabilities, optimum generator dispatch, and optimal renewable resource integration. The 2.5 MW cybersecure microgrid incorporated one distribution feeder; two electrically isolated loads; two isolated diesel generators; and an isolated photovoltaic (PV) array.

U.S. Army Corps of Engineers, ERDC-CERL, Energy Security Assessments for Next Generation Microgrid Controllers, Champaign, IL. Information assurance specialist for this project. The project consisted of development of the IPC and DoD-specific interfaces, security layers and Information Assurance (IA). The

Aura Lee Keating
continued

project further developed plug-and-play software for use on DoD installations and Forward Operating Bases. DoD-compliant Information Assurance measures and documentation were incorporated to facilitate attainment of an Approval to Operate (ATO) and Certificate of Networthiness (CTO).

SPIDERS Phase II, Fort Carson, CO. Lead ISO for the SPIDERS JCTD Phase II effort, the second of three phases—all of which feature IPERC control systems—demonstrating a cybersecure microgrid architecture with integration of smart grid technologies, distributed and renewable generation, and energy storage on military installations for enhanced mission assurance. Phase II, conducted at Fort Carson, Colorado, was a design-build project. The Fort Carson microgrid incorporated seven buildings with prioritized loads, three generators (3.5 MVA), 1 MW solar array, three distribution feeders, and five bidirectionally charging electric vehicles. Aura Lee served as the Cybersecurity and Accreditation lead for IPERC's control system.

SPIDERS Phase III, Camp Smith, HI. The SPIDERS Joint Capabilities Technology Demonstration (JCTD) Phase III effort was the final of three phases—all of which feature IPERC control systems—demonstrating a cybersecure microgrid architecture with integration of smart grid technologies, distributed and renewable generation, and energy storage on military installations for enhanced mission assurance. As designed for the microgrid at Camp Smith, there are two distinct modes of operation: grid-tied (normal) mode and microgrid mode. The microgrid utilizes two existing government-furnished 1 MW generators and two new 750 kW generators plus two 250 kW battery devices called Integrated Storage and Inverter Modules (ISIMs). As part of the overall microgrid integration, the generators will be controlled by Woodward governors, while the switchgear, breakers, and switches will be controlled by a network of Schweitzer relays. The GridMaster® system will coordinate this communication and instruct the relays. Led the accreditation effort for the SPIDERS microgrid control system, achieving Authority to Operate (ATO).

CERDEC, Plug-and-Play Architecture for Tactical Power Grids, Fort Belvoir, VA. Lead security officer for both phases of this project to develop an intelligent and distributed control architecture and algorithms to enable plug-and-play capabilities for tactical power grids. IPERC developed a routerless design that identifies and exchanges information between devices using peer-to-peer communications. The communications incorporates Internet Protocol Version 6 (IPv6), which is the next generation protocol that supports advanced cybersecure techniques. The project deliverable was a generic reconfigurable plug-and-play distributed control system hardware-in-the-loop demonstration of the prototype suitable for integrating any source or demand. A Phase II Enhancement was awarded to leverage the research on embedding intelligent retrofit kits into power systems to provide a universal interface into non-standard devices.

ERDC-CERL, Intelligent Demand Side Management for Electric Grid, Champaign, IL. The objective of this effort was to design, build, and test a prototype simulated grid with prioritized load shedding capability for islanded tactical or commercial power grids. This SBIR is the foundation that has allowed IPERC to rewrite much of the software that was originally designed to operate on a single computer running on a Microsoft Windows platform. The deliverable for the Phase II SBIR developed software that demonstrates repeatable decisions on a simulated grid. This project was nominated for the *2010 U.S. Army SBIR Phase II Achievement Award*. Aura Lee provided cyber and IA research for this effort.

Intelligent Integrated Tactical Power Grids, Huntsville, AL. IA specialist for this project, which included investigation of cybersecurity and IA methodology for software, hardware, and overall technology integration for a tactical microgrid. A full-scale prototype was developed in which IPERC's control technology was retrofitted onto a military program of record products and demonstrated an average 36% fuel reduction.

Peter Curtiss, PhD, PE

Communications/Control Center

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 32 years' experience in the energy/power industry
+ Extensive experience in energy systems, renewable energy technology, neural network modeling, and distributed generation analysis
+ Involved in designing and demonstrating technologies for the SmartGrid
+ Managed team that created control systems for SPIDERS microgrid projects

Years of Experience

With IPERC: 11
With Other Firms: 21

Education

PhD, Civil Engineering, University of Colorado, Boulder, 1992
MS, Civil Engineering, University of Colorado, Boulder, 1990
BSE, Civil Engineering, Princeton University, Princeton, 1986

Professional Licenses/Certifications

Professional Engineer: Colorado

Work History

2004 to Present, IPERC, Technology Director
1998 to 2004, Curtiss Engineering, Owner
1996 to 1998, Architectural Energy Corporation, Senior Engineer
1994 to 1996, University of Colorado, Assistant Professor
1992 to 1994, Ecole des Mines de Paris - Centre d'Energetique, Research Associate

About Peter

Peter has extensive experience in building energy systems, renewable energy technology, neural network modeling, and distributed generation analysis. He developed a neural network-based process controller currently used by Honeywell, Inc. In a separate project, he was the project manager for a team that assisted Honeywell in the design of an Internet-based building monitoring, energy management, and systems diagnostic program. Other recent projects include the creation of distributed generation evaluation software that has been used for market penetration by the planning departments of several multinational companies. He has also been working with the U.S. Army on the development of intelligent control systems for increasing reliability and decreasing fuel consumption in tactical power grids, as well as large energy generation facilities. He managed the development team that created the control systems for the SPIDERS microgrid projects at Joint Base Pearl Harbor Hickam and Camp H.M. Smith in Hawaii, as well as at Fort Carson in Colorado.

Peter is also actively involved in designing and demonstrating technologies for the SmartGrid, and has participated in major demonstration projects for large East and West Coast electric utilities.

Relevant Project Experience

SPIDERS Phase I, Joint Base Pearl Harbor Hickam, HI. The SPIDERS Joint Capabilities Technology Demonstration (JCTD) Phase I effort was the first of three phases—all of which feature IPERC control systems—demonstrating a cybersecure microgrid architecture with integration of smart grid technologies, distributed and renewable generation on military installations for enhanced mission assurance. Phase I was a design-build project and was verified through a successful operational demonstration, including microgrid black start capabilities, optimum generator dispatch, and optimal renewable resource integration. The 2.5 MW cyber secure microgrid incorporated one distribution feeder; two electrically isolated loads; two

Peter Curtiss, PhD, PE
continued

isolated diesel generators; and an isolated photovoltaic (PV) array. Dr. Curtiss was senior engineer for this effort.

Energy Security Assessments for Next Generation Microgrid Controllers, U.S. Army Corps of Engineers, ERDC-CERL, Champaign, IL. Senior engineer for this project that consisted of development of the IPC and Department of Defense (DoD)-specific interfaces, security layers and Information Assurance (IA). The project further developed plug-and-play software for use on DoD installations and Forward Operating Bases. DoD-compliant Information Assurance measures and documentation were incorporated to facilitate attainment of an Approval to Operate (ATO) and Certificate of Networthiness (CTO).

SPIDERS Phase II, Fort Carson, CO. Senior engineer for the SPIDERS JCTD Phase II effort, the second of three phases—all of which feature IPERC control systems—demonstrating a cybersecure microgrid architecture with integration of smart grid technologies, distributed and renewable generation and energy storage on military installations for enhanced mission assurance. Phase II, conducted at Fort Carson, Colorado, was a design-build project. The Fort Carson microgrid incorporated seven buildings with prioritized loads, three generators (3.5 MVA), 1 MW solar array, three distribution feeders, and five bidirectionally charging electric vehicles.

Universal Controls with Intelligent Power Distribution Expeditionary Power Systems, Marine Corps Systems Command. Senior engineer for this project for design, development, and demonstration of an intelligent power distribution (IPD) control system for a tactical microgrid. This highly reconfigurable supervisory control system was built off of previous technologies. The IPD control system coordinates multiple generators, loads, power distribution units, and load banks to provide increased reliability and fuel efficiency. Included in this effort were several new technologies which were integrated into a management retrofit kit. This improved control system enables systems to automatically reconfigure and optimize, thus reducing fuel consumption, machine run time, and maintenance requirements while providing advancing monitoring and diagnostics. This effort concluded with an operational demonstration in Fall 2014.

SPIDERS Phase III, Camp Smith, HI. Senior engineer for this project for the SPIDERS JCTD Phase III effort, the final of three phases—all of which feature IPERC control systems—demonstrating a cybersecure microgrid architecture with integration of smart grid technologies, distributed and renewable generation, and energy storage on military installations for enhanced mission assurance. As designed for the microgrid at Camp Smith, there are two distinct modes of operation: grid-tied (normal) mode and microgrid mode. The microgrid utilizes two existing government-furnished 1 MW generators and two new 750 kW generators plus two 250 kW battery devices called Integrated Storage and Inverter Modules (ISIMs). As part of the overall microgrid integration, the generators will be controlled by Woodward governors, while the switchgear, breakers, and switches will be controlled by a network of Schweitzer relays. The GridMaster® system will coordinate this communication and instruct the relays.

Plug-and-Play Architecture for Tactical Power Grids, CERDEC, Fort Belvoir, VA. Senior engineer for this project for this project that developed an intelligent and distributed control architecture and algorithms to enable plug-and-play capabilities for tactical power grids. IPERC developed a routerless design that identifies and exchanges information between devices using peer-to-peer communications. The communications incorporates Internet Protocol Version 6 (IPv6), which is the next generation protocol that supports advanced cybersecure techniques. The project deliverable was a generic reconfigurable Plug-and-Play distributed control system hardware-in-the-loop demonstration of the prototype suitable for integrating any source or demand. A Phase II enhancement was awarded to leverage research on embedding intelligent retrofit kits into power systems, to provide universal interface into non-standard devices.

Octavian Cana, PE, PMP

Security

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 32 years of experience in the security industry
+ Established AECOM's security and IT group in New York City
+ Senior PM for Security Programs for Amtrak, MTA and Port Authority of NY & NJ
+ Licensed PE and Certified Project Management Professional

Years of Experience

With AECOM: 10

With Other Firms: 22

Education

ME, Electrical Engineering, City College of New York, 1991

BE, Electronics and Telecommunications, Polytechnic Institute of Bucharest, Romania, 1982

Professional Licenses/Certifications

Professional Engineer: New York

Project Management Professional

Work History

2005 to Present, AECOM, Vice President, Security and IT Group Leader

1987 to 2000, Electronic Systems Associates, Vice President

About Octavian

Octavian Cana is a senior program and project manager with more than 30 years of diverse experience in the security field. He has managed more than 400 projects, estimated at approximately $400 million in construction costs, including a single security design-build project of $25 million. He has been involved in the security industry since 1986, working on several prestigious and award-winning security systems design and implementation projects. He interfaced with owners, real estate management and operating personnel, and contractors on capital projects.

At AECOM, he established the security and IT group in New York City. Nearly 20 professionals are working on projects in the tri-state area and interfacing with numerous security specialists around the country.

Relevant Project Experience

Metropolitan Transportation Authority, IDIQ Contract for Security Planning and Design Services, New York, NY. Senior project manager for an Indefinite Quantity Contract for security planning and design services under the MTA Security Capital Program. Task orders include Threat Risk Vulnerability (TRV) assessments, mitigation planning, and design of Electronic Security Systems (ESS) for subway stations, including Chamber Street, Roosevelt and 74th Street, Lexington and 51st Street, Court Street and Borough Hall. A PSIM pilot project is part of this program. The IP Video Management System (VMS), is integrated with the MTAs IESS/C3 program and NYPD VMS.

Amtrak, ARRA Security Projects Program Management, Various Locations. Design manager managed security and fire life safety projects under a contract to provide Program Management Oversight (PMO) for Amtrak's $1.3 billion program to construct, renovate and upgrade properties under the American Recovery and Reinvestment Act. Responsibilities include site assessment and development of design scopes of work for security projects at facilities throughout the country.

Octavian Cana, PE, PMP
continued

Port Authority of New York and New Jersey, Security Program. Senior project manager in charge of numerous confidential projects awarded by the Security Project Management and Engineering departments. Extension of staff to Technology Services Department, Capital Program Management Group, on various consulting and engineering assignments. Peer review of security systems design, including biometric technology, IP CCTV, DVR/NVR over SONET infrastructure. Provided technical support to line departments including TB&T, Aviation and PATH.

MTA New York City Transit, Access Control and Intrusion Detection System for Communications Rooms. Project manager for design and technical services for the installation of an access control and intrusion detection system at 468 communications rooms at various NYCT facilities.

Port Authority of New York and New Jersey, George Washington Bridge, Holland Tunnel, Lincoln Tunnel, and Bus Terminal Access Control Systems and CCTV Upgrades. Engineer-of-Record for this multi-facility project, including design and construction support services for Lenel-based access control, intrusion detection, fiber optics, IP CCTV and intercom systems. Managed a large team concurrently designing Access Control and CCTV upgrades for the George Washington Bridge, Lincoln Tunnel, Holland Tunnel and the Bus terminal. The project went through several significant value engineering phases.

Arizona Public Service Company, Pinnacle Peak Substation project. Principal in charge for the hardening of Pinnacle Peak Substation project, including design and construction support services for access control, perimeter intrusion detection, video assessment and communications infrastructure using strategically placed security devices including thermal cameras, video analytics, multi-technology sensors, radars, and fiber optic cables.

New York State Thruway Authority, Tappan Zee Hudson River Crossing, Tarrytown. Engineer of Record on the design-build project to replace the Tappan Zee Bridge. The Security Management System includes video surveillance subsystem (VSS), access control alarm monitoring subsystem (ACAMS), intrusion detection subsystem (IDS), perimeter intrusion detection subsystem (PIDS), vehicle access control subsystem (VACS), license plate readers (LPR), emergency phone subsystem (EPS), lifeline phones (LLP), verification and integration of existing systems through a Physical security information management (PSIM) system.

Port Authority of New York and New Jersey, World Trade Center, New York, NY. Principal in charge and senior project manager for the ConOps, design and construction support services for the Site Logistics Coordination Center (SLCC). AECOM personnel provided the professional services for all the trades involved, including architectural, MEP, security and communication infrastructure. The SLCC provides situational awareness for the entire WTC site during the construction phase.

Port Authority of New York and New Jersey, PATH. Engineer-of-Record for multi-stage temporary and permanent various tunnels event detection systems. Projects include redundant 10 Gigabit Ethernet and SONET backbone networks, redundant Storage Area Networks (SANs), PSIM, event aggregation and correlation of video, access control, seismic, air pressure, water pressure, and fiber optic continuity sensors. All systems have local and remote monitoring and control features.

Port Authority of New York and New Jersey, Newark International Airport Terminal B, NJ. Project manager for design of telecommunications and variable messaging system (VMS) for the mid and upper level upgrade of Terminal B.

NY State Office of General Services, Statewide Security Standards Implementation at Office of Mental Health Facilities, Various Locations,. Senior project manager for various design, review, and construction assistance projects, including upgrades of access control /facility management and CCTV systems. Some of the facilities covered under a 3-year term contract include: Nathan Kline Research Institute, Elmira PC, Mid-Hudson PC, and Mohawk Valley PC.

Scott Roberts

Cybersecurity System Startup

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 25 years of experience in software development
+ Expertise in building energy simulations, HVAC diagnostics and commissioning systems, and business enterprise applications
+ Manages development of microgrid controls software and algorithms
+ Succesfully commissioned multiple microgrid control systems

Years of Experience

With IPERC: 5
With Other Firms: 25

Education

BS, Architectural Engineering University of Colorado, Boulder, 1990

Professional Licenses/Certifications

Sun's Distributed Programming Course
Sun's Enterprise JavaBeans Course

Work History

2010 to Present, IPERC, Software Development Director
2009 to 2010, RidgeviewTel, Software Developer/Engineer
2005 to 2009, Oracle / BEA Systems, Senior Software Engineer
2003 to 2005, Digital Global, Senior Software Engineer
2002 to 2003, Avolent, Senior Software Engineer
2001 to 2001 IWitness, Senior Software Engineer
2000 to 2001 Solant / Avolent, Senior Software Engineer
1999 to 2000, Nexdata Solutions, Lead Software Developer
1990 to 1999, Architectural Energy Corporation, Staff Engineer

About Scott

Scott is a senior software developer and programmer with 25 years of experience. His expertise is in the architecture and programming of object oriented software which includes the development of building energy simulations, HVAC diagnostics and commissioning systems, business enterprise applications, GIS programming, and desktop and web UI development. At IPERC, Scott manages the software development team and leads the programming efforts for the development of microgrid controls software and control algorithms. Scott has commissioned multiple microgrid control systems, including installation, deployment, testing, verification and demonstration efforts.

Relevant Project Experience

SPIDERS Phase I, Joint Base Pearl Harbor Hickam, HI. Software engineer and provided on-site commissioning support for the SPIDERS Joint Capabilities Technology Demonstration (JCTD) Phase I effort, the first of three phases—all of which feature IPERC control systems--demonstrating a cyber-secure microgrid architecture with integration of smart grid technologies, distributed and renewable generation on military installations for enhanced mission assurance. Phase I was a design-build project and was verified through a successful operational demonstration, including microgrid black start capabilities, optimum generator dispatch and optimal renewable resource integration. The 2.5 MW cyber secure microgrid incorporated one distribution feeder; two (2) electrically isolated loads; two (2) isolated diesel generators; and an isolated photovoltaic (PV) array.

SPIDERS Phase II, Fort Carson, CO. Software engineer and participated in on-site installation, deployment and commissioning for the SPIDERS Joint Capabilities Technology Demonstration (JCTD) Phase II effort, the second of three phases—all of which feature IPERC control systems--demonstrating a cyber-secure microgrid architecture with integration of smart grid technologies, distributed and renewable generation and energy storage on military installations for enhanced mission assurance. Phase II, conducted at Fort Carson,

Scott Roberts
continued

Colorado, was a design-build project. The Fort Carson microgrid incorporated seven buildings with prioritized loads, three generators (3.5 MVA), 1 MW solar array, three distribution feeders and five bi-directionally charging electric vehicles.

SPIDERS Phase III, Camp Smith, HI. Senior software engineer for the SPIDERS Joint Capabilities Technology Demonstration (JCTD) Phase III effort was the final of three phases—all of which feature IPERC control systems—demonstrating a cyber-secure microgrid architecture with integration of smart grid technologies, distributed and renewable generation and energy storage on military installations for enhanced mission assurance. As designed for the microgrid at Camp Smith, there are two distinct modes of operation: Grid-tied (normal) mode and Microgrid mode. The microgrid utilizes two existing government furnished 1 MW generators and two new 750 kW generators plus two 250 kW battery devices called Integrated Storage and Inverter Modules (ISIMs). As part of the overall microgrid integration, the generators will be controlled by Woodward governors while the switchgear, breakers, and switches will be controlled by a network of Schweitzer relays. The GridMaster® system will coordinate this communication and instruct the relays.

CERDEC, Plug-and-Play Architecture for Tactical Power Grids, Fort Belvoir, VA. Software engineer for this project to develop an intelligent and distributed control architecture and algorithms to enable Plug-and-Play capabilities for tactical power grids. IPERC developed a routerless design that identifies and exchanges information between devices using peer-to-peer communications. The communications incorporates Internet Protocol Version 6 (IPv6), which is the next generation protocol that supports advanced cybersecure techniques. The project deliverable was a generic reconfigurable Plug-and-Play distributed control system hardware-in-the-loop demonstration of the prototype suitable for integrating any source or demand. A Phase II-Enhancement was awarded to leverage the research on embedding intelligent retrofit kits into power systems to provide a universal interface into non-standard devices.

U.S. Army Corps of Engineers, ERDC-CERL, Intelligent Demand Side Management for Electric Grid, Champaign, IL. Software engineer for this effort to design, build and test a prototype simulated grid with prioritized load shedding capability for islanded tactical or commercial power grids. This SBIR is the foundation that has allowed IPERC to re-write much of the software that was originally designed to operate on a single computer running on a Microsoft Windows platform. The deliverable for the Phase II SBIR developed software that demonstrates repeatable decisions on a simulated grid. This project was nominated for the 2010 US Army SBIR Phase II Achievement Award.

U.S. Army Corps of Engineers, ERDC-CERL, Energy Security Assessments for Next Generation Microgrid Controllers, Champaign, IL. Lead software engineer for this project. The project consisted of development of the IPC and DOD-specific interfaces, security layers and Information Assurance (IA). The project further developed plug-and-play software for use on DOD installations and Forward Operating Bases. DOD-compliant Information Assurance measures and documentation were incorporated to facilitate attainment of an Approval to Operate (ATO) and Certificate of Networthiness (CTO).

Intelligent Integrated Tactical Power Grids, Huntsville, AL. Provided software development for this project, which included investigation of cybersecurity and IA methodology for software, hardware and overall technology integration for a tactical microgrid. A full-scale prototype was developed in which IPERC's control technology was retrofitted onto military program of record products and demonstrated an average 36% fuel reduction.

Joel Sonkin, Esq.

Compliance/Regulators/Reviewers Lead

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ Specializes in working for or on behalf of government agencies engaged in resiliency and sustainability policy and implementation
+ Chief of Energy and Environment under Mayor (now Senator) Cory Booker
+ Extensive experience coordinating with PSE$G, NJ BPU, NJDEP, USEPA, USDOE, USACE and NJ TRANSIT, and other federal, state, regional stakeholders
+ Communication and coordination for public outreach and stakeholder coordination for complex energy assurance projects

Years of Experience

With AECOM: 1

With Other Firms: 9

Education

Juris Doctorate, University of California, Hastings, 2003

BA, Indiana University, 1999

Work History

2015 - Present, AECOM, Senior Project Manager

2014 - 2015, Greener by Design, Director of Special Projects

2011 - 2014, City of Newark, Chief of Energy and Environment

2010 - 2011, United States Environmental Protection Agency, Senior Policy Advisor to the Regional Administrator

2007 - 2010, Brick City Development Corporation, Senior Associate

2006 - 2007, City of Newark, Special Counsel to the Deputy Mayor

About Joel

Joel Sonkin is a specialist in resiliency planning and project management and holds a juris doctor degree. He has spent most of his career working for or on behalf of government agencies engaged in resiliency and sustainability policy and implementation. He was Chief of Energy and Environment under Mayor (now Senator) Cory Booker, and led a department integrating sustainability and resiliency principles into municipal decision-making around operations, capital investments, asset management and land use policy. He coordinated these activities with other government agencies and regional stakeholders, such as PSE&G, the NJ Board of Public Utilities (BPU), the Governor's Office, NJ Department of Environmental Protection (DEP), US EPA, US DOT, US Department of Energy (DOE), US Army Corp of Engineers (USACE), and NJ TRANSIT. Joel also served as an Obama Administration appointee with the USEPA, primarily charged with developing pilot programs to assist municipalities with resiliency planning and coordinating with federal and state agencies.

Relevant Project Experience

Maher Terminals, Container Terminal Operator Energy Master Plan, NJ. Key member of the consulting team tasked with creating an energy master plan for Maher Terminals, a large terminal operator in Port Newark/ Elizabeth and with achieving compliance with the terms of a USEPA Administrative Consent Order. His responsibilities included the development of a technical approach, project oversight, and communicating and coordinating activities with local community groups, unions, other port terminal operators, Port Authority of New York and New Jersey, USEPA, NJDEP, and PSE&G. The project cost was $23 million, which included a comprehensive energy audit, extensive energy efficiency upgrades, scoping and installation of solar power generation, development of a fleet management plan, and performing fleet retrofits. The USEPA Administrative Consent Order was lifted due to the success of the project.

Joel Sonkin, Esq.
continued

City of Hoboken Energy Assurance and Microgrid Planning, NJ. Integral member of small consulting team engaged by the city of Hoboken in the aftermath of Superstorm Sandy to collaborate with Sandia National Laboratory on the creation of an energy assurance plan and the development of a microgrid feasibility study. Responsibilities included working closely with city officials and representatives of Sandia on the study while communicating and coordinating activities with multiple stakeholders including PSE&G, NJBPU, PJM, FERC, NJDEP, and the Governor's Office and making sure that the parameters of a proposed microgrid project would be consistent with local and federal regulations.

City of Newark/U.S. Department of Energy (DOE), Local Energy Assurance Plan, NJ. Managed the development and implementation of a USDOE-funded Local Energy Assurance Plan (LEAP). The LEAP included energy assurance and resiliency policies, plans and capabilities to rely on before, during, and after energy emergencies and disruptions. The centerpiece of the plan was working closely with all significant public and private stakeholders to perform a vulnerability assessment and then creating a coordinated response for any regional energy disruption. Participating stakeholders included NJ Transit, Amtrak, N.J. Office of Emergency Management (NJOEM), NJDEP, PSEG, Verizon, PANYNJ, Passaic Valley Sewage Commission, all relevant municipal departments and authorities, local and state police, various community groups, universities and hospitals, and multiple layers of elected officials.

City of Newark, Municipal ESCO Project, NJ. Managed the development of a $40 million energy efficiency, building management software and energy resiliency project for 17 critical municipal facilities, including Newark City Hall, emergency facilities, and multiple police and fire stations. Role included overseeing necessary energy audits, determining proper scope of project, coordinating project with various municipal departments, BPU, PSE&G, NJ Department of Commercial Affairs (NJDCA) and the New Jersey Office of the State Comptroller, working with state agencies and legislators to develop state regulatory framework, drafting necessary procurement documents, heading group selecting consultants, and communicating the virtues of the project to various community groups and political officials.

City of Newark, Hess Newark Energy Center, NJ. Lead negotiator for the City of Newark in discussions with the Hess Corporation regarding locating a 655 MW, gas-fired combined cycle power plant in the industrial section of Newark. Key components of the negotiation involved securing appropriate community benefits from Hess as well as working with Hess to quantify and minimize any environmental or public health impacts. Responsibilities included local community outreach and engagement, as well as constant communication with the Governor's Office, NJBPU, NJDEP, and various environmental organizations. Also assisted in the negotiation between Hess and PVSC for the use of PVSC waste water in the power plant operations.

City of Newark, West Ward Switching Station, NJ. Represented the City of Newark in negotiations with PSE&G and multiple community groups concerning the location and construction of a proposed PSE&G switching station in a residential neighborhood located in Newark's West Ward. The purpose of the negotiations was to determine the necessity of the project being located within a residential neighborhood, determine proper community benefits, establish environmental and public health risks associated with the project, confirm project's regulatory compliance, and reach consensus on project design.

United States Environmental Protection Agency (USEPA), Partnership for Sustainable Communities. USEPA regional point person for the Partnership for Sustainable Communities, a partnership between USEPA, US Department of Housing and Urban Development (HUD), and USDOT, designed to coordinate federal housing, transportation, water, and other infrastructure investments. Responsibilities focused on coordinating with other federal agencies on determining priority projects and areas, establishing investment priorities, enforcement actions, and grant application review standards.

Steve McEvoy

Rail Force Account/Rail Ops Coordinator

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 50 years of experience in operation and design of railroads and transit systems
+ Expertise in rail ops, system and signal system analysis and design, train scheduling, computer simulation, and systems planning
+ Extensive knowledge of railroad/transit operating rules and regulations

Years of Experience

With AECOM: 1

With Other Firms: 49

Education

MS, 1975, Transportation Engineering, Polytechnic Institute of New York, New York, NY

BS, 1970, Electrical Engineering, New York University, New York, NY

Work History

2014 to Present, AECOM, Senior Signal & Rail Operations Engineer

2013 to 2014, Gannett Fleming Transit & Rail Systems, Vice President; Director - Railroad & Transit Operational Design

1989 to 2013, SYSTRA Consulting, Inc., Vice President

About Steve

Steve has 50 years of experience in the operation and design of railroads and transit systems. He has expertise in rail operations, administrative and project management, system analysis, signal system analysis and design, train scheduling, computer simulation, and planning of rail transportation systems. His experience ranges from heavy rail (including freight, passenger, commuter, and transit) to light rail and driverless transit systems. He possesses extensive knowledge of railroad/transit operating rules and special instructions, and he has worked closely with the Code of Federal Regulations.

Relevant Project Experience

Amtrak, Signal Design Safety Check on the Northeast Corridor, New Brunswick to Trenton, NJ. Managed the safety check of a new bidirectional signal-block layout and cab-signal control lines on the Northeast Corridor between New Brunswick's County Interlocking and Trenton's Ham Interlocking, including the interfaces with existing signaling at the project boundaries. This new Rule 562 nine-aspect (cab without intermediate wayside) signaling was designed to permit 160-mph train speeds on (express) Tracks 2 and 3, and 125-mph train speeds on (local) Tracks 1 and 4, while providing close train headways on the local tracks at the critical 60-mph and 80-mph intermediate cab-signal speeds.

Moynihan Station Development Corporation (MSDC), Farley/Moynihan Station Development, New York, NY. Senior rail operations analyst responsible for working on a new passenger station being constructed on the site of the Farley Post Office on the west side of Manhattan's 8th Avenue. The station is to be part of the Penn Station complex. While this new station will primarily serve New Jersey Transit, many Amtrak and LIRR passengers will also use the station. Much structural remediation and construction work will be occurring near and/or above many tracks that are electrified for AC catenary and DC third-rail operations. This work had to be safely conducted with minimal impacts on Amtrak, LIRR, and NJ TRANSIT train operations. Responsibilities included supporting the multidisciplinary team in developing construction staging plans and track outage

Steve McEvoy
continued

requirements, as well as coordinating these plans with the involved railroads.

MTA Metro-North Railroad, New Haven Line Signal-System Design of Signal-Block Layouts and Cab-Signal Control Lines, New York, NY. Designed the signal block layouts for the New Haven Line between CP 229 (Green) and New Haven. Designed the cab-signal control lines for the New Haven Line between CP 229 (Green) and CP 244 (Saga), including those for the entire Stamford Complex.

MTA Metro-North Railroad, Security System Operational Support, New York, NY. Senior rail operations analyst responsible for providing guidance as to how and where to locate equipment and cable runs that could be installed and subsequently maintained with acceptable track outages and minimal impacts to train operations. Assisted with scheduling the installation work and required track outages, and coordinated the installation schedules and track outages with MNR. This work encompassed the entire Grand Central Terminal (GCT) complex, including upper and lower levels, through the Park Avenue tunnels, and north to the Harlem River lift bridge.

Central Puget Sound Regional Transit Authority (Sound Transit), Operations Review of Light Rail System, Seattle, WA. Senior transportation specialist responsible for performing a review of existing and future train operations to identify and verify the requirements for a new operations and maintenance satellite facility and associated storage yard. Work included verifying fleet requirements, comparing and analyzing location alternatives, and determining how the existing and new maintenance facilities and storage yards could best provide for efficient and cost-effective train services. The operations review addressed a wide range of mainline operational issues and constraints. Also reviewed a value engineering proposal for reducing the required fleet size for future operations.

Bay Area Rapid Transit (BART), Signal System Headway Calculations, CA. Senior signal system and operations analyst responsible for determining the governing signal-system headway and capacity constraints imposed by the underlying cab-signal system and the Sequential Occupancy Release System (SORS) functionality for each normal-direction track and route in the entire BART System. This included the signaling approaching and departing terminal interlockings, and approaching and departing yard interfaces with mainline trackage. SORS, an important component of BART's train detection system, is an overlying and supplemental signal-system logic that is designed to protect against poor shunting and a train being "lost" by the signal system. The results of this effort included the identification of potential concepts for improving the largest and most restrictive headway constraints.

MTA Long Island Rail Road and MTA Metro-North Railroad Positive Train Control (PTC) Projects, NY. Senior signal system and operations analyst responsible for implementing the Advanced Civil Speed Enforcement System (ACSES) PTC system on both the LIRR and MNR high-density commuter railroads, including the implementation plans, the LIRR development plan for implementing ACSES in non-cab-signaled automatic block signal (ABS) and controlled manual block (CMB) wayside signal system territories, Federal Railroad Administration filings for mainline exclusions (Mainline Track Exclusion Addendums), operating rules and timetable special instructions, and unique operational requirements and concerns.

Southern California Regional Rail Authority/Los Angeles County Metropolitan Transportation Authority, Metrolink Commuter Rail Specialty Services, Los Angeles, CA. Senior signal system and operations analyst responsible for identifying issues and concerns related to the implementation of an electronic train management system/vital train management system form of positive-train-control system on Metrolink's commuter-rail network; reviewing signal system aspect-chart designs; and analyzing complex alternatives for accommodating California high-speed rail at Los Angeles Union Station.

Tom McDermott

Power/Utility Regulators

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 40 years of experience in the generation and transmission industry
+ Project Manager for $900 million PSE&G Northeast Grid Reliability Project
+ Former New York Power Authority Director of Asset Management and Performance Engineering

Years of Experience

With AECOM: 6

With Other Firms: 34

Education

MS, Electrical Engineering, Polytechnic University, 1974

BS, Physics, State University of New York, Stony Brook, 1972

Work History

2009 to Present, AECOM, Principle High Voltage Transmission & Substation Engineer

2009 to Present, The Woodhouse Partnership, Senior Consultant

1975 to 2009, New York Power Authority, Director Asset Management

About Tom

Tom has more than 40 years of hands-on experience in the generation and transmission business, with strengths in analysis, design, problem-solving, and project management. His work includes design and modification of hydro, fossil, and nuclear generation, extra-high- voltage (AC and DC) transmission, and substation facilities, as well as licensing and environmental impact analysis of generation and high-voltage transmission facilities.

Relevant Project Experience

PSE&G Northeast Grid Reliability Project. Project manager for a $900 million program for the redevelopment of 230 kV transmission lines and substations, including engineering, procurement and construction. The project is a upgrade of 138kV lines with 230kV (26 miles). Developed the Phase 1 plan, including engineering and licensing impacts of alternatives, which led to the engineering and construction of the program overhead and underground transmission, and substation conversions.

Renewable Energy Projects, Various Locations. Conducted transmission routing and system integration studies for several renewable energy projects in the Northeast, California, and the Dakotas.

Cape Wind and Fishermen's Offshore Wind Projects. Provided project management for the engineering of the offshore turbine and station platforms, station components, and transmission interconnections.

Southern California Edison, Harry Allen - Eldorado Transmission Project, CA. Provided project engineering for the development of the 500 kV line in California, including routing and design.

PEPCO, Parkside Pedestrian Bridge Transmission Modification, Washington, DC. Provided engineering services for the reconstruction of a 138 kV line to facilitate the construction of a large Pedestrian bridge over Amtrak property and public highway.

Tom McDermott
continued

Duke-American Transmission, Delaney – Colorado River Project, CA. Provided project engineering for the development of the 500 kV line, including routing and design.

Transmission Developers Inc, Champlain Hudson Power Express, NY. Provided project engineering for the routing and engineering development for a 500 kV HVDC submarine cable from Canada to New York City.

Amtrak, Zoo-Paoli Upgrade. Conducted electric and magnetic field and electromagnetic interference studies to support Amtrak's electrification upgrade of the Keystone corridor from Zoo to Paoli. These studies included the electric and magnetic field (25 Hz, 60 Hz and 100 Hz) and electromagnetic interference characterization.

Dallas Water Utility Southwest Pipeline, TX. Provided engineering services for the co-location of a large water pipeline on an existing double circuit 345 kV right-of-way.

Solar Millennium, CA. Provided the electric and magnetic field and electromagnetic inference studies for 500 kV and 230 kV transmission lines to be built in California.

New York Power Authority, New York Regional Interconnection. Responsible for the analysis of a 450 kV HVDC power line based on the conversion of a 345 kV HVAC line to HVDC operation. The analysis included HVAC-HVDC system integration, insulation coordination, DC corona and effects, ions and audible noise, DC magnetic fields, effects, and construction impacts. Analysis supported expert testimony in Article VII hearings before the New York State Public Service Commission.

New York Power Authority, Marcy-South 345 kV Transmission Project. Provided electrical engineering analysis and design with expert testimony at the NYS Public Service Commission Article VII licensing hearings on design and EMF issues for the project.

New York Power Authority, Long Island Sound 345 kV Cable Crossing. Provided electrical engineering design and analysis with expert testimony at the NYS Public Service Commission Article VII licensing hearings on design and EMF issues for the project.

New York Power Authority. Provided electrical engineering analysis and design for the electro-magnetic compatibility of collocated rights-of-way for several gas and electric transmission reinforcements within New York State, with expert testimony before the NYS Public Service Commission as required.

New York Power Authority. Provided insulation coordination analysis for required rebuilds and maintenance of NYPA's EHV lines. Provided grounding analysis of NYPA EHV substations and EHV transmission lines, provided lightning analysis of NYPA's substations and EHV transmission lines, provided electrical engineering analyses of all transmission rights-of-way public impacts and permit requests, and was responsible for the interface and analysis of public inquiries arising from the operation of NYPA's EHV transmission system, leading to the resolution of issues.

New York Power Authority, Asset Management. As Director of Asset Management (and Performance Engineering), developed an engineering group of senior professionals for the purpose of improving the performance of multiple large hydro, fossil generation, and extra high voltage transmission and substation facilities, including the equipment, thermal performance of fossil plants and improving the productivity of its maintenance and engineering workforce. Developed an enterprise performance center for the collection and analysis of information and data for the operations of electrical and mechanical equipment at hydro and fossil generation and substation facilities. Expanded the horizon of NYPA's Asset Management initiatives to include reliability centric (RCM) asset management, integrating both engineering and maintenance personnel into an asset management organization. Developed and implemented reliability engineering concepts of criticality and failure mode assessments of hydro, fossil, and substation equipment, to reshape the maintenance basis of these critical equipment, based on FMEA and PDM processes. Implemented a systematic lifecycle cost management program for generation and transmission equipment.

Jeffrey Roushey, PE

Resliency and Cybersecure Regulations

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ Leads development of innovative product designs and infrastructure protection projects
+ Led design and development team for the Resilient Tunnel Plug system in conjunction with Department of Homeland Security
+ Succesfully contributed to multiple space, high altitude, and terrestrial based projects

Years of Experience

With ILC Dover: 8

With Other Firms: 10

Education

BSME, University of Delaware, 1999

Professional Licenses/Certifications

Professional Engineer: Delaware

Work History

2008 to Present, ILC Dover, Sr. Project Engineer

2000 to 2008, Arlon, Process Engineering Manager

1999 to 2000, Naval Surface Warfare, Project Engineer

About Jeff

Since joining ILC in 2008, Jeff has been involved with and led in the development of, several innovative product designs. He was the ILC team lead for the Inflatable Reentry Vehicle Experiment II (IRVEII), which successfully reentered Earth's atmosphere at hypersonic velocity, and has led several other technology development efforts related to inflatable reentry vehicles for the NASA Langley Research Center. Additionally, Jeff was project lead for an ocean float program supporting a classified military program.

In conjunction with the Department of Homeland Security, Jeff led the design and development team for the Resilient Tunnel Plug system. This system is designed to prevent subway tunnels from flooding. The success of this project led to a multitude of other infrastructure protection projects, including the patent pending Flex-Gate™ which is designed for flood mitigation at critical entrances.

Jeff has worked on a multitude of other space, high altitude, and terrestrial based projects with the primary focus of using softgoods technology for innovative approaches to engineering challenges.

Relevant Project Experience

MTA New York City Transit, Flood Mitigation - Eight Station Project, CM1410. Project lead for the development and installation of a prototype subway stairwell entrance flood barrier that is stored at the point-of-use, is rapidly deployable, can withstand 16 feet of water, is deployable in a 30 MPH wind, and does not encroach on the stairwell. This project resulted in a fully functional system being installed on the 1 Line at the Canal Street Station for NYCT.

MTA New York City Transit, Flood Mitigation – 23 Stairwell Protection Devices Production Systems A37615 – J-Track. ILC Dover project lead for contract to J-Track and GCCOM to supply 23 Flex-Gate™ Stairwell Protection Devices (SPDs). These systems, based on the prototype installed at Canal Street as referenced above, will be fabricated and delivered these two contractors on one week centers following the initial shop test

Jeffrey Roushey, PE
continued

required in the Bid Specification. AECOM is the CM on this project.

MTA New York City Transit, Flood Mitigation – 8-2-1 Station Project, CM1535. ILC Dover project lead, as a subconsultant to the AECOM (URS)/Arup team, supporting the review of additional stairwells for the application of Stairwell Protection Devices (SPDs) for 15 subway stairwells in Manhattan, Brooklyn, Queens, and Roosevelt Island. Installations are planned for early 2016.

MTA Bridges and Tunnels, Portal Flex-Gate™ for the Brooklyn Battery Tunnel (BBT) and Queens Midtown Tunnel (QMT), New York, NY. Project lead providing technical input and review of Design Study being developed for the client to protect these tunnels against major storm flooding. Part of this project includes site visits to evaluate program options. This project is a direct result of White Paper developed by ILC Dover.

Ray Hinkle, CWB

Environmental Impact Statement

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 40 years of experience in environmental/ecosystem management in support of power industry projects
+ Managed many projects in support of PSE&G transmission and distribution services
+ Expertise in preparation of environmental assessments, impact statements, and other environmental compliance documents

Years of Experience

With AECOM: 43

With Other Firms: 2

Education

MS, Pennsylvania State University, 1972

BS, Pennsylvania State University, 1969

Professional Licenses/Certifications

Certified Wildlife Biologist

Work History

2014 to Present, AECOM, Impact Assessment and Permitting Group Manager – NY Metro Area

1998 to 2014, Ecosystems/Permitting Group Manager

1972 to 1998, Woodward-Clyde Consultants, Project Manager

About Ray

Ray has 40 years of experience as both a project manager and environmental/ecosystem management consultant in support of power industry projects. As a project manager, Ray has been responsible for the preparation of various environmental assessments, impact statements, and other environmental compliance documents pursuant to state and federal regulations/guidelines.

His ecosystem management experience includes both conducting and managing aquatic, wetland, and terrestrial ecology studies in a wide variety of habitats. These include coastal and freshwater wetlands, riverine and lacustrine systems, and a diversity of uplands. Ray has managed various projects in support of PSE&G transmission and distribution services in New Jersey. These include support for the upgrading of PSE&G transmission lines including routing evaluations, state/federal permitting support, NEPA consultation, and development of mitigation measures related to transmission line construction material removal/recovery from construction sites in accordance with regulatory requirements.

Relevant Project Experience

PSE&G Resource Recovery and Environmental Compliance, NJ. Project director for AECOM services to PSE&G in support of the removal/re-use/recycling of materials from PSE&G at various construction sites, and maintaining compliance with applicable environmental permits/approvals. AECOM (legacy URS) staff involved in the Environmental Compliance Assistance program completed visits to assess environmental regulatory and permitting compliance. Positive environmental regulatory and permitting compliance practices are identified along with any deficiencies. Assistance is also provided, in conjunction with the PSE&G Permitting Group and PSE&G Project Management, to guide and verify resolution of any deficiencies.

Ray Hinkle, CWB
continued

PSEG Fossil Environmental Services, NJ. Project manager for AECOM services to PSE&G Fossil related to the implementation of a fleet-wide Environmental Management Information System (EMIS) as well as facility-specific permitting requirements. Permitting services have included federal and state approvals related to the demolition of retired facilities as well as permit renewals. Services have also include annual surveys in compliance with the Emergency Planning and Community Right-to-Know Act (EPCRA), including site inventories at each facility in the PSE&G Fossil Fleet.

FAA Permitting Services, Teterboro, NJ. Project director for environmental permitting services provided to the Federal Aviation Administration, associated with the construction of a new control tower at Teterboro Airport. Both the New Jersey Department of Environmental Protection (NJDEP) and New York District Corps of Engineers' approvals are required to construct the project within jurisdictional wetlands. Services provided have included site investigations relating to the type and extent of wetlands present, alternative analyses, flood hazard area analyses, and mitigation site identification and characterization.

AEP Transmission Line, NEPA Environmental Impact Statement (EIS) Preparation, Virginia-West Virginia. Project director for preparation of Draft and Final NEPA Environmental Impact Statement for construction of a 765 kV transmission line crossing the Jefferson National Forest in Virginia/West Virginia. The EIS was prepared utilizing third-party procedures, with the EIS documents being prepared for the U.S. Forest Service by AECOM. Alternative routes were developed and assessed with respect to a wide range of environmental criteria, including cultural resources, threatened and endangered species, and viewshed quality. Facilitation of the public involvement process was included in the scope of services provided and a final Record of Decision was prepared. The project was constructed and is now in operation.

Farmland Industries Phosphate Mine NEPA EIS Preparation, Hardee County, FL. Project manager for the preparation of a Draft and Final NEPA Environmental Impact Statement for the development of a phosphate mine and associated processing facilities in Hardee County, Florida. The EIS was prepared utilizing third-party procedures, with the EIS documents being prepared for the U.S. Environmental Protection Agency by AECOM. Alternative mining techniques and processing technologies were evaluated.

Tidal Marsh Restoration, Jamaica Bay, NEPA Environmental Assessment (EA) Preparation, NY. Project manager for the preparation of a NEPA Environmental Assessment relating to the use of thin-layer dredged material placement as an approach to restoring tidal wetlands in Jamaica Bay. Alternative sources of dredged material and approaches to material placement were assessed.

Leslie Roche, AICP

NEPA Coordination

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 30 years of environmental planning experience
+ NEPA experience includes environmental impact statements, assessments, categorical exclusion, Section 4(f) evaluations, and technical studies
+ Prepared New Jersey environmental permit compliance for NJT Hudson-Bergen Light Rail
+ Prepared permit applications for PSE&G substations, energy generating plants, and transmission corridors

Years of Experience

With AECOM: 21

With Other Firms: 11

Education

BA, Anthropology, Drew University, 1982

Professional Licenses/Certifications

Certified Planner

Work History

1994 to Present, AECOM, Environmental Planner

1990-1994, Paulus Sokolowski & Sartor, Senior Environmental Planner

1983-1990, Abbington-Ney Associates, Senior Environmental Planner

About Leslie

Leslie manages feasibility studies, corridor screening analyses, alternatives analyses, and preparation of National Environmental Policy Act (NEPA) compliant documentation for traditional and tiered environmental impact statements, environmental assessments, categorical exclusion, Section 4(f) evaluations, and technical studies that are consistent with Federal Highway Administration (FHWA), Federal Transit Administration (FTA), and state agency procedures. She has implemented community involvement efforts including advisory committees, public meetings, and resource/regulatory agency coordination. Leslie has overseen State Historic Preservation Office Section 106 consultation. She has been responsible for acquiring federal, state, and regional environmental permits such as for the US Army Corps of Engineers, in addition to records of decision (RODs) and findings of no significant impact (FONSIs). Leslie has managed studies within the framework of statewide NEPA/environmental streamlining agreements and consensus-building legislation.

Relevant Project Experience

NJ TRANSIT, Hudson-Bergen Light Rail System Permits, Various Locations. Prepared the New Jersey environmental permit compliance statements for the initial operating system (IOS) and subsequent operating system (SOS) of the HBLRTS. These were prepared for Jersey City, Bayonne, Hoboken and North Bergen, and Hudson County.

NJ TRANSIT, Access to the Region's Core Permits, New Jersey and New York. Prepared USACE and NJDEP permit applications for a new 7-mile commuter rail surface connection and tunnels between New Jersey and Penn Station in New York City. Key issues include minimizing impacts on wetlands, riparian areas and wildlife habitat; mitigation.

PSE&G, Permit Applications, Newark, NJ. Prepared permit applications for substations, energy generating plants, and transmission corridors.

Leslie Roche, AICP
continued

NJ TRANSIT, Summit Station Parking Expansion Environmental Assessment. Completed an EA according to NJ Executive Order No. 215 for a new 600-space commuter parking deck and expansion of an existing surface parking facility associated with the Summit Rail Station. Key issues included visual and architectural compatibility within an historic district as well as air quality, noise and traffic impact potential.

NJ TRANSIT, Raritan Valley Line Historic Corridor Feasibility Study. Environmental task manager that coordinated a historic/archaeological resources study. The focus on this study was on related architecture, engineering components, landscape features, and rolling stock.

NJ TRANSIT, Port Morris Rail Yard, Morris County. Environmental task manager that coordinated historical/archaeological studies associated with new construction at the historic Port Morris Yard. A key issue involved mitigation for unavoidable impacts to archaeological resources.

NJ TRANSIT, Bus Maintenance Facility, Egg Harbor. Prepared air quality and noise analyses of motor vehicle emissions on roadways including the Atlantic City Expressway in the vicinity of a proposed bus maintenance facility in Egg Harbor.

Southeastern Pennsylvania Transportation Authority, Market Street Elevated Environmental Impact Statement, Philadelphia. Assistant NEPA compliance manager that coordinated completion of an FTA EIS/Section 4(f) evaluation to reconstruct two miles of elevated rail and six stations. Key issues involved community impacts associated with construction, noise, air quality, traffic, and historic resources.

New York State Department of Transportation and Metropolitan Transit Authority, Tappan Zee Bridge Replacement. Key author of draft FTA/FHWA environmental impact statement for multi-modal bridge, highway, and transit improvements along the NY state thruway. Collaborated with a technical team to develop the following chapters: cultural resources, Section 4(f), natural resources, air quality, energy, and coastal zone consistency.

Tri-County Commuter Rail Authority, Double Track Corridor Improvement Program Environmental Assessment, Segment 5, Maintenance and Layover Facility, Palm Beach County, FL. NEPA compliance manager of an FTA EA/Section 4(f) evaluation and technical studies to construct a new maintenance and layover facility associated with extended commuter rail service. Key issues include potential impacts on communities, noise, and water quality.

Delaware River Port Authority, Aerial Tram Environmental Assessment and Permits, Camden, NJ. Secured a finding of no significant impact (FONSI) involving an FHWA/FTA EA/Section 4(f) evaluation for an aerial tram across the Delaware River. The task included formal Section 106 consultation, a public involvement program, and public hearing as required by FTA.

Washington Metropolitan Area Transit Authority, Dulles Corridor Rapid Transit Project Environmental Impact Statement, Washington, DC. Provided environmental assistance to prepare a supplemental draft NEPA EIS/Section 4(f) statement for extension of Metrorail service to Dulles Airport and Loudoun County, Virginia. Key issues include impacts on communities, land acquisition, noise, and aesthetics.

Washington Metropolitan Area Transit Authority, Demonstration Line Project Environmental Assessment, Anacostia. Environmental planner that participated in development of a NEPA-compliant environmental assessment/Section 4(f) statement for a new streetcar line. Key issues include purpose and need, impacts to the community, environmental justice, Section 4(f) parklands and cultural resources, and noise.

Metropolitan Atlanta Rapid Transit Authority, Atlanta Belt Line EIS, GA. NEPA compliance task leader responsible for completing a Tier 1 environmental impact statement (EIS/Section 4(f) evaluation and obtaining a record of decision for a new 22-mile, multi-modal light rail transit and multi-use trails facility. The EIS and tiering process enabled MARTA to identify and secure right of way needs early. The EIS examined the feasibility and benefits of alternative alignments and modes in an environmental context, and assessed potential impacts of the alternatives on communities, adjacent property owners, and the environment.

Mark Gander, AICP

Real Estate/Property Acquisitions

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 27 years of experience in land use for rail/transit
+ Expertise in funding plans and financing structures
+ Real Estate Program Manager for THE Partnership tri-venture in coordination with NJ TRANSIT and PANYNJ
+ Real Estate Manager for PSE&G Northeast Grid Reliability project

Years of Experience

With AECOM: 14

With Other Firms: 13

Education

MA, Urban Planning, University of California, Los Angeles,1990

BA, Politics and Economics, University of California, Santa Cruz, 1985

Professional Licenses/Certifications

American Institute of Certified Planners

National Association of Environmental Professionals (NAEP)

Work History

2002 to Present, AECOM, Principal Planner/Project Manager

2011 to Present, Green Parking Council, Board of Directors, Chair of Advisory Committee

1996 to 2002, Parsons Corporation, Principal Planner/Studio Lead

1991 to 1996, Metro King County Government, Senior Economic Development Specialist

1988 to 1991, Real Estate Economist; Stanley R. Hoffman Associates

1986 to 1988, Ford Foundation, Policy Analyst

About Mark

Mark Gander is an innovative director of mobility and development, with 27 years of interdisciplinary experience, including land use and multimodal transportation strategies. His portfolio includes management of several of North America's largest and most complex infrastructure and land reuse projects, as well as the preparation of funding plans and financing structures to achieve the objectives of project delivery. He has managed real estate elements of transportation, energy, and private development projects.

Relevant Project Experience

NJ TRANSIT Access to the Region's Core (ARC), Trans-Hudson Express (THE) Mass Transit Tunnel Project, NEPA, Preliminary Engineering and Final Design, Metro New Jersey to New York City. Real estate program manager for THE Partnership tri-venture in coordination with NJ TRANSIT and the Port Authority of New York & New Jersey. Responsible for staff and consultant management; coordination of design and acquisition of right-of-way/real estate; preparation of studies of highest-and-best development; transit oriented development and overbuild real estate potential; drafting of deed agreements and covenants; management of environmental studies and appraisal of 500 parcels; preparation of the Real Estate Acquisition Management Plan (RAMP), approved by U.S. DOT FTA. The eight-mile $9 billion commuter rail project along the NEC proposed two new tunnels under the Hudson River between Midtown Manhattan and New Jersey Meadowlands, maintenance yard, station cavern, and several new entrances along 34th Street to double capacity at New York Penn Station in Midtown Manhattan.

PSE&G Northeast Grid Reliability (NEG) Project, Hudson and Essex Counties, NJ. Real estate manager on the PMOC team. Managed survey crews, appraisals, property analysis, formulated access agreements, rights-of-entry agreements, and property rights acquisition with four railroads (CSX, Conrail, Amtrak, NJ Transit). The $1 billion NEG project upgrades existing

Mark Gander, AICP
continued

energy facilities and transmission infrastructure/lines running from Hudson Co. to Roseland in Essex County.

LCOR Development/NJ TRANSIT, Hudson Crossing at Hoboken Terminal and Yard, Hudson County. Supported LCOR/NJ TRANSIT team for over seven years on a three million square foot TOD project at the 65-acre Hoboken Intermodal Terminal and Yard at the Hudson River waterfront. The Jersey City project adds another six million square feet of commercial and residential property, with new LRT station. Responsibility: Optimizing the site's real estate and transport functions; transportation demand management plan; access plan; pedestrian studies (applying the Legion model); design modifications of bus plaza; parking management strategy and guidelines; strategies to reactivate the historic terminal and over-build of the yards; and design strategies to enhance NJ TRANSIT's operational efficiency between rail, light rail, bus, PATH, and ferry services.

Amtrak, Gateway Hudson Yards Project, New York, NY. Real estate lead responsible for providing technical managerial support to Amtrak in preparation of real estate packages, appraisal support, property survey, acquisition maps, and due diligence to acquire permanent and temporary property rights/interests to accommodate new rail tunnel infrastructure at the two super blocks located in the Midtown Manhattan (Hudson Yards) location, in coordination with a $20 billion over-build commercial and residential mega-development complex sponsored by the Related Oxford Companies, served by the No.7 line subway.

Amtrak, Northeast Corridor, Next Gen and Gateway Projects, High-Speed Rail Feasibility Study, Washington, DC to Boston, MA. Real estate lead responsible for determining new rights-of-way/ real estate requirements, costs, benefits, economic development/TOD options of acquiring eight square miles of real estate with grade, aerial, and tunnel along the a 430-mile alignment at average speeds of 218 mph between Washington Union Station to the Boston South Station via New Haven. This feasibility plan for a dedicated, two-track, high speed rail (HSR) corridor is the next generation of intercity passenger rail delivered by Amtrak for the Northeast Corridor (NEC).

Amtrak, Long Island Rail Road, and NJ TRANSIT, New York Penn Station Vision Study. Lead planner on this landmark undertaking to transform Penn Station into a premier rail facility with improved functionality, appearance, circulation and mobility, customer amenities, and retail. The transit-supportive development project includes a consortium of rail agencies – MTA, LIRR, Amtrak, and NJ TRANSIT – and was inclusive of stakeholders' coordination. Oversee real estate optimization, retail strategy, station reprogramming, redesign, remerchandising, funding strategy, and other parts of the comprehensive program.

U.S. Department of Transportation and Federal Transit Administration, Environmental Oversight, Lower Manhattan Recovery Office, NY. Technical review, environmental oversight, and strategic policy guidance to Federal Transit Administration HQ and FTA Region 2 on grantees' project delivery, risk management, NEPA, and state/city environmental documentation of $4.5 billion in mass transit transportation and infrastructure recovery projects. New York City MTA and PANYNJ agency and stakeholder coordination was conducted.

New York State Thruway Authority and Metro-North Railroad, I-287 Corridor/Tappan Zee Bridge Environmental Review. Senior planner responsible for oversight and technical review of land use, socio-economic, and mass transit elements of the Environmental Impact Statement (EIS) as part of AECOM's program management role. Prepared an assessment of land use/transportation strategies and transit-oriented development opportunities along the 50-mile corridor.

Delaware River Joint Toll Bridge Commission, Compact Authorized Investment Program, New Jersey. Program manager of a $40 million bi-state multi-jurisdictional community/transportation enhancement program on a diverse range of projects from the installation of traffic signals and traffic calming, streetscape and landscape design, and projects that support walkability, to large-scale intermodal transportation centers. Oversaw contract procurement, funding program, and saw that program objectives were being met. Performed grant evaluation and community/municipality outreach in Pennsylvania and New Jersey.

Timothy Hand, AICP

Permitting Support

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 28 years of experience in the transportation and site development industry in NJ
+ Expertise in permitting for NJ infrastructure projects and federal, state and local regulatory compliance
+ Demonstrated NJ TRANSIT/PSE&G project experience: THE Tunnel, Metropark Station, Matewan Station Park and Ride, Oradell Bus Facility, Northeast Grid Reliability Project

Years of Experience

With AECOM: 26
With Other Firms: 8

Education

MS, Environmental Science, Rutgers University, 1995
BS, Biology, College of Mount St. Vincent, 1986

Professional Licenses/Certifications

Certified Planner

Professional Affiliations

Society of Wetland Scientists
American Planning Association

Work History

1989 to Present, AECOM, NJ Planning Department Manager
1988 to 1989, DeGrace and Salamone, Inc., Environmental Scientist
1987 to 1988, Bergen County Soil Conservation District, Erosion Control Inspector

About Timothy

Timothy Hand is a senior environmental planner with more than 28 years experience on transportation and site development projects, mainly in New Jersey. Tim's background involves preparing environmental assessments and impact statements; performing wetland delineations; conducting natural resources surveys; preparing and filing of environmental permit applications and providing sound and practical mitigation alternatives including creation and restoration of wetlands.

Relevant Project Experience

NJ TRANSIT, Trans-Hudson Express (THE) Tunnel, NJ and NY. Environmental task leader for a new tunnel beneath the Hudson River to connect NJ TRANSIT's rail corridors with New York Penn Station. Responsible for preparation of the U.S. Army Corps of Engineers Section 404/10 Permit, NJDEP Waterfront Development Permit, NJDEP Flood Hazard Area Permit, and New Jersey Meadowlands Commission Approval. The project also required extensive coordination with NJDEP regarding Cultural Resources and Contaminated Materials.

NJ TRANSIT, Metropark Station Improvements, Iselin. Environmental Task Leader for the preparation of an Executive Order No. 215 Environmental Assessment for proposed improvements to the Metropark Station. Improvements include reconstruction of the station, the platforms, and circulation pathways. Project required Section 106 consultation with the NJDEP – State Historic Preservation Office since the Northeast Corridor may be eligible for inclusion on the National Register of Historic Places.

NJ TRANSIT, Matawan Train Station Park and Ride Facility, Aberdeen. Performed wetlands delineation and prepared NJDEP Freshwater Wetlands Letter of Interpretation and NJDEP Transition Area Waiver applications associated with the expansion of the Park and Ride facility.

NJ TRANSIT, Oradell Bus Facility Rehabilitation. Environmental task leader responsible for the preparation of an Executive Order No. 215 Environmental Assessment for rehabilitation and

Timothy Hand, AICP
continued

expansion of the facility. Performed wetlands delineation and prepared Transition Area Waiver application. Participated in public involvement process.

NJ TRANSIT, Meadowlands Bus Facility, North Bergen. Environmental task leader responsible for the preparation of Waterfront Development Permit, Treatment Works Approval, Tidelands License and Stream Encroachment Permit applications required for the construction of this new bus maintenance facility.

PSE&G, Northeast Grid Reliability Project Upgrades and New Merchant Transmission Project. Licensing and permitting (L&P) program manager for major transmission reliability upgrade and new merchant transmission line projects in northeastern NJ. The project involves the upgrade of an existing overhead transmission line, construction of several new underground circuits, and associated upgrades at various substations. The projects require more than 400 permits including USACE, NJDEP Waterfront Development, NJDEP Flood Hazard Area, NJDEP DCA, local approvals, and numerous others. Also responsible for program management of L&P compliance throughout construction. Program Management includes providing technical, regulatory and strategic input regarding permitting, coordination with and direction of L&P contractors, coordination with design engineering and construction management teams, quality control for all permit application submittals, and management of permitting schedules.

PSE&G, Electrical Transmission, Electrical Distribution, and Gas Distribution. Project manager responsible for the environmental clearance required for maintenance of PSE&G's electrical transmission spans. Surveys are conducted along transmission lines where wetlands and stream corridors are delineated in the field. Environmental reports are then prepared which depict existing conditions as well as summarize applicable seasonal timing restrictions associated with threatened and endangered species. For the electrical and gas distribution projects, AECOM is also providing environmental clearance where electric poles or gas lines are being relocated or installed for new service. The review is prompted after consultation with NJDEP's i-Map which identifies sensitive environmental resources adjacent to project sites.

New Jersey Turnpike Authority, Interchange 6 to 9 Widening Program, Burlington, Mercer and Middlesex Counties. Environmental task leader for 34 miles of widening. Responsible for the acquisition of the NJDEP Land Use Regulation Program permits including Freshwater Wetlands Individual Permit, Flood Hazard Area Permit, and Water Quality Certificate as well as the Soil Erosion and Sediment Control Plan certifications from the respective Soil Conservation Districts. The Widening Program also required a Certificate of Approval from the Delaware and Raritan Canal Commission (DRCC). The project requires extensive coordination with the eight Design Engineers to ensure consistency in the application submissions.

New Jersey Turnpike Authority (NJTA) Interchange 16W/Route 3 Ramps Improvements, East Rutherford. Environmental task leader for improvements to Interchange 16W of the New Jersey Turnpike as well as the associated ramps to Route 3 and Route 120 in the vicinity of the Meadowlands Sports Complex. The project required an NJDEP Executive Order No. 215 Environmental Impact Statement, a USACE Section 404 Permit, NJDEP Waterfront Development Permit/ Stream Encroachment Permit/Water Quality Certificate, Tidelands Conveyance, New Jersey Meadowlands Commission approval, Soil Erosion and Sediment Control Permit Certification from the Bergen County Soil Conservation District, and an NJDEP NJPDES General Permit for Construction Activities.

Consolidated Rail Corporation, Bridge Vertical Clearance Program for Port Reading and Chemical Coast Secondaries; Piscataway, South Plainfield, Metuchen, Woodbridge, and Linden, NJ. Environmental task leader responsible for preparation of environmental permits for the improvements to two Conrail lines. The project required the delineation of freshwater wetlands and the preparation of an NJDEP Freshwater Wetlands Individual Permit, Water Quality Certificate, and Stream Encroachment Permit. In addition, applications were submitted for two Soil Erosion and Sediment Control Plan Certifications.

Amr Elmeged

Project Controls Lead

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 38+ years of experience in project controls for major infrastructure and energy programs
+ Successful delivery of complex mega projects for AECOM worldwide
+ Extensive local project experience with strong focus on transit/rail programs: Second Avenue Subway, Tren Urbano Rail System, Riyadh Metro

Years of Experience

With AECOM: 38
With Other Firms: 0

Education

MS, Civil Engineering, West Virginia University, 1973
BS, Civil Engineering, Cairo University, Egypt, 1970

Professional Associations

American Society of Civil Engineers
Kuwait Society of Civil Engineers
Chi Epsilon & Honor Fraternity

Work History

1988 to Present, AECOM, Project Controls Manager

About Amr

Amr Elmeged is a highly experienced senior project controls manager with leading expertise in the delivery and control of complex design and construction/ program management projects worldwide, particularly in the transportation and rail/transit industry. He is proficient in the financial and schedule management, subcontract management, and client relations for all phases of planning, design, program and construction management. His managerial experience is extensive, and he has managed project controls for complex, multi-billion dollar projects that include transit, highway, bridge, and building facilities. Amr develops and implements project control systems, program and construction management procedures, documentation and configuration management, and quality assurance procedures. A primary component of his experience is the supervision and coordination of project teams in diverse structural, civil, and site development projects.

Relevant Project Experience

Champlain Hudson Power Express, Canada-NY. Project controls manager for a $2.2 billion energy project including a 335-mile, high voltage direct current (HVDC) cable system transferring power from Quebec to Astoria, New York. Responsible for developing the project master CPM schedule, project budget, and the document control system. Supported the project manager and the client legal consular during the negotiation with the design-builder.

MTA New York City Transit, Second Avenue Subway. Project controls manager responsible for developing the cost, schedule, and document control systems. Developed a resource loaded baseline CTM schedule, conducted a monthly update including an end value analysis and produced monthly reports for different levels of management. Civil project control manager on the project that includes a two-track line along Second Avenue from 125th Street to the Financial District in Lower Manhattan. A flex rail connection will be constructed from the Second Avenue Line to the 63rd Street Line. Sixteen new stations will be constructed, in addition to improvements to the 63rd Street Station.

Amr Elmeged
continued

The design fee for the concept design and preliminary engineering is $200 million. The estimated construction cost of the project is $16 billion. Estimated year of completion is 2015.

Riyadh Metro Transit System, Saudi Arabia. Project controls manager for six new metro rail lines in the city of Riyadh, to form the backbone of the future Riyadh public transport network along with a comprehensive bus network. The metro system will be mostly underground in a bored tunnel and elevated on a viaduct. Line 1 extends over a length of 38 Km and features 22 stations, in addition to 4 transfer stations with Lines 2, 3, 5, and 4&6. Led a team developing and maintaining the master schedule for 11 under ground stations and he developed the weekly and monthly reports to inform the client about the progress of the work, financial status, change orders, trend analysis, issues and opportunities.

Massachusetts Bay Transportation Authority, Southwest Corridor Rail/Rapid Transit, Section II, Boston. Assistant control manager responsible for project scheduling, estimating, construction phasing, sequencing, and staging. Also responsible for structural design of boat sections, cut-and-cover tunnels, and station design. Provided design review, coordination, and quality assurance.

Rhode Island DOT, Rhode Island Freight Rail Improvement, Quonset Point/Davisville to Central Falls. Procurement manager responsible for developing the procurement strategy. There were two major project components: rehabilitation/construction of a freight-dedicated third track and modification of bridges and other structures to provide sufficient vertical clearance to accommodate modern freight equipment.

Tren Urbano Rail System, San Juan, Puerto Rico. Control manager during design phase, responsible for development of the management control system, which encompassed developing a master and detailed CPM schedule, developing the project budget and the cost containment program, and working with a team of professionals in developing a document control system for the project. During the construction phase, Involved in claim analysis and claim litigation process. Tren Urbano is a new-start transit project, a 10-mile fixed guideway, with 16 stations within the San Juan Metropolitan area.

Etihad Rail, Railway Network, Abu Dhabi, United Arab Emirates. Responsible for setting up the project control system, Developed the base line schedule and program budget. Developed reporting system with multilevel dashboards to monitor the project.

Massachusetts Highway Department, Central Artery/Tunnel, South Bay Interchange, I-90/I-93 Interchange, I-93 Northbound, Boston. Design manager responsible for final design of I-90 main line and auxiliary tunnels; I-93 northbound main line and auxiliary bridge and transition structures; and, at-grade, depressed ramps, and tunnels connecting I-90 and I-93. Project control manager responsible for development and monitoring of the design schedule and budget; development of the construction estimate and monitoring the design to ensure construction costs; and construction staging and sequencing for the interchange.

Massachusetts Bay Transportation Authority, South Boston Piers Transitway. Managed scheduling, cost estimating, and construction staging for the new underground mass transit system. The project includes approximately 1.6 miles of tunnel, with ancillary facilities, reconstruction of South Station Red Line to accept additional platform, construction of new World Trade Center Station, and coordination with concurrent projects, including Central Artery/Tunnel and the Massachusetts Port Authority's World Trade Center Development. Also responsible for developing baseline budget thereafter, and implementing a cost-containment program up until the development of construction cost estimate.

Tunc Gundogdu

Cost Control

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 18 years of experience as a program controls manager for large-scale projects
+ Program Controls Manager for MTA NYCT Integrated Electronic Security System/Command, Communication, and Control Center Project
+ Risk/Project Controls Manager for design of security solutions and technical and construction services for MTA facilities throughout New York City.

Years of Experience

With AECOM: 7

With Other Firms: 11

Education

BS, Civil Engineering, Middle East Technical University, Turkey, 1992

MS, Courses completed on Construction Management and Coast & Harbor Engineering, Middle East Technical University, Turkey, 1994

Professional Licenses/Certifications

Engineer in Training: New York

Work History

2013 to Present, AECOM, Program Controls Manager

2008 to 2013, The LiRo Group, Sr. Project Controls Manager

2003 to 2008, AECOM, Project Controls Manager

2001 to 2003, PACO Group, Cost Engineer

1997 to 2000, Garanti/Balfour Beatty Construction, Project Planning Engineer

About Tunc

Tunc is a highly qualified risk/program controls manager with more than 18 years of experience in designing, implementing, integrating, and managing project control systems for large-scale construction projects, from design to construction. A graduate civil engineer with computer programming skills and on-site construction experience, he has extensive knowledge in project and construction management tools for tracking construction cost, budget, and change orders; performing risk management/analysis; planning and scheduling; design management; resource control; on-site inspection; claims analysis; and reporting.

As Program Controls Manager for the LaGuardia Airport Redevelopment Program for the Port Authority of New York and New Jersey, he managed schedule, cost, and risk reporting with dashboards and BIM/4D, and was responsible for implementation of the overall program. He also implemented a program risk management added value to the program.

Tunc also managed development of risk analysis and summary schedules for the $15 billion World Trade Center construction program, including infrastructure and facilities in Lower Manhattan Construction Command Center, for the Port Authority NY&NJ. He prepared weekly schedule impact analysis and recovery schedules, and developed risk schedules into a WTC 3D BIM model for risk management (4D/5D).

For the MTA Integrated Electronic Security System/ Command, Communication, and Control Center Construction Project, he implemented a detailed monthly progress and reporting solution, gaining MTA management's praise. He recommended an advanced solution for change management, process preparation, and implementation for the MTA East Side Access project, and delivered a sophisticated cost control, earned value analysis, and document control by using Primavera Contract Management software.

Tunc Gundogdu
continued

Relevant Project Experience

MTA New York City Transit, Integrated Electronic Security System/Command, Communication, and Control Center Construction Project. Project controls manager responsible for all project controls duties associated with delivery of comprehensive construction management services for the MTA's IESS program ($500 million), a secure, integrated, automated system of systems designed to facilitate normal and emergency security operations across the MTA. Implemented and managed Primavera Contract Manager as an all-electronic document/contract control solution for the project manager, resident engineers, and inspectors. Prepared all computerized monthly reports and trained staff.

MTA New York City Transit, Capital Security Program Security Risk Assessment for Verrazano Bridge, Grand Central Station, Penn Station Complex and other New York Subway Station Complexes and Security Capital Program. Risk/project controls manager for confidential $50 million security contract to provide design of security solutions and related technical and construction services for MTA facilities throughout New York City. The MTA facilities include rail transit, commuter rail, bridges, buses, stations/terminals, maintenance facilities, and office buildings.

Port Authority of New York and New Jersey, LaGuardia Airport Redevelopment Program, Flushing, NY. Program controls manager of the redevelopment program, responsible for management and reporting of project cost/budget, schedule, and risk with BIM/4D of the $4 billion Redevelopment Program, which consists of new terminal, garages, roadway, and bridges.

Lower Manhattan Construction Command Center, New York, NY. Senior project controls and risk manager, serving as a member of the Lower Manhattan and World Trade Center ($15 billion) infrastructure coordination and support team. He managed risk assessments and risk analysis of the WTC schedules using Primavera risk analysis. Tracked project metrics of 500 Lower Manhattan construction projects, from Canal Street south, in a database ($30 billion). Also directed a team to prepare a 3D/4D web construction map to visualize all construction for Lower Manhattan with a time feature to review 3D buildings and streets.

MTA/LIRR, Eastside Access Project, New York, NY. Cost engineer and Primavera Expedition contract control database administration for this $10 billion new railroad Line for LIRR from Sunnyside, Queens, to historical Grand Central Terminal Station. Managed multiple projects and prepared custom reports and prepared applications (change management add-on), according to the project procedures. Also trained staff. Prepared and maintained value engineering tracking database application. Tunc worked on Earned Value calculation reporting and assisted in planning, development, and issuance of business procedures and policies for project management team and consultant/contractor contracts.

Garanti/Balfour Beatty Construction, MIGROS Shopping Center, Ankara, Turkey. Project planning engineer for a $30 million shopping center construction project. Responsible for schedules and planning.

Dane McBlaine, PMP, LEED AP

Schedule

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 12 years of experience with project controls, scheduling, and cost control on major capital projects
+ Scheduling for NJ TRANSIT/PANYNJ Access to the Region's Core Program
+ Expertise with scheduling softwares: Oracle Primavera P6 Enterprise Project Portfolio Management®, P3®, NetPoint®, Oracle Primavera Risk Analysis®, Palisades @Risk®, and various web-based project management systems

Years of Experience

With PMA Consultants: 12
With Other Firms: 0

Education

BS, Civil Engineering, Michigan State University, 2003

Professional Licenses/Certifications

Project Management Professional
LEED Accredited Professional

Work History

2003 to present, PMA Consultants, Associate/Senior Associate

About Dane

Dane has extensive scheduling and cost controls experience on a wide variety of major capital projects. His experience with owner oversight, project controls, and construction claims allows him to provide a comprehensive approach to project management and implementation. Dane is experienced with Oracle Primavera P6 Enterprise Project Portfolio Management®, P3®, NetPoint® (a collaborative planning/forensic schedule analysis tool), Oracle Primavera Risk Analysis®, Palisades @Risk®, Microsoft Office Suite®, and various web-based project management systems. He recently performed schedule management, validation, and oversight as part of the construction management team on a large-scale campus reconstruction program.

Relevant Project Experience

NJ TRANSIT/Port Authority of New York and New Jersey, Access to the Region's Core Program. The approximately $8.5-14.5 billion Access to the Region's Core Program (Trans-Hudson Express Tunnel) consisted of two new additional tracks and supporting infrastructure adjacent to NJ TRANSIT's/Amtrak's Northeast Corridor Line as well as tunnels under the Palisades, Hudson River, and Manhattan into a new Penn Station terminal. This program was partially funded by the PANYNJ, for which PMA provided project controls services. PMA was tasked by PANYNJ with schedule and cost oversight of the program, working under NJ TRANSIT's project controls lead, but reporting to PANYNJ. Responsible for review of the final design schedule, which was generated by the design consultants, as well as tracking of the design progress for each active package. Additionally, facilitated planning and high-level scheduling of property/easement acquisition and construction for early packages.

Port Authority of New York and New Jersey, Multiple Projects, Newark, NJ. The PANYNJ has an annual capital program in excess of $1 billion, consisting of hundreds of projects in various phases of design and construction.

About Dane

Dane McBlaine, PMP, LEED AP
continued

Worked with the Project Management Office team to assist their agency-wide project controls efforts. Led the execution of a master baseline schedule for the World Trade Center Redevelopment Department's project portfolio. This involved working with Security, Operations, Development and Retail Business Areas to generate:

- WBS, OBS, baseline, controls and reporting framework
- Generating approximately 36 project-level schedules via planning sessions
- Project Interfaces with WTC Master Construction Schedule (IMS)
- Program and Executive-level Milestone Tracking

Dormitory Authority, State of New York,Bronx Mental Health Redevelopment, Bronx. PMA provided scheduling and project controls services in the construction of the $400 million Bronx Psychiatric Center being constructed by DASNY. As the program schedule responsible for performing the following work:

- Generated monthly master program schedule updates through integration of individual project updates from 11 active contracts.
- Provided comprehensive review of general contractor schedules (periodic recovery schedules and monthly updates for five contracts) with the construction management (CM) team.
- Updated the project schedule directly for one of the 11 contracts with the CM team on a monthly basis.
- Provided delay analysis for contractor time extension review/validation/justification.
- Provided progress tracking analysis for DASNY executive meetings and various ad hoc schedules to assist the CM team.
- Facilitated "pull planning" sessions with the CM, General Contractor (GC), and subcontractor superintendents.
- Facilitated periodic updates of qualitative risk assessment including the owner, CM and GCs. This included risk review sessions and update of the risk register.
- Forecasted expected completion through risk exercises.

Detroit Water and Sewerage Department (DWSD) Various Projects, MI. At the PMA Detroit location, worked for the DWSD, performing project oversight services, including cost and schedule control, field QA, change control, correspondence, RFI and submittal management, contractor billings, facilitation of weekly progress meetings, and generating progress reports. Responsible for developing, maintaining, and reviewing CPM schedules for various projects under this call-in contract. Also assisted on many projects in providing PMA claims support services for expert witness/ consultant testimony.

Port Authority of New York and New Jersey Implementation of PMO's Prescribed Risk Process. While working for the Port Authority's PMO, assisted in introducing and implementing PMO's Project Risk Assessment process, and oversaw the team's execution of risk management. The PMA Team facilitated project risk analysis on approximately 150 projects, ranging from $2 million to $1.9 billion, with a cumulative total of approximately $4 billion. The team's risk project portfolio spans all four lines of the Port Authority's business – Aviation, Tunnels and Bridges, PATH (Rail) and Ports.

Jay Bayersdorfer, PE

Cost Estimating

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 33 years of experience in estimating for major heavy/civil construction projects
+ Expertise in costing and implementation of rail/transit, power/energy projects
+ Specializes inproviding realistic A/E construction cost estimates based on contracting experience
+ Chief estimator for NJ TRANSIT's Portal Bridge Replacement and Amtrak's Fire & Life Safety Program in NY and NJ

Years of Experience

With AECOM: 15

With Other Firms: 18

Education

BS, Civil Engineering, University of Vermont, 1982

Professional Licenses/Certifications

Professional Engineer: New Jersey, Connecticut, Vermont

Work History

2001 to Present, AECOM, Chief Estimator

1999 to 2001, Kiewit Constructors, Inc., Senior Estimator

1997 to 1999, Barbella Environmental Technology, Inc., Senior Project Engineer/Estimator

1993 to 1997, Moretrench American Corporation, Project Manager

1991 to 1993, Loughney Dewatering Division, Remcor, Project Manager

1983 to 1991, Griffin Dewatering Corporation, Sales Engineer

About Jay

Jay Bayersdorfer is an accomplished civil engineer with more than 30 years of experience in all types of heavy/civil construction, mechanical and plumbing, and electrical energy projects. His experience includes the planning, costing, and implementation of rail/transit, power/energy, underground utility construction, complex excavations for underground structures, earth support systems of every type, slurry walls, groundwater control, environmental remediation, HVAC, and energy.

Jay's experience in planning, managing, and executing large civil construction work provides for superior insight not only from a cost standpoint, but also of constructability, sequencing of work, and developing realistic means and methods to suit project schedule and project conditions and restrictions. Prior to joining AECOM, Jay's career was with the leading contractors in the types of work mentioned. At AECOM, he has been instrumental in providing A/E construction cost estimates for complex projects.

Relevant Project Experience

NJ TRANSIT Portal Bridge Replacement, Kearny-Secaucus. Prepared bottom-up estimate for all major civil and structural components of this nearly $1B project. Project involves multiple viaduct structures, retained embankments, drilled shaft foundations and new arch-cable bridge over the Hackensack River to replace 100 year old swing span.

Riker's Island GTG Cogeneration Project, Queens, NY. Performed complete bottoms up quantity takeoff and cost estimating for installation of twin 7.5 MW Gas Turbine Generators and all related equipment. Project included a building on pile foundations, all distribution piping, exhaust stacks and amenities. Also included was heavy electrical work including 27kV Switchgear and 1.6 miles of underground ductwork in areas containing numerous existing utilities and contaminated soils.

Ward's Island WWTP Heating Improvements, New York, NY. Responsible for complete cost estimate for heavy mechanical work including the replacement of low pressure steam boilers and replacement of steam

Jay Bayersdorfer, PE
continued

piping distribution above and below grade through heavily congested active Wastewater Treatment Plant.

Amtrak, Fire & Life Safety, Rehabilitation of three Ventilation Shafts, New York, NY and Weehawken, NJ. Work was performed in vent shafts constructed over 100 years ago. Responsible for preparing independent estimates for all work including civil/structural, demolition, architectural, and mechanical/plumbing/electrical. In preparing the estimate, extensive review of constructability issues had to be considered in order to select practical and realistic means and methods for construction. Provided key inputs to the overall constructability review. Lead negotiator representing Amtrak in negotiation of fair and reasonable settlements for contract changes.

Amtrak Gateway Right of Way Preservation – Hudson and West Side Yards, New York, NY. Tasks included complete bottoms up estimates for Cut & Cover tunnel structures to depth of 100-ft below grade. Work involves various earth support systems including secant pile walls, slurry walls, and temporary support of roadway bridges within congested rail yards, and massive concrete tunnel barrels for support of future overbuild. Participated in negotiations with single source procurement method and saved the client approximately $20M.

Brooklyn-Battery Tunnel, Governors Island Vent Structure Resiliency, New York, NY. Developed conceptual estimates for construction alternatives to hardening of vehicle tunnel that was inundated as a result of Superstorm Sandy. Work involves construction and extension of diaphragm walls and other heavy civil/marine construction in a marine environment from floating equipment. Developed costs based on realistic construction means and methods.

Dormitory Authority of State of New York (DASNY), Hospital Emergency Electrical Upgrade for six Hospitals. Complete takeoff and estimation of construction costs for replacement of diesel generating systems ranging from 350 kW to 1,500 kW. Work involves structural and mechanical demolition, heavy rigging, all mechanical piping for fuel and exhaust systems, electrical distribution including automatic transfer switches, distribution panels, and installation of feeders in a hospital environment.

MTA Metro North Railroad, Yankee Stadium Station, Bronx, NY. Prepared full design build estimate from 30% design drawings for new MNR station including complex track staging, pile supported platforms and structures, replacement of pedestrian overpass, and all other site work performed within footprint of operating railroad. Estimate required extensive review of project work restrictions in order to select appropriate means and methods from the standpoint of constructability. This estimate came within 10% of the successful bidder.

Dulles Corridor Metrorail Project – Phase 2, Washington, DC. Prepared quantity takeoffs and bottoms up contractor's type estimate in HCSS for approximately 12 mile new rail line including guideway, track, utilities and traction power. Project includes six stations and yard facility.

MTA New York City Transit, Second Avenue Subway. Prepared all phases of mechanical and electrical estimates for preliminary design of Second Avenue Subway, New York, NY. The proposed project includes eight miles of twin tunnel in soft ground and rock and 16 stations.

MTA New York City Transit, Whitehall Ferry, Secant Pile Wall & Drilled Shafts for Subway Transfer. Complete takeoff and estimation within 5% of successful bidder for complex underground subway station upgrade. Work consisted of drilling and installation of secant pile wall for temporary earth support, temporary bracing, roadway decking during construction, drilled shaft foundations, and utility relocations.

Port Authority of New York and New Jersey, EWR, JFK, LGA and TEB. Performed numerous estimates involving security hardening including Perimeter Intrusion Detection Systems, hardening of perimeter, Bollard construction in heavily congested terminal frontage areas, and interior reconfigurations to accommodate state of the art security systems.

Kevin Meehan

Cost Estimating

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 15 years of experience in the field of construction cost estimating
+ Cost estimating services on $1B in construction projects
+ Track Certified with the NJ TRANSIT

Years of Experience

With JCMS: 4.5

With Other Firms: 10

Education

BS, Civil & Environmental Engineering, Rutgers College of Engineering, 1999

Professional Licenses/Certifications

Track Certified - NJ Transit

Work History

2011 to Present, JCMS, Lead Cost Estimator

2009 to 2011 AECOM, Senior Cost Estimator

2008 to 2009, Gilbane Building Company, Senior Cost Estimator

2000 to 2007, Bovis Lend Lease, Cost Estimator

About Kevin

Kevin Meehan has over 15 years of experience in the field of construction cost estimating. His diverse experience comprises a wide variety of projects that includes estimation of transit, industrial, commercial, institutional, high-rise, and educational. Kevin has been responsible for developing budgetary and final construction cost estimates, contract pricing and change orders, contract negotiations, interface and coordination with contractors, owners and A/E consultants on project issues, assisting owners on construction phasing and scheduling, coordinating with the A/E of record regarding change orders, interpretation of contract documents, submittal and approvals and related technical matters, review of contractors claims of disputed work, providing detailed takeoff and pricing for site work, foundations and recommending appropriate action to owner.

Relevant Project Experience

NJ TRANSIT, Sandy Recovery and Long Term Flood Mitigation and Resiliency, Secaucus Junction and Newark Penn Station. Cost estimating for flood barriers, electrical redundancy, Sandy repairs

NJ TRANSIT, Sandy Repairs and Remediation, Flood Mitigation and Resiliency, Hoboken Terminal and Yard. Cost estimating for project to restore the terminal and yard operations, while at the same time increasing the system's resiliency - its ability to withstand and recover quickly from future storms.

NJ TRANSIT, Sandy Recovery: Initial Flood Assessment, Newark. Cost estimating for flood mitigation, backup generator and electrical hook-up-conduits-wire-transfer switch, sump pump, trash pump, on-call implementation cost for contractor before and after storm for NJ TRANSIT facilities: Newark Penn Station, Secaucus junction, NLR Bloomfield Station, NLR Broad St. Station.

Kevin Meehan
continued

NJ TRANSIT, Capital Asset Replacement Program (HBLR &SNLRT). The CARP program consists of projects including Resurfacing of the Plank Interlocking and the Lackawanna Curve, Harbor side track replacement, Replacement of light fixtures, the UPS system and fire protection piping at the LRV Maintenance Facility, bollard replacement at the Newport Viaduct and replacement of various equipment and furniture. Responsible for providing capital cost estimates for NJ TRANSIT's Hudson-Bergen Light Rail and River Line system infrastructure and facilities.

NJ TRANSIT, NEC Mid Line Loop Project. Responsible for conceptual estimate. Prepared estimate from Conceptual design report and 10% Design drawings. Project included design, engineering and construction assistance to improve NJT commuter rail service by eliminating the grade crossing conflict that exists on NEC approximately at MP32 at Jersey Avenue Station/ County Yard Facility.

NJ TRANSIT, Secaucus Junction Platform Extensions. Cost estimating for $1.5M effort to extend two island platforms an additional 120 feet each on the four tracks NJ TRANSIT Main Line.

MTA Long Island Rail Road (LIRR), Replacement of the Port Washington Yard Traction Power Substation, New York, NY. Responsible for managing change order process and negotiations, for the construction of a new Traction Power Substation located within the LIRR yard in Port Washington, Nassau County, New York.

MTA Long Island Rail Road, Station Master's Office Renovation (Concourse Level), New York, NY. Provided preconstruction management and estimating services. The renovation at New York's Penn Station is a $2.5M project to update the nexus of the railroad's station monitoring and information network.

MTA Metro-North Railroad, Grand Central Terminal Leak Remediation, New York, NY. Provided preconstruction management and estimating services. The midtown manhattan terminal is planning a $20M leak remediation project to repair and prevent damage from water intrusion.

Port Authority Trans-Hudson (PATH). As lead estimator, currently working on various PATH task orders:

- Task Order # 4 Replacement of Track, Third Rail and Appurtenances in Tunnel E & F at Exchange Place
- Task Order # 12 Replacements of Auxiliary Power Equipment and Cables at Exchange Place
- Task Order # 5 Replacement of Signal Cabling and Equipment at Tunnels E &F,
- Task Order # 8 Replacement of Blue Light Station, 480V Power Distribution and Tunnel Lighting at Tunnel E & F
- Task Order # 6 Replacement of 27kV, 15kV, traction power and Inter-tripping cables at Tunnel E & F, Exchange Place & WTC
- Task Order # 19 Exchange Place Station-Escalator Replacements

Port Authority New York and New Jersey, Newark Aviation Fuel System Modification, NJ. Responsible for providing cost estimating services on the $90M Newark Liberty International airport fuel systems modifications project that will install nearly 30,000 linear feet of underground double walled aviation fuel piping. The project will also add two new 47,600 bbl above ground tanks, two new truck fueling racks, a contact water treatment facility, fuel selection area manifold, modifications to four pump stations including new PLCs and controls.

CATS Charlotte Area Transit System, Lynx Blue Line Extension, NC. Responsible to perform a risk management and contingency review for this $1 billion, 9.3 mile extension of the Charlotte, NC light rail system. The extension will service 11 new stations, including seven walk-up stations and four stations with park and ride facilities.

FTA – PMO -Blue Line Extension of the Charlotte Light Rail System, Raleigh, NC. Responsible for the estimating portion of FTA PMOC risk analysis before project was released for final design. The $1.1B, 9.3 mile extension of the light rail system will service 11 new stations, including seven walk-up stations and four stations with park and ride facilities.

Dave Collett, PE

Configuration Management

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 26 years of experience in the engineering and construction industry
+ Expert in configuration management
+ Experienced in advanced configuration management and deployment of SmartPlant Enterprise for EPC project delivery
+ Similar experience worldwide

Years of Experience

With AECOM: 22

With Other Firms: 6

Education

M.S., Geotechnical Engineering/University of California, Berkley

B.S., Civil Engineering/Brigham Young University

Professional Associations

American Society of Civil Engineers

Geotechnical Society, University of California, Berkley

Work History

1993 to Present, AECOM, Senior Project Director

1987 to 1993 Canonie Environmental, Various Positions

About Dave

Dave Collett is a 28-year veteran of the engineering and construction industry who has held positions with increasing management responsibility, with the current role of senior director leading project information management and plant configuration management initiatives on projects. Most recently, Dave has been working in the advanced configuration and deployment of SmartPlant Enterprise for EPC project delivery and information/configuration management schemes. This work started in his role of corporate leader for SmartPlant Enterprise configuration and deployment and extended to commercial and US government based nuclear programs, leveraging SmartPlant Enterprise for information and configuration management applications.

Dave also has a broad spectrum of international experience spanning nuclear, environmental, industrial process, oil and gas, mining, power, and infrastructure industries and comprising the entire project lifecycle including business case, pre-planning, technology, FEED, detail engineering, procurement, construction, commissioning, operation, and decommissioning.

Relevant Project Experience

LNG Canada MIC. Senior project director, currently working to lead a team to configure and suport a cloud-based Integrated Engineering Environment (IEE) on an Intergraph SmartPlant platform, for consistent development and management of plant information.. The objective is to facilitate configuration of tools within the IEE for consistent use and information gathering, leading to implementation assistance and oversight.. This also includes information management within an ITIL frame work: IQMF (Information Quality Management Frame Work); System and Software Life Cycle Management (Change Management); and Service Management System to administer and assure use by a global network of FEED contractors.

Dave Collett, PE
continued

Hanford Waste Treatment Plant. Senior project director assigned to support configuration and deployment of SPF/SPO for information and configuration management purposes at the DOE Waste Treatment Plant at Hanford.

US Navy Nuclear Reactor Spent Fuel Handling Project. Senior project director assigned to support configuration and deployment of configuration management strategies.

MHI APWR/North Anna 3 Project. Senior project director assigned to develop, configure and deploy configuration management strategies on large scale commercial nuclear program with emphasis on requirements definition and management, extending to engineering, procurement and construction phases leading to project compliance demonstration for turnover and long term owner asset management strategies.

SmartPlant Project, Boise, ID. Special assignment as the senior director for this strategic corporate initiative to develop new work processes and systems to better facilitate global multi-office project execution, with specific emphasis on engineering. This project is part of a broad company effort to standardize the company's project execution processes, specifically within engineering and implement cutting edge technology to improve efficiency and quality in complex plant based projects.

Nuclear Decommissioning Authority, Sellafield Project, Seascale, Cumbria, United Kingdom. Led the Project Management PAIS (Partner Assess Innovate Sustain) team at the NDA (Nuclear Decommissioning Authority) Sellafield Site, including the assessment of existing project management/execution methods and development of practical innovations to help facilitate sustainable improvements.

Katie Donahue

Document Control

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ MEP design engineer on energy conservation projects in existing buildings throughout NYC
+ Responsible for document control on several projects

Years of Experience

With Macan Deve Engineers: 1

With Other Firms: 7

Education

BS, Mechanical Engineering, Boston University, College of Engineering, 2008

Work History

January 2015 to Present, Macan Deve Engineers, DPC, Project Manager, Document Control, CAD Designer

2014 to 2015, Elite CAD Designs, Drafter / Project Coordinator

2012 March 2014 to Owner, Small Business

2010 to 2012, Harbour Mechanical Corporation, Project Manager

2008 to 2010, AECOM, Mechanical Engineer, Document Control

About Donna

Katie Donahue has seven years of experience in MEP design, equipment layout, CAD design, project management, project Controls (including, cost estimation, schedule management and budget reviews), and CM services. As an engineer and construction manager, Katie has the talent required to coordinate between contractors and engineers, through RFIs/RFCs, coordination meetings, and field inspections of work performed to ensure compliance with specifications and drawings. Katie also has an understanding of change order negotiations and cost estimating and has been responsible for document control on several projects.

Relevant Project Experience

Harbour Mechanical Corporation, Hoboken, NJ. Project Manager, Construction Manager:

- Managed job sites in the constructing of mechanical systems in both new and existing buildings
- Responsible for organization of sub-contractor work and on site workers
- Met with building owners and on site managers to resolve problems and ensure projects built on time
- Dealt with suppliers to acquire necessary equipment within the project time frame
- Analyzed bid documents and specifications as well as created as-builts
- Assisted in the estimating department

Elite CAD Designs, Ringwood, NJ. Drafter, Project Coordinator:

- Responsible for creating 3D BIM drawings using AutoCAD MEP
- Assisted in coordination of trades using Navisworks on large scale construction projects
- Created equipment layout plans for air and water-side systems in existing spaces
- Interpreted construction documents and specifications to design systems and create shop drawings

Katie Donahue
continued

- Generated spool sheets for fabrication based on final designs

AECOM New York, NY. Mechanical Engineer, Document Controller:

- MEP design engineer on energy conservation projects in existing buildings throughout NYC
- Knowledge of both air-side and water-side systems
- Projects include lab safety upgrades, humidification systems, air supply and exhaust systems
- Performed all aspects of design including relevant calculations and equipment selection
- Generated contract documents including bid drawings and specifications
- Provided construction support for projects including shop drawing reviews, answering RFIs, and site visits
- Responsible for document control on several projects

Timothy E. McClive

Analysis of Ancillary Services and Market Revenue Opportunities

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 30 years of experience in utilities consulting
+ Expert in market strategies relating to transmission and generation investments
+ Actively engaged in 40 power sector analyses
+ Knowledge of energy sectors including PJM, FERC, and others
+ Previously worked at the New York State Energy Office, Conectiv, Niagara Mohawk, the Edison Electric Institute

Years of Experience

With Navigant: 6

With Other Firms: 29

Education

PhD studies, Resource Economics (finished all requirements but dissertation), Cornell University, 1991

MA, Economics, SUNY Albany, 1985

BA, Economics, Trinity College (CT), 1979

Work History

2013 to Present, Navigant Consulting, Director – Energy

2009 to 2013, Navigant Consulting, Associate Director – Energy

2007 to 2009, Pace Global Energy Services, Director – Utility and Risk Management Services

2001 to 2006, Edison Electric Institute, Chief Economist

1994 to 2001, Niagara Mohawk Power Corp., Senior Planner & Manager – Corporate Planning

1991 to 1994, Delmarva Power & Light, Supervisor – Corporate Planning

1988 to 1988, Resource Management International, Consultant

1987 to 1991, Cornell University, Dept. of Agricultural Economics

1980 to 1987, New York State Energy Office, Policy Analyst - Policy Analysis & Planning

About Tim

Timothy McClive manages the power markets modeling team at Navigant's Energy Practice. He is a resource economist and project manager with 30 years of experience in government, utilities, and consulting. At Navigant, Tim has been actively engaged in over 40 power sector analyses, spanning areas in SPP, MISO, PJM, NYISO, ISO-NE, Ontario, SERC Reliability Corporation (SERC), Electric Reliability Council of Texas (ERCOT), California Independent System Operator (CAISO), Pacific Northwest, Arizona, Nevada, Colorado, and British Columbia. His professional works have included strategic regulatory, public policy and market assessments related to electric, fossil fuel, and economic forecasting; economic analyses of demand side management, distributed generation, and net metering; retail and wholesale price design; and market power assessments and wholesale sector competition. He previously worked at the New York State Energy Office, Conectiv, Niagara Mohawk, the Edison Electric Institute, and consulting firms.

Relevant Project Experience

Navigant Consulting. Director – Energy. Direct assessments of wholesale electric energy and capacity markets; advise on market strategies relating to transmission and generation investments.

- Leads forecast and analysis of location-based marginal prices, transmission flows, and congestion prices for major proposed transmission investment, generation investments, and asset restructurings. Projects have included over forty investment and asset studies in ISO-NE, NYISO, PJM, IESO, MISO, SERC, FRCC, ERCOT, SPP, CAISO, and other WECC for utilities, merchant plant owners, equity and investment funds, and equipment manufacturers.
- Manages development and maintenance of market simulation and forecasting models, and of semi-annual reference case national and regional forecasts.

Pace Global Energy Services. Director – Utility and Risk Management Services. Directed market price forecasts for power, oil, gas and coal sectors; market power assessments; analysis of commercial and

Timothy E. McClive
continued

regulatory impacts in markets; and development of competitive and strategic intelligence for energy market participants.

- Sponsored successful filings at FERC that demonstrated lack of market power for gas storage facilities seeking market-based rates authorization.
- Directed price forecast service for power, oil, gas and coal markets, including strategic assessments of economic and policy drivers and of price volatility.
- Manager of market assessments for developers, operators and investors for wind, gas, coal, and biomass power plants and for large suppliers and consumers of power, gas, oil and coal. Markets include North America, Eastern Europe and Russia.

Edison Electric Institute. Chief Economist. Directed economic analyses for Institute policies on competition, market power, transmission and retail pricing, transmission right-of-way, demand response, renewable energy, and cost recovery.

- Developed economic analysis and critique of a proposed national Renewable Portfolio Standards based on its potential to impose in excess of $50 billion of cost-shifts onto retail consumers.
- Conceived and managed production of economics papers that were instrumental in advancing economic and business strategies for demand response and advanced retail rate designs.
- Developed and let regulatory filings that successfully led to modifications in FERC's proposals for new market power screens.
- Managed EEI's Annual Transmission and Market Design School and refocused that school's agenda and revamping the marketing campaign.

Niagara Mohawk Power Corp. Project manager/principal contributor for corporate restructuring and strategic planning initiatives.

- Market power analysis and testimony for federal & state deregulation proceedings and for regulatory filings for generation divestiture. Cleared the way for regulatory approvals for over $1 billion in transactions by making successful regulatory filings showing that company's generation divestitures would not create market power concerns.
- Distributed generation analyses and corporate strategy. Produced several million $ in savings to the company by leading corporate-wide team that advised senior management on investment and regulatory policy decisions on distributed generation. Policy development and negotiation in statewide collaborative on interconnection of small-scale generation to utility grid (co-chairman.)
- Involved in development and regulatory support in retail rate cases.

Managed economic impact study that was critical to communications effort to gain public support for the company's corporate restructuring plan which was approved by the state PSC.

- Manage demand-side management evaluations, support research in resource, environmental and regulatory economics. (1994-1996)
- Managed company's Resource Economics and DSM Program Evaluation area. Directed the process and impact evaluations of company's $40 million annual demand continuing viability of the existing DSM programs.
- Business plan, staff development, and other administrative activities
- Evaluation of DSM programs for large industrial customers
- New York Power Pool Program Evaluation Task Force (chairman)
- Research theory and applications of 'options analysis' for risk management

Delmarva Power & Light. Supervisor – Corporate Planning. Directed development of economic, sales and load forecasts providing analytic support for special research projects. PJM Power Pool Load Analysis Subcommittee representative. Associated duties included independent research and/or task force projects addressing merger/buy-out opportunities, billing system redesign, load research, DSM compliance, fuel price forecasts, tariff design, environmental externalities, and career path development guidelines.

Elizabeth Carter

System Safety, Security and Resiliency

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 16 years of progressively responsible analytics and management experience
+ Formerly Plan Manager for Weapons of Mass Destruction (WMD) for New York City Emergency Management
+ Served as interagency task force liaison during Emergency Operations Center activations
+ Managed extensive security assessment initiative for Port Authority of NY & NJ

Years of Experience

With Chertoff Group: 4

With Other Firms: 16

Education

Master of Public Health, Columbia University, 2010

BA, Yale University, 1999

Specialized Training

Incident Command System (ICS) 100, 200, 300, 400, 700, 800

Work History

2011 to Present, The Chertoff Group, Senior Director; Director; Senior Associate

2010 to 2011, New York City Office of Emergency Management, WMD Plan Manager

2004 to 2007, Bear, Stearns & Co., Vice President; Associate

2002 to 2004, Aetos Capital LLC, Associate

2000 to 2001, Bank of America, Analyst

1999 to 2000, Morgan Stanley, Analyst

About Elizabeth

Elizabeth Carter joined the Chertoff Group after serving as the Plan Manager for Weapons of Mass Destruction (WMD) for New York City Emergency Management, where she was responsible for the development of hazard-specific emergency plans to respond to Chemical, Biological, Radiological and Nuclear (CBRN) incidents. In this capacity, she worked closely with New York City agencies and other regional municipalities to foster interagency coordination and spearhead collaborative efforts to develop WMD playbooks and protocols. In addition, she served as an interagency task force liaison and Health and Medical Emergency Support Function coordinator during Emergency Operations Center activations, including severe weather events and multiple fatality incidents.

Previously, Elizabeth spent nine years in the financial services industry, most recently with Bear, Stearns & Co., where she was a Vice President in High Yield and Corporate Bond Research. In this role, she published industry and company-specific reports for institutional clients and conducted fundamental, quantitative, and relative value analysis on debt securities issued by real estate companies. Prior to holding her position at Bear Stearns, she was an Associate with Aetos Capital and an Analyst at Bank of America and Morgan Stanley. She was awarded a fellowship with the Center for Health Security's Emerging Leaders in Biosecurity Initiative and was named one of the Irish Echo's "40 Under 40" in the Irish-American community for 2014.

Relevant Project Experience

Port Authority of New York and New Jersey Security Assessment, New York, NY. Managed extensive security assessment initiative for Port Authority of New York & New Jersey. Oversaw research, composition and presentation of security analysis, including cyber security assessment. Developed and delivered findings and recommendations relating to World Trade Center security, including emergency response planning, situational awareness platform integration and review of security technology. Facilitated interagency meetings to encourage development of coordinated emergency plans and protocols.

Elizabeth Carter
continued

Bloomberg LP, New York, NY. Performed global risk and threat assessment for a media company. Project managed cyber security review. Prepared data center design specifications. Provided recommendations on crisis management capabilities and organizational structure. Developed concept of operations for new Europe headquarters.

MetLife Security Assessment, New York, NY. Conducted site threat and risk assessment for global insurance company. Oversaw team that created and implemented company-wide security design standards and Security Operations Center (SOC) specifications. Led team that designed business continuity, emergency response, and crisis management plans and protocols.

New York City Office of Emergency Management, Brooklyn. Oversaw research, development and production of hazard-specific emergency plans for New York-New Jersey-Connecticut-Pennsylvania region to respond to radiological dispersal devices (RDD). Improvised nuclear devices (IND) and other radiological emergencies. Recruited, hired, and supervised junior planning team. Managed grant budget for project. Sourced, selected, and managed subcontractors.

Financial Services Company (Confidential), New York, NY. Evaluated security practices and protocols regarding "white powder" and infectious disease risk mitigation and response. Created comprehensive plan to guide corporate response to biological incidents. Helped client forge relationships with relevant public sector agencies that would be involved in any response.

Gas Pipeline Company (Confidential), Houston, TX. Devised and facilitated enterprise resilience, risk management, and business continuity exercise. Oversaw stakeholder communications and built relationships with law enforcement and first responder communities. Designed emergency response handbook for first responders and other public sector stakeholders.

Consumer Products Company (Confidential), White Plains, NY. Performed detailed assessment of client's current security department organizational structure as well as policies and procedures. Benchmarked client's programs against its peer group.

Carlos Campillo

System Safety, Security and Resiliency

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 40+ years of experience in transit/rail systems design, safety and security
+ Successful assignments managing systems safety, reliability and integration: Tren Urbano Syste, BART SFO Extension, Second Avenue Subway
+ Expertise in systems selection, qualification, and hardware/software integration; reliability and systems assurance; and management of hazards, threats and vulnerabilities for transit systems

Years of Experience

With AECOM: 23

With Other Firms: 17

Education

MBA, Business Management, Peter F. Drucker Graduate School of Management, 1989

BA, Strategic/Operations Analysis, Claremont Men's College, 1975

Specialized Training

Safety Trained Supervisor

Substation Entry

Professional Associations

American Public Transportation Association

International Code Council

Building Officials and Code Administrators International

National Fire Protection Association

Work History

1993 to Present, AECOM, Resident Engineer

1986 to 1990, Ralph M. Parsons, Senior Quality Assurance Engineer

1982 to 1984, Northrop Aircraft, Senior Industrial Engineer

1980 to 1982, Ralph M. Parsons, Cost Engineer and Quality Assurance Auditor

1979 to 1980, Hughes Aircraft, Senior Industrial Engineer

1978 to 1979, Edwards Laboratories, Operations Analyst

1976 to 1978, R&G Sloane Manufacturing Co., Industrial Engineer

About Carlos

Carlos Campillo has extensive recent experience in project management, systems oversight and integration for major transportation infrastructure projects, notably in complex large-scale transit and rail programs. His expertise includes systems selection, qualification, and hardware/software integration; reliability and systems assurance; management of hazards, threats and vulnerabilities; and system integration and quality management. He is skilled in installation and construction activities including construction site management, dynamic testing, project close out, and pre-revenue operations.

Carlos' 40-year career focus has been exclusively on transit-related project activities, including managing systems safety, reliability and integration for such major, complex projects as the Second Avenue Subway in New York City, BART San Francisco Airport Extension Project, and Tren Urbano Rail System in San Juan, to name a few.

Relevant Project Experience

Atlanta Street Car (ASC) and MARTA, GA. Systems oversight and certification for a project consisting of 12 street-level stations, 2.8 miles of shared guideway and vehicle maintenance facility. Established the scope of work; reviewed base line documents, identified deviations, integrated client provided systems; managed hazard logs, threat analysis and safety plans; integrated civil, structural, systems and trackway. Oversaw inspection, testing, and safety certification. Managed tunnel ventilation studies for stabilization and rehabilitation, rail services control center rehabilitation, certification of train control system upgrade, and revision of operations, maintenance and emergency response plans and procedures. Performed CM for integration of civil, structural, systems and trackway elements for rolling stock, stations, guideway, and maintenance facility; managed safety and security certification.

MTA Capital Construction, Second Avenue Subway, New York, NY. Manager of systems safety, reliability and integration. The project includes design and construction of 16 subway stations and eight miles

Carlos Campillo
continued

of connecting tunnels. Developed and coordinated all systems safety, certification, reliability and integration related programs, plans and procedures. Managed hazard, threat and vulnerability analyses for design, construction and operation phases including security related equipment, training, coordination and response. Wrote project Safety and Security Certification Program and design and specification checklists. Performed MTBF/MTTR calculations; established lowest level of replacement units (LLRU); definition of maintenance equipment, personnel and time to repair; induced failure mode tests and fault tree analysis. Managed communications interface management system.

Dulles Corridor Metro Rail, Herndon, VA. Systems integration for preliminary engineering phase 2, including roadway improvements, parking structures, utility relocations, substations, at-grade and elevated guideways, rail tunnels and support infrastructure, a major rail yard with 30 tracks, maintenance facilities, and a service and inspection facility. Established basis of design, including design criteria, specifications and drawings, and developed test and verification documents.

Miami Dade Transit, MIC-Earlington Heights and North Corridor Projects, FL. Manager of safety and security for rail extensions. Assignments included the intermodal station and 2.5 mile guideway for the MIC-Earlington Heights Connector and the seven stations and 10 miles of elevated guideway for the North Corridor Extension. Oversaw certification; threat, hazard and risk management; developed criteria, specifications, procedures and plans; oversaw procurement, construction and startup; established quality control; prepared equipment test plans; reviewed station egress calculations, fire detection and suppression systems, and emergency response plans.

Bay Area Rapid Transit San Francisco Airport Extension Project, CA. Manager of safety and security construction oversight for a project consisting of five miles of tunnel, two underground stations, three miles of elevated guideway, one elevated station, plus one at grade intermodal station. Managed surveillance of contract sites; identification and elimination of construction site hazards; plus accident investigation, reporting, and follow up. Managed environmental compliance; hazardous materials handling and testing; interface with state and federal OSHA inspectors; and emergency response with local authorities.

Tren Urbano Rapid Transit System, Puerto Rico. Manager of safety and security, coordinating all safety and security related programs, procedures and policies for $2.5 billion turnkey design-build project. Chaired fire/life safety committee; developed criteria and specifications; issued safety certification checklists; performed egress calculations; OSHA, ADA, NFPA and RCRA compliance; systems assurance calculations and analysis (RAM/MTBF/MTTR); systems safety integration studies; accident prevention, response and corrective actions; witnessing of critical testing; and facility and systems turn over. Coordinated emergency response for all agencies; security investigations; crowd and panic control; graffiti abatement; fare enforcement and anti-drug surveillance.

Los Angeles Metro Rail Project Red MOS 2 and Green Lines, CA. Systems assurance supervisor and safety certification lead. Duties included generation of MTBF/MTTR Calculations; establishing LLRU; definition of maintenance equipment, personnel and time to repair; supervision of induced Failure Mode Tests and Fault Tree Analysis; and producing Operations and Maintenance Manuals. Further duties included generation of design, procurement and construction phase safety certification checklists; verification of checklist requirements; and issuance of final Certificates of Beneficial Occupancy. Project included above ground, at grade and below ground transit systems and facilities.

SFMTA, Central Subway Project, San Francisco, CA. Design and integration oversight manager. The project consists of three underground and one surface station with 1.7 miles of street and tunnel trackway. Managed safety and security certification, hazard and threat management, development basis of design such as criteria, specifications and drawings, including integration of station and infrastructure elements. Oversaw budget and schedule performance.

Nick Tomizawa, Esq., AICP, CEM

Concept of Operations

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ Transit system safety and security expert with a strong background in preparedness and management
+ PM for NJ TRANSIT's Hurricane Response Strategy following Hurricane Katrina
+ Served as a senior planner at New York City's Office of Emergency Management
+ Led the development of FEMA's New England Cyber Disruption Coordination Plan

Years of Experience

With AECOM: 6

With Other Firms: 8

Education

MCRP, Rutgers University Bloustein School of Policy and Planning, 2000

JD, Hofstra University School of Law, 1998

BA, University of Wisconsin, Madison, 1991

Professional Licenses/Certifications

State Bar of New York

American Institute of Certified Planners

Certified Emergency Manager

ICS 100, 200, 300, 400, 700, 800

Specialized Training

Texas A&M Engineering and Extension (TEEX) Jurisdictional Crisis Incident Management

DHS Homeland Security Exercise and Evaluation Program (HSEEP)

Work History

2009 to Present, AECOM, Program Manager – Transportation Resilience

2008 to 2009, NYC Office of Emergency Management, Senior Transportation Planner

2005 to 2008, Gale International, LLC, VP – Project Development

2004 to 2005, Parson Brinkerhoff, Security Planner

2000 to 2004, Transportation Resource Associates, Project Manager

2000, Edwards & Kelcey Engineers, Planner

About Nick

Nick Tomizawa is a leading expert in transit system safety and security assessment and emergency preparedness and response planning. He writes and critiques FTA System Safety Program Plans (SSPP), Security and Emergency Preparedness Plans (SEPP), Security and EM Concepts of Operations (CONOPS), Safety/Security Certification Plans (SSCP), Safety and Security Management Plans (SSMP), Emergency Operations Plans (EOP), and Continuity of Operations Plans (COOP). He helps federal, state and local transportation agencies to prepare for safety and security audits and conducts regulatory and policy research for government agencies and industry clients. He is a Certified Emergency Manager and a Certified Urban Planner with a background as a senior planner for the New York City Office of Emergency Management. He was also the City's Emergency Support Function 1 (Transportation) coordinator for activation of the City's Emergency Operations Center.

Relevant Project Experience

NJ TRANSIT Hurricane Response Strategy Development Rail Operations, Light Rail, Bus and Paratransit. Project manager for the development of a Hurricane Response Strategy (HRS) for the different operational modes of NJ Transit. The HRS introduces the concept of Zero Hour (the arrival of sustained storm force winds) as the point from which all agency preparedness activities work back, which synchronizes NJ Transit with state and local hurricane plans in the tristate region. Nick developed sets of protective measures to shelter over 700 rail vehicles and protect assets from storm damage at various NJ Transit locations, including its largest maintenance facility (the Meadows Maintenance Complex), Hoboken Terminal, and Oradell Bus Garage. URS coordinated, planning closely with the various operational groups in NJ Transit, including the rail operations GM, DGMs of transportation, mechanical and engineering, heads of IT and procurement, the AGM of bus operations, public relations, and the NJ Transit police department office of emergency management.

Nick Tomizawa, Esq., AICP, CEM
continued

FEMA New England Cyber Disruption Plan, Boston, MA. Plan manager for the FEMA New England Cyber Disruption Coordination Plan, a nationally first-of-its-kind project to develop a framework to guide multi-jurisdictional incident management of massive cyber disruptions. Fostered collaboration between the Boston and Providence Urban Area Security Initiatives (UASI), and the States of Rhode Island and New Hampshire, and the Commonwealth of Massachusetts to develop a comprehensive framework to prepare for, respond to, and recover from catastrophic interruptions of IT systems and networks. Pursuant to a DHS/ FEMA grant, provided emergency management plan development services for the region, including:

- Working with state and city emergency management agencies to revise state and city emergency operations plans to include cyber disruption teams and cyber disruption plans
- Assessment of emergency plans, policies and procedures from each jurisdiction
- Coordination with law enforcement, IT, emergency management, National Guard and other stakeholders to develop jurisdictional cyber disruption response teams
- Developing training programs for each jurisdiction to implement training and exercise classes on Cyber Disruption Plans

Foothill Consortium, Risk Assessment and Security/ Emergency Management Plan Development Services, Los Angeles, CA. Project manager performing security consulting services for a partnership of Foothill Transit, Long Beach Transit, the City of Los Angeles Department of Transportation (LADOT), and the Santa Monica Big Blue Bus. Managed implementation and delivery of safety and security assessments. Developed plans for these agencies through funding from the DHS Transit Security Grant Program. Developed plans based on FTA systems planning templates including Security and Emergency Preparedness Plans (SEPP), Emergency Response Operations Plans (EROP), and Continuity of Operations Plans (COOP) for each of the four transit systems. The review and work product reflect each agency's unique organizational and operational characteristics and needs. In an unusually short timeframe of five months (due to grant administration constraints), completed 20 deliverables on budget and on time. The project produced safety, security, and emergency management organizational and operational reviews at each agency simultaneously to develop:

- Threat and Vulnerability Assessment (TVA)
- Risk mitigation reports and strategies, including cost-effective measures to respond to identified risks
- Plan documents compliant with FTA, FHWA, APTA, and FEMA's National Incident Management System

Pennsylvania Department of Transportation, Rail Transit Safety Review Program. System safety/security/ emergency management plan evaluator of SEPTA and the Port Authority of Allegheny County for PennDOT. Oversaw the annual plan review process for FTA- and FRA-regulated vehicles. Worked with system safety and security departments on development of System Safety Program Plan and Security and Emergency Preparedness Plans for SEPTA and the Port Authority.

New York Power Authority, Wards Island Wastewater Treatment Plant. Project director providing overall project vision and development. AECOM developed a comprehensive heating alternative feasibility study for the New York City Department of Environmental Protection (DEP) - Wards Island WPCP. AECOM analyzed various options for a new heating plant to be constructed on the Wards Island property. The new $80 million heating plant will use the available digester gas as fuel with natural gas as a secondary fuel. The recommended heating plant will consist of a newly centralized low pressure steam facility as well as new low pressure heating distribution and condensate return systems. Scope of work also included new natural gas service to the island as well as complete restoration of a historic building to house the new plant.

Adam Zellner

Public Involvement and Stakeholder Coordination

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ Founder and president of Greener by Design, focusing on governmental and public relations and policy development
+ Extensive public and private sector experience in outreach, communication and stakeholder involvement
+ Knowledgeable in microgrids, resiliency and response to power outages and regional emergencies
+ Served as policy director for a NJ governor and as executive in NJDEP and NJ Office of Smart Growth

Years of Experience

With Greener by Design: 6

With Other Firms: 22

Education

BA, Rowan University, 1992

Work History

2009 to Present, Greener by Design, President - Finance and Government Relations

2010 to Present, Rutgers University, Adjunct Professor of Political Science

2007to 2008, State of New Jersey, Policy Office, Director

2006 to 2007, NJDEP, Deputy Commissioner

2004 to 2006, NJ Highlands Council, Executive Director

2002 to 2004, NJ Office of Smart Growth, Executive Director

About Adam

Adam Zellner has served as President of Greener by Design since its founding and is responsible for all aspects of its operations, including client and partner relationships. He serves as the company's lead on government and finance-related work. Previously, he served as Policy Director to a former Governor of New Jersey, overseeing the development of a variety of policies, including those pertaining to energy, land use, and environment.

Prior to joining the Governor's staff, Adam served as the Deputy Commissioner of the New Jersey Department of Environmental Protection (NJDEP) and was the former Executive Director of the New Jersey Office of Smart Growth. He served in Washington and New Jersey for several members of Congress and has worked for a variety of elected and appointed officials throughout his career. Adam is currently Adjunct Professor of Political Science at Rutgers University.

Relevant Project Experience

City of Hoboken, NJ. Strategic planning advisor assisting with post-Sandy recovery and planning; member of Rocky Mountain Institute e-Lab Accelerator team for innovating at the electricity system's distribution edge; featured with Mayor Zimmer in The PEW Clean Energy Initiative video, "How Microgrids Improve Resiliency in Power Outages," and conducted a cost-benefit analysis of the full microgrid project versus other resilient projects.

Maher Terminal, Elizabeth, NJ. Project manager and governmental consultant for energy use and environmental impact analysis at this intermodal facility. The project includes technical and financial analyses, solar feasibility and implementation, sustainable/energy efficiency building audits, fuel switching plan for equipment and fleet, and energy policy advisement for myriad other tasks.

Adam Zellner
continued

Municipal and County Energy Policy Advisor for the Township of Woodbridge, Cities of Paterson, Linden, and Newark, and Hudson County, NJ. Specific services include reviewing energy efficiency and renewable energy plans and projects – ongoing, planned, and proposed – relative to project-specific and overall energy management and sustainability objectives; formulating these objectives and associated metrics; overseeing compliance with EECGB grants and other funding sources; identification of project funding sources; serving as executive of grants.

Hartz Mountain Industries, NJ. Energy and sustainable policy consultant, including coordinating solar and renewable energy meetings and updates at the local, state and national levels.

Various Campus-Based Solar Projects, NJ. Team lead for the development of many of New Jersey's most significant campus-based solar projects, including the Atalanta projects based in Elizabeth, NJ, totaling 1.5 MW, the McGraw Hill East Windsor Campus solar project of 10 MW, and various projects for the Newark Archdiocese, Hartz Mountain Industries, and Bayshore Recycling.

McGraw-Hill, NJ. Serves on the project management team in development of a net-metered 10 MW solar array. Advises on financial and technical feasibility, bidding, review, selection, and governmental permitting as photovoltaic solar development progresses. Secures local, state, and federal incentives. Previously conducted an extensive energy audit of the East Windsor campus and will oversee retrofits under New Jersey's Pay for Performance program.

Bayshore Recycling, NJ. Strategic advisor for evaluation and incorporation of new alternative technologies and initiatives to the New Jersey-based concrete recycling operation. Developed financial modeling for recycling facility, to lead to expansion of existing revenue opportunities.

Organic Diversion, NJ. Policy and financial consultant in the permitting, site selection, and financing of New Jersey's first anaerobic digestion facility. Specific tasks include development of a robust financial model, introduction to a variety of financing partners, and identification and security of local, state, and federal incentives. Assists in the acquiring of permits for construction and operation.

Ruby Siegel

FTA Funding Reviews and Compliance

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 38 years of rail/transit planning experience
+ Extensive experience with and knowledge of NJ TRANSIT system
+ Leads the development of major investment studies, alternatives analyses, and environmental studies
+ Expert at leading large projects through NEPA environmental review process
+ Deputy PM for NEC Passenger Rail Corridor Investment Plan NEPA EIS
+ PM for Access to the Region's Core NEPA EIS

Years of Experience

With AECOM: 5

With Other Firms: 33

Education

MA, City and Regional Planning, Harvard University Graduate School of Design, 1977

BA, Urban and Economic Geography, University of California, Berkeley, 1974

Work History

2010 to Present, AECOM Senior Project Manager

1992 to 2010, SYSTRA Consulting Senior Vice President

1986 to 1992, Acutech, Inc. President

1982 to 1986, Multisystems, Inc. Senior Transportation Planner

1981 to 1982, New Jersey Transit Capital Program Supervisor

1979 to 1981, Massachusetts Bay Transportation Authority Manager - Grant Program

1977 to 1979, Central Transportation Planning Staff Planner

About Ruby

Ruby Siegel has 30 years of management and planning experience in transportation. She works with transportation agencies on long-range and strategic plans, corridor and major investment studies, feasibility studies and alternatives analyses, cost/benefit and financial analyses, and capital investment strategies. In conjunction with her role on these and other assignments, she provides technical and management support in the analysis of demographic, economic, service characteristic, and capital project data, including ridership demand and capital/operating costs. Ruby is an expert at leading large projects through environmental reviews as part of the federal National Environmental Policy Act (NEPA). She has pioneered techniques in public outreach and interdisciplinary participation that have resulted in a more productive study process for the clients, stakeholders, and the public.

Relevant Project Experience

Federal Railroad Administration Northeast Corridor (NEC) Passenger Rail Corridor Investment Plan (PRCIP). Deputy project manager for environmental analysis of the NEC PRCIP that will result in an integrated rail transportation solution for the Northeast Corridor between Washington, DC and Boston. The PRCIP includes both a Service Development Plan (SDP) to develop, evaluate and screen alternatives as well as a Tier 1 EIS under NEPA.

NJ TRANSIT/Port Authority of New York & New Jersey, Access to the Region's Core EIS. Project manager for the FTA sponsored NEPA-compliant study. Leading an interdisciplinary team of environmental, engineering, and operations experts. Worked closely with client staff for NJ Transit's high-priority major-investment project to meet the growing demand for travel between midtown Manhattan and west-of-Hudson communities. Project manager of the consultant team responsible for successful completion of a draft EIS, supplemental draft EIS, final EIS, and record of decision (ROD) for the complex, bi-state project that includes construction of a new tunnel under the Hudson River and a new station in midtown Manhattan. Led extensive public

Ruby Siegel
continued

outreach and citizen participation strategies as well as consultant team and interagency coordination to meet an aggressive project schedule.

NJ TRANSIT/Amtrak/Long Island Rail Road, Penn Station 5-Year Strategic Business Plan, NY. Project manager for development of a 5-year strategic business plan for Penn Station that represented a common vision of the three railroads operating into and out of this facility. The shared understanding of the current situation was accomplished through extensive data collection and one-on-one interviews across the three agencies. Through a facilitated conference technique, railroad staff across multiple disciplines within all three railroads participated in both the establishment of a shared vision and mission as well as the goals and strategies to achieve the ideal future.

NJ TRANSIT, Monmouth-Ocean-Middlesex EIS. Project manager responsible for the FTA-funded study of rail alternatives to serve a rapidly growing 3-county region. The project has been controversial and support for the three short-listed alignment alternatives has been divided. A key element was to build a positive environment to establish consensus and to select a preferred alternative. Project elements included alternatives development, NEPA environmental assessment, public outreach, ridership analyses, station and transit-oriented development planning, operations analysis, and preparation of cost and financing plan documents. The study included development of detailed alternative alignments, including engineering of connections to Amtrak's Northeast Corridor and NJ Transit's North Jersey Coast Line.

NJ TRANSIT, Long-Range Plan and Public Transportation Facilities Equipment Management System. Deputy project manager supporting NJ TRANSIT for a long-range plan through the establishment of a baseline of current conditions, including identification of market trends and customer-focused future service requirements. The baseline established a reference for development of a 2020 long-range plan of network and service improvements. Also led development of the public transportation facilities and equipment management system, a management information system that includes a database of existing facilities, equipment, and rolling stock; a standardized methodology for condition assessment; and the capability of forecasting deterioration and future replacement needs.

MTA Metro-North Railroad, West of Hudson Regional Transit Access Study Alternatives Analysis/EIS. Project director for Phase 2 of this FTA sponsored study of transit alternatives to evaluate alternatives for improving transit services between Central Orange County and Manhattan and access to Steward International Airport from the surrounding regions, Lower Hudson Valley and New York City. Phase 1 of the study was the initial Alternative Analysis phase to evaluate the benefits, costs, and impacts of a broad range of transit alternatives including bus, BRT, and commuter rail for both airport and commuter markets. Phase 2 concludes the Alternatives Analysis and includes the further development and evaluation of the short list of alternatives and the recommendation of a Locally Preferred Alternative.

NJ TRANSIT, Non-Traditional Suburban Transit Services. TMA coordinator for a statewide project to identify non-traditional (other than fixed route) transportation needs of seven transportation management associations (TMAs) and three additional corridors. The study was to develop implementable "transit first" solutions designed to meet individual needs of each TMA and reduce vehicle work trips. Work included data collection and analysis, identifying needs and service corridors, developing alternative transit options, evaluating transit options, and developing implementation plans for selected service options.

Morris County, Northwest New Jersey – Northeast Pennsylvania Passenger Rail Study. Project manager for a MIS/draft EA that evaluated restoration of passenger rail service in the Lackawanna corridor between Scranton, PA and New York City. Worked with Morris, Sussex, and Warren counties in New Jersey and Monroe and Lackawanna counties in Pennsylvania to update previous studies as well as conduct analyses to prepare documentation necessary to meet FTA New Start Criteria and NEPA requirements.

Michael Pacy, PE

Coordination with Phase 1

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ Energy industry design and construction expert with 40+ years of experience
+ Professional mechanical engineer and licensed construction supervisor
+ AECOM energy practice leader with quality management and project interface responsibility
+ Experience in all phases of project development and delivery
+ Grid reliability project experience

Years of Experience

With AECOM: 12

With Other Firms: 29

Education

BS, Mechanical Engineering, University of Massachusetts, Lowell, 1970

Professional Licenses and Certifications

Professional Engineer: Indiana, Massachusetts, New Hampshire, New York, Virginia, and Wisconsin,

Construction Supervisor: Massachusetts

Refrigeration Technician Apprentice: Massachusetts

Work History

2003 to Present, AECOM,

About Mike

A licensed mechanical engineer, Michael Pacy has extensive experience in project management, construction management, and engineering and design management for power stations (fossil, combined cycle and nuclear, wind), chemical plants, sewage treatment plants, transmission and distribution engineering and construction, and natural gas transmission and distribution. His experience includes design, construction management and operation of power stations, engineering, project management, and oversight of design and installation consultants for mechanical systems, piping, pressure vessels, and structural design.

As chief engineer for AECOM Energy West, Mike has had management and oversight responsibility for engineering and design of power and energy projects, and he manages teams of electrical transmission and distribution and natural gas transmission and distribution engineers. He has served as a quality representative to establish compliance with the AECOM's Quality Management System (QMS) for the energy practice and works with project managers in planning, execution, technical verification, and close-out to meet AECOM corporate-wide QMS standards.

Relevant Project Experience

PSE&G Northeast Grid Reliability Project. Technical lead to the NGRP for upgrading underground and overhead transmissions lines in the PSE&G northeast service corridor. AECOM is responsible for the engineering of underground 230 kV pipe cable system including routing and civil design of conduits for the four circuits, pumping station, system integration, and procurement.

PG&E Whiskey Slough Rebuild. Rebuild and retrofit (modified with newly developed parts, components and services) PG&E's Whisky Slough Station gas gathering and processing facilities at its McDonald Island underground gas storage facility, to achieve PG&E's Project objectives for improving the safety, reliability, and operating flexibility of the facility and maintain current gas withdrawal capacity (840 MMSCFD).

Michael Pacy, PE
continued

New York Power Authority 500MW Combined Cycle Project. Construction engineering manager responsible for the interface between the Client, equipment suppliers, Design Engineers and the construction staff. Provide engineering direction for requests for information, and specification interpretation. Responsible for drawing and materials submittals review and tracking; drawing and document control and configuration management. Provided direct oversight as owner's representative of engineering and design consultants.

General Electric Company, Schenectady, NY. Project mechanical engineer for the power plant engineering department performing project engineering and project management tasks on various domestic and overseas power plants. These are all gas turbine combined cycle power stations fired with a variety of fuels.

Alton Natural Gas Storage Facility, Nova Scotia. Performed conceptual design and engineering for the Alton Natural Gas Underground storage facility in. Performed system design for compression injection and withdrawal to / from new underground salt caverns at maximum 100 MMSCFD. Conceptual design and layout of the facility compressors, gas heating, pressure control, glycol contactors, filter separators and process controls. Facility includes a seven-mile-long lateral designed for intelligent inspection and pigging. Developed construction estimate and schedule.

Imperial Irrigation District Transmission Line Upgrade Project, CA. Provided a structural analysis and assessment on existing transmission line towers found within a 21 mile portion of the KS & KN LINE corridor. Utilized software programs PLS-CADD, PLS-TOWER and SAP2000 to determine structural capacity for upgrading from a 230kV single conductor double circuit to two conductor bundle per phase. Provided detailed design remediation for transmission tower found to be overstressed.

8 Minutenergy Renewable LLC & Gestamp, CA. Owner's engineer for five eight minutenergy and gestamp projects, totaling 355 MW of photovoltaic power. Conducted electrical design work for all five sites which consists of creating and reviewing one-line diagrams, design and specification of all high voltage equipment, switchyard design, preliminary estimates, and schedules.

USAID North Park Power Project, Haiti. As engineering manager for the EPC contract development to construct a 10 MW diesel driven power station in the country of Haiti. Performed engineering and specification development on behalf of the USAID.

Solar Millennium (SM) Solar Parabolic Trough Power Projects, Blythe, Ridgecrest, Palen, CA. Technical director in the function of owners' engineer supporting the engineering, procurement and construction staff of Solar Millennium for the Blythe, Ridgecrest, Palen and Amargosa solar parabolic trough projects in the California and Nevada deserts. Led AECOM technical staff to support and advise SM during the permitting, engineering and construction phases of the projects. Provide technical expertise and assistance during the design phase and interface with the EPC contractor to ensure best means, methods and operational reliability.

NRG Air Quality Control Projects, Dunkirk, NY. On-site resident engineer at the six unit NRG Dunkirk and Huntley coal fired power stations. These are retrofit projects to install air quality control enhancement features to meet EPA mandated emissions standards. Installation includes an SNCR system to inject urea into the boilers for NOx reduction, activated charcoal injection for mercury capture and TRONA injection for SOx suppression. New pulsed jet fabric filter houses are included for particulate control. Responsible for all Engineering interface among the Owner, Operations, several Engineers and Constructors. As owner's representative responsible for Engineering interface, problem resolution, document control and quality. Tasks included review of sub-contractors performance in design, schedule and contract compliance, specification preparation, bid evaluations.

Bob Fisher, PE

Traction Power and Grid Controls

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 40+ years of transit design/construction experience
+ Project manager, railroad systems engineering manager, and resident engineer on NJT projects
+ Technical expert in generation and distribution, traction power, systems, signals, and communications
+ Develops and implements interconnection agreements and operating procedures

Years of Experience

With Parsons Brinckerhoff: 5

With Other Firms: 38

Education

BSEE, Bath University, UK, 1973

Professional Licenses/Certifications

Professional Engineer: New Jersey, New York, Pennsylvania, California, Illinois, Texas, Maryland, Minnesota, Chartered Engineer (CEng) United Kingdom

Work History

2010 to Present, Parsons Brinckerhoff, Program Manager – Rail Traction Power

1998 to 2010, AECOM, various project and systems management positions

1983 to 1996, Southeastern Pennsylvania Transportation Authority (SEPTA), Manager – electric facilities

1978 to 1983, Morrison Knudsen – various design and construction management positions

1973 to 1977, Balfour Beatty – various design and construction supervision positions

About Bob

Bob Fisher is an accomplished project manager, professional engineer and technical expert with a strong record of leading design, construction, testing and startup teams developing electrified railroad and mass transit systems. His experience includes management of major transit renovation projects involving signals, communications, and traction power components in the public and private sectors. During his tenure with the Southeastern Pennsylvania Transportation Authority, he held a variety of project and program management posts, including manager of the Electrical Facilities Department. Bob has considerable experience supporting NJ TRANSIT.

Relevant Project Experience

NJ TRANSIT, Electric Traction Power Grid Analysis, Newark. Project manager for the development of traction power load flow studies for the Newark and Hoboken electric traction power systems on NJ TRANSIT's electrified commuter rail network. The objective of the project is to determine the impact of introducing dual mode locomotives onto the system, under normal and various contingency operations, and to provide NJ TRANSIT with a model for future analysis.

NJ TRANSIT, Trans-Hudson Express (THE) Tunnel Project. Manager of railroad systems engineering on an $8.7 billion project to construct new electrified commuter rail tunnels between Amtrak's Northeast Corridor in New Jersey and a new station in Manhattan. The project involved interface with NJ TRANSIT and Amtrak's existing rail systems. Responsible for the preliminary and final design of traction power systems, catenary, signaling, train control, and communications elements of the project, as well as developing a systems integrated testing program for the entire project.

Amtrak, New Jersey High Speed Rail Improvements Project, Trenton. Traction power, OCS and signals and communication systems integration manager on this project to increase speeds to 160 mph on the section of the Northeast Corridor between Trenton and New Brunswick. The project involves upgrading the catenary to a constant tension system, new substations and

Bob Fisher, PE
continued

frequency converters, new cab no wayside signals, and two new high speed interlockings.

Amtrak, Philadelphia, PA. As an extension of Amtrak's staff, held the position of senior program director in Amtrak's Electric Traction Department, where he had overall responsibility for Amtrak's electric traction capital improvements projects. Responsible for representing Amtrak's engineering department in the final construction, commissioning and startup on the $2 billion program to upgrade and electrify Amtrak's high speed Northeast Corridor between New Haven, Connecticut, and Boston, Massachusetts. This 150-mile section of the Northeast Corridor was upgraded for speeds of up to 150 miles per hour and electrified with a 55/27.5-kV autotransformer power system and constant tension catenary system. Led testing and acceptance of substation and catenary systems, including high speed interlockings and moveable bridges; negotiations for utility interconnection agreements and operating procedures with various utility companies; interface with Amtrak's operating divisions, training of maintenance staff; and coordination with high-speed train set procurement and signal systems teams.

Southeastern Pennsylvania Transportation Authority, Reconstruction of the Frankford Elevated Line, Philadelphia. Project director for the design and construction of the rehabilitation of a 5.25-mile elevated section of SEPTA's Market-Frankford rapid transit line. Led a team of project managers, engineers, inspectors, safety officers, and community relations personnel responsible for all aspects in managing this $750 million program.

Southeastern Pennsylvania Transportation Authority, Wayne Junction Static Frequency Converters. Program manager for the design and construction of the first static frequency converter (SFC) station installed in the U.S. for traction power applications. This $40 million program included three 15-MVA, 60 to 25-Hz SFCs, a new 230 kV substation and transmission lines. Eleven prime contractors/vendors were involved in the program, which also included extensive force account work by the utility company. Because of the unique nature of the installation, detailed analysis was required to establish that the electrical characteristics of the SFCs would not adversely affect the operation of the railroad or utility systems, and this was followed with extensive testing and startup procedures.

SEPTA, West Chester Electric Traction Rehabilitation Project. Project manager for the rehabilitation design for the catenary and electric traction system on the West Chester line between Arsenal on the Northeast Corridor and Lenni. The scope included a detailed inspection of the 138/25 kV substations at Morton and Lenni, the 138 kV transmission lines and catenary system, and preparing detailed plans and construction specifications for the rehabilitation work. The scope also included a new supervisory control and data acquisition (SCADA) system for the two substations and motorized sectionalizing switches.

NJ TRANSIT, Erie-Lackawanna Re-Electrification Project. Resident engineer for traction power and signal power substation installation and catenary modifications for the re-electrification of the Morris and Essex lines. The lines were converted from 3 kV, dc to 25 kV, 60 Hz and all work was performed under traffic.

Port Authority of Allegheny County, North Shore Connector Preliminary Engineering (PE)/Final Environmental Impact Statement (FEIS), Pittsburgh, PA. Engineering task manager for the preparation of preliminary engineering for the traction power, corrosion control, OCS, train control and communications elements and involved extensive interface with all other disciplines including station design, tunnel lighting, drainage and life safety. This $400 million project extended the region's light rail system via new bored tunnels under the Allegheny River, connecting the City's vibrant North Shore which features several new sports venues and stadiums with the central business district and new Convention Center via a cut-and-cover tunnel.

Thomas P. Quaranta, FCMAA

Coordination with Phase 1

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 40+ years of experience
+ Nationally recognized leader in construction management
+ Served as president of the Construction Management Association of America (CMAA)
+ Has lectured on program management at several universities and teaches project management at Columbia's School of International and Public Affairs

Years of Experience

With AECOM: 12
With Other Firms: 27

Education

MS, Construction Management, Columbia University, 1980
BS, Civil Engineering, Columbia University, 1976

Work History

2003 to Present, AECOM, Vice President, Construction
1976 to 2003, Parsons Brinckerhoff

About Tom

Tom Quaranta has extensive construction management experience, at staff and project levels, on both foreign and domestic projects. A nationally recognized leader in construction management, he was elected president of the Construction Management Association of America (CMAA), a national organization dedicated to education and representation. He is a member of the Industry Advisory Board for Construction Engineering and Management, Department of Civil Engineering at Columbia University, and teaches Project Management at Columbia's School of International and Public Affairs. He has also lectured in construction management and project management at Lehigh University, Northeastern University and Pratt Institute.

Tom is a leader in the firm's Program and Construction Management Practice working on various capital programs and initiatives. He has also developed and implemented corporate policies, procedures, professional development and best practices associated with the management and control of projects in rail and transit, highway and bridge and other industries throughout the country. Tom has led training programs in CM for public agencies, and has led reviews and assessments of major projects for AECOM as well for various clients.

Relevant Project Experience

NJ TRANSIT, Meadows Rail Equipment Maintenance Facility, Kearny. Served on the construction management joint venture board of control for the construction of $100 million rail maintenance facility.

MTA NYC Transit, Montague Tube Rehabilitation, "Sandy" Repair Project, Brooklyn and Manhattan. CM advisor and principal for construction management and inspection services.

Amtrak, Fire & Life Safety Program, Metropolitan NY. Officer in charge of three CM contracts for construction of tunnel ventilation facilities in Manhattan and Long Island City, NY, and Weehawken, NJ.

Thomas P. Quaranta, FCMAA
continued

Connecticut Department of Transportation (ConnDOT), Stamford Rail Yard Rehabilitation,. Principal in charge of construction engineering and inspection (CEI) services.

Park Tower Realty, Times Square Subway Complex Reconstruction, New York City, NY. Project manager for a private developer responsible for logistics, value engineering, constructability review, and cost estimating as part of preconstruction phase services.

MTA Metro-North Railroad, Group III Substations, NY. Contract principal responsible for overseeing construction management services during the construction of substations along Metro-North's Harlem and Hudson River lines.

MTA NYCT Coney Island Main Repair Facility, Brooklyn. Contract principal responsible for construction management staff assigned to the modernization and rehabilitation of the world's largest rapid transit car repair overhaul and service shop. The shop occupies 100 acres and encompasses 470,000 square feet.

New York City Public Development Corporation, South Street Seaport Redevelopment. Project manager responsible for project control services for this $350 million project, and construction manager for the rehabilitation of Pier 17 streetscape and the Fulton Fish Market buildings rehabilitation.

Terminal One Group Associates, Terminal One, JFK International Airport, Jamaica, NY. Contract principal responsible for overseeing program management services on behalf of Terminal One Group Associates, for the construction of a new terminal servicing Air France, Lufthansa, Japan Airlines, and Korean Air.

Port Authority of New York and New Jersey (PANYNJ), LaGuardia Airport Redevelopment Program, Flushing, NY. Contract principal as subconsultant for oversight of program management services.

New York State Department of Transportation (NYSDOT), Brooklyn Queens Expressway, 25th Avenue to Broadway, Queens. Principal in charge for construction inspection services.

NYSDOT, I-287 Viaduct Replacements, Westchester County. Principal in charge for construction inspection services.

ConnDOT, I-95 Rehabilitation, Guilford. Principal in charge for construction inspection services.

New York City Department of Transportation (NYCDOT), Manhattan Bridge Reconstruction, Contract #6 & #10. Principal in charge for resident engineering and inspection (REI) sub-consultant services.

NYSDOT, North Channel Bridge, Queens. Principal in charge for construction inspection (CI) services.

NYCDOT, Third Avenue Bridge. Principal in charge for resident engineering and inspection (REI) services.

ConnDOT, Tomlinson Bridge Replacement, New Haven. Principal in charge for construction engineering and inspection (CE&I) services.

NYSDOT / NYTA / MTA-MNR, Tappan Zee Bridge, Westchester & Rockland Counties. Program controls manager for Stage 2 Environmental Studies.

Frank Russo, PE

Peer Review/Constructability Review/Value Engineering

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ Registered PE with 45+ years of experience
+ Former Asst. Executive Director - New Rail Construction at NJ Transit
+ Career focus in the development and delivery of large, complex transit rail programs: Hudson-Bergen LRT System and Southern New Jersey LRT System
+ A pioneer in risk management; guided the development of the FTA's risk management program

Years of Experience

With AECOM: 5

With Other Firms: 42

Education

ICS Center for Degree Studies,1974-1978

Civil Engineering, Drexel University, Philadelphia, PA, 1972

Professional Licenses/Certifications

Professional Engineer: Pennsylvania, 1977

Registered Surveyor, PLS, Pennsylvania, 1974

Professional Associations

American Railway Engineering Association (AREA)

Work History

2005 to present, Frank Russo Consulting, President

2000 to 2005, AECOM, Vice President, Project Development Group

1998 to 2000, Raytheon Engineers and Constructors, Vice President, Transportation

1994 to 1998, New Jersey Transit Corporation, Asst. Executive Director - New Rail Construction

1989 to 1994,Associate and Regional Manager, Bergmann Associates

1981 to 1989, Southeastern Pennsylvania Transportation Authority (SEPTA):

- Manager of Rail Facility Programs 1981 to 1984
- Manager of Structural Engineering 1984 to 1986
- Assistant Chief Engineer - Bridges and Buildings 1986 to 1989

1967 to 1981 Reading Railroad, Conrail, and Franklin & Lindsay, a Philadelphia engineering

About Frank

Frank Russo is a senior transit industry program and project manager and an accomplished engineer with extensive public and private sector experience on major NJ TRANSIT projects and initiatives. He is a pioneer in developing risk management strategies for major transit rail projects and he has extensive experience in traditional project development and alternative delivery methods such as design-build, design-build-operate-maintain (DBOM), design-build-operate-maintain-finance (DBOMF), CM at Risk and Public-Private Partnerships (P3). In the past 10 years he has directed the development and implementation of four world class transportation projects with a combined value in excess of $8 billion, including the first DBOM public transportation contract in the United States — the Hudson Bergen LRT. He provides advisory services, including the development of business plans, finance plans, technical and performance guidelines, contracts, procurement, and program level budgets and schedules.

Relevant Project Experience

NJ TRANSIT, Hudson-Bergen Light Rail Transit System. This project included design and construction of the first 10 miles of a new 20-mile light rail system; procurement of 29 vehicles; construction of a shop and yard facility to house the ultimate fleet of 79 vehicles; stations; rail systems; and a variety of utility and municipal improvements. This was the first public transportation project in the United States awarded through a turnkey procurement. At $1.1 billion, it was the largest public works contract ever issued in New Jersey and the first DBOM project in North America. The DBOM concept required the contractor to design and build the system and operate and maintain it for 15 years at a predetermined cost. Managed all aspects of the project, including negotiating the FTA Full Funding Grant Agreement; working with the New Jersey State Treasurer to finance the project; and consolidating political and community support working with the Governor's office, the New Jersey State Assembly Light Rail Panel, and mayors to establish the alignment, resolve issues and gain acceptance for the DBOM model. Risk mitigation and contract packaging were critical and politically

Frank Russo, PE
continued

sensitive issues. Developed risk allocation between the DBOM contractor and the agency. The project was completed on schedule and without claims and is now in operation.

NJ TRANSIT River Line Light Rail Transit System. The $605 million project connects Camden and Trenton and was built under a unique DBOM approach. The corridor is 33 miles long and shared with freight operations. It was designed and constructed and is now being operated and maintained through a single procurement. Responsibilities were similar to those described for Hudson-Bergen. Developed new operating and liability agreements with the freight railroad to accommodate their needs. The agreements were submitted to and approved by the FRA and included financial and operating arrangements to allow the freight railroad to serve its customers from both ends of the line, and allowed partial use of the corridor during the day, when the passenger light rail system was operating.

NJ TRANSIT, Assistant Executive Director, New Rail Construction. Developed and implemented the agency's highest priority rail projects. Responsible for all aspects of project development and execution, including planning, engineering, contract development, project funding and financing, community and government relations and construction management.

NJ TRANSIT Newark International Airport Monorail. Managed the $500 million extension of the Newark International Airport Monorail to the Northeast Corridor, providing a direct connection for N J TRANSIT and Amtrak riders to the airport. It included the extension of the existing monorail and the construction of an intermodal transfer station on Amtrak's Northeast Corridor. Managed the needs of three separate operating agencies as well as the operator of the monorail. Structured contracts to allocate risks among N J TRANSIT, The Port Authority of New York & New Jersey, Amtrak, Adtranz (the private operator of the monorail system), and the design-build contractor.

York Rapid Transit, Ontario, Canada. Officer in Charge for the York Consortium joint venture, the private partner in Canada's first public-private transit partnership. This project is a partnership with the Region of York to design, build, and operate a 100Km bus rapid transit network. The initial phase of construction ($180 million) is complete and became operational in 2005.

MTA New York City Transit, Second Avenue Subway. Assistant project manager for the design of a $17 billion, eight-mile-long subway under Second Avenue serving the east side of Manhattan and a connection to the 63rd Street tunnel to Brooklyn and Queens. Developed the project's strategic goals and objectives and worked with NYCT on issues regarding federal process, risk allocation for design-build contracts, privatization opportunities, and development opportunities. Developed creative funding and financing alternatives, innovative procurement strategies, strategic plan, risk management program, constructability reviews and construction cost assessments. Worked with the NYCT and MTA legal staff, procurement managers, and grant managers to determine the schedule, develop innovative construction contracts, and formulate industry outreach programs to maximize interest and competition. Established an approach to constructing the system in phases that are affordable, minimize community impacts, satisfy political obligations, and deliver segments of operating subway as early as possible. Helped formulate the agency's internal funding plan and the capital program obligations.

Houston METRO "Metro Solutions" Program, TX. Provided program management, project development, and contract administration services. Managed the development of the program from the strategic planning to implementation of the DBOMF contracts. Supervised the work of general engineering, management and legal consultants and prepared the agency's application for the new FTA P3 Pilot Program. The program is an integrated set of system expansion projects that will add 50 miles of new public transportation service to the Houston METRO system. Projects include an extension of the existing light rail line, new light rail systems, a number of new bus rapid transit corridors, new commuter rail service, and two new inter-modal centers. The total value of the program exceeds $2 billion.

Richard A. Falcon, PE

Peer Review/Constructability Review/Value Engineering

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ Leading industry expert transit rail systems
+ NJ PE with 45+ years of experience
+ 25 years with NJ TRANSIT in engineering and management positions
+ Project Director Systems, HBLRT, New Rail Construction
+ Peer review for design for consulting teams on major transit projects

Years of Experience

As Consultant: 48

Education

BSEE, Electrical Engineering, Newark College of Engineering (New Jersey Institute of Technology), 1967

Professional Licenses/Certifications

Professional Engineer, New Jersey

Professional Associations

American Railway Engineering and Maintenance-of-way Association (AREMA), Life Member

AREMA Committee 33: Electrical Energy Utilization, 1973 to present: Chairman, 1999-2002; Vice Chairman, 1996-1999

Work History

2008 to Present, Independent Consultant

1995 to 2008, NJ TRANSIT, Director, Systems Engineering and Design, Capital Project Management

1995 to 2001, NJ TRANSIT, Project Director Systems, HBLRT, New Rail Construction

1993 to 1995, NJ TRANSIT, QA Manager, Infrastructure Eng.

1987 to 1993, NJ TRANSIT, Chief Engineer – Electrical

1985 to 1987, NJ TRANSIT, Principal Engineer – Electrical

1983 to 1985, NJ TRANSIT, Engineer - Electric Traction

1979 to 1982, Consolidated Rail Corporation (Conrail), Regional Engineer – Electrification

1976 to 1979, Conrail, Supervisor Electric Traction

1975-1976, Erie-Lackawanna Railway Company, Chief Engineer - Electric Traction

1969-1975, Electrical Engineer, Underwriters' Laboratories, Inc.

1967-1969, Project Engineer, Underwriters' Laboratories, Inc.

About Richard

Richard Falcon is a professional electrical engineer and an accomplished electrical department manager and project manager. Richard has had extensive experience for NJ TRANSIT where, among other accomplishments, he directed an engineering department responsible for planning, design, engineering, construction, operation, and maintenance of electrified railroads. He led project management, coordination, design, and facility modifications; coordinated the development of rail operational rules and guidelines; was an integral part of project management; and has been a key participant in overhead electrification projects throughout New Jersey. Richard has comprehensive knowledge of NJ TRANSIT system elements such as signals, communications, operations, vehicles and electrification, including experience in coordinating services and departments for several major new systems like the HBLRT, as well as improvement and renovation projects.

Relevant Project Experience

The Gateway Trans-Hudson Partnership, Amtrak, NJ. Peer reviewer in a workshop for a joint venture consulting contract in which AECOM was a partner. The peer review team was tasked with reviewing the 100 Day Draft of the System Level Design for the Amtrak Gateway Project.

New Jersey High-Speed Rail Improvement Program. Peer reviewer for proposed modifications of Amtrak's existing catenary to permit operation of passenger trains at speeds up to 160 mph.

Systems Engineering for the Hudson-Bergen LRT, Union County LRT, Southern New Jersey LRT (River Line) Systems. Director, systems engineering and design. Managed engineering, design, and construction of systems, including traction power, overhead contact systems, signals, communications, power and vehicle engineering for a number of complex transit projects and systems including HBRLT, Union County LRT, Southern New Jersey LRT and extension of light rail systems on the Northern Branch.

Richard A. Falcon, PE
continued

NJ TRANSIT Hudson Bergen Light Rail Transit. As project director, systems, managed the engineering, design, and construction of the systems portion of a number of complex transit projects for the purpose of creating a transit system along the waterfront in Hudson and Bergen counties. Established design, construction, and maintenance standards and provided technical support for electric traction, catenary, substations, signal, communications and the light rail transit car. Established project budgets, and established schedules. Contributed to the establishment of the safety certification requirements and process.

NJ TRANSIT Quality Assurance Management. As quality assurance manager for infrastructure engineering, completed a special assignment to establish a new quality assurance department for rail infrastructure group; including signals, communications, structures, track, and electric traction departments and mandates for auditing internal and external quality programs for compliance with ISO 9000.

NJ TRANSIT Electrical Engineering. As chief electrical engineer, established design, construction, maintenance, standards and provided technical support for electric traction catenary, substation, and industrial electrical power facilities. Responsible for the planning, and development for the Hoboken Terminal Electrical System Upgrade, Hoboken Terminal Switch Heater Conversion, Catenary Trolley Wire Replacement Program, Dover Wayside power, and electrical technical and managerial interface with the extension of electrification between Matawan and Long Branch. On special assignment, directed the Arrow III Overhaul and Upgrade Project (AC traction motor conversion) to resolve FTA (UMTA) issues concerning documentation control and the project management plan. Responsible for the review and approval of design and manufacturers' drawings.

NJ TRANSIT Electric Traction Engineering. Principal engineer for the planning, design, engineering, inspection and supervision of capital electrical and electric traction projects. Key member of the design review team for extension of electrification on the North Jersey Coast Line (Matawan to Long Branch) was responsible for review of all catenary, substation, and supervisory control plans and specifications. Responsible for the planning, engineering and design of the 13,800 volt distribution system to replace antiquated high voltage distribution system as a part of planned Hoboken Waterfront Development project.

NJ TRANSIT Engineer Electric Traction. Managed all electric power fixed facilities including catenary, substations, and signal power and represented the railroad with NJDOT for the railroad electrification projects. Performed design review, electric traction force account estimates, and monitoring the re-electrification and conversion of the former Erie-Lackawanna Railway electrified zone from 3000 volts DC to 27,500 volts 60 Hertz, and the extension of electrification on the former New York and Long Branch Railroad (Jersey Coast Line). Responsible for the approval of contractors work, coordinated contractors track outages with electrical outages. Prepared force accounts transitional electrical plans, switching instructions and overall direction for the electrical department employees. Directed railroad activities for system testing and start up.

Consolidated Rail Corporation (Conrail) Electrification and Electric Traction Program. As regional engineer and supervisor, assembled and directed maintenance, design team of more than 50 employees from the merged railroad organization. Managed the engineering and maintenance of electric traction facilities, movable drawbridges, passenger station lighting, office and terminal power systems. Analyzed and evaluated electric power consumption of the rail electrification system. Liaison between New Jersey DOT and railroad for to the re-electrification of the Erie-Lackawanna Suburban Service (Morris and Essex Lines) and the extension of electrification on the New York and Long Branch (Jersey Coast Line).

Robert Wood, PE

Peer Review/Constructability Review/Value Engineering

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 40+ years of experience in electric power generation and distribution systems
+ Engineering, procurement, construction (EPC), installation, inspection, start-up and operation of power generation, distribution and storage systems
+ Extensive experience in project and system safety
+ Modernization of mechanical and electrical systems
+ High voltage substations and transmission lines, civil infrastructure, and energy distribution projects

Years of Experience

With AECOM: 14
With Other Firms: 29

Education

BE, Mechanical Engineering, Pratt Institute 1968
MS, Mechanical Engineering, Polytechnic Institute of Brooklyn (Now NYU) 1971

Professional Licenses/Certifications

Professional Engineer: New Jersey, New York and Pennsylvania

Work History

2006 to Present, AECOM, VP/Program Manager
1996 to 2006, Parsons Corporation, VP Power
1990 to 1996, AECOM (Gibbs & Hill, UE&C), VP Power Group
1986 to 1990, General Electric Co., Manager of Projects
1983 to 1986, Fuller Company, Manager of Projects
1979 to 1983, Kuljian Corporation, Project Manager
1974 to 1979, General Electric International, Project Manager
1972 to 1974, General Electric International, Buyer-Mechanical Equipment
1970 - 1972, U.S. Army- Lieutenant, Platoon Leader

About Robert

Robert Wood has more than 40 years of professional experience in power generation, storage, and distribution projects encompassing a total scope of development and delivery, including planning, design engineering, procurement, construction, start-up and commissioning, operation, maintenance, and inspection.

Bob experience includes power stations of various types and sizes, high voltage (HV) transmission lines and stations, cement manufacturing plants, infrastructure, and oil pipelines. He has worked on several projects in New Jersey. He has performed extensively for public and private sector clients. Recently he played a key leadership role in AECOM's contract for the U.S. Army Corps of Engineers for the reconstruction and rehabilitation of the power grid and energy sector throughout Iraq.

Relevant Project Experience

LIVEWIRE Program – Power and Cooling System Service Provider (PCSSP). Supported and assisted the US Government in the development, management and execution of LIVEWIRE—the program to restore and modernize a DOD agency's electrical and mechanical infrastructure. Facilities under this agency's auspice worldwide possess a complex integrated electric power and mechanical infrastructure which, because of its vital role supporting our national security, require the most up-to-date systems design approach with minimized exposure to interruption.

Ameren Illinois Rivers 345 kV Transmission Lines and Substations Program, IL and MO. Program director for program management and construction management of 375 miles of 345 kV transmission lines, comprised of nine transmission line segments, three river crossings, more than 60 area connections and ten 345 kV substations that will interconnect Missouri, Illinois and Indiana. The line will consist of single shaft, self-supported steel poles designed for a single, 3000A, 345 kV circuit, along a 150-foot right-of-way.

Robert Wood, PE
continued

Competitive Renewable Energy Zone (CREZ) Transmission Program Management, TX. Program manager for a 450-mile segment of the 2,500 mile CREZ program designed to bring 18,500 MW of wind energy from West Texas to the Dallas/Fort Worth and Austin areas. ETT's section was 450 miles of 345 kV transmission lines and 12 substations. AECOM also managed two 100-acre storage yards that held more than 15,000 truckloads of material.

Bayji to Baghdad West, 400 kV Transmission Line; Haditha to Baghdad West, 400 kV Transmission Line, Iraq. Directed engineering, design, procurement, construction management, construction, testing, and commissioning to repair and/or replace damaged transmission lines and substation components in order to restore the two lines to operation. The project included: the restoration and energizing of the 223 km Baghdad West to Haditha 400 kV transmission line; the restoration and energizing of 230 km Baghdad West to Bayji #2 kV transmission line; furnishing, installing, and commissioning the necessary work at the Haditha and Baghdad West Substations to ensure that the stations are ready to send and receive power on this line.

Distribution System and Substation Project (T&D Contract W914NS-04-D-0010), Iraq. Managed engineering, design and reconstruction of over thirty Medium Voltage Distribution Substations and over one hundred kilometers of 33 kV Distribution Lines throughout the regions of Iraq. The work included project management, security, site assessment, engineering, procurement, installation, start up and commissioning.

High Voltage Substation Project (T&D Contract W914NS-04-D-0010), Iraq. Oversaw the engineering, design and reconstruction of various High Voltage Substations throughout Iraq. Included in the project: TO-0004 (ET- 012) – Baghdad West High Voltage Substations; TO-0005 (ET-014) – Baghdad East High Voltage Substations; TO- 0014 (ET-010) – Baghdad 400 kV Substations; TO-0018 (ET-021) – Diyala 400 kV GIS Substation Rehab.

Iraq Reconstruction – 33 kV Distribution Lines. Oversaw the engineering, design, procurement, construction for the following 33 kV distribution lines under the Iraq Restoration Project: 30 km 33 kV Erbil Shaqlawa-Khoshnaw overhead double circuit steel lattice tow r line; 6 km 33 kV Erbil Salahaddin-Khanzad overhead double circuit steel lattice tower line; 37 km 33 kV Dahuk-Atrush overhead double circuit steel lattice tower line; 15 km 33 kV Dahuk-Darkar overhead double circuit steel lattice tower line; 8 km 33 kV Ninawa Al Khazer overhead single circuit steel lattice tower line; 7 km 33 kV Wassit Al-Ahrar overhead single circuit steel lattice tower line; 27 km 33 kV Basra/Umm Qasr Water Supply overhead single circuit steel pole line.

Transmission Lines, Distribution System Restoration Program, Iraq. Oversaw the engineering, procurement, and construction services to refurbish various high voltage transmission lines and substations throughout Iraq, under a contract with the US Government's Iraq Project Contracting Office. AECOM performed the engineering, procurement, and construction of five high voltage 400 kV substations, more than twenty medium voltage 33 kV distribution substations and more than 100 kilometers of 33 kV distribution lines throughout the country. AECOM also provided rehabilitation and expansion of the Iraq country-wide SCADA system, including regional control centers. AECOM provided engineering, design, procurement and installation services for the SCADA and communications facilities to link together over 200 substations throughout the country.

Iraq Reconstruction Program, $1.5 billion. Program manager for the design, procurement, construction, and startup as well as personnel security. New simple cycle gas turbine, both large frame and Aero Derivative machines, 400 km 400kV transmission lines, 200 km33 kV distribution lines, 80 HV substations, 50 distribution substations, and a complete country-wide SCADA system.

American Re-fuel, Trash to Energy Plant, New Power Generation Plant, Newark, NJ. Managed the group performing this project.

James J. Peterson

Advisory Committee

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 40+ years in energy and power transmission industry
+ Director of Navigant's Energy Practice
+ Extensive professional experience drafting and negotiating power purchase agreements and contracts
+ Formerly employed with New York State agencies — LIPA, NYPA and NYS DPS
+ Expertise in utility resource procurements and the drafting/negotiation of purchase agreements on behalf of utilities and other market participants

Years of Experience

With Navigant Consulting: 7
With Other Firms: 36

Education

MBA, Economics, Pace University, 1982
BE, Industrial Engineering, Pratt Institute, 1970

Work History

2008 Present, Navigant, Director – Energy Practice
2001 to 2008, Long Island Power Authority, Acting VP Power Markets (Director of Power Contracts
1978 to 2001, New York Power Authority, Director of Power Contracts and Billing
1977 to 1978, American Electric Power Service Corporation, Associate Engineer
1973 to 1977, New York State Public Service Commission, Case Analyst

About Jim

Jim Peterson is a Director in Navigant's energy practice, where he has primarily been involved with utility resource procurements and the drafting and negotiation of related power purchase agreements and firm transmission capacity purchase agreements on behalf of utilities and other market participants. Prior to Navigant, he was employed by New York State agencies (Long Island Power Authority, New York Power Authority and New York State Department of Public Service) for 35 years. His experience includes overseeing the planning, power and transmission contracts, project management, fuel supply, and energy scheduling functions of LIPA. Prior to LIPA, Jim oversaw the power and transmission contracts and billing functions of NYPA. Previously, he worked for American Electric Power Service Corporation, where he was involved in power contract negotiations and the development of retail and wholesale electric rate filings with regulatory agencies. Jim began his career at NYS DPS, first on staff reviewing retail utility rate filings and then in the Office of Administrative Law Judges preparing Recommended Decisions.

Relevant Project Experience

Caithness 326 MW Combined Cycle Power Plant, Yaphank, NY. Negotiated a 20-year power purchase agreement with Caithness and a three-party interconnection agreement among LIPA, Caithness, and the NYISO. Negotiated numerous other agreements (e.g., gas transportation and several easements). Caithness commenced operations in 2009. This plant was selected in connection with the Long Island Power Authority's 2007 generation and transmission request for proposal, for which Jim was responsible. Proposals for generating projects and/or merchant transmission lines (between 250 MW and 600 MW) to neighboring control areas were the subject of this RFP. After a thorough evaluation of all proposals pursuant to a multi-phase review process, an award was granted to the Caithness Long Island Energy Center, a new 326 MW combined cycle power plant located in Yaphank, New York.

James J. Peterson
continued

400 MW Big Wind Cable Project, HI. Drafted a report on behalf of the State of Hawaii Department of Business, Economic Development and Tourism ("DBEDT") setting forth a plan for developing the cable project and interconnecting the wind farms. Also served as a member of the team that developed the project plan, including determining cable routes and locations for converter stations and interconnection points. Supported the preparation of Hawaii State legislation that was adopted providing for the development of a Certified Cable Company, since the local utility (Hawaiian Electric Company) could not finance such a project, and developed project cost estimates and consumer rate impacts. The project involved an HVDC cable that would interconnect wind farms (200 MW each) planned for Molokai and Lanai that would serve the load center on Oahu (an AC cable would interconnect the wind farm on Lanai with the converter station on Molokai. The project is pending before the State of Hawaii Public Utilities Commission.

New York Power Authority, Hudson Transmission Partners (HTP) High Voltage Direct Current (HVDC) Transmission Project. Supported the development of HVDC transmission project interconnecting New York City with New Jersey; drafted reports providing economic analyses; addressed PJM interconnection issues; participated in negotiation of 20-year Firm Transmission capacity Purchase Agreement between NYPA and HTP.

New York Power Authority, Great lakes Offshore Wind Project. Managed the procurement process; drafted all major documents including Request for Information, Request for proposals, Preferred Power Purchase Agreement, RFPs for engineering support; conducted interviews with short-listed bidders; performed qualitative and quantitative reviews of proposals with recommendations for selection.

New York Power Authority, Procurement process for 100 MW Solar RFP. Managed the procurement process; drafted all major documents including pertinent contracts and tariffs; performed qualitative and quantitative reviews of proposals.

New York Power Authority, 1,500 MW project interconnecting New York City with Hydro-Quebec. Performed commercial arrangements in support of proposed 1,500 MW project interconnecting New York City with Hydro-Quebec; drafted reports and performed economic analyses of project.

New York Power Authority, Marcy-South Series Compensation Project. Reviewed those proposed for participation in NYISO selection process; drafted reports on economic benefits of project.

New York Power Authority, Moses-Adirondack Transmission Project. Prepared economic review of alternatives for replacing an aging and unreliable transmission facility.

New York Power Authority, Tropical Storms Irene and Lee After-Action Report. Conducted a detailed review of NYPA's actions during and after the storms, and proposed recommendations for improvement.

New York Power Authority, Indian Point Contingency Plan. Managed an RFP for new generation or transmission projects to replace the Indian Point nuclear power plants (2,000 MW) in the event that it does not secure a renewed license from the NRC.

Long Island Power Authority, 2,500 MW Generation and Transmission RFP . Performed qualitative review of proposals; made recommendation for selection; negotiated Power Purchase Agreement with winning bidder.

Cogentrix, Deepwater Wind and Northville Industries (individual engagements). Supported developer proposals in responding to a Long Island Power Authority RFP for new generation projects. Reviewed and commented on proposed responses and Power Purchase Agreement exceptions.

New Jersey Utilities (Atlantic City Electric, Jersey Central Power & Light and Rockland Electric). Managed nine RFPs on behalf of the utilities pertaining to the New Jersey BPU's Solar REC II initiative. Worked with BPU staff in connection with selection process approvals.

Lyle Rawlings, PE

Advisory Committee

QUALIFICATIONS FOR TRANSITGRID PROJECT

+ 30+ years of renewable R&D, design and policy
+ Recognized expert in solar energy
+ Initiated working group leading to $100M PSEG loan program pilot – the first securitized SREC program in the country
+ Has served on New Jersey's Clean Energy Council since its inception

Years of Experience

With CCMT/Advanced Solar Products, Inc.: 17

With Other Firms: 22

Education

BS, Chemical Engineering, West Virginia University: 1977

Professional Registration

Professional Engineer: NJ, PA, MA, NY, CT, VA, IL, Puerto Rico

Work History

1999 to Present, Advanced Solar Products, Inc., President and CEO

1988 to 1998, Analyst, Non-Profit Research and Development Company for solar commercialization

1981 to 1988, Solar Designer for residential properties

1977 t o 1981, Exxon Research and Engineering, Research Engineer

About Lyle

Lyle Rawlings is one of the nation's most respected professionals in the field of solar energy, with more than 30 years experience in research and development, design and policy work in renewable energy. He is the founder and president of Advanced Solar Products, Inc., one of the leading solar photovoltaic integrators in the mid-Atlantic region. Lyle holds one patent in photovoltaic module design and has another patent for an improved module mounting system. He also has extensive experience and expertise in hydrogen, fuel cells, energy storage, zero-emission vehicle design, synfuels and waste-to-energy conversion.

- Worked for Exxon Research & Engineering Company from 1977 to 1981 on converting coal to natural gas.
- Starting in 1981, began designing integrated solar homes, first for an architectural firm, then started own business in 1983.
- Founded a non-profit research & development company in 1988 for education and to research, develop, and commercialize solar innovations. Co-developed and commercialized factory-built, zero-energy homes.
- Founded Advanced Solar Products in 1999.
- From 1999 to 2002, participated in Team New Jersey, a multi-sector partnership to design, build, and race a hydrogen-powered car (The New Jersey Venturer). Participated in the design and construction of the New Jersey Genesis, the world's first hydrogen car to achieve a 400+ mile range.

Professional Activities

- In 1997 Mr. Rawlings was one of three founders of the Mid-Atlantic Solar Energy Industries Association. Led the effort to raise funds and hire a lobbyist, and worked with the lobbyist to develop legislation in New Jersey, successfully establishing a large fund for renewable energy. Led the Association for the first six years as its President (and currently as its Vice-President), to grow the fund and develop it into a successful market growth program, and a thriving and fast-growing industry.

Lyle Rawlings, PE
continued

- Has served on New Jersey's Clean Energy Council since its inception and as Chair of its Renewable Energy Committee for three years.
- Served on the Governor's Renewable Energy Task Force in 2003 to structure New Jersey's RPS, and to fight for a solar share of the RPS (and succeeded, despite some internal opposition from within the PV industry). The solar share became the SREC program and is now the basis for an approx. $10 billion build-out of PV in New Jersey by 2020.
- Provided, through MSEIA, the first seed money to develop solar legislation in Pennsylvania.
- Initiated a working group among PSEG and the solar industry, leading to the $100 million PSEG loan program pilot – the first securitized SREC program in the country.
- Founded New Jersey Chooses Solar in 2007 as a non-profit advocacy organization to simplify and securitize government incentives, establish a level playing field, fight monopolization, and preserve diversity in the solar market. The organization has retained former NJ Governor Jim Florio and his group as its lobbyist.
- In 2008 started the Community Service Committee of MSEIA to organize its 80 member companies to use their financial and human resources to help New Jersey's many community-based organizations serving those who need it most. Volunteers at, and supports, the soup kitchen and Families in Transition program at the Church of Christ at Clinton Avenue, Trenton.
- Has lived in an off-grid, advanced solar home for 17 years.

Specialty Resources

Name/Assignment	Credentials	Expertise	Experience Highlights
Edward Sitler, PE Civil Engineering	• 27 years of experience • BE, Civil Engineering, Stevens Institute of Technology, 1987 • PE: NJ	• Energy, transportation and site design • Civil engineering • Environmental permitting • NJ TRANSIT, NJDOT and PSE&G project experience	• PSE&G, Site Engineering for NE Grid Reliability Project • PSE&G NE Grid/O-66 • NJDOT/NJ TRANSIT/Howard Boulevard Park-and-Ride Facilities • NJDOT Route 46 over Hackensack River
Karen Kramkowski, PE, PP Civil Engineering	• 36 years of experience • BS, Agricultural Engineering, Rutgers University, 1979 • PE: NJ • PP: NJ	• Highway and municipal engineering • Roadway design, • Site development • Drainage/flood control • Urban streetscape design • Construction supervision	• PSE&G Public Site Engineering for NE Grid Reliability Project • Port Newark Container Terminal Renovation • NJDOT Route 1&9 Improvements • NJ Tpke Interchange 10 Improvements
Rajendra Navalurkar, PE Structural Engineering	• 21 years of experience • PhD, Structures, NJIT, 1996 • MS, Civil Engineering, 1991, NJIT • BS, Civil Engineering, 1988, Bangalore • PE: NJ, NY	• Structure analysis and design of tunnels, buildings, bridges, retaining walls • Blast modeling • Seismic analysis/evaluation • Load rating analysis/ inspection • Finite element modeling	• NJ Transit Light Rail System Newport Viaduct • NJDOT General Engineering Services On Call Services • NJDOT Route 46 Bridge over Hackensack River • NJTA Newark Bay Bridge • NJDOT Route 70 Over Manasquan River
Stewart Willis, PE Structural Engineering	• 30 years of experience • MS, Civil Engineering, University of Central Florida, 1993 • BS, Civil Engineering, University of Florida, 1985 • PE: NJ, NY	• Bridge design and rehabilitation • Retaining walls, noise barriers and overhead and cantilever sign support structures • PSE&G and NJ public agency client experience	• PSE&G Northeast Grid Reliability Underground Transmission Circuits • NJDOT Route 46 over Hackensack River • NJDOT Pulaski Contract 2, Conrail Viaduct and Hoboken Viaduct • NJ Tpke Interchange 10 Bridge Widening and Pavement Reconstruction
Antoine AbiDargham, PE Structural Engineering	• 30 years of experience • MBA, Baruch College, 1992 • MS, Structural Eng., Polytechnic University of New York, 1985 • BS, Civil Engineering, Polytechnic University of New York, 1984 • PE: NJ, NY	• Structural analysis and design • Condition assessment, • Facility rehabilitation • Construction support services • Future capacity and growth project design	• NYC Department of Buildings Superstorm Sandy Rapid Assessments • NYC Build It Back Program Design Build • World Trade Center Flood Resiliency Design and Water Infiltration Protection • MTA Coney Island Yards Flood Mitigation Design • Laguardia Airport Flood Mitigation • Coney Island Yards Flood Mitigation
Joel Fisch, PE MEP Engineering	• 35 years of experience • BS, Mechanical Engineering/Physics, Carnegie Mellon University, 1980 • PE: NJ, NY	• HVAC systems analysis and design • Energy facility condition assessment • Energy conservation and sustainability	• MTA NYCT Capital Program 207th Street Yard Boiler Plant Upgrade • VAMC Manhattan Superstorm Sandy Mitigation – Buildings 2 & 3 • PANYNJ Newark Liberty Airport HVAC System Condition Assessment
Ajmal Khan, PE MEP Engineering	• 40 years of experience • MS, University of Aston, Birmingham • BS, Electrical Engineering, Queens University of Belfast • PE: NJ	• Electrical distribution systems design • Substations, generation, AC and DC Traction Power • Control Centers SCADA	• NJ TRANSIT New Jersey East/West Bound Tracks • AMTRAK Northeast Corridor • Minneapolis Hiawatha Light Rail

Specialty Resources
continued

Name/Assignment	Credentials	Expertise	Experience Highlights
Gerardo Aguilera MEP Engineering	• 20 years of experience • BS, Civil Engineering Batangas State University, Philippines, 1990	• Plumbing and fire protection systems engineering design • Transportation and transit facilities • Industrial and commercial spaces	• NJ TRANSIT Hilton Bus Facility and Office Building Parking Deck Repair • PATH Substations 7 and 9 Plumbing and Fire Sprinkler Systems and Special Hazard Fire Protection System • Sandy Resiliency Program projects
April Thomann, PE Utility Engineering	• 20 years of experience • MSCE, University of Michigan, 1988 • BSCE, University of Michigan, 1987 • PE: NJ	• Utilities engineering design • NJDOT utility procedures • State utility and railroad accommodation policy • NJDOTcapital project delivery process	• NJDOT Route 130 over Raccoon Creek, Gloucester County • NJDOT Route 120 Paterson Plank Road Reconstruction • NJDOT Route 93 Drainage Improvements, Bergen County
Murtaza Shah Utility Engineering	• 15 years of experience • BS, Electrical Engineering/Power Distribution Systems, Drexel University, 2004	• Electrical engineering • Utilities design • PSE&G substations • Northeast Grid • Amtrak substations	• PSE&G, 40th Street, Branchbrook, Belleville, Warren Point, Front Street South Second, Greenbrook, and Plainfield Substations • PSE&G NE Grid Transmission Line • PSE&G Linden Substation
David Male, PE Signals Engineering	• 34 years of experience • BS, Applied Science/ Technology, Edison State College, 1989 • AAS, Electrical Engineering Technology, Mercer County Community College, 1987 • PE: NJ, NY	• Rail systems planning and design • Operations analysis • Systems engineering and implementation • Train control and control center systems, • Data communication and security systems • Major NEC experience	• Amtrak, Gateway - Systems Level Design • Amtrak, NEC Improvement • MTA MNR and LIRR Positive Train Control • LIRR Jamaica Central Control System • LIRR Speonk to Montauk Signaling Program • MTA MNR Signal System Capital Programs
Frederick Voss, PE, PLS Survey	• 40 years of experience • MS, Civil Engineering, New Jersey Institute of Technology, 1982 • BS, Civil Engineering, New Jersey Institute of Technology, 1978 • PE: NJ • PLS: NJ	• Survey and site plan preparation • Highway deseign • ROW acquisition plans and agreements • Construction staging and MPT plans • Utility coordination • NJ TRANSIT experience	• NJ TRANSIT Lackawanna Cut Off • NJ TRANSIT West Summit Interlocking • NJ TRANSIT Trans-Hudson Express Tunnel • NJ TRANSIT Hudson Bergen Light Rail • NJ TRANSIT County Yard • Amtrak Durant Yard • NJ TRANSIT Morrisville Yard
Adam Decker, CP Survey	• Rutgers University Cook Campus, Certificate in Geomatics • CP - Certified Photogrammetrist • GIS/LIS	• CADD Manager • Photogrammetric mapping • NJ TRANSIT and NJDOT procedures and guidelines	• NJ TRANSIT Rare Interlocking • NJ TRANSIT Mid Line Loop • NJ TRANSIT Central NJ Rail Line • NJDOT Proposed South Amboy Ferry Terminal • NJ TRANSIT Portal Bridge Replacement
Janelle Ella BIM	• 21 years of experience • BS, Civil Engineering, NJIT, 2003	• Engineering/BIM experience • Field inspections • Traffic counting and survey • Bridge inspections • Design and estimating • NJ TRANSIT experience	• NJ TRANSIT THE (Trans-Hudson Express) Tunnel • PANYNJ Lincoln Tunnel Helix • PANYNJ Goethals Bridge Modernization Program

Specialty Resources
continued

Name/Assignment	Credentials	Expertise	Experience Highlights
Matthew Blizard, PE NERC Compliance	• 30 years of experience • MS, National Security and Resourcing, National Defense University • MS, Computer Sci., Rensselaer University • MS, Electrical Eng., Purdue University • BS, Electrical Eng., USCG Academy • PE	• Security, law enforcement, and operations and mission support activities • Critical infrastructure protection (CIP) electric system reliability and security • National and homeland security • Mission assurance and program management	• Former Director, CIP, at NERC responsible for security of the Bulk Power System (BPS) • Directed the CIP of the BES (cyber and physical security) with NERC • White House and DOE-led Cybersecurity Risk Management Maturity Model • US Coast Guard Deputy Chief of Staff and Executive Director to the Deputy Commandant for Mission Support
Keshav Sarin, CISA NERC Compliance	• 15 years of experience • MBA, David Eccles School of Business, University of Utah • BE, Electronics and Communications, Karnataka University, • Certified Information Systems Auditor	• NERC Compliance management and auditing • Cyber security • Risk management • Security audits using GAGAS	• Western Electricity Coordinating Council (WECC) - Analyzed cyber security and engineering risks to Bulk Power System (BPS) or the electric grid for over 400 utility companies • Audited utilities to verify compliance with NERC Reliability Standards related to Critical Infrastructure Protection (CIP) and Operations and Planning (O&P) areas.
Phil Owen, CISSP-ISSAP Cybersecurity	• 28 years of experience • MS, Computer Science, University of Oxford • BA, English, Auburn University • Certified Information System Security Professional (CISSP)	• Information Systems Security • Enterprise Risk Analysis Program (eRAP) • National Initiative for Cybersecurity Education (NICE) • National Cybersecurity Workforce Framework 2.0 (NCWF 2.0) development	• Federal Trade Commission. Information Security Manager • US Army Corps of Engineers, Advanced Metering Program information assurance and systems security engineering • US Navy Sea Systems Command Headquarters Senior Information Assurance Officer • US GSA Information Systems Security Manager
Ken Donaldson, CISSP-ISSAP Cybersecurity	• 21 years of experience • MBA, Business Administration/ Technology Management, University of Phoenix • BS, Information Technology, University of Phoenix • CISSP	• Systems development lifecycle • Enterprise computing, communications, systems integration, and ICS environments • Information security consultation - penetration testing, RF spectrum analysis, and vulnerability assessment	• AECOM Enterprise Risk Analysis Program, Department of Defense Security Clearance Senior Information Security Architect • Northrop Grumman Corporation, Fallon Tactical Training Range (FTTR) Program Senior Information Assurance Analyst • Nevada Cyber Solutions LLC - Provide engineering and implementation solutions
Edward Dobrowolski, PE Market Integration	• 40 years of experience • MS, Engineering Management, Drexel University • BS, Electrical Engineering, Drexel U. • PE	• NERC reliability standards • Utility operations and control systems • Strengthening the Bulk Power System (BPS)	• NERC Definition of the Bulk Electric System (BES) • NERC Transmission Planning • NERC System Restoration • Smart Grid Task Force Liaison • Integrated Variable Generation Task Force Liaison
Chitra Radin Environmental	• 20 years of experience • BA, Rutgers University, 1981	• Environmental planning of transportation infrastructure • Conducting reviews on federal and state-funded projects (NEPA, EIS, EA, CE and EO 215 documents) • NJ TRANSIT project experience	• NJ TRANSIT High-Speed Rail Improvement Project • NJ TRANSIT Access to the Region's Core/THE Tunnel Project • NJ TRANSIT/Amtrak Portal Bridge Replacement • PATH Extension to EWR • NJ TRANSIT Northwest NJ Bus Study

Specialty Resources
continued

Name/Assignment	Credentials	Expertise	Experience Highlights
Jane Darcy Environmental	• 16 years of experience • BA, English Literature, Fordham University, 1990 • MUP, Hunter College, 1999	• Large capital transportation projects • Environmental analyses, • Planning and feasibility studies • Public outreach • NJ TRANSIT project experience	• NJ TRANSIT Mid-LIne Loop • NJ TRANSIT Access to the Region's Core/THE Tunnel Project • NJ TRANSIT West Trenton Line Update
Richard Johnson, PE, DEE, CVS VE Facilitation	• 35 years of experience • BS/MS, Civil/Environmental Engineering, University of Central Florida, 1984 • PE • Certified Value Specialist (CVS) • Diplomat Environmental Engineer Certification	• Civil and environmental engineering • Railroad and multi-modal transportation systems • Utility improvements • Team Leader on over 150 transit and transportation value engineering studies	• Lower Manhattan Construction Command Center Value Planning Exercises & Risk Management Program of the World Trade Center Site • Metro-North/ConnDOT Bridge Over Atlantic Street VE Study • PANYNJ World Trade Center Transportation Hub VE Study • MBTA Green Line Extension VE Study • MBTA Government Center Sta. VE Study • FDOT Statewide VE Services
Robert Harwig Microgrid	• BS, Computer Engineering, Virginia Polytechnic Institute and State University	• Software engineering • Lifecycle software design, development, deployment, maintenance, and reporting • Installation, deployment, commissioning and demonstration of microgrids	• SPIDERS Joint Capabilities Technology Demonstration (JCTD) Phases II and III • Army Research Lab Cooperative Project Adaptive Intelligent Tactical Grids • Universal Controls with Intelligent Power Distribution Expeditionary Power Systems, Marine Corps Systems Command
Robert Zmudzinski Communications	• AS, Engineering Science, SUNY, 2004	• Systems engineering specialist • Manages communications initiatives for transit projects • Extensive experience with NJ/NY Metro area transit agencies	• MTACC Second Avenue Subway network engineer and communication technical expert • MTACC Fulton Transit Center. Fiber optic network engineer/communications technical expert • Amtrak, Penn Station Life Safety Improvements. Director Telecommunications & System Development
Edmund Gurtatowski, PE Design Development/ Criteria	• 37 years of electrical engineering experience • BS, Electrical Engineering, New Jersey Institute of Technology, 1977 • NJ Licensed PE	• Expertise in distribution systems for transit/rail and energy sectors • Extensive experience in design of energy efficient electrical systems for NJ TRANSIT, NYPA and other local agencies	• NYPA for NYC Department of Corrections, Rikers Island Cogeneration Plant • NJ TRANSIT Hoboken Rail Yard and Terminal. • MTA New York City Transit Grand Ave Bus Depot and Central Maintenance Facility

04 References

The AECOM team has provided quality services to many agencies across the nation, as demonstrated throughout this proposal and which can be affirmed by our clients.

FIRM REFERENCES

Project Name and Brief Description	Reference Contact Information	Start/End Dates
AECOM		
Rikers Island Cogeneration Facility. Evaluated and built a reliable microgrid and energy efficient cogeneration facility on Rikers Island.	New York Power Authority 123 Main Street, White Plains, NY 10601	2011 – 2015
California State University, Fullerton 1.16MW Rooftop/Canopy PV System. Design and installation of a 1.16 Megawatt photovoltaic (PV) system divided equally on two rooftops and an elevated parking structure.	California State University, Fullerton , Manager, Commissioning and Energy 800 North State College Blvd. Physical Plant T-100, Fullerton CA 92831	2009 – 2012
Hudson-Bergen Light Rail Line. FTA-funded transportation public-private partnership with NJ TRANSIT, designed to FRA standards involving alignment on private rights-of-way, city streets, and elevated structures through Jersey City.	NJ TRANSIT One Penn Plaza East, Newark, NJ 07105 *Design-Build:* *O&M:*	1996 – 2020
Long Slip Canal Fill. Engineering services including alternatives evaluation, conceptual design development, and final engineering associated with the filling of a 2000-foot channel along the Hudson River adjacent to Hoboken Yard.	NJ TRANSIT One Penn Plaza East, Newark, NJ 07105-2246	AA, Concept Design: 2000 – 2003 Prelim/Final Eng: 2008 – 2013
NJ TRANSIT Hurricane Response Strategy Development – Rail Operations, Light Rail, Bus and Paratransit. Developed protective measures to shelter over 700 rail vehicles and protect assets from storm damage at various NJ TRANSIT locations, including its largest maintenance facility (the Meadows Maintenance Complex), Hoboken Terminal, and Oradell Bus Garage.	NJ TRANSIT One Penn Plaza East, Newark, NJ, 07105	2013 – 2015

Project Name and Brief Description	Reference Contact Information	Start/End Dates
AG Consulting		
NJ TRANSIT Agreement No. 09-086B Task Order Contract (TOC) for Pennsylvania Station. Electrical engineering for installation and commissioning of two auto transfer switch, interlock scheme, control & indication circuits, and all normal and emergency backup power (4160V) cables.	Parsons Transportation Group, Inc. 100 Broadway, 20th Floor New York, NY 10005	2012
NJ TRANSIT Contract # 13-006D A/E Design Services TO #2 Super Bowl 48 – Temporary Emergency Power System. Evaluated existing electrical systems configuration and sizing at Secaucus Junction station and Henderson Street substation in Hoboken Yard in the event of a local or regional power outage during Super Bowl 48.	SYSTRA 1600 Market St., Suite 1310 Philadelphia, PA 19103	2013 – 2013
NYCT Flood Mitigation/Resiliency Design for Cranberry Tube in the Boroughs of Queens and Manhattan. Traction power design work followed by construction phase services of the circuit breaker houses and substations.	HNTB Corporation 5 Penn Plaza, New York, NY 10001-1810	2013 – 2015
CCMT		
MTA NYCT Traction Power Substation at 53rd Street and 6th Avenue. Delivery of a 1 MW / 733 kwh stationary lithium ion wayside battery energy storage system (WESS) to substation in mid-town Manhattan.	Transpower 13000 Danielson Street, Poway, CA 92064	2013 – 2015
Cozzoli Machine Co. Solar PV Array Installation. Assisted with all aspects and phases of the installation of a 345 kW solar photovoltaic (Solar PV) array on Cozzoli's Somerset manufacturing plant.	Cozzoli Machine Co. 50 Schoolhouse Road, Somerset, NJ 08873	Ongoing
Amtrak Northeast Corridor Battery Storage Applications. Performing a study of battery storage and DG applications for the Keystone line, Hell Gate line, and Amtrak's Sunnyside Yards in Woodside, Queens.	Amtrak 30th Street Station, Philadelphia, PA 19104	Ongoing
The Chertoff Group		
Port Authority Security Services. Conducted a review of the PANYNJ's public safety and security procedures.	Port Authority of NY of NJ 225 Park Avenue South, New York, NY 10003	2011 – 2013
Bloomberg LP Security Services. Provided security advisory services and risk analysis with respect to the potential vulnerabilities on and in the vicinity of the client's building complexes.	Bloomberg LP 731 Lexington Avenue, New York, NY 10022	2012 – 2013
MetLife Security Services. Provided strategic risk management advisory services as well as tactical security design criteria for new facilities under construction in the US southeast region.	MetLife 1095 Avenue of the Americas, NY, NY 10036	2013 – 2014

Project Name and Brief Description	Reference Contact Information	Start/End Dates
Greener by Design		
American Dream Mall, Meadowlands, NJ. Green building and sustainability analysis, preliminary review of potential incentives such as the NJ Economic Redevelopment and Growth grant program, Pay for Performance, and the NJ Large Energy Users program.	Triple Five Group, Edmonton, Alberta, Canada 300 Paterson Plank Road East East Rutherford, NJ 07073	2011 – Ongoing
Maher Terminals Energy Retrofit. Comprehensive energy master plan and implantation of facility wide energy upgrades.	Maher Terminals Building 1210, Corbin St., Elizabeth, NJ 07201	2010 – Ongoing
City of Hoboken Post Sandy Recovery and Planning. Assisting with grant writing and strategic planning services, preparation of applications and submittals required to obtain grants and funding. Performing extensive stakeholder outreach to the residential and business community as well as to major real estate developers, engineers and others	City of Hoboken 94 Washington Street, 2nd Floor Hoboken, NJ 07030T	2012 – Ongoing
GTS Consultants		
County of Monmouth Replacement of Bridge MA-14. Provided topographic utility, and right of way survey, stream cross-sections, wetland locations and developed right of way acquisition documents for the replacement of a Monmouth County Bridge over Matawan Creek.	Greenman Pedersen, Inc.	2011 – 2015
Meadowlands Maintenance Complex. topographic and utility survey and mapping for approximately 190 acres of NJ Transit's rail yard / maintenance complex in Kearny.	NJ TRANSIT One Penn Plaza East, Newark, NJ 07105	2013 – Ongoing
County Yard Improvements. Provided ground survey and mapping for approximately 5 miles of the NEC to support the design of a new rail yard and new rolling stock storage tracks.	NJ TRANSIT One Penn Plaza East, Newark, NJ 07105	2014 – Ongoing
ILC Dover		
Flood Mitigation - 8 Station Project, CM1410 – ARUP for MTA NYCT. Sub-consultant for development and support of installation of a flood mitigation cover for a standalone, single stairwell entrance on the Canal St. Subway line for NYCT.	MTA NYCT 2 Broadway, New York, NY 10004	2013 – 2014
Flood Mitigation – 23 Stairwell Protection Devices Production Systems A37615 – J-Track/ GCCOM Construction for MTA NYCT. Under contract to J-Track and GCCOM to supply 23 Flex-Gate™ Stairwell Protection Devices (SPDs).	MTA NYCT 2 Broadway, New York, NY 10004	2015 – Ongoing
Flood Mitigation – Hugh L. Carey Tunnel (BBT) **Design Study, TBTA GFM468C Project under Contract No. PSC-06-2807C.** Part of the design team to address flood protection for BBT and the Queens Midtown Tunnel (QMT).	MTA Bridges and Tunnels 2 Broadway New York, NY 10004	2014 – Ongoing

Project Name and Brief Description	Reference Contact Information	Start/End Dates
IPERC		
SPIDERS Phase I. Demonstrated a cyber-secure microgrid architecture with integration of smart grid technologies, distributed and renewable generation on military installations for enhanced mission assurance.	U.S. NAVFAC Joint Base Pearl Harbor-Hickam, HI 96860	2011 – 2013
SPIDERS Phase II. Demonstrated a cyber-secure microgrid architecture with integration of smart grid technologies, distributed and renewable generation and energy storage on military installations for enhanced mission assurance.	U.S. NORTHCOM 6151 Specker Avenue Fort Carson, CO 80913	2013 – 2015
SPIDERS Phase III. Demonstrated a cyber-secure microgrid architecture with integration of smart grid technologies, distributed and renewable generation and energy storage on military installations for enhanced mission assurance.	NAVFAC Camp Smith, HI, 96861	2013 – 2015
JCMS		
Amtrak Stations Development Program (ASDP). Maintains/updates weekly the detailed cost loaded Program Master Schedule in Primavera P6 with survey, design, procurement, and construction and Amtrak force account activities.	Amtrak 30th Street Station, Philadelphia, PA 19104	2013 – 2014
Power & Track Project Control/Scheduling Services for LIRR Force Account Projects. Provided project control/CPM scheduling services to the Engineering Department at LIRR, responsible for all power and track projects.	Long Island Rail Road 93-02 Sutphin Boulevard, Jamaica, NY 11435	2009 – 2011
Jamaica Capacity Improvements - Phase 1. Develop detailed cost and resource loaded design schedule, and monthly update with activity progress, resource usage and actual cost.	Long Island Rail Road 5 Pennsylvania Plaza #6, New York, NY 10001	2012 – Ongoing
The Lower Hack Undergrade Bridge Rehabilitation. Structural steel repairs, replacement of walkways and ladders, machinery house/operator house rehabilitation, and inspection and machine work of the counterweight sheaves of Lower Hack Bridge.	NJ TRANSIT One Penn Plaza East, Newark, NJ 07105-2246	2009 – 2010
Bay Head Rail Yard Improvements. Installation of pedestal pit for servicing and maintenance of the trains in the yard, as well as construction of substation building and compressor building to support the operation of the pit.	NJ TRANSIT One Penn Plaza East, Newark, NJ 07105-2246	2011 – 2012
Portal Bridge Capacity Enhancement Project between Kearny and Secaucus. CM services for replacement of the century-old bridge to improve the reliability of AMTRAK and NJ Transit trains.	NJ TRANSIT/Amtrak sub to AECOM	2010 – Ongoing

Project Name and Brief Description	Reference Contact Information	Start/End Dates
Macan Deve		
NYCHA Castle Hill Boiler Replacement, Climate Control and Lighting Upgrade, NYPA City-wide On-call Energy Savings Program. Design of new boilers to reduce carbon emissions, in addition to the design of a climate control system and replacement of inefficient lighting.	New York City Housing Authority 90 Church Street, NY, NY 10007	2008 – 2010
NYPA City-wide On-call Energy Savings Program. Several energy efficiency projects, which required design and implementation of multiple energy conservation measures.	New York Power Authority 123 Main Street, White Plains, NY	2006 – 1010
NYCDOC Rikers Island 15 MW Cogeneration Facility. Construction of a $125M Combined Heat and Power Facility with two 7.5MW gas turbine generators.	New York Power Authority 123 Main Street, White Plains, NY	2014 – 2015
Navigant		
NERC/NPCC Standards Compliance Services. Presently assisting with NYPA's CIP Version 5 and CIP-014 Physical Security transition efforts.	New York Power Authority 123 Main St., White Plains, NY 10601	2007 – Ongoing
Reliability Standards Compliance. Assisting with TANC's CIP Version 5 and CIP-014 Physical Security transition efforts.	Transmission Agency of Northern California P.O. Box 15129, Sacramento, CA 95851-0129	2007 – Ongoing
Generation Asset Valuations and Dispatch Forecast. Provided Independent Consultant Market Assessments of 15 generation assets.	Topaz Power Management, LP 2901 Via Fortuna Dr., Bldg 6, Ste 650 Austin, TX 78746	2013 – 2014
Parsons Brinckerhoff		
Global Tungsten Powders 7.0 MW Cogeneration Plant. Design of Taurus 70 natural gas-fueled combustion turbine generator with heat recovery.	Global Tungsten Powders 1 Hawes Lane, Towanda, PA18848	2014
High Sierra Cogen. Design, procurement, and construction of a new 6.0 MW combined heat and power plant (CHP).	Plumas-Sierra Rural Electric Cooperative 73233 State Route 70, Portola, CA 96122-7069	2007 – 2009
Lahey Hospital 3.0 MW Cogeneration Plant. Design of MWM reciprocating natural gas-fueled engine generator system with heat recovery.	Lahey Hospital 41 Mall Road, Burlington MA 01805	2002 – 2015
NJ TRANSIT Morrisville Yard. Provided services throughout the life of this project from site alternatives analysis and selection into preliminary and final design and through completion of construction.	NJ TRANSIT One Penn Plaza, Newark, NJ 07105 Thomas Nodar	2007 – Ongoing
2012 Rail Ops & Infrastructure Ping On-call: NEC Initiatives. Developed track alignments, structural concept designs, electric traction power and overhead catenary impacts for multiple projects.	NJ TRANSIT One Penn Plaza E., Newark, NJ 07105	2013 – Ongoing

Project Name and Brief Description	Reference Contact Information	Start/End Dates
2012 Rail Ops & Infrastructure Ping On-call: Newark Light Rail – Track Circuits 244T/255T. Provided engineering and testing services for two track circuits near the Silver Lake train stations of Newark Light Rail.	NJ TRANSIT One Penn Plaza E., Newark, NJ 07105	2013
PMA Consultants		
PSE&G Project Controls Office. Assisting PSE&G in establishing a world class Project Controls Office (PCO) within the Delivery Projects & Controls (DP&C) department.	PSE&G 14000 Hadley Road, South Plainfield, NJ 07080	2008 – Ongoing
Lower Manhattan Construction Command Center (LMCCC) Value Planning Exercises, 3D/4D BIM Modeling, & Risk Management Program of the World Trade Center (WTC) Site. Responsible for several key areas of the LMCCC program.	LMCCC One Penn Plaza, New York, NY 10119	2005 – 2011
NJ TRANSIT Access to the Region's Core (ARC). Project controls for commuter rail project designed to increase NJ TRANSIT's passenger rail capacity between Secaucus Junction and Manhattan.	NJ TRANSIT One Penn Plaza East, Newark, NJ 07105	2010
Radin Consulting		
PATH Extension to EWR Rail Link Station Project. Program Management Consultant overseeing preparation of NEPA documentation.	Port Authority of New York & New Jersey 5 Pennsylvania Plaza # 6, New York, NY 10001	2015 – Ongoing
AMTRAK High-Speed Intercity Passenger Rail (HSIPR). Prepared a Categorical Exclusion document in compliance with NEPA for the Program.	Amtrak	2012 – Ongoing
Access to the Region's Core (ARC)/THE Tunnel Project. Performed environmental services for the development of a new commuter rail line from New Jersey to Manhattan.	NJ TRANSIT	2002 – 2010
Robinson Aerial Survey		
Portal Bridge Partners, NJ Transit Portal Bridge, FEIS Phase, Kearny and Secaucus, NJ. Responsible for the color aerial photography, ground control, aerial triangulation, supplemental field survey, ROW survey including IPM and GPPM preparation, wetland survey, detailed track surveys along with developing topographic mapping with contours.	Portal Bridge Partners sub to Gannett Fleming, Inc. One Riverfront Plaza 1037 Raymond Blvd. Suite 1420	2008 – 2010
NJ TRANSIT Mid-Line Loop Project Study, New Brunswick, NJ. As part of the Parsons Brinkerhoff team, provided new color digital aerial photography consisting of approximately 22 exposures at a scale of 1"=600'. Established the primary and photogrammetric ground control required.	NJ TRANSIT sub to Parsons Brinkerhoff 506 Carnegie Center Princeton, NJ 08540	2012 – 2013
The Trans Hudson Express (THE) Tunnel. RAS established primary and aerial ground control, supplemental field survey, ROW survey, obtained new color aerial photography, developed topographic mapping, color digital ortho photos and performed supplemental field edit for the EIS stage of this project.	NJ TRANSIT sub to Transit Link Consultants Christopher	2006 – 2010

KEY PERSONNEL REFERENCES

Project Name & Brief Description	Reference Contact Information	Start/End Dates
Ayokunle Kafi, PE – Project Manager		
Champlain Hudson Power Express. Project Manager for the development of a 1,000 MW 330 mile underground 320 KV HVDC power line connecting from the Canadian border to Astoria Substation in Queens, NY.	Transmission Developers Inc. 600 Broadway Albany, NY 12207	2012 – Ongoing
Dominion Power Idylwood Substation GIS Upgrade Project. Program Manager for OEM supplier to provide turnkey delivery services for Dominion Power Substation Upgrades.	HICO America Three Penn Center West, Suite 300 Pittsburgh, PA 15276 USA	2014 – Ongoing
Delaney – Colorado River 500kV Line Preliminary Development Proposal to CAISO. Project Manager for 30% preliminary design and cost proposal for a 114 Mile 500KV overhead transmission line development proposal to California Independent System Operator.	Duke American Transmission Company 550 South Tryon Street, Charlotte, NC 28202	2014 – 2015
Edward Hrinewski, PE – Deputy Project Manager		
Hudson Bergen Light Rail MOS 3 Extension. Design-build project, new interlocking in the operating system	NJ TRANSIT One Penn Plaza East, Newark, NJ 07105-2246	2008 – 2011
Hudson Bergen Light Rail Program. DBOM program for major light rail system.	NJ TRANSIT One Penn Plaza East, Newark, NJ 07105-2246	1996 – 2006
Atlanta Streetcar. Design-build of 2.4 mile streetcar system in downtown Atlanta	MARTA	2012 – Ongoing
Donna Hager, PE – Coordination Management		
NYCHA Castle Hill Boiler Replacement, Climate Control and Lighting Upgrade, NYPA City-wide On-call Energy Savings Program. Program Manager and Project Manager for the design of new boilers to reduce carbon emissions, in addition to the design of a climate control system and replacement of inefficient lighting throughout a campus-style housing development and community center.	New York City Housing Authority 90 Church Street, NY, NY 10007	2008 – 2010
NYPA City-wide On-call Energy Savings Program. Program Manager and Project Manager responsible for several energy efficiency projects, which required design and implementation of multiple energy conservation measures.	New York Power Authority 123 Main Street, White Plains, NY	2006 – 1010
NYCDOC Rikers Island 15 MW Cogeneration Facility. Client Executive and Project Director during construction of a $125M Combined Heat and Power Facility with two 7.5MW gas turbine generators.	New York Power Authority 123 Main Street, White Plains, NY	2014 – 2015

Project Name & Brief Description	Reference Contact Information	Start/End Dates
Andrew Agopian – Photovoltaic Technology & Energy Storage		
California State University, Fullerton 1.16MW Rooftop/Canopy PV System. Performed the design-build implementation of an energy efficiency and infrastructure upgrade, including design and installation of a 1.16 Megawatt PV system.	California State University, Fullerton 800 North State College Blvd. Fullerton, CA92831	2009 – 2010
LADWP Pine Tree Solar Solar PV Project. Design Manager for a 9.75 MW photovoltaic project installed at LADWP's Pine Tree wind farm — one of the largest PV projects in the United States.	Los Angeles Department of Water and Power 1630 N. Main St., Bldg. 15, LA, CA 90012	2010 – 2013
Ventura County Waterworks District No. 1, Moorpark Water Reclamation Facility 958kW AC Photovoltaic System. Project Engineer on behalf of County for a 1.14 MW photovoltaic tracking system installed at the WRF.	County of Ventura, Public Works Agency 6767 Spring Road, Moorpark, CA 93020	2007 – 2009
James Buchok – CHP, EV & Demand Side Energy Management		
Riker's Island Combined Heat & Power Project. Senior Manager for 15 mW cogeneration project. Construction began in March of 2012, plant is up and running and providing beneficial use. Close out in process.	New York power Authority 123 Main St., White Plains, NY 10601	2014 – Ongoing
Lahey Clinic: 3.0 mW Combined Heat & Power Project. Senior Manager for Construction began in August of 2013 and completed October of 2014	Bond Brothers 145 Spring St., Everett, MA 02149	2013 – 2014
University of New Hampshire, Durham, NH. Senior Manager for 4. 5 MW Gas turbine co-generation project designed to operate on landfill gas. Project won a national DEP award.	University of New Hampshire Ritzman Lab, 22 Colovos Rd., Durham, NH 03824-3515	2009 – 2011
Bob Zogg – Fuel Cell Technology		
Roadmap for Building Energy Modeling. Developing a roadmap that characterizes the current status of building energy modeling and outlines recommended actions to significantly expand the use of building energy modeling in the design and operation of residential and commercial buildings in the U.S.	Arizona State University, School for Engineering of Matter, Transport, & Energy 501 E. Tyler Mall, Tempe, AZ 85287-6106	2015 – Ongoing
Assessment of DEVap for Light-Commercial and Residential Applications. Conducted an independent review of a novel HVAC technology to validate developer claims, confirm projected energy-cost savings and economics, assess its market potential, and recommend additional development efforts.	U.S. Department of Energy 1000 Independence Ave., SW, Washington, DC 20585	2012 – 2013
Small-Scale CHP Market and Technology Development. Produced a detailed report outlining the technology, market, and policy/regulatory status of small-scale combined heat and power systems (CHP), including fuel-cell technologies. Also provided recommendations to assist the U.S. Department of Energy in developing a program to advance small-scale CHP.	U.S. Department of Energy 1000 Independence Ave., SW, Washington, DC 20585 Washington, DC 20585	2012 – 2013

Project Name & Brief Description	Reference Contact Information	Start/End Dates
Darrell Massie – Cybersecurity		
SPIDERS Phase I. Design, develop, implement and commission microgrid control system for microgrid at Joint Base Pearl Harbor Hickam.	U.S. Army Corps of Engineers	2011 – 2013
SPIDERS Phase II. Design, develop, implement, and commission control system for microgrid at Fort Carson, CO.	U.S. NORTHCOM	2012 – 2013
SPIDERS Phase III. Design, develop, implement and commission complex control system for microgrid at Camp Smith, HI. Designed and implemented network communications for microgrid.	U.S. Army Corps of Engineers, CERL	2013 – 2015
Joel Sonkin, Esq. – Compliance/Regulators/Reviewers		
Municipal Buildings ESCO project. Conceptualized and managed a $40 million energy retrofit and building management system installation for Newark's 17 most energy intensive buildings.	City of Newark	2012 – 2014
Local Energy Assurance Plan. Managed the development and implementation of the first local Energy Assurance Plan in the State of New Jersey.	City of Newark	2011 – 2013
Partnership for Sustainable Communities. Served as EPA regional representative for an interagency partnership between EPA, HUD and DOT that focused on coordinating federal housing, transportation, water and other infrastructure investments.	United States Environmental Protection Agency	2010 – 2011
Amr Elmeged – Project Controls		
NYCT Second Avenue Subway. Project Control Manager responsible for developing and maintain the design Schedule. Developed the base line construction schedule for multiple Construction Packages. Developed cash flow projections and contingencies to comply with FTA requirements. Produced monthly and quarterly reports.	MTA Capital Construction 2 Broadway, NY, NY 10004	2001 – 2006
NYCT Second Avenue Subway. Project Control Manager responsible for developing and maintain the design Schedule.	MTA Capital Construction 2 Broadway, NY, NY 10004	2001 – 2006
Champlain Hudson Power Express. Project controls for the development of a 1,000 MW 330 mile underground 320 KV HVDC power line connecting from the Canadian border to Astoria Substation in Queens, NY.	Transmission Developers Inc. 600 Broadway Albany, NY 12207	2013

Project Name & Brief Description	Reference Contact Information	Start/End Dates
Eduardo Gamez, PhD – Risk Management		
New York State Thruway Authority, (New New York Bridge. Risk assessment for project to replace Tappan Zee Bridge in the state of New York.	New York State Thruway Authority	2012 – Ongoing
Georgia DOT, Transportation Investment Act (TIA) Program Management. Risk assessments, risk advisory for Program management with a portfolio of 851 projects.	Georgia DOT	2013 – Ongoing
Lions Gate Secondary Watewater Treatment Plant. Risk advisory, risk allocation and risk assessment services for design-build-finance project providing.	Metro Vancouver	2014 – Ongoing
Philip Castellano – Technology Integration		
NYCHA Castle Hill Boiler Replacement, Climate Control and Lighting Upgrade, NYPA City-wide On-call Energy Savings Program. Technical Manager for the design of new boilers to reduce carbon emissions, in addition to the design of a climate control system and replacement of inefficient lighting throughout a campus-style housing development and community center.	New York City Housing Authority 90 Church Street, NY, NY 10007	2008 – 2010
NYPA City-wide On-call Energy Savings Program. Technical Manager responsible for several energy efficiency projects, which required design and implementation of multiple energy conservation measures.	New York Power Authority 123 Main Street, White Plains, NY	2006 – 1010
NYCDOC Rikers Island 15 MW Cogeneration Facility. Technical Advisor during design of a $125M Combined Heat and Power Facility with two 7.5MW gas turbine generators.	New York Power Authority 123 Main Street, White Plains, NY	2014 – 2015
Tim McClive – Analysis of Ancillary Services and Market Revenue Opportunities		
Indian Point Contingency Plan RFP. Managed the procurement process under which proposals were sought for new generation facilities to replace the Indian Point Nuclear Power Plants. I drafted key documents for the procurement including the RFP and the preferred Power Purchase Agreement.	New York Power Authority 123 Main Street, White Plains, NY 10601	2012 – 2013
Long Island Power Authority 2,500 MW Generation RFP. Evaluated proposed generating projects proposed in response to the RFP and made recommendations for selection. I participated in the negotiations of a Power Purchase Agreement with the winning bidder, Caithness Long Island Energy II.	PSEG Long Island 333 Earle Ovington Blvd., Uniondale, NY 1153	2011 – 2013
Hawaii PUC Proceeding – Oahu-Maui Interisland Transmission System. Reviewed economic and reliability benefits expected to be achieved with installation of a new HVDC cable project between Oahu and Maui. Prepared comments on the project on behalf of Hawaii State Energy Office for submission to PUC.	Hawaii State Energy Office 235 S. Beretania Street, 5th Floor Honolulu, HI 96804	2013 – Ongoing

Project Name & Brief Description	Reference Contact Information	Start/End Dates
Elizabeth Carter – System Safety, Security and Resiliency		
Port Authority Security Services. Conducted a review of the PANYNJ's public safety and security procedures.	Port Authority of NY of NJ 225 Park Avenue South, New York, NY 10003	2011 – 2013
Bloomberg LP Security Services. Provided security advisory services and risk analysis with respect to the potential vulnerabilities on and in the vicinity of the client's building complexes.	Bloomberg LP 731 Lexington Avenue, New York, NY 10022	2012 – 2013
MetLife Security Services. Provided strategic risk management advisory services as well as tactical security design criteria for new facilities under construction in the US southeast region.	MetLife 1095 Avenue of the Americas, NY, NY 10036	2013 – 2014
Nick Tomizawa, Esq., AICP, CEM – Concept of Operations		
NJ TRANSIT Hurricane Response Strategy Development – Rail Operations, Light Rail, Bus and Paratransit. Project Manager to develop a Hurricane Response Strategy (HRS) for the different operational modes of NJ TRANSIT.	NJ TRANSIT One Penn Plaza East, Newark, NJ 07105	2013 – 2015
FEMA New England Cyber Disruption Plan. Plan Manager for the FEMA New England Cyber Disruption Coordination Plan, a nationally first-of-its-kind project to develop a framework to guide multi-jurisdictional incident management of massive cyber disruptions.	Boston Office of Emergency Management One City Hall Square, Rm. 204, Boston MA, 02201	2010 – 2012
Foothill Consortium Risk Assessment and Security/ Emergency Management Plan Development Services. Project Manager to deliver security consulting services to a partnership of Foothill Transit, Long Beach Transit, the City of Los Angeles Department of Transportation (LADOT), and the Santa Monica Big Blue Bus.	LADOT - Project Manager 100 S. Main Street, 10th Floor MS 725-42	2010 – 2011
Adam Zellner – Public Involvement/Stakeholder Coordination		
Hoboken Microgrid Project. Strategic planning advisor assisting with post Sandy recovery and planning; member of Rocky Mountain Institute e-Lab Accelerator team for innovating at the electricity system's distribution edge	City of Hoboken Hoboken City Hall 94 Washington Street, Hoboken NJ	2013 – Ongoing
Maher Terminal. Project Manager and Governmental Consultant for energy use and environmental impact analysis at this intermodal facility.	Maher Terminals Building 1210, Corbin Street Elizabeth, NJ 07201	2010 – Ongoing
Woodbridge Township. Supporting Woodbridge in sustainable energy planning and implementation	Woodbridge Township Redevelopment Agency One Main Street, Woodbridge, NJ	2009 – Ongoing

Project Name & Brief Description	Reference Contact Information	Start/End Dates
Ruby Siegel – FTA Funding Review and Compliance		
Northeast Corridor (NEC) Passenger Rail Corridor Investment Plan (PRCIP). DPM fpr a Tier 1 EIS under NEPA and Section 106 and a Service Development Plan (SDP) to further detail and analyze a Selected Alternative.	Federal Railroad Administration One Bowling Green, Suite 429, NY, NY 10004	2012 – Ongoing
Access to the Region's Core. FTA NEPA process through Record of Decision for the complex, bi-state project to construct a new tunnel under the Hudson River and a new station in midtown Manhattan.	NJ TRANSIT One Penn Plaza East, Newark, NJ 07105	2003 – 2009
West-of-Hudson Regional Transportation Study. FTA funded study to evaluate alternatives for improving transit services between Central Orange County and Manhattan and access to Steward International Airport from the surrounding regions, Lower Hudson Valley and New York City.	Metro-North Railroad 420 Lexington Avenue, New York, NY	2011 – Ongoing
Robert Fisher, PE – System Integration		
Electric Traction Power Grid Analysis. Project manager on the project to develop and perform traction power load flow studies for the Newark and Hoboken Electric Traction Power systems on NJ TRANSIT's electrified commuter rail network.	NJ TRANSIT One Penn Plaza East, Newark NJ 07105	2012 – 2013
Trans-Hudson Express (THE) Tunnel Project. Manager of railroad systems engineering on the $8.7 billion project to construct new electrified commuter rail tunnels between Amtrak's Northeast Corridor in New Jersey and a new station in Manhattan.	NJ TRANSIT One Penn Plaza East, Newark NJ 07105	2006 – 2010
New Jersey High Speed Rail Improvements Project. Systems integration manager on the project to increase speeds up to 160 mph on the section of the Northeast Corridor between Trenton and New Brunswick.	Amtrak 44 South Clinton Ave., Trenton, NJ 08609	2012 – Ongoing

05 Technical Approach

The NJ TRANSITGRID project is more than providing sustainable power . . . it is about creating a safer, more secure, more resilient and more sustainable transit infrastructure for the New Jersey/New York region.

UNDERSTANDING OF OBJECTIVES AND PURPOSE

The TRANSITGRID will be a first-of-its-kind microgrid system providing for a sustainable level of transit service for contingent events or immediately following major events that negatively impact the supply of electric power to transit infrastructure operated by NJ TRANSIT and the National Railroad Passenger Corporation (Amtrak). Because this project is partially funded by the Federal Transit Administration (FTA), it must follow the federal NEPA process. NJ TRANSIT has engaged a team led by BEM Corporation to develop the NEPA documents and prepare permitting documents.

The service goal is to transport as many people as possible to greater Newark, the New Jersey Hudson River waterfront in Hudson County, or the Manhattan Central Business District (south of 59th Street) using an array of bus, commuter rail, light rail, rail rapid transit, and ferry services. Although some services will operate in a limited manner because of available electrical power, and others will remain fully operational, all will benefit from the implementation of the NJ TRANSITGRID.



A limited portion of the NJ TRANSIT commuter rail system in northern New Jersey will receive electrical power from the NJ TRANSITGRID to sustain a core system operation. NJ TRANSIT's intrastate bus services will operate from intermodal nodes along rail rights of way.

NJ TRANSIT, the Northeast Corridor, and other public transit systems remain vulnerable to prolonged impacts that could limit the ability to power locomotives, stations, and critical facilities. Events such as Hurricane Irene, Hurricane Floyd, and the 2003 Northeast blackout demonstrate that a reliable source of electric power is critical to safety and security in the region. System-wide resiliency remains beyond NJ TRANSIT's control. However, new and innovative solutions need to be developed and implemented to reduce transit agencies' energy vulnerabilities, and the busy Northeast Corridor is a good place to start.



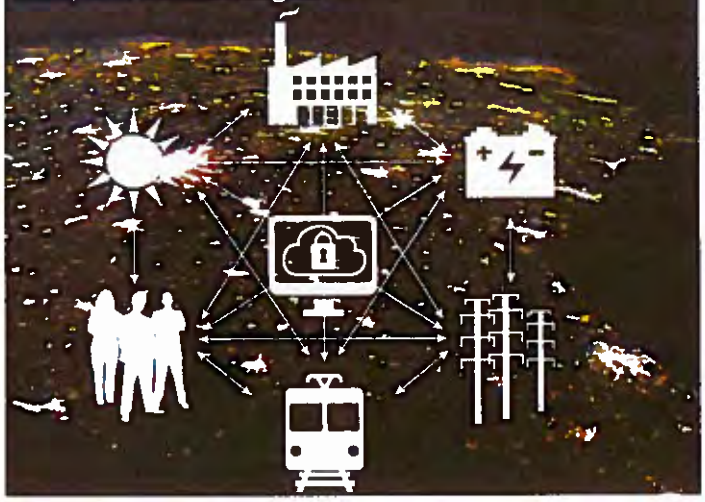
During the past several years, NJ TRANSIT has made great progress in restoring service, planning for early storm warning systems, long-term repair and replacement of key NJ TRANSIT assets, and identifying opportunities to incorporate mitigation and resiliency elements. The NJ TRANSITGRID Project promises to continue and increase the momentum of securing,

hardening, sustaining, and supporting the service goal for New Jersey and the region.

It is unlikely that the major utility grid in the region will implement sectionalization, backing up, or other solutions to identify the location of system faults and to provide rapid repairs or backups for the grid. Therefore, NJ TRANSIT and its customers will have to rely on TRANSITGRID and other local solutions.

The code requirements of 1900's diesel emergency generation technology will not work in times of extreme flooding or fuel scarcity. Centralized generation and distribution of power in these days of rapid technological development of hacking and malware technologies and HAEMP (high altitude electromagnetic pulse) by nation states or "lone wolves" may make it impossible for utilities with a large-scale grid to harden sufficiently or recover from serious cyber or physical attacks. As a result, the NJ TRANSITGRID and similar independent solutions will be the only viable way to protect the millions who rely on these rail transit systems for mobility in times of widespread outages.

Throughout this section we highlight solutions and innovations that will result in added value for NJ TRANSIT and the key players in terms of assessment, engineering, communication, coordination, safety, and project completion on time, and within budget.



PROGRAM MANAGEMENT APPROACH

AECOM recognizes that the NJ TRANSIT system is a lifeline for our communities as well as a source of economic vitality for the entire region. Our awareness of its importance has driven the formation of our team and the development of our systematic, proven approach to the conceptual design for the distributed generation (DG) needs of the TRANSITGRID.

We considered a number of elements that are essential in meeting the challenges and delivering a system with the greatest reliability. These elements and our team members directly responsible for them include:

+ Energy management for a Metro region (AECOM, PB)
+ A cybersecurity plan to protect the assets once they are in place (IPERC, Chertoff Group)
+ Detailed knowledge of rail systems and the energy systems required to integrate the grid into existing transit system operations (AECOM)
+ The involvement of governmental entities and regulators that will be instrumental in securing funding and support to get the grid built (RCI, AECOM)
+ Recent, relevant microgrid development experience, which will mitigate risk and help assure outstanding performance (Navigant)
+ Work with the involved stakeholders and third parties, including PSE&G and Hudson County, to secure their support and commitment (AECOM, Greener by Design)
+ Formulation of a reliable, flexible network that will provide confidence that the recommended solutions will work (AECOM, Navigant)

These are essential ingredients for success that we considered when we formed our leadership and production team—a group of professionals who share an absolute commitment to meeting the 10-month schedule and to delivering the 20 percent conceptual design on time and to the highest standards of quality and safety.

Our complete team organization chart appears in Section 6 of this proposal.

Ayokunle (Kunle) Kafi, PE, our project manager, and **Edward Hrinewski, PE**, our deputy project manager, were chosen to lead our team because they understand the energy options as well as how the railroad operates. Both bring extensive local experience and keen sensitivity to the needs of NJ TRANSIT, your stakeholders, and the community.

As illustrated in our leadership organization chart, our team is focused on two major areas: 1) developing and delivering the project, and 2) working with NJ TRANSIT, the public and key stakeholders to achieve the best solutions and to build support and consensus for the project.

DELIVERY

The AECOM delivery team is an integrated, co-located team that will work with NJ TRANSIT's team collaboratively and transparently to develop the most viable and beneficial solutions for each site and an integrated solution for the overall project.

Kunle Kafi will work with NJ TRANSIT's management, operations and maintenance, stakeholders and third-parties such as PSE&G, FTA and county agencies, to enable the production team under the Ed Hrinewski to evaluate sustainable energy options and drive the 20 percent conceptual design to timely completion.

Reporting to this management team are highly qualified key personnel forming a discipline leadership team that reports to the management team and will perform key activities to meet the project's ambitious, ten-month schedule. These discipline leaders will work with the PM and DPM to support the production team as they deliver the 20 conceptual design.

Key performance areas for our team include:

- **Risk Management**, with the purpose addressing the challenges, formulate mitigation plans, and foster a culture of "no surprises"
- **An independent Peer Review Team** comprised of outside consultants, who understand the requirements for modifying an operating railroad. The team will assess whether the design is buildable through constructability reviews that will starts on day one. They will also focus on how it will be implement the project effectively and with minimal impact on the community.
- **Stakeholder Interface** to keep the public, utilities and federal entities aware of the program.
- **Interface with the environmental impact statement (EIS) team** to provide the input to allow them to deliver the EIS for the program
- **An Integration Team** that will work with the Phase 1 team to ensure a seamless execution with their goals and objectives
- **A Systems Integration Leader** who knows NJ TRANSIT and which measures are critical to interject the new power options without disruption to the assets -A technology integration leader to allow the various technologies chosen to seamlessly interact with each other
- **A "Fast-Start Team"** that will develop the procedures, guidelines, reporting mechanisms and controls to allow the production team to focus on developing energy options for the key assets

CONCEPT OF OPERATIONS

The AECOM team's approach includes a reliable Concept of Operations Plan as one of the first priorities. When this plan is in place it will drive the technologies employed at the various assets. A parallel activity is the early analysis of the service, market revenue opportunities, and sustainable energy options that deliver the best value to NJ TRANSIT, your stakeholders and customers.

We understand that we are not developing a final design but rather a 20 percent conceptual design of what the grid will look like and how it can be implemented. To achieve this we are aware of the importance of coordinating what we propose with NJ TRANSIT and your key stakeholders. Our mission is to develop reliable, best-value solutions that provide confidence to NJ TRANSIT, the federal government, the involved utilities and the public, that in the event of any disruption to power for whatever reason, the TRANSITGRID will be a lifeline, keeping the transit system operational and the public safe.

APPROACH TO DELIVERING ENGINEERING SOLUTIONS

To initiate the Engineering Task process, AECOM will conduct a kick-off meeting attended by AECOM's project leadership team and representatives from NJ TRANSIT. At this meeting the team meeting will confirm the required activities, timeline, roles and responsibilities, communications protocols, and Fast-Start (mobilization) activities. The meeting will also address the updated schedule for the delivery of key engineering tasks and will be a forum for NJ TRANSIT review and approve or request revisions to the schedule.

Organizin and Managing the Work. At the kick-off meeting and throughout the engineering delivery process, our goal is to obtain NJ TRANSIT's and key stakeholders' approvals for each of the elements of the work. As we perform the Engineering Task, our production team, under the leadership of key disciple managers shown in our project organization chart, will work together and keep NJ TRANSIT informed throughout the process, primarily at progress meetings and through the communication process. Under the direction of AECOM's project manager and deputy project manager, the AECOM production team will carefully analyze, validate and report on the most appropriate engineering solutions for NJ TRANSIT's review and approval.

Project Management Plan. In delivering the engineering services task, the AECOM team will conduct all of its activities in conformance with a formal Project Management Plan (PMP), which subsumes the approved schedule, quality management plan (QMP) and Communication Management Plan (CMP). These plans will be provided to NJ TRANSIT during the mobilization period for review.

The critical elements of our engineering delivering process will focus on meeting the prescribed schedule required to meet NJ TRANSIT's milestones and overall program schedule. The AECOM engineering team will leverage its expertise and experience to ensure that the individual and aggregate Distributed Generation technology recommended for each of the facilities included in the portfolio represents an the optimal solution and will deliver a constructible, stable, safe, resilient, secure and reliable operation when installed.

COORDINATION OF THE OVERALL CONTRACT EFFORT

There is no time to waste in the project. AECOM will meet the ambitious schedule for the engineering task and all of the other tasks by mobilizing immediately with the support of a ***FastStart*** team.



The use of a FastStart team approach has proven effective on some of the most complex, multiple-discipline infrastructure programs in the world, among which are NJ TRANSIT's Hudson Bergen Rail Transit project (above), NYC's Second Avenue Subway, London Crossrail, and Jeddah Metro's complete new transit system, which include sustainable energy and resiliency components.

The AECOM engineering team will be managed from a project office in which the management team and key discipline leaders work together to develop solutions, track all development activities, and focus on integration of the design elements and on providing complete, accurate and error-free deliverables and recommendations to NJ TRANSIT. Representatives of NJ TRANSIT will always be welcome in our project office, and we will operate in an atmosphere of collaboration and transparency.

We will also work in close collaboration with our locally-based, NJ TRANSIT-experienced subconsulting team. Our subconsultants are an accomplished, specialized and professional firms that have successfully worked with AECOM on previous assignments and has been actively involved in our brainstorming and proposal development for this NJ TRANSITGRID proposal.

Detailed Energy Survey. As first step in the optimization of the Distributed Generation assets for the NJ TRANSIT portfolio, our energy engineers will perform a detailed energy survey of each of the sites for the purposes of identifying energy reduction measures that can be initially accomplished prior to the deployment of any potential distributed generation solution. With this measures implemented, the most appropriately sized DG solution can them be recommended using a conservative energy baseline for each facility.

Verification of Concept Design Criteria. Following the identification of the energy conservation measures, we will recommend the appropriate DG technology commencing with our detailed analysis of each technology required for the TRANSITGRID, i.e., solar PV, CHP and fuel cells that will provide the required system reliability, resiliency and back-up power. This analysis of the technology application process will culminate in the delivery of the Verification of Concept Design Criteria Documents as well as the Concept of operations Plan for the each of the facilities within the portfolio.

Progressive Submittal Process. Understanding the time sensitivity of the this procurement, the AECOM team may propose a progressive submittal process for the development of concepts that will enable timely approval by NJ TRANSIT and its stakeholders. This activity will then be able to balance the overall work flow for the entire team. Concurrent with the development of the appropriate concepts, the AECOM engineering team will work with its project management and procurement teams to identify the recommendation for overall procurement strategy for the program. Following the submittal of the conceptual design criteria, it the AECOM team will work closely with NJ TRANSIT to ensure that all the necessary buy in and approvals are obtained prior to proceeding with the completion of the 10% design plans and specifications.

Technology Reports. Concurrent with the delivery of the design concept, the AECOM engineering team will also complete all required technology reports identified as part of the required deliverables such as the PV, Fuel Cell AND CHP Evaluation and Recommendation Reports. Moreover, pursuant to ensuring the viability of installation of the proposed systems and also to better qualify the financial impact of the proposed installations, our extended engineering team will conduct the required civil, structural, geotechnical and utility engineering surveys around the vicinity of the proposed scope of work. Systems integration will be a key consideration during the process to ensure a seamless integration of the proposed recommended back up power source. Input received from these additional technical exploration processes will be used to progress the design to the 20 percent level.

As required by the RFP upon completion of all the engineering tasks, the AECOM team will present complete 20 percent engineering package with the appropriate plans and specifications.

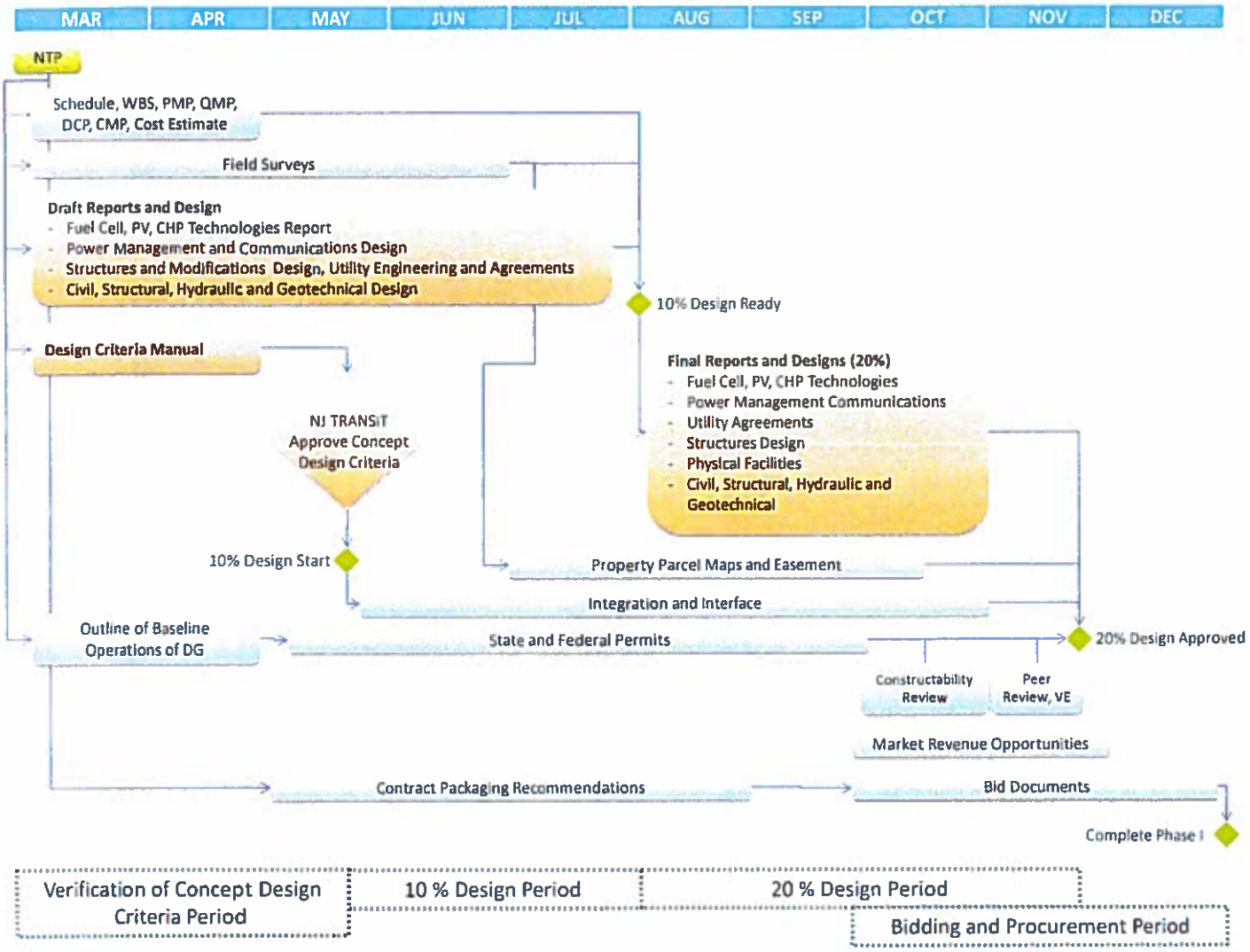
Engineering Process Flow Diagram. The AECOM team will use a proven a workflow to deliver the project on time, integrate its elements, mitigate risks, and add significant for NJ TRANSIT both in the short term and long term. The diagram on the following page provides an overview of our engineering process flow for this NJ TRANSITGRID project.

The pages that follow provide our detailed work plan of approach to all the tasks in your scope of work:

TASK	Page
PHASE I - PROJECT MANAGEMENT AND ENGINEERING	
Task 1 Project Management and Administration	71
Task 2 Engineering	87
Task 3 Cost Estimating	147
Task 4 Federal Environmental Categorical Exclusion (CE)	149
Task 5 State and Federal Permits	150
Task 6 NJDEP Site Remediation Compliance	151
Task 7 Risk Management	151
Task 8 System Safety and Security Management	156
Task 9 Public Involvement and Agency Coordination	164
Task 10 Integration and Interface	165
Task 11 Constructability Reviews	166
Task 12 Contract Packaging	167
Task 13 Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	169
Task 14 Analysis of Ancillary Services Market Revenue Opportunities	172
PHASE II CONSTRUCTION ASSISTANCE/ENGINEERING SUPPORT.	177
Task 1 Shop Drawing Review	177
Task 2 Technical Meetings and Workshops	178
Task 3 CPM Schedule Review	178
Task 4 Participation in Construction Progress Meetings	178
Task 5 Risk Management	179
Task 6 Systems Coordination and Testing	179
Task 7 Support NJ TRANSIT in Dispute Resolutions	180
Task 8 Change Order Analysis Support	180
Task 9 NJ TRANSIT-DG Start-Up Support	181
Task 10 Project Closeout Support	181
Task 11 Alternate Designs	181

NJ TRANSITGRID-DG PROJECT - PHASE I HIGH LEVEL SCHEDULE FLOW

The AECOM team is organized to meet key deliverable dates and to coordinate and integrate the overall work effort.



WORK PLAN
PHASE I - PROJECT MANAGEMENT AND ENGINEERING

Our team approaches every project with a proven method that allows us to provide consistent success at every stage of project delivery.

This section describes the AECOM team's proposed approach to completing work under this contract. Our strategy focuses on well-defined project implementation steps that enable checks and balances and promote collaboration and quality.

TASK 1
PROJECT MANAGEMENT AND ADMINISTRATION

As part of our primary management responsibilities, AECOM brings program management excellence and in expert management of schedule, cost, and quality. Our goal is to deliver effective control of the schedule, cost and quality on behalf of NJ TRANSIT. The FTA relies on risk-analyzed and P90 performance (90% probability of meeting key milestones as a basis of payment). AECOM's years of experience working with and for FTA are a good indication that we will manage schedule risks and control the project in accordance with FTA's expectations. AECOM will:

- Deploy its experienced team and proven tools to collaborate and share information with NJ TRANSIT on a timely basis with respect to the progress, status of project tasks, deliverables, schedules, and all elements of the project's associated budgets.
- Use Primavera Unifier project controls from inception through operations — a system designed to work with Primavera P6 to integrate BIM processes with schedule, automating procurements, milestone status, cost, mapping document management, and issues, which are outlined in real time, better assuring project success.
- Implement a risk management process that mitigates risk factors seamlessly from the planning phase through construction.
- Proactively support and coordinate all activities closely with the designated NJ TRANSIT project manager.

We will diligently work to anticipate issues or occurrences to eliminate or mitigate potential adverse consequences to the project scope, schedule, and budget.

Key to the successful implementation of our proven program management approach is to maintain an organized, efficient, and continuous communication and interface program with the NJ TRANSIT project manager, and other key stakeholders as necessary, to deliver the successful implementation of the project. AECOM's use of Primavera Unifer system facilitates that communication.

AECOM's experienced, multidisciplinary management team will lead the project and meet all contract requirements. The following subsections explain our management and demonstrate our compliance with FTA regulations for major capital projects, 49 CFR Part 633 – Project Management Oversight and associated guidance.

1.1 FASTSTART TEAM

AECOM believes that a program started efficiently will succeed. Our Corporate Global Program Management Group assigns a FASTSTART implementation team upon receipt of Contract Commencement Date. That team will mobilize quickly and establish the program's governing procedures, systems and tools.



The FASTSTART team is comprised of senior AECOM global program management practitioners, who have developed our work plan in conjunction with our project management team. We combine our professional resources with a proven set of web-based management tools that enable effective internal communications and knowledge share, establishing an intelligent management platform that supports our commitment to provide NJ TRANSIT with the certainty of delivery it expects from a world-class team.



The FASTSTART team will be led by a senior member of AECOM's PM/CM team responsible for tailoring the global AECOM standards, systems and tools to the NJ TRANSITGRID project. AECOM's corporate standards, systems and tools have been developed to support the rapid and effective development and issuance of the project plans, policies, procedures and forms. Our leadership team and FASTSTART team will customize each source document to meet NJ TRANSIT's requirements.

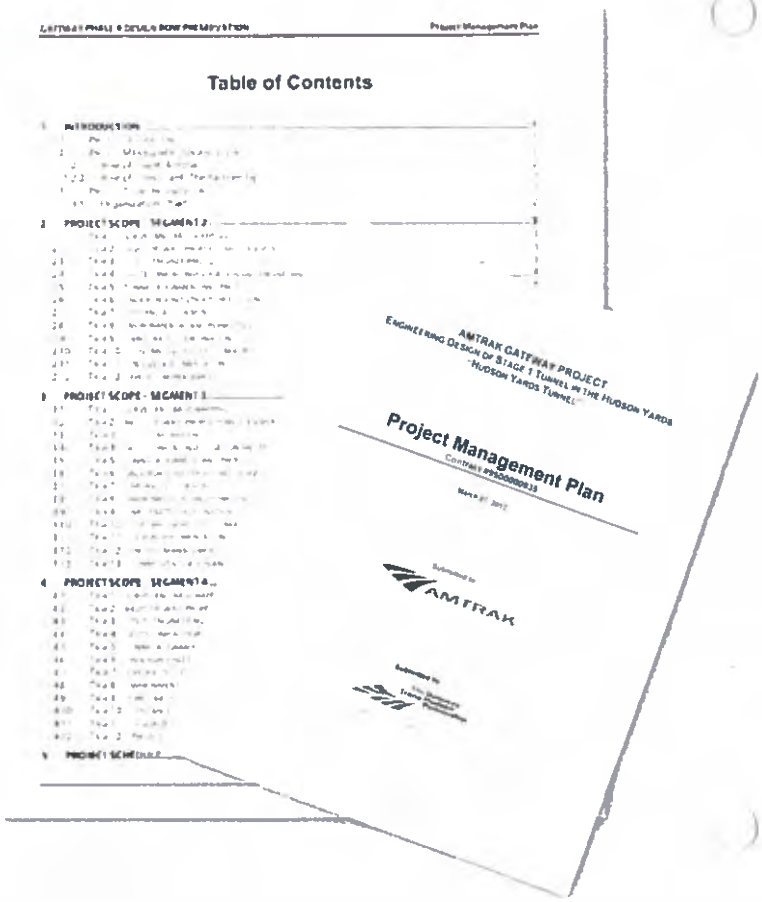
Following the completion of the FASTSTART Team's duties, AECOM's global program management director, Adrian Shaw, will monitor performance through the AECOM's program management tool called ***Health Check***.

1.2 PROJECT MANAGEMENT PLAN

The Project Management Plan (PMP) is the overarching governing document that outlines the scope, schedule, and budget of the project as well as the project management team and the processes it uses to execute the project. The PMP is an evolving document used by NJ TRANSIT and the AECOM team to establish and disseminate project parameters, policies, and practices that govern all project activities outlined by the FTA.

The PMP will identify the procedures and practices to be observed and executed by NJ TRANSIT, AECOM team management and staff, contractors, and all other parties as applicable. This allows performance to be (qualitatively and quantitatively) measurable through sound design, engineering, construction, operations, and other industry practices that are readily identifiable, credible, and consistently applied.

The AECOM team will prepare and implement the PMP at the beginning of the project, define roles and responsibilities of all parties involved. The PMP will outline formal lines of communication, budgets, schedules, quality control and invoicing procedures. It will comply with FTA regulatory mandates and guidance, including 49 CFR Part 633 – Project Management Oversight, FTA Circulars 5800.1 and 5010.1D, FTA Project and Construction Management Guidelines, and the FTA Safety and Security Certification Handbook.



The PMP will contain sufficient detail to enable monitoring of the project's planning, engineering, and third party coordination. The AECOM team will comply with the requirements for programmatic submittals developed by NJ TRANSIT for the Superstorm Sandy Recovery and Resilience Program.

In accordance with FTA regulations, the PMP will address:

- Project organization, reporting relationships, functional relationships, job descriptions, and job qualifications
- A budget covering the project management organization, consultants, property acquisition, utility relocation, systems demonstration staff, audits, and other payments
- A project schedule; FTA relies on a risk-analyzed and P90 (90% probability of meeting key milestones as a basis of payment). Our team has experience with this technique and will provide NJ TRANSIT with a similar risk managed schedule to demonstrate to the FTA that the project is on track.
- A document control procedure and record-keeping system
- A change order procedure that includes a systematic approach to construction change orders
- A description of organizational structures, managerial/technical skills, and staffing levels required during the construction phase
- A proven configuration management plan and approach
- Quality control and quality assurance programs that define functions, procedures, and responsibilities for construction and constructability, and for system installation and integration of system components
- Materials testing policies and procedures
- An internal plan implementation and reporting requirements
- Criteria and procedures to be used for testing the operational system or its major components
- Periodic updates of the plan, especially related to project budget and schedule, financing, ridership estimates, and the status of local efforts to enhance ridership where ridership estimates partly depend on the success of those efforts
- Safety and security management (with a keen focus on cyber-security); this section is described Task 8, Safety and Security Management Plan.

Deliverables

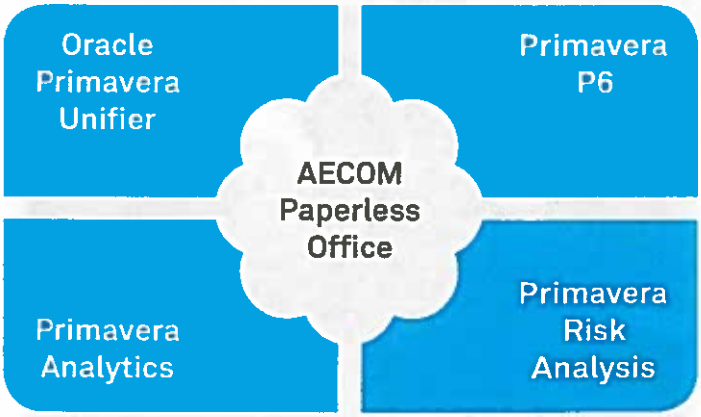
- Draft PMP – Four weeks from NTP
- Interim PMP – Two weeks after receiving comments from NJ TRANSIT
- Final Draft PMP – Two weeks after receipt of comments from FTA
- Updates to the PMP – made annually, as changes dictates, or as directed by NJ TRANSIT

1.3 PROJECT CONTROLS

The AECOM team has extensive project controls experience in managing complex programs from concept through completion in a wide array of markets, providing services ranging from planning, scheduling, and cost control to design, construction, and commissioning.

Our focus is on representing the interests of NJ TRANSIT and skillfully driving the Project to success. The AECOM team has experts who have delivered similar projects on time and within budget using the latest project controls technology.

To accomplish the continuous, timely collaboration and management of the project, the AECOM team will use the best project management tools available to establish a paperless office. These tools can be used from conceptual design to commissioning, and even during operations and facility management.



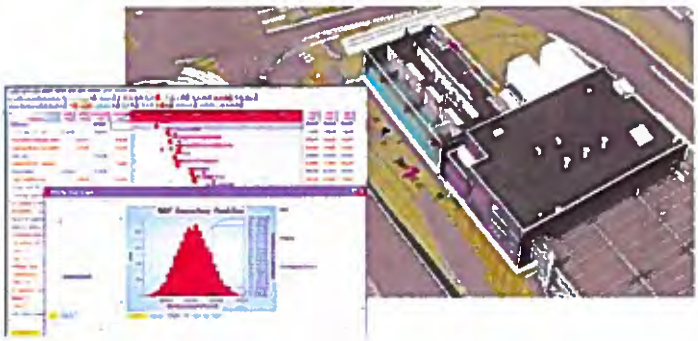
Oracle Primavera Unifier will be the cloud-based records management control system for superior visibility and control in managing all documents and submittals electronically, including cost management, collaboration, and dashboards. Oracle Primavera P6 is the industry standard for schedule management.

Primavera Risk Analysis is a full lifecycle risk analytics solution for cost and schedule risk management. Primavera Analytics works with Unifier for dashboards and reports.

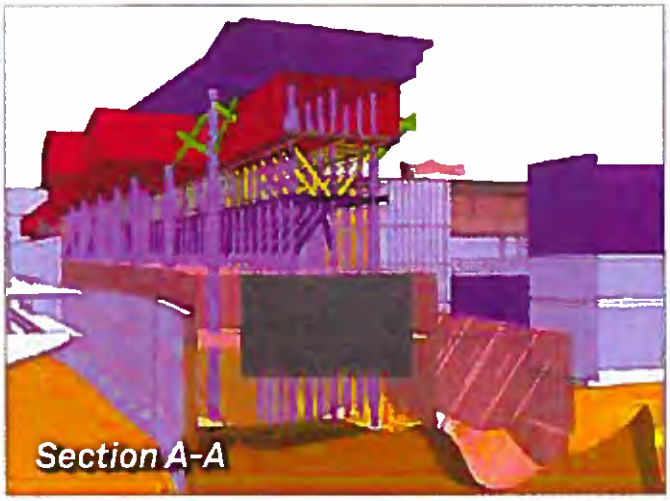
These tools integrate with each other with work breakdown structures and/or cost breakdown structures. They will provide transparency to NJ TRANSIT for management and forecasting, save cost, and increase efficiency by using:

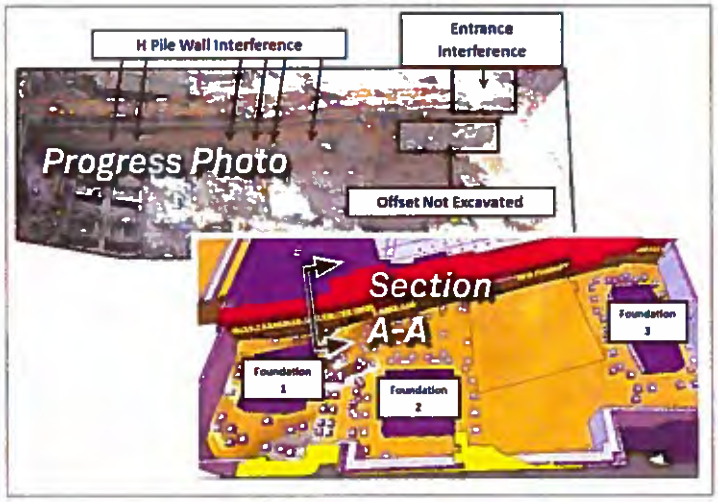
- Real-time information
- Cloud-based records management control system, a paperless office
- Integrated, automated cost, schedule, risk, and configuration management through the project lifecycle
- Collaboration with internal and external stakeholders including design coordination, field engineering, construction administration, and other project facets
- Timely management of submittals and deliverables
- Enhanced dashboards and fast reporting
- Timely communicating of project risks and opportunities for risk management
- Automated business processes for all deliverables

Aspects of the NJ TRANSITGRID will employ BIM in 3D models, and project reporting will also benefit from these models. BIM helps owners, designers, and managers accomplish projects efficiently, saving cost. AECOM is experienced in preparing BIM/4D (3D + schedule) models to manage and report project progress. AECOM is proficient in the application of BIM 4D/5D. BIM is a way to communicate a building's design in three dimensions 3D); the fourth dimension (4D) is time or tying a schedule to each element of the model, and the fifth dimension is cost-loading the schedule with resources or money. These visuals are available on-screen in Primavera Unifier, furthering the "paperless office" approach and enhanced communications. The graphics on this page provide an example of comparing an as-built progress photo with a view of the risk-adjusted schedule BIM 4D, showing progress on the same project.

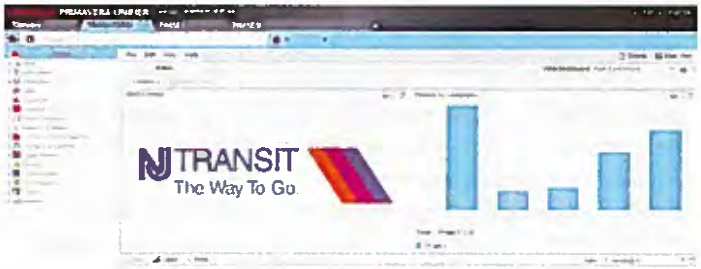


Major airport redevelopment: These images show a comparison between progress photos and a BIM4D of the schedule, showing where progress should be.



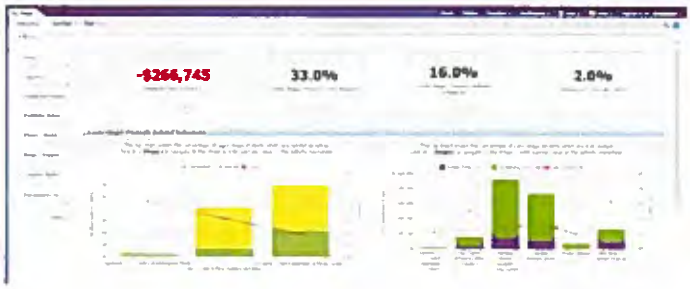


A multi-billion-dollar rail transportation project: Section A-A shows complications that have caused a delay. The next step in the process was to resolve the interferences and recover the schedule.



We will use Oracle Unifier for wrap-around project controls from inception through operations. This system is designed to integrate various project control aspects, better assuring project success.

Following a discussion and consensus with NJ TRANSIT, the AECOM team will establish a formal critical path method (CPM) project baseline schedule using P6. The schedule will incorporate the activities defined in the approved Work Breakdown Structure.



Primavera Analytics works with Unifier and P6 to create easy to use dashboards and reports.

The AECOM team will provide CPM updates monthly or upon request. The CPM will be updated with the latest simulation of the risk management software (Primavera Risk Analysis) to identify emerging risks that could impact schedule, budget, or quality.

We will establish a system of monthly progress and cost control reports, attached to monthly invoices, in accordance with the Sample Invoice Report included in the RFP. Subconsultants employed will render invoices for the general time periods that are used by the AECOM team.

Our team will resolve issues identified during NJ TRANSIT's invoice review within two working days. The report form and invoice will include a description of current technical, budget, and schedule status and a comparison of this information to the preceding month, project-to-date, and projected future work efforts as applicable.

Milestones, decisions, issues, and action items will be highlighted. As part of configuration management, any unanticipated delays or gains or cost adjustments driven by unforeseen circumstances will be discussed with an eye toward schedule and budget adherence. The AECOM team will provide a summary of invoice costs in a format depicting values as described in the RFP.



Our team's proven project controls capabilities are being demonstrated for PSE&G during the system-wide upgrade that will meet additional demand with increased capacity. Team member PMA Consultants established a world-class Project Controls Office for PSE&G and is currently providing day-to-day project controls functions for their $1 billion project portfolio.

1.3.1 Final Scoping/Preliminary Engineering Schedule

Preliminary Engineering Schedule

The AECOM team will develop and maintain a detailed conceptual and preliminary engineering CPM schedule representing a practical plan to complete the scope of work on time. The purpose of the schedule is to provide an effective management tool by which the AECOM team and NJ TRANSIT can measure progress, and identify and mitigate schedule risks. Using the P6 EPPM software, the AECOM team will provide the most technologically advance schedule and reporting tools in the industry.

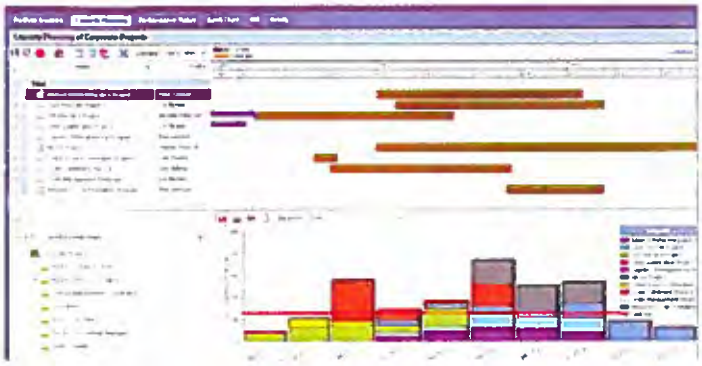
The project entails significant regulatory compliance and permits. Successful completion of preliminary engineering requires detailed schedule management. The number of activities in the schedule will be sufficient to enable planning, evaluation of progress, and analysis of time impacts. The preliminary engineering schedule will be detailed and correlate with the work plan described in the PMP and organized based on the tasks and major project elements.

AECOM team schedulers will use the latest version of P6 or NJ TRANSIT-approved equal. The format of the CPM schedule will include bar chart plots and show columns for:

- Activity ID (maximum eight alpha-numeric characters)
- Activity description
- Original duration
- Early start, late start, early finish, and late finish
- Total float
- WBS

For schedule update meetings, the following columns will be added:

- Percent complete
- Actual start and finish dates
- Remaining duration
- Earned value



Oracle Primavera P6 EPPM is an effective schedule, cost, and resource management tool to measure progress and deliverable status.

After NTP, we will develop the WBS in an organizational chart format and submit it to NJ TRANSIT for approval. The WBS will reflect all the major elements and sub-elements of the task order scope of services and the deliverables.

The AECOM team will develop a preliminary engineering schedule and implement the NJ TRANSIT-approved WBS. This will be the draft baseline schedule. The WBS and the schedule narrative report will be submitted within three weeks of NTP. The narrative report will list the assumptions, estimates of original durations, calendars, and holidays included in the schedule, estimate of resources, and will discuss basis of activity durations and the project's longest path. This longest path will be verified and constitutes the critical path.

Schedule activities will include:

- NJ TRANSIT designated milestones
- Commercial and regulatory milestones
- Licenses, agreements, and coordination with municipalities, other agencies, and community groups
- Interim and final contractual milestones with constraint dates
- All phases of design development activities.
- Design submittals
- Submittal review by NJ TRANSIT
- Submittal review by outside agencies, including Amtrak
- Interface coordination and dependencies with proceeding, concurrent, and follow-on contracts
- Non-contractual milestones (without constraint dates) to highlight the end of a phase
- Acceptance of the project, including completion of unfinished items prior to completion of any milestones
- Work to be performed by third party agencies and/or consultants
- Permitting activities and the processes involved in obtaining each permit
- Final EIS acceptance and related environmental approval

The AECOM team will revise/modify and resubmit the draft baseline schedule incorporating NJ TRANSIT review comments, if any, prior to proceeding with resource/cost loading the schedule.

The NJ TRANSIT-approved baseline schedule, loaded with resources and costs, will be submitted in two weeks and will be the final project baseline preliminary engineering schedule. It will be the basis for schedule updates and project control reports. The AECOM team will prepare and maintain the schedule according to the contract specification and established industry practices.

During the development of this proposal we reviewed all RFP-specified activities and related documentation and prepared typical schedules for NJ TRANSITGRID project phases,

showing the planned sequence and durations for each phase. They are included in Section 8, Schedule.

Monthly Progress Schedule and Schedule Status Report

The schedule will be updated monthly, summarizing activity progress, resource consumption, and cost accrual as of the end of every month. The AECOM team will submit the Monthly Progress Schedule and Schedule Status Report five days before the progress meeting for review by NJ TRANSIT. The schedule status report will include:

- Activities completed
- Progress achieved
- Issues and their impact on the schedule
- Problem areas and anticipated delays
- Alternatives schedule recovery and narrative to mitigate any potential delay
- Corrective action and recovery plan
- Potential issues
- Delay chain analysis
- Actions required to correct and negate float (actual or predicted)
- Potential delays and problems and their estimated impact on performance and contract completion date
- Status of longest path and changes since the previous update
- Activities planned for the forthcoming report period

The progress meeting will confirm percentage complete, actual start/finish, earned values, and remaining duration.

Recovery Plan and Schedule

The AECOM team understands the challenges of the NJ TRANSITGRID Project, which is based on a new technology that entails time constraints. We will identify, mitigate, and manage schedule risks as a project management practice.

If there are delays to interim milestones or to the overall project, our team will develop a recovery plan and schedule and submit them to NJ TRANSIT. The plan will be a supplement attachment to the Schedule Status Report, which will address:

- Remedial actions if interim milestones, constraints, or submittal dates will not be met
- Recovery schedule as a separate break- out schedule, which includes activities to achieve milestones that coincide with the baseline schedule
- Notifying NJ TRANSIT of planned remedial action and obtaining the agency's approval before proceeding
- Obtaining NJ TRANSIT's approval prior to incorporating any revised dates into the progress schedule if the original baseline schedule dates cannot be maintained

Final Scoping

The AECOM team will submit a Final Progress Schedule (as-built schedule) as the last updated schedule. It will include start and completion dates, activities, durations, sequences, and logic in the exact manner in which the Project was actually completed, and will be signed and certified by our project manager and the scheduler.

Deliverables

- WBS codes – prior to developing the Contract Schedule for approval
- Baseline schedule – draft within three weeks of NTP and within final two weeks of receiving NJ TRANSIT comments
- Monthly progress schedule and schedule status report
- Recovery plan and schedule – as required
- As-Built Schedule – by the end of the project

1.3.2 Records Management Control System

We will develop and maintain a cloud-based system, Oracle Primavera Unifier, to identify and manage correspondence, business documents, and current revision of instructions, procedures, drawings, specifications, reports, and analyses in compliance with Subtask 1.5 – Configuration Management. Our team will provide training in the use of the software.

Oracle Primavera Unifier will be the intra-project, password protected website through which NJ TRANSIT and the AECOM team can communicate and share data, drawings, and reports rapidly and efficiently. This will help us to inform NJ TRANSIT of issues and resolve the rapidly keep the project on track.

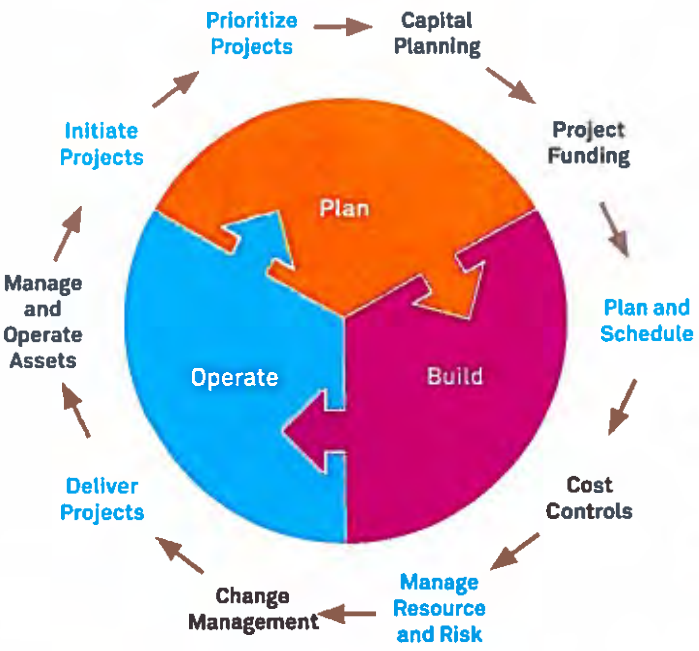
The software will meet program requirements as it accommodates document, cost, schedule, portfolio, facilities, and real estate portfolio management, and provides an easily accessible dashboard.

The Document Manager module will enable us to organize and archive CAD drawings, spreadsheets, image files, Microsoft Office files and correspondence. Version tracking enables everyone to have ready access to the most current version of any document. Documents will be organized in an agreed-upon folder structure, making them readily available. The

check-in/ check-out, commenting/redline capabilities of the software streamline project management.

Moreover, Document Manager is integrated with business processes (customized forms + workflows) so that decision-making may be automated collaboratively. The software can be configured to match unique business workflow needs or enforce business rules for compliance and routing of documents. This will allow NJ TRANSIT to gain immediate visibility into problem areas and fulfill auditing requirements.

Any files attached to business processes will be automatically published to predefined folders in Unifier Document Manager. For example, documents of a site survey, photographs, and survey data may be uploaded to Primavera Unifier from the site using a mobile device or a computer. Later, if part of a workflow, the next person in the workflow will receive an email to accept or reject these documents. Similarly, the project scheduler may update activities using the Primavera Team Member application, remotely using a phone or tablet.



Primavera Unifier and P6 is the ideal application to carry the project from design through operations and management.

Some of the standard workflows integrated into Oracle Primavera Unifier are:

- Notice to Proceed
- Correspondence
- Daily reports
- Design review
- Design change requests
- Meeting minutes
- Request for information (RFI)
- Monthly updates
- Submittals and submittal register
- Transmittals
- Project requests
- Incident reports
- Lessons learned
- Warranties
- Punchlist
- Project closeout



Primavera Unifier can conveniently be updated remotely on a tablet or mobile device.

The AECOM team will implement workflows for change management, configuration management, schedule review, and cost management.

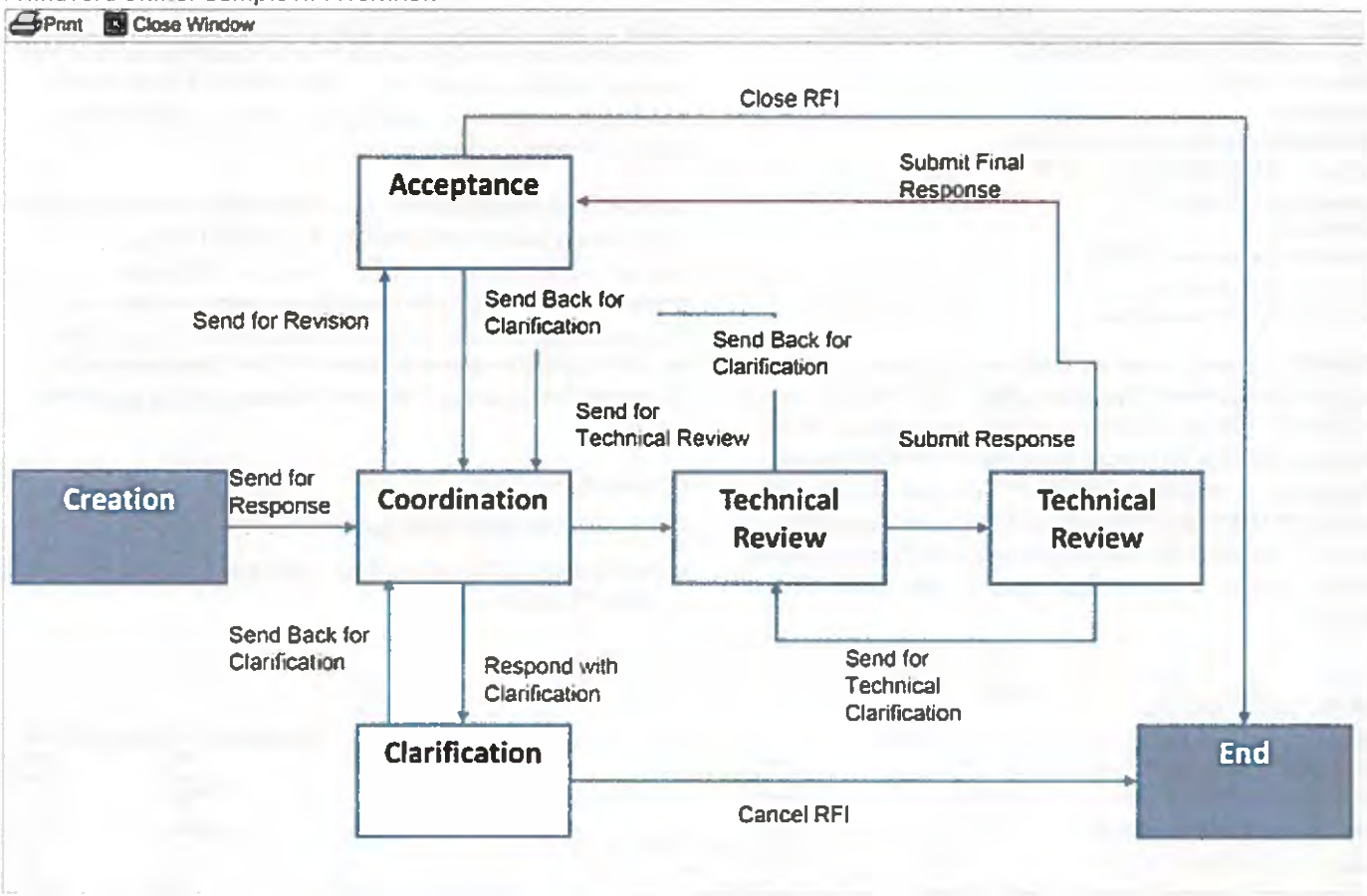
Whenever a project team member adds a document or makes a change, NJ TRANSIT and our team will be informed. The system provides easy traceability from attachments and documents back to their originating business process and provides alerts to notify users when certain thresholds are met.

Preconfigured reports will help NJ TRANSIT periodically review the records and logs stored in Oracle Primavera Unifier at any time; they may be exported in many formats (HTML, CSV, Excel, PDF or XML). Employing NJ TRANSIT document formats and requirements is readily accomplished, using a user-defined reports features.

The system, at a minimum, will:

- be designed according to NJ TRANSIT's work flow and business practices
- provide an electronic interface ("desktop") that requires nominal user training and provides quick response time for document creation, storage, and retrieval
- provide for different access levels for staff and project stakeholders
- be fully compatible with and use the same assumptions as the NJ TRANSIT ECMS document control system.

Primavera Unifier Sample RFI Workflow



The system will manage manual and electronic documents, such as:

- General correspondence
- Contracts, specifications, progress reports, invoices
- Budget and finance data
- Drawings, plans, and images
- Email messages and attachments
- CDs, DVDs, and other hard media
- Native files and image files of all documents

It will have the following features:

- A central clearinghouse for all project documents
- Categorization of inbound traffic
- Marking of each document with (at a minimum):
  - Originating date, Received date, From organization, To organization, Subject, and unique sequence number
- Scanning and indexing
- Posting of scanned documents for retrieval
- Email notification to document recipients
- Maintenance of the document database
- On-site printing capability for all document sizes and formats
- Filing of original hardcopy
- Transmitting of original hardcopy to off-site records warehouse (if needed for compliance with NJDARM requirements)

The system will also provide a fully integrated electronic content management (ECM) system, including the following components.

- Digital mailroom (DM) or future project field office
- Scan, index, and distribute
- Electronic document management system (EDMS), web-based
- Electronic document posting and notification
- Document collaboration capabilities

- Email management including forced classifications
- Check-in and check-out protocols
- Revision control
- Audit trail
- Security (document by user/group)
- Watermarking for printed copies
- Administrator reports
- Workflow
- Records management (RM)
- Retention schedules
- Notification of destruction

NJ TRANSIT currently uses an in-house Enterprise Content Management System (ECMS), using Open Text Live Link as the platform. The AECOM team will provide personnel at a designated NJ TRANSIT office to assist NJ TRANSIT in data entry as well as downloading and uploading of documents to the NJ TRANSIT ECMS. The schedule for data uploads to the ECMS will be determined subsequent to Contract award; however, such uploads will occur on a monthly basis, at a minimum.

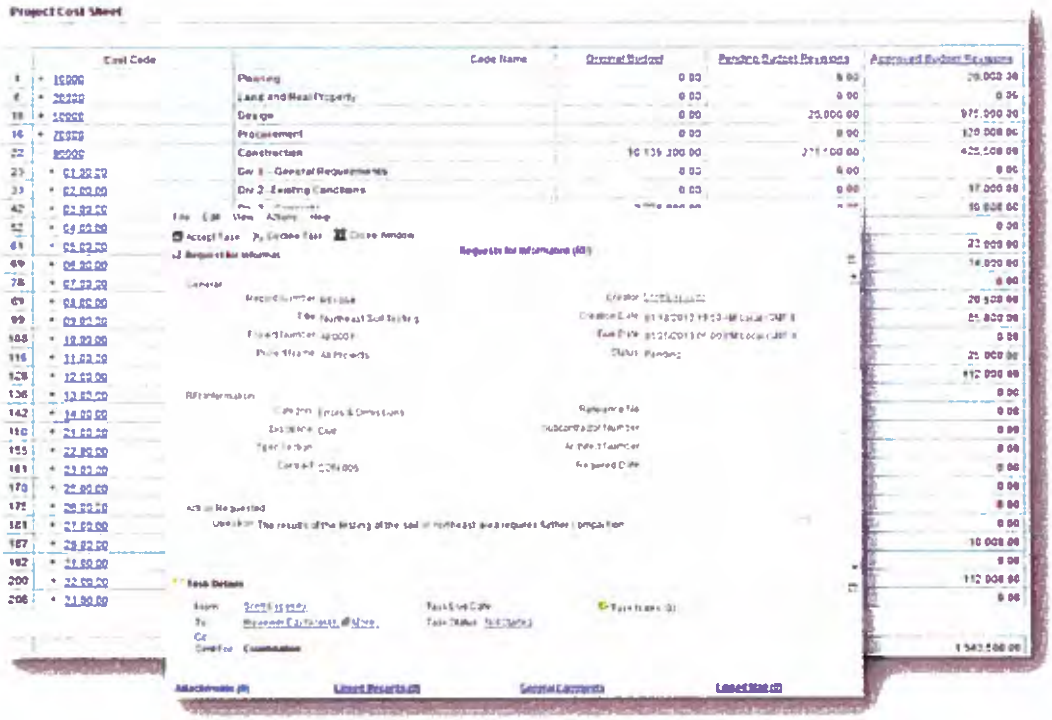
For estimating purposes, our team has included a staff member for an average of two full days per week for the duration of the design and construction support periods to assist NJ TRANSIT with data entry. The AECOM team will export Oracle Primavera Unifier-saved documents for transfer to NJ TRANSIT's ECMS. The personnel assigned will be cognizant of NJ Division of Archives and Records Management (DARM) regulations concerning document scanning and management procedures.

Oracle Primavera Unifier is compatible with the document control records management system. Upon completion of the project, or when directed by NJ TRANSIT, the AECOM team will provide all data for incorporation into the NJ TRANSIT computer network system.

Our team will keep the document database current throughout the contract life and provide it to NJ TRANSIT without the need for additional licenses for five years after project completion. A software allowance has been included in our proposal to account for this future application, in compliance with the Configuration Management Plan. Consistent with NJ TRANSIT's objective, the result will establish a paperless project.

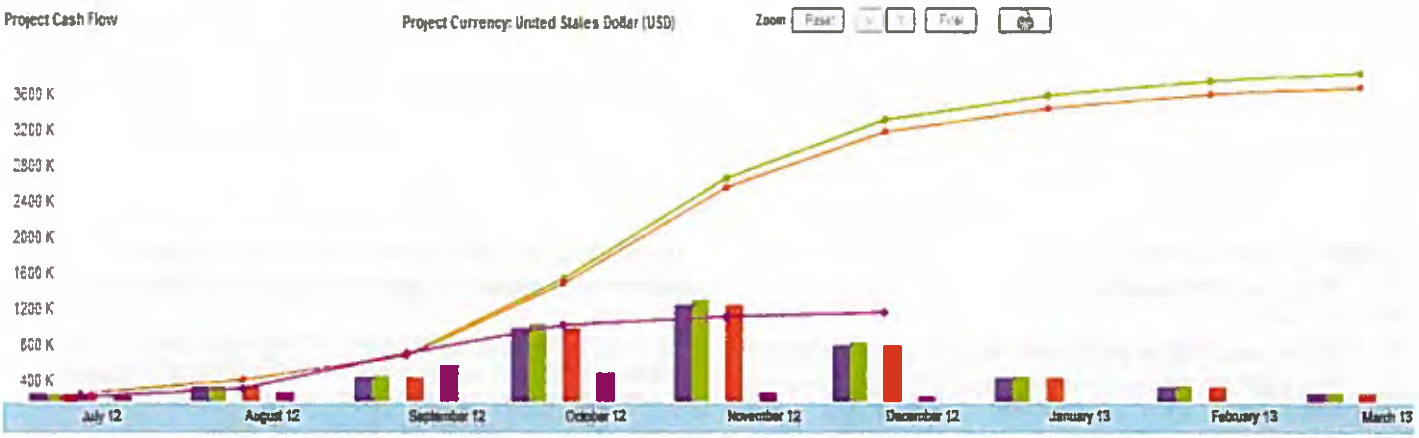
Deliverables:

- Records Document Management System
- Identification of appropriate support staff subject to NJ TRANSIT approval



Primavera Unifier - Typical Data Entry and Log Screen

Oracle Primavera Unifier - Cost Worksheet and S Curve



1.3.3 Monthly Progress Reporting

The AECOM team will monitor progress during the design phase and provide monthly progress reports and will use the approved schedules for planning, scheduling, management, and project execution and to enable NJ TRANSIT to evaluate progress and requests for payments.

Our team will use the NJ TRANSIT-developed document formats for programmatic submittals in accordance with reporting used in NJ TRANSIT's Superstorm Sandy Recovery and Resilience Program. On NJ TRANSIT's direction, the AECOM team will provide support in the submittal of project reports to the FTA.

The AECOM team will submit one hard copy and one electronic copy of the Monthly Progress Report by the seventh day of each month that covers a reporting period for the preceding month. The Monthly Progress Report will include:

- An executive summary
- Accomplishments during the month
  - Activities started/ongoing
  - Activities completed
  - Decisions
  - Detailed progress on each stage of the design
  - A written description of technical, budget, and schedule status for that month with specific reference to the activities detailed on the Baseline Schedule as well as a comparison of this information to the preceding month
- Areas of concern and action items
- Problem areas and critical issues
  - Current and anticipated delays with cause of the delay
  - Impact of the delay on other activities, milestones, and completion dates
  - Risk register status (details of any delays highlighted together with details of the AECOM team's actions to mitigate risks or other corrective action for schedule recovery
  - Any unanticipated delays, gains or cost adjustments driven by unforeseen circumstances
  - Corrective action and schedule adjustments to correct the delay
  - Proposed resolution of the concern
  - Future work: activity completions projected for the next month
- Schedule status
  - Schedule Summary
  - Discussion of critical path
  - Per task, planned schedule percentage complete versus actual percentage achieved from the resource and price loading
  - An up-to-date copy of the Delivery Submittal Schedule and milestones
- Cost/budget status
  - Budget summary
  - An overall cumulative progress curve in calendar months
  - Comparative progress curves and histograms showing actual versus planned performance in respect to major activities as may be required by NJ TRANSIT
  - A monthly update of the overall progress curve (or S curve) versus baseline progress curve
- Resource status
  - Earned value versus planned usage for each resource per task from the resource and price loading in tabular format
  - Updates of the AECOM team's labor curve/table showing actual and planned labor, including subconsultant labor



During negotiations, we will use a similar set of curves that will cite tasks and subtasks against cost.

- Pending items and status
  - Environmental studies
  - Permits
  - Commercial agreements with third parties (i.e., natural gas pipeline supply connections, interconnections with PJM, and so on)
  - Change order status
  - Time extensions
  - Interim milestone dates and contract completion dates status
- Quality management
- SBE report (DBE Participation)
- Decisions log
- Definitions of terminology
- Other content as directed by NJ TRANSIT

The Primavera Unifier Monthly Report Workflow will be used to automate the process and expedite the preparation time for the Monthly Progress Report.

The AECOM team will provide a certificate signed by our quality manager certifying for the previous month that:

- All work, including that of subconsultants at all tiers, has been checked or inspected by the AECOM team's quality staff and that all work, except as specifically noted in the certification, conforms to the requirements of the contract.
- The Quality Management Plan and its procedures are functioning properly and are being followed, except as specifically noted in the certification.

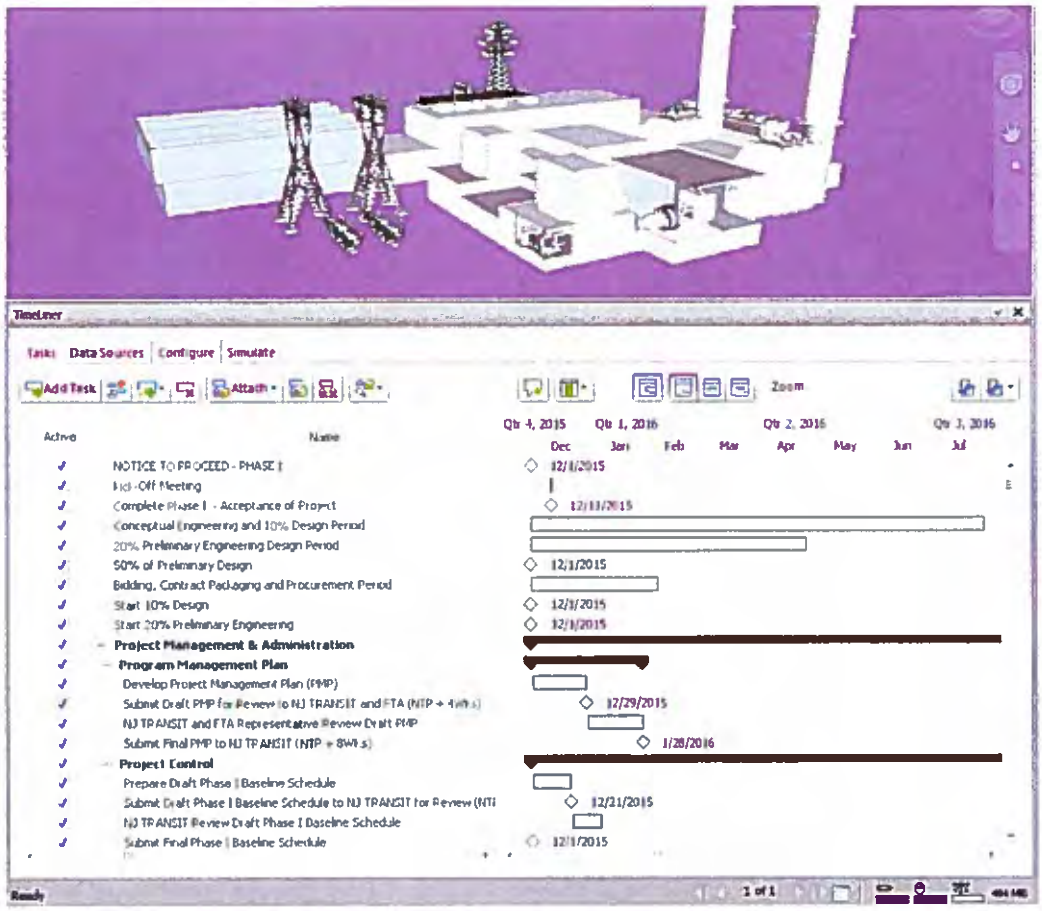
Deliverables:

- Monthly Progress Reports
- Monthly Quality Certificate

The AECOM team will include BIM with 3D/4D model images in the Monthly Progress Report and any presentations required by NJ TRANSIT for progress tracking. During design review, value engineering, constructability and peer review meetings, BIM/3D and 4D models may be used to aid in managing the project. Design will be combined into BIM software to feed 4D software and Primavera P6 schedule linkage for 4D model reporting. NJ

TRANSITGRID project managers will be able to review the design and progress using 4D review software.

BIM/4D models allow us to review design and progress and identify clashes that can be resolved as part of the risk management process.



1.4 QUALITY CONTROL

The AECOM team has developed an Integrated Management System (IMS) manual that provides a common management system for use by project staff, consultants, and subcontractors on all AECOM professional technical services projects. We will apply the system to all phases of the NJ TRANSITGRID Project.

The IMS includes of three main components: a Quality Management System (QMS), Environmental Management System (EMS), and Safety Management System (SMS). As there are elements in common throughout these systems, especially in the context of addressing ISO standard requirements, a single, top-level IMS manual is used to outline our approach to these components.

AECOM offers NJ TRANSIT a proven quality management system (QMS) that is certified to the internationally recognized ISO 9001:2008 standard.

Our quality program is described in more detail in Section 7 of this proposal.

Quality Manager. Our proposed quality manager, Peter Totten, PE, is a professional engineer with more than 40 years of relevant experience. He is trained in all aspects of project quality management and will:

- Implement the QMP
- Have the authority to stop work; this authority will be set for in the QMP and promulgated throughout the project team.
- Report directly to our project executive, Fred Werner
- Assure that our team's quality management is effective
- Have access to NJ TRANSIT's Quality Director

Peter will conduct an internal quality management review at least bimonthly and will submit a report of the review.

Quality Audits. For the NJ TRANSITGRID project, internal audits will be conducted at least quarterly. Deficiencies will be reviewed to identify cause and to take corrective or preventive action. The results of the audit will be made available to NJ TRANSIT, including the corrective actions (if necessary within 30 days). Our internal policies require completion of corrective actions quickly, as well as monitoring and verification of completion of the corrective action. The AECOM team will provide a report of these actions to NJ TRANSIT.

Deliverables:

- Quality Management Plan
- Design Control Plan
- Internal Quality Management Review reports
- Audit Reports
- Report of Completion of Corrective Actions

1.5 PEER REVIEW OF DESIGN

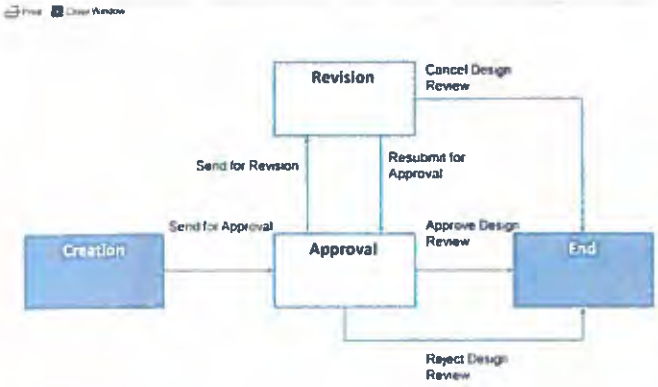
The control, review, approval, and distribution of engineering drawings and documents will be governed by a Project Execution Plan, AECOM IMS, and NJ TRANSIT Design Standards.

The AECOM team includes an Engineering and Design Team Leader, who will work with the engineering disciples to identify the engineering and design standards and to coordinate the implementation of these standards with project stakeholders.

The AECOM team will also develop design criteria based on the scope of the contract scope of work. The criteria will cover the following project related information:

- Project description
- Location of the project site
- Physical attributes of the site, elevation, temperature range, seismic zone
- Civil loading criteria
- Structural deflection criteria
- Foundation design parameters
- Foundation types
- Steel structure types
- Electrical constraints and clearances
- Electrical short circuit and impedance criteria including continuous current ratings
- Grounding design criteria
- All bus and conductor sizes
- Cable types and sizes
- All electrical equipment ratings
- Electrical equipment descriptions
- Conduit and trench sizes and types
- Ductbank criteria
- Relaying criteria and relays to be used
- Control building design criteria

This list is does not include all areas that will be defined prior to beginning the design. The document will be project-specific and will include NJ TRANSIT's preferences.



Primavera Unifier - Sample Design Review Workflow

The AECOM team will engage outside consultants and subject experts to perform a comprehensive, independent project review of all design documents the AECOM team produces before the documents are submitted to NJ Transit. We will implement the following measures:

- The independent review will be performed by personnel not working on the project
- The review will be performed by senior, experienced engineers or designers
- QA documentation will accompany the package identifying the review scope, documents to be reviewed and the reviewing personnel
- QA documentation will have places for the reviewer's signature both before and after comments are incorporated.
- The reviewed drawing or document will indicate individual items checked by means of a highlighter or checkmark. (Reviewed drawings typically have all informational items highlighted.)
- The reviewer will use a standardized marking scheme. Example: red = add, green = delete, blue = comments or questions
- The AECOM team will hold a meeting after the review to discuss the comments. The reviewer and the responsible engineer will be present.
- After incorporation of comments, those not addressed will be initialed by the reviewer at the comment location on the document.
- Multidiscipline reviews are necessary. Electrical and civil engineers review both disciplines. Control schematics and wiring diagrams are an exception to this rule. Additionally, both electrical and civil engineers will review vendor approval drawings.
- Material catalog documentation sheets are part of the check and will be included
- The review package will contain the drawings from all disciplines
- All vendor drawings and electrical equipment documentation will be included with the package for the reviewer's reference
- Each drawing and reviewed document will be identified by a stamp or other means indicating the review type, date, and the name of the reviewer.

The AECOM team will initiate an RFI process using standard procedures, including forms to communicate necessary clarifications and submittal of information to NJ TRANSIT's project team.

The project team will provide constructability reviews to the Peer Review Team. Other project team personnel may provide input regarding operability and maintainability issues.

Checking and Verification Procedure. As part to the checking and verification step, the AECOM team will follow a prescribed sequence of steps outlined in the following checklists and forms:

1. General Issues Document Review Checklist
2. Document Review Comments
3. Calculation Review Checklist
4. Quality Review and Deliverable Release Record
5. Drawing Review Checklist
6. Study/Report Review Checklist
7. Specification Review Checklist
8. Software Validation Form

Deliverables

- Peer Review Reports

1.6 CONFIGURATION MANAGEMENT

The AECOM team will prepare and submit to NJ TRANSIT for approval a Configuration Management Plan (CMP) in accordance with the requirements of ISO 10000. The CMP will use a proven, auditable electronic-based configuration management system for the design.

The CPM will explain the configuration management approach, impacts to the NJ TRANSITGRID Project, tools needed, training, and how these will be applied.

The CMP will define the project structure and methods to:

- Identify, define, and baseline configuration items (CI)
- Report and record status of CIs and any requested modifications
- Ensure completeness, consistency, and correctness of CIs
- Control storage, handling, and delivery/reporting of the CIs

The AECOM team recommends using Oracle Primavera Unifier for configuration management, which will integrate with the records management system. Document change control is built into Oracle Primavera Unifier business processes, which record, track, index, and report configuration items.

The program will include configuration management of drawings, specifications, documents, reports, and analyses. We will maintain document change control with versioning, including engineering plans, drawings, and specifications and will update all project documents as the design progresses.

Configuration management will also provide an accurate historical record that traces decisions throughout the project.

The AECOM team will develop and maintain a contract documents log in Oracle Primavera Unifier. The log will list all design drawings, specifications, design calculations, analyses, reports, and other documents prepared by our team. Only one version of a document will be in effect at any time. The log will keep a history of each document created by the design team and its evolution. The log will form an integrated part of the records management system.

At the end of the Project, the AECOM team will provide NJ TRANSIT a complete configuration management history in electronic format and documenting the final revision status of all design elements.

Deliverables

- Configuration Management Plan – draft and final
- Contract Document Log

1.7 PROJECT MEETINGS

The AECOM team will schedule and attend meetings with NJ TRANSIT, its representatives, government officials and other stakeholders as determined by NJ TRANSIT or as needed.

We will initially coordinate with NJ TRANSIT to schedule a project kick-off meeting within 10 calendar days of NTP. The purpose of the meeting is to review the AECOM team's scope and schedule, key milestones, procedures, submittals, and assignments. This meeting, chaired by NJ TRANSIT, will include representatives of NJ TRANSIT and representatives of the AECOM team and major subconsultants. The agenda of the kick-off meeting will include:

- Project organization and key personnel, including subconsultants
- The Project Management Plan (PMP)
  - Schedule, WBS, critical paths, and milestones
  - Design Management Plan
  - Interface and Integration Management Plan
  - Configuration Management Plan
  - Quality Management Plan, including quality documents and records to be generated
  - Procedures for processing design decisions and approvals
  - Procedure for processing applications for payment
- Project mobilization issues

Partnering. The AECOM team suggests partnering sessions after the kick-off meeting to include interested parties and third party stakeholders. The purpose is to review project details, needs, concerns and points of control.

Meetings. We further propose a risk management workshop with NJ TRANSIT to promote the development and implementation of risk mitigation plans. Our goal is "no surprises" that could adversely affect project implementation, cost or schedule.

For meetings subsequent to the kick-off meeting, The AECOM team will prepare a record containing the date, time, location, purpose of meeting, meeting participants, a summary of

matters discussed, agreements and decisions, action items, and the party responsible each action.

We will prepare meeting minutes within seven calendar days after each meeting and submit them to NJ TRANSIT for review and comments. Final meeting minutes will be issued to appropriate parties within two calendar days of receipt of comments from NJ TRANSIT.

The AECOM team will also hold monthly progress meetings with NJ TRANSIT (or more frequently if deemed necessary by NJ TRANSIT). The AECOM team and NJ TRANSIT will determine who should attend the meetings. We will produce a Monthly Progress Report for discussion during the monthly meetings.

The purpose of the meetings is to determine that the activities described in the AECOM team's Monthly Progress Report and Progress Schedule are correct. The monthly meeting will address technical and administrative issues, determine actions, develop deadlines for issue resolution, and assign individuals to resolve the issues. Agenda items for the monthly meetings will include matters of significance that could affect progress, such as:

- Review of the previous monthly meeting minutes
- Status of action items or identified issues
- Status and adherence to project schedule
- RFIs or approvals
- Changes
- Invoices, payments, and other related issues

We will hold status meetings prior to the submittal of the Application for Payment. NJ TRANSIT's disposition of the matter will be documented in our minutes for each monthly progress meeting.

Deliverables:

- Kickoff Meeting Minutes
- Monthly Progress Report
- Monthly Progress Meeting Minutes

1.8 PAYMENT PROCEDURES

The AECOM team will be eligible to receive payment upon successfully achieving demonstrated progress and compliance with the requirements of this subtask and other applicable provisions of the contract.

We will notify NJ TRANSIT in writing that verifiable progress has been achieved and request reimbursement in connection with the progress. NJ TRANSIT will determine whether the claimed progress has been achieved during the status review meetings and by review of valid Progress Reports as prescribed above.

Applications for payment will contain:

- Name and address
- The remittance address or bank to which payment is to be made
- The contract name/title and number
- An invoice for the amount identified plus amounts due under any provision of the contract
- The AECOM team's certification that the amount requested is payable and has not been previously invoiced or paid
- Certified payrolls
- Supporting documentation for all expenses incurred
- DBE participation levels

Monthly invoices will include:

- The Monthly Progress Report
- All invoices (AECOM and subconsultants)
- A summary of all invoice costs in a format depicting values as described (using Sample Invoice Report)

NJ TRANSIT will review the Application for Payment for accuracy and conformance with the above and will prepare and issue a payment certificate, with a copy provided to the AECOM team.

Deliverables:

- Applications for Payment
- Final Invoices

TASK 2 ENGINEERING

INTRODUCTION

The AECOM project team has reviewed the RFP and addenda and studied wide ranging research results to develop our approach to engineering distributed energy resources for transit, rail, and passenger ferry terminals and critical infrastructure for NJ TRANSIT. The following facilities are included:

	Facility Type	Transit Stations	Ferry Terminals	Bus Garages	Office	Maintenance Facility
1	Newark Broad Street	■				
2	Secaucus Junction	■				
3	Newark Penn Station	■				
4	Port Imperial		■			
5	Hoboken South		■			
6	Paulus Hook		■			
7	Liberty State Park		■			
8	Ferry Maintenance Facility So. of Port Imperial					■
9	Edgewater		■			
10	Greenville			■		
11	Meadowlands			■		
12	Wayne			■		
13	NJ TRANSIT Headquarters				■	
14	Meadows Maintenance Complex*					■

* *for electric vehicle measure*

Our team will validate the potential for these sites to support the deployment of Distributed Energy Resources (DER) solutions such as photovoltaic systems, on-site power generation systems such as Combined Heat and Power plants, and other combinations of systems such as the deployment of fuel cells and battery storage systems.

Our team will provide engineering services for the validation of the appropriate beneficial concept of operation for the aggregate of DER solutions recommended for each facility.

Following the approval of these concepts, AECOM will progress the design to the 10 percent and then 20 percent levels. AECOM will coordinate all design elements to ensure compliance with the NEPA, permitting and regulatory compliance requirements and will complete the risk assessment and contract packaging tasks to deliver value for NJ TRANSIT. We will provide the necessary architectural, engineering and professional services to prepare contract plans, technical specifications, special provisions, a detailed cost estimate, and bid documents.

AECOM will use the information to develop the appropriate financial analysis for use by NJ TRANSIT in determining the efficacy of applied resiliency technologies, also accounting for reconstruction and modification costs of existing structures and infrastructure. Finally, our project development activities will include assisting with the development of the appropriate contracting mechanism to complete the design and construction of projects.

2.1 VERIFICATION OF CONCEPT DESIGN CRITERIA

Our intent in this section is to first to identify facilities that NJ TRANSIT would like to include in the program. Once these are identified, the AECOM team will begin a study process for the screening of facilities to apply appropriate DER solutions. The approaches outlined in the Sandia Report will be used as the initial basis to screen the options. During the analysis, we will pay close attention to the operational requirements of the facilities and their abilities to accommodate one or more of the proposed DER solutions when in grid-connected or grid-isolated mode.

The confirmation of our concept verification process encompass the baseline energy use profile for each facility. We will obtain information about the peak and baseload

demand and the energy requirements for each facility. To the extent possible, we will obtain 15-minute incremental historical usage data to solidify our understanding of the required loads to be served for each of these facilities and to establish optimum equipment sizing requirements for the DER solution. We will conclude a detailed evaluation of these parameters for each facility and of the space available for the appropriate systems (i.e., photovoltaic systems, combined heat and power (CHP) plant, and/or fuel cells) to determine the right combination of solutions for each facility. The lifecycle costs for each solution will also be used in the ranking process, as we use projected costs to establish the viability of individual or aggregate measures to enhance the resiliency of each facility in NJ TRANSIT's portfolio of buildings.

Our energy engineers will analyze which of the DER solutions form the base technology to be deployed for each facility and which of the remaining options can be integrated as part of an overall system that provides each facility reliable, resilient operation. For example, a facility may meet the criteria for the recommendation of solar PV solutions, but its operating profile may require that battery storage technology and/or a CHP solution also be deployed to allow for continuous availability of an alternate source of energy.

During the verification of concept phase we will consider NJ TRANSIT's communication, resiliency and reliability requirements for the selection of technology to be recommended. Integration with the secure communication and control network for the entire distributed generation portion of the NJ TRANSIT Microgrid will be critical in monitoring and controlling these systems during any event. The communication protocol and network established for these systems will be coordinated and designed and can be integrated into the larger communication backbone to align with the larger Microgrid Project.

AECOM will evaluate these basic parameters along with other parameters outlined in the RFP. This will facilitate our recommendation of DER deployment options for each of facility. As part of the verification process, our engineers will perform site surveys to determine the appropriate distributed generation units and plant configurations with an eye on redundancy and operational characteristics in order to recommend the most viable options. We will evaluate the economics of operations as we develop solutions for NJ TRANSIT's consideration.

The AECOM team has considerable experience in the evaluation, design, construction and oversight of the deployment of DER.



As outlined in Section 4, References, we have overseen the development of various sizes of photovoltaic systems ranging from 200kW to more than 10 MW. On the CHP side, we recently completed a 15MW microgrid system for the Rikers Island Correctional Facility (above) and a 3MW CHP System for Leahy Hospital in Boston. With regard fuel cell installation, we have overseen the turnkey deployment of UTC fuels and are currently overseeing the installation of expandable Bloom Energy fuel cells for large commercial projects in the State of New York.

This section of our proposal also provides an overview of the evaluation criteria and the selection process for DER solutions, based on technical, environmental and economic criteria.

AECOM will work with NJ TRANSIT to ensure the accuracy and to update the engineering/design data developed in previous efforts to develop the design criteria or 10 percent design documents. This is a prerequisite to initiating further engineering. We will prepare the design criteria for NJ TRANSIT's review and approval; once the design criteria are approved, we will use proceed with design.

The design criteria document establishes the general and discipline-specific requirements to accomplish the design. It also provides a definitive project description and outlines specific information required by each discipline.

AECOM will use existing Project Execution Procedures (PEPs) to manage the performance of this task. Figure 2.1-1 outlines the procedure we will use to develop the Design Basis Document.

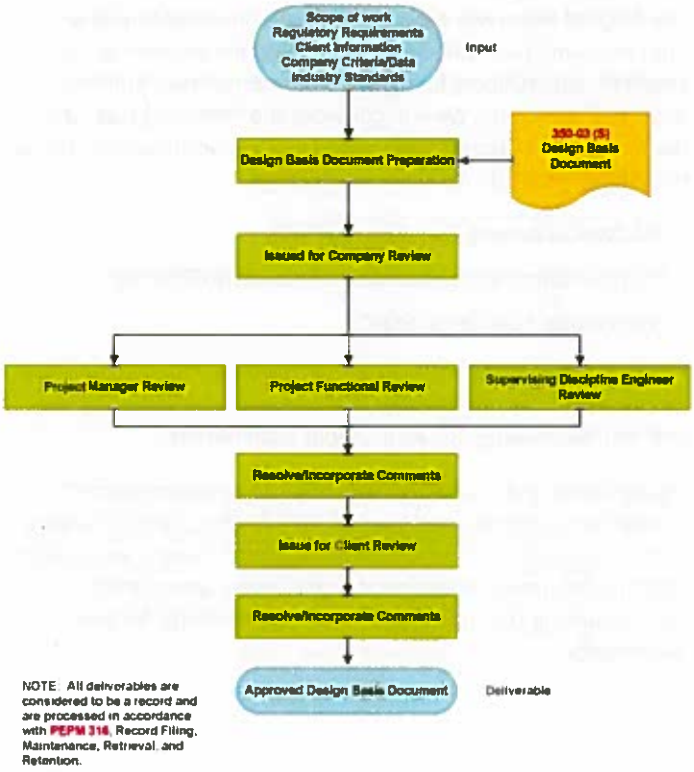


Figure 2.1. AECOM's procedure for developing the Approved Design Basis Document

A key part of this subtask is the selection and verification of the appropriate distributed generation technology. AECOM is well suited for this effort. To date, we have provided DER services ranging from feasibility studies and owner's engineer, to engineering, procurement, construction, and start-up. Our experience encompasses a variety of CHP technologies up to 5,000 MW of generation and covers a wide range of technology, including solar PV technologies, gas-fired engines, turbine drive CHP plants, and fuel cell technologies.

AECOM has extensive experience designing, managing the construction, and commissioning distributed PV systems ranging from several kilowatts to hundreds of megawatts in size. Our team will work with NJ TRANSIT's staff to identify the best available PV strategy and storage options for the proposed sites. Our experience and knowledge of the PV industry will help NJ TRANSIT navigate the many PV technology options available, such as:

- Thin film modules versus crystalline modules
- Tracking versus fixed mounted arrays
- Roof-mounted options
- Car canopy structures outfitted with PV solar
- Optimum storage options: batteries, flywheels, compressed air
- Inverter and interconnection issues
- Integration of PV with other DG options being considered such as CHP, fuel cells, EV charging and other technologies

Towards the deployment of a CHP solution, we will select systems that maximize the reliability and resiliency of the facilities while maintaining the required financial metric. In these solutions, electric generation capacity will be selected such that both the electric demand and the thermal utilization demand can be maintained at high levels and so that fuel to energy efficiency over an annual cycle remains at a high level (e.g., 65 percent efficiency or greater).

Further, the AECOM team will assist NJ TRANSIT to select and implement fuel-cell-based DER systems to service the selected rail stations, bus garages, headquarters building, and ferry terminals. We will consider the following fuel-cell technologies for both power-only and CHP applications, for up to 7 MW generation capacities per facility:

- Molton Carbonate Fuel Cells (MCFC)
- Polymer Electrolyte Membrane Fuel Cells (PEMFC)
- Solid Oxide Fuel Cells (SOFC).

AECOM's extensive experience base includes the major original equipment manufacturers (OEMs) and state-of-the-art technology experience. Our work with each of these OEMs covers virtually every PV technology, CHP-based gas engine and turbine models, and fuel cell installations.

Our knowledge of these technologies is not limited to a single design aspect. We are experienced with each machine in terms of performance, emissions control techniques, plant integration, cycle optimization, production schedules, installation issues and schedules, startup and testing

procedures, and operability. Our detailed knowledge of DER solutions will benefit NJ TRANSIT in the form of optimized plant performance and schedule.

AECOM has an experience base with the manufacturers and suppliers of every piece of equipment, materials, and associated systems that comprise a distributed generation project. As a result, the design and cost saving benefits that enhance performance, availability, and cycle integration will be applied to system components, including balance-of-plant equipment, pumps, valves, electrical switchgear, piping, and concrete.

Deliverables:

Design Criteria Manual with the following sections:

- A design basis document that itemizes the technical parameters and operating criteria for all systems
- Supporting documents, including but not limited to, key plans, single line diagrams, P&IDs, control architecture, communication network topology, major equipment list and their associated calculations
- Distributed generation resource technology analysis, including cost comparison and associated efficiency and physical requirements

2.2 ENGINEERING AND DESIGN

2.2.1 Evaluation and Design Application of Fuel Cell Technology

The AECOM team will assist NJ TRANSIT in selecting and implementing fuel-cell-based DER systems to service the selected rail stations, bus garages, headquarters building, and ferry terminals. We will consider the following fuel-cell technologies for both power-only and CHP applications, for up to 7 MW generation capacity per facility:

- Molton Carbonate Fuel Cells (MCFC)
- Polymer Electrolyte Membrane Fuel Cells (PEMFC)
- Solid Oxide Fuel Cells (SOFC)

Figure 2.2 summarizes selected performance characteristics for each fuel-cell technology that can guide selection of the fuel-cell technology for a particular application.

Figure 2-3 on the following page depicts an example cost breakdown for small-capacity PEMFC CHP systems. It shows that 37 percent to 38 percent of the system cost is associated with the reformer, reflecting the challenges associated with achieving the high-purity fuel requirements for this technology.

Characteristic	PEMFC	SOFC	MCFC
Generation Capacity (MW)	0.001 to 0.1	0.001 to 2	0.3 to 3
Typical Generation Efficiency (LHV)	25% to 35%	35% to 55% (simple cycle) Up to 65% (hybrid cycle)	Up to 55% (simple cycle) Up to 65% to 75% (hybrid cycle)
Ramp Up/Ramp Down Capability	Excellent	Fair	Fair
Fuel Reforming Requirements	Requires high-purity hydrogen	Tolerant of CO	Tolerant of CO
Suitability for CHP	Fair–suitable for low-temperature heating applications only	Excellentvsuitable for high-temperature applications	Excellentvsuitable for high-temperature applications

Figure 2-2. Comparison of Fuel-Cell Performance Characteristics

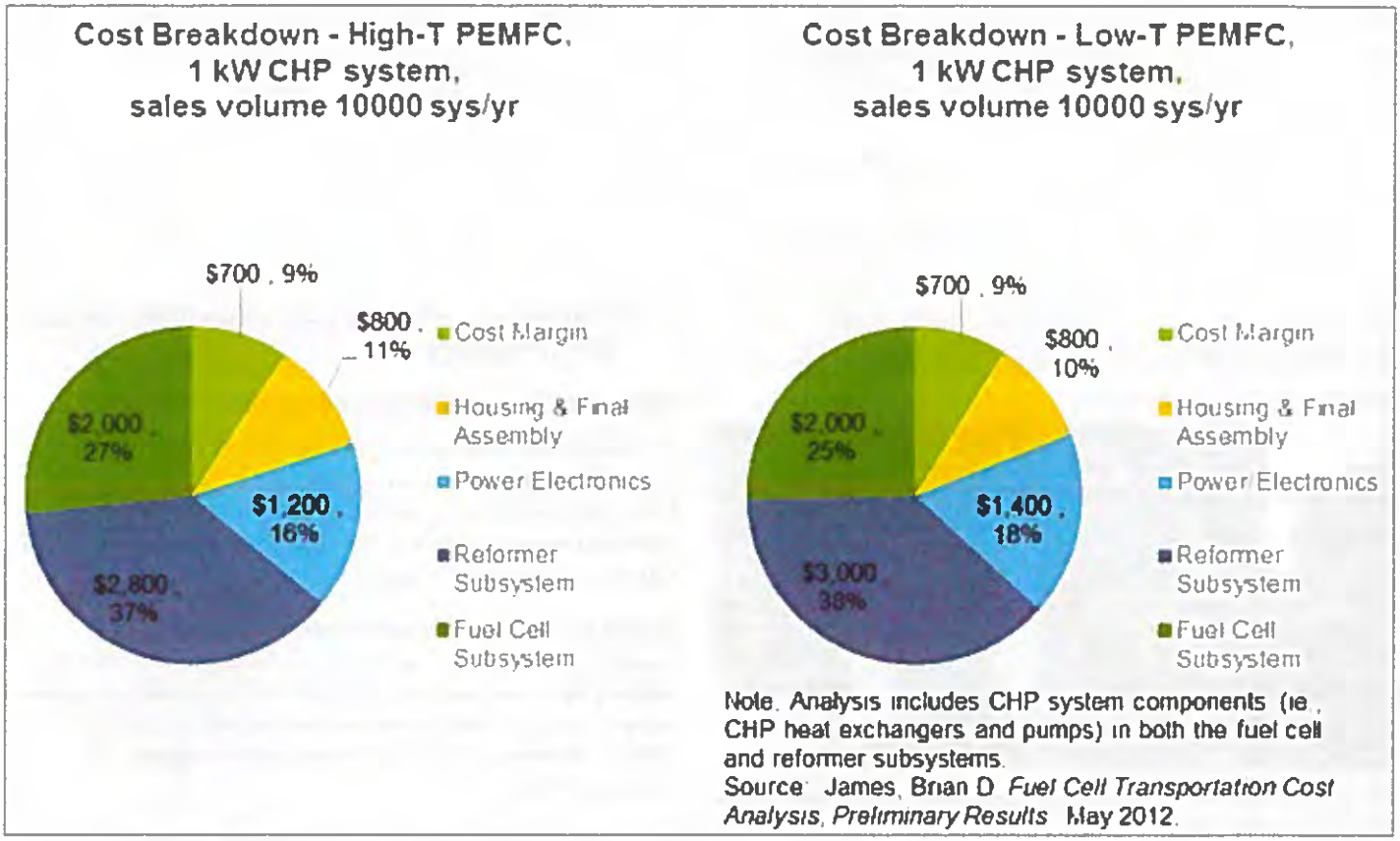


Figure 2-3: Example Cost Breakdown—1 kW, PEMFC CHP System

To execute this task, we will review the requirements for each candidate facility, including:

- Peak electric and thermal loads
- Typical daily and hourly electric and thermal load profiles
- Critical and non-critical electric and thermal loads—non-critical loads are those that are not required when operating without central grid-supplied power
- DER siting considerations, including:
  - Space constraints
  - Proximity of thermal loads
  - Locations of electric mains
  - Locations of natural-gas supplies
  - Other siting factors

Based on these requirements, we will evaluate the relative merits of fuel-cell technology and recommend the most appropriate technology for each candidate facility, including:

- Number of fuel-cell systems
- Nominal generation capacities
- Nominal generation efficiencies
- Thermal loads to be served, if any
- Preliminary siting options

Our recommendations will consider:

- Fuel-cell-technology development status, including:
  - Sales, installation, and service infrastructure
  - Demonstrated service life, maintenance requirements, reliability, and availability
  - Cost ranges
- Policy factors such as the availability of net metering, utility incentives, and interconnection requirements
- Benefits of minimizing the number of fuel-cell technologies deployed
- Benefits of minimizing the number of fuel-cell models deployed



Our project experience includes both small and large scale of the fuel cell CHP feasibility assessment and design.



For the US Department of Energy's National Energy Technology Laboratory, **Navigant**, AECOM's strategic partner for the fuel cell application, led the conceptual design and assessment of a community-based distributed-generation (DG) system using a solid-oxide fuel cell (SOFC). The community, a Southpointe development near Pittsburgh, PA, consists of a variety of industrial, commercial, and residential end users. The conceptual design/assessment included:

- Evaluation of simple-cycle and hybrid (SOFC and turbine) plants
- Hourly performance modeling based on detailed load profiles and various utility rate structures
- Two system architectures—one using a large, central generation plant and the other using several generation plants distributed within the community
- For each system architecture, evaluation of distribution systems to use waste heat to serve building heating and cooling loads (using absorption cooling systems)

The results showed that an SOFC DG system could reduce community energy use by between 35 and 45 percent. Adding distributed heating could reduce community natural-gas consumption for heating loads by 40 to 45 percent, and adding distributed cooling could reduce community peak electric demand associated with the DG system.

Deliverables

- An Evaluation and Recommendation Report (draft and final)

2.2.2 Evaluation and Design Application of Photovoltaic (PV) Technology

Solar PV Technology Opportunities at NJ TRANSIT

NJ TRANSIT is implementing a comprehensive DG plan to provide reliable power in support of critical transit infrastructure. Studies, particularly by Sandia National Laboratories, indicate that PV power plants, possibly coupled with storage, provide a reliable DG option.

AECOM will apply our extensive experience designing, managing construction, and commissioning distributed PV systems. Our team has delivered systems ranging from several kilowatts to hundreds of megawatts and will work with NJ TRANSIT to develop to identify the best PV strategy and storage options.

Moreover, our knowledge of the PV industry will help NJ TRANSIT navigate the many PV technology options available such as:

- Thin film modules versus crystalline modules
- Tracking versus fixed mounted arrays
- Roof mounted options
- Car canopy structures outfitted with PV solar
- Optimum storage options: batteries, flywheels, compressed air
- Inverter and interconnection issues
- Integration of PV with other DG options, such as CHP, fuel cells, EV charging and other technologies

AECOM has many years of experience implementing PV technologies coupled with "hands-on" design and installation work.

The drastic drop in PV pricing in the last five years has made it a highly competitive electric generation option. Based on recent experience and published reports, large-scale distributed PV plants can be installed for an average capital cost of $1,490/kW (Source: SEIA Solar Market Insight 2015 Q2). Recently, the electric utility in Austin, Texas received power purchase agreement bids for electricity generated by PV power plants for less than 4 cents/kWh. (Source: CleanTechnica, July 2, 2015)

Based on our knowledge of the New Jersey solar insolation data and potential incentives, we offer preliminary design options for several of the proposed sites. These are preliminary conceptual designs based on our knowledge of the available roof and land area. Final designs will be based on detailed discussions with NJ TRANSIT, field assessments, discussions with the local electric utility company, interconnection options, and financing options.

The following narrative, through page 98, describes the processes AECOM will implement to develop the best PV and storage options for the proposed DG plan at the best pricing.

PV Preliminary Design Concepts

AECOM has developed a detailed iterative screening process for evaluating multiple sites using a feasibility analysis for solar PV power plants. The goal is to identify optimal sites for solar electric production and constructability. We use publicly available site data and computer modeling techniques to evaluate each site and to estimate energy production. The screening process results in a matrix used to rank the prospective sites. Once the ranking is established we develop conceptual layouts and designs used for preliminary (20 percent) drawings and specifications. Depending on how the project will be financed AECOM will assist NJ TRANSIT in obtaining bids from developers that might offer the projects through a power purchase agreement (PPA), either from qualified EPC contractors or other entities that could build the PV projects. The process is interactive and will involve NJ TRANSIT through discussion and feedback.

Step 1 - PV Site Screening; Evaluation Matrix

Our experienced solar team will conduct a detailed initial screening process to rank the NJ TRANSIT sites. A preliminary assessment and ranking of the sites listed in the RFP is provided later in this section for NJ TRANSIT's initial consideration. This process will result in a ranking of potential sites best suited to a solar PV system. A financial assessment will also be applied to the top ranked sites. AECOM has developed the screening process as a desktop study using available resources to assess the viability of each site. We will examine each site for:

1. **Available Roof or Land Area:** Using publicly available Google and GIS aerial imagery and confirmation of land owner by NJ TRANSIT we will estimate the area available for solar PV at each site. Areas being considered should be unobstructed by pipelines, utility right-of-way, vents, buildings, roof penthouses, or objects causing excessive shade such as trees and buildings.
2. **Environmental Permitting and Licensing:** Our environmental and permitting experts will examine each site to identify permitting requirements, licensing, endangered species, licensing issues, and potential fatal flaws that would rank the site as less feasible. Once the selected facilities are ranked, our team will provide the required site background information for the design development to NJ TRANSIT's environmental permitting and licensing team.
3. **Proximity to Point of Electrical Interconnection:** The PV and/or storage systems will be interconnected to the electric grid either at the service entrance in or near the facility or at the distribution substation. Ideal sites are close to points of interconnection. For facilities that may qualify for the battery storage capacity, the connection point will be coordinated to determine the location of the storage system best suited to the charging/discharging sequences that support the facility's electrical system needs or for export to the utility's grid.
4. **Constructability:** Issues related to constructability will be evaluated including road access to the site, access to equipment, lay-down during construction, and general ease of construction. These activities will be closely planned and coordinated with the NJ TRANSIT staff during the design development phase to ensure that proposed construction activities will not interfere with or disrupt NJ TRANSIT's primary operation at the sites.
5. **Roof or Land Slope:** PV arrays facing south in land areas and south-orientated, lightly pitched roofs are preferred. Sites with rolling hills or north-facing roofs will be given low preference. Land areas with relatively level profiles are preferred for PV power plants, as this minimizes the installation cost for foundations and rack mounts. South-facing roofs optimize annual energy production. Parking areas with long east-west parking rows are suited for car canopy structures outfitted with PV solar.
6. **Structural Integrity:** Roof mounted solar PV systems require structurally sound roofs and preferably outer membranes that are not old and cracked. Similarly, underground soil conditions need to be non-corrosive with minimal rock for

pile driven ground-mounted PV systems. The canopy parking structures require fewer, but larger, reinforced concrete columns in obstructed soils.

7. **Electrical Load (If Available):** Electrical loads to be served should be equal to or greater than the annual production of the solar PV system in a net metering arrangement on the NJ TRANSIT buildings. Net metering allows electric utility customers to install renewable systems on their side of the meter and allow generation to flow into the utility grid. However, at the end of the year any excess energy that is netted into the grid will be purchased at the low wholesale price of electricity. Therefore, it is advisable to design a solar PV system to generally provide less than the total usage in a building. AECOM will analyze the electric loads at each site to ensure that the PV system is sized properly to work within the net metering rules of the utility.

8. **Suitability for Storage:** Electric battery storage systems typically require distribution system upgrades or electrical service upgrades. The potential for minimal upgrades will be considered. Buildings with large on-peak loads will be considered and are better suited for storage applications, as the economics of daily operation will be optimized. We will study the possibility of incorporating battery storage for these facilities in subsequent tasks as outlined in the RFP.

9. **Solar Resource:** AECOM will use publicly available solar insolation historical data to analyze the resource at each site. Since the sites are close to each other, it is unlikely the solar resource will significantly vary from site to site. Nevertheless, we will analyze data from the National Renewable Energy Laboratory (NREL) and local sources to compare the sites. The Solar Prospector tool provides access to solar insolation data by zip code which drills down to 10 km square grids. AECOM will determine the best data for each site during this assessment. We will rank sites from the most to least suitable using a weighted scoring and prioritize the top ranked sites for further evaluation.

Step 2 – Preliminary PV Layouts and Production Modeling

AECOM will develop preliminary solar layouts based on the site analysis and rankings completed in Step 1. Examples of our preliminary layouts for some of the proposed NJ TRANSIT sites (list sites) are provided at the end of this section.

Each site will be evaluated for the best technology application according to the following design considerations:

- Best PV technology application; thin film, crystalline, or CPV
- Tracking vs. fixed mount
- Battery storage
- Building, ground-mount, or canopy parking structure.
- String inverters with DC optimizers or centralized inverters

Our team will perform production modeling using the licensed software PVsyst for each of the preliminary designs to determine hourly and annual energy production from the proposed PV system. We will use historical solar resource data for each site in this process. We will factor in assumptions based on our relevant engineering and installation experience regarding system performance characteristics and derate factors.



Above: Project Sunroof (Google image)
Below: High School Roof, Austin, TX



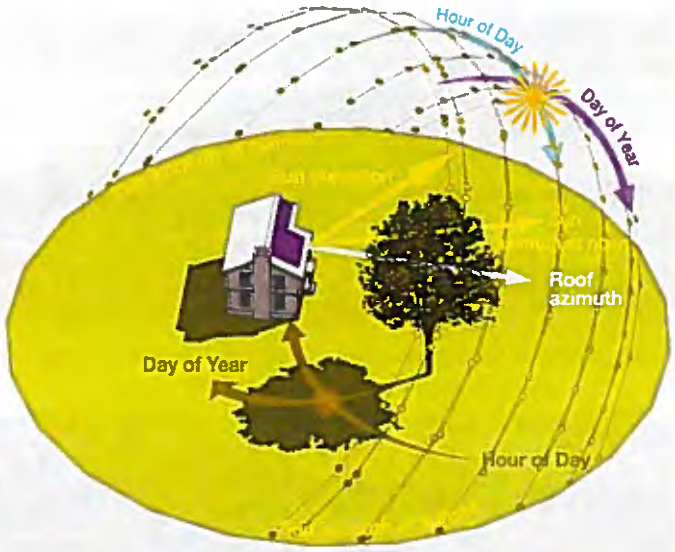


Figure 2-4. Modeling Tools and Techniques



Figure 2-5. Solar Pathfinder used for Field Verification of Roofs and Sites

Step 3 - Field Verification and Assessment

AECOM PV engineers have extensive experience assessing the suitability of buildings and land sites for solar PV. They will visit each site to verify the information gathered in Step 1. Each site's ranking will be reviewed in consideration of issues such as shade, roof membrane integrity, land and roof slops, environmental issues, obstructions, right-of-way, and any risks associated with installing a PV or storage system.

Step 4 - Preliminary Designs

The AECOM team will develop preliminary conceptual designs for the top PV sites as ranked in the screening process. The designs will include conceptual layouts, electric interconnect concepts, preliminary one-line diagrams, performance data, recommended solar modules, inverters, and other major PV system components. Preliminary drawings and specifications will include sufficient information for contractors to develop initial pricing for the PV/storage installations. AECOM will work with NJ TRANSIT to develop a complete design or a bid package and evaluation procedure for the procurement method NJ TRANSIT selects, including for design-build procurement.

Step 5 – System Cost and Financial Analysis

AECOM has developed customized economic models that helps evaluate the long-term investment in PV systems. Our team will complete economic analyses for the scenarios that NJ TRANSIT considers moving forward on. Examples of scenarios we will analyze include:

- Roof, ground, and parking canopy sizes ranging from 100kW up to 500kW
- Roof, ground, and parking canopy sizes ranging from 500kW up to 1000kW
- Roof, ground, and parking canopy sizes over 1000kW

Our economic analysis will consider incentives, financing options and other tools that could optimize the return on investment for NJ TRANSIT.

Contracting Options

This section provides a preliminary description of Solar PV related assets. We will examine procurement options in coordination with NJ TRANSIT.

These include:

1. **Third Party Finance Option (through a Power Purchase Agreement, PPA):** NJ TRANSIT is not subject to income tax and therefore is not eligible for the federal solar income tax credit (FITC). Solar PV systems installed before the end of 2016 are eligible for an income tax credit up to 30 percent of the capital investment for a PV system. It is uncertain a what the Federal Government will do after December 31, 2016, when the tax credit is scheduled to change from 30 percent to 10 percent. It is possible that the legislature will extend the 30 percent credit, or consider a gradual reduction.

   To capture the tax credits, NJ TRANSIT might consider partnering with a third party that would provide the capital investment for the proposed PV system, own and operate the system, and then sell the solar electricity generated from the system through a power purchase agreement (PPA) to NJ TRANSIT. This option could be explored with companies that provide these services. NJ TRANSIT could purchase the solar electricity for less than what it would cost from PSE&G for standard electricity, realizing potentially significant cost savings. Another option could be to lease the PV equipment.

   AECOM develops financial models that allow our clients to determine whether entering into a PPA or lease arrangement with a third party is advantageous.

2. **New Jersey Solar Photovoltaic Incentive Program "Solar Renewable Energy Certificates Registration Program" (SRECs):** Incentives are available for PV systems on commercial buildings (private and government). Electric providers in New Jersey, such as PSE&G, are obligated to purchase SRECs from solar photovoltaic generators to meet a minimum goal of 4.1 percent power from solar generation by year 2028. SRECs can be generated for the first 15 years of a solar project. The average price for SRECs in June, 2015 was $183/MWh, or 18.3 c/kWh. Thus, if NJ TRANSIT installed the solar PV systems at the proposed sites, the agency could sell the SRECs to PSE&G for about 18.3 c/kWh while avoiding electricity purchase from the grid for the on-site electric generation. Purchasing retail electricity at 10 c/kWh, NJ TRANSIT would realize about 28 c/kWh for the electricity generated by a solar PV plant on the roof.

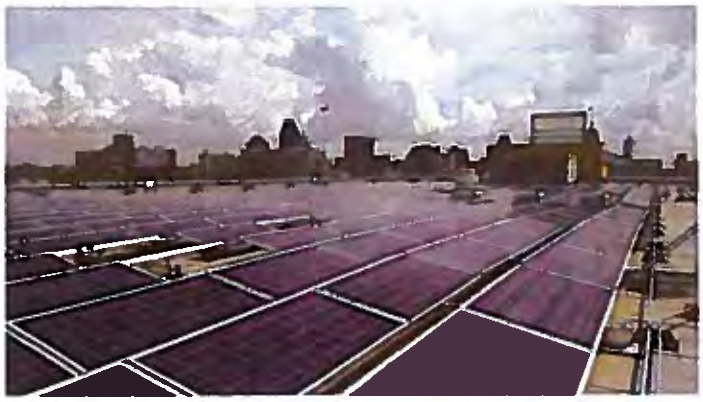
   AECOM will analyze risks associated with using SRECs. Notably, if NJ TRANSIT decided to develop the solar projects using a PPA financial structure, the SRECs would belong to the third party and not NJ TRANSIT.



Example of PV covered parking, one option we are considering



Ecolibrium Solar, Ecofoot Ballasted System



Rooftop PV Installation at University of Texas San Antonio Downtown Campus

3. **Solar Loan Program from PSE&G:** NJ TRANSIT could apply for a loan from PSE&G to cover up to 60 percent of the capital investment for the solar systems. However, it may not be advisable as the interest rate is 11.2 percent. It might be advisable to consider the CREBs described below, as these interest rates are closer to 3 to 4 percent.

4. **Clean Renewable Energy Bonds (CREBS):** These are highly attractive low interest loan bonds for local governments, schools, and state governments. They are available for renewable energy projects. NJ TRANSIT could use CREB funds for the solar PV installations.

5. **Energy Efficiency Program: "Pay for Performance Program":** PSE&G provides incentives for existing and new commercial buildings with high efficiency lighting, chillers, furnaces, boilers, air conditioners, and energy management systems. NJ TRANSIT may work with an approved "Program Partner" to benefit from these incentives. Rather than offer incentives for specific measures, PSE&G would pay based on an engineering analysis of the expected energy savings. The design engineer and the Program Partner determine the estimated savings for a proposed list of energy efficiency measures. PSE&G would then provide incentives based on a tiered payment schedule. This could be a format for financing some of the storage options.

Our financial team will work with NJ TRANSIT to complete a comprehensive economic analyses considering the available incentives and financing tools available for the solar and storage projects.

Solar Site Assessment

A preliminary site assessment to determine the suitability of the identified NJ TRANSIT locations for solar energy PV capacity was performed based on available usable area. The assessment examined the rail and ferry terminals as well as bus garages and parking lots associated with NJ TRANSIT. Figure 2-6 indicates the site, mounting type, usable area, and DC power capacity for the identified sites.

NJ TRANSIT Site	Potential Mounting Type	Estimated Usable Area (ft2)	Estimated DC Capacity (kW)
Newark Broad St. Terminal	Roof-tilt	2,435	24
Newark Broad St. Ground Mount	Ground	87,322	437
Secaucus Junction Terminal	Roof-flat	73,415	514
Secaucus Junction Parking Lot	Carport	112,294	1,572
Newark Penn Station Terminal	Roof-flat	21,314	149
Newark Penn Station Parking Lot	Carport	55,123	772
Port Imperial Ferry Terminal	Roof-flat	7,465	52
Hoboken Ferry Terminal	Roof-flat	35,755	250
Paulus Hook Ferry Terminal	Roof-flat	2,155	15
Liberty State Park Ferry Terminal	Roof-flat	2,249	16
Ferry Maintenance Facility	Roof-flat	1,539	11
Ferry Maintenance Parking Lot	Carport	60,758	851
Edgewater Ferry Terminal	Roof- tilt	919	9
Greenville Bus Garage	Roof-flat	59,942	420
Meadowlands Bus Garage	Roof-flat	206,702	1,447
Meadowlands Parking Lot	Carport	110,294	1,544
Wayne Bus Garage	Roof-flat	152,400	1,067
Wayne Transit Center Parking Lot	Carport	81,313	1,138
		Total	10.3 MW

Figure 2-6: Preliminary Site Assessment

Preliminary Layouts and Energy Production Modelling

Three sites from the assessment were explored in detail to showcase the possible PV system types (rooftop, parking shade structure, and ground mounted):

- The Meadowlands Bus Garage can accept a rooftop ballasted system, which could also be applied to other facilities
- The Wayne Transit Center can accommodate a carport shade canopy structure system applicable to other parking lots
- The Newark Broad Street site demonstrates a ground mounted fixed tilt system

We will explore the availability of other adjacent and/or contiguous land parcels that may be available to support the installation of PV systems. Preliminary layouts and PVsyst energy production models indicate the following DC capacity, AC capacity, energy produced, and specific production at the three sites as shown in Figure 2-7:

The DC capacities resulting from the preliminary layouts and energy production models are greater than the initial preliminary site assessment values, indicating a conservative estimate from the preliminary site assessment. Thus, the total combined capacity resulting from all the sites would be greater than 10.3 MW.

Deliverable:

- Evaluation and Recommendation Report (draft and final)



Site	DC Capacity (kW)	AC Capacity (kW)	Energy Produced (MWh/year)	Specific Production (kWh/kWp/year)
Meadowlands Bus Garage	1,885	1,500	2,299	1,220
Wayne Transit Center Parking Lot	2,011	1,600	2,435	1,211
Newark Broad St. Ground Mount	880	700	1,122	1,276

Figure 2-7: Preliminary Layouts and Energy Production Modelling. Layouts and system reports for Meadowlands, Newark Broad St and Wayne are presented in the following pages.

MEADOWLANDS BUS GARAGE
PROJECT AND SYSTEM SUMMARY

AC System Capacity (MW)	1.50	Inverter Quantity	15
DC System Capacity (MW)	1.89	Module Quantity	5,985
Total DC to AC Ratio	1.26	Modules per string	19
Racking Type	Ballast	Strings per Inverter	21
Racking Tilt	10°	Racking Azimuth	200°

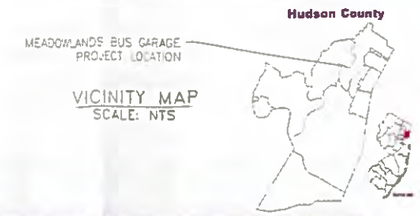
MEADOWLANDS BUS GARAGE
INVERTER SPECIFICATIONS

Manufacturer	Power Electronics	Model	FS100_T	Module	CS6X-315P
Input		Output		Pmp (W)	315
Maximum Voc (V)	1000	Nominal g to g AC Voltage (V)	480	Voc (V)	45.1
Maximum PV Current (A)	258	Max. AC Output Current (A)	145	Vmp (V)	36.6
Number of MPPTs	4	Nom. AC Frequency (Hz)	60	Isc (A)	9.18
Mpp Low (V)	450	Output Power (KVA)	100	Imp (A)	8.61
Mpp High (V)	820	PF Range (leading & lagging)	0.95	TCVoc (%/K)	-0.32

MEADOWLANDS BUS GARAGE
MODULE SPECIFICATIONS

# Modules per Series String	19
Vmp, Series String (V)	695.4
Vmp, High Temp. (V)	601.3
Design High Temp. (°C)	33.0
Voc, Series String (V)	856.9
Voc, Low Temp. (V)	969.3
Design Low Temp (°C)	-16.0

NOTE: MODULE AND INVERTER MANUFACTURES SPECIFIED ABOVE ARE PRELIMINARY AND USED FOR DEMONSTRATION OF SYSTEM CHARACTERISTICS AND ENERGY PRODUCTION MODELING ONLY. FINAL DESIGN MAY BE DIFFERENT



VICINITY MAP
SCALE: NTS



LANDSCAPE ELEVATION/ISO VIEWS
SCALE: NTS

PLAN
SCALE: 1"=40'

PRELIMINARY DESIGN ONLY - NOT FOR CONSTRUCTION

DESCRIPTION OF REVISION	BY	DATE
PRELIMINARY LAYOUT	SM	09/17/2015

NJTRANSIT The Way To Go.

AECOM

DESIGNED	SM
DRAWN	SM
CHECKED	JH, AA
PEER REVIEWED	
PROJECT MANAGER	JH
DATE	09/21/2015

NJ TRANSIT
MEADOWLANDS BUS GARAGE
PRELIMINARY SOLAR ARRAY LAYOUT
HUDSON COUNTY, NEW JERSEY

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Grid-Connected System: Simulation parameters

Project :	**NJ Transit**			
Geographical Site	**Newark International Arpt**		Country	**United States**
Situation	Latitude	40.7°N	Longitude	74.2°W
Time defined as	Legal Time	Time zone UT-5	Altitude	3 m
	Albedo	0.20		
Meteo data:	**Newark International Arpt**	TMY - NREL: TMY3 hourly DB (1991-2005)		

Simulation variant :	**Meadowlands Bus Garage**			
	Simulation date	21/09/15 17h28		

Simulation parameters				
Collector Plane Orientation	Tilt	10°	Azimuth	20°
Models used	Transposition	Perez	Diffuse	Imported
Horizon	Free Horizon			
Near Shadings	No Shadings			
PV Array Characteristics				
PV module	Si-poly	Model	**CS6X - 315P**	
		Manufacturer	Canadian Solar Inc.	
Number of PV modules	In series	19 modules	In parallel	315 strings
Total number of PV modules	Nb. modules	5985	Unit Nom. Power	315 Wp
Array global power	Nominal (STC)	**1885 kWp**	At operating cond.	1682 kWp (50°C)
Array operating characteristics (50°C)	U mpp	615 V	I mpp	2735 A
Total area	Module area	**11484 m²**	Cell area	10489 m²
Inverter	Model	**FreeSun FS0100 LVT**		
	Manufacturer	Power Electronics		
Characteristics	Operating Voltage	450-820 V	Unit Nom. Power	100 kWac
Inverter pack	Nb. of inverters	15 units	Total Power	1500 kWac

PV Array loss factors				
Array Soiling Losses			Loss Fraction	3.0 %
Thermal Loss factor	Uc (const)	20.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
Wiring Ohmic Loss	Global array res.	3.8 mOhm	Loss Fraction	1.5 % at STC
LID - Light Induced Degradation			Loss Fraction	2.0 %
Module Quality Loss			Loss Fraction	0.0 %
Module Mismatch Losses			Loss Fraction	1.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Param.	0.05
System loss factors				
Wiring Ohmic Loss	Wires: 3x1500.0 mm²	79 m	Loss Fraction	1.1 % at STC
Unavailability of the system	3.6 days, 3 periods		Time fraction	1.0 %

User's needs : Unlimited load (grid)

PVsyst Licensed to URS Corporation (United States)

NEWARK BROAD ST
PROJECT AND SYSTEM SUMMARY

AC System Capacity (kW)	700.0	Inverter Quantity	7
DC System Capacity (kW)	879.8	Module Quantity	2,793
Total DC to AC Ratio	1.26	Modules per string	19
Racking Type	Fixed Tilt	Strings per inverter	21
Racking Tilt	15°	Racking Azimuth	213°

NEWARK BROAD ST
INVERTER SPECIFICATIONS

Manufacturer	Power Electronics	Model	FS100_T
Input		Output	
Maximum Voc (V)	1000	Nominal φ to φ AC Voltage (V)	480
Maximum PV Current (A)	258	Max. AC Output Current (A)	145
Number of MPPTs	4	Nom. AC Frequency (Hz)	60
Mpp Low (V)	450	Output Power (KVA)	100
Mpp High (V)	820	PF Range (leading & lagging)	0.95

NEWARK BROAD ST
MODULE SPECIFICATIONS

Module	CSGX-315P	# Modules per Series String	19
Pmp (W)	315	Vmp, Series String (V)	695.4
Voc (V)	45.6	Vmp, High Temp. (V)	601.3
Vmp (V)	36.6	Design High Temp. (°C)	83.0
Isc (A)	9.18	Voc, Series String (V)	866.4
Imp (A)	8.61	Voc, Low Temp. (V)	987.2
TCVoc (%/K)	-0.34	Design Low Temp (°C)	-16.0

NOTE: MODULE AND INVERTER MANUFACTURES SPECIFIED ABOVE ARE PRELIMINARY AND USED FOR DEMONSTRATION OF SYSTEM CHARACTERISTICS AND ENERGY PRODUCTION MODELING ONLY. FINAL DESIGN MAY BE DIFFERENT.

Essex County



VICINITY MAP
SCALE: NTS



ELEVATION/PROFILE VIEW
SCALE: NTS

PLAN
SCALE: 1"=30'

PRELIMINARY DESIGN ONLY - NOT FOR CONSTRUCTION

REV	DESCRIPTION OF REVISION	BY	DATE
A	PRELIMINARY LAYOUT	SM	09/21/2015

NJTRANSIT The Way To Go

AECOM

DESIGNED SM
DRAWN SM
CHECKED JH, AA
PEER REVIEWED
PROJECT MANAGER JH
DATE 09/21/2015

NJ TRANSIT
WAYNE TRANSIT CENTER
PRELIMINARY SOLAR ARRAY LAYOUT
ESSEX COUNTY, NEW JERSEY

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PVSYST V6.37		21/09/15	Page 1/3

Grid-Connected System: Simulation parameters

Project : **NJ Transit**

Geographical Site	**Newark International Arpt**		Country	**United States**
Situation	Latitude	40.7°N	Longitude	74.2°W
Time defined as	Legal Time	Time zone UT-5	Altitude	3 m
	Albedo	0.20		
Meteo data:	**Newark International Arpt**	TMY - NREL: TMY3 hourly DB (1991-2005)		

Simulation variant : **Newark Broad St**

Simulation date 21/09/15 19h16

Simulation parameters

Collector Plane Orientation	Tilt	15°	Azimuth	33°
Models used	Transposition	Perez	Diffuse	Imported
Horizon	Free Horizon			
Near Shadings	No Shadings			

PV Array Characteristics

PV module	Si-poly	Model	**CS6X - 315P**	
		Manufacturer	Canadian Solar Inc.	
Number of PV modules	In series	19 modules	In parallel	147 strings
Total number of PV modules	Nb. modules	2793	Unit Nom. Power	315 Wp
Array global power	Nominal (STC)	**880 kWp**	At operating cond.	785 kWp (50°C)
Array operating characteristics (50°C)	U mpp	615 V	I mpp	1276 A
Total area	Module area	**5359 m²**	Cell area	4895 m²
Inverter	Model	**FreeSun FS0100 LVT**		
	Manufacturer	Power Electronics		
Characteristics	Operating Voltage	450-820 V	Unit Nom. Power	100 kWac
Inverter pack	Nb. of inverters	7 units	Total Power	700 kWac

PV Array loss factors

Array Soiling Losses			Loss Fraction	3.0 %
Thermal Loss factor	Uc (const)	29.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
Wiring Ohmic Loss	Global array res.	8.2 mOhm	Loss Fraction	1.5 % at STC
LID - Light Induced Degradation			Loss Fraction	2.0 %
Module Quality Loss			Loss Fraction	0.0 %
Module Mismatch Losses			Loss Fraction	1.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Param.	0.05

System loss factors

Wiring Ohmic Loss	Wires: 3x1500.0 mm²	150 m	Loss Fraction	1.0 % at STC
Unavailability of the system	3.6 days, 3 periods		Time fraction	1.0 %

User's needs : Unlimited load (grid)

PVsyst Licensed to URS Corporation | United States

WAYNE TRANSIT CENTER
PROJECT AND SYSTEM SUMMARY

AC System Capacity (MW)	1.60	Inverter Quantity	16
DC System Capacity (MW)	2.01	Module Quantity	6,384
Total DC to AC Ratio	1.26	Modules per string	19
Racking Type	Carport	Strings per inverter	21
Racking Tilt	15°/10°	Racking Azimuth	151°/241°

WAYNE TRANSIT CENTER
INVERTER SPECIFICATIONS

Manufacturer	Power Electronics	Model	FS100_T
Input		Output	
Maximum Voc (V)	1000	Nominal ø to ø AC Voltage (V)	480
Maximum PV Current (A)	258	Max. AC Output Current (A)	145
Number of MPPTs	4	Nom. AC Frequency (Hz)	60
Mpp Low (V)	450	Output Power (KVA)	100
Mpp High (V)	820	PF Range (leading & lagging)	0.95

WAYNE TRANSIT CENTER
MODULE SPECIFICATIONS

Module	CS6X-315P	# Modules per Series Strng	19
Pmp (W)	315	Vmp, Series String (V)	695.4
Voc (V)	45.6	Vmp, High Temp. (V)	601.3
Vmp (V)	36.6	Design High Temp. (°C)	33.0
Isc (A)	9.18	Voc, Series String (V)	866.4
Imp (A)	8.61	Voc, Low Temp. (V)	987.2
TCVoc (%/K)	-0.34	Design Low Temp (°C)	-16.0

NOTE: MODULE AND INVERTER MANUFACTURES SPECIFIED ABOVE ARE PRELIMINARY AND USED FOR DEMONSTRATION OF SYSTEM CHARACTERISTICS AND ENERGY PRODUCTION MODELING ONLY. FINAL DESIGN MAY BE DIFFERENT.



VICINITY MAP
SCALE: NTS



PLAN
SCALE: 1"=50'

ELEVATION/PROFILE VIEW
SCALE: NTS

PRELIMINARY DESIGN ONLY - NOT FOR CONSTRUCTION

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A	PRELIMINARY LAYOUT	SM	09/18/2015

NJ TRANSIT The Way To Go.

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PROJECT MANAGER JH
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PASSAIC COUNTY, NEW JERSEY

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PVSYST V6.37		21/09/15	Page 1/4

Grid-Connected System: Simulation parameters

Project :	**NJ Transit**			
Geographical Site	**Newark International Arpt**		Country	**United States**
Situation	Latitude	40.7°N	Longitude	74.2°W
Time defined as	Legal Time	Time zone UT-5	Altitude	3 m
	Albedo	0.20		
Meteo data:	**Newark International Arpt**	TMY - NREL: TMY3 hourly DB (1991-2005)		

Simulation variant :	**Wayne Transit Center**			
	Simulation date	21/09/15 18h20		

Simulation parameters				
2 orientations	Tilts/Azimuths	10°/61° and 15°/-29°		
Models used	Transposition	Perez	Diffuse	Imported
Horizon	Free Horizon			
Near Shadings	No Shadings			
PV Arrays Characteristics	**(2 kinds of array defined)**			
PV module	Si-poly Model	**CS6X - 315P**		
	Manufacturer	Canadian Solar Inc.		
Sub-array "Sub-array #1"	Orientation	#1	Tilt/Azimuth	10°/61°
Number of PV modules	In series	19 modules	In parallel	320 strings
Total number of PV modules	Nb. modules	6080	Unit Nom. Power	315 Wp
Array global power	Nominal (STC)	**1915 kWp**	At operating cond.	1709 kWp (50°C)
Array operating characteristics (50°C)	U mpp	615 V	I mpp	2779 A
Sub-array "Sub-array #2"	Orientation	#2	Tilt/Azimuth	15°/-29°
Number of PV modules	In series	19 modules	In parallel	16 strings
Total number of PV modules	Nb. modules	304	Unit Nom. Power	315 Wp
Array global power	Nominal (STC)	**95.8 kWp**	At operating cond.	85.5 kWp (50°C)
Array operating characteristics (50°C)	U mpp	615 V	I mpp	139 A
Total Arrays global power	Nominal (STC)	**2011 kWp**	Total	6384 modules
	Module area	**12250 m²**	Cell area	11188 m²
Inverter	Model	**FreeSun FS0100 LVT**		
	Manufacturer	Power Electronics		
Characteristics	Operating Voltage	450-820 V	Unit Nom. Power	100 kWac
Sub-array "Sub-array #1"	Nb. of inverters	15 units	Total Power	1500 kWac
Sub-array "Sub-array #2"	Nb. of inverters	1 units	Total Power	100 kWac
Total	Nb. of inverters	16	Total Power	1600 kWac
PV Array loss factors				
Array Soiling Losses			Loss Fraction	3.0 %
Thermal Loss factor	Uc (const)	29.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
Wiring Ohmic Loss	Array#1	3.7 mOhm	Loss Fraction	1.5 % at STC
	Array#2	75 mOhm	Loss Fraction	1.5 % at STC
	Global		Loss Fraction	1.5 % at STC
LID - Light Induced Degradation			Loss Fraction	2.0 %

PVsyst Licensed to URS Corporation (United States)

Energy Storage

AECOM will perform an economic and technical analysis to determine the best energy storage (ES) technology options. Figure 2-8 provides an overview of the relevant ES options. Determining the best option or combination of options requires:

- An understanding of the current state of ES application and lessons learned that can be applied
- Coordinating ES with the proposed solar PV and other energy generation assets

AECOM has teamed with Navigant, a global leader in the ES industry to provide insight and analysis of the industry, economic development opportunities, market opportunities, industry-focused programs, and policy alternatives.

Our team has relationships with an extensive network of stakeholders in this industry:

- **Navigant's Director-in-Charge, Colette Lamontagne,** is the Immediate Past Chair of the Energy Storage Association's (ESA) Board of Directors and has served on the ESA Board of Directors since 2010.
- **Our experts have decades of experience working in utility firms.** They understand how grids operate and how energy storage is deployed to support grid operations. Over the last five years alone, they have applied this expertise on more than 50 consulting assignments related to ES for government, utility, financial, and technology provider clients.
- **Navigant's Market Intelligence Team follows trends to produce forecasts and will leverage existing syndicated market research reports.** The team has conducted research on the ES industry for the last six years, including interviews with stakeholders in all aspects of the industry. Each report includes the market landscape, a summary of the key technologies and market actors, market drivers, and market trends. This provides us with a current and comprehensive knowledge base of technology capabilities and trends. Relevant recent reports include but are not limited to:

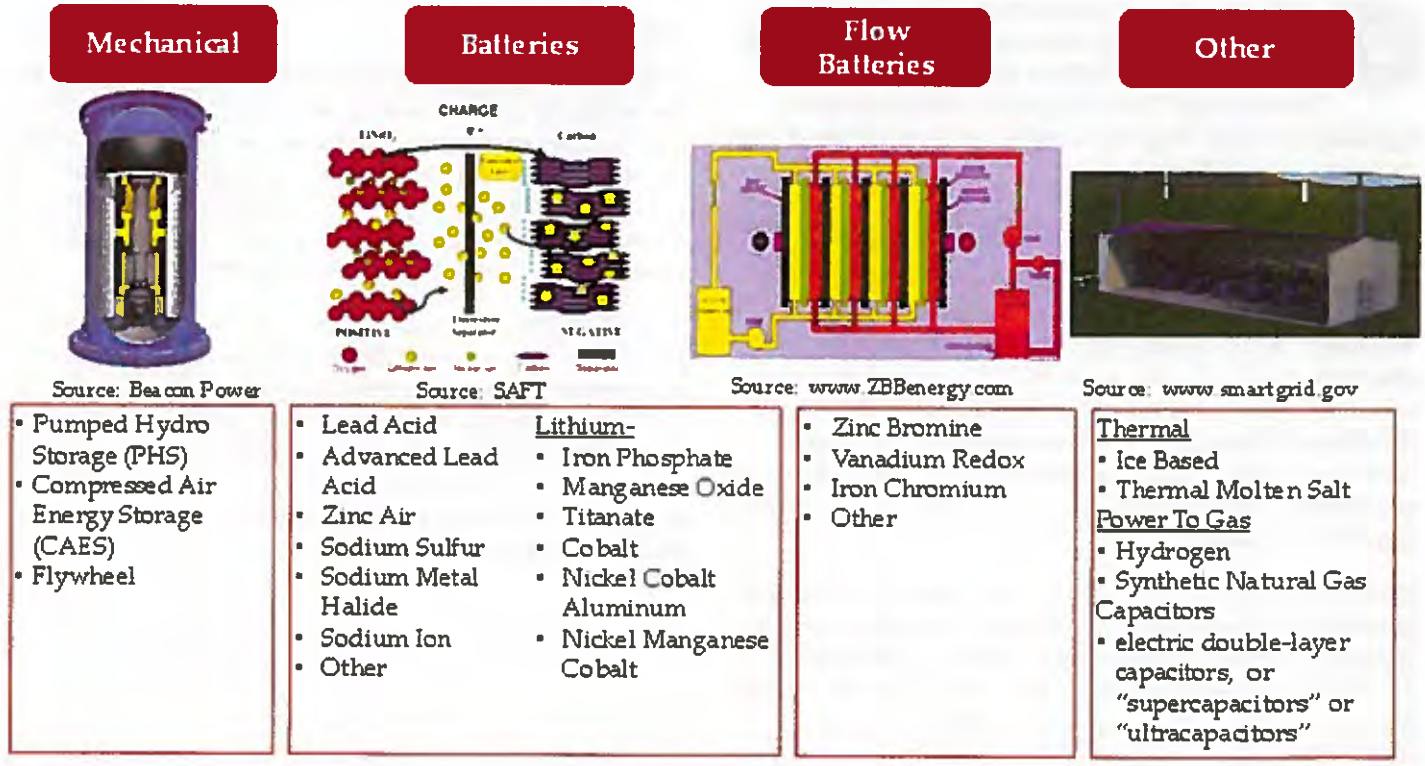


Figure 2-8. Energy Storage Technologies

- Leaderboard Report: Li-Ion Grid Storage (2Q15)
- Leaderboard Report: Energy Storage Systems Integrators (2Q15)
- Energy Storage Enabling Technologies (1Q15)
- Energy Storage Tracker (1Q15)
- Community, Residential, and Commercial Energy Storage (4Q14)
- Energy Storage for the Grid and Ancillary Services (3Q14)
- Energy Storage for Wind and Solar Integration (2Q13)

Cost Benefit Analysis

Our team is expert in cost-benefit analysis and framework development. We leverage proven tools and modeling techniques to develop models for emerging electricity technologies such as energy storage, smart grid, and high temperature conductivity. Our energy storage and smart grid cost-benefit methodologies have been peer reviewed and adopted by DOE as the standard approach for the Smart Grid Investment Grant (SGIG) and Smart Grid Demonstration (SGD) projects.

In the recent grid modernization initiative, the Massachusetts Department of Public Utilities (DPU) referenced our smart grid methodology, which is documented in the EPRI report, Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects.

Approach to Applying and Coordinating Energy Storage

To build the foundation for the study, it is essential to understand the ES industry, including characteristics of relevant technologies, utility applications, benefits, companies, and programs. A variety of ES technologies store electricity through mechanical, chemical, thermal or electro-chemical means. Some are more appropriate for energy applications that require a longer duration of output. Some are more appropriate for power applications that require a larger output for a shorter time.

The AECOM team will leverage our peer-reviewed cost-benefit analysis framework, which is a rigorous approach to identify, quantify and monetize the benefits of ES technologies in a comprehensive list of stationary applications. Energy storage applications fall into three categories: load leveling, grid operational support, and grid stabilization.

Load Leveling (Generating power off peak and using it on peak)

- Renewable Energy Shifting
- Wholesale market & Cost Optimization (e.g., arbitrage)
- Retail Market (e.g., time of use rates, demand charge management)
- Asset Management

Grid Operational Support (Matching supply to demand)

- Load Following
- Operating Reserves
- Frequency Regulation
- Renewable Energy Firming
- Black Start

Grid Stabilization (Improving reliability)

- Renewable Energy Ramping
- Renewable energy Smoothing
- Backup Power
- Bridging Power

On the following page, Figure 2-9 illustrates our framework for identifying economic, reliability, and environmental benefits that could be realized by each of these applications. Benefits will vary depending on factors such as the location on the grid (i.e., generation, transmission, distribution, behind the meter), the regulatory structure (regulated vs. deregulated), ownership, and which technology is selected.

In this study, Renewable Energy Shifting, Renewable Energy Smoothing, Frequency Regulation, and Backup Power are the most relevant. Figure 2-10 defines each of these applications. To select the appropriate energy storage technology, it's important to consider the necessary energy and power, cycles, and calendar life. Shifting and backup power are considered energy applications, and smoothing and frequency regulation are considered power applications.

Applications	Economic									Reliability		Environmental		
	Market Revenue		Asset Utilization					Efficiency	Cost	Interruptions		Air		Water
	Arbitrage Revenue	Capacity Revenue	Ancillary Service Revenue	Optimized Generator Operation	Reduced Congestion Cost	Deferred Generation Capacity Investments	Deferred Transmission Capacity Investments	Deferred Distribution Capacity Investments	Reduced Electricity Losses	Reduced Electricity Cost	Reduced Outages	Improved Power Quality	Reduced CO_2 Emissions	Reduced SO_x, NO_x, and Particulate Emissions	Reduced Water Use
Load Leveling															
Renewable Energy Shifting	X			X	X	X	X	X	X	X			X	X	X
Wholesale Market & Cost Optimization	X			X	X	X	X	X	X	X			X	X	X
Retail Market				X	X	X	X	X	X	X			X	X	X
Asset Management				X	X	X	X	X	X				X	X	
Grid Operational Support															
Operating Reserves			X	X		X							X	X	X
Load Following				X		X							X	X	X
Frequency Regulation			X	X		X							X	X	X
Renewable Energy Firming		X													
Black Start			X			X									
Grid Stabilization															
Renewable Energy Ramping				X		X							X	X	X
Renewable Energy Smoothing				X									X	X	X
Backup Power											X				
Bridging Power												X			

Figure 2-9. Energy Storage Benefits

Application	Definition
Renewable Energy Shifting	This application involves storing electricity from intermittent renewable sources when the price of electricity is low and selling that stored energy when the price of electricity is higher. Energy storage can be paired with solar PV to make PV "dispatchable" by storing it and discharging at a different time when solar energy is not available.
Renewable Energy Smoothing	Solar and wind resources are intermittent on a seconds to minutes basis due to cloud cover or inaccurate wind forecasts. ES can help to smooth the output volatility and improve power quality. This is similar to providing Frequency Regulation but more distributed and local. Frequency regulation typically refers to smoothing across the grid.
Frequency Regulation	Frequency regulation is an ancillary service concerned with managing energy flows to reconcile momentary differences between supply and demand. This service is provided by on-line generation equipped with automatic generation control (AGC) that can change output quickly to track the moment-to-moment fluctuations in customer loads and correct for the unintended fluctuations in generation. Regulation helps maintain interconnection frequency, manage differences between actual and scheduled power flows between balancing areas, and match generation to load within the balancing area. The application can involve using ES to provide this service and participate in the market for area regulation services. Because ES can respond to system regulation needs more accurately and quickly than some conventional generation sources, less capacity could be required if ES devices rather than conventional devices are used to provide this service, which frees up conventional capacity to meet energy needs.
Backup Power	ES may be used to ensure highly reliable electric service. In the event of an extended system disruption ES can be used to ride through the outage, to complete an orderly shutdown, or to transition to on-site generation.

Figure 2-10. Application Definitions

To conduct a cost benefit analysis of the various ES options, we will start with our team's excel-based model, "Navigant's Valuation of Energy Storage Tool" (NVEST). This user-friendly tool allows the user to identify, quantify, and monetize the benefits of an energy storage investment resulting in a net present value analysis. Figure 2-11 illustrates the process. Figure 2-12 illustrates the tabular output. The results are displayed graphically in a variety of charts. This methodology has been peer reviewed and adopted by the U.S. DOE for use by the recipients of the Smart Grid Demonstration program. We have used NVEST for other clients to determine the most cost-effective ES approach. We also used this methodology to study the opportunity for energy storage deployment across North America.

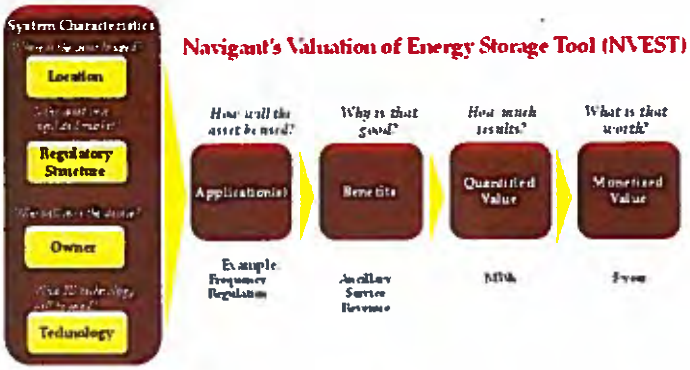


Figure 2-11. NVEST Process Flow

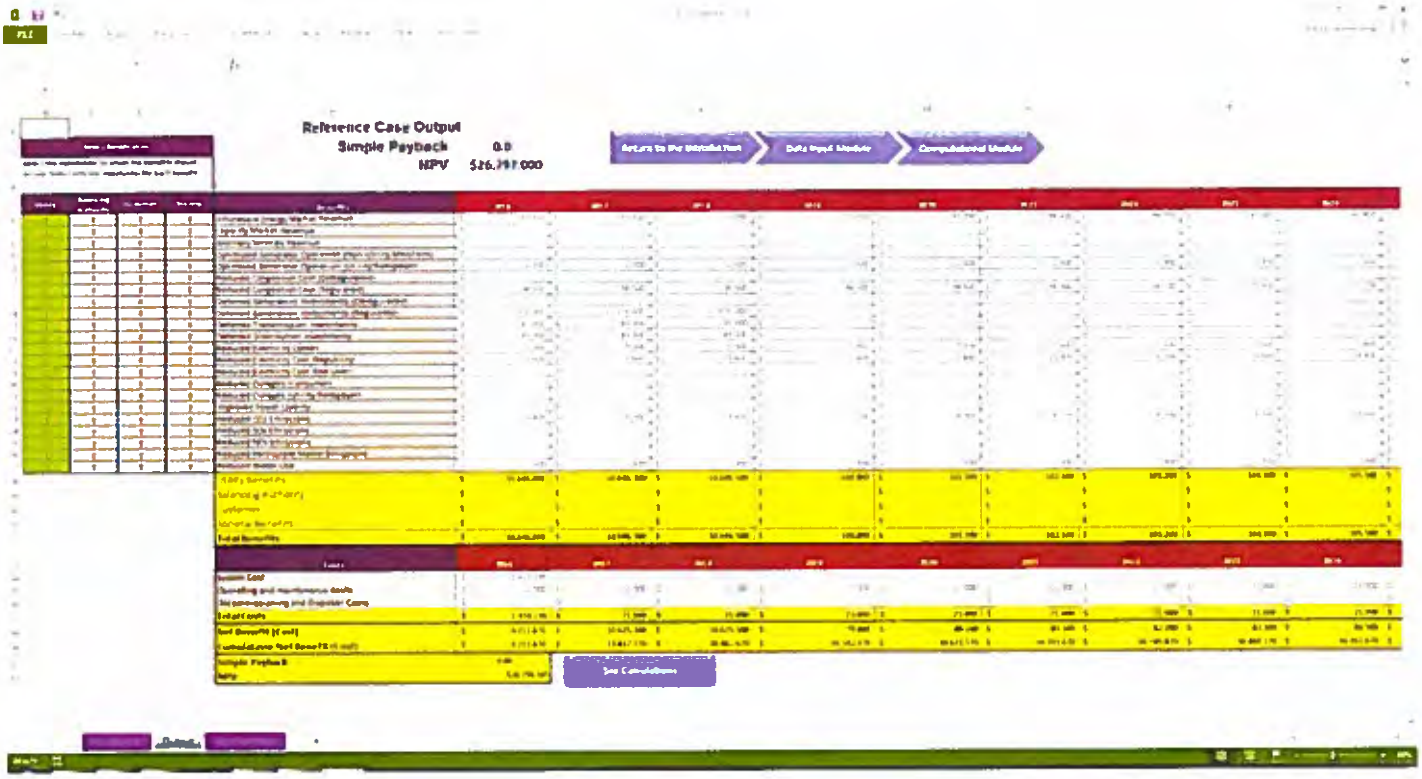


Figure 2-12. Example of NVEST Tabular Output

2.2.3 Evaluation and Design Application of Combined Heat and Power (CHP)

As NJ TRANSIT recognizes, CHP is not a technology for producing energy but an approach to using energy production technologies in ways that maximize efficiency in meeting electric and thermal energy needs, or ways in which the thermal energy byproduct from the primary power production mode is then converted into additional energy through a thermal recovery system.

Each technology that produces electricity has some inefficiency which manifests as heat. What is different among the technologies is the efficiency of conversion of fuel into electricity and the quantity and quality of the by-product heat. The quality and quantity of recoverable heat versus the required electricity guides the selection of electric production technology.

AECOM will work with NJ TRANSIT in reviewing the Sandia report and the fundamental information used by the report along with the most recent information available to prepare recommendations for each of the identified sites.

The objective of selecting and sizing a CHP system is to maximize financial value during normal day-to-day operations and to provide some measure of resiliency to protect a plant, often in conjunction with the facilities emergency generators. In these solutions the electric generation capacity is selected such that the electric demand and the thermal utilization demand can both be maintained at high levels and so that fuel to energy efficiency (fuel/[electricity and heat]) over an annual cycle is high, i.e., at 65 percent efficiency or greater.

Depending on the program and location, the efficiency may be based on either the Low Heating Value of Fuel (LHV) or the High Heating Value (HHV) of fuel. The fundamental difference between these two values is that the former looks only at the energy that can typically produce work and disregards the energy drawn from the fuel to form water during combustion. In pragmatic terms with natural gas as the fuel the efficiency expressed on an LHV basis is 90 percent that of HHV.

However, when the objective of the CHP includes the requirement that the facility be capable of sustaining mission critical activities when the normal utility grid would not be available, then the design for the facility needs to have what might normally be a "suboptimum" design, or the CHP elements of the design need to be augmented with additional elements to provide sufficient capacity to operate during the extended outage period. Typically oversizing the CHP will achieve the capacities with the smallest capital cost while adding separate peaking hardware will keep operating efficiency higher. Assuming that physical space is not a limitation, the comparative value of the incremental added cost versus differences in efficiencies would drive the solution.

The sites for which CHP facilities are to be considered vary significantly in size and in nature of the thermal loads available.

Technology Analysis and Comparison

The following discussion provides a brief overview of technologies likely to be recommended for the various sites. It reviews the selection parameters for the CHP technology evaluation. Internal combustion reciprocating engines (IC), combustion gas turbines (CGT) microturbines (MT), fuel cell technologies (FCT), and PV collection cells with battery storage were all considered for the NJ TRANSIT's facilities. In related work, our team recently applied CHP technology evaluating technology types for the Northport, Virginia CHP project to reduce peak electric demand and offset heating and hot water demand.

In consideration of system capacity, operation requirements and space constraints, IC and MT CHP technologies are the most suitable. Several vendors representing manufacturers of IC and MT generator sets (engine + generator or gensets) were contacted for operational specifications and costs to enable an evaluation of as many systems as possible. We will go through a similar evaluation process to determine the most suitable CHP technology type for each site.

In the RFP the size of CHP opportunities is identified as ranging from as low as 100 kW to 7 MW, although most were at the smaller end. Using our experience in evaluating and developing CHP solutions we will customize the solution for each location based on its electric and thermal demands.

Internal Combustion Reciprocating Engines

IC reciprocating engines are a widespread and well-known technology, suited for standby, peak and continuous duty applications for standard electricity generation. Typical gas fueled IC engine generators are 1 to 5 MW for CHP applications, although smaller and larger units are available.

Current generation natural gas engines offer low first cost, fast start-up, reliability when properly maintained, excellent load-following characteristics, and significant heat recovery potential. Electric efficiencies of natural gas engines range from 28 percent LHV for small stoichiometric engines (<100 kW) to over 40 percent LHV for large lean burn engines (> ~ 1 1/2 MW). Waste heat can be recovered from the hot engine exhaust (low to medium pressure steam or hot water) and from the engine cooling systems (hot water) for CHP applications. Overall CHP system efficiencies (electricity and useful thermal energy) of 70 percent (LHV) are attainable with natural gas engine systems. A typical schematic of a reciprocating engine-based CHP system is shown in Figure 2-13.

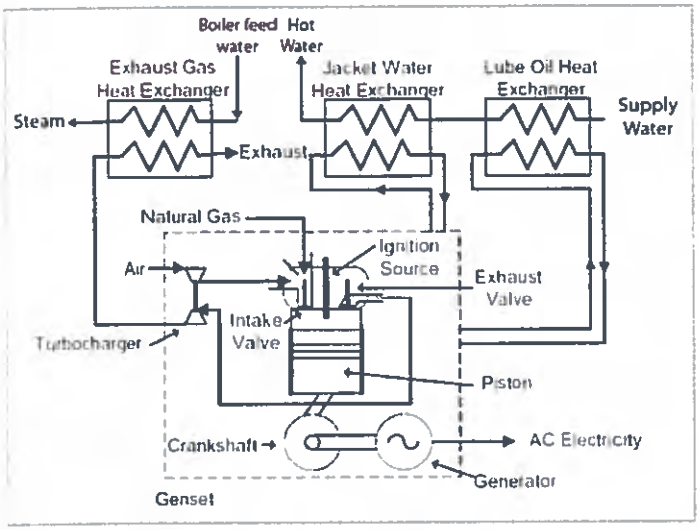


Figure 2-13. Schematic of a reciprocating, engine-based CHP system.

Gas Combustion Turbines (GST) Engine

Figure 2-14 shows a schematic of a GST engine. Gas combustion turbines are perhaps the most significant technology in use today for power generation. In the realm of CHP almost all new base-loaded utility power plants employ a special form of CHP known as a combined cycle, in which waste heat from the CTGs is used to produce steam that then drives a steam turbine generator. In industrial and institutional settings steam or hot water is typically produced from the CTG's exhaust to create steam for facility use. Less commonly, the heat is recovered and used as hot water and even less commonly used to fire an absorption chiller.

With respect to industrial or institutional CHP projects - CTGs are typically small frame-style machines (~1.5 to 25 MW) or aeroderivative turbines – (25-100 MW). The majority of the projects use CTGs with a capacity of less than 15 MW. CTG efficiencies range from the low 20s for the small units to about mid 30s for the larger units in this bracket. The sole exception to this relationship is the one 4.5 MW recuperated turbine, which has an efficiency percentage in the low 40s.

In this group of CTGs the equipment design is reasonably mature and generally quite reliable. Fuel flexibility is available and many units are installed with dual or tri fuel options. Depending upon location and existing site emissions cleanup of the exhaust with SCR for NOx and Oxidation Catalyst for CO and VOC's is like to be required. While fuel to electricity conversion is not as high as for reciprocating engines, CTGs are a good choice when there is also a use for thermal energy recovered as steam.

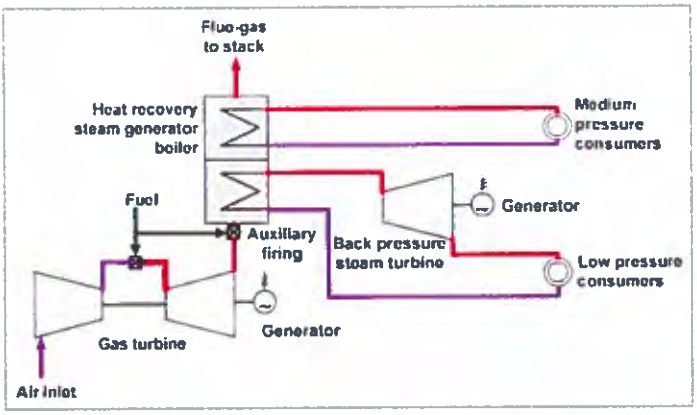


Figure 2-14. Schematic of a gas combustion turbine engine.







AECOM designed and constructed the Rikers Island cogeneration facility – a 5MW natural gas plant, a 15 kV medium voltage electrical distribution system, a control room and a new microgrid controls system. Above left, major equipment is rigged into place. Above right, plant near completion.

Microturbine

Microturbines (MT) are very small combustion turbines with outputs of 30 kW to 400 kW. Individual units can be packaged together to serve larger loads. Designed to combine the reliability of auxiliary power systems used on-board commercial aircraft with the design and manufacturing economies of turbochargers, the units are targeted at CHP and prime power applications in commercial buildings and light industrial applications. A typical microturbine-based CHP system is shown in Figure 2-15.

In most configurations, a high speed turbine (100,000 rpm) drives a high speed generator producing direct current (DC) power that is electronically inverted to 60 Hz (or 50 Hz) AC. MT systems are capable of producing power at around 25-33 percent efficiency by employing a recuperator that transfers exhaust heat back into the incoming air stream. As with all combustion turbines, efficiencies generally decrease at elevated ambient temperatures.

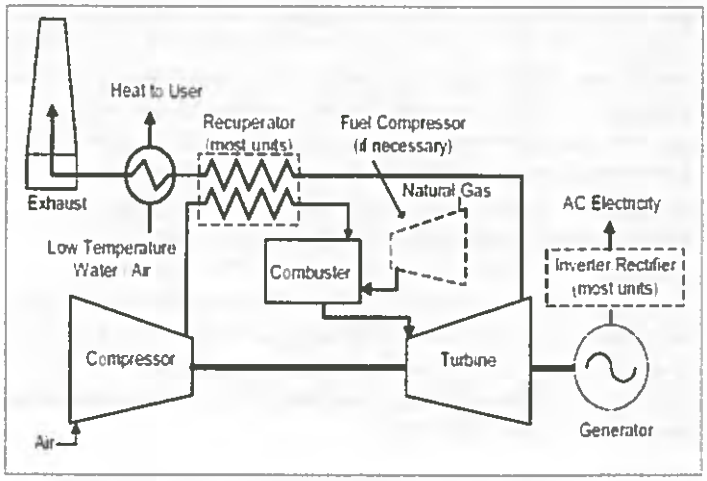


Figure 2.15. Schematic of a Microturbine Cogen

Fuel Cells

Figure 2-16 is a schematic of a typical fuel cell. There are many different types of fuel cells available for use in a number of different applications. For stationary cogeneration (production of electricity and hot water) however, two technologies predominate. They are differentiated by the composition of the electrolytic membrane within the fuel cell. The membrane is what drives the electrochemical reaction and can be thought of as the "engine" of the process. **Phosphoric acid fuel cells (PAFCs)** use a membrane composed of liquid phosphoric acid, while **molten carbonate fuel cells (MCFCs)** employ a porous matrix filled with a molten carbonate salt mixture.

Each technology has its merits and deficiencies. MCFCs generate much more heat. This works well with sites that have a high heat demand, but this characteristic results in longer start-up times. PAFCs consume very little water compared to the MCFCs but require separate devices that use nitrogen to reform the natural gas into a useable fuel. The pros and cons of each technology and their differences mean that depending on the specific application, one type is more appropriate than the other.

With a molten carbonate-filled core, the MCFCs operate at extremely high temperatures (roughly 1,200 °F) to ensure that the liquid does not solidify. This not only allows for more waste heat to be collected but also allows for greater diversity of fuel composition. At higher operating temperatures, the natural gas fuel does not require a separate reformation process and can be used in the fuel cell directly from the utility supply. This, however, requires the use of water to satisfy the electrochemical reaction within the fuel cell – about four gallons per kW per day. Not only do the MCFCs consume a large amount of water every day, but they also discharge water. Water discharge can amount to two gallons per kW per day. It should be noted that water discharge is not gravity-fed, and pressurized water discharge may require special provisions as mandated by local authorities.

As mentioned previously, the PAFC variety (such as United Technologies Corporation's PureCell® 400 Fuel Cell) requires a separate supply of nitrogen, which is typically provided from a set of cylinders. Under typical operating conditions, this set of cylinders must be replaced each year. This is performed as part of a long-term service contract. Other items covered by such a contract may include replacement of air and water filters, change-out of charcoal and resin bottles, inspection of wiring and hoses, controller software updates, and replacement of larger items like pumps and cooling fans.

Not included with these service contracts is the replacement of the fuel cell stack. This is by far the most expensive service cost. For the UTC PureCell® 400, the stack costs roughly half the cost of a new fuel cell. The UTC fuel cell stack used to require replacement every five years, but the recent addition of an ammonia scrubber helps reduce the presence of harmful ammonia in the cell stack and has increased the stack life to ten years for the Purecell® 400. While the MCFC units avoid this problem with their high operating temperatures, the molten carbonate cells themselves are highly corrosive and require regular replacement. With the DFC300 unit, offered by FCE, the initial stack life is three years, with replacement stacks lasting five years. Pricing of a new FCE fuel cell stack is roughly equivalent to that of the PureCell® 400.

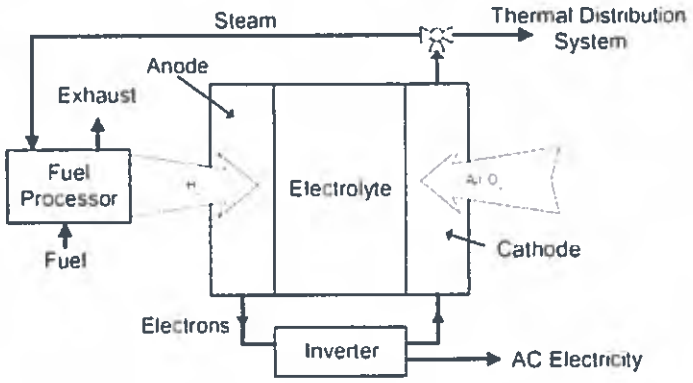


Figure 2.16. Schematic of a typical fuel cell.

Energy Auditing and Analysis

As we develop DER solutions, we will conduct an energy audit for each affected facility. The energy audits will benefit NJ TRANSIT in a several ways. They—

1. **Establish a reliable energy baseline.** Through a detailed utility data review and on-site verification of equipment/system and operating data, we will develop an energy baseline. This includes energy information the facility needs for successful energy management.

2. **Establish an energy end-use allocation.** Based on data collected prior to and during the on-site visit, we will establish an energy end-use allocation by major system. The systems typically include, but are not limited to, heating, cooling, lighting, fans, pumps and domestic hot water system. Energy end-use allocation provides the facility staff with information about how much energy is used and where and to track savings realized from energy savings projects. End-use allocation is a key component of effective energy management.

3. **Identify energy savings opportunities.** It is important to identify energy conservation measures (ECM) while developing the DER solution. Depending on the size of the potential energy savings, the capacity of the distributed generation might be influenced. If there are feasible ECMs that can permanently reduce the peak demand will be taken into consideration when sizing a DER system. The facility will have a list of ECMs with an estimated energy savings, implementation cost and economic analysis of each.

4. **Review and identify areas for improvement in O&M.** Based on ASHRAE energy audit guidelines, the energy audit can include a review of the O&M practices. There is almost always considerable room for improvement in O&M, leading to energy savings and/or operating cost savings.

Energy Audit Process

The following sections describe the process of the energy audit.

Preliminary Energy-Use Analysis (PEA). Prior to the on-site walk-through survey, we will engage with facility contacts and request basic utility use and cost information. Typically, we review 12 to 36 months of utility billing information to identify irregularities in monthly use patterns and to develop the energy utilization index (EUI) for the building. We compare the building EUI to similar buildings' EUIs to assess the potential for energy performance improvements and energy savings. This step enables us to engage with facility staff early in the process and also puts us in a position to conduct the on-site energy audits and to develop effective DER solutions.

To best prepare for on-site visits and data gathering, we develop initial energy end-use allocations for each building type with the utility data and a preliminary evaluation of energy conservation opportunities. We use AECOM's SSIMe audit methodology to undertake this analysis. This methodology is Excel-based and uses an off-the-shelf DOE- and USGBC-approved energy simulation tool, IES Virtual Environment. This approach has been used for the assessment of more than eight million square feet of US Air Force facilities and over 25 million square feet of Navy facilities.

A sample energy end-use allocation for the Wayne Bus Garage is illustrated in Figure 2-17. Annual electricity and natural gas consumption information was available from the Sandia report. A typical bus garage monthly energy usage profile was applied to the annual consumptions, and additional assumptions were made to estimate energy end-use allocations.

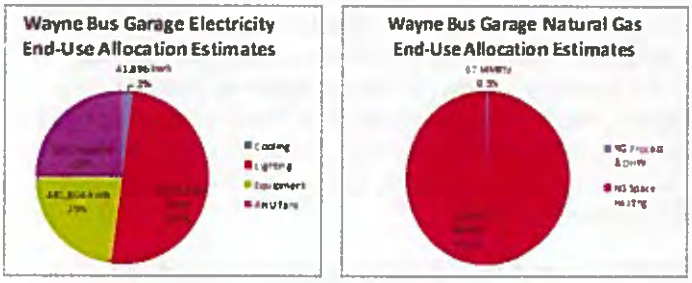


Figure 2-17. On-site walk-through survey.

On-site walk-through survey consists of interviews with the facility staff team, data collection and on-site observation / measurement. The main goal of the on-site survey is to understand building operation, performance, and systems in the context of potential ECMs.

The survey starts with a meeting with facility staff, including the O&M staff, who know the building and the energy using systems and can answer technical questions. During the meeting, the energy auditor leads discussions to gain an understanding of building systems and operations, planned improvements, existing problems and any O&M issues. The energy auditor will work with facility staff to coordinate the on-site survey.

For data collection, we will use tools appropriate to the site. One of the tools is a cloud-based mobile data collection platform called iFormBuilder and its data collection template, iForm. We have established a comprehensive iForm for energy audits over past two years. It enables us to collect equipment data and measurements via mobile devices during the site survey. iForm allows us to collect the required data efficiently

and facilitates an data transition into an Excel file. Data download from the cloud results in significant time savings when compared to transcribing hand-notes.

During the survey, we typically take different types of measurements, including both spot and interval measurements. If we need to analyze a set of measurements over a period of time, we will install data loggers during the site survey and collect them when data logging is complete. Our team will discuss data measurements with the facility staff prior to the site survey.

Energy Survey Data Analysis. Following the site visit, the energy auditor will perform two main tasks to prepare the final deliverable: First, he/she will finalize the energy end-use allocation by building system. The energy auditor performs quality control or quality assurance of the collected data on the system/equipment and operations such as capacity, diversity factor, and operating hours. These data are used to fine-tune the preliminary energy end-use allocation prior to the site visit. The total energy usage will be calibrated to the actual utility bill data.

The other component is developing the energy conservation measures (ECMs) based on findings from the interviews, field observations and supporting data collected from the site. Our energy auditor will use a number of tools to assess the potential benefits associated with various energy conservation strategies across the range of opportunities from lighting and HVAC upgrades to enhanced controls strategies, waste stream recovery and reuse, and on-site renewables.

Our team will examine capital improvements and O&M opportunities. We may conduct additional system-specific analyses in which, for example, EMS data or logged/observed conditions provide insight into energy use to develop energy conservation opportunities.

For each ECM, we will develop an energy savings estimate, impact on greenhouse gas emissions (GHGs), implementation cost estimate and economics analysis. Predicted energy savings will be presented by building systems. An economic analysis may include, but not be limited to, the investigation of potential incentives/rebates, simple payback and life-cycle cost analysis.

Deliverable

- On completion of the energy audit, AECOM will prepare an energy audit report addressing the evaluation and making recommendations. The report will address relevant sections of the ASHRAE energy audit guidelines. Supporting information such as analysis, measured data, cut sheets and sketches will also be included in the report as appropriate.



Typical condensate return piping



Typical boiler system



Typical air handling unit & fan system

Electric Vehicle (EV) Charging and Procurement

The Sandia Feasibility Study for the NJ TRANSITGRID has called for a range of electric vehicles (EVs) including 27 EV golf carts, 62 electric powered fork/scissor lifts, and 27 "standard" EVs distributed across sedans, pick-up trucks, cargo trucks, and specialty vehicles. These EVs will be electrically charged. The feasibility study specifically calls for an EV Charging Station at the Meadowlands Maintenance Center. We will revisit these recommendations and verify them with additional data and investigations as part of the verification of design process.

EVs use chemical energy stored in a battery pack instead of an internal combustion engine for traction power. EVs are more efficient than internal combustion engines and eliminate local air pollution. When powered from renewable resources, like solar photovoltaic systems (solar PV), they also eliminate CO2 emissions. EVs now come as plug-in hybrid electric (PHEVs) vehicles that combine a battery pack that can be recharged with a J1772 plug and a small internal combustion engine that provides longer range than a full battery electric vehicle. PHEVs and all battery electric vehicles are recharged by connecting to 120V (Level 1 Charging), 240V (Level 2), or 480V 3-phase DC direct (Level 3) charging stations. Depending on the level, charging can take anywhere from 7 hours to an 80 charge in 30 minutes. A variety of commercial Level 1, 2, and 3 charging stations are available.

EV charging technology now involves "bi-directional" charging, which allows for charging but also provides the EV with the capability to export power to remote buildings and sites during an emergency. This feature is important when making provision for handling a power blackout, as the vehicle can supply emergency power to a hospital, or emergency community center, or power to handle street engineering tasks. Since solar photovoltaic (Solar PV) panels, battery storage, and combined heat and power (CHP) units will be co-located at multiple NJ TRANSIT Grid DG locations, EVs can be kept charged and available for emergency service independent of what may happen to the gasoline, diesel fuel, or CNG motor fuel supply chains.

TransPower, CCMT's strategic partner, has worked on every pre-standard AC and DC on and off-board charging systems, and with the Society of Automotive Engineers (SAE) and the Electric Power Research Institute (EPRI) to create the standards widely used today by all plug-in vehicles.

TransPower is the first firm in North America to demonstrate heavy duty all-electric trucks for 80,000 pound class vehicles operating at or near ports (in California and Texas).





TransPower's system architecture of using on-board, bi-directional chargers at up to 70 kW of power is driving the new standards of SAE's J3068 Heavy Duty Vehicle development programs, as well as updates to the SAE J1772 light duty charge standards for AC and DC charging. TransPower is also working with the University of Delaware, the National Renewable Energy Laboratories, and many major utilities to test bi-directional, vehicle-to-grid (V2G) capable trucks and buses using their on-board charger technology and upcoming grid interface standards such as Open ADR and SEP2.0b.

TransPower's team was involved in the recently patented 500 kW overhead DC fast charging system used for transit buses throughout the country. TransPower has demonstrated a one-MW, bi-directional grid-tied energy storage system in partnership with the California Energy Commission and DOE's Sandia National Labs. TransPower is an original equipment manufacturer of full battery electric Class 8 yard tractors and drayage trucks now in regular service at ports in California.

EV Charging Using Solar PV and/or CHP

The Sandia Study calls for up to 5.5 MW of Solar PV systems and between 4.5 MW and 6 MW of CHP DG units, depending on whether Plan A or Plan B is selected. To be functional during emergency conditions, the fleet of EVs has to be able charge from solar PV systems and/or CHP units at the DG locations. The energy from the solar PV systems and/or CHP units has to be integrated with the balance of system, including battery storage.

CHP is a widely applied technology with hundreds of contractors who have installed such systems. For the small sized units appropriate for the NJ TRANSIT DG program, 100 kW to 500 kW commercial shop- assembled units are available that require a minimum footprint and can be serviced by the vendor's local service staff. Some of these units come with advanced air pollution controls that do not require an air permit. If the natural gas supply system were to fail simultaneously, the EVs could be charged from the solar PV panel, providing an additional layer of resilient mobility during emergencies.

The AECOM team has extensive experience in PV and energy storage recognized by PSE&G. Advanced Solar Products, AECOM's strategic partner, is a leading integrator and installer of hybrid solar PV-battery storage systems in New Jersey. Based on its experience in solar and battery integration, Advanced Solar Products was selected by PSE&G to be its EPC contractor for the installation of 12 MW of solar PV systems in New Jersey and to manage the integration of up to 3 MW of battery storage with its solar PV systems.

Deliverable:

- Evaluation and Recommendation Report (draft and final)



AECOM developed a plan for electric vehicles in Columbus, Cleveland, and along I-71, integrating Ohio's current EV activities and produced a replicable, ready-to-implement plan for plug-in vehicles and charging infrastructure.



TransPower's EDD2 Plugged in and Charging at SA Recycling – Port of Long Beach

2.2.4 Facility Structural Modifications Supporting DG

The engineering work will consist of the design of the physical support systems for potential technologies, which will improve the resiliency of the power grid for NJ TRANSIT. Our role is to help guide the best use of technologies for this enterprise. Potential systems include:

- Photovoltaic arrays consisting of semiconductor devices that convert sunlight into electricity
- CHP for joint production of heat and electricity from a single fuel source or cogeneration
- Fuel cells to generate electricity by converting chemical energy into electrical power with few moving parts
- Energy storage devices

Building Modifications

All these systems require modifications or additions to existing facilities and possibly standalone facilities integrated into the existing systems. The modifications depend on the selected equipment or combinations of DG equipment including fuel cells, PV and CHP with provisions for future expansion and aesthetic and environmental considerations.

The AECOM team will select DG equipment areas that do not interfere with future facility expansions and that are isolated from main facilities to control noise. For locations that require semi-outdoor or outdoor spaces we will design enclosures for the controls either with prefabricated manufacturer-supplied walk-in metal housings or stick-built enclosures as required based on the various layouts. AECOM will advise NJ TRANSIT of modifications necessary to support the addition of DG equipment.

AECOM will perform an analysis for structural support options that will examine settlement and stability characteristics of proposed foundations for DG equipment, as well as a conceptual-level comparison of construction costs. The analysis will take into account the regulatory compliance implications for presented options. AECOM will support NJ TRANSIT with regulatory compliance and permitting.

We will review existing documents, geotechnical reports, surveys and drawings and will plan and identify test pit and boring locations to assess geological conditions, foundation requirements, water table locations, and utilities runs. The structural design will account for loads required by modifications to the facility or for the equipment foundations, including:

- **Live loads:** building modifications will be designed and constructed to support all live and dead loads without exceeding the allowable stresses of the selected materials in the structural members and connections. If reinforcing and strengthening of existing members is required AECOM's structural engineer will advise NJ TRANSIT of this.
- **Wind loads:** modified structures will be designed to resist the horizontal wind pressure on all surfaces exposed to the wind and in accordance with ASCE 7 and other applicable code or standards.
- **Seismic loads:** the modified structures will be designed to resist seismic loading in accordance with the zone in which the building is located and in accordance with ASCE 7 and any applicable code or standards.
- **Equipment loads:** equipment loads as furnished by the manufacturers will be taken into account in the structural design. All equipment dead loads, impact loads, short circuit forces for generators, and other special loads prescribed by the equipment function or requirements will be included.
- **Foundation design:** foundations will safely support all structures, considering type of foundation and allowable bearing pressures. The foundation design will be based on the soil conditions and on the report of the geotechnical engineer and its recommendations. AECOM's structural and geotechnical team will work together to achieve the a cost-effective solution.

All structural design recommendations will include the provision for support of piping, trays and conduits. The structural design will also take into account and provide design solutions for all equipment to properly support and anchor it to its foundations. The structural designer will work with NJ TRANSIT to avoid vibration mounts or "floating floor" foundations where equipment or equipment foundation inertia blocks are separated from the main building floor by springs or pre-compressed. Where these conditions cannot be avoided we will provide a written justification in the design analysis supporting such a necessity.

AECOM will consider alternatives for buildings and structures and will evaluate options between spread footings and deep foundations. In areas where deep foundations are required we will evaluate the vibrations induced by pile driving. If vibration caused by pile driving may cause structures to settle, we will examine alternatives such as deep foundations, micropiles or

helical piles. Micropiles are a drilled in pile and can be used in clearance areas as low as eight feet high. Drilling minimizes vibration and the capacities of these piles is up to 100 tons. Helical screw piles also reduce vibration and can be used for pile support. AECOM has experience with design of all these pile types.

Additionally, AECOM will coordinate safety requirements mandated by NJ TRANSIT.

Prior to the start of any work, we will submit a design schedule to NJ TRANSIT for review and approval. Once the best option is agreed upon, NJ TRANSIT can direct AECOM to advance the conceptual design to the 20 percent (preliminary) design level.

Deliverable:

- Design plans and specifications of the new DG facility modifications and additions and associated electric power distribution requirements.

2.2.5 Power Management Design

Microgrid Controls

The AECOM team, with team member **IPERC** leading this technical effort, will design a robust, resilient distributed control architecture for the NJ TRANSITGRID DG based on IPERC's advanced, intelligent control solution, the GridMaster. The primary advantages of such a distributed architecture in this application is that it mimics the distributed nature of the microgrid assets and is therefore more responsive and can more closely manage demand response.

In addition, a distributed architecture is easily scalable to accommodate the addition of new loads or generation assets and is better suited to accommodate renewable energy and energy storage resources. Through the effective design and installation of our control system, these renewable assets at each site can be utilized to reduce carbon footprint, provide for more efficient generator loading via active load-generation balancing, peak shave or smooth energy waveforms and provide for energy and cost reduction at each location. Furthermore, the GridMaster control system is inherently the most cybersecure controls solution on the market today. Through the application of a DoD accredited, multi-layered approach incorporating an extensive 'defense in depth' strategy, our control solution offers a robust, secure design that is unparalleled in the industry.

Distributed Control Architecture. A distributed control architecture provides an unmatched level of redundancy and reliability that is unavailable with old schemes (typically PLC technology) in wide use. The microgrid controller will be designed to have multiple nodes that are networked together with each representing a specific piece or group of equipment connected to the microgrid. All of the controllers will act in peer-to-peer (and point-to-point) communication with each other. The combined CPU capabilities of controllers will provide intelligent load balancing and prioritized microgrid operations. Each controller will be capable of providing independent coordination at localized locations as well as supervisory control over the entire grid, so that even if a single controller fails, the remaining available controllers automatically nominate a replacement to act as the supervisory controller.

The AECOM team's controller solution will consist of a combined Energy Management System (EMS) and a SCADA and uses an innovative technology developed through years of research and development.

This technology, protected by two patents, has been operationally proven at three microgrid locations and for US military tactical power systems.

IPERC's first US patent (8,447,707) is for metadata streams that control equipment and for the dynamic creation of predictive models and our second US patent (8,350,412) is for the automatic configuration of a grid into sub-grids.

These two patents allow for the automated configuration of a grid and support our fundamental approach to a distributed architecture, which makes our architecture more resilient, reconfigurable and cyber secure. These patents support intelligent microgrid automation versus a centralized control approach used by all known competitors. These patents were filed in 2009, well before most industry realized the market potential of microgrids and reflects our team's forward thinking and practical application. The architecture has been subject to extensive cyber penetration testing and code analysis and has yet to be broken by highly skilled government and non-government agencies.

A distributed approach involves having one "node" per piece of equipment or group of related equipment. Each node is in constant communication with all other nodes in the network and control decisions are made based upon the best interest of the microgrid as a whole. Communication connectivity for each type of DG asset is summarized in Figure 2-18. Each node needs to be capable of running a suite of software that performs all the necessary communications with directly attached peripheral equipment. Each node will be designed to have the same software, with the only difference between each node being a set of configuration files that describe equipment information and communication parameters for directly-connected equipment. This architecture facilitates a highly reliable controller that operates in low latency environments and recovers well from disruptions. All nodes will include an uninterruptible power source to provide auxiliary backup power and black start capability to the microgrid controller.

The control strategies, critical to the monitoring and control of the TRANSITGRID, will include "rules" to provide all required control functionality and serve specific descriptions of how the system should behave, at each site, under a given set of observed characteristics. Inherent in these descriptions is a great deal of flexibility in handling both normal and abnormal operation conditions. For example, if some equipment goes off line or experiences communication loss, the control algorithms are automatically updated to account for the new array of available equipment. A single node will be in charge of gathering data from all of the other nodes and using the control descriptions to determine how the microgrid assets should be controlled. All nodes can perform this function, but only one does at any given time. Should that host fail or suffer a communication loss, the remaining nodes recognize that this functionality is missing and another node will be able to automatically take over the control responsibilities.

The use of the distributed controllers also facilitates limitless future expansion of the microgrid assets or any change in existing assets. This includes the addition of distributed generation or load assets. Since each node interacts with a subsection of the microgrid, additional equipment can be connected to an existing or new node and with minimal hardware and software changes, be allowed to participate in microgrid functionality. Incorporating new assets into the microgrid will require that the control algorithms understand the capabilities of the new hardware, but this is easily accomplished through the proper commissioning and configuration of the node that communicates with that asset.

Control System Coordination

For the NJ TRANSITGRID distributed generation efforts, the control system at each site will operate as a subgrid. The various subgrids will likely not be electrically connected but will communicate data between the grids and could allow for monitoring and control of the subgrids by NJ TRANSIT. This will ensure stable, reliable operations at all locations identified for this effort while assisting system Operators in making real time, informed decisions.

To provide control of the assets within each subgrid, the GridMaster will communicate between and manage the microgrid components, such as photovoltaics, distributed generation, and energy storage using standard protocols such as TCP/IP, Modbus or CANbus and standard hardware connections such as Cat5 or serial connections, which are supported by most manufacturers. The decision to use one standard communications method over the other will be dependent on vendor equipment and cyber considerations.

Potential DG Asset	Required Communication Equipment	Communication Protocol	Communication Medium
Photovoltaic	External inverter	• Modbus over serial • TCP/IP	• Fiber • Wireless
Energy Storage	External inverter	• Modbus over serial • TCP/IP	• Fiber • Wireless
Fuel Cell	Integrated inverter	• TCP/IP • Modbus over serial	• Fiber • Wireless
CHP	Internal controller	• Modbus over serial	• Fiber • Wireless
Reciprocating Engine	Internal controller	• Modbus over serial	• Fiber • Wireless

Figure 2-18. NJ TRANSITGRID DG assets and their associated communication equipment, protocols and media.

For communications between subgrids, our team will use the GridMaster control network sending information via various mediums including fiber, Ethernet or wireless. The GridMaster system is designed to be inherently flexible and adaptable, with the ability to accommodate additions or changes to the various subgrids. System Operators will use the graphical user interface to display information and data of the subgrids. This information is relayed through encrypted communications between GridMaster Intelligent Power Controller (IPC) to IPC.

Although it has not been determined if the DG subgrids will interface with the larger NJ TRANSITGRID, this could be done if the separate microgrids are co-located. The subgrids would, for all intents and purposes, treat the larger microgrid as if it was utility power. If the same control system is used for both the TRANSITGRID and DG sites, the communication between the systems would be quite simple. If different control systems are implemented for the separate microgrids an interface between the two control systems would be required. This would generally pose technical challenges depending on the implemented control systems, but our GridMaster control system can interface using a variety of communication protocols, thereby minimizing any risks of TRANSITGRID and DG subgrid interface

As the microgrid infrastructure will be operated over a large geographical area, the microgrid controller will have the ability to dispatch all assets over the entire footprint. The solution will be easily implemented as the proposed controller design has a distributed architecture and has been proven reliable after several field implementations.

Figure 2-19 illustrates a variety of methods the GridMaster control system can communicate with to provide overall microgrid management.

Operator Workstations

To accommodate physical and logical isolation to the microgrid control system, a Human Machine Interface (HMI) computer with GUI will be located in the MOCC /MMC. The computer will have a dedicated communications line to the microgrid control system for real-time monitoring of each subgrid. Manual control, if so desired, can also be implemented via this workstation. Other Operator Workstations may be accessed at locations near the equipment being controlled to allow for visibility by operators and maintenance personnel. Furthermore, data from each subgrid and these operator workstations can be fully integrated into any existing monitoring workstation or system in the MMC, should this be desired.

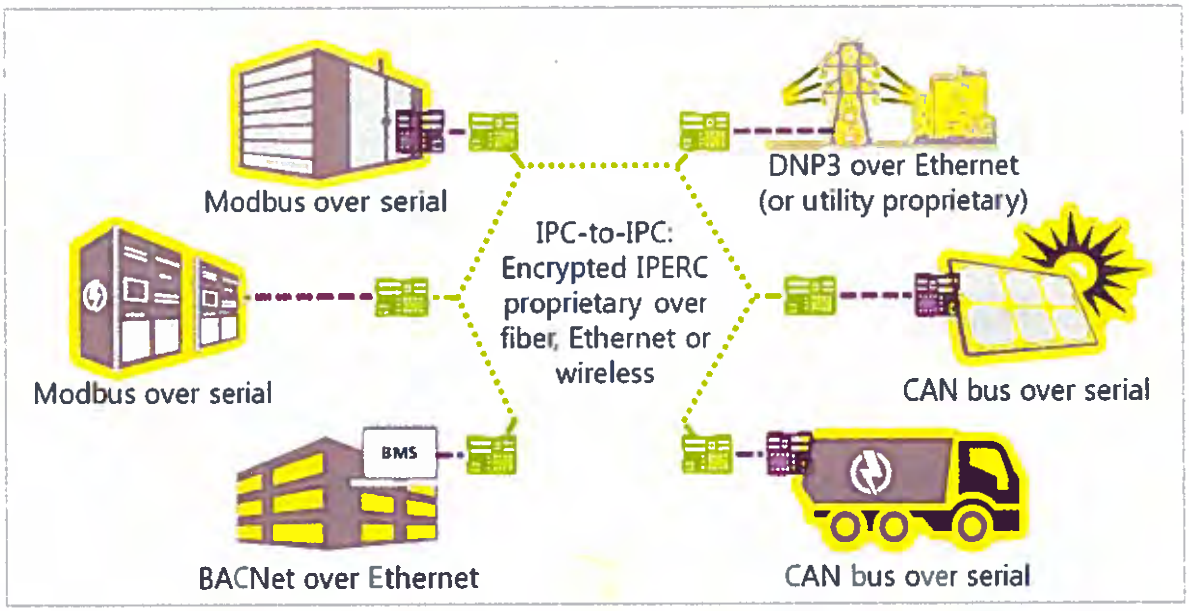


Figure 2-19. The GridMaster control system's diverse and reliable communication methods provide the optimal solution with the lowest risk.

Communications Structure

The control system will have multiple layers to accommodate differences in response times, automated versus manual control and cybersecurity. However, some control actions will need to occur at a much more rapid rate (for example electrical stability controls) than a human can respond. To account for this a high-speed requirement, the control network will be split into multiple networks that operate at significantly different speeds. A stability control network will operate and make decisions that occur at less than one second response time. This architecture is common in the industry. Since this network could be compromised by cyber intrusion, it will be connected to the microgrid controller to receive high level commands and to be protected from cyber incidents. The following section describes the **cybersecurity** approach that will be used at each site.

Figure 2-20 is a snapshot of the communication architecture showing both stability controls and enterprise controls.

Beyond Best Practice for ICS

The proposed design for the NJ TRANSITGRID DG microgrid system includes a robust **cybersecurity architecture** that includes recommended best practices in both industry and government Industrial Control System (ICS) and Smart Grid environments. Further, the design references a proven, cybersecure architecture deployed in DOD critical facilities. There is no other entity more attacked than the DOD. AECOM references IPERC's Navy Fleet Cyber Command-approved microgrid control system for the NJ TRANSITGRID-DG cybersecure controls. The security controls implemented are from a baseline that incorporates current and pending standards and guidelines, including NERC Critical Infrastructure Protection (CIP) version 5, National Institute of Standards and Technology (NIST) Interagency Report (IR) 7628, NIST 800 series and the Department of Homeland Security (DHS) Catalog of Control Systems Security.

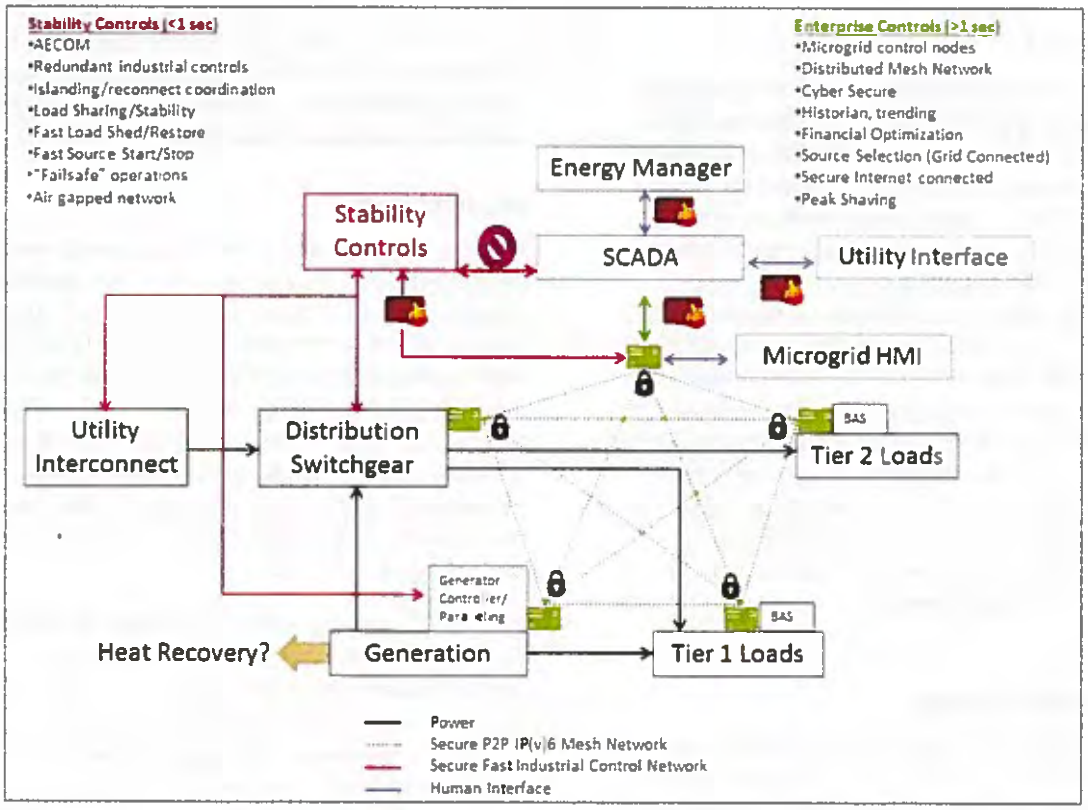


Figure 2-20. The AECOM team's communication structure architecture has been refined and proven effective on similarly complex microgrid systems such as on IPERC's extensive work for the Department of Defense.

The cybersecurity architecture has undergone extensive, third-party testing and evaluation. It has withstood prolonged penetration testing with no confidentiality, integrity or availability breaches. The source code has been reviewed by a national lab and deemed high quality and secure. The Testing & Evaluation phase of the DoD system accreditation process yielded an Approval to Operate (ATO) – the first for a microgrid control system.

To date, ICS and Bulk Electric Systems (BES) have not included cybersecurity in system design and operation. The IPERC cybersecurity architecture for the microgrid control network has included security measures and controls from the beginning stages of system development. This approach negates the need for ad hoc cybersecurity systems and measures that may have unwanted (or disastrous) operational impacts. The AECOM Team brings a depth of understanding, and recent and relevant lessons learned to the NJ TRANSITGRID-DG. The following sections address key elements of the Defense in Depth design approach.

Policy/Procedural

Assembling a cross functional cyber security team and establishing security policies, specific to the microgrid, are foundational in the proposed effort. The design team will identify cyber security roles and responsibilities for a NJ TRANSITGRID-DG Cybersecurity Team, consisting of, at minimum, IT Staff, a control engineer, controls operator, network, physical and system security experts, and management. The design will also include recommended security measures, policies and procedures, based on AECOM team controls and cyber security engineering expertise, the specific microgrid design, and sensing sessions with NJ TRANSITGRID-DG operators and administrators. System security plans, configuration guides and procedures will address security throughout the lifecycle, including design, procurement, installation, maintenance, and decommissioning. Training plans and materials will be designed, including a training system for simulated operator exercises.

Authentication/Encryption

The design will ensure encryption of IP-based microgrid control data in transit, including any remote connections and utility interfaces. Configuration files and other sensitive data at rest (data storage) will also be encrypted. Passwords will be hashed (encrypted) and credentials for the microgrid control system will be separate and unique from any other system or network. Role Based Access Control (RBAC) will be configured so that the principles of least privilege and separation of duties are employed. RBAC also facilitates tight management of user accounts and groups to ensure timely changes when user privileges and/or need to know change. Two-factor authentication (i.e., something you have, a token, and something you know, a password) will also be part of the design.

Sample Microgrid Operator Roles:

- **Administrator:** can add/delete/edit users and passwords
- **View user:** can view values but cannot set control
- **Control user:** can view values and set controls
- **Data user:** can download archived microgrid data values

Technical security controls of the microgrid control network will not be increased or decreased IAW the National Terrorism Advisory System (NTAS) (replaced Homeland Security Advisory System (HAS)), rather will maintain the tightest controls possible while ensuring system availability. Physical security of the system will be designed to increase heightened security levels IAW the NTAS threat levels.

Segmentation

Figure 2-22 shows a notional topology with network segmentation (or VLANs/Enclaves). This facilitates a multi-layered, defense in depth architecture, with the controllers being at the most protected, innermost layer. The distributed controls architecture in this design lends itself to robust segmentation and brings encrypted communication paths all the way out to controlled devices. Each external interface between the control network and other IP networks/segments/devices will be physically and logically separated by a de-militarized zone (DMZ) and monitored by intrusion detection and prevention (IDS/IPS).

Security monitoring traffic and control systems audit/log traffic will travel through DMZs via secure communication paths. The control system network will be otherwise air-gapped (physically and logically separated) from all other networks. A manual on/off toggling ability will be provided for external connections. Remote vendor communications may be accommodated in this manner for temporary, but secure (encrypted with timeouts and access control), connections for

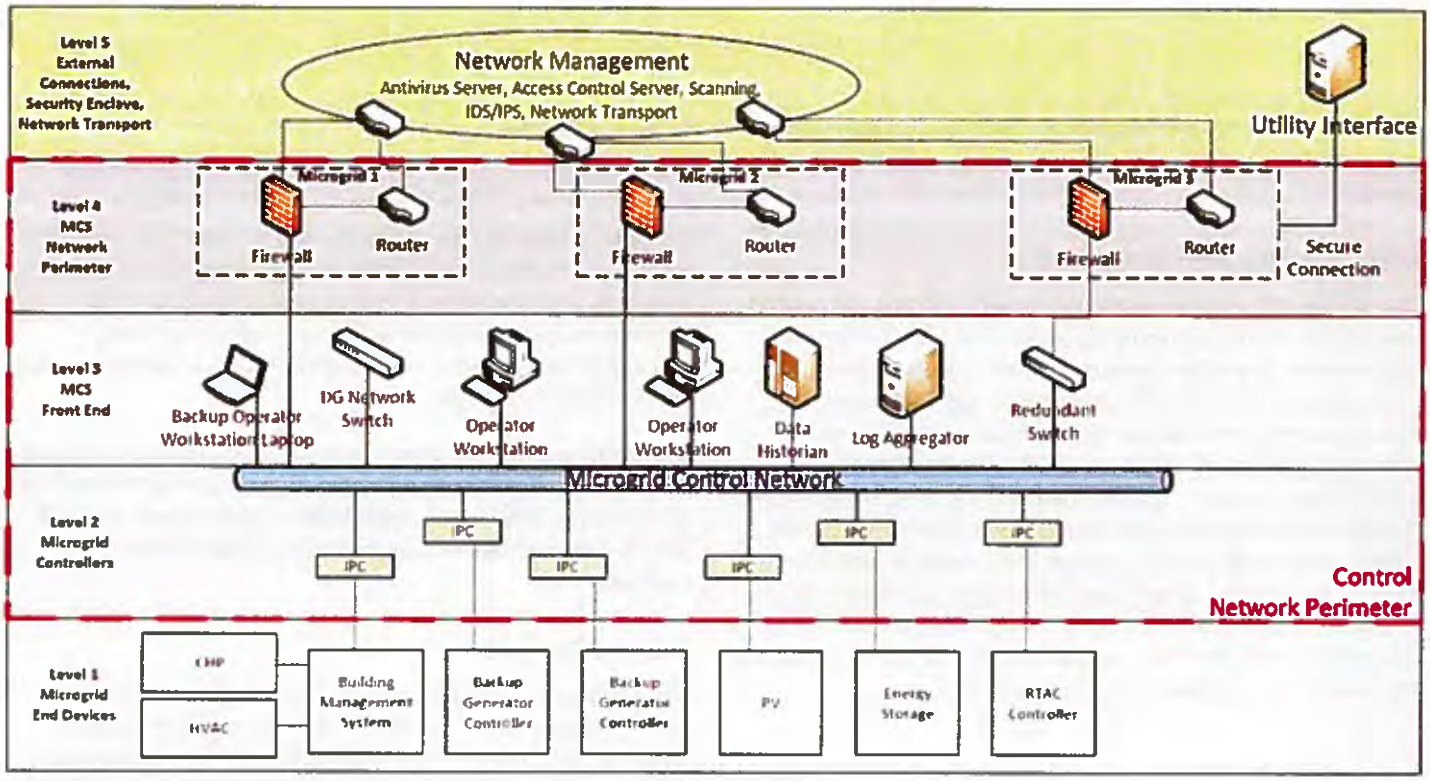


Figure 2-21. Notional NJTRANSITGRID-DG Control System Network Topology. Note: this is a conceptual rather than comprehensive diagram.

troubleshooting, maintenance and software updates. Remote systems will be required to meet cyber security controls and will be disconnected while not in use.

Redundancy/Spares

Redundancy techniques will be designed and employed for critical components. For example, more than one of the distributed controllers may have connections for microgrid control to any given critical component. Redundancy will be built in for critical measurements, such as breaker positions. Should a controller be lost for any reason, the system will be able to remain in microgrid mode. Where necessary, secure, redundant network paths will be designed to ensure microgrid communications remain viable for critical components. Optimal media for the backup network paths will consider secure communications, as well as power supply. Uninterruptible power supplies (UPS) will be specified for control system components, including spares.

The control system software and cyber security measures will be designed with the guiding principle of "do no harm" and the prevention of cascading events that could be catastrophic. Should the control system not be available, controlled components will revert to original, non-microgrid functionality. Each controller will be capable of running any and all functions associated with the control system. All controllers will detect the loss of any controller and collectively nominate another controller to run the software.

A suitable number of operator workstations will be provided and one or more backup laptop HMIs, fully configured and hardened, will be provided. In addition, spare hard drives and controllers will be required in the design as deliverables, along with system configuration guides and detailed recovery/restore procedures. In addition, ongoing sustainability guidelines, specific to the continued operation and maintenance of the microgrid system will be developed.

Physical Protection

Like the logical protections in the design, the physical protections also follow a defense in depth approach. Control system devices and network/communications media will be secured in access-controlled rooms and facilities and/or fencing. Locked racks with access logs and key management

provide another layer of physical protection. The distributed controllers will be housed in locked enclosures with tamper alerts.

Cyber security Monitoring/Audit

Our design will provide unprecedented penetration of control system monitoring/auditing for authorized administrators. Distributed controller operating system logs, as well as control application, and network device logs are collected by a log aggregation server internal to the control network. This log aggregation server provides a redundant copy of control system logs and a secure interface to Rail Operations Center monitoring systems. IAW designed Security Policies (RBAC, secure passwords, separation of duties) access to the control system will be managed effectively. A holistic, security information and event management (SIEM) approach will be used to provide real-time analysis of security alerts generated by control network hardware and applications.

Change Control

Change control/management policies and procedures will be built in to the design for both installation and ongoing operation activities. This will provide a structure for change management including a formal change request process, a security and operational impact assessment, testing, implementation, validation and versioning procedures, management/committee approval/disapproval procedures and documentation policies.

A test environment (i.e., set of virtual machines and microgrid simulation software) will be included in the design for testing of security patches prior to production deployment. This will assure safe and expeditious deploying of tested security patches.

Security Controls

This design will include the selection of robust, defense in depth, security controls, down to the microgrid end device level. Security mitigations are designed to prevent, deter and detect unauthorized activities within and in/out of the control system network. Controls include, but are not limited to those summarized in Figure 2-22.

Policies, Procedures, Awareness	Physical Security	Account Management, Authentication	Network and Host Security	Auditing, Logging, Monitoring	System Recovery Patch Management
• Cross Functional Security Team • Operator Training • Trainer HW/SW • Support & Sustainability Plan • Detailed Artifacts, System Configuration Guides • Change Management	• Secured, Monitored Access • Doubly Locked Controller Enclosures • Tamper Alerts • Secured Patch Panels, Racks • Manual On/ Off Control of remote vendor interfaces • Spare Configured Hardware	• Role Based Access • Secure Password Management • Robust Account Management • Network Config for Secure Access Control Server (ACS) • Two-factor Authentication	• FIPS Encryption • Antivirus • Routerless, IPv6 • Network & Host Firewalls, IDS • System Hardening • DMZs & Segmenting • Deny by default, disable unused PPS • Secure remote connections • Network Redundancy	• Audit, Syslog Aggregation • Log Redundancy • Software, File Integrity Checks • Robust Log Analysis Tool • Controller Forensics and Baselines • SIEM Approach	• Simple, Quick Image/Restore • Patch Testing Before Deploy • Detailed Configuration and Restore Guides and Media

Figure 2-22. Comprehensive security controls are designed to prevent, deter and detect unauthorized activities.

Remote System Access

We will investigate a data diode communications structure (such as optical transmitter/receiver) that allows for data to be communicated to other SCADA systems located in the operations center. The diode will have the ability to push data to the SCADA system, but not receive instructions or information back to the microgrid. This arrangement would allow for continuous monitoring using existing assets, but eliminates the risk of cyberattack or remote control. A disadvantage of this technique is that communications errors are not possible to verify, which is why a dedicated GUI will be installed.

A jump box will be inserted between the NJT Corporate network and the microgrid control network. The jump box will be capable of physical separation of the network and are commercially available. This will allow constant and verified information for limited periods of time.

Graphical User Interface

Our team has found through our experience of multiple microgrid projects that the Graphical User Interface (GUI) with the following features is well received by most operators. This format provides them with the information they want most, is familiar to them and is easy to navigate.

The microgrid GUI will specify that four major aspects of a GUI be executed. They will consist of Navigation, Message Display (Alerts and Warnings), Main Schematic and System Status and Controls.

The main screen will be specified to have two viewing options "Schematic" and "Details". This will allow the user to see both a visual schematic of the system or a detailed listing of information. Figure 2-23 shows an example of what the GUI might look like.

The main page will incorporate interactive schematics of the high and medium voltage distribution systems and key portions of the switchgear. These graphics will have real-time data labels indicating power flows and key operating conditions of the salient pieces of equipment.

The GUI pages will include a side bar that shows a summary of the operating conditions (System Status and Controls) of the microgrid, such as whether it is powered by PSE&G and the current state of the generators.

The lower portion of the screen will be used to show any alerts dictated by the operating conditions of the microgrid (as defined in the microgrid control system).

Other views will allow the use to scroll through all available data streams from the system, historical graphs, logging and security. User priority for the individual breakers outside of the microgrid core will be set from this screen.

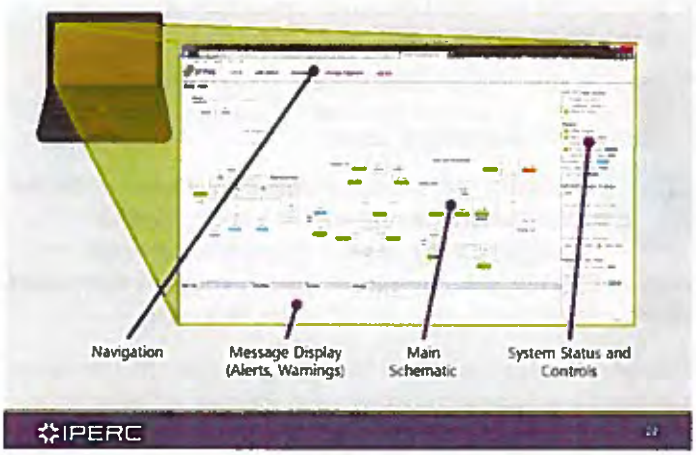


Figure 2-23. Example of Graphical User Interface (GUI) features.

A user administration screen will allow user roles to be defined where users can be added or removed. The user roles determine which parts of the GUI can be accessed by specific users and whether or not they have permission to implement control actions.

Deliverables

- 20% Preliminary Design of Microgrid Control System
- Design Analysis (per site)
- Site Specific Analysis and Evaluation reports
- Development of Preliminary Microgrid Drawings & Schematic (per site)

2.2.6 Civil, Structural, Geotechnical and Hydraulic Engineering

As the AECOM team develops DER solutions for NJ TRANSIT stand-alone facilities, AECOM's civil design team will assist in siting these facilities to minimize environmental, community, utility and ROW impacts. Our work for the major civil components includes, but is not limited to:

- Siting of the proposed DG equipment installations and associated generation and distribution equipment
- Development of disturbance areas and additional engineering design and documentation to support the ACOE and NJDEP permitting process

AECOM's civil team that developed the plans for the PSE&G Northeast Grid Reliability Program is assigned to this project. They understand the electrical design considerations, permit needs, municipal and county requirements, and specification language.

They will develop the 10 and 20% plans and specifications for a design that is permittable and that meets the needs of NJ TRANSIT.

As part of the overall conceptual design process, we anticipate the following preliminary plans will be developed:

- Key Map with Location Map
- Estimate of Quantities
- Distribution of Quantities
- Typical Sections
- Site/Construction Plans
- Grading and Drainage Plans
- Soil Erosion and Sediment Control Plans
- Plan/Profile Sheets
- Construction Staging Plans
- Standard Details
- ACOE and NJDEP Permit Plans

The civil design plans will show the DER to identify any utility conflicts and right-of-way needs. Site plans will highlight the plant and equipment, circulation patterns, parking, and site access.

Through our work with PSE&G, we are very familiar with the project area. We know the process for approval by the site's Licensed Site Remediation Professional (LSRP). The current and the former owners have each contracted with an LSRP, and the same person fills this role for both owners.

Structural Engineering

AECOM will perform an analysis of the structural support options including settlement and stability characteristics of the proposed foundations for DG equipment, as well as a conceptual-level comparison of construction costs. The analysis will take into account the regulatory compliance implications for presented options. AECOM will assist NJ TRANSIT in meeting regulatory and permitting requirements.

We will review the documents and reports of any geotechnical investigations, surveys and drawings and will plan and identify test pit and boring locations to assess geological conditions, foundation requirements, water table location, and existing subsurface utilities.

Our structural design will account for all of the loads required by the modifications to facilities or for equipment foundations, including:

- **Live loads:** Any impact to live loads due to the building modifications will be designed and constructed to support live and dead loads without exceeding the allowable stresses of the selected materials in the structural members and connections. If reinforcing and strengthening of existing members is required the structural engineer will inform NJ TRANSIT.
- **Wind loads:** The modified structures will be designed to resist the horizontal wind pressure available for the site on all surfaces exposed to the wind and in accordance with ASCE 7 and any other applicable code or standards .
- **Seismic loads:** The modified structures will be designed to resist seismic loading in accordance with the zone in which the building is located and in accordance with ASCE 7 and any applicable code or standards.
- **Equipment loads:** Equipment loads as furnished by the various manufacturers of the equipment will be taken into account by the structural design. Equipment dead loads, impact loads, short circuit forces for generators, and other pertinent special loads prescribed by the equipment function or requirements will be included.
- **Foundation design:** Foundations will be designed to safely support all structures, considering type of foundation and allowable bearing pressures. The foundation design will be based on the soil conditions and on the report of the geotechnical engineer and its recommendations. The AECOM structural and geotechnical team will work together to achieve the most cost-effective solution.

Structural design recommendations include the provision for support of piping, trays and conduits. The structural design will also provide design solutions for equipment to support and anchor it to its foundations. The structural designer will work with NJ TRANSIT to avoid vibration mounts or "floating floor" foundations where equipment or foundation inertia blocks are separated from the main building floor by springs or pre-compressed. Where these conditions cannot be avoided, written justification will be included in the design analysis supporting such a necessity. Our structural design team will meet safety requirements mandated by NJ TRANSIT.

Geotechnical Engineering

AECOM has geotechnical engineering expertise in-house for design and management of on-site or off-site geotechnical studies. The geotechnical work will be managed from AECOM's New Jersey office in Piscataway. This will facilitate communication between the field crew and the design department.

The Geotechnical Department in AECOM's New Jersey and New York offices has a staff of more than 20 professionals. AECOM also has a testing laboratory in Conshohocken, Pennsylvania that will be used for lab testing of geotechnical samples as required for the subsurface investigation.

AECOM has extensive experience in unstable and unsuitable soil conditions and associated ground improvement techniques such as the use of: wick drains with surcharge, light weight fill, low-density cementitious fill, Deep Dynamic Compaction, Vibro Probe Compaction and Controlled Modulus Columns. We have used ground improvement methods throughout New Jersey. Moreover, AECOM's geotechnical engineers have extensive experience designing shallow foundations, deep foundations such as drilled shafts and piles, and retaining walls, including cast in place, floodwalls, sheeting and secant pile walls.

Hydraulic Engineering

AECOM will provide an hydraulic analysis for the project, including delineation of drainage patterns, location of drainage features, drainage requirements in flood plains and wetland areas. Findings will be documented in a drainage report. The hydraulic design will have two components: 1) collection and disposal of runoff at generation stations, supporting facilities, and isolated facilities; 2) protection of facilities from the Design Basis Threat (DBT) tidal flooding (and fluvial flooding at higher elevations).

To make sure equipment and installations are functional during the DBT, we will design the site layout to avoid inundation during storm surges up to a FEMA 100-year flood elevation plus 2.5 ft. flooding event, or 19.5 ft. above mean sea level (Sandia Report). Our design team is familiar with flood characteristics in the project area. AECOM recently completed a threat assessment study associated with climate change along Route 7 in Kearny for FEMA. That study specifically evaluated the impacts of future flooding events on the transportation network.

Runoff will be collected and conveyed to discharge points, so that site operation is not hindered during rainfall. Drainage systems will accommodate facility operations in a 100-year rainfall event. The plans will define the sizes and locations of drainage features. Existing drainage patterns and points of outfall will be maintained where possible. If cable trenches are used, runoff collection points will be arranged so that sheet flow does not drain into the trenches. The PV generation facilities are not considered impervious surfaces under State Law S-921. At isolated facilities, any increased impervious areas will be minimal and will not need to be addressed.

AECOM will make sure that all plans and drawings comply with project permit conditions and associated regulatory compliance requirements. Our plans will include Soil Erosion and Sediment Control (SESC) Plans. Associated with our recent PSE&G work nearby, including at the Hudson and Essex Generating Stations Plans, AECOM prepared SESC plans, notes and details to gain approval from the Hudson/Essex/Passaic Soil Conservation District. These plans were used as the basis of the permit plans prepared for the ACOE and NJDEP.

Deliverables:

- Civil, Structural, Geotechnical & Hydraulic Report
- 10 percent plans and specifications in conformance with project general plan and specification requirements as well as General Notes as detailed in Task 2 of the RFP
- 20 percent plans and specifications in conformance with project general plan and specification requirements as well as General Notes as detailed in Task 2 of the RFP

2.2.7 Subsurface Investigations

AECOM will minimize uncertainty relative to subsurface conditions through subsurface investigation to support additional structures or modifications to existing facilities.

Our geotechnical effort will include the collection and review of pre-existing geotechnical test boring and any laboratory data available from facilities designated for energy resilience improvements. Additional borings and laboratory testing may be needed as a part of future design efforts.

The AECOM team will prepare boring plans, including railroad flagging requirements where necessary, subject to NJ TRANSIT and Amtrak approvals, for a soil engineer's use to take borings and provide diagrammatic sketches for foundation explorations and test pits for subsurface, DG related facility modifications and design, associated distribution infrastructure, natural gas supply connections, and service road design data.

If they are required, AECOM will prepare Site Specific Work Plans (SSWP) for NJ TRANSIT's and Amtrak's review and approval. The report will include a proposed schedule which will allow work to continue without impact to daily rail passenger service as applicable. The plan will identify the locations at which additional subsurface information is required to ascertain the bedrock profile and quality of subsoils. We will conduct the investigation and document the data and findings in a geotechnical report, providing an appropriate level of analysis as required to support final design, temporary support and underpinning design and to determine constructability implications for all facilities and systems associated with the project.

An outline of the Geotechnical Investigation and a Soil Borings Plan will be submitted to NJ TRANSIT for approval prior to the initiation of the detailed investigation. Our team will arrange for the services of an archeological subconsultant acceptable to NJ TRANSIT to provide field support during this phase and in concert with the findings of any previously developed Section 1(A) Report of Archeological Resources and Effects. In the event that such a report is not available, AECOM will develop required Federal and State compliance documentation. The archeological subconsultant will inspect the test boring samples to determine the existence of archeologically significant artifacts and will submit documentation in compliance with requirements of the New Jersey State Historic Preservation Office and in compliance with Federal Section 106 guidelines.

The geotechnical team will stake out boring locations prior to initiation of field activities and will notify NJ TRANSIT when the task is complete to facilitate NJ TRANSIT's review. The team will not rely on historic or archived soils data to formulate the documentation. Key tasks include, but are not limited to:

- Foundation borings and field and laboratory soil tests
- Coordinating and inspect any boring operations and test pit excavations
- Analyzing all data obtained by borings and laboratory tests and preparing a soils report

Deliverables:

- Geotechnical Investigation Plan and Boring Program
- Boring plan and profiles
- Geotechnical Report with boring logs and analysis for each geologically discrete project element
- Section 1(A) Report of Archeological Resources and Effects, as necessary



AECOM team engineers have extensive experience in the Northeast Corridor, with both NJ TRANSIT and Amtrak, including projects at the Secaucus Transfer Station, Penn Station, the Portal Bridge, and many others, and are thoroughly familiari with the corridor, conditions and regulatory requirements.

2.2.8 Topographical Survey Reference NJDOT Survey Standards

AECOM team member GTS will coordinate the development of aerial topographic mapping for the project. The team will identify the project limits and obtain new aerial photography, with cost and vendor information provided to NJ TRANSIT for approval. We will identify ground survey control locations and survey for horizontal and vertical position (coordinates and elevations) in the project data. Following the completion of the ground control, our production of aerial topographic mapping will begin. Once the aerial mapping is complete, it will be edited for identification of the surface features.

The AECOM team will perform a supplemental ground survey to address other project needs, such as surface and subsurface utility locations, bridge clearances, rail profiles, soil boring and utility test pit/probe locations, and other tasks. Conventional ground survey data will be incorporated into the project's topographic base map.

Deliverables:

- Topographical Survey
- Topographic Survey (supplement to NJ TRANSIT's baseline mapping as necessary)

2.2.9 Utility Engineering

AECOM will identify all existing and proposed utilities within and immediately adjacent to the site. We will contact each utility to determine if they have facilities within the project area and, if so, request the companies' as-built plans so existing facilities can be added to the base mapping. The utility drawings will include all facilities such as ductbanks, vaults, manholes, telephone poles, utility poles, hydrants, and other relevant structures or facilities that may be potentially impacted by the project. Where agreed upon by NJ TRANSIT,

AECOM will perform Subsurface Utility Engineering (SUE) to determine the location of underground utilities. AECOM will prepare a SUE Plan, comprising Test Pit Plans identifying where test pits are needed, a description of what equipment and methods will be used, method of repair to existing properties, and a plan for coordinating with municipal and state requirements during the investigations.

Based on the design plans, AECOM will identify the locations of possible utility impacts or conflicts resulting from the project and if possible, modify the design to avoid impacts. Where impacts are unavoidable, AECOM will work closely with the affected utilities to develop a plan for relocation. AECOM will develop relocation schemes and utility cost estimates for all temporary and permanent work. The format of the

Cost Estimate Reports will be consistent with NJ TRANSIT's Superstorm Sandy Recovery and Resilience Program requirements.

AECOM will prepare a construction staging plan, including methods and sequence of construction. The plans enable construction activities to proceed without interruption to passenger rail service while providing a safe zone for workers, NJ TRANSIT personnel, passengers and motorists. The plans will define the allowable construction work hours based on discussions with NJ TRANSIT, Amtrak, NJDOT, and the municipalities.

We will prepare the traffic control and staging plans in accordance with NJDOT and MUTCD criteria. The construction staging plans will provide the timelines, durations, and methods of construction to make sure that passenger rail service is uninterrupted. Our specifications will be in CSI format, and our Construction Schedule will be prepared in Primavera software.

Deliverables:

- Subsurface Utility Engineering Plan
- Existing Utility Drawings
- Proposed Utility Relocation Drawings
- Utility Cost Estimates
- Utility Agreements – drafts and final for reimbursement of engineering cost
- Utility Catalog and Files
- Draft and Final Physical Facilities 20% Construction Plans

2.2.10 Structures

The preliminary structural design will be based on the concept design described in the Sandia Study, although AECOM understands that the design will be iterative and subject to the layout and operational schemes of the proposed DG-related facility modifications, new or modified alignments for power distribution, and existing utilities, infrastructure, and topography.

Our team will evaluate alternate structural systems, elements, and components, considering various substructure and superstructure systems to achieve low maintenance, aesthetically pleasing, practical, cost-effective structures. We will develop preliminary designs and plans for structural elements in sufficient detail to evaluate the alternatives.

We will develop preliminary plans, including foundation, building and superstructure plans, culverts, retaining walls, and structural modifications to existing facilities. Initial costs, maintenance criteria, constructability, construction staging, operational and environmental constraints, ROW limitation, and impacts on abutting properties and facilities will be considered when we compare structural alternatives. Recommended structures with supporting documentation will be included in the Draft Preliminary Design/Project Definition Report AECOM submits to NJ TRANSIT for approval.

Our engineering team performed structural engineering design and construction support for the PSE&G Northeast Grid Reliability Project.

We design culverts without concrete bottom, which is necessary in securing the environmental approval and scour countermeasures at the foundations, such as permanent steel sheeting or articulated concrete block mattress. We are also adept at designing structural modifications to existing facilities that may encroach on adjacent properties; for instance the use of soldier piles, timber lagging, tiebacks and reinforced concrete facing as an innovative retaining wall solution. We have designed hand-dug concrete reinforced soldier pile pits in areas that have low clearances (e.g., under electrical lines) that do not allow pile driving. AECOM also design traditional reinforced concrete walls on spread footings and piles, mechanically stabilized earth (MSE) Walls, prefabricated modular walls and driven sheet pile walls with or without concrete facing.

Structural modifications to existing facilities typically require retrofit of the existing foundations. If standard spread footings are not adequate for the necessary increase in loads for the given soil conditions, pile foundations may be necessary. Since low clearance is typically encountered we design and install micropiles as shown in the photographs below.



AECOM recently designed a double barrel concrete culvert for NJDOT on Route 57, where we staged construction to maintaining traffic on half of the existing culvert. After transferring traffic to the new structure, demolishing the existing culvert and placing the remaining three-sided frame segments, post-tensioning was used to make each precast segment into a durable structural system.





AECOM designed micropiles in low head room areas at Bents 20 through 24 of the 14th Street Viaduct in Jersey City. Existing foundations were widened and strengthened to carry the required heavier loads.

Deliverables:

- Preliminary Structures Plans and Specifications
- Structural Cost Estimates

2.2.11 Power Management Communications

The NJ TRANSIT Distributed Generation (NJ TRANSIT-DG) Project is envisioned to protect NJ TRANSIT Morris & Essex lines, a portion of Amtrak's Northeast Corridor Line, NJ TRANSIT's Hudson-Bergen Light Rail system, and several NJ TRANSIT bus, station, maintenance and ferry facilities from regional power blackouts, by supplying independently generated, reliable and consistent electric power directly to the constituent systems as required. This level of protection will allow light rail and bus service, to retain critical inner-core rail functionality during major power disruptions due to weather related or man-made catastrophic events.

Communication System Overview

The communications system designed, furnished and installed for the NJ TRANSITGRID DG project will have the capability of transmitting voice, data, and video between the NJ TRANSITGRID assets on the power distribution grid and the following remote locations identified in the Sandia Report and not serviced by the NJ TRANSITGRID:

1. Newark Broad Street
2. Secaucus Junction
3. NJ TRANSIT commuter rail station at Newark Penn
4. Ferry Terminals at:
   - Port Imperial
   - Hoboken South
   - Paulus Hook
   - Liberty state Park
   - Ferry Maintenance Facility south of Port Imperial
5. Bus Garages at:
   - Greenville
   - Meadowlands
   - Wayne
6. Other sites to be identified upon further analysis





The NJ TRANSITGRID DG communication systems at these remote locations will be integrated and compatible with the existing NJ TRANSIT and Amtrak communications facilities. The following major communications components and

respective subsystems will support the NJ TRANSITGRID DG Project:

1. Network Connectivity
   - Fiber Optic Cable Infrastructure (FOCI)
   - DG Gateway Nodes
2. Control and Monitoring
   - Energy Management System (EMS)/System Control And Data Acquisition (SCADA)
3. Safety and Security
   - Fire Alarm System (FAS)
   - Intrusion Detection and Controlled Access System (IDCAS)
   - Closed Circuit Television System (CCTV)
4. Voice Communications
   - Telephone System (TEL)
   - Radio System (RAD)
5. Data Archiving and Storage
   - Master Clock (MC)
   - Digital Data Archiving (DDA)

The identified subsystems are briefly described in the following sections, including their relevant characteristics that meet the requirements of the RFP.

Network Connectivity

AECOM proposes distributed control architecture for the NJ TRANSITGRID DG in which control elements are distributed throughout the Distributed Generation system in a set hierarchy of controllers connected by communications networks for command and monitoring instead of using a single controller at a central location. We propose a robust, secure, and highly available Internet Protocol (IP) based communications infrastructure to ensure uninterruptible service of the NJ TRANSITGRID DG assets while avoiding interference with normal operation of existing communications systems and facilities of the Northeast Corridor rail line.

The proposed communications network will connect and provide for the transport of the data between all of the DG locations and the NJ TRANSITGRID assets including:

- DG locations identified in the Sandia Report
- TRANSITGRID Operations Control Center (TGOCC)
- TRANSITGRID Network Control Center (TGNCC)
- NJ TRANSIT Headquarters (HQ), and NJ TRANSIT Rail Operations Center (ROC)
- Amtrak Operations Center (AOC)
- PSE&G, and PJM Commercial grid
- Other locations required and/or identified during design

Each of the DG locations will be configured as a Gateway node with the purpose of providing and maintaining reliable and secure communications with the TGNCC over existing or new fiber optic infrastructure as illustrated in Figure 2-24 on the next page. The proposed method provides no single point of failure through a number of design features which provide for both redundancy and alternative connection routing as described below:

- The communications will use physically alternate Fiber Optic (FO) cable routing providing redundancy resulting in no loss of communication paths due to a catastrophically event affecting either one of the connection routing.
- Depending on DG location FO connection, the DG Gateway node will be configured as follows:
  - Two redundant routers connected into existing FO infrastructure. The routers will connect to the redundant gateway network switches via redundant firewalls offering intrusion prevention and detection.
  - Two redundant network switches connected to new FO infrastructure

In addition to interconnecting all of the DG asset locations, this method will also provide communications to the TGOCC, AOC, NJT HQ, and NJT ROC. Connection to the AOC, NJT HQ, and NJT ROC could be achieved over a leased Ethernet carrier service configured as a VPN or using existing Railroad (RR) communications networks which could be tapped along the right of way (ROW) at a point to be determined. Leased Ethernet carrier service or existing communications networks will be used also to establish controlled communication channels for data transfer between the DG and NJ TRANSITGRID network and commercial utility partners PSE&G and PJM.

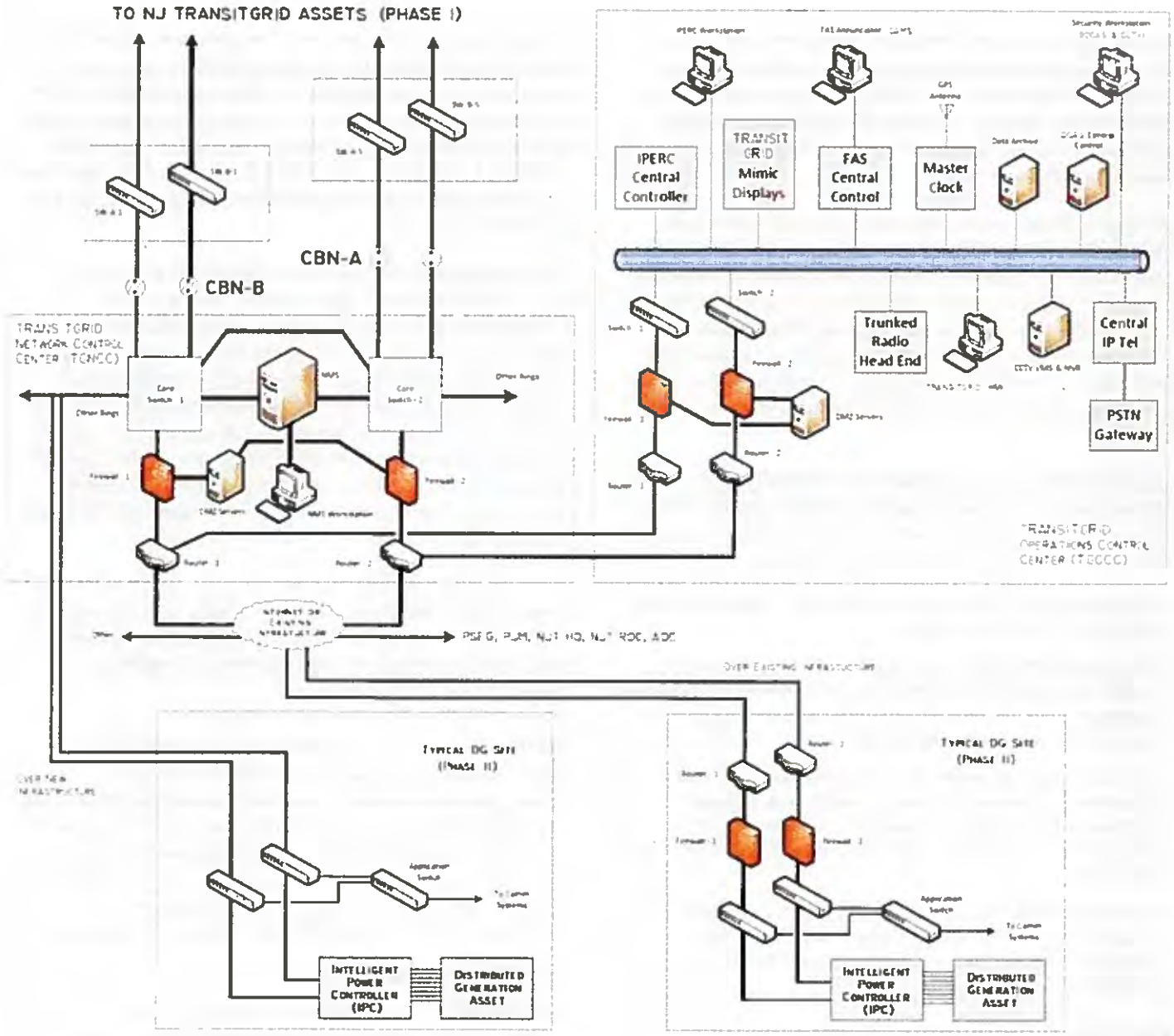


Figure 2-24. The AECOM team will provide reliable network connectivity as demonstrated in this high-level TRANSITGRID communications architecture diagram.

Throughout all aspects of the DG communications design special care will be taken to ensure network survivability under the most adverse of circumstance and environment conditions by utilizing hardened and ruggedized network components able to operate at extreme temperature ranges (typically -400C to 850C).

Critical communications equipment and subsystems will have UPS and battery backup power and redundant (dual) power supplies. Mission-critical communications systems, subsystems, equipment and facilities will be environmentally controlled and located above the Design Basis Threat (DBT) flood level. Critical spare parts will be identified and provided to allow for reliable DG communications operation by improving network maintainability and lowering service downtime.

The DG communications systems will be monitored by the NJ TRANSITGRID Network Management System (NMS) that will allow network supervision and configuration to be managed from the TGNCC and among others assist with:

- Device discovery and identification of all devices present on the DG communications grid.
- DG communications monitoring at the device level to determine the health of network components and the extent to which their performance matches capacity plans and service-level agreements (SLAs).
- DG communications performance analysis of indicators such as bandwidth utilization, packet loss, latency, availability and uptime of routers, switches and other Simple Network Management Protocol (SNMP) – enabled devices.
- Intelligent notifications and configurable alerts that will respond to specific network scenarios by alerting the network administrator via paging, emailing, calling or texting.

Fiber Optic (FO) Cable Infrastructure

All DG locations will be subject to an analytical assessment of FO infrastructure availability. Existing RR FO infrastructure close to DG locations will be surveyed for spare FO capacity and if found lacking, further testing and analysis will be performed on the used FO cable to determine bandwidth capacity and performance margins required for satisfactory support of the additional communications traffic required by the DG Gateway nodes. Where the results of the FO infrastructure performance study are positive, additional surveys will be conducted to determine space and power availability for the new communications equipment required on site as well as any required FO cabling extensions. At each existing FO infrastructure location deemed to satisfy the assessment criteria, a dedicated DG communications cabinet will be installed containing all network equipment and cable splice trays required.

For those locations where existing RR FO infrastructure fails to meet the assessment criteria, a study will be conducted to determine alternative communications paths such as laying new FO cables to the closest location identified by the performance assessment report as DG communications ready, laying new FO cables to the closest NJ TRANSITGRID asset access node designed under phase I, or evaluating the feasibility of implementing an NJ TRANSIT Wireless Communications standards compliant wireless communications network in a MESH configuration operating at 5GHz frequency.

The installation methods for the required FO cables will be determined by the installation topography involving a mix of aerial and direct bury cables as dictated by the environment and other circumstances to be weighed during design.

FO Cable Construction Characteristics

The DG communications network will use Single Mode (SM) FO cables compliant with standard industry specifications regulated by institutions such as International Telecommunication Union (ITU), International Electrotechnical Commission (IEC), Telcordia Generic Requirements (GR) and other applicable industry standards. Figure 2-25 shows a typical cross section of a suitable FO cable which will minimally have the following construction characteristics:

- 250 micron primary buffer coating
- Tight buffer coating to provide additional protection for the fiber, allowing easier handling, and direct termination on the fiber if needed
- Loose Tubes (loose tube cables) to isolate the fiber strands from high pulling tension
- Strength members (usually aramid yarn) to absorb the tension needed to pull the cable and provide cushioning for the fibers
- Central fiberglass rod for additional strength and to stiffen the cable to prevent kinking and damaging the fibers

- Low Smoke Zero Halogen (LSZH) cable jacket composed of thermoplastic or thermoset compounds to withstand the installation environment and resist moisture and sunlight exposure
- Water and moisture protection achieved by use of water-blocking materials
- Tough layer of armor (steel, fiber-glass, or Kevlar) under the outer cable jacket offering rodent protection or for strength to allow pulling by the jacket

The selected FO cable for the NJ TRANSITGRID DG project will nominally have a minimum of 72 FO strands with sufficient spare capacity for future expansion.



Figure 2-25. Cross Section of a 72-Strand Fiber Optic Cable.

FO Cable Transmission Characteristics

The SM FO cables used for the NJ TRANSITGRID DG will operate at a transmission link rate of 10Gbps over inter-nodal distances of nominally 5 miles. Figure 2-26 lists key optical performance typical values needed to deliver the wideband performance required by the DG communications systems.

Fiber Type	Low Water Peak	
Mode Field Diameter	9.2 µm ± 0.4 µm @ 1310nm	10.4 µm + 0.5 µm @ 1550nm
Cladding Diameter	125.0 µm + 0.7 µm	
Attenuation	< 0.50 dB/Km @ 1310nm	< 0.40 dB/Km @ 1550nm
Dispersion:	< 3.0 ps/nm-km @ 1310nm	< 19 ps/nm-km @ 1550nm

Figure 2-26. FO Cable Typical Performance Characteristics

DG Gateway Nodes

The DG Gateway nodes will be configured based on the results of the FO performance assessment as described in the following subsections. The DG Gateway nodes will possess the following operational characteristics:

- 10GigE bi-directional transmission links
- Internet Protocol version 6 (IPv6) Layer 2/3
- Support for RSTP, TCP/IP, QoS, OSPF, BGP, VoIP+ and VLAN.
- Sufficient transmission power and receiver sensitivity allowing transmissions over a minimum link length of 5 miles
- RJ-45, 10/100BASE-T Ethernet Ports

The DG communications design of the hardware, systems and protocols will be geared towards minimizing the time taken to move units of data between any two points on the network thus offering low latency-high throughput performance. Maintenance, software updates, troubleshooting and diagnostic capabilities will be provided at each DG Gateway node locally via equipment maintenance ports or remotely from the TGNCC.

Existing RR FO Infrastructure

At DG locations with access to existing RR FO infrastructure identified by the FO performance assessment report as satisfactory for DG communications operation, the DG Gateway node will consist of two redundant Routers connected into existing RR FO infrastructure. The routers will connect to the redundant gateway network switches via redundant firewalls offering intrusion prevention and detection. This configuration will be secured following stringent cybersecurity measures such IPsec tunnel and DMZ implementation.

Redundant network equipment will maintain an active transmission route through the node despite individual switch failure. An application switch will connect to both network switches and provide network access to all communications subsystems as shown in Figure 2-27 on the next page.

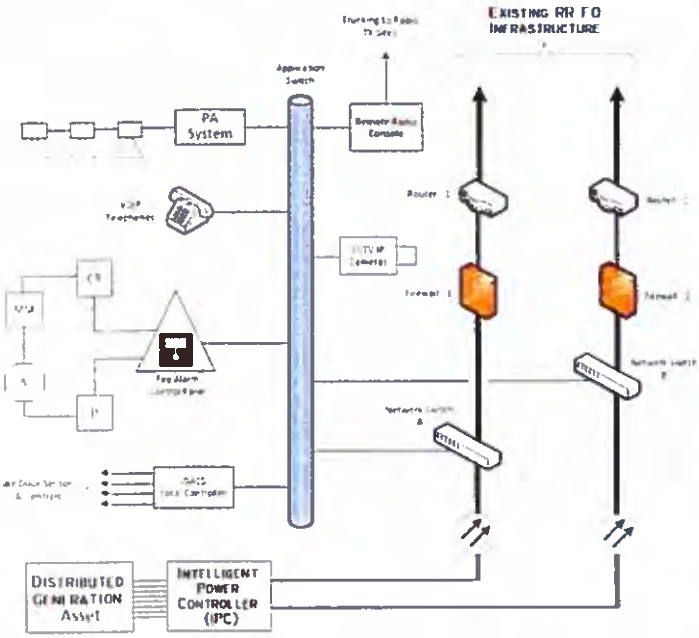


Figure 2-27. Typical DG Gateway Node Diagram for Existing RR FO Infrastructure

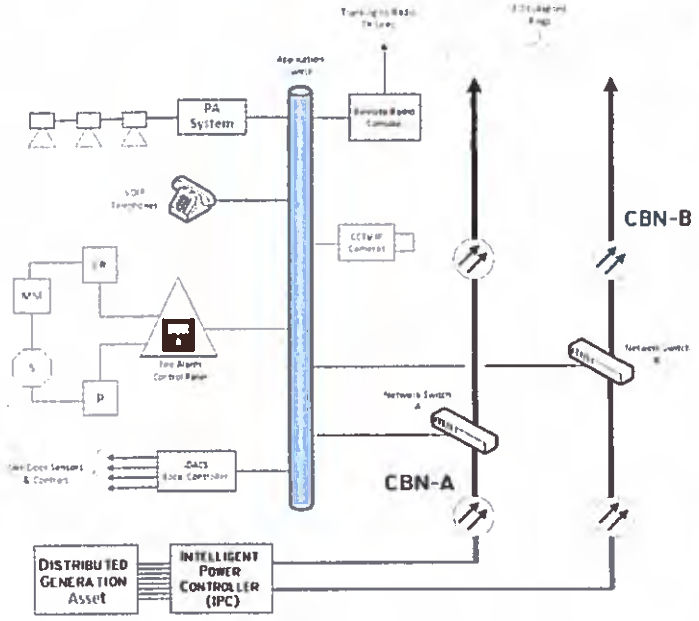


Figure 2-28. Typical DG Gateway Node Diagram for New FO Infrastructure

New FO Infrastructure

At DG locations requiring new FO infrastructure as an extension of NJ TRANSITGRID Phase I network design, the DG Gateway node will consist of redundant network switches straddling the two rings and maintaining an active transmission route through the node despite individual switch failure. An application switch will connect to both network switches and provide network access to all communications subsystems as shown in Figure 2-28. Maintenance, software updates, troubleshooting and diagnostic capabilities will be provided at each switching node locally via equipment maintenance ports or remotely from the TGNCC.

Cybersecurity

The NJ TRANSITGRID-DG project's critical nature will require the implementation of a robust cybersecurity architecture derived from industry standard best practices for typical power grid industrial control systems (ICSs), including those found in NERC Critical Infrastructure Protection (CIP) and the National Institute of Standards and Technology (NIST) Interagency Report (IR) 7628 and enhanced to ensure asset operation in emergency situations.

As part of the cybersecurity enhancement effort, a cross functional cyber security team will be established consisting of IT staff, control engineer, control system operator, network and system security experts, management staff, and physical security department member. The cyber security team will be responsible for developing and maintaining security policies, procedures, training and educational material that applies specifically to the NJ TRANSITGRID project and addressing system security issues throughout the lifecycle of the NJ TRANSITGRID DG system, including architecture design, procurement, installation, maintenance, and decommissioning. Additionally, the cyber security team will evaluate control system security policies and procedures based on the Homeland Security Advisory System Threat Level and deploy increasingly heightened security postures as the Threat Level increases.

Policies and procedures we will recommend to prevent unauthorized intrusions will include but not be limited to:

- Reviewing user accounts on regular basis and providing a means of quickly changing accounts when access privileges change (e.g., employment termination).

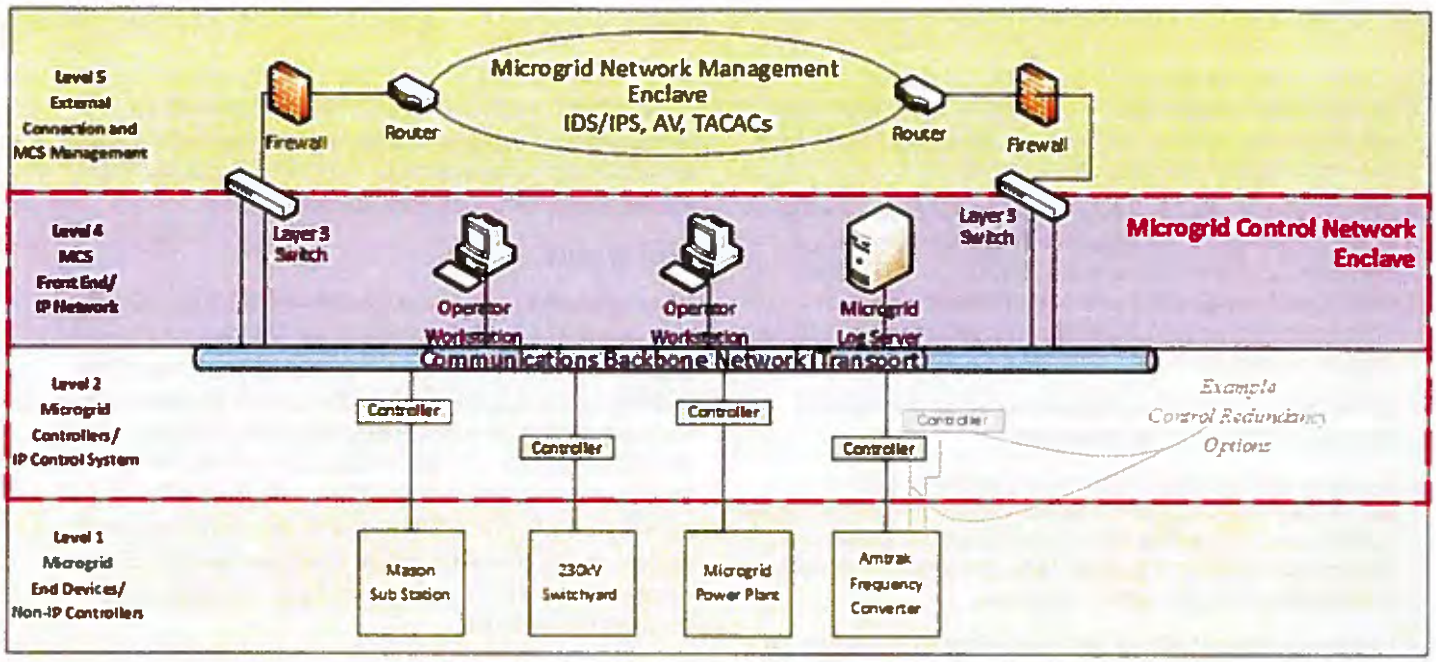


Figure 2-29. The NJ TRANSITGRID DG System's layered architecture will use segmentation strategies that mitigate the risk of cascading failures in the event of malicious activity or natural disaster.

- Separate authentication mechanisms and credentials for NJ TRANSITGRID DG system network and corporate network users.
- Establishing role-based access and configuring each role based on the principle of least privilege.
- Applying security techniques such as encryption and/or cryptographic hashes to control system data storage and communications where appropriate.
- Using modern technology, such as smart cards, for additional factors for identity verification.

The NJ TRANSITGRID DG control system's defense-in-depth will be augmented by implementing segmentation strategies within the system to reduce the risk of cascading failures caused by malicious activity or unexpected events. The system will be implemented as a multiple layered network with the most critical communications occurring in the most secure and reliable layer in addition to providing physical separation between the corporate and the system networks as shown in Figure 2-29.

The NJ TRANSITGRID DG employs a De-Militarized Zone (DMZ) network architecture preventing direct traffic between corporate and control system networks while allowing historical data transfer. Access to the CBN will be provided by redundant routers and Fire Walls (FW) managed by DMZ servers located at both TGNCC and TGOCC. The FW will provide threat prevention capabilities by not only identifying and stop virus attacks with known ID signatures but also stop unique malware, or what the industry call "zero day malware" defined as unknown files never detected before. The FW deployed can be managed under vender subscription whereby they will be continuously updated on line with the latest determined malware viral signatures and thus minimize security threats to the CBN.

The DMZ Firewall will perform the following security prevention tasks:

- Virus and malware scans in all applications and on all ports
- Systematic management of all unknown traffic
- Identification and control of circumventors
- Decryption of outbound Secure Socket Layer (SSL) and control Secure Shell (SSH) transport layer protocols

Other initiatives and procedures to be implemented as part of cybersecurity will include:

- Tracking and monitoring audit trails on critical areas of the control system
- Establishing use restrictions, monitors, and effectively managing access to the control system

- Expeditiously deploying security patches after testing all patches under field conditions on a test system if possible, before installation on the control system
- Implementing security controls such as intrusion detection software, antivirus software, and file integrity checking software, where technically feasible, to prevent, deter, detect, and mitigate the introduction, exposure, and propagation of malicious software to, within, and from the control system network
- Disabling unused ports and services on control system devices and networking equipment.
- Establishing usage restrictions and implementation guidance for allowing remote vendor connections, including authorization of remote access before each connection, automatic session termination, and physical disconnection of remote connection when complete.
- Implementation of strong, non-default passwords and two-factor authentication where feasible.
- Restricting physical access to the control system network and devices

Control and Monitoring

Energy Management System Approach

As we noted inn the Distributed Control Architecture discussion on page 119, our design will feature one "node" per piece of equipment or group of related equipment:

- Each node is in communication with all other nodes in the network.
- Each node is capable of running a suite of software that performs all the necessary communications with directly attached peripheral equipment.
- Each node is designed to have the same software, with the only difference between each node being a set of configuration files that describe equipment information and communication parameters for directly-connected equipment.

This architecture facilitates a highly reliable controller that operates in low latency environments and recovers well from disruptions. All nodes will include an uninterruptible power source to provide auxiliary backup power and black start capability to the TRANSITGRID DG controller.

Connections to equipment controlled by the TRANSITGRID will be made using standard protocols such as TCP/IP, Modbus or CANbus and standard hardware connections such as Cat5 or serial connections, which are supported by most manufacturers. The decision to use one standard communications method over the other will be dependent on vendor equipment and cyber considerations.

EMS-SCADA Interface

Existing SCADA facilities at TRANSITGRID DG locations will remain in operation as designed. EMS implementation requires an Intelligent Power Controller (IPC) at each DG location to control and monitor the station paralleling many of the existing SCADA connections. The IPCs at the DG locations will communicate with the IPERC head end at TGOCC via the DG communications system where individual point status will be presented on a MIMIC display for monitoring and adjustment by the HMI console operator. Each IPC will be synchronized with the MC for accurate time stamping of archived IPERC data.

Safety and Security

Fire Alarm System

A comprehensive Fire alarm System (FAS) design will be deployed throughout the NJ TRANSITGRID DG Project area as required. The FAS scope will consist of two parts:

- Each DG facility will be subjected to individual site fire alarm protection assessment and will be equipped with FAS based on the individual results of the assessment.
- Overlaying the FACP operation will be a Centralized Alarm Monitoring System (CAMS) which will provide centralized monitoring of each FACP from an operations console at the TGOCC. The CAMS will provide a system wide FAS Annunciator Panel display of all alarm conditions throughout the NJ TRANSITGRID DG project area. Further the CAMS console at the TGOCC will be able remotely to interrogate any FACP on the network and "drill down" to inquire as to the status of any addressable device on the FACP.

The FAS will consist of the following addressable monitoring and control devices:

- Fire Alarm Control Panel (FACP)
- Thermal (Heat) Detectors
- Smoke Detectors (Photoelectric)
- Manual Pull Stations
- Strobe/Horns

- Monitor and Control Modules for
  - Fire Suppression Control
  - HVAC Control
  - Damper and Fan Control
  - SCADA Notification

The FAS monitoring and control devices will be addressable and connected in a Class-B circuit. Addressable monitor modules will be used in conjunction with non-addressable devices where required. In all cases FA wire circuits and devices will be supervised with an End of Line (EOL) resistor.

Intrusion Detection and Controlled Access System

Mission-critical communications equipment will have adequate physical protection from tampering and unauthorized access provided by an Intrusion Detection and Controlled Access System (IDCAS) at all TRANSITGRID DG locations. Specifically, depending on individual site configuration, the IDCAS will monitor and control entry through designated doors, roll-up-grilles and hatches into the DG locations. All detected entries, unauthorized activity (i.e. forced entry) alarms, and troubles will be transmitted to the TGOCC for reporting. Card readers along with magnetic door contacts and exit request devices will be provided for all access controlled doors. The IDCAS produced alarms will sound locally and reported to the TGOCC within 2 seconds. The system will maintain a record on the main IDCAS server at the TGOCC including door and card activity, alarms, attempted use of invalid cards, and operator commands. All IDCAS system control commands and detected alarms will be time stamped and stored in the DDA.

Closed Circuit Television System

The CCTV system design will provide comprehensible video monitoring of all DG locations from the TGOCC. Camera deployment will be determined per NJ TRANSIT security surveillance guidelines. The CCTV equipment and Video Management System (VMS) software installed for the NJ TRANSITGRID DG project will be compatible with the existing NJ TRANSIT CCTV facilities. All installed CCTV cameras will be IP based with Pan Tilt Zoom (PTZ) capability controllable from the TGOCC.

All DG location CCTV camera signals will transmit live video to the TGOCC where they will be time stamped and archived at the NVR. Viewing of the video signal, live or recorded will be from a designated CCTV console. All CCTV cameras will record video images in real time. The NVR will be equipped to provide sufficient storage capacity per storage duration as proscribed by NJ TRANSIT CCTV guidelines. The recorded video images will be capable of being retrieved and controlled by the TGOCC CCTV control console. CCTV individual alarms will be transmitted from each camera to the CCTV console in the TGOCC. We will make provisions to allow designated law enforcement organizations to access live or remote video via remote client.

Voice Communications

Telephone System

Land-based communications in the project area will be provided by a telephone system designed to connect TGOCC to all DG locations as required. Given the rugged design of the proposed communications methods, transitioning to IP based telephony will greatly improve survivability and quality of land based communications during emergency situations created by extreme weather or human activity. The proposed Voice over IP (VoIP) telephone system will service all IP phones connected to each DG site's communications network. A Unified Telephone Management Server (UTMS) at the TGOCC will communicate with IP Gateways provided at DG locations as required to connect analog emergency telephones. The UTMS will be configured with a full processor and directory and sufficient capacity to control all of the telephones at DG locations. The UTMS will also be equipped with a Gateway for connection to the PSTN for off net call routing.

Radio Systems

All NJ TRANSITGRID DG facilities will be provided with radio coverage for use by the NJ TRANSITGRID Operations (NTGO), Rail Train Operations (RTO), and Emergency Services (ES) as needed. Before proceeding with a new design, all existing radio facilities such as licenses, transmission towers, radio equipment, etc. must be surveyed and inventoried in order to determine any vulnerabilities or flaws of the existing radio design as well as existing system capability to expand and support additional radio traffic.

Some design remediation measures AECOM will take to improve survivability will include:

- Replacing all radio equipment with improved models with higher MTBF and built in functional redundancy
- Re-analyze the coverage provided by the existing design. Replace with increased margins, shorter base-lines between

towers and move all trunking to the CBN and away from land line copper trunks.

- Relocate all radio bungalows to higher ground
- Replace radio tower with lower on that are designed to present reduced wind loading
- Re-analyze Distributed Antenna System (DAS) facilities where they may exist in DG locations at tunnels and wide underpasses and increase the design margins
- DAS will be designed for the interior areas of DG location buildings on an as needed basis to ensure satisfactory radio coverage

During the design of any new radio additions special care and consideration will be given to avoid interfering with existing radio systems and maintain current system performance.

Data Archiving and Storage

Digital Data Archiving

All EMS/SCADA system parameters, measurements and control commands will be stored in a DDA facility utilizing historian functionality providing for retrieval by any of the following means:

- unique source identifier
- unique destination identifier
- location
- event date
- event time stamp

The data historian filters provided will allow for retrieval based on time, value rate of change and a selectable data sampling rate. The DDA will be programmed to provide for the integrated retrieval of simultaneously occurring EMS/SCADA data in an integrated playback mode capable of being displayed on the NJ TRANSITGRID MIMIC displays.

The DDA system will be capable of storing data for up to 365 days to support daily to annual report generation. All recordings will be time stamped and watermarked to ensure the security and integrity of the source data. The DDA system will allow for the transfer of information to portable media. The DDA system will not allow any alteration of the original digital multimedia recorded data. Archived recorded data will be stored for periods of durations as dictated by NJ TRANSIT guidelines for archived data.

The DDA subsystem will reside at the TGOCC and will under normal operation would be accessible from the operator workstations. Remote access will be provided for designated authorized users password protected.

Master Clock

A common Master Clock (MC) time source will be provided for the NJ TRANSITGRID and DG projects to allow for all system clocks to be synchronized with the Coordinated Universal Time (UTC). All system elements will use the MC as their time source for event logging, device time synchronization and time stamping of recorded and archived data. All change of system state and system alarms messages will be time stamped by the originating system in YYYY/MM/DD: HH/MM/SS/MS format as derived from the MC system.

The MC system will receive clock data from a Global Positioning System (GPS) source. The MC system will be on battery backup in the event of a power failure. The MC system will use the Network Time Protocol (NTP) for all clock data. The MC system will provide regular time updates at sufficiently frequent intervals such that the performance of external systems are not degraded due to time skew.

In the absence of any clock signal from the GPS receiver, the MC system will continue to provide accurate clock data will indicate GPS receiver failure to the maintenance and send an alarm to the SCADA system.

Deliverables:

- Performance Specification for Microgrid Communications Backbone - Preliminary design plans, specifications and cost estimates
- Preliminary design of communications infrastructure
- Preliminary design of network topology
- Identification of required network and communications equipment
- Preliminary cyber requirements evaluation
- Preliminary design of communications siting

2.2.12 Concept of Operations

The objective of this subtask is to assist NJ TRANSIT to develop a Concept of Operations (ConOps) plan for all the proposed Distributed Energy Resources (DER) to be deployed at NJ TRANSIT facilities as well as Ferry Operations. The end product will be the Baseline Operations Model consisting of calculations, drawings, specifications, graphs, and diagrams that will clearly outline the concept of operations.

The AECOM team has prepared numerous Concepts of Operations plans, including for:

- NJ TRANSIT Trans-Hudson Express (THE) Tunnel Project
- NYCT's Traction Power Supervisory Control and Data Acquisition (SCADA) Upgrade Project
- NYCT/Metropolitan Transportation Authority (MTA) Bus Camera Security System (BCSS) process improvement project
- California High-Speed Rail Program
- Baltimore Red Line Light Rail Project

Major Systems

Systems addressed in the Concept of Operations include:

Distributed Energy Resources (DER). Distributed Energy Resources are electric generation units within the electrical distribution system at or near the end user. They can operate in parallel with the electric utility or stand alone. DER being considered include:

- Photovoltaics
- Stored Energy
- Fuel Cells

Photovoltaic Systems. PV cells, or solar cells, convert sunlight directly into electricity. They are assembled into flat plate systems that can be mounted on rooftops or other sunny areas. They generate electricity with no moving parts, operate silently with no emissions, and require little maintenance.

Energy Storage/UPS Systems. Energy storage technologies produce no net energy but can provide electric power over short periods of time. They may be used as uninterruptible power supplies to correct voltage sags, flicker, and surges that occur when utilities or customers switch suppliers or loads, or have short-term outages. Energy storage systems are also useful to time-shift load. They can be used to store energy when photovoltaic systems are producing in bright sunlight and discharge larger, perhaps at night. Energy storage systems can also allow the Owner to take advantage of time-of-day pricing from the electric utilities, charging the system at night with low rates and discharging during the day to avoid paying peak prices. As such, energy storage technologies are considered to be a distributed energy resource.

Fuel Cells. Fuel cell power systems are quiet, clean, highly efficient on-site electrical generators that use an electrochemical process—not combustion—to convert fuel into electricity. In addition to providing power, they can supply a thermal energy source for water and space heating, or absorption cooling. In demonstration projects, fuel cells have been shown to reduce facility energy service costs by 20 percent to 40 percent over conventional energy service.

Development of the Concept of Operations

AECOM will work with NJ TRANSIT staff to determine and define physical facility, hardware, and software requirements to effectively support integration and interface of the DER with NJ TRANSIT facilities as well as ferry operations when regional commercial grid operations are suspended or as supplement to offset energy purchased from the utility grid.

NJ TRANSIT is planning to design and construct a microgrid power generation and transmission system to protect the availability of a continued source of electrical power should there be a large-scale interruption of normal power sources due to a major power outage or an extreme weather event such as Superstorm Sandy. NJ TRANSIT's goal is to maintain a sufficient level of operating capacity to initially transport passengers home safely and then, in the aftermath of the event, to provide the highest level of transportation services possible – including trains, buses, light rail, and ferries – to allow the resumption of movement within the region to the greatest extent possible while repairs are being made.

However, the microgrid may not reach every transit facility or ferry operations facility that needs to run under the various contingencies for which the microgrid is to be built. Accordingly, NJ TRANSIT will deploy the DER to these unreachable facilities. The DER will be a combination of photovoltaic, stored energy and fuel cell systems at various NJ TRANSIT facilities which can be used as alternative

energy sources during normal and emergency operations. In particular, fuel cells produce waste heat (although less waste heat than engine-generator sets) and the waste heat might be employed at the facility for space heating, domestic hot water, or other purposes. Further, the ability to use the waste heat may determine the economics of preferring to use the DER on a normal basis in lieu of the utility grid.

Some distributed energy resources may make sense even when the microgrid can reach a particular facility. If a photovoltaic panel set can be economically installed at some facility, it should be and used as a primary source of energy. In this case, the PV system might operate without energy storage.

Plan Development

AECOM will develop an operating plan as a detailed description of power assets to be operated on a given network under normal and emergency conditions. The first step in the development of the ConOps is to confirm NJ TRANSIT's vision of the type of service intended under the emergency conditions that would accompany a large-scale power outage and further to be used as alternative energy sources during normal operations.

AECOM will use the IEEE Guide for Technology – System Definition – Concept of Operations (ConOps) Document, IEEE 1362. Initial plans as proposed within previously developed efforts contained in the Sandia Report will also be studied. Once that understanding has been confirmed, the ConOps can be prepared.

The ConOps document will contain the shared understanding of the stakeholders as to how the system will be operated and maintained in terms that all can understand. It answers the "who, what, when, where, why, and how" for the new or existing system, and forms the basis for the project's design phase. The stakeholders for this project would include NJ TRANSIT Rail and Power Operations groups, the FTA, U.S. Department of Energy, NJBPU, PSE&G, other regional transportation agencies (Amtrak, HBLR, and so on), emergency response agencies, and others.

We will first document NJ TRANSIT operations, systems, and procedures currently in place and describe the impact of the power outage scenario under the current conditions (the "as-is" scenario). It will then describe the desired condition (the "to-be" scenario), including the desired capabilities, systems and sub-systems, and then perform a gap analysis to determine what is needed or missing.

The ConOps will provide the basis for the cost estimates of discussed options, and make recommendations if the desired capabilities cannot all be obtained due to budget constraints, and will list long lead procurement projections. It will address a Phasing and Transition Plan, including operations, procedures and systems, and discuss required system upgrades, hiring and training of personnel, as well as updates to Standard Operating Procedures (SOPs).

The ConOps will assist in developing an outline for the baseline operation of the NJ TRANSITGRID and distributed energy assets and in developing and submitting necessary certifications and registrations with appropriate regulatory agencies.

The ConOps will be based on the IEEE 1362 industry standard model for upgrades of existing systems. The table of contents for the ConOps appears in Figure 2-30 on the following page.

The ConOps will address operations in the following conditions:

- When the utility grid is fully available
- When distributed energy assets are working normally and connected to the grid. (Note: it will establish a means of determining the preference for use of utility grid or DER as "normal." For example, where PV systems and energy storage are deployed together, it may be reasonable to first charge the energy storage system to its capacity and then use the PV system in preference to the Utility Grid even when the Utility Grid is available. The fully charged storage system might then be held as standby for a loss of the utility grid, or it might be used for economic dispatch on a regular basis, or some combination of these.)
- When the utility grid is not available
- When DER are deployed and working without the utility grid and with or without the microgrid

The ConOps will identify and evaluate factors that may restrict or improve operations including:

- Existing infrastructure
- Load profiles

TITLE PAGE
EXECUTIVE SUMMARY
Revision Chart
Table of Contents
List of Figures
List of Tables
1.0 Scope
- 1.1 Identification, Project Purpose and Objectives
- 1.2 Task Order Background
- 1.3 Project Background
- 1.4 Document Overview/Structure

2.0 Referenced Documents
- 2.1 NJT Organizational Charts
- 2.2 Orientation presentation
- 2.3 Project Management Procedure/Guidelines (PMP/G)

3.0 The Current System or Situation
- 3.1 Background, Objectives, and Scope
- 3.2 Operational Policies and Constraints
- 3.3 Description of the Current System or Situation
- 3.4 Modes of Operation for the Current System or Situation
- 3.5 User Classes and Other Involved Personnel
- 3.6 Support Environment

4.0 Justification for and Nature of Changes
- 4.1 Justification of Changes
- 4.2 Description of Desired Changes
- 4.3 Priorities among Changes
- 4.4 Changes Considered but not Included

5.0 Concepts for the Proposed System
- 5.1 Background, Objectives, and Scope
- 5.2 Operational Policies and Constraints
- 5.3 Description of the Proposed System
- 5.4 Modes of Operation
- 5.5 User Classes and other Involved Personnel
- 5.6 Support Environment

6.0 Operational Scenarios
- 6.1 Normal Operation
- 6.2 Abnormal (Degraded) Operation
- 6.3 Emergency Operation
- 6.4 Maintenance Operation

7.0 Summary of Impacts
- 7.1 Operational Impacts
- 7.2 Organizational Impacts
- 7.3 Impacts during Development

8.0 Analysis of the Proposed System
- 8.1 Summary of Improvements (new Capabilities, Deleted
- 8.2 Capabilities, Improved Performance)
- 8.3 Disadvantages and Limitations
- 8.4 Alternatives and Trade-Offs Considered

ATTACHMENTS
- Attachment A – Stakeholder Management Plan

Figure 2-30. Sample IEEE 1362 ConOps Outline.

Functional testing and system commissioning will include discussions of alternate energy deployments, including:

- Whether the distributed generation facility can continue to operate in the face of an extended commercial power outage.
- In the case of a photovoltaic (only) or photovoltaic + storage installation, the energy obtained on a daily basis will be used to offset purchased energy and thereby gain a savings on the electric energy bill.
- In the case of a CHP installation, we will make the case to use the distributed generation as the primary source of energy in lieu of utility energy, in order to gain a savings on the electric (and gas) bills.

Preliminary Design Basis

AECOM will work with NJ TRANSIT staff and relevant stakeholders to develop an outline for baseline operations of the distributed energy assets. The following information will be considered.

- Existing Infrastructure
  - Physical facility locations
  - Grid switching protection and control
- Load profiles
- Right sizing generation
  - Sources will be arranged to operate at the maximum economy consistent with reliability requirements.
  - The energy storage systems will be used to handle sudden increases (and possibly decreases) in electrical demand.
- System separation
  - The simplest way to implement the distributed energy approach is to allow a momentary blackout during the transition from utility grid to distributed energy, or vice-versa. Computer systems should already be backed up with UPS. HVAC and normal lighting can usually tolerate a momentary interruption.
  - Part of our work in developing the concept of operations for the distributed energy systems will be to investigate the tolerance of the various loads to momentary outages, and determine where that is and is not feasible.
  - If the distributed energy system is operating in parallel with the utility grid, as photovoltaic + storage would, then the loss of the utility grid should be unnoticeable to the facility users.

  - Load shedding to maintain partial continuous service.
  - Influence of high harmonic loads when the grid is not available
  - Reconnection to the grid
- Reliability requirements
  - Deployment of the distributed energy resources will be aligned with the designer's RAMS projections.

Potential Sequence of Operations

During abnormal or anticipated conditions, The AECOM team will evaluate a number of different control sequence scenarios for both entering and exiting islanded mode, as well as for "right-sizing" of the distributed energy assets for on-line generation and contingency handling.

Make vs. Buy on an Hourly Basis. During normal operations, NJ TRANSIT can decide if it is depending on utility generation from the grid to supply its loads or if it will rely on its own distributed energy on a day-to-day basis. This will be more than a simple comparison of cents-per-kWh from PJM vs. cents-per-kWh from NJ TRANSIT's own resources.

Given the substantial impact of demand charges on the monthly bill, NJ TRANSIT will be able to evaluate what has already occurred during the billing cycle to project the cost impact at the end of the billing cycle. (If it seems likely that the billing demand has already been set, the evaluation need consider only energy costs; if the billing demand has yet to be set, then the projected billing demand must be part of the equation.) Further, the thermal energy provided by distributed energy assets, such as the waste heat from fuel cells, must also be considered. This evaluation needs to be a continuous process, taking in to account what has already happened, day-ahead pricing for commercial electric energy, day-ahead pricing for natural gas, the weather forecast, and anticipated maintenance activities.

Self-Diagnostics. The control system will be required to perform self-diagnostics to help prevent failures due to communications or hardware failure. These diagnostics will include periodic checks that all applications are running, communications checks, memory allocation and hard disk space information at a minimum. The control system will be required to perform quality checks on the measured data, including whether the data are out of range or stale. The control system will be specified to provide specific alerts to operators regarding any abnormal conditions. This can include power outages, unresponsive breakers, unanticipated generator usage, or any other conditions defined during the preparation of the system.

Performance Verification (Demonstration). When commissioning of all assets and the distributed energy assets is completed for each scenario, our team will perform demonstration testing to validate that the project meets NJ TRANSIT's requirements.

Distributed Energy Training. Final commissioning activities will include distributed energy assets operator training executed through live simulations, review of manuals, and classes to teach and train operators on how to safely and efficiently operate and maintain the new systems. The AECOM commissioning agent will review training materials and confirm operator training is performed. Key aspects of system training will include:

- A task-and-skills analysis to determine the skills presently held by the NJ TRANSIT employees who will be operating and maintaining the new systems. Training is necessary to build up those skills that are not present.
- In-person training conducted by AECOM team members and/or equipment manufacturers' representatives to include both physical equipment training and GUI training. The extent of this training will be determined by the task-and-skills analysis, and could run to several weeks, for example, where a completely new technology is introduced.
- PC-based software simulation package with the HMI/GUI to train operators under different scenarios. This simulation package serves as both introductory and ongoing training.
- Operation manuals for the controls, cybersecurity, communications, and key support equipment throughout the project site and within each building.

Registration Analyses and Applications

AECOM will also assist NJ TRANSIT in defining, developing, and submitting the necessary registrations/certifications with appropriate energy regulatory agencies or bodies in support of the system developed with this concept of operation. Photovoltaic and battery systems, and the plumbing associated with combined heat and power facilities, are largely handled with routine building permits. Fuel cells may require environmental permits, and will certainly require natural gas service.

Deliverables

- Outline of Baseline Operations Model, including applicable drawings, specifications, graphs, and diagrams as necessary in support of the concept operating plan
- Registration analyses and applications as necessary

2.3 EXISTING RIGHT OF WAY (ROW)

AECOM will research and perform an early-on gap analysis of availability, utility, and efficacy of all property maps from NJ TRANSIT, Amtrak (railroad valuation maps), PSE&G, PATH, and other agencies resources that own ROW within a proposed site boundary. The following narrative addresses the two parts of existing and future right-of-way definition and associated surveying.

Existing Right of Way

The AECOM team will research, recover, and locate existing ROW/property boundary lines. The project areas and potential project needs will be identified. All relevant record documents including deeds, tax maps, filed maps, and railroad valuation maps will be researched. The property lines will be plotted and brought together to form a deed or property mosaic. Record document citations of physical evidence will identified for field investigation, recovery, and location. Once the physical boundary evidence is located, it will be incorporated into the topographic survey base map. Then the deed mosaic is superimposed on the physical evidence to relate boundary lines to the topography.

The research of record documents from NJ TRANSIT, Amtrak, NJDOT, PATH, PSE&G, and others as deemed appropriate to obtain available record data for the development of a Deed Mosaic of the project limits will be undertaken by AECOM.

We understand that NJ TRANSIT will, under separate contract, obtain a "Title Company" to obtain record deeds/title reports for properties with the project area. Title reports will be used to prepare drawing figures of each property with associated encumbrance as cited in the record documents per NJ TRANSIT standards.

An AECOM surveyor will tap the NJDEP Tidelands Bureau for the presence of now or formerly flowing waterways and/or obtain grants as provided by the NJDEP.

Field surveys will be conducted to locate cited record documentation and/or site features to aid in the finalization of a comprehensive right-of-way plat; all of the above will be compiled to prepare a Record Deed Mosaic of the project limits.

Proposed New Right of Way

This applies if early phase design identifies limits of the proposed improvements considering several project elements such as proposed construction, access, utilities, or environmental impacts. As the various project elements are established, they in turn are superimposed on the project base mapping developed earlier. Real estate needs are identified and developed into Right-of- Way Impact Plans. Once the project needs have been identified and assessed for alternatives, the proposed right-of-way is developed.

2.3.1 Right-of-Way Research

Research of properties will be conducted in compliance with a priority order of need that respects project objectives, criteria, costs, and design requirements. Early in the project schedule, the proposed standard base sheet for all study drawings will be developed and submitted to NJ TRANSIT for approval. Typical cross-sections and sketches will be prepared at an appropriate scale and in sufficient numbers to portray the range of conditions encountered within the project study area. While developing project-specific design alternatives, additional engineering studies will be prepared with the support of survey and mapping definition.

The following activities will be undertaken early in the process by the AECOM ROW/real estate team, to integrate effectively with the NEPA and design phase:

- **Evaluation of Property Interests and Needs.** The AECOM team will identify and describe property needs and interests includes statistical grouping into high- and low-valued properties; describe properties (demographics; use and type); examine permanent property interests for fee-simple acquisition, easements, and temporary easements; and examine the duration of temporary property requirements and need (e.g., location for lay down/ staging; and pedestrian and vehicular traffic mitigation).
- **Evaluation of Property Encumbrances.** We will review titles and chain of titles for occupancies, easements, liens, environmental, legal issues, and other potential constraints.

Assessment of Property and Acquisition Risk. We will evaluate cost and time exposure related to acquiring real estate property and easements needed to construct, operate, and maintain the Project. This information will be integrated into the Risk Management Plan (RMP) to provide a systematic process for identifying, evaluating, mitigating, managing, and documenting risks.

Environmental Investigations. Limited environmental investigations have been conducted prior to the ROD to enable property appraisals and negotiations to begin promptly after the issuance of the ROD by the FTA. Preliminary Environmental Site Assessments (PESA) for New Jersey sites are anticipated to be completed prior to the DEIS, for each property to be acquired for the Project. Property Acquisition Environmental Cost Estimating (PAECE), Hazardous Materials Investigations, and Site Investigation Reports are to be prepared during PE and final design for NJ properties to be acquired for the Project. The PAECE reports estimate NJ TRANSIT environmental remediation costs to bring property into compliance with NJDEP regulatory criteria.

Mapping. In accordance with NJ TRANSIT and NJDOT mapping standard, AECOM will conduct general surveys, and prepare general property parcel maps and individual parcel maps with legal descriptions for acquisition map requirements as design progresses. Pursuant to New Jersey State law, the project can conduct reasonable field and building surveys as part of the design effort. NJ TRANSIT will coordinate access requirements with the AECOM team. Specialized surveys of properties may be required to inform design work, and specialized maps may be used to explain the project to affected property owners and tenants. Surveys will be used by the appraisers and reviewing appraisers to determine right-of-way impacts affecting value and to accurately estimate any impact on market value for each parcel.

The timing and sequencing of ROW mapping and other associated information will need to be scheduled in a cohesive timetable of activities.

AECOM team member **GTS** will prepare the various mapping instruments. These include Entire Tract Maps (ETMs), General Property Parcel Maps (GPPMs), Individual Parcel Maps (IPMs), and parcel descriptions. Under the mapping subtask, GTS will prepare right-of-way plans such as Entire Tract Maps (ETM), General Property Parcel Maps (GPPM), and Individual Parcel Maps with associated legal description for each impacted property.

Permits/Approvals. The AECOM team will develop permit applications to a level commensurate with the design phase. The AECOM-prepared project schedule will outline the agency, permit, timeframe, and key elements of the permit process. Several early and ongoing coordination meetings with permitting and resource agencies will occur as part of the NEPA process and design phase. The major project-wide permits necessary for the project include the Army Corps of Engineers (USACOE) Section 10/404 Permit, and the NJDEP Land Use Permit. The AECOM ROW/real estate team will support the permits/approvals process in: a) survey delineation and support mapping for permits, b) wetland delineation survey, c) and other support services requiring survey and property information.

The management of all potential acquisitions, condemnation, and relocation information will be supported by PAECETrak™ – a property acquisition management system tool. PAECETrak™ facilitates tracking for the entire property acquisition process, from initial identification of a preferred alignment and parcel selection through appraisal, negotiation, acquisition, land and property management, and the tracking and disposition of excess property utilization.

AECOM, coordinating with NJ TRANSIT, will participate in the use and development of the system. Safeguards and confidentiality controls will be instituted within the database. As a confidentiality safeguard, no valuations or conclusions as to ownership will be entered into the database for properties. However, this information will be available to the FTA and their PMOC real estate consultant staff assigned to this TRANSITGRID project.

Moreover, the AECOM team has assigned staff to track property utilization and associated issues. All appraisers, review appraisers, surveyors, property engineers, environmental consultants, lawyers, acquisition and relocation staff, and others involved in any aspect of the acquisition process will be required to enter their respective information, appraisals, maps, reports, all correspondence, deeds, titles, executed documents, and so on in PAECETrak™ for New Jersey properties.

NJ TRANSIT, supported by AECOM, will be able to easily monitor the system to make sure that all disciplines have adequately input information.

Deliverables:

- General Property Parcel Maps (GPPMs), Individual Property Parcel Maps (IPPMs), Temporary and Permanent Easements, Right-of-Way Survey/Support and Site Inspection/Inventory Reports and Surveys (10 copies)
- Data input and maintenance of Project PAECETRAK System
- General Property Parcel Maps (GPPMs) 50%, and final Preliminary Assessment Report



AECOM team members have a successful history of conducting cost estimates on a broad range of projects across the NJ/NY area. Above; NYPA In-City Generation and Transmission Program (AECOM). Below: NJ TRANSIT Superstorm Sandy Recovery Program (JCMS)



TASK 3 COST ESTIMATING

AECOM provides cost estimates for major energy and transit projects, including for combustion turbine projects delivering up to 32,000 MW of power. AECOM serves as the prime contractor for design, procurement, construction, and start-up for these complex programs.

Our estimating team will assist NJ TRANSIT and AECOM's design team by evaluating options during the conceptual design process. We will develop an initial cost of work budget based on the conceptual design; the estimate is included in an Opinion of Probable Cost Report detailed Basis of Estimate narrative, and it is typically used to establish a schedule of values to be used in the final design and solicitation of both vendors and subcontractors.

AECOM's cost estimating activities will include:

- Quantifying project elements for pricing
- Developing cost estimates, typically using Timberline software
- Estimating labor, material, process equipment, and construction work items from our database of costs developed from past projects and industry standard production rate schedules, plus labor rates
- Consulting with major process equipment vendors to solicit budget numbers, and review bid tabulations from recently bid and comparable projects to input into the estimate
- Consulting with subcontractors familiar with the type of work being proposed for budget numbers
- Completing the estimate and preparing the Opinions of Probable Construction Cost Report, which includes qualifications, assumptions, contingencies, and allowances

Typically, AECOM classifies estimates based on the stage of the project. Figure 3-1 shows the accuracy and contingency rate represented by each level of estimate. For this project, the levels will apply through 20 percent design; an experienced AECOM estimator will prepare the estimates; prior to their submittal to NJ TRANSIT they will be reviewed by our design team and chief estimator.

Reference: AACE International Recommended Practices and Standards
Recommended Practice No. 19R-07 Cost Estimate Classification Date 6/4/2014

		Primary Characteristics	Secondary Characteristics				Calculated	
AECOM Classification Level	**Estimate Classification Description**	**Level of Project Definition** Expressed as a % of complete definition	**End Usage** Typical purpose of estimate	**Methodology** Typical estimating method	**Expected Accuracy Range** Typical +/- range relative to best index of 1 (a)	**Preparation Effort** Typical degree of effort relative to least cost index of 1 (b)	**Preparation Effort** Typical degree of effort relative to estimate index of 1 (c) as a %	**Contingency Range**
5	Order-of-Magnitude (ROM)	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgement, or Analogy	L: -20% to -50% H: +30% to +100%	1	0.005%	30 - 50%
4	Schematic / Conceptual Design	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4	0.010% to 0.020%	30 - 40%
3	Design Development	10% to 40%	Budget, Authorization, or Control	Semi-Detailed Unit Costs w/ Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	3 to 10	0.015% to 0.050%	15 - 30%
2	Construction Documents	30% to 70%	Control or Bid / Tender	Detailed Unit Cost w/ Forced Detailed Takeoff	L: -5% to -15% H: +5% to +20%	4 to 20	0.020% to 0.100%	10 - 20%
1	Bid	50% to 100%	Check Estimate or Bid/Tender	Detailed Unit Cost w/ Detailed Takeoff	L: -3% to -10% H: +3% to +15%	5 to 100	0.025% to 0.500%	5 - 10 %

Notes:
(a) The state of process technology and availability of applicable references cost data affect the range of markedly.
The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for a given scope.
(b) If the range index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%.
Estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools.

Figure 3-1. AECOM's estimating methodology classifies estimates in accordance with the current design stage.

TASK 4 FEDERAL ENVIRONMENTAL CATEGORICAL EXCLUSION (CE)

AECOM understands that NJ TRANSIT and third party consultants will be responsible for preparing the National Environmental Policy Act (NEPA) documentation the NJ TRANSITGRID Project. AECOM will assist NJ TRANSIT and your consultants in the preparation of the NEPA Categorical Exclusion (CE) and supporting documents by providing the requisite engineering and design details. The design details will verify impacts associated with selected build alternatives, and provide technical justification for the extent, configuration, and basis of the proposed project, including the operational characteristics of the microgrid plan, the function of the improvements, and the effect of the proposal on the rail system including operational efficiency.

The viability of a CE depends on the impacts associated with that action, whether the proposed action is within existing right-of-way, and the effects of the proposed action on transit services and overall operational efficiencies. In developing the engineering and design details to support the CE documentation, AECOM will take into consideration FTA's final rules of February 2013 adding new actions that are eligible for categorical exclusions. Such actions include but are not limited to:

- maintenance, rehabilitation and construction of existing facilities
- facilities development
- facility modernization
- actions within existing transportation right of way
- acquisition, installation and operation of new or existing utilities such as utility poles, underground wiring, cables, information systems, power substations and transfer stations.
- actions providing safety, security and accessibility
- emergency recovery actions

Our CE documentation will provide technical justification for how the proposed action meets the new CE requirements and will demonstrate that there will be no potential for significant environmental impacts associated with the proposed action. To achieve this, our NEPA support specialists will work closely with our design engineers through the conceptual design process and provide guidance/review of drawings and supporting documents to achieve compliance with the requirements of the FTA NEPA review, as well as other environmental permits/approvals.

The AECOM team will partner with NJ TRANSIT and its consultants to identify opportunities to enhance the effectiveness and timeliness of the environmental review process, drawing on the experience and relationships of AECOM staff with the FTA – both Region II and headquarters staff – and regulatory and resource agencies.

A priority in supporting the CE, especially in light of the various entities involved, will be the seamless exchange of information between AECOM, NJ TRANSIT and your Consultants. To this end, our focus will be on regular coordination and communication to pro-actively identify areas of potential concern and respond to them in the development of engineering and design details. The extent to which the design and environmental efforts are integrated will improve the thoroughness and quality of the CE documentation.

AECOM has a track record of successfully managing the federal environmental review process, incorporating an approach that starts with early coordination with the federal funding agency as well as federal and state regulatory and resource agencies. AECOM can draw on extensive environmental resources to complete hydrologic and hydraulic assessments, flood hazards, and other related environmental resources. The subsequent requirements for permitting will be considered in the designs provided in support of the CE to maintain consistency through project implementation.

AECOM's experience in preparing NEPA documents spans both the transportation and energy sectors, providing the breadth of knowledge related to the preparation of the technical information and design drawings that will be required to meet the needs of the NEPA process.

Deliverables

- Engineering and design details to verify impacts associated with selected build alternatives
- Technical justification for the extent, configuration, and basis of the proposed project

TASK 5 STATE AND FEDERAL PERMITS

Through its 2012 Capital Planning and Programs Task Order Consultant Contracts Program, NJ TRANSIT has retained BEM Systems, Inc. (BEM) to prepare the necessary permit submittals for Superstorm Sandy projects, including NJ TRANSITGRID.

AECOM also understands that the scope of services that has been requested is to support NJ TRANSIT and BEM in the preparation of the engineering and design details to support all federal, state and local permits and approvals, as required during Phase 1 for permit submittals and during Phase 2 for permit modifications, as may be required during construction.

Our experience in preparing permit submittals to both New Jersey and federal agencies provides the basis for developing project design products that comply with permit and regulatory requirements.

We have prepared permit submittals for virtually every permit that would be required to construct the NJ TRANSITGRID.

They are identified by NJ TRANSIT in the following listing:

- NJDEP Flood Hazard Area Individual Permit and Riparian Zone Mitigation Plans
- NJDEP Freshwater Wetlands Letter of Interpretation
- NJDEP Freshwater Wetlands General Permits, as applicable
- NJDEP Freshwater Wetlands Individual Permit and Freshwater Wetland Mitigation Plans
- NJDEP Waterfront Development Permit
- NJDEP Water Quality Certification
- NJDEP Division of Solid and Hazardous Waste and Site Remediation Program
- NJDEP BAQM Air Quality Permitting Program
- NJDEP No Net Loss Reforestation Act Assessment
- County Soil Conservation Districts - Soil Erosion and Sediment Control Plan Certification
- USEPA and NJDEP Memorandum of Agreement
- USACE Section 404 Individual Permit and Nationwide General Permits, as applicable
- New Jersey Meadowlands Commission – Site Plan Approval

Phase 1 tasks to be completed include:

- Support/serve as liaison between AECOM design engineering team and BEM (re: specific deliverables required by BEM for permitting/EIS)
- For each site/project element, develop a list of regulatory requirements/limitations affecting design/siting for each applicable permit and/or project element/site, to facilitate development of designs which avoid regulatory triggers/ jurisdictional areas, minimize impacts, and/or comply with specific design/siting requirements
- Provide internal review of engineering deliverables for conformance with applicable regulatory requirements
- Work with design engineers, NJ TRANSIT and BEM to address and resolve regulatory constraints/issues



As the Environmental Consultant for the NJ Turnpike's Interchange 6 to 9 Widening Program, AECOM implemented a permitting process based on agency coordination, dissemination of permitting requirements to the Team and development of a transportation solution that minimized environmental impacts. Once permit applications were submitted, it took 6 months to acquire permits for 120 acres of wetland impacts, 400 acres of deforestation and 38 stream crossings.

The NJDEP referred to the Widening Program as a "model" for the way major transportation projects should be permitted.

TASK 6 NJDEP SITE REMEDIATION COMPLIANCE

AECOM has a successful history of providing remediation services to clients in New Jersey and our staff has a detailed understanding of relevant NJDEP procedures and requirements. We know the applicable environmental standards, criteria and requirements established by NJDEP and USEPA.

AECOM has performed hundreds of remedial and hazardous waste investigation projects in New Jersey over the past 20 years, and our staff has in-depth knowledge of the applicable regulatory requirements.



Our recent projects include two large linear facilities: the New Jersey Turnpike Authority Interchange 6 to 9 Widening Program (left) and the PSE&G Northeast Grid Reliability project. The combined projects include approximately 60 miles of linear construction in New Jersey.

AECOM has 19 New Jersey-licensed site remediation professionals (LSRPs) and numerous remediation engineers, based in local offices. Together with our engineers, we have the regulatory expertise to coordinate with and support NJ TRANSIT and the third party consultants to comply with NJDEP rules, regulations, and guidance.

Our LSRPs and remediation engineers will provide required engineering, design drawings, remediation plans, and other related information and, if requested by NJ TRANSIT, certify deliverables, provide regulatory guidance, and close out sites. We will assist NJ TRANSIT and its third party consultants to develop conceptual site models for comprehensive site characterization to comply with the NJDEP Technical Requirements for Site Remediation (N.J.A.C. 7:26E) and the NJDEP's 2012 Linear Construction Technical Guidance.

Deliverables

- Engineering and design details in support of all NJ TRANSIT Regulatory Compliance

TASK 7 RISK MANAGEMENT

Risk management is a proactive, formalized effort to identify, analyze and plan for risk events which have not yet occurred. Proactive risk management is designed to mitigate the adverse impact and to increase the opportunity for success in an environment that recognizes that risk events do occur.

Risk Management is part of AECOM's core PM services and it is particularly important in unique projects such as the NJ TRANSITGRID PROJECT. The objectives of such projects are difficult to achieve and require a well-managed Risk Management processes that recognizes that plans can change do to internal or external events.

A characteristic of AECOM's implementation of formal risk management on large capital projects is the transparency and engagement we bring to the entire program and project community. Risk management becomes part of the project culture, fully engaging the program and project management at all levels. A key to successful risk management is having effective cost estimating and scheduling capability that is experienced and knowledgeable in the types and technologies of the projects to be implemented in order to support the cost and schedule impact estimates required for good quantitative risk management. AECOM has extensive, scalable expertise in the disciplines required for this project.

Risk Management Process

AECOM's risk assessment process is consistent with industry best practices and it has evolved through the experience acquired in projects where AECOM has provided formal risk assessment and risk management practices. The proposed process follows ISO 31000:2009 "Risk Management – Principles and Guidelines." and consistent with PMI's "Practice Standard for Project Risk Management" 2009 and Federal Transit Administration`s Oversight Procedures for Risk and Contingency.

The Risk Management process includes the following steps:

Risk and Contingency Management Plan (RCMP)

Risks will be identified, managed and reported in accordance with the RCMP. AECOM will develop this plan at the outset of the project and establish the context in which risk management will interface with the project. The RCMP will be customized to address project needs, capturing NJ TRANSIT's

objectives and risk tolerance. AECOM will maintain the RCMP throughout the project and will assess the effectiveness of the approach as the project evolves. The RCMP sets limits based risk tolerance and will frame the methodology and procedures that are to be applied to prioritize, allocate and/or mitigate the effect of project risks as shown in the continuum in Figure 7-1.

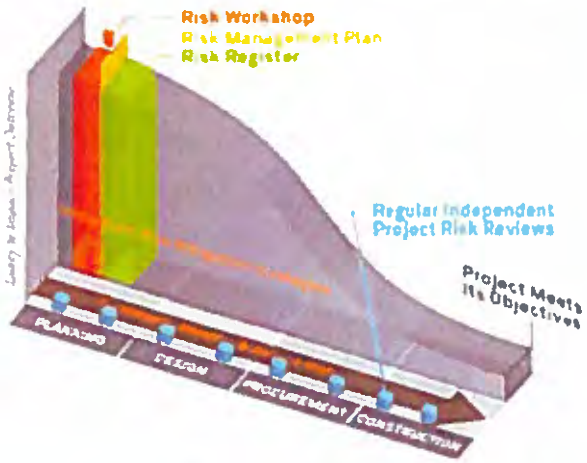


Figure 7-1. AECOM's risk-based approach assesses risks early and continuously monitors risks to prevent future impacts.

At various point in the project risk assessments will be necessary to align the identification process with the project objectives, validate the contingency budgets and keep the focus on the priorities that sometimes are not evident unless a formal and systematic risk management process is followed. AECOM's integrated risk assessment model includes the following steps, which are also shown in Figure 7-2:

Risk Identification. The purpose of risk identification is to locate sources of risk exposure before they are realized. These sources of risk exposure are called risk events. The risk identification process will begin by compiling the **risk events.**

Preliminary risk identification is the first step of risk assessment and it begins with a critical review of project scope, cost and schedule. A comprehensive list of risks that would add costs or time to the project will be identified. These risks will be entered into a preliminary Risk Register. The preliminary Risk Register will be submitted to NJ TRANSIT for review.

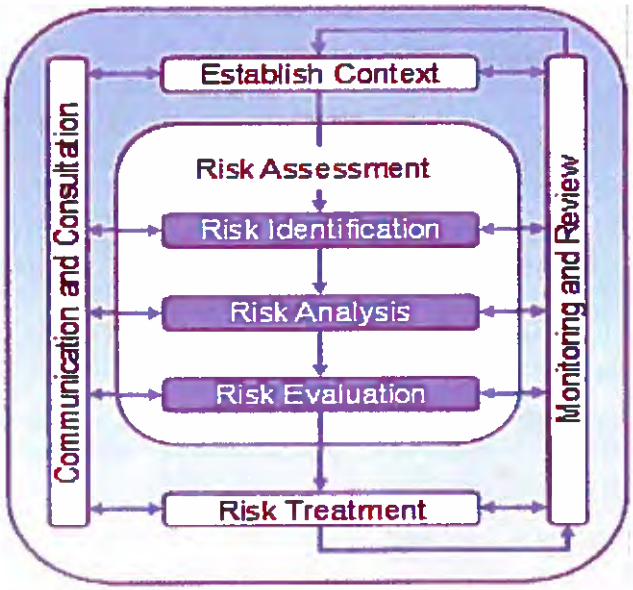


Figure 7-2. AECOM follows the ISO 31000 Risk Management Process.

A number of documents and tools are available to support the risk identification process. The following methods will be used to assist in the identification and assignment of risks:

- Team Workshop
- Brainstorming
- Risk Breakdown Structure
- Checklists
- Cause and effect diagrams
- Root-cause analysis
- Questionnaires
- List of assumptions and constrains
- Delphi technique (anonymous polling)
- Project documents review
- SWOT analysis
- Force field analysis
- Industry knowledge base
- Influence diagrams
- Post-Project review
- Lessons learned/historical information

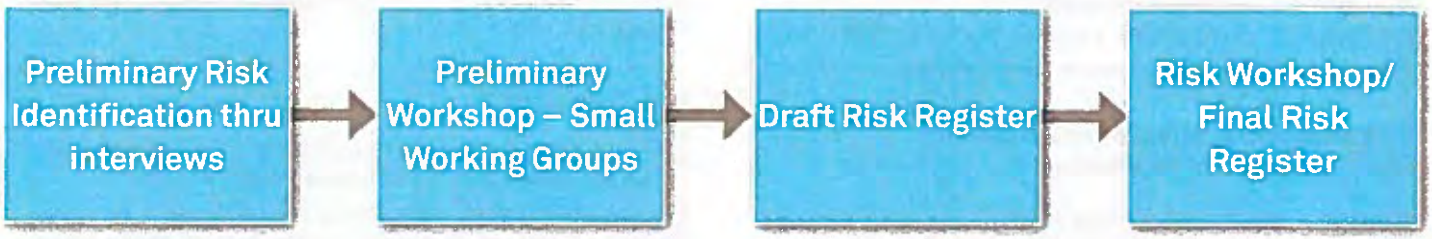


Figure 7-3. The AECOM risk identification, risk register and workshop sequence.

In Phase I, risk identification will involve at least two workshops. The actual number of the risk workshops may be influenced by the delivery method selected by NJ TRANSIT.

The AECOM Risk Manager and expert team members will meet with NJ TRANSIT and review the preliminary Risk Register in the **Preliminary Risk Workshop.** A Risk Register will be refined to add or remove risks. Discussions will include possible mitigation, allocation strategies and workarounds. The deliverable will be a **Draft Risk Register** which will be shared with NJ TRANSIT for discussion before the consensus risk workshop.

Risk Analysis

Risk Analysis is the process of quantifying all identified risks by estimating the probability of occurrence and the impacts of the risk event After Draft Risk Register review the project team will conduct a **risk workshop** led by our designated risk manager. We will establish smaller working groups. Each working group will be assigned specific risks to review, evaluate, assign ownership, perform a qualitative analysis and develop mitigation strategies. Each group will present its findings to the entire team.

The risk workshop participants will include an evaluation of environmental factors, organizational culture and the project management plan including the project scope, schedule, cost, or quality. Careful attention will be given to the project deliverables, assumptions, constraints, WBS, cost/ effort estimates, resource plan, Risk and other key project documents.

Risk Evaluation

Risk Evaluation is the process of analyzing the results of the integrated risk model. Using the data gathered in the Risk Analysis step, the project will create a customized integrated model. The goal in using a simulation technique is to allow management to understand the potential outcomes at different confidence level for the project in terms of costs and completion date of the desired milestones, and determine in a documented and systematic fashion a contingency provision to establish.

Risk Response Plan (Risk Treatment)

The objective of the Risk Response Plan, or Risk Treatment as referred to in the ISO 31000:2009, is to develop strategies over the identified priority risks and when appropriate, actionable responses. The process for developing the risk register is shown in Figure 7-3.

The Risk Response Plan will facilitate a transparent tracking of each major risk, monitoring and controlling progress to ensure that the risk is proactively followed through.

For each major risk, one of the following approaches will be selected to address it:

- **Avoid** – Eliminate the threat or condition or protect the project objectives from its impact by eliminating the cause
- **Mitigate** – Identify ways to reduce the probability or the impact of the risk
- **Accept** –Define actions to be taken in response to risks
- **Transfer** – Shift the consequence of a risk to another party together with ownership of the response by making such party responsible for the risk (Contractually, insurance, outsourcing, etc.)

AECOM recognizes that major decisions, with important cost and/or schedule implications, are not easy to isolate and are frequently made with limited information due to timing. To address this issue, AECOM establishes a formal and traceable process to make and document important project decisions.

Risk-based decision making provides a process that isolates the issues regarding a decision in order to understand their

risk exposure and to compare different options based on probabilistic scenarios. This method has been applied on projects with multiple interfaces such as for AECOM's design of the Second Avenue Subway in New York City.

Risk Monitoring, Mitigation/Control and Communication of Risk Issues

The success of the risk management effort depends on the effective implementation of the risk responses. Our risk mitigation process is summarized in Figure 7-4.

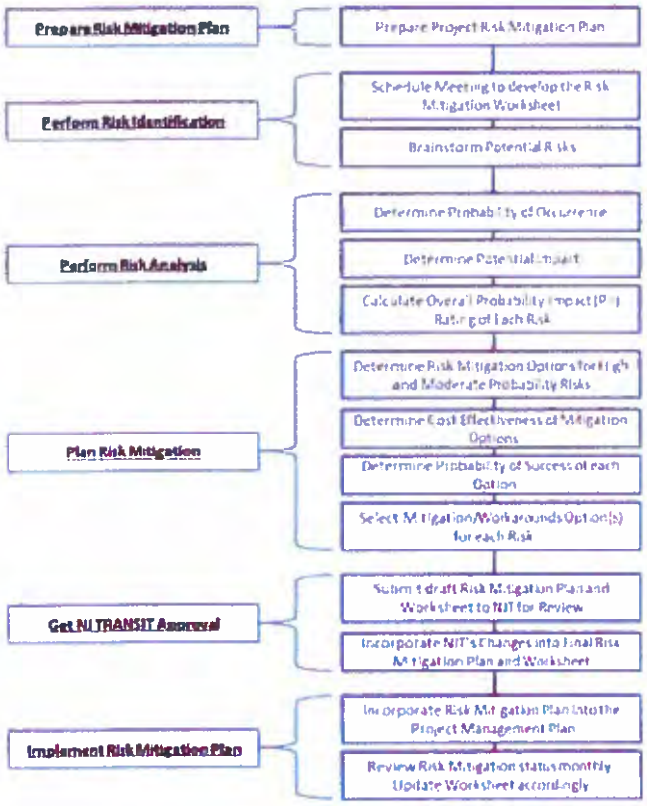


Figure 7-4. Project Risk Management Flow Chart

AECOM will maintain a Top Risk Priority List and report on the list as a component of our monthly project reporting for NJ TRANSITGRID project.

Project change requests will be analyzed as to their potential impact. As risk events occur, our team will tie their consequence to the area affected (e.g., change orders) and will evaluate the residual risk. We will prepare a re-prioritized list and Risk Register to reflect changes and new scenarios, including secondary and residual risks. As the risk is a dynamic aspect of every project, we plan to hold quarterly risk management meetings with NJ TRANSIT in a risk committee format.

Risk Allocation

A key component of the delivery of best value is the allocation of risk between the client and the supply chain. The Procurement Strategy seeks to achieve a sensible approach to risk by allocating program's risks to the party best placed to manage the risk and identify associated incentives. In taking forward the procurement arrangements the optimal balance of risk will be sought by assessing the impact of risk allocation on the achievement of value for money.

AECOM's approach to risk management is to allocate risks to the parties best able to manage them and to incentivize the allocation to ensure the best outcome is achieved. This is reflected in the development of the contracts to deliver the project; this approach also attracts the best suppliers and helps achieve healthy competition.

It is also be important for the procurement arrangements to motivate and encourage all parties to continue to investigate and implement improvements and efficiencies. The contractual arrangements will be developed and reviewed to promote incentives for effective risk management, with the objective of delivering the program within budget and on time.

Risk Register

We will apply risk management principles to develop and manage the project risk register, mitigate risks and reprioritize the list as the project develops. Figure 7-5 on the next page is an excerpt of a typical risk register that reflects some often-seen issues.

Risk Approach Summary

Meeting the schedule, compliance and local opportunity goals defined by NJTRANSIT will entail managing risk and exploiting opportunity. To accomplish this, a formal Risk Management Plan based on proven, robust Risk Management principles will be developed. The risk management process includes the following activities:

- Risk manager develops Risk Management Plan and roll-out strategy in first 60 days
- Training starts for Program/NJTRANSIT staff (knowledge transfer) in 90 days
- First Risk assessment in the first 120 days

Issue	Impact	AECOM Solution
Lack of clarity about / changing PM roles and responsibilities	• Lack of understanding of PM responsibility leads to Program confusion • Lack of comprehensive management plans leads to abortive works and slow starts	Changes are difficult, but AECOM has effectively taken over delivery tasks smoothly by: • Early establishment of PMO responsibilities / partnering Sessions • Mobilization of locally established project team
Scope creep – Failure to fully define the Program boundaries	• Lack of coordination of scope, schedule and budget leads to scope creep and significant changes • Lack of budget management leads to cost overrun and to the requirement to obtain additional funding or reduce scope	• Early establishment of budget, schedule & scope definition consistent with master plan and program execution (management) plans • Well defined change (configuration) management plan
Inadequate decision making - due to Ineffective and untimely data management; lack of control	• Decisions/approvals made with incorrect information • Political embarrassment and exposure • Schedule and progress delays	• Establishing a risk-based decision making process • Implementation of Integrated program management information system..."single source of truth" • Lay out of decision and business processes and timing along the project life cycle • Responsibility matrices defined to include all parties
Inadequate / lacking risk management	• Inadequate or incorrect contingency funds • Late significant and unanticipated changes and delays • "Scope reduction" due to lack of budget	• Early establishment of risk management plan • Dedicated risk manager • Risk assessment workshops
Establishment of "acceptable" public procurement processes	• Delayed procurement and tendering plans • Lack of interest from supply chain • Political challenges and exposure	• Early definition of allowable procurement processes • Structured contracting program • Risk sharing terms and conditions

Figure 7-5. Example pf a risk register from another project showing solutions develoed from lessons learned. We will develop a similarly detailed project-specific risk register for the NJ TRANSITGRID project and work with NJ TRANSIT to identify prioritize and manage risks.

- Risk manager performs monthly audits to cover 100% of ongoing projects annually.

Deliverables:

- Program Risk and Contingency Management Plan, associated meetings and workshop findings, reports
- Risk Management Workshops
- Risk Registers
- Risk Response Plan
- Updates of the Risk Register following Project Progress
- Cost and Schedule Contingency Budgets
- Contingency drawdown control curves and ETC forecast
- Project Audits
- Corrective Action Reports
- Monthly Risk Report
- Quantitative Analysis

TASK 8 SYSTEM SAFETY AND SECURITY MANAGEMENT

The Project Safety and Security Management Plan (SSMP) complements the Project Management Plan (PMP) and provides details of our approach delivering the project in a safe, secure manner. The SSMP will describe the roles and responsibilities of NJ TRANSIT, AECOM in safety and security, and the processes by which we identify and address and mitigate unintentional (hazards) and intentional (threats) risks to the project.

The AECOM team will apply recent, directly relevant experience in the preparation of SSMPs, including the Hudson Bergen Light Rail Transit System (HBLRT), Charlotte Area Transit System (CATS), and other major projects.

In line with 49 CFR Part 633, FTA Circular 5800.1, and the FTA Safety and Security Certification Handbook, AECOM will work with NJ TRANSIT to prepare a SSMP and associated deliverables to document the approach taken to perform safety and security activities. Following FTA regulations and guidance, the SSMP will be developed in 11 sections:

1. Management and Commitment Philosophy
2. Integration of Safety and Security into Project Development Process
3. Assignment of Safety and Security Responsibilities
4. Safety and Security Analysis
5. Development of Safety and Security Design Criteria
6. Process for Ensuring Qualified Operations and Maintenance Personnel
7. Safety and Security Verification Process (Including Final Safety and Security Certification)
8. Construction Safety and Security
9. Requirements for 49 CFR Part 659, Rail Fixed Guideway Systems: State Safety Oversight
10. 10. FRA Coordination
11. 11. DHS Coordination

In accordance with FTA Circular 5800.1 and the FTA Handbook for Safety and Security Certification, Sections 4-7 of the SSMP will describe NJ TRANSIT and AECOM's process to evaluate safety and security issues, develop design criteria, and execute a verification process. Following FTA guidance, AECOM will develop a Safety and Security Certification Plan (SSCP) to detail more thoroughly the processes described in Sections 4-7 of the SSMP.

Unintentional conditions relate to safety, while intentional conditions relate to security. A process diagram excerpted from the FTA Handbook and outlining the process of the SSCP, is shown as Figure 8-1. To develop the SSCP, AECOM will comply with guidance set forth in the FTA Handbook for Safety and Security Certification (SSC) while identifying, documenting, and addressing risks as outlined in Task 7 above, as well as seeing that identified mitigations to risks are addressed and have been incorporated into the design and final constructed deliverable.

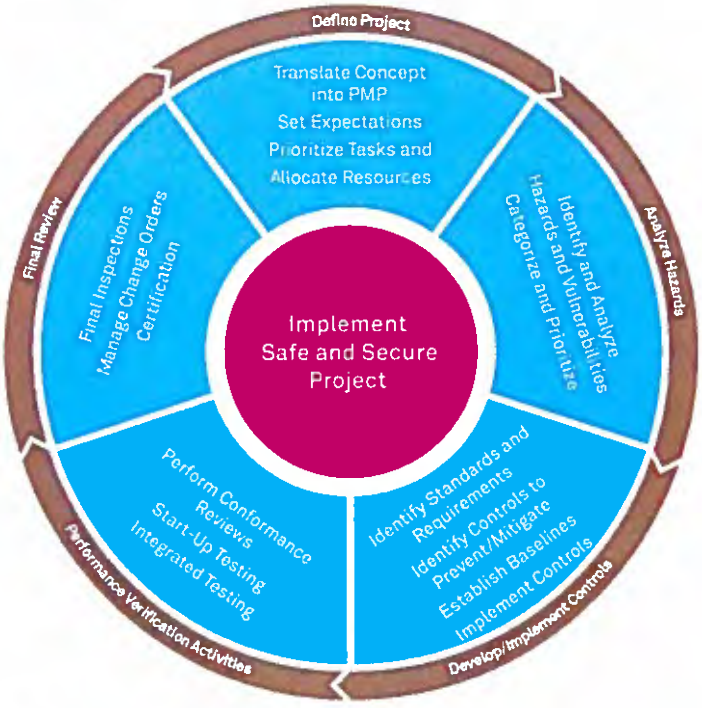


Figure 8-1. Process of the SSCP

While safety and security management has primary responsibility for SSC, the tasks required to complete the certification process include many functional disciplines. As indicated in Figure 8-2, certification management supports a coordinated effort that brings the capabilities and resources of the design team, the construction team, the acceptance and testing team, and the activation team together to accomplish the safety and security certification activities.

The AECOM team will partner with NJ TRANSIT to development a description of the SSMP that specifies the distinct types of safety and security analyses that will be performed.

Examples of analyses that may be identified include:

- Preliminary Hazard Analysis (PHA)
- Threat and Vulnerability Analysis (TVA)
- Subsystem Hazard Analysis (SSHA)
- System Hazard Analysis (SHA)
- Failure Modes and Effects Analysis (FMEA)
- Failure Modes, Effects and Criticality Analysis (FMECA)
- Fault Tree Analysis (FTA)
- Terrorism Risk Assessment (TRA)
- Software Safety and Security Analysis (SSSA)
- Operations and Support Hazard Analysis (O&SHA)
- Health Hazard Assessment (HHA)

AECOM will assist NJ TRANSIT in the development of a description of the SSMP that identifies the types of analysis to be performed, which entity will perform them (i.e., contractor, committee, in-house personnel, other), and when they will be performed. The AECOM team will assist NJ TRANSIT to develop a description of how project personnel will communicate the results of these analyses to other members of the project team and the process to assure resolution of hazards and vulnerabilities resulting identified in the analysis.

One of the goals of this project is to produce a design for the NJ TRANSITGRID that will be hardened or otherwise protected from floodwaters similar to those resulting from Superstorm Sandy.

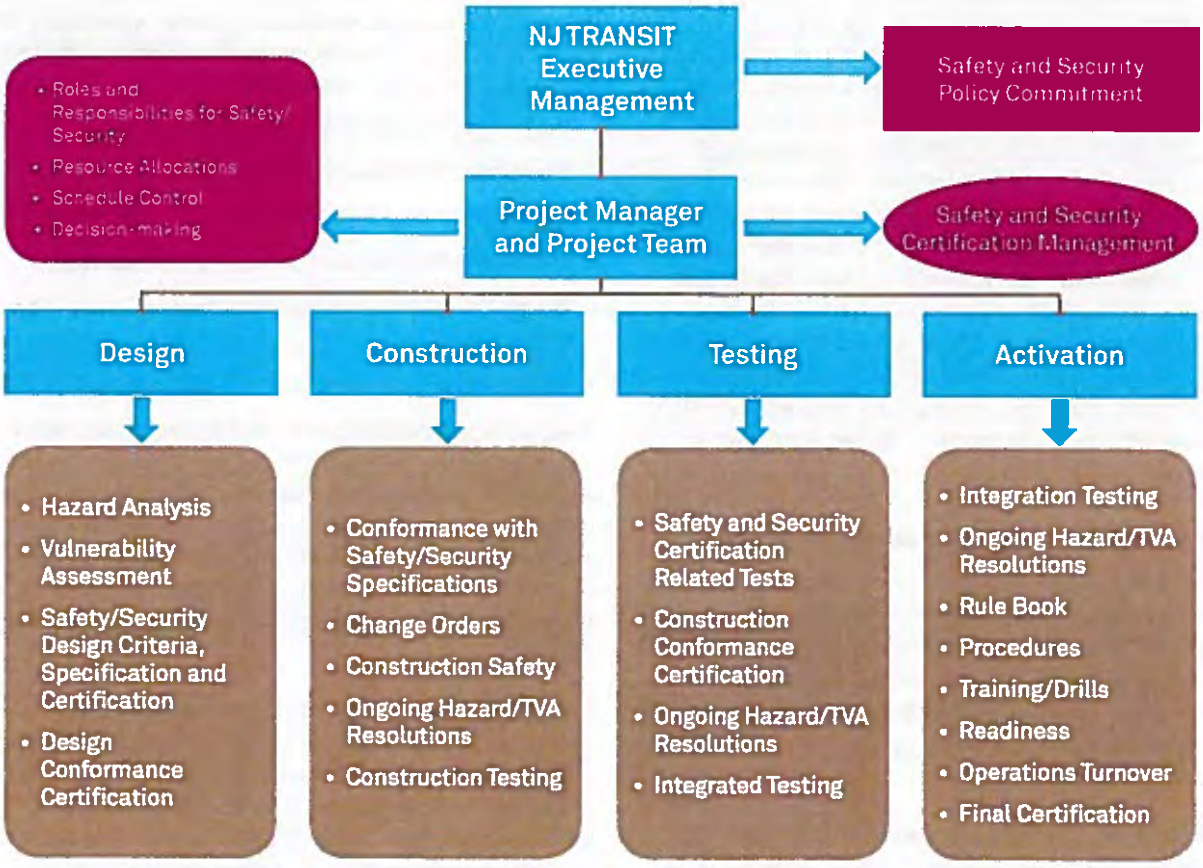


Figure 8-2. Certification Management Support Chart

Our approach for the resiliency and hardening of the project will be based on a rigorous and proven approach that begins with a Threat, Vulnerability, and Risk Assessment (TVRA), which is a systematic evaluation of vulnerabilities and provides design teams and decision-makers with the tools for creating a safer, more secure environment.

Our approach also includes examining both the existing conditions and expected conditions following completion of the project.

Before the actual TVRA can be performed, the applicable threats are identified. These may be natural disasters (e.g., flooding such as resulted from Superstorm Sandy), accidental conditions, and/or man-made threats. The AECOM team will conduct open-source research and analysis to identify threats or risks potentially facing projects in this area, and their probability of occurrence.

The TVRA will include asset characterization, threat characterization, consequence analysis, vulnerability analysis, threat assessment, risk assessment, and risk management (mitigation). We will perform a review of open-source intelligence (OSINT) and other relevant information and factors involved in assessing the threat environment pertaining to this project. We will focus on open-source intelligence information, including social media outlets, published news reports, blogs, and other online resources; "gray" (but unclassified) data available to the AECOM team through our global intelligence network; commercial data mining and exploration of widely available data sources that could be exploited by bad actors to identify the degree and magnitude of information that is publically available; and link the analysis and relationship mapping based on research findings.

Threat, Vulnerability, and Risk Assessment Process

We apply the methodology embodied in our SecureRiskTM database to facilitate the risk mitigation process. Initially developed to analyze risks and vulnerabilities from man-made (e.g., terrorism and insurgency, serious and organized crime, protests, insider threats) and accidental threats, we have used this same methodology successfully for natural disasters such as flooding.

The AECOM team will evaluate local and national security concerns. Local concerns, or high probability, lower impact risks that an entity is likely to face, include inclement weather, utility failure, theft, trespassing, and vandalism. National concerns, or low probability, higher impact risks include categories of events such as terrorism, weapons of mass destruction (WMDs), hate crimes, and civil unrest, and are relevant to some clients due to both the nature of their business and their sites' proximity to high-profile infrastructure and high-threat targets.

The process involves several component tasks, involving two sets of workshops.

Pre-mitigation Workshop

The first workshop is a Vulnerability and Risk Assessment workshop. During the brainstorming session of the workshop, a list of vulnerabilities is developed for further evaluation. The threats are limited to those defined at the inception of the project. The list of vulnerabilities is developed based on the experience of the participants, their knowledge of the facility and other related or similar facilities, their technical expertise, and their previous experience with other workshops. The vulnerabilities are then assessed based on several factors, which include but are not limited to:

- The probability that the event could occur
- How easily the threat can be carried out
- The magnitude of the threat
- The impact the threat could have on the facility
- Design conditions or physical barriers that could prevent the threat
- Planned operational procedures/staffing of the facility

The goal is the determination of the premitigation risk index, i.e., an analysis of the system design at the time of the TVRA workshops to assess the risk index before threat mitigation measures are considered. It consists of conducting a multi-day threat assessment workshop attended by personnel from the AECOM team, including specialists in security, TVRA, structural engineering, electrical engineering, and security systems.

Next, a comprehensive threat assessment matrix is developed to facilitate scoring site-specific threats and vulnerabilities in a multidiscipline project team workshop. During this workshop, credible perimeter and interior threats are assessed. This workshop permits team interaction and brainstorming, threat development, and preliminary risk analysis using the methodology guidelines. This process

permits an analysis of all interdependent threats and vulnerabilities, and arrays relative risks in a single database.

Using the database, all risk items captured are analyzed and prioritized, showing results on a graphical interface. An initial screening permits collapsing all the risk items to global risks for further analysis. The SecureRiskTM database maintains a comprehensive record of the disposition of risks identified by the multidiscipline team workshops. The output of the first workshop is the premitigation risk index.

Mitigations Workshop

The first workshop is followed by the Mitigations Workshop. Similar to the first workshop, the mitigation workshop is a multi-day workshop attended by personnel from the AECOM team, including the same specialists in security, TVRA, structural engineering, electrical engineering, and security systems.

Based on the threats and vulnerabilities identified, mitigation options are developed for each threat and vulnerability. We will consider security measures already in place, as well as new mitigations to supplement or replace existing systems or components. Both physical (e.g., hardening, increasing stand-off, intrusion detection measures, and others) and procedural mitigations (e.g., changes to visitor access protocols, and so on) are considered. The proposed mitigations are subjected to risk mitigation effectiveness by "re-scoring" the risks (premitigation risk scores) giving consideration to the effectiveness of the potential mitigations.

Rough order of magnitude (ROM) cost estimates are prepared for the various mitigations. Utilizing the ROM cost estimate and the reduction in relative risk, the mitigation options are ranked and prioritized. Options that have a high rank/priority and high risk reduction are those that are generally the best candidates for possible advancement to final design. Figure 8-3 summarizes the workshop and risk mitigation process.

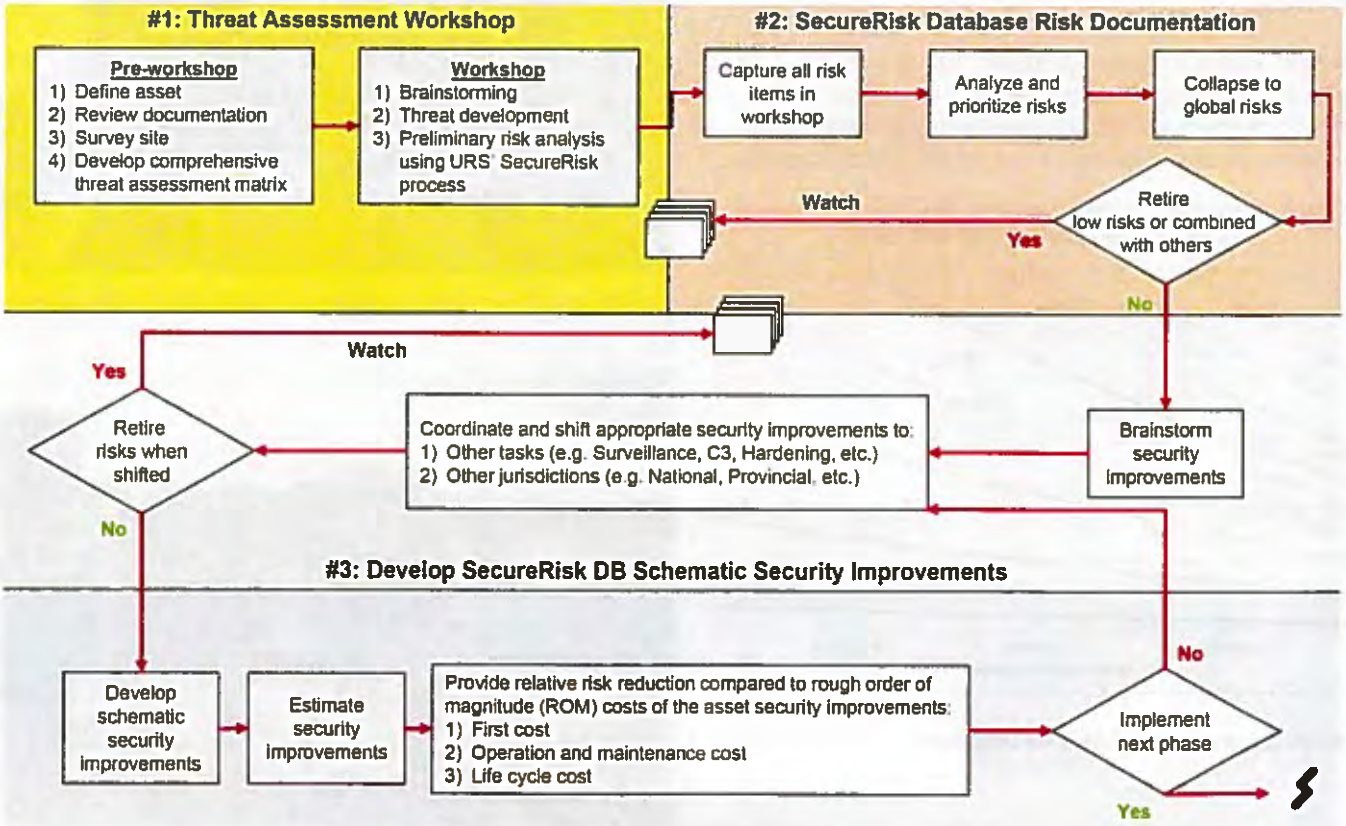


Figure 8-3. Workshop and Risk Mitigation Process

Identify and Prioritize Various Mitigation Measures

Using the facility characteristics and data collected earlier, AECOM will develop a risk mitigation/facility protection scheme to minimize injuries, structural damage, and loss of operation and revenue. The conceptual engineering design provides direct and indirect costs of mitigation options. These estimates comprise the first part of the risk mitigation/mitigation benefit equation. After costs for risk mitigation are collected, the risk assessment scores are recalculated, and the resultant improvement evaluated.

In the final step, risk mitigation projects are prioritized against the rough order of magnitude (ROM) capital cost to determine the greatest return for the risk mitigation investment. Risk mitigation projects are evaluated against the resultant benefits of the mitigation. Cost-benefit analysis is a systematic approach to organizing and quantifying this information to support the decision process in selecting among a group of alternative mitigation projects to reduce specific risks.

An example of a Cost-Benefit Analysis chart is shown as Figure 8-4. Cost-benefit information can assist in the determination of which hardening/resiliency mitigation options will yield the most risk reduction for the lowest cost.

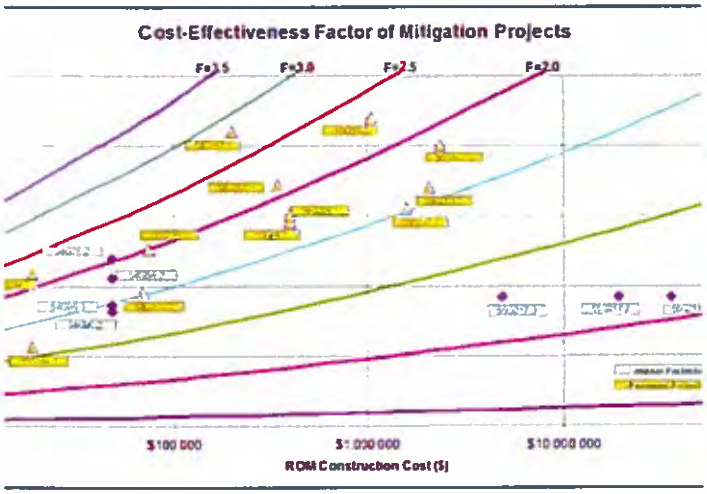


Figure 8-4. Example, Cost-Benefit Diagram

Resiliency Measures

Resiliency measures to be incorporated into the conceptual design include such basic design features as the elevation of critical equipment with relation to any flood elevations. All entry paths that could lead to water ingress will be identified and assessed in terms of their vulnerability and risk level. These entry paths include equipment doors, hatches and plenums, ventilation gratings, emergency exits, conduit entering at service entrances at critical rooms, manholes and ventilation ports, and so on. To the extent practical, floor slabs and walls can be designed with flood-proofing in mind.



FloodBreak Flood Gates Installed at Cyride (Iowa) Bus Barn.



FloodBreak Perimeter Floodwall and Flood Gates at Lourdes Hospital (Binghamton, NY) shown deployed in 2011.



Figure 8-5. ILC Dover's Flex-WallTM

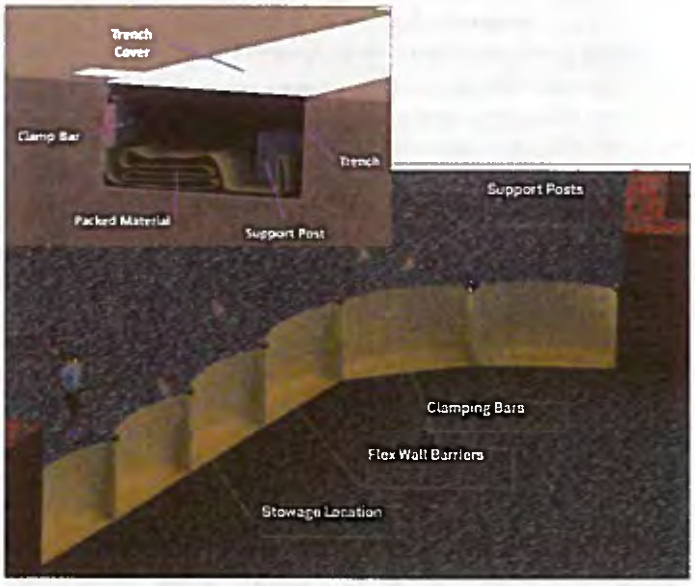


Figure 8-6: Flex-WallTM Deployable Flood Mitigation Solution for Street Level Protection

We will assess the mitigation to flooding afforded by reinforced concrete walls as well as deployable walls. To the extent possible, currently available industry products, such as those offered by FloodBreak or ILC Dover, will be included in the investigation of mitigation options.

One mitigation option that may be attractive for openings in a perimeter wall might be FloodBreak's perimeter flood wall and flood gates (Figure 8-5).

Another mitigation option that may be attractive for perimeter protection is ILC Dover's Flex-WallTM (Figure 8-6), a flood mitigation barrier designed for street level protection. It is a deployable flexible wall system that is stored at the point of use in a container. According to the manufacturer, this system is virtually leak-free, as there are no moving parts and the gasket seals are always clamped, reducing wear on the elastomerics.

Any configuration, straight or curved, can be created as the Flex-Wall™ follows the trench, which can be mitered into the roadway. This assessment will include alternatives to deployable post-log walls such as high strength flood protection fabric walls as manufactured by ILC Dover. Their Flex-Wall™ system is a deployable flexible wall system that is stored at the point of use in vertical containers. It utilizes pre-mounted anchors with surface-mounted components. These fabric walls may offer point of use storage, a more rapid deployment, with less manpower required for deployment than post-log walls, while being cost competitive with post-log walls.

Equipment Location

AECOM's concept development for location of equipment will focus primarily on the items most relevant for evaluating the feasibility, desirability, and cost of the alternatives. These include:

- space requirements (including required clearance and maintenance access)
- implications for other aspects of the facility (changed structural live loads, space for rerouted pipes and conduits, continued compliance with egress paths and capacities, and so on)
- environmental and code requirements, and potential impacts on operations (during construction and permanently).

Health and Safety Plan (HASP)

The System Safety and Security Management plan will also address construction safety. A Health and Safety Plan (HASP) is required for work in any high-risk operation, such as construction, demolition, hazardous waste operations, or any activity specified as high risk. The HASP is often required by regulation, insurance policy requirements, or client requirement. AECOM will prepare a HASP that includes the following components, as applicable:

- Descriptions of roles and responsibilities for the activity
- Hazard analysis for each task and operation found in the work plan
- Supervision
- Training requirements
- Personal protective equipment requirements for the separate tasks or operating areas
- Medical surveillance requirements for chemical exposure, noise, radiation
- Frequency and types of monitoring for physical and chemical hazards
- Pre-entry briefings requirements for visitors and workers
- Emergency and routine medical treatment hospital/clinic locations
- Emergency action and fire protection procedures
- Traffic plan and site access controls
- Electrical and machinery protective measures
- Trench and excavation safety
- Fall protection and rescue plans
- Storage for combustible and flammable materials
- Sediment and community noise control plans
- Materials movement plan
- Critical task sequencing
- Dust control measures

Job Safety Analyses (JSAs) and Task Safety Analyses (TSAs)

JSA's and TSAs will also be included in AECOM's Health and Safety Plan where they are applicable:

- **Job Safety Analyses** describe the task being performed, the inherent hazards or risks, the training requirements, and the control measures (including protective equipment) for those risks. Typically, JSAs are completed before the task begins and are updated regularly based on task revisions and lessons learned. All workers involved in the task should participate in the JSA process so that best practices are shared and possible hazards of the task are identified. Workers also feel ownership of the hazard control process when they are part of the analysis team.

- **Task Safety Analyses** are important elements in an effective hazard identification and risk reduction program. A TSA should be accomplished before every assigned task at the work location. The focus of the analysis is on the specific assigned task and the evaluation of risks and assignment of control measures based on actual work conditions. Among the items to be considered in preparing a TSA are:

  What am I about to do?
  Have I stepped through the task in my mind?
  Do I really understand the task?
  Have I done this task before?
  What could go wrong?
  What could move slip or fall?
  Does the equipment need to be checked?
  Could something spill, splash, or leak?
  What could be done to make it safer?
  Should I get help with the task?
  Do I have the right tools, PPE, or equipment?
  Do I need to review the JSA/procedures?
  What have I done to communicate the hazards?
  Have I spoken to my team about the hazards?
  Have I informed others in the area?
  Does someone know where I am and what I am about to do?

Quality Management Plan

The Project Safety and Security Management Plan (SSMP) is a complement to the Project Management Plan (PMP). A critical part of the PMP is the Quality Management Plan, which is described in detail in Section 7 of this proposal.

AECOM's approach to quality follows the international standard for quality management systems (QMS), ISO 9001. As one of the few ISO 9001-certified professional and technical services firms in North America, AECOM developed its system to address the standard's requirements, and we confirm compliance through formal auditing and verification. Initially certified in 2002, we have continuously expanded the scope of our ISO certification. In 2011 we achieved a single, unified ISO

9001:2008 certification covering all our business practices in North America.

Integrated Electronic Security Design Approach

AECOM has extensive experience designing Integrated Electronic Security Systems (IESS) for various vertical markets, nationwide and especially in the New York Metropolitan area.

As part of our experience with IESS design, we develop protection schemes for transit facilities, utility companies, highways, bridges, tunnels, airports, and commercial facilities. We use a combination of various solutions including visible light and thermal cameras with built in video analytics, fiber optic cable perimeter detection systems, access control devices, radar, and multi-technology sensors. The designs for each of these use a suite of sensors to reduce the false and nuisance alarms, thus increasing the reliability of the system.

AECOM has also designed Physical Security Information Management (PSIM) Systems that facilitate the integration of multiple systems (especially legacy systems) and provide ease of management as the systems get updated.

There are several key issues that lead to successful IESS design. These issues include:

1. **Camera and Device Placement.** The first key issue to a successful design is proper camera and device placement so that the system has the necessary sensor coverage to detect the threats. There are a number of ways that AECOM makes sure that the necessary sensor coverage is provided. The first is to understand the coverage requirements and the vulnerabilities being protected. AECOM works with the client to fully understand what areas need to be protected and from what types of intrusions. This is important to determining camera field of views, since we need to know if the camera is supposed to provide general surveillance of an area, or identify and recognize something specific. Specific field of views can be a person's face, body, or a stopped vehicle.

   To further refine these requirements, AECOM typically will perform a field of view survey of the locations where we intend to locate a camera. This survey accomplishes several things. The first is that the design team and the client both understand what the camera is intended to see before the camera is installed, thus allowing any field of view issues to be worked out in the design phase. The second is that the contractor has a clear understanding of what the camera is supposed to see when they go to install the camera. This process means that that the coverage requirements are captured correctly and carried through to project completion.

   AECOM tests all of the cameras that we specify in our own CCTV lab, which is located in our New York City office. In this lab we test each camera to fully understand the camera's capabilities, including field of view. Additionally, we test a variety of video management systems and PSIM systems. This lab allows AECOM to design based on a real-world understanding of the equipment we specify, instead of just based on the sales literature.

   AECOM will place devices based on the project environment and the ability to maintain the device. The environment that the device is being placed in will determine the type of camera enclosure needed and the type of suitable devices. For instance, whether a camera is to be installed indoors or outdoors will determine if an environmental enclosure is required and the lighting in the area will help determine if a day/night camera will be sufficient or if a thermal camera is required. Additionally, the type of traffic in the field of view of the device will help determine the type of device that can be installed. If the area has restricted access, then a more traditional intrusion detection device can be used. If the area has more unrestricted traffic, then a device with some form of analytics will be required. Regardless of the type of device installed, AECOM will always take the ability to maintain the device when determining its placement.

2. **Small Space Considerations.** The second key issue in a successful IESS design is flexibility in design to suit small space installations. Whether we are installing equipment on a bridge superstructure, perimeter of a large facility, airport terminals and property, or in one of the support buildings, AECOM realizes that space to install equipment is very limited. Before looking at options for expanding or building out a new space to support the system's equipment, AECOM looks at design options that will allow the equipment to fit in the space provided.

   We look very carefully at proper equipment selection so that it will fit in an enclosure sized for the available space. Since this does not solve every space issue, we look at the design as a whole. In many cases, an IP-based system will allow for greater flexibility. In an IP-based system, it is not

necessary to group large pieces of equipment in one room or area; additionally, the overall footprint of the equipment is usually smaller. This flexibility allows us to look at installing the equipment in multiple locations, which can then be networked together.

A system like this does not need be completely IP (i.e., IP cameras). Depending on the requirements, a mix of IP and analog equipment can be used and still maintain the core IP flexibility. Since space allocation can sometimes change between design and construction, AECOM tracks this issue through the construction phase of the project.

3. **System Integration.** The last key issue in a successful IESS design is system integration. This is not just integration with the new systems installed as part of the project, although that is a part of it. Since most IESS systems leverage the capabilities of existing systems, the new systems will also need to integrate with various existing systems. These types of systems often include intelligent transportation systems (ITS), CCTV, access control, building management, or fire detection systems.

   To integrate new and existing systems properly, AECOM will work with NJ TRANSIT and the systems manufacturers. Integration requirements include the information transmitted between the systems; which system will display alarms; and where and by whom the alarms will be viewed. With these requirements identified, AECOM works closely with system manufacturers to understand which integration requirements can be accomplished and by whom, and what system components will need to be upgraded or replaced.

   Recently, we found that although seamless integration can be accomplished through programming of various APIs by system integrators, APIs either stop working or need adjustment when a version upgrade is introduced on one of the integrated systems. This can sometimes limit future system growth. We have found that in many cases the installation of a PSIM provides greater flexibility in initial integration and future system upgrades. Many PSIM manufacturers provide a library of drivers with their product that leverages all of the product's past integration efforts. This is an advantage over typical security system integration, where many times the API needs to be written or customized for each and every project.

Deliverables

- Safety and Security Management Plan

TASK 9 PUBLIC INVOLVEMENT AND AGENCY COORDINATION

The AECOM team will support NJ TRANSIT's outreach efforts at the senior team level with those responsible for stakeholder engagement reporting directly to the project manager, while communicating with and operating under the direction of NJ TRANSIT. This structure promotes communication, feedback, and the ability to respond to issues quickly.

Public involvement will include all communications and activities involving the project's stakeholders and the public. The stakeholders include the North Jersey Transportation Planning Authority, other regional planning and transportation organizations, municipalities and local government units, and electric distribution companies.

AECOM has selected an experienced public involvement team in partnership with Greener by Design (GbD), a New Jersey-based small business enterprise with expertise in public outreach and agency coordination. GbD worked with Sandia National Laboratories and has led public involvement and agency coordination efforts for the City of Hoboken in the City's post-Sandy energy resiliency and microgrid feasibility efforts.

At the beginning of the project, our public involvement team will prepare a project-specific public involvement plan and an agency coordination plan. These plans will identify the regulatory requirements for public and agency participation and spell out the means and methods of communicating and coordinating with the stakeholders. The means and methods will address:

- Meeting types, such as public information meetings, focus groups, public hearings, presentations to government representatives, and agency coordination meetings.
- The production and use of print and audio-visual materials, project sheets, project detail graphics, videos, hand-outs, presentations, design packages, social media and web materials, and will establish the approval process for all materials.

Agency Coordination Plan (ACP)

The ACP will define the process by which NJ TRANSIT will communicate project information to and seek feedback from other local, state and federal agencies and authorities. The ACP will identify the relevant agencies, each agency's role/ regulatory authority and key agency representatives; the

responsibilities of each party; major coordination points and tasks; methods and timing for involving the public; and a proposed schedule. The ACP will be a living document that can be modified throughout the project.

The ACP will assist NJ TRANSIT to establish procedures that facilitate the presentation of information to the FTA and to local, state and other federal agencies. The procedures support the PMP, confirm the project's regulatory compliance requirements, and support NJ TRANSIT's process for to secure FTA's consent for funding.

AECOM's Public Involvement Team

Our team will assist NJ TRANSIT in the following principal areas, based on our experience with FTA's procedures and policies.

- Technical capacity and capability reviews
- PMP and the various sub-plans
- Safety and security management plan
- Quality assurance/quality control plan
- NEPA commitment establishment and incorporation into the project design and construction
- Risk assessment and contingency management plan development and use
- Readiness to enter project development, engineering, construction, and operations
- Readiness to execute the FTA Full Funding Grant Agreement or equivalent
- Monthly and quarterly reports to FTA
- Project delivery methods reviews
- Capital cost estimate reviews
- Project schedule reviews

This will require monthly, quarterly, and periodic coordination and preparation of reports and other documentation to FTA. AECOM will assist NJ TRANSIT to prepare documents that report the status of the project and enable NJ TRANSIT to start major activities to advance the project with FTA's approval.

Open Houses and Meetings

AECOM's plan will include coordinating open houses at the direction of NJ TRANSIT on various points during the design process. The ACP will also address assisting NJ TRANSIT with presentations to governmental representatives and interested parties and will address relevant document production.

TASK 10 INTEGRATION AND INTERFACE

AECOM is a leading supplier of large-scale, single-location, and linear projects. Many of these projects involve multiple local, state and Federal government agencies, suppliers, contractors, work areas, utilities, and other entities. If not properly managed, interface points are an area in a project where problems most frequently develop. Such interface points include the technical design elements of a utility interface or the compatibility of a new system with NJ TRANSIT O&M requirements. Proper integration of multiple system interfaces, including division of responsibility, planning and verification, is crucial for the success of a project with the magnitude of the NJ TRANSITGRID.

AECOM will implement an interface and integration process with the design process. We recognize that design elements must interface properly with existing NJ TRANSIT facilities and infrastructure, the NJ TRANSIT corporate-wide Sandy Recovery and Resiliency Plan, and with the NEC infrastructure and design elements outside this scope. AECOM will coordinate activities with other consultants and governmental agencies and other entities that may be affected by the project.

AECOM's design integration approach addresses design interfaces that will enable for progress beyond the preliminary engineering phase without the need for re-engineering or redesign. We will prepare and submit an **Integration Management Plan (IMP)** to NJ TRANSIT for approval. The IMP will establish a comprehensive, systematic, verifiable, and continuous integration process to achieve NJ TRANSIT's objectives. Our interface and integration effort will at a minimum:

- Follow the Work Breakdown Structure (WBS) and provide the capacity to scale the WBS as needed
- Provide an integration design document that systematically identifies and formally documents all interfaces and establishes a process for addressing each interface
- Identify best methods to confirm interface compatibility and demonstrate this compatibility through tests or methods
- Coordinate civil infrastructure, utility, electrical, and mechanical interfaces, ensuring their compatibility with NEC and other facilities
- Allow NJ TRANSIT to assess the effectiveness of, and audit, AECOM's integration process

AECOM will develop and maintain an **Interface Database** that lists all physical elements and other interfaces it will encounter on the project. The interface database is an integrated part of the records management system. Data fields and tables in the database will include such items as:

- Interface type, including relevant characteristics
- Purpose of the interface
- Current status of the interface
- Relevant safety standard, if any
- Primary responsibility for defining the interface
- Specific division of responsibility
- Any open issues and/or conflicts

Once NJ TRANSIT has approved IMP, AECOM will prepare and submit an **Interface Control Document (ICD)** that addresses all identified interfaces during design. For preliminary engineering design, we will take into consideration the O&M requirements of the NJ TRANSIT-approved design and work with NJ TRANSIT so that the design criteria do not conflict with the O&M requirements. AECOM will also prepare and submit an Integration Report for Amtrak Sub-41, which address the interfaces related to that site, taking into consideration site-specific O&M requirements.

TASK 11 CONSTRUCTABILITY REVIEWS

AECOM will participate in formal constructability reviews at various stages of preliminary engineering (and during peer reviews) and prior to 100% stages of preliminary engineering, evaluating issues that affect the construction, adjacent properties, and the public. We will follow Construction Industry Institute (CII) guidelines, which define constructability as "the optimum use of construction knowledge and experience in planning, design, procurement, and field operations, to achieve the overall project objectives." AECOM will provide experienced construction personnel from the earliest stages to make sure that the construction focus is communicated to the planners and engineers.

Constructability will be used as a design consideration, by factoring in cost and schedule effectiveness. Based on constructability aspects of the project, AECOM will develop appropriate productivity rates.

Constructability Review Process

The key to cost and schedule control is the accuracy and completeness of the construction documents. A well prepared, thoroughly coordinated set of documents will make bidding easier, leave less room for contractor errors and, most importantly, will contain all of the information necessary to fully communicate the engineer's intended design. Complete, accurate construction documents are the first line of defense in negotiating change orders and minimizing claims. Our goal is to identify problems on paper before they become problems in concrete and steel.

This Distributed Generation program requires a number of projects throughout much of the NJ TRANSIT system. It includes installations along the right-of-way, at maintenance facilities and at facilities used by passengers. The projects will interface with systems and utilities provided by the Port Authority of New York and New Jersey and the local power companies.

Besides the speed and efficiency of construction, our constructability reviews and construction staging recommendations will address the safety of operations, safety of passengers, the integrity of vital systems, and the integrity of power supplies and other utilities managed by others.

Among NJ TRANSIT's vital systems will be signal power, grade crossing protection power and power for switch motors. Other systems, non-vital but important, are passenger information systems and communications systems in the maintenance facilities and stations. Construction staging must also address access for emergency vehicles and personnel during construction and the security of systems and equipment within the construction zone. The safety of employees and customers and the security of vital equipment may dictate that some contract packages have their work performed off hours, when temporary safety and security measures may be less costly and more efficient.

Final design plans may be prepared by others through design-build or design-build-operate maintain contracts. The AECOM team will review the designs for constructability and adherence to the performance criteria and delivery strategy. We will make formal recommendations to the project architects/engineers for their consideration and inclusion in the design. Our constructability reviews will be performed in conjunction with the cost estimates so that complete, coordinated and accurate drawings get distributed to bidders.

We look at the documents the way a potential bidder will review and bid them.

AECOM will recommend alternative construction methods, where appropriate, to achieve cost and schedule goals and encourage local subcontractor participation. In addition to analyses of constructability, it is important that contract documents be reviewed for biddability. We will review bid documents so that:

- Items proposed allow for realistic evaluation of the bids; plans and specifications portray the project in sufficient detail to enable accurate bidding
- Special conditions and work hours are explained. In particular, railroad rights-of-way are in restricted work areas; work rules are clearly identified, and work around live high-tension power lines is identified
- Contract documents can be clearly understood by the parties involved; special provisions and drawings are consistent, accurate, and practical
- Responsibilities and authority of each party are defined
- Construction quality control and quality assurance responsibilities are clearly delineated
- Responsibilities for shop drawings, O&M manuals, and final test and acceptance procedures are specified
- Required permits and approvals have been obtained
- The scope and schedule are realistic and supported by a construction scheduling system; and constraints are considered

Constructability reviews will begin with a presentation by the design team, explaining the scope and intent of the contract, and describing the essentials of the project to the review team. This presentation will afford the construction manager's independent constructability review team the opportunity to learn the basis and criteria for the design and to ask questions. This approach will enable the review team to accomplish significantly more within the planned period for this activity and enhance its ability to identify omissions and other types of design errors that are more difficult to catch. AECOM's project manager will determine whether the points of interface between one discipline and another are clearly defined.

Comments and Recommendations

All comments or recommendations of the review team will be considered and logged by our project manager, confirming that the constructability review has been completed. We will produce a narrative report to transit with the entire document to NJ TRANSIT for review, approval, distribution to the design manager. Prior to bid solicitation, the design team will incorporate modifications deemed appropriate into the bid document to minimize the number of potential change order requests, claims, budget increases, and undesirable surprises.

Properly conducted constructability reviews help avoid construction claims as many claims result from acts of omission rather commission, and the former are more difficult to catch. Many claims also arise out of basic dimensioning or design conflicts and errors in the construction drawings.

TASK 12 CONTRACT PACKAGING

AECOM will work cooperatively with NJ TRANSIT to provide the appropriate contracting strategy to achieve success. We have experience with many different types of contracting approaches and are capable of developing a comprehensive contracting strategy.

By definition the Distributed Generation program will involve projects at various locations. These must stand alone and yet be part of a connected power supply network. The work itself will include the procurement, installation, integration and testing of sophisticated equipment. In many cases it will require contractors to have highly specialized skills and equipment. The work will also require a high degree of coordination with other agencies, the local power companies and other contracts.

Depending on the contract model selected, the work may also include O&M of the installations. The nature of the work and the delivery method will dictate how contracts are packaged. Packaging could range from a number of smaller contracts to one or a few comprehensive packages. These interdependencies will be carefully studied as part of AECOM's overall contract strategy review and recommendations.

Contract Strategy

To determine the best approach, it is important to review and understand NJ TRANSIT's goals, including risk tolerance, time horizon, cash flow position, operations, and so on. We can then overlay the current supply side market trends, including commodities/materials, major equipment, engineering, and construction services, while taking into consideration the union labor environment and competing projects in the NJ/NY metropolitan area.

These factors will help determine the preferred project procurement approach, e.g. design-build, design-build-operate-maintain (DBOM), engineer-procure-construct-maintain (EPCM), engineer-procure-construct (EPC), construction manage, program manage, or other. A collaborative evaluation with NJ TRANSIT is essential. AECOM's experience with NJ TRANSIT and knowledge of the electrical and rail systems will allow our team to hit the ground running.

Sub-projects

Depending on the delivery method, there will be some variation in how the project is further broken down into sub packages. It is likely that sub-packages will be considered for the following major scope areas:

- Fuel cell installation
- Solar photovoltaic
- Combined heat and power (CHP) plants
- Resiliency and Cybersecurity Technology

All sub-projects/packages will include well-defined performance criteria for key items such as:

- Safety performance, based on recordable incident rate or other measure
- Total project cost and implementation of effective cost control measures
- Schedule management, with milestone dates established for each task and early and late finish dates specified for use in grading performance
- Quality performance, based on design document reject rates, document revisions, interferences, and rework

Combined Heat and Power (CHP) Plant

In today's energy market, whether utility, IPP, or industrial, the prevailing CHP plant contracting model is lump sum EPC, provided the project is relatively well defined. The contracting environment in this sector has been favorable for owners for the past several years and there is little expectation for change due to the relatively flat demand for power. For these reasons, we view an EPC approach to the power plant as the probable starting point.

There is some potential to reduce cost by moving to an EPCM or fixed/variable model, which reduces the contractor's contingency/risk premium compared to a fixed price EPC approach. This is particularly true for craft labor intensive projects in certain large metropolitan areas such as New York; due to the relatively high craft labor cost and sometimes uncertain craft productivity in the region. Labor availability over the project period is another risk that must be evaluated carefully, as it will also affect price levels and schedule certainty.

The CHP plant, whether it is based on reciprocating engine, microturbine or fuel cell technology, is composed of equipment with relatively long lead deliveries. In addition to the engines, the transformers, and HRSGs represent items that will require special attention with respect to schedule, and this may have a bearing on how and when the equipment is procured.

Solar Photovoltaic

For the solar PV portions of the project, we will evaluate several contracting approaches to achieve a high level of price and schedule certainty. One approach is third-party financing through a power purchase agreement (PPA). NJ TRANSIT is a government agency, is not subject to income tax, and therefore is not eligible for the federal solar income tax credit (FITC), which is up to 30 percent for the projects installed before the end of 2016.

To capture the tax credits, NJ TRANSIT might consider partnering with a third party that would provide all the capital investment for the proposed PV system, own and operate the PV system, and then sell the solar electricity generated from the PV system through a power purchase agreement (PPA) to NJ TRANSIT. This option could be explored with companies that provide these services. NJ TRANSIT could potentially purchase the solar electricity for less than what they would be paying PSE&G for standard electricity resulting in immediate savings and over the life of the PPA contract. Another option could be to lease the PV equipment.

When different contracting options are evaluated for the sub-projects, available incentives, rebates and grants opportunities will be explored and considered in making the final recommendations.

Cybersecurity Systems and Resiliency

AECOM's plan includes the implementation of the expert team's IPERC proprietary cybersecurity technology. The IPERC system will be integrated into the project design concept and appropriate subsystems will be specified to support the requirements of the cybersecurity platform.

In addition to cybersecurity, resiliency measures will take many different forms, including flood resiliency, storm resiliency, and Terrorism Vulnerability Assessment (TVA) hardening. These critical measures will be incorporated into the overall project design concept, which will then flow down by sub-package and by system. There will be a high level of coordination between our technical team and our safety and security experts so that the resiliency requirements are appropriately specified and implemented.

TASK 13 PREPARATION AND SUBSEQUENT SUPPORT OF CONTRACT BID DOCUMENTS AND BIDDING PROCESS

AECOM has the resources and experience necessary to provide technical assistance during the procurement process and assist NJ TRANSIT in determining the optimum method of project delivery.

Task 13 is divided into 13A and 13B. During the first, AECOM will assist NJ TRANSIT in selecting the optimum project delivery methods for the project. Once the optimum methods of project delivery are selected, during the conduct of 13B, AECOM will assist the agency in the preparation of the solicitation documents and the subsequent solicitation process and selection.

13A Select the Project Delivery Method

The project delivery method is the process by which a construction project is designed and constructed for an owner/agency—including project scope definition; organization of designers, constructors, and various consultants; sequencing of design and construction operations; execution of design and construction; and closeout and start-up. Selecting the most appropriate project delivery method is a critical factor in the future success of a project.

In selecting a project delivery method, the window of opportunity to select some methods closes as the project moves through various stages of development. The decision on the type of delivery (e.g., design-build) should have been made much earlier, so that the design documents can be developed to properly accommodate the type of delivery method.

Several methods of project delivery are available. Contractual relations, laws and regulations, perceptions of risks, awarding mechanisms, and method of payment may influence their selection. Objectivity is important in selecting the project delivery method, and each method has advantages and disadvantages which must be considered. Depending on governing laws and regulations, the following contract delivery methods will be considered in this analysis:

Design-Bid-Build (DBB). DBB is the most widely used project delivery method and is generally viewed as the traditional project delivery method in the United States. It is well understood and accepted by the transportation agencies and members of the design and construction industries. In this method, a complete design is provided and then, based on the designer's completed construction documents, a separate construction invitation for bit (IFB) is advertised. The agency is responsible for the details of design and warrants the quality of the construction design documents to the construction contractor. DBB projects can also be awarded on a negotiated basis and a best-value basis. DBB involves less builder input to the design than design-build (DB) or construction management at risk (CMR). Thus, the agency must rely on the designer or construction manager for constructability review, if there is any. In this method the owner has full control over the details of design.

Design-Build (DB). DB is a project delivery method in which the agency procures design and construction services in the same contract from a single legal entity referred to as the design-builder. A variety of methods exist for selecting the design-build constructor. Common methods are the one-step and the two-step processes. The one-step process provides for competitive evaluation of technical proposals, with the contract award decision based on best value to the owner agency. The determination of best value is based on a combination of technical merit and price. A two-step

process separates the technical proposal from the price. This method typically uses RFQ/RFP procedures rather than DBB IFB procedures. There are a number of variations of the DB process, but all involve three major components. 1) The owner develops an RFQ/RFP that describes essential project requirements in performance terms. 2) Qualifications and proposals are evaluated. 3) With evaluation complete, a contract is awarded for both design and construction. The DB entity is liable for all design and construction costs and must usually provide a firm, fixed price in its proposal.

Among the variations on the DB method, are: design-build-operate-transfer, design-build-operate-own (sometimes called lease-back), design-build-operate-maintain (DBOM), all require the DB contractor to remain with the project after construction is complete. In the DBOM model, which is includes design-build, the contractor assumes the operation and maintenance risks and is responsible to operate the new facility according to a set of regulations and codes for a determined duration.

DB simplifies the project's chain of responsibility considerably. The builder has early constructability input to the design process. The design-builder literally controls this project delivery method. The DB project delivery method has proven to be successful in compressing the project delivery period and is therefore often used for fast-track projects.

Construction Management at Risk (CMR) or Construction Manager/General Contractor (CM/GC). CMR projects are characterized by a contract between an agency/owner and a construction manager who will be at risk for the final cost and time of construction. In this agreement, the construction manager is authorized to handle the construction phase and give inputs during the design development. The idea of CMR is to furnish professional management of all phases of a project life to an agency whose organization may not have those capabilities. Typically, CMR contracts contain a provision in which the CMR stipulates a guaranteed maximum price (GMP) above which the agency is not liable for payment. Often, these contracts include incentive clauses in which the CMR and agency can share any cost savings realized below the GMP. CMR contracts can contain provisions for the CMR to handle some aspects of design, but generally, the agency retains the traditional responsibility by keeping a separate design contract and furnishing the CMR with a full set of plans and specifications upon which all construction subcontracts are based. The CMR is usually paid for furnishing preconstruction services such as cost engineering, constructability review, and development of subcontractor bid packages. Constructability and speed of implementation are typically the major reasons that the CMR method is selected. There are aspects of the process which may not comply with 4220.1.

Delivery Method Selection

Selection of the appropriate project delivery method is a decision-making process. Ideally, the decision is made as early in the design phase as possible, preferably in the project scoping process and before the final construction estimates are ready. The window of opportunity to select certain delivery methods closes as the project moves through stages of development. Most of the benefits can be realized by engaging the constructor as soon as possible. An owner may decide to engage a design-build contractor at the end of preliminary engineering or even later in order to clarify the scope and reduce uncertainty. However, that delivery method should be selected much earlier so that the design and construction documents are in line with the method.

Selection Process

As one of the world's leading program management firms for complex infrastructure projects, AECOM typically uses the following subtasks to assist owners to select the best project delivery method for their projects. The process entails up to three subtasks:

Subtask 1: Defining Goals. The first subtask provides a framework to define project goals and examine the advantages and disadvantages of each delivery method within the context of these goals. The intent of this approach is to help understand project delivery method attributes and to determine if their specific project goals align with the attributes of a particular delivery method.

Subtask 2: If delivery method cannot yet be determined in Subtask 1, a more detailed level of analysis is conducted as Subtask 2. While Subtask 1 involves prioritizing objectives and selecting the delivery method that best aligns with them, the analysis in Subtask 2 focuses on key parameters affecting the selection. Weights are assigned to each parameter, and a score calculated for each delivery method. The optimum project delivery method is determined based on the outcome of the scoring.

Subtask 3. If the delivery method still can't yet be determined to NJ TRANSIT's satisfaction, Subtask 3 provides an even more detailed analysis that uses risk-based cost-estimating methods. The analysis entails qualitative and quantitative risk analyses using a risk-allocation matrix that defines the risks under competing delivery methods.

13B Procurement Process

Following the selection of the project delivery, AECOM will assist NJ TRANSIT throughout the procurement process, including the following steps.

Development of the Draft Solicitation Packages

We will assist with the development of the draft solicitation packages. Depending on the type of procurement, its size, complexity, and other factors, it may be necessary to conduct an industry review process. We will help to develop the required documents for this process and to incorporate industry feedback into the solicitation.

Prequalification Process

AECOM will support NJ TRANSIT in the prequalification of bidders and assist with RFQ development, including the qualification criteria, with issuing the RFQ, and with the evaluation process to select prequalified proposers/bidders. The prequalification process will address items such as:

- Safety record
- Prior experience in similar work
- Qualifications of personnel
- Qualification of team
- Financial capacity
- Teams capacity
- Past performance

RFP Process

AECOM will prepare a design packages and issue a formal RFP suitable for the selected project delivery method. The RFP package will include:

- Instructions to bidders for their proposal preparationTerms and conditions and commercial requirements
- Design documents
- Specifications and Program Management draft which establish requirements and applicable tolerances/ margins for:
  - Project scope
  - Safety requirements
  - QA/QC procedures and objectives
  - Mobilization
  - Installation
  - Testing
  - Commissioning
- Project Schedule
- Project Controls requirements addressing:
  - Progress reports
  - Cost tracking and reporting
  - Schedule updates and actualization
  - Cash flow
- Documents controls

We support the preparation for and conduct of any pre-bid meetings or technical, commercial, or legal one-on-ones. We will help NJ TRANSIT to respond to proposer/bidder questions, requests for clarifications, and requests for information (RFI) and to modify the RFP as necessary.

Evaluation and Selection

Concurrent with Subtask 3, AECOM will assist NJ TRANSIT in the development of the solicitation source selection plan. The plan will detail the selection process, how the proposals will be evaluated, and the criteria that will used by NJ TRANSIT in the evaluation and selection of the winning proposal/bid. This will be completed in advance of the receipt of proposal and kept confidential until after the receipt of the proposals/bids. AECOM will also assist in the training of any of the evaluators and members of the selection teams. This insures that all of the evaluators have a thorough understanding of how to arrive at the decision while maintaining procurement integrity.

Upon receipt of the proposals/bids, AECOM will assist with the initial review of bids for RFP compliance. This may include obtaining clarifications from bidders. We will assist with the bid evaluation using NJ TRANSIT's evaluation manual. Once a proposer or bidder is selected, AECOM will assist in the award process, including supporting post-award discussions. In the event there is a need for a best and final offer (BAFO), we will support that process, including both the solicitation and evaluation.

TASK 14 ANALYSIS OF ANCILLARY SERVICES MARKET REVENUE OPPORTUNITIES

It is possible that some or all of the generating facilities installed pursuant to this RFP will be interconnected with the PJM transmission system. (The PJM system is described below.) With respect to any such interconnected facilities, there may be excess generation available from time to time that potentially could participate in PJM administered markets and produce net revenues for NJ TRANSIT.

The AECOM team, including Navigant Consulting, has extensive experience performing economic market simulations of the PJM system as well as numerous other electricity control areas in the United States.

Based on Navigant's analyses described below in this section, NJ TRANSIT will be provided with results that will support the selection of the optimal generation configuration (e.g., a mix of fuel cells, photovoltaic solar generation and CHP) for the NJ TRANSITGRID DG. In addition, our team's analyses will support decisions as to the appropriate PJM administered markets, if any, in which to participate.

PJM

Before describing our team's market modeling capabilities, a brief description of PJM is warranted since it is expected that the power plant will be involved with numerous aspects of PJM and its markets. PJM is a regional electricity transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of 13 states and the District of Columbia. PJM operates competitive wholesale electricity markets and provides transmission services pursuant to its Open Access Transmission Tariff which is subject to FERC regulation. Notwithstanding that the power plant will likely be a "behind the meter" facility according to the Sandia report, it will be required to comply with PJM Interconnection requirements, and NJ TRANSIT may be required to become a member of PJM.

The primary competitive wholesale markets administered by PJM include the **energy market**, the **capacity market** and the **ancillary services market**. A brief review of these markets and the preliminary prospects for the power plant to participate in each follows:

- **Energy Market.** There are two markets: day ahead and real time. These are essentially spot markets in which generators sell and utilities or electricity providers buy energy for delivery the next day or next hour. To the extent that the DG Generation has available generation after serving the hostloads, it would be expected to be able to participate in these markets if its generation is economically advantageous.
- **Capacity Market.** This market is also referred to as the reliability pricing model or RPM. In this competitive auction-based market, PJM secures power resources to meet predicted peak loads three years in the future.
- **Ancillary Services Market.** Ancillary services, which are provided largely by generators, help to balance the transmission system as it moves power from generators to customers. The major ancillary services markets administered by PJM involve operating reserve markets and the regulation market. Operating reserves refer to generating capacity that is available (generally within 10 or 30 minutes) to meet contingency conditions in the event of an unscheduled generation or transmission outage. Regulation applies to generating capacity that can respond instantaneously to maintain frequency.

The AECOM Team's Models

AECOM team member, Navigant, employs a variety of commercial and proprietary energy market modeling tools to project generating capacity retirements and additions, generating unit dispatch, fuel consumption, gas pipeline flows, and commodity prices in both PJM and other organized markets (e.g., Independent System Operator of New England, New York Independent System Operator, Electric Reliability Council of Texas, Midwest Independent System Operator, Southwest Power Pool and California Independent System Operator). A schematic of these tools is shown in Figure 14-1 on the following page.

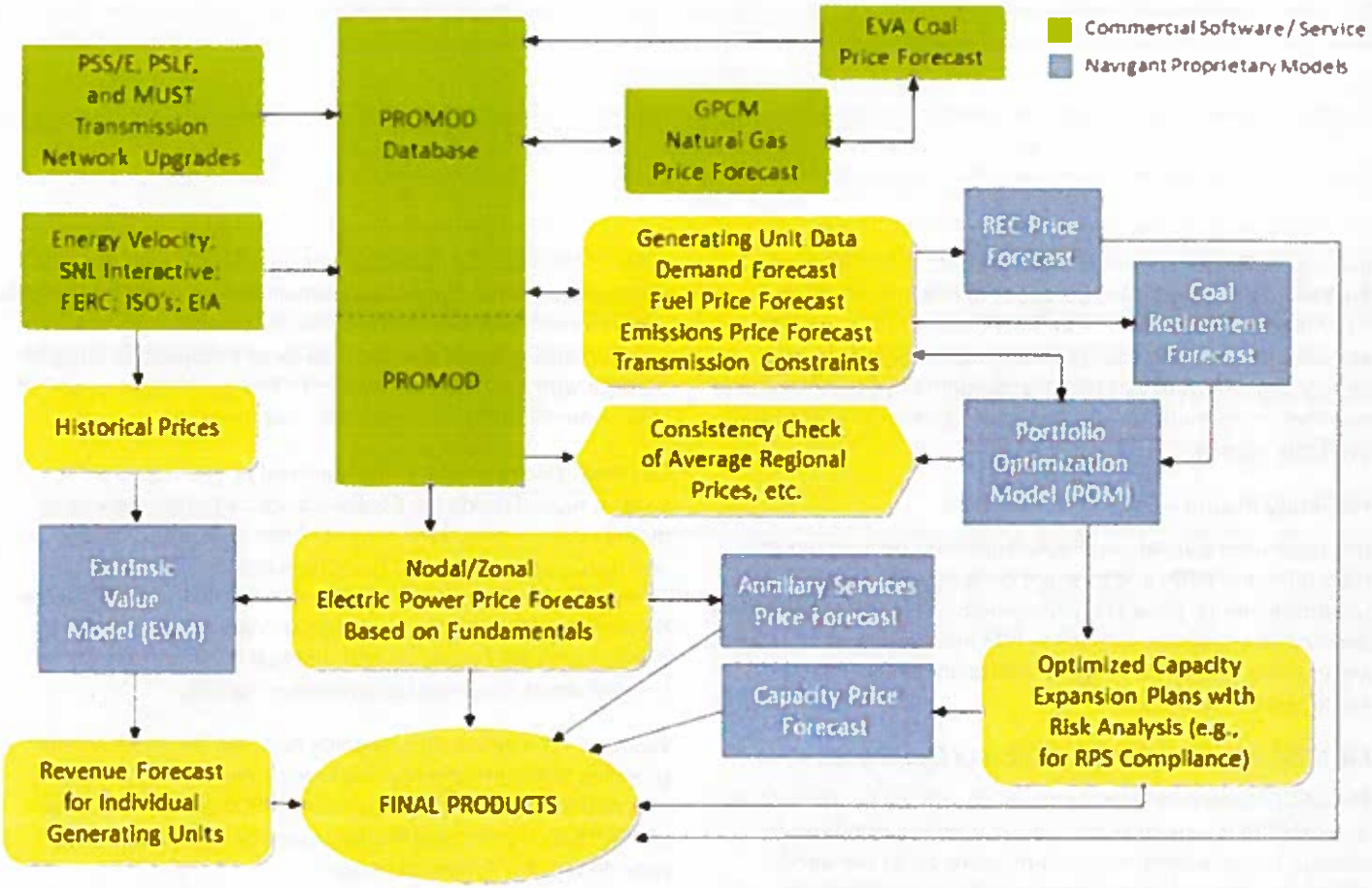


Figure 14-1. The AECOM team's commercial and proprietary energy market modeling tools and their inter-relationships.

The AECOM Team's Energy Market Modeling Toolkit

PROMOD

For fundamental energy market simulation and forecasting, we use PROMOD IV, a detailed hourly chronological market model and tool that simulates the dispatch and operation of the wholesale electricity market including PJM. (ABB/Ventyx's PROMOD IV is commercial software that is widely used in the U.S. by utilities, consultants and ISOs for electricity market modeling.) PROMOD is a least-cost optimization model and tool that simulates the hourly operation of the energy market, while observing generator operating limitations and transmission constraints. PROMOD can be run as a zonal or nodal model, and for this analysis Navigant would use its current nodal transmission representation for all regions studied.

The PROMOD database for base-year and forecasted generation assets, fuel prices, and emissions allowance prices in all regions is maintained and updated by Navigant on a semiannual basis in spring and autumn, and demand forecasts are updated annually depending on release dates of demand forecasts. We update power flows and event files in PROMOD annually, using the most recently available FERC 715 power flows.

PROMOD Inputs - Generation

We continually monitor and research generation retirements, announced additions, and plant parameters using public databases and news services in order to maintain current information and to identify and correct for gaps and/or errors which may be imbedded in the vendor's "off-the-shelf" PROMOD database. Forecasts of future generation additions are developed in POM as part of our semi-annual Reference Case forecast updates.

PROMOD Inputs - Emissions Prices

Regional prices for CO2 are modeled as the shadow price of compliance with regional and/or national CO2 limits. Our current assumption is that national limits on CO2 emissions will be in place in 2020 under a variant of the EPA's Clean Power Plan. For the period 2015-2019, Navigant incorporates publicly available information on Regional Greenhouse Gas

Initiatives (RGGIs) for New England, California (California Air Resources Board rules pursuant to Assembly Bill [AB] 32), Alberta, and British Columbia. Prices for SO2 and NOx emissions have been adopted from forecasts prepared by energy ventures analysis (EVA), a specialist in coal and related markets under contract with Navigant, and other publicly available sources.

PROMOD Inputs - Demand Forecasts

Our team uses publicly available finalized planning reports from ISOs and RTOs and forecast data sets from ABB/Ventyx to update annual peak and energy demand forecasts. ISO/RTO demand data sets are drawn for PJM and certain other control areas and are input to Navigant's version annually in late winter or early spring.

PROMOD Inputs – Gas, Fuel Oil, and Coal Prices

The AECOM team forecasts natural gas prices by trading hub using GPCM (formerly known as gas pipeline competition model.) This is a linear-programming model of the North American natural gas market that captures the complex interactions among gas producers, pipelines, storage facilities, gas marketers, and consumers.[1] Based on a pipeline specific model of the industry, GPCM contains more than 90 delivery points, 200 existing and proposed pipelines, 400 storage areas, 85 production areas, 15 LNG import/export terminals, and nearly 500 demand centers.

We apply our own analysis to provide macroeconomic outlook and natural gas supply and demand data for the model, including infrastructure additions and configurations, and our own supply and demand elasticity assumptions. Forecasts are based upon the breadth of our detailed knowledge of the U.S. and Canadian natural gas markets. Adjustments are made to the model to reflect accurate infrastructure operating capability as well as the rapidly changing market environment regarding economic growth rates, energy prices, gas production growth levels, sectoral demand and natural gas pipeline, storage and LNG terminal system additions and expansions.

GPCM is co-optimized with Navigant's Portfolio Optimization Model to develop equilibrium solutions for gas prices, gas use, gas-fired generation capacity (MW) and energy (megawatt-hour [MWh]) by region. To capture current expectations for the gas market, this long-term monthly forecast is combined with near-term NYMEX average forward prices for the first two years of the forecast. Navigant has used GPCM in numerous engagements over the last six years including work for the LNG export sector, in which the firm developed a leading market position having supported six LNG export projects in filing for permits with the U.S. Department of Energy to allow export of LNG to non-Free Trade Agreement countries.

Our team also develops a long-term oil price forecasts for several fuel oil products. Forecasts are based on regression models established from historical relationships between various oil product prices. The Reference Case Oil Price Forecast is produced in conjunction with the Reference Case Natural Gas Forecast twice a year, and consists of monthly prices for NYMEX crude oil and residual and distillate oil for the gulf coast, northeast and western regions.

We obtain the delivered coal price forecast from EVA, which provides forecasts of delivered coal prices and emissions inputs that are coded for direct use in POM and our version of PROMOD. Plant-specific inputs and projected costs are provided for the following factors:

- forecasts of annual coal prices by coal supply region and coal type
- revised coal commodity price forecasts using Navigant inputs on natural gas prices (Henry Hub basis) and coal-fired power plant retirements
- coal selection by plant and unit
- coal transportation costs

PROMOD Inputs – Transmission

Updates for the Eastern Interconnection were completed in the second half of 2014 using power flow data sets obtained from the FERC 715 power flows. These transmission representations include all known significant and likely transmission upgrades as planned by ISO/RTO's and other balancing area planners through 2023, the time horizon of current transmission expansion plans. Forecasts for power flows for 2028 and 2033 are developed by Navigant based on analysis and judgment regarding likely transmission expansion needs beyond the 2023 horizon.

Portfolio Optimization Model (POM)

Navigant's proprietary POM is a capacity expansion model that emphasizes impacts of environmental policies and focuses on renewable generation, while being suitable for risk analysis.

[1] *See http://www.rbac.com/ProductsServices/GPCMGasModel/tabid/80/Default.aspx for further detail.*

It is linked with the PROMOD input data set and incorporates the same generation base, demand forecasts, fuel prices, other operating costs, and plant parameters which are used in PROMOD. POM's algorithmic structure and solution methods are also compatible with Navigant's models for forecasting fuel prices, capacity market prices, and emissions prices. POM is a linear program that dynamically solves for the multi-decade planning horizon simultaneously to simulate economic investment decisions and power plant dispatch on a zonal basis subject to capital costs, reserve margin planning requirements, renewable portfolio standards, fuel costs, fixed and variable O&M costs, emissions allowance costs, and zonal transmission interface limits. It includes a multi-regional representation of the North American electrical system with constraints on inter-zonal transmission, and adopts a load duration curve representation to speed computational times.

POM specifies every individual generating unit, allowing for state-by-state reporting of generation data. Optionally, POM can perform multivariate optimization, which considers other value propositions than just cost minimization, such as sustainability, technological innovation, or spurring economic development. This makes it especially suitable for modeling future renewable generation expansion. Our team has used POM in a number of engagements over the last several years.

PSS/E, PSLF, MUST

Our team uses PSS/E and PSLF for transmission analyses. These are transmission planning software licensed from Siemens PTI and GE, respectively. Both programs include power flow, optimal power flow, balanced and unbalanced fault analysis, dynamic simulations, extended term dynamic simulations, open access and pricing, transfer limit analysis, and network reduction. In addition, Siemens PTI's MUST is used to determine transmission transfer capability by simulating network conditions with equipment outages under different loading conditions.

Capacity Market Price Model

Navigant's proprietary Capacity Price Forecast model estimates clearing prices in PJM as well as the ISO-NE and NYISO capacity markets. It can be used to both forecast expected revenue from entering the capacity markets as well as for scenario analysis of uncertainties (both market parameters and regulatory) that may impact the revenue forecasts.

The model is consistent with the assumptions and outputs of our PROMOD/POM modeling. The basic structure is to determine the intersection of supply and demand for capacity in each locational subzone of the markets subject to import constraints from other subzones. The model estimates the capacity demand curve in each ISO following the ISO's administrative rules combined with a forecast of net Cost of New Entry that uses PROMOD output. The capacity supply curve is estimated by calculating the "missing money" for each unit in the PROMOD database and setting the unit bid to the amount needed to be made whole. Imports from other regions and energy efficiency and demand reduction resources are also considered.

Individual Plant Dispatch and Optimization Modeling

The AECOM team will use our proprietary Electric Valuation Model (EVM) to evaluate bidding behavior, volatility, and arbitrage opportunities. It generates a single unit's dispatch based on input forecast prices. Using an hourly price stream from PROMOD, EVM models the plant as a price-taker, dispatching the unit over a horizon of expected prices. By repeatedly solving a weekly (or longer) problem to optimality, EVM replicates bidding patterns that reflect the plant operator's profit maximizing strategy. EVM also explicitly accounts for the additional volatility in market prices that is generally absent from simulated prices, including the effect of intra-month volatility in fuel and emissions prices, stochastic variations in demand, and deviations of market bidding away from marginal cost bidding. Navigant includes these adjustments in EVM as the forecasted hourly prices generated within PROMOD represent expected day-ahead market clearing prices under conditions of perfect foresight.

The adjusted prices are used in EVM, and the expected values of day-ahead market revenues predicted by EVM are defined as intrinsic revenue. An additional revenue component called extrinsic revenue is added to account for unpredictable price deviations. Extrinsic revenue is a fraction of intrinsic revenue, calculated by applying the expected value of the price spikes that were excluded from the benchmarking ratios (those greater than two standard deviations from average). The same seasonal and time-of-day blocks from the benchmarking step are re-used. Because large price deviations are assumed to be unpredictable, they are applied in this last step after dispatch decisions are fixed.

The intrinsic and extrinsic energy revenues are provided as separate revenue line items. The intrinsic represents a minimum energy revenue expectation. The extrinsic energy revenues are revenues beyond the intrinsic and may be discounted depending on the nature of the market, as well as the performance expectations of the team bidding the unit into the market.

The AECOM Team's Ancillary Services Price Forecast Model

Our team's Ancillary Services Price Forecast model estimates prices in the regulation and reserve markets including those administered by PJM and other organized markets. The model is based on regression analysis of historical hourly market prices and is tailored to individual RTO areas. Forecasts of individual generators' prospective ancillary service revenues are modeled as the product of the predicted market price and the power plant's ability to provide regulation or reserve services, given its availability and operating characteristics as modeled by EVM and market rules.

The RFP requires the consultant to assist in determining if participation in PJM markets is statutorily and technically feasible and will result in further revenue optimization from the operation of the DG Power Generation Infrastructure. With respect to being statutorily and technically feasible, Navigant will conduct an independent review of these aspects. The results from the ProMod and Ancillary Service model runs will provide the information necessary to estimate the economics of the Power Plant participating in PJM Energy Markets and/or Ancillary service Markets.

New Jersey Board of Public Utility Rules

Task 14 also includes a requirement that the Consultant be thoroughly familiar with BPU requirements as applied to construction and operation of the Power Plant and associated transmission and distribution facilities. Consultant support should include providing the project design information such that the BPU regulatory applicability can be determined. The pertinent BPU regulations are set forth in P.L. 1999, Chapter 23.

Our team knows the NJ BPU regulations and recognizes that the ultimate applicable regulatory regime can have a substantial impact on how the plant operates, the loads that it is authorized to serve, and the cost recovery arrangements. The key determinant entails whether the plant qualifies as an on-site generation facility, an electric power generator or an electric public utility under the legislation. The following are the pertinent aspects of the definitions from the statute:

- **Electric power generator**, an entity that proposes to construct, own, lease or operate, or currently owns, leases or operates an electric power production facility that will sell or does sell at least 90 percent of its output, either directly or through a marketer, to a customer or customers located at sites that are not on or contiguous to the site on which the facility will be located or is located.
- **Electric public utility**, a public utility, as that term is defined in R.S. 48:2-13, that transmits and distributes electricity to end-users within this state.
- **On-site generation facility**, a generation facility, and equipment and services appurtenant to electric sales by such facility to the end use customer located on the property or on property contiguous to the property on which the end user is located. An on-site generation facility shall not be considered a public utility.

The extent to which the NJ BPU requirements will apply to the project electrical power DG generation will depend on a number of factors. In addition, the contractual arrangements between/among the NJ TRANSITGRID participants may impact the BPU's role, for example, if the DG generation is selling energy under contract at a location that is not contiguous with the property on which the DG Generation is located. As indicated above, the AECOM team is familiar with NJ BPU rules and will support NJ TRANSIT in resolving any regulatory issues associated with the project.

The primary tools required for this engagement are: (i) PROMOD for wholesale market simulation;(ii) PSS/E and MUST for transmission impact analysis: (iii) the Ancillary Services Price Forecast Model to review opportunities to participate in the Ancillary Services markets; (iv) the Capacity Market Model (CMM) for capacity market simulation and (v) the Portfolio Optimization Model (POM) to develop the optimum generation configuration. Each of these modeling tools is described below, with additional descriptions of the related modeling tools that are integrated into Navigant's modeling platform and processes and may be required for this project.

PHASE II – CONSTRUCTION ASSISTANCE/ ENGINEERING SUPPORT

TASK 1 SHOP DRAWING REVIEW

Managing the submittal review process is a critical part of the project, and can make the difference between field work beginning on time, or getting off to a late start. Efficient and timely review of submittals during the course of the project is critical for ensuring the GC receives the required guidance to know if they can order material and begin site layout efforts.

There are many specialized equipment and materials with long lead time items for this project. A prompt review by our design team is required to keep the project on schedule. AECOM will also work with NJ TRANSIT in-house design and management, as well as with the user departments who also have key interests in the integration and management of the finally installed system.

For the quick and efficient management of submittals, AECOM has developed a system using Primavera Unifier that will effectively manage the shop drawing review process. We have also used Loadspring for many years on NJ TRANSIT projects and can employ this online tool for the efficient tracking and management of submittals.

AECOM will review shop drawings submitted by the contractors for general conformance with plans and specifications within the 21 day requirement for submittals. Additional benefits of the system is that it is intended to be a paperless system, and user rights can be tailored to restrict or allow parts of the system among the user groups.

AECOM will work with NJ TRANSIT to define the key elements and responsibilities for this effort:

- Review construction contractor's and manufacturer's drawings, catalog cuts and data sheets for the materials and or systems incorporated in the work
- Identify within a purchase order/subcontract what supplier procurements need to be submitted either for information or for review
- Establish a matrix outlining the contractor submittal schedule and review schedule and responsible parties
- Process the Supplier Documents once they have been received.
- Manage the review process including documenting and communicating NJ TRANSIT review comments
- Review all comments and changes to contractor submittals with NJ TRANSIT before submission to the contractor
- Return the supplier documents to the supplier for use in executing the purchase order/subcontract within 21 calendar days
- Observe and report on the construction contractor's development of procedures for final field acceptance and commissioning of the completed project or system elements

We will review all comments and changes to contractor submittals with NJ TRANSIT before issuing them to the contractor. NJ TRANSIT comments will be incorporated by AECOM in the submission responses. Final acceptance and commissioning documents will be key submittals which AECOM will review thoroughly and compare against the NJT/ AECOM Commissioning and Testing Plan.

The chronology of records and "ball-in-court" schedule review and tracking functions of Primavera Unifier will help us reliably track documents and comments through shop drawing review workflow—enabling fast turnaround time and keeping the Project on schedule.

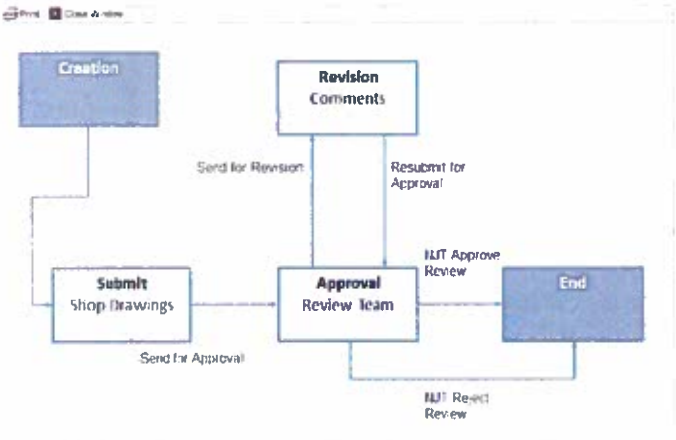
AECOM will assign the roles and responsibilities of every team member into Primavera Unifier so that the shop drawing review process works efficiently. Primavera Unifier will automatically manage the following:

- Receipt and control of incoming correspondence and documents including supplier correspondence and documents
- Maintenance of project documents
- Maintenance of indices and logs of project documents and status reports
- Processing of incoming and outgoing documents including supplier documents
- Reproduction and distribution of all project documents
- All review comments with history

TASK 2 TECHNICAL MEETINGS AND WORKSHOPS

During the project, AECOM will attend technical project meetings with NJ TRANSIT and the contractor including:

- **Pre-bid meetings**, where the contractors who are bidding will be introduced to the RFP and review the design drawings and specifications, bid process, project controls requirements, schedule and cost tracking, safety, and quality requirements.
- **Design review meetings**, where the contractor's design and specifications will be discussed.
- **Equipment factory testing** – AECOM will attend key manufacturing testing as required.
- **Preconstruction meeting** – Upon mobilization of the contractor, we will meet at site and review site rules, safety, and communication.
- **Construction progress review meeting** – These meetings will be held on site at least bi-weekly to review the contractor's progress against schedule, safety performance, and quality issues.
- **Pre-Commissioning Walk-throughs** – These will be held with the contractor to "Walk Through" each system as it is ready to be energized. The purpose of this "Walk Through" is to see that the system is complete and can be safely started.
- **A pre-test meeting** will be conducted prior to performance testing to be sure the parameters of the performance test are clear to everyone. A final walk through to verify all punch lists are completed.



Primavera Unifier - Sample Shop Drawing Review Workflow

- **"Lessons learned"** – This meeting will be with NJ TRANSIT at the end of the project to identify and catalog lessons learned and best practices for use in future projects. AECOM has over 200 Project Execution Procedures (PEPs) that will be used to manage this project. These procedures provide guidelines to the project team for the execution of the project. These PEPs cover virtually all of the project management efforts, such as: Quality control – Inspection and handling non- conforming materials and construction

For all of these efforts, Primavera Unifier will be used to automate the process as described in Phase I, subtask 1.2.2. Our paperless office approach will expedite inputs from stakeholders, increase reliability and will assist AECOM with tracking, monitoring, and reporting all of the NJ TRANSITGRID efforts to NJ TRANSIT.

TASK 3 CPM SCHEDULE REVIEWS

AECOM will assist NJ TRANSIT's construction manager during review of each contractor's schedule and support the effort needed by the Construction Manager to incorporate information into the project's Master Construction Schedule (MCS). This will also include the review of initial and all subsequent contractor and Force Account CPM schedules and inclusion into the MCS as required by NJ TRANSIT.

The review will include design change implementations, VE recommendation, construction changes, permits, and regulatory approval status and all other deliverables for Phase II.

We will compare the baseline MCS to each subsequent schedule update to measure progress of the work, identify areas of schedule risk, and recommend mitigations against any potential delays on a timely basis.

TASK 4 CONSTRUCTION PROGRESS MEETINGS

The AECOM team will support NJ TRANSIT at the bi-weekly construction progress review meetings. These meetings are conducted with each contractor individually and cover all aspects of the work. While the meetings will address a number of topics such as safety, procurement, construction progress, startup and project closeout, our team's principal involvement be the engineering aspect. Namely, we will review the design schedule against progress focus on resolving any outstanding engineering questions. Included in this discussion will be the status of resolution of any open RFIs; these are technical questions that our team will address, such as resolution of interferences or quality issue resolution.

TASK 5 RISK MANAGEMENT

Communicating risk among the TRANSITGRID project team is an important part of project success. In assistance to NJ TRANSIT, AECOM will help NJ TRANSIT with identifying (risk assessments), analyzing (risk analysis), prioritizing, and monitoring project risks. We will also make sure that all of the mitigation projects are assigned to project members (response planning); and we will make sure that risk communication is adequate by sharing project risks by connecting the NJ TRANSITGRID project team with that information (ownership) and by making sure the risks and risk responses are understood.

Starting with preliminary design and construction, our team will handle the risk management cycle by organizing risk assessment workshops, by updating the risk register and risk matrix, by risk response planning, and by updating the RMP as necessary.

During this period, the same risk procedures defined in PHASE I – Task 7 Risk Management will be used. We will use our experience of creating and maintaining risk registers on NJ TRANSIT projects, most recently the Portal Bridge Project.

The Risk Management Continuum



TASK 6 SYSTEMS COORDINATION AND TESTING

The purpose of the system coordination and testing function is to verify that the DG infrastructure systems have been properly installed, and function as designed and required by NJ TRANSIT. AECOM will assist the NJ TRANSIT Construction Manager with the development of a detailed work plan, which will describe the required testing criteria and list the tests required for the system. The manual will be clear and concise, and will be divided into multiple parts based on geographic location, facility name, as well as by system component (i.e. power generation equipment, power distribution equipment, DG component microgrid to regional grid interconnections, microgrid control functions, natural gas supply/combustion fuel connection equipment).

Our talented Systems Test Engineers will develop the plan, which will describe testing as well as prefinal and final inspections, creation of punchlist items. Our staff of professional personnel in the applicable engineering disciplines, with extensive experience in the coordination, testing, startup, and commissioning of large integrated systems such as is being planned for the TRANSITGRID.

To prepare a thorough report on the many systems and tests, we will look to our team of project coordinators, testing managers, I&C Engineers, Electrical Start up Engineers, Distributed Control System Engineers.

Equipment demonstration tests procedures will be developed prior to mobilization to the field. Procedures will be developed along with engineering, in accordance with the following:

- Electric Power Distribution Capabilities
- Protective Relay and Metering Capabilities
- Distributed Control System (DCS) Capabilities
- Ammonia Systems Capability
- NOx Analyzer Capabilities
- Eye Wash Station Capabilities
- Switching Equipment Capabilities
- Control Systems (including hardware and software)

DEVELOPMENT OF COMPONENT TESTING

The testing plan will reference proven electrical, mechanical, and instrumentation test procedures to perform component testing. These tests are identified in each scoped system's test matrix. The plan will provide the test engineers with the guidelines and data sheets for testing of any component associated with a system. List of testing includes but are not limited to the following:

- Cable/equipment insulation resistance tests
- Cable/equipment hi-potential tests
- Low Resistance Tests (DLRO)
- Battery tests
- Transformer tests
- Switchgear energization tests
- Circuit breaker testing
- AC/DC motors initial operation tests
- Rotating mechanical equipment tests
- Instrument transformer tests
- Meter and relay tests
- Motor operated valve/damper testing
- Ground grid resistance tests
- Instrument transmitter calibration
- Pressure switch/temperature switch calibration
- Valve Positioner calibration
- Self contained control valve tests
- Vessel/piping systems cleaning procedure
- Vessel/piping integrity tests
- Coupling alignment procedure
- Sheave alignment/v-belt tensioning procedure

During the development of the testing manual, AECOM will meet with NJ TRANSIT to provide status and updates. By working with NJ TRANSIT and their user (MOW) departments, we can assure that the final product will be acceptable and recognized as a valulable tool for ensuring the systems installed fully function as intended.

TASK 7 DISPUTE RESOLUTION

AECOM believes that project issues must be handled promptly with open communication between client and GC, so that dispute resolution processes are not required. Nevertheless, when not resolved in a timely manner, construction disputes can become very expensive in terms of finances, personnel, and time. AECOM will use Primavera Unifier to assist with eliminating major issues by tracking a "chronology of issues." If an issue requires an enhanced resolution process, the project may consider an independent third party to facilitate. Dispute resolution should be written into the construction contract as either binding or not binding with the back-up and steps clearly outlined. AECOM will attend meetings and provide assistance with NJ TRANSIT's preparation of reports, and analysis for the dispute resolution process.

A number of different Alternative Dispute Resolution (ADR) methods are currently used in the construction industry. A few of the more common methods are highlighted briefly: Step negotiation generally requires the individuals directly involved in the dispute to seek resolution through direct negotiation. If a resolution is not reached within a predetermined length of time, the dispute is elevated to the next level in the organizations. This process normally continues to senior levels of each organization. Dispute review boards typically consist of three neutral experts, who visit the site periodically in order to monitor progress and potential problems.

When requested by the parties, the board conducts an informal hearing of the dispute and issues an advisory opinion that the parties use as a basis for further negotiations. Except as otherwise credited, information presented on Dispute Review Boards is largely based on the Construction Dispute Review Board Manual (Matyas, et al. 1996).

TASK 8 CHANGE ORDER ANALYSIS SUPPORT

AECOM has provided NJ TRANSIT with change order support on a number of projects, both design and construction management. On the DG Project, we will bring this knowledge and experience of working with NJ TRANSIT Project Managers and Contract Officers on the change order process to bear.

Specific elements AECOM will support the change order process include provide analysis on potential Change Order issues. This includes attending meetings, and working with the NJ TRANSIT Construction Manager during the review of a contractor's requests for change orders. The majority of change orders are created due to three reasons; owner requested change, unforeseen site condition, and errors/ omission.

The first line of defense in the change order process is to have a complete, accurate, and comprehensive set of contract drawings so change orders can be mitigated or eliminated. Contract drawings must not be ambiguous as this is typically a source of change orders in the industry. Additionally the contract drawings and the specifications must support one another and be consistent with the required construction elements. Inconsistency and insufficient details are additional sources of change orders in the industry.

For each change order request forwarded to AECOM for information, we will review the contract requirements to determine if it should be rejected or considered by NJ TRANSIT.

TASK 9 NJ TRANSIT DG STARTUP SUPPORT

AECOM has a great amount of experience in the startup of power generating stations and transmission systems with over 32,000 MW of combustion turbine plants and thousands of miles of transmission and distribution lines built.

Our startup team will mobilize to the job site as the construction of the project nears completion. Using the system descriptions and the control logic, the team will become familiar with the systems. Our startup team will work with the contractors and equipment suppliers to develop startup and test plan and procedures.

Prior to energization of any of the generating plant systems or the grid, the AECOM personnel will Walk Through each system to make sure it is ready to be commissioned. If any items are found that need correction, we will advise the contractor and, once remedied, the energization will commence.

Upon completion of all the system commissioning, our performance test requirements, prepared as part of AECOM's design work, will be used to determine the plant's acceptance.

TASK 10 PROJECT CLOSEOUT SUPPORT

During the project closeout process, AECOM design will provide as-built review support to NJ TRANSIT. Our review of these submitted drawings by the contractor complies with the original plans and specifications of the project. We understand that the role of the construction management team will be to verify that the as-builts accurately reflect what was approved and ultimately installed and tested in the field. Our review will enhance the Construction Manager's role by supporting the review on a technical level. It would be expected that the submitted as-builts are consistent with the contract documents, the approved shop drawings, as well requests for information, and change management processes.

TASK 11 ALTERNATE DESIGNS

It is important that contractors, equipment manufacturers, and other business enterprises performing services for the project propose solutions in accordance with the project specifications and requirements. However, it is also good practice to consider alternate designs that perform the same function at a reduced cost or that improve the function at the same cost.

Following direction by NJ TRANSIT, AECOM will perform reviews of all alternate designs proposed for use or implementation by the contractors, equipment manufacturers, and other business enterprises performing services for the project. This may also include review of contractor value engineering proposals.

AECOM will use a systematic approach to review proposed alternates and make recommendations as to the validity and appropriateness of any design that deviates from the original plans and specifications.

When reviewing alternate designs, the goal is to determine if the alternate performs the same function at a reduced cost or improves the function at the same cost. Both first cost and lifecycle cost savings are taken into account when considering possible alternatives. AECOM will recommend avoidance of alternatives that simply cut costs by eliminating parts of the project, or that do not conform to the schedule.

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06 Team Organization/ Resource Allocation

The AECOM team is ideally suited to be NJ TRANSIT's consultant for this assignment. We have at our disposal outstanding technical resources with the capability to deal with all expected and unexpected issues related to this complex project.

PROJECT MANAGEMENT STRUCTURE

The success of the NJ TRANSITGRID will require an experienced team of seasoned power and transportation professionals who have successfully provided preliminary design, engineering, and construction service assignments, using proven project management methods. Our team organization focuses on a dedicated core management group who will lead and work efficiently within the team. Our organization charts demonstrate the impressive depth of resources available to NJ TRANSIT to work on this project.



No complex project can succeed without clear goals, thorough planning, and decisive leadership. This is particularly true of the NJ TRANSITGRID project because of its aggressive schedule, and the necessary and extensive integration of concurrent activities by numerous regulators and stakeholders.

Proven Leadership You Can Trust

Leading our team is our project manager, **Ayokunle ("Kunle") Kafi, PE**, who will work closely with NJ TRANSIT as we develop innovative and cost-efficient solutions. He will be the single point of contact with NJ TRANSIT and will serve as liaison to all parties implementing this project, and direct the execution of work during the life of the contract. Kunle will have a direct line of communication between Project Executive **Fred Werner** and the advisory committee.

Kunle will have the authority to act on behalf of the AECOM team, assign resources, adjust staffing, and manage all aspects of design, construction assistance and engineering support. He will work full-time in the core project office and manage day-to-day operations. He will have the full backing and support from AECOM's local, regional, and national offices depending on the need. Our project executive Fred Werner will make sure that Kunle and NJ TRANSIT have access to the resources needed to successfully deliver this project. We also have a team of senior advisors who are available to the team for high-level planning and strategy.

Kunle will be supported by **Ed Hrinewski, PE** as the deputy project manager. Ed spent more than 12 years working on the HBLRT system in New Jersey and understands the needs and requirements of work specific to NJ TRANSIT and the area – and he is respected by NJ TRANSIT. Ed will use his experience to assist Kunle in leading the team to develop the 20 percent design, applying lessons learned and balancing resources.

Kunle will monitor the direct reports to him and coordinate daily with Ed and discipline leads on the project's progress. The discipline leaders for the individual disciplines will manage the work efforts of their respective staff, and the individual task deliverables for all scope items.

With the combined energy and transit experience of our leadership team we are confident of meeting all of NJ TRANSIT's expectations on the NJ TRANSITGRID Program.

The AECOM Team

The following chart shows the firms on the AECOM team along with their principal roles on this project. This is a proven team of leading subject matter experts with a strong record of successful performance on similar projects.

AECOM has worked with all of the firms on our team on past successful projects. Descriptions of these firms appear on the following pages.

AECOM

KEY SUBCONSULTANTS

IPERC
- Cybersecurity

Navigant Consulting, Inc.
- Economic analysis
- Fuel cell/energy storage

Climate Change Mitigation Technologies
- Electric vehicles
- Photovoltaic/energy storage

Parsons Brinckerhoff
- CHP
- System integration

Greener by Design
- Public involvement/ stakeholder coordination

The Chertoff Group
- Security

SPECIALTY AND DBE SUBCONSULTANTS

A.G. Consulting Engineering, P.C.
- MEP
  DBE

GTS Consultants
- Surveying
  DBE

ILC Dover
- Resiliency and Cybersecure Regulations

JCMS, Inc.
- Cost estimating
  DBE

Macan Deve
- Coordination management
- Technology integration
- Document control
  DBE

PMA Consultants
- Scheduling
- Value engineering

Radin Consulting
- Environmental support
  DBE

Robinson Aerial Surveys, Inc.
- Aerial surveys
  DBE

STAFFING RESOURCES

AECOM has undertaken a comprehensive assessment of the NJ TRANSITGRID staffing needs and hours based on our proposed schedule, scope of services, and specific tasks. For staffing calculations, we used resource loaded Primavera P6 CPM schedules for both phases, which are included with this proposal. The staffing curves on the following page show that the AECOM team expects to reach an average 26 full-time equivalent personnel during Phase I and 13 full-time equivalent personnel during Phase II of the NJ TRANSITGRID Distributed Generation project.

Phase 1 labor efforts show a significant ramp up in labor at the onset of the project increasing to a mid-schedule peak, and then ramping down in the closing months. With respect to Phase 2, the use of required staff and a steady flow of activities depict less of a curve as labor is expected to be largely consistent throughout the duration of the effort.

To negotiate the contract cost, we will allocate staffing to each task and subtask and load it on our schedule for each independent task, and will come to agreement with NJ TRANSIT regarding appropriate staffing and cost. This will allow us to develop a plan for the duration of both phases and track against them and inform NJ TRANSIT of any deviations, then develop workarounds, mitigation or recovery plans for the tasks and the project.

OPTION TO PERFORM BOTH TRANSITGRID PROJECTS FOR NJ TRANSIT

As an alternate approach to ensuring the successful delivery of the entire NJ TRANSIT Microgrid Program, AECOM is able provide an option of implementing both projects. As a worldwide full service provider of marquee projects, the AECOM team has the ability to assemble a uniquely qualified team of local talent that can simultaneously execute both Project 1 (RFP No. 15-031) and Project 2 (RFP No. 16-001) projects. Under this option, both teams will operate under the leadership of an AECOM project director. We are offering this option to best leverage the potential 20 to 25 percent economies of scale reduction that can be harnessed with a single team approach, as well as the ability to ensure consistency of approach to the overall Microgrid system deployment.

AECOM believes that adopting this approach will afford the NJ TRANSIT the following benefits:

- Seamless integration of Microgrid operating philosophies across both projects
- A single point of accountability including ability to provide an aggregate market leveraged procurement plan
- An integrated project management, project controls and risk management approach that will be shared with all major decision makers and that will avoid conflicts
- Reduction in interface time with the stakeholders and potential contractor for either phases
- Improved communication with NJT and other team members
- A focus on seamless integration of the assets with the potential backup energy solution so as not to impact system operations
- Less likelihood of redundancy in execution of both programs

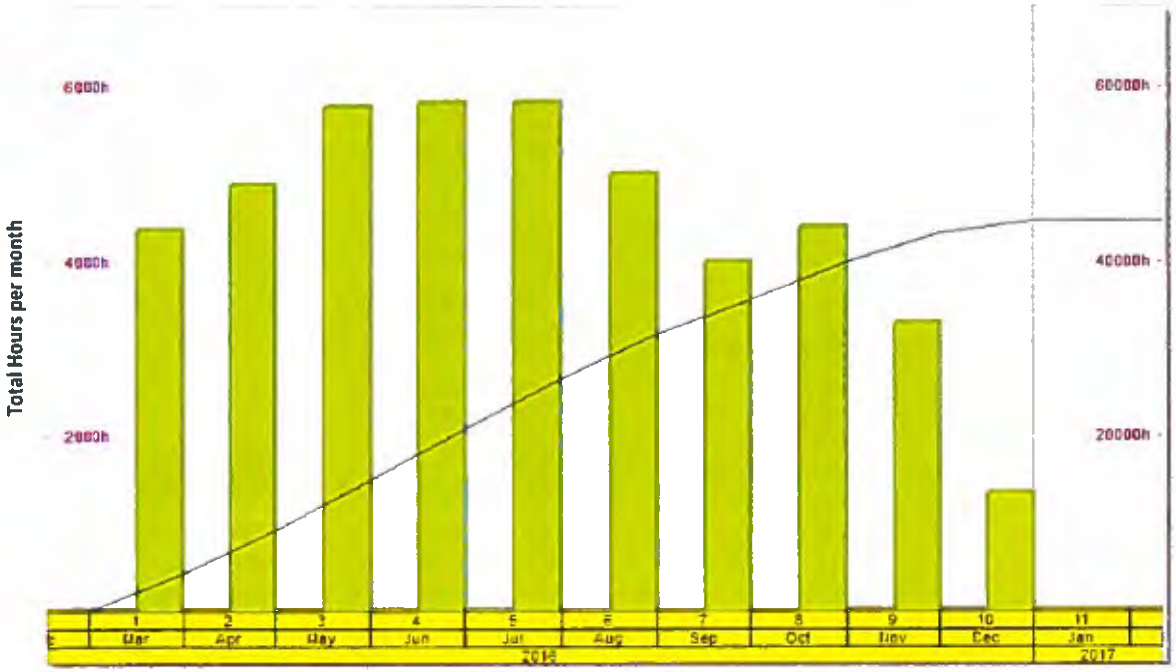
This "One Stop" accountability will also provide NJ TRANSIT the assurance of having one voice for all stakeholders and government officials, as this ambitious plan secures key funding and approvals necessary to make this program a reality. The AECOM team possesses the depth of resources, knowledge and expertise to offer this option to NJ TRANSIT.

ORGANIZATION/STAFFING CHARTS

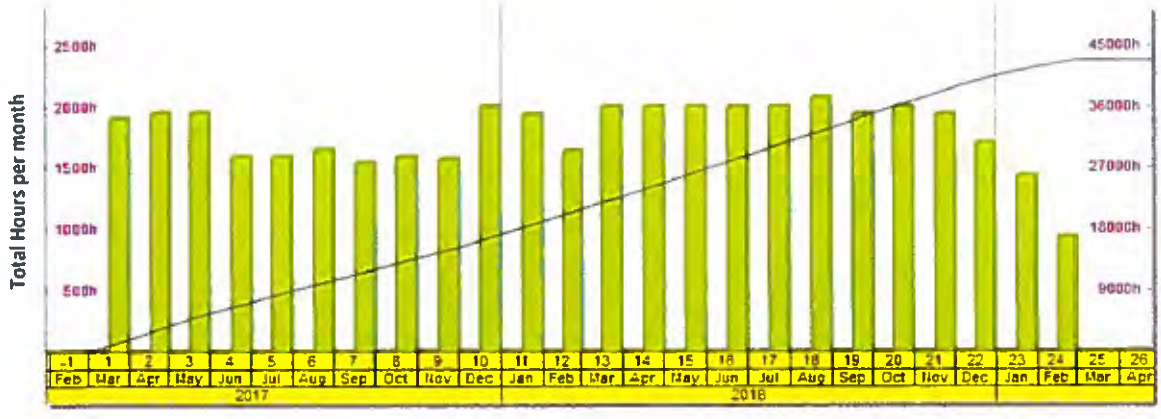
On the following pages we present the following:

- **Staffing Curves** showing staffing levels during the course of the project
- **Project Organization Chart**, illustrating all other project positions and reporting relationships that comprise the project's organizational structure.
- **List of Key Staff Responsibilities**, summarizing the roles and responsibilities of our proposed key discipline leads.
- **Alternate Organization Chart** if selected for both projects
- **Resource Allocation**:
  - **Matrix of Person-Hours by Consultant** showing, by task, the total person-hours for the entire team and separately for each Consultant
  - **Matrix of Person-Hours by Individuals**

NEW JERSEY TRANSIT CORPORATION REQUEST FOR PORPOSAL NO. 16-001
PHASE I - Man-Hours



NEW JERSEY TRANSIT CORPORATION REQUEST FOR PORPOSAL NO. 16-001
PHASE II - Man-Hours



The AECOM Team Project Organization

All personnel are AECOM employees unless otherwise indicated:

AG	A.G. Consulting Engineering, PC *DBE*
C	Climate Change Mitigation Technologies LLC (and Subcontractors: Transpower, Advanced Solar Products and Power Analytics)
CG	The Chertoff Group
GB	Greener by Design LLC
GT	GTS Consultants, Inc. *DBE*
I	Intelligent Power & Energy Research Corporation (IPERC)
ID	ILC Dover LP
J	JCMS, Inc. *DBE*
M	Macan Deve Engineers, DPC *DBE*
N	Navigant Consulting, Inc.
PB	Parsons Brinkerhoff
PM	PMA Consultants, LLC
RC	Radin Consulting, Inc. *DBE*
R	Robinson Aerial Surveys, Inc. *DBE*

NJ TRANSIT The Way To Go.

PROJECT EXECUTIVE
Fred Werner, PE

PROJECT MANAGER
Ayokunle Kafi, PE

DEPUTY PROJECT MANAGER
Edward Hrinewski, PE

SAFETY MANAGEMENT
Peter Gregory, CSP

QUALITY MANAGEMENT
Peter Totten, PE

PEER REVIEW/CONSTRUCTABILITY REVIEW/VALUE ENGINEERING
Frank Russo
Richard Falcon, PE
Robert Wood, PE

ADVISORY COMMITTEE
James Peterson (N)
Lyle Rawlings, PE (C*)

RISK MANAGEMENT
Eduardo Gamez, PhD

TECHNOLOGY INTEGRATION
Phillip Castellano, PE (M)

Analysis of Ancillary Services and Market Revenue Opportunities
Timothy McClive (N)

System Safety, Security and Resiliency
Elizabeth Carter (CG)
Carlos Campillo

Concept of Operations
Nick Tomizawa, Esq., AICP, CEM

Public Involvement/ Stakeholder Coordination
Adam Zellner (GB)

FTA Funding Review and Compliance
Ruby Siegel

Coordination with Phase 1
Michael Pacy, PE

System Integration
Robert Fisher, PE (PB)

FastStart Team
Thomas Quaranta, FCMAA

COORDINATION MANAGEMENT
Donna Hager, PE (M)

Coordination of Bid Packages Bid Documents Coordination Support
Riad Habib

Recommendations for Future Procurements
Robert Brownstein

Ongoing Commissioning and Maintenance & Operation
Daniel Gold
Kenny Pimenta, PE

DBE and Subcontracts Management
Lauri Hack

PHOTOVOLTAIC TECHNOLOGY & ENERGY STORAGE
Andrew Agopian

Photovoltaic
John Hoffner, PE
Samuel Monger

Energy Storage/Integration
James Sherman, Esq. (C)
Jose Vivas, PhD, PE (C)

CHP, EV & DEMAND SIDE ENERGY MANAGEMENT
James Buchok

Combined Heat and Power
Jeff Brier
Paul Yallouris (M)
Roger Lemos (PB)

Electric Vehicles
Michael Simon (C)

Demand Side Energy Management
Leah Milcarek, PE
Damee Choi, PE, CEM, LEED AP

FUEL CELL TECHNOLOGY
Robert Zogg (N)

Assessment/Verification
Lisa Jerram (N)
Colette Lamontagne (N)

Incentives/Economic Analysis
Jonathan Thompson

CYBERSECURITY
Darrell Massie, PhD, PE (I)

System Architecture/ Operating Protocols
Aura Lee Keating (I)

Communications/ Control Center
Peter Curtiss, PhD, PE (I)

Security
Octavian Cana, PE, PMP

Cybersecurity System Startup
Scott Roberts (I)

COMPLIANCE/REGULATORS/ REVIEWERS
Joel Sonkin, Esq.

Rail Force Accounty/Rail Ops Coordinator
Steve McEvoy

Power/Utility Regulators
Tom McDermott

Resiliency and Cybersecure Regulations
Jeffery Roushey, PE (ID)

Environmental Impact Statement
Ray Hinkle, CWB

NEPA Coordination
Leslie Roche, AICP

Real Estate/Property Acquisitions
Mark Gander, AICP

Permitting Support
Tim Hand, AICP

PROJECT CONTROLS
Amr Elmeged

Cost Control
Tunc Gundogdu

Schedule
Dane McBlaine, PMP, LEED AP (PM)

Cost Estimating
Jay Bayersdorfer, PE
Kevin Meehan (J)

Configuration Management
Dave Collett, PE

Document Control
Katie Donahue (M)

SPECIALTY RESOURCES

Civil Edward Sitler, PE Karen Kramkowski, PE	Structural Rajendra Navalurkar, PE Stuart Willis, PE Antoine Abidargham, PE	MEP Joel Fisch, PjE Ajmal Khan, PE (AG) Gerardo Aguilera (AG)	Utility Engineering April Thomann, PE Murtaza Shah Signals David Male	Survey Fredrick Voss, PE, PLS (GT) Adam Decker, CP (R) BIM Janelle Ella	NERC Compliance Matthew Blizard, PE (N) Keshav Sarin (N) Design Development/Criteria Ed Gurtatowski, PE	Cybersecurity Phil Owen, PMP, CISSP-ISSAP Ken Donaldson, CISSP-ISSAP Communications Robert Zmudzinski	Market Integration Edward Dobrowolski (N) Environmental Chitra Radin (RC) Jane Darcy (RC)	Value Engineering Facilitation Rich Johnson, CVS (PM) Microgrid Robert Harwig (I)

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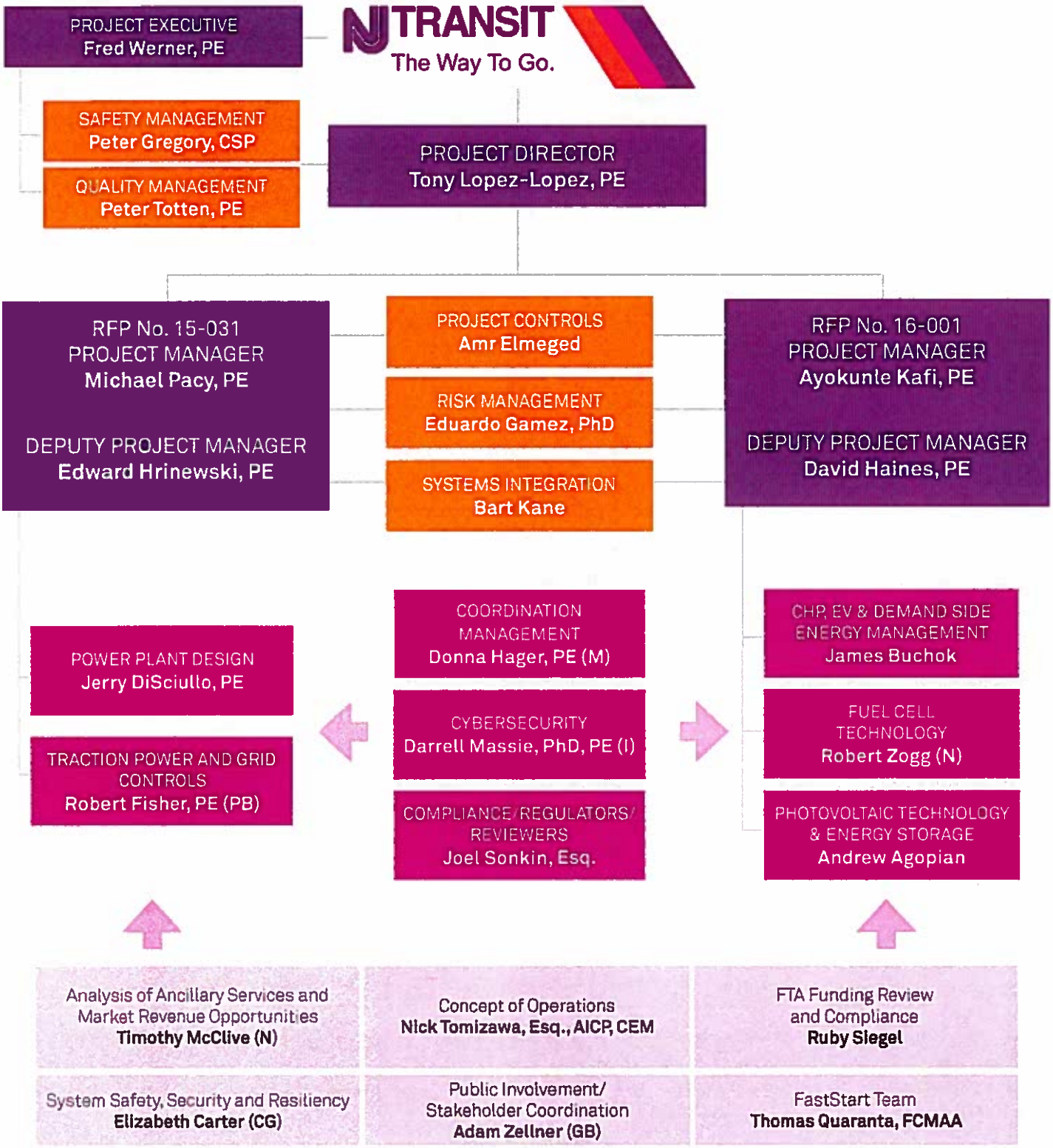
KEY STAFF RESPONSIBILITIES

Role/Name	Responsibilities
PROJECT MANAGER **Ayokunle Kafi, PE**	• Single point of contact • Overall responsibility, including technical solutions, safety, quality, budget, and schedule • Liaison between all parties implementing the project • Conducts review and progress meetings or workshops with other regulators, reviewers and other consultants
DEPUTY PROJECT MANAGER **Edward Hrinewski, PE**	• Assists with day-to-day management • Oversees the design aspects, specifically to address rail and utility interconnections • Integrates review/regulatory process • Coordinates efforts between disciplines
COORDINATION MANAGEMENT **Donna Hager, PE**	• Oversees peer review, constructability, and value engineering efforts • Guides DBE participation and subcontract management • Coordinates procurement/bid packages
PHOTOVOLTAIC TECHNOLOGY & ENERGY STORAGE **Andrew Agopian**	• Oversees PV technology selection • Installation feasibility and general design development • Assists with incorporation of applicable energy storage resources into integrated design
CHP, EV & DEMAND SIDE MANAGEMENT **James Buchok**	• Oversees energy efficiency audits of building portfolio to reduce baseline building demand • Leads CHP opportunity evaluation and recommendation • Coordinates EV installation feasibility and design
FUEL CELL TECHNOLOGY **Robert Zogg**	• Leads evaluation of applicable fuel cell technology and recommendation • Oversees design effort
CYBERSECURITY **Darrell Massie**	• Leads efforts to implement cybersecurity architecture, operations, and interfaces • Leads integration of microgrid control system into transit properties
COMPLIANCE/REGULATORS/ REVIEWERS **Joel Sonkin**	• Manages regulatory review/approval process and permitting requirements • Integrates EIS and NEPA documentation • Oversees Rail Force Account work
PROJECT CONTROLS **Amr Elmeged**	• Establishes project controls system • Leads development of integrated project/document/risk control system – "paperless office" • Oversees schedule and cost • Integrates 4D/5D BIM into risk management program
ANALYSIS OF ANCILLARY SERVICES AND MARKET REVENUE OPPORTUNITIES **Timothy McClive**	• Investigates market options for excess generation • Drafts and negotiates agreements with appropriate power regulators – PJM and other power regulators
SYSTEM SAFETY AND SECURITY **Elizabeth Carter**	• Conducts TVA • Focuses on security, resiliency, and hardening of all aspects of the NJ TRANSITGRID
CONCEPT OF OPERATIONS **Nicholas Tomizawa**	• Assesses during early design future testing and commissioning needs • Coordinates development of PMP and other management protocols and procedures • Defines physical facility, hardware, and software requirements • Develops ConOps documents
PUBLIC INVOLVEMENT/AGENCY COORDINATION **Adam Zellner**	• Maintains proactive communication with NJ TRANSIT, public agencies and stakeholders • Supports public outreach efforts
FTA FUNDING REVIEWS AND COMPLIANCE **Ruby Siegel**	• Ensures FTA regulations, processes and reporting requirements are followed • Ongoing liaison with FTA in support of NJ TRANSIT
COORDINATION WITH PHASE 1 **Michael Pacy**	• Interface to ensure seamless integration of design philosophies and microgrid control principles into Project 2.
SYSTEM INTEGRATION **Robert Fisher**	• Lead site specific technology integration, aggregate portfolio integration, and overall system operability design
RISK MANAGEMENT **Eduardo Gamez**	• Lead development of risk register • Development of risk mitigation steps and processes • Lead risk workshop and develop risk management plan
TECHNOLOGY INTEGRATION **Phillip Castellano**	• Lead coordination of PV, energy storage, CHP, and fuel cell technologies as aggregate operating systems within each facility

ALTERNATE ORGANIZATION CHART



NEW JERSEY TRANSIT CORPORATION REQUEST FOR PORPOSAL NO. 16-001 - ATTACHMENT C

NJ TRANSITGRID-DG

Task	Task Description		Estimated Effort Hours By Task and Firm															Estimated Total Hours by Task
			AECOM	PB	IPERC	Navigant	PMA	Greener by Design	ILC Dover	CCMT	The Chertoff Group	JCMS	Radin	GTS	Macan Deve	AG	Robinson Aerial Survey	
	PHASE I Percentage		52.0%	5.5%	5.7%	3.8%	3.8%	1.9%	0.8%	5.7%	1.9%	1.9%	3.8%	3.8%	5.7%	0.9%	3.0%	
	PHASE I FTE by Firm		13.7	1.5	1.5	1.0	1.0	0.5	0.2	1.5	0.5	0.5	1.0	1.0	1.5	0.2	0.8	
	PHASE I Total FTE	26.4	21.4									5.0						
	Phase I (10mo, 211 wd = 1688hrs) (March ~ December 2016)		23184	2448	2532	1690	1688	844	337	2532	844	844	1688	1688	2532	400	1344	**44595**
	Task 1 – Project Management and Administration		6564	320	320	60	1044	80	37		160				1768			10353
	Task 2 – Engineering		12784	1688	1992	1120			300	2160				1688	244	400	1344	23720
	Task 3 – Cost Estimating		480									844						1324
	Task 4 – Federal Environmental Categorical Exclusion (CE)		580										728					1308
	Task 5 – State and Federal Permits							360					400					760
	Task 6 – NJDEP Site Remediation Compliance												560					560
	Task 7 – Risk Management		768		220		444				160							1592
	Task 8 – System Safety and Security Management		320			300					524							1144
	Task 9 – Public Involvement and Agency Coordination		240					404										644
	Task 10 – Integration and Interface		488	440						372								1300
	Task 11 – Constructability Reviews		280				200								160			640
	Task 12 – Contract Packaging		80												240			320
	Task 13 – Preparation and Subsequent Support of Contract Bid Documents and Bidding Process		320												120			440
	Task 14 – Analysis of Ancillary Services Market Revenue opportunities		280			210												490
	Task 15 – As Directed by NJ TRANSIT																	
	Phase II (24mo = 3376hrs) (March 2016 ~ February 2018)		24288	2031	2112	338	4848	338	254	0	405	1216	574	1620	1620	3241	0	**42887**
	PHASE II Percentage		56.6%	4.7%	4.9%	0.8%	11.3%	0.8%	0.6%	0.0%	0.9%	2.8%	1.3%	3.8%	3.8%	7.6%	0.0%	
	PHASE II FTE		7.2	0.6	0.6	0.1	1.4	0.1	0.1	0.0	0.1	0.4	0.2	0.5	0.5	1.0	0.0	
	PHASE II Total FTE	12.7	10.3									2.5						
	Task 1 – Shop Drawing Review		3808	847	467	338		338	254					1620		810		8483
	Task 2 – Technical Meetings and Workshops		3408	508	142								574		864	810		6306
	Task 3 – CPM Schedule Review		2208				2232					811						5251
	Task 4 – Participation in Construction Progress Meetings		2608	508	312		2232								528	810		6998
	Task 5 – Risk Management		2208	169	61		384				405							3227
	Task 6 – System Coordination and Testing		2208		389											810		3408
	Task 7 – Support NJ TRANSIT in Dispute Resolutions		2208		156													2364
	Task 8 – Change Order Analysis Support		2208		74							405						2687
	Task 9 – NJ TRANSITGRID Start-Up Support		2208		206													2414
	Task 10 – Project Closeout Support		208		210										228			646
	Task 11 – Alternate Designs		1008		95													1103
	Task 12 – As-Directed by NJ TRANSIT																	0
	Phase I and II Totals		47472	4479	4644	2028	6536	1182	591	2532	1249	2060	2262	3308	4152	3641	1344	**87482**

Phase I	**44595**
Phase II	**42887**
Total	**87482**

NJ TRANSITGRID - DG (Man Hours)

Firm: AECOM

Employee Name	Title	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Ayokunle Kafi, PE	Project Manager	740	688					100		160						
Edward Hrinewski	Deputy Project Manager	420	1000					188		80						
Fred Werner, PE	Project Executive															
Peter Totten, PE	Quality Manager	400						80								
Peter Gregory, CSP	Safety Manager	320														
Frank Russo	Peer Review/Constructability Review/VE		80													
Richard Falcon	Peer Review/Constructability Review/VE		80													
Robert Wood, PE	Peer Review/Constructability Review/VE		80									40				
Carlos Campillo	System Safety, Security and Resiliency								320							
Nick Tomizawa	Concept of Operations		560													
Ruby Siegel	FTA Funding Reviews and Compliance	160	160													
Riad Habib	Coordination of Bid Packages												80	240		
Eduardo Gamez, PhD	Risk Management	160						160								
Philip Castellano, PE	Technology Integration	80									240					
Michael Pacy, PE	Coordination with NJ TRANSITGRID Project										168					
Robert Brownstein	Recommendation for Future Procurements	88												80	80	
Daniel Gold	Ongoing Commissioning and Maintenance & Operations	88														
Kenny Pimenta, PE	Ongoing Commissioning and Maintenance & Operations	88														
Lauri Hack	DBE and Subcontracts Management	168														
Andrew Agopian	Photovoltaic Technology & Energy Storage		1048									40				
John Hoffner	Photovoltaic Technology		320													
Samuel Monger	Photovoltaic Technology		320													
James Buchok	CHP, EV & demand Side Energy Management		1608									80				
Jeff Brier	Combined Heat and Power		300									80				
Leah Milcarek, PE	Demand Side Energy Management		600													
Damee Choi, PE	Demand Side Energy Management		1688													
Jonathan Thompson	Fuel Cell Technology / Incentives/Economic Analysis		120												200	
Ed Gurtatowski, PE	Fuel Cell Technology / Design Development/Criteria		160													
Octavian Cana, PE	CyberSecurity		640								80					
Joel Sonkin, Esq.	Compliance/Regulators/Reviewers		320													
Steve McEvoy	Rail Force Account/Rail Ops Coordinator	300	240													
Tom McDermott	Power/Utility Regulators		240		80							40				
Ray Hinkle, CWB	Environmental Impact Statement	60			500											
Mark Gander, AICP	Real Estate/ROW/Property Acquisitions		320													
Tunc Gundogdu	Cost Control/Schedule	1448		80				160								
Amr Elmeged	Project Controls	240						80								
Jay Bayersdorfer, PE	Cost Estimating			400												
Dave Collett	Configuration Management	320														
Edward Sitler, PE	Civil															
Karen Kramkowski, PE	Civil															
Murtaza Shah	Utility Engineering															
Dave Male	Signals															
Stuart Willis, PE	Structural															
Antoine Abidargham, PE	Structural															
Rajendra Navalurkar, PE	Structural															
Janella Ella	BIM															
Joel Fisch, PE	MEP	844	844													
Tim Hand, AICP	Permitting Support	160														
Leslie Roche, AICP	NEPA Coordination	160														
Phil Owen, PMP, CISSP-ISSAP	CyberSecurity															
Ken Donaldson, CISSP-ISSAP	CyberSecurity															
April Thomann, PE	Utility Engineering	320	1368													

NJ TRANSITGRID - DG (Man Hours)

Firm: Parsons Brinkerhoff

Phase I

Employee Name	Title	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Bob Fisher	System Integration	160	160								440					
Roger Lemos	Combined Heat and Power	160	1528													

Firm: IPERC

Phase I

Employee Name	Title	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Darrell Massie, PhD, PE	Cyber Security Grid	320	320					140								
Aura Lee Keating	System Architecture, Operating Protocols		636					40								
Peter Curtiss, PhD, PE	Communications, Control Center		636					40								
Scott Roberts	Cybersecurity System Startup		400													
Robert Harwig	Microgrid															

Firm: Navigant Consulting

Phase I

Employee Name	Title	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Timothy McClive	Analysis of Ancillary Services and Market Revenue Opportunities	60	160						100						70	
Edward Dobrowolski	PJM Market Integration		160													
Robert Zogg	Fuel Cell Technology		160													
Lisa Jerram	Assessment / Verification		160													
Matthew Blizard, PE	NERC Compliance		160						100						70	
Keshav Sarin	NERC Compliance		160						100						70	
Colette Lamontagne	Assessment / Verification		160													

Firm: PMA Consultants

Phase I

Employee Name	Title	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Rich Johnson, CVS	Peer Review/Constructability Review, VE	300						200				200				
Dane McBlaine, PMP	Schedule	744						244								

Firm: Greener by Design

Phase I

Employee Name	Title	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Adam Zellner	Public Involvement Agency Coordination	80				360				404						

Firm: Chertoff Group

Phase I

Employee Name	Title	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Elizabeth Carter	System Safety and Security	160						160	524							

Firm: ILC Dover

Phase I

Employee Name	Title	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Jeffery Roushey, PE	Resiliency and Cybersecure Regulations	37	300													

Firm: JCMS

Phase I

Employee Name	Title	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Kevin Meehan	Cost Estimating			844												

NJ TRANSITGRID - DG (Man Hours)

Firm: AG Consultants

Employee Name	Title	Phase I														
		Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Gerardo Aguilera	MEP		200													
Ajmal Khan, PE	MEP		200													

Firm: GTS

Employee Name	Title	Phase I														
		Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Fredrick Voss, PE, PLS	Survey		1688													

Firm: Radin Consulting

Employee Name	Title	Phase I														
		Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Chitra Radin	Environmental				364	200	280									
Jane Darcy	Environmental				364	200	280									

Firm: Robinson Aerial Survey

Employee Name	Title	Phase I														
		Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Adam Decker, CP	Survey		1344													

Firm: CCMT

Employee Name	Title	Phase I														
		Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Jose Vivas, PhD, PE	Energy Storage / Integration		720								124					
Michael Simon	Electric Vehicles		720								124					
James Sherman, Esq.	Energy Storage / Integration		720								124					

Firm: Macan Deve

Employee Name	Title	Phase I														
		Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15
Donna Hager, PE	Coordination Management	80										160	240	120		
Paul Yallouris	Combined Heat and Power		244													
Katie Donahue	Document Control	1688														

07 Quality Assurance Program

Quality is an attitude, a culture, and a way of life at AECOM. *It is part of everything we do, every day. It is inherent in the way we plan, do, check and act, and will be a core value of our NJ TRANSITGRID-DG team.*

AECOM offers NJ TRANSIT a proven quality management system (QMS) that is certified to the internationally recognized ISO 9001:2008 standard, yet is sufficiently flexible to address the specific requirements of the project. Quality management is central to our project management approach, and our project team includes individuals assigned to specific quality roles under our system.

AECOM's Quality Management system does not differentiate between projects whose end result is a conceptual study, a preliminary design, or a final design. We apply the same proven quality principles on each of our projects, no matter what the level of detail is that we are required to perform.

Our approach to quality follows the international standard for quality management systems (QMS), ISO 9001. As one of the few ISO 9001-certified professional and technical services firms in North America, AECOM developed its system to address the standard's requirements, and we confirm compliance through formal auditing and verification. Initially certified in 2002, we have continuously expanded the scope of our ISO certification. In fact, during 2011 we achieved a single, unified ISO 9001:2008 certification covering all our business lines in North America.

What does this mean to NJ TRANSIT? It means that AECOM has a world-class quality program with tools and means to confirm it is followed. It means that AECOM will apply a set of quality practices for this project. It means that AECOM's QMS is built upon the foundational principles that lie at the core of the ISO standard, providing a strong footing for positive results.





Quality is created by following a cycle that applies skills, knowledge, experience and professional judgment to do things right and engage the client in all aspects of the project. The quality tools provided by AECOM improve the likelihood of success.

Our commitment to quality is an ongoing process where we regularly enhance the program to allow us to achieve the high standards of quality demanded by our clients.

Phase	Planning and Approach	Design and Development	Checking	Review	Verification
Responsible Parties	Project Manager Project Director Discipline Leads Project Quality Rep	Discipline Leads Discipline Staff	Discipline Reviewers	**Discipline Leads** **Project Manager** **Project Principal** **Peer Teams**	Project Quality Rep Project Manager

OUR QA PROGRAM

The general components of AECOM's approach to project quality management, and the parties responsible for them, are depicted above.

Initiating Quality

Quality begins with AECOM's understanding of your project goals and objectives, emphasizing communication with NJ TRANSIT and a thorough review of project inputs. Assigning technically qualified and experienced personnel to produce and review the work is an important next step. Our initial planning and scheduling activities, including defining the various project work tasks and associated quality activities, are foundational to a successful project.

Producing Quality

AECOM requires a project plan on all projects to define key parameters and guide the work of the team. The plan is discussed at the project team kickoff meeting and updated as needed to inform the team of new developments. As work proceeds, a number of critical technical activities are undertaken, including:

- Proper application of codes, standards, and design criteria
- Ongoing oversight and supervision for accuracy and completeness as work proceeds
- Distribution of in progress documents at defined intervals for quality review
- Coordination among disciplines
- Verification of compatibility and consistency among document types, such as drawings and specifications
- Resolution and closure of in progress review comments

Confirming Quality

While it is important to build quality into the work as it is performed, formal checking and review are critical QMS activities. Quality checking activities, which are documented with two-level approvals, include:

- *Checking calculations* to verify correctness and completeness of mathematics, methodology, selection of software, application of standards and codes, and general approach.
- *Checking drawings* within each discipline to confirm design layout, dimensions and details. Potential interferences, conflicts, and interface issues are resolved through interdisciplinary reviews.
- *Checking specifications* for content and application, as well as compliance with the prescribed format, and for consistency throughout the specifications.
- *Checking reports/studies* for content, logic, clarity and soundness of recommendations, as well as grammar, punctuation, and format.

For the NJ TRANSITGRID project, this means checking documents, including:

- the 10% design documents (plans and specifications)
- the 20% design documents (plans and specifications) at both the 50% and 100% complete stage
- the value engineering report
- the reports related to fuel cell technology, photovoltaic technology, combined heat and power
- the draft and final performance specifications for the communications backbone and power management infrastructure, the emergency alarm stations, fire alarm systems, and radio systems
- other design packages and reports submitted to NJ Transit and/or regulatory agencies

Delivering Quality

All deliverables undergo a final verification check before they are submitted. As noted above, this verification check is performed for our projects without differentiating whether the final product is a conceptual study, a preliminary design, or a final design. An independent reviewer evaluates the deliverables for completeness and consistency, adherence to quality requirements, and resolution of comments. The reviewer then signs a Deliverable Release form and transmits it to our project manager, who is then responsible for the final review, approval, and submittal. This final independent evaluation assesses the submittal's state of readiness, without diminishing the project manager's accountability for the quality of the work being released. As a check-and-balance activity, this review pairing helps AECOM consistently deliver quality and value to our clients.

Improving Quality

A key component of AECOM's quality program and ISO 9001 is continuous improvement. We learn from our experiences and apply those lessons to future work through a formal, iterative process. The true focus is to generate client satisfaction, one of AECOM's core values.

OUR PROPOSED QA TEAM

AECOM's quality management team members have the qualifications and experience to execute their responsibilities on the project. The Quality Management Plan will define the necessary qualifications for technical staff detailed checkers, reviewers, and design leadership. Roles and assignments will only be given to personnel that meet or exceed the required qualifications. Typical titles and experience for the project personnel include:

Project Manager (PM). The project manager role is consistent throughout the AECOM organization. In terms of QMS, the project manager has the responsibility for the quality of the work delivered to the client. In terms of checking and verification, the PM will:

- Schedule and monitor quality review activities
- Sign off on all deliverables on the Deliverable Release Record (DRR)
- Be sure that any output of Project Approach Review activity has been provided to the project team for incorporation into the project work and then verified through the checking and verification process

Originator. The originator initially develops the work product. Some input and/or guidance may be provided by others. In terms of checking and verification, originators are responsible for:

- Performing a self-check before submitting their work product for checking by others
- Working with reviewers to address and resolve comments, questions and/or necessary corrections to their work product

Discipline Lead. This role refers to the individual who has overall responsibility for the work product for a specific discipline, technical field, or practice area on a project. Discipline leads may also carry functional or organizational titles such as technical practice leaders, department head/manager/chief, discipline manager, squad leader, studio manager, group chief, or other similar designations. In terms of checking and verification, discipline leads are responsible for signing the Deliverable Release Record and verifying that:

- The work was prepared by qualified staff in accordance with generally accepted professional practice
- The work was checked by qualified staff who did not produce the original work
- The resulting review comments and any outstanding comments from previous reviews have been satisfactorily resolved
- Calculations have been checked including those prepared using technical software tools such as Microsoft Excel (with macros or equations), MathCAD, and other programs, by means of a secondary method (i.e., line-by-line manual check, alternate calculation, independent calculations)
- Microsoft Excel spreadsheets with macros, internally embedded equations, and other programming logic can be validated by performing a line-by-line check of the equations, macros, and other logic and then lock the spreadsheet and complete the software validation process, so the spreadsheet does not require the line-by-line rigor for each use
- When applicable, interdiscipline reviews have been completed and comments resolved
- The work complies with the scope and regulatory or statutory requirements
- The work product is suitable for delivery to the client

Although it is ideal to have separate individuals serve as originator, discipline reviewer and discipline lead, this is not always practical. Therefore, it is permissible, but not preferred,

that the Discipline Lead also is the originator or the discipline reviewer, but not both.

Interdiscipline Reviewer (where applicable). This role is in play on projects that involve multiple disciplines. The interdiscipline reviewer is responsible for checking for potential conflicts, interferences, gaps or other inconsistencies between their discipline's work and that of other involved disciplines — a critical step in the review process.

There are different ways to accomplish interdiscipline reviews. Most desirably, interdiscipline reviews are conducted jointly among the involved disciplines during a combined review meeting, using a complete set of plans or other documents comprising the deliverable. It is up to the project manager to work with the discipline leads and establish a process that works best for the project team and organization involved.

To effectively provide this review, the interdiscipline reviewer should be familiar with their discipline's work. As such, it is permissible for the interdiscipline reviewer to also be a discipline reviewer or discipline lead. The review is recorded by the discipline lead on the DRR form.

Discipline Reviewer. Discipline reviewers are qualified by education and experience to serve in the reviewer role, and may be licensed professionals depending on the discipline, the nature of the work product, and local professional regulation requirements. Discipline reviewers must have very limited, if any, involvement in the production of the work product, so as to preserve their independence and unbiased review position.

Independent Peer Reviewer (where applicable). This role is not utilized on all projects. Project deliverables may be subject to an independent peer review (IPR) for any number of reasons, including:

- Client requirement
- Reviewing or regulatory agency requirement
- Risk mitigation strategy
- Project manager or project director preference

When an IPR is required, the role is filled by individuals outside of the normal project quality review team and process. The use of an IPR will be specified in the project plan and the completion of an IPR documented in a separate section on the DRR form. An IPR is conducted over and above the normal checking and verification and does not replace the discipline review and discipline lead review and signoff.

Project Quality Representative (PQR). This role is filled by staff authorized by the Regional Quality Manager. Authorization is granted by RQMs based on qualifications and completion of PQR training. The PQR role in checking and verification is to confirm that the quality review process has been completed satisfactorily and to sign the DRR form. In doing so, the PQR will review the completed forms and other records to make sure that all fields have been completed, boxes appropriately checked, and that all required signatures and dates have been added. The PQR, in general, can perform their duties by examining the completed forms and/or mark-up sets or check prints only. However, the PQR may examine supporting documentation and the deliverable as necessary to confirm the completion and suitability of the quality review process.



For the NJ TRANSITGRID DG project, we have assigned Peter Totten, PE to lead quality management and fulfill the role of PQR. Peter is a senior quality manager with a background in project management and design. He is responsible for the quality of engineering and design on transit/rail and security projects involving architecture, civil, structural, mechanical, electrical, and plumbing (MEP) engineering design. He has participated in the preparation and revision of AECOM's Quality Assurance Manual Corporate Standards and is one of AECOM's leading quality management system (QMS) experts. He is thoroughly familiar with ISO 9001:2008 requirements and in tailoring quality systems for project-specific requirements to meet client-specified standards and program goals.

Peter is very familiar with NJ TRANSIT requirements and facilities; his experience includes supervision of engineeirng and design engineering for the Hudson-Bergen Light Rail Transit System project.

He has also provided oversight for numerous infrastructure security projects in the New York and New Jersey metropolitan region.

08 Schedule

Our team has provided quality services to many agencies across the nation, as demonstrated throughout this proposal and which can be affirmed by our references.

AECOM has prepared Phase I and Phase II CPM schedules as an example for all of the tasks and subtasks of the NJ TRANSITGRID-DG Project. We included all major activities, from design, review, and procurement, to construction, and start-up/commissioning. Those needed to be completed by the project manager, architect/engineers, contractor, NJ TRANSIT, Amtrak, federal, and local entities.

At the beginning of the project, we will prepare a more detailed baseline schedule and highlight all activities, including 10% and 20% design packages, review durations by NJ TRANSIT and all regulatory agencies, cost estimating, code analysis, levels of manpower, and design deliverables, at the direction of NJ TRANSIT as required in the RFP.

PHASE I SCHEDULE

Phase I of the schedule is planned to be completed in 10 months. The logical sequencing of the CPM schedule starts with preparation of required documents such as the PMP, Phase I Baseline Schedule, QMP, DCP, CMP, RMP, and SSMP.

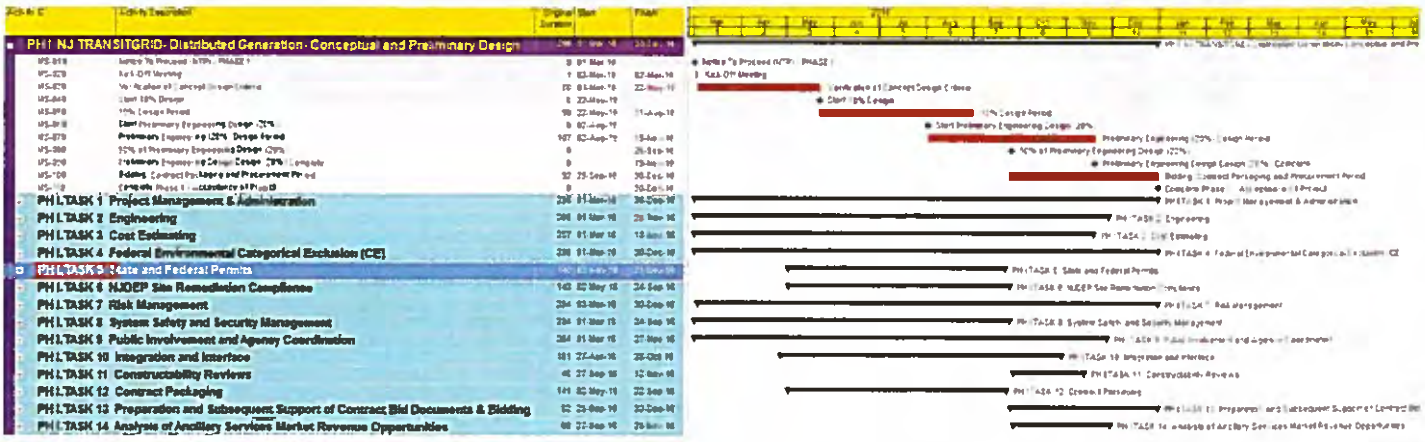
A records management control system will be established immediately after staff approval from NJ TRANSIT, which will be based on Oracle Primavera Unifier web-based (cloud) service. Primavera Unifier will be the center of a "Paperless Office" and will help manage all delivery cycles by workflows (design delivery, change management, monthly reporting, permits and regulatory requirements, and so on), documents by ball-in-court tracking, and version control. This will make sure the review times are met, and any outstanding items will be completed before they become critical.

During the first three months after NTP there will be the preparation of concept design criteria. 10% Design Plans and Specifications start after NTP. NJ TRANSIT will need to validate the concept design criteria in order for AECOM to advance the design.

The 10% design is going to be ready in less than five months. For this, it is assumed that all of the field survey will be accomplished in the first four months.

The critical path is on the evaluation and design application of technologies like Fuel Cell, PV, CHP and Power Management with all civil, structural, geotechnical and hydraulic designs. After review and approval of the 10% design by NJ TRANSIT, 20% design is on the critical path.

Figure 8-1. Sample Phase I Schedule



There will be value engineering exercises after 10% design, a constructability review half way to 20% design, and final value engineering exercise and final constructability report before the end of 20% design.

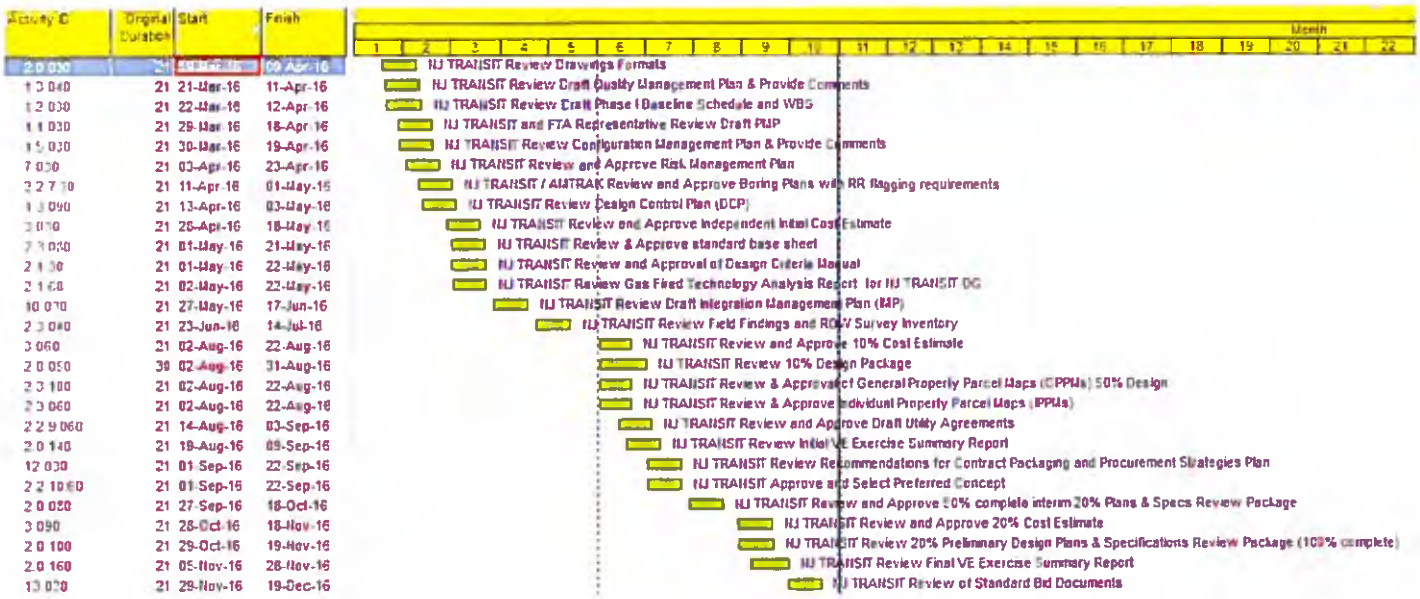
The last two months before the end of Phase I will include activities such as preparation of bid documents, statement of work, and post-RFP activities. The NJ TRANSITGRID-DG Phase I schedule is grouped by WBS and is attached to the end of this proposal.

REVIEW DURATIONS

All durations for permits and regulatory approvals from federal and local entities are assumptions, and are not exact. The target is to have all permits and regulatory approvals received before 50% of 20% design.

NJ TRANSIT review period is set to 21 calendar days throughout the schedule. Figure 8-2 is a list of activities that shows only the NJ TRANSIT review periods during Phase I.

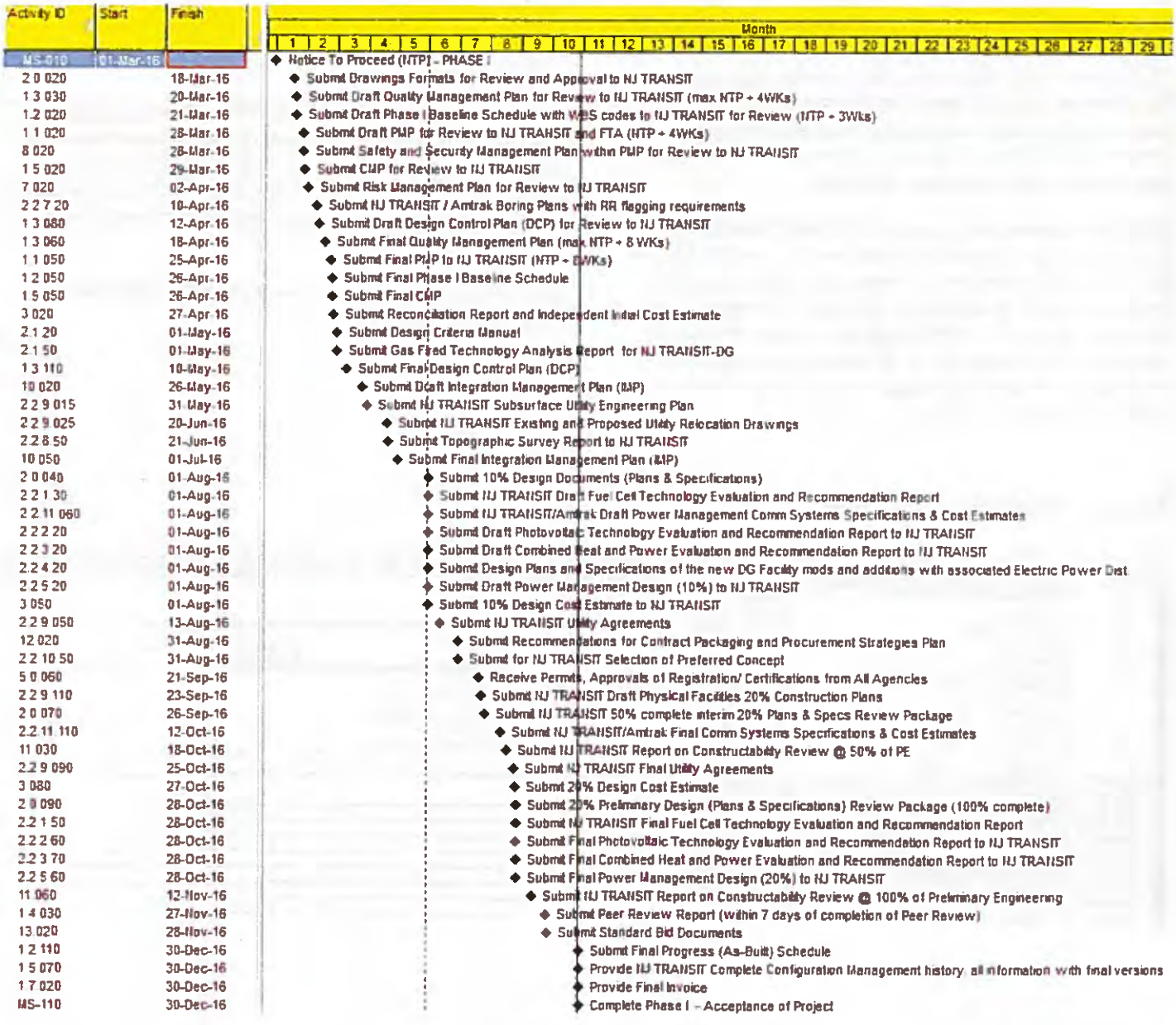
Figure 8-2, Phase I Review Periods



MILESTONES AND DELIVERABLES

All milestones and deliverables of the RFP are filtered out from the schedule and attached into this proposal.

Figure 8-3. Schedule of Milestones and Deliverables



PHASE II SCHEDULE

Phase II of TRANSITGRID-DG Project is assumed to start by March 1st of 2017 and be complete in 24 months. Final design starts immediately after NTP and it is assumed that the final design period will be eight months.

AECOM planned that the construction will start approximately in the ninth month after a two-month procurement time. During the final design time, the contractor has to prepare a long-lead equipment and material (shop drawings, fabrication, and delivery) schedule and order these equipment and materials. AECOM will track this schedule and make sure it is incorporated into the master schedule.

AECOM will assist and support NJ TRANSIT during the construction period with all of the tasks in the RFP. AECOM will attend technical and progress meetings, review shop drawings, assist in analysis of contractor's change orders, review all contractor CPM schedules, manage the master schedule, accomplish overall project risk management, and provide technical assistance during system tests of infrastructure and facilities.

AECOM will complete Phase II by assisting NJ TRANSIT during startup, major component tests, any dispute resolution, and the commissioning and closeout period.

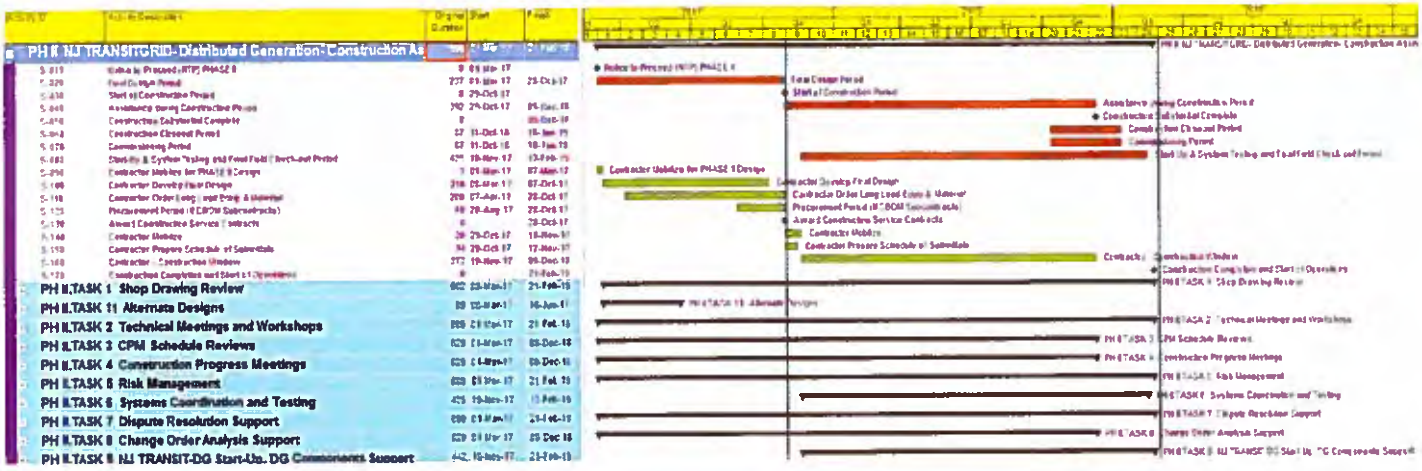
The Phase II critical path is on the final design and construction period. System tests, and startup and commissioning are the last activities on the critical path.

SCHEDULE CALENDARS

The schedule reflects that the NJ TRANSITGRID project staff is off during NJ TRANSIT-approved holidays (New Year's Day, Martin Luther King Jr. Day, Presidents' Day, Good Friday, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans' Day, Thanksgiving Day, Friday after Thanksgiving Day, Christmas Day).

All schedule activities use a seven-day/week calendar as requested in the RFP.

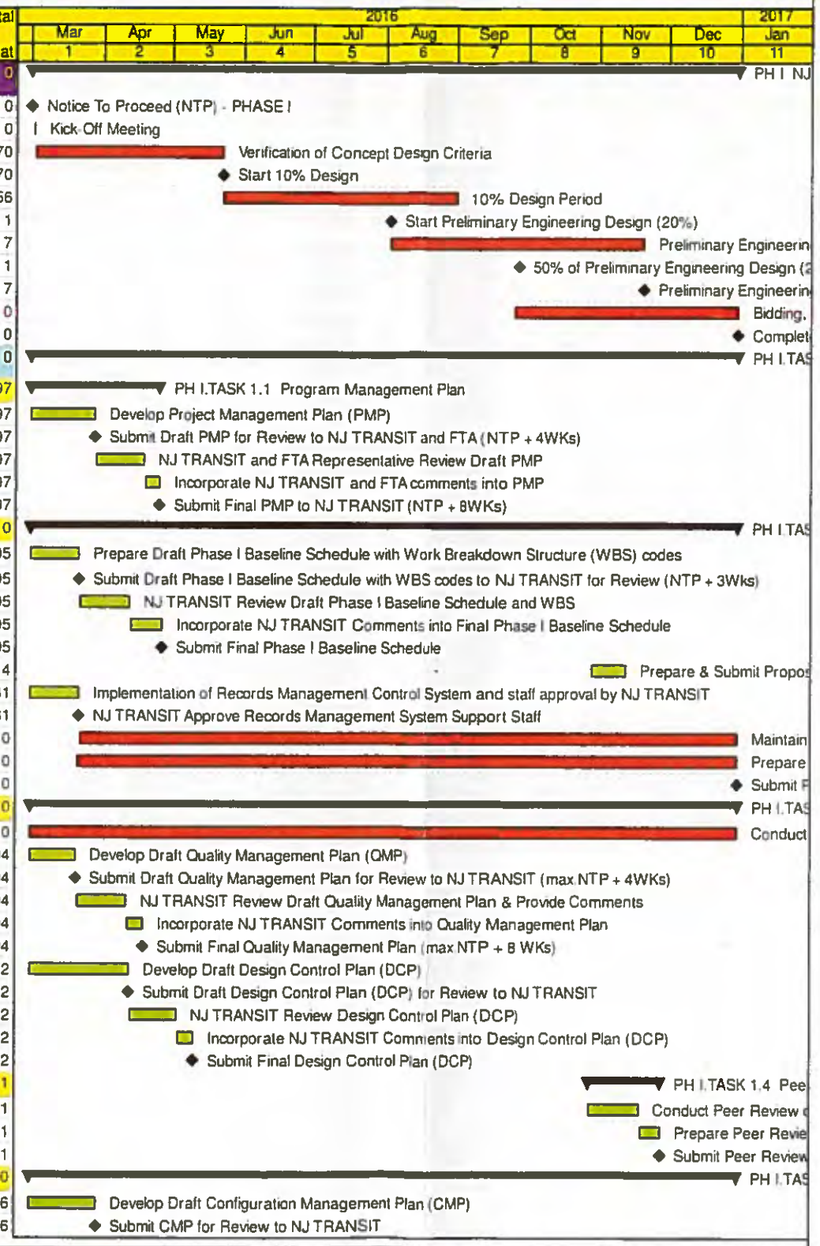
Figure 8-4. Sample Phase II Schedule



NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO.16-001

NJ TRANSITGRID PROJECT - DISTRIBUTED GENERATION PHASE I

Activity ID	Activity Description	Original Duration	Start	Finish	Total Float
PH I NJ TRANSITGRID- Distributed Generation- Conceptual and Preliminary Design		296	01-Mar-16	30-Dec-16	0
MS-010	Notice To Proceed (NTP) - PHASE I	0	01-Mar-16		0
MS-020	Kick-Off Meeting	1	02-Mar-16	02-Mar-16	0
MS-030	Verification of Concept Design Criteria	80	03-Mar-16	22-May-16	70
MS-040	Start 10% Design	0	22-May-16		70
MS-050	10% Design Period	99	22-May-16	31-Aug-16	56
MS-060	Start Preliminary Engineering Design (20%)	0	02-Aug-16		1
MS-070	Preliminary Engineering (20%) Design Period	107	02-Aug-16	19-Nov-16	7
MS-080	50% of Preliminary Engineering Design (20%)	0		26-Sep-16	1
MS-090	Preliminary Engineering Design Design (20%) Complete	0		19-Nov-16	7
MS-100	Bidding, Contract Packaging and Procurement Period	92	25-Sep-16	30-Dec-16	0
MS-110	Complete Phase I - Acceptance of Project	0		30-Dec-16	0
PH I.TASK 1 Project Management & Administration		296	01-Mar-16	30-Dec-16	0
PH I.TASK 1.1 Program Management Plan		55	01-Mar-16	25-Apr-16	97
1.1.010	Develop Project Management Plan (PMP)	27	01-Mar-16	28-Mar-16	97
1.1.020	Submit Draft PMP for Review to NJ TRANSIT and FTA (NTP + 4WKs)	0		28-Mar-16	97
1.1.030	NJ TRANSIT and FTA Representative Review Draft PMP	21	29-Mar-16	18-Apr-16	97
1.1.040	Incorporate NJ TRANSIT and FTA comments into PMP	7	19-Apr-16	25-Apr-16	97
1.1.050	Submit Final PMP to NJ TRANSIT (NTP + 8WKs)	0		25-Apr-16	97
PH I.TASK 1.2 Project Control		296	01-Mar-16	30-Dec-16	0
1.2.010	Prepare Draft Phase I Baseline Schedule with Work Breakdown Structure (WBS) codes	21	01-Mar-16	21-Mar-16	95
1.2.020	Submit Draft Phase I Baseline Schedule with WBS codes to NJ TRANSIT for Review (NTP + 3Wks)	0		21-Mar-16	95
1.2.030	NJ TRANSIT Review Draft Phase I Baseline Schedule and WBS	21	22-Mar-16	12-Apr-16	95
1.2.040	Incorporate NJ TRANSIT Comments into Final Phase I Baseline Schedule	14	13-Apr-16	26-Apr-16	95
1.2.050	Submit Final Phase I Baseline Schedule	0		26-Apr-16	95
1.2.060	Prepare & Submit Proposed Construction Schedule	14	29-Oct-16	12-Nov-16	14
1.2.070	Implementation of Records Management Control System and staff approval by NJ TRANSIT	21	01-Mar-16	21-Mar-16	131
1.2.080	NJ TRANSIT Approve Records Management System Support Staff	0		21-Mar-16	131
1.2.090	Maintain Records Management Control System: Primavera Unifier - Cost, Schedule, Document Collaboration	275	22-Mar-16	30-Dec-16	0
1.2.100	Prepare Monthly Progress Report (Monthly Progress Schedule, Schedule Status Report, Recovery Plan & Schedule)	276	21-Mar-16	30-Dec-16	0
1.2.110	Submit Final Progress (As-Built) Schedule	0		30-Dec-16	0
PH I.TASK 1.3 Quality Control		296	01-Mar-16	30-Dec-16	0
1.3.010	Conduct an ongoing Quality Program (Internal Quality Management Review Reports, Audit Reports, Quality Certificate)	296	01-Mar-16	30-Dec-16	0
1.3.020	Develop Draft Quality Management Plan (QMP)	20	01-Mar-16	20-Mar-16	104
1.3.030	Submit Draft Quality Management Plan for Review to NJ TRANSIT (max NTP + 4WKs)	0		20-Mar-16	104
1.3.040	NJ TRANSIT Review Draft Quality Management Plan & Provide Comments	21	21-Mar-16	11-Apr-16	104
1.3.050	Incorporate NJ TRANSIT Comments into Quality Management Plan	7	12-Apr-16	18-Apr-16	104
1.3.060	Submit Final Quality Management Plan (max NTP + 8 WKs)	0		18-Apr-16	104
1.3.070	Develop Draft Design Control Plan (DCP)	42	01-Mar-16	12-Apr-16	82
1.3.080	Submit Draft Design Control Plan (DCP) for Review to NJ TRANSIT	0		12-Apr-16	82
1.3.090	NJ TRANSIT Review Design Control Plan (DCP)	21	13-Apr-16	03-May-16	82
1.3.100	Incorporate NJ TRANSIT Comments into Design Control Plan (DCP)	7	04-May-16	10-May-16	82
1.3.110	Submit Final Design Control Plan (DCP)	0		10-May-16	82
PH I.TASK 1.4 Peer Review of Design		28	28-Oct-16	27-Nov-16	1
1.4.010	Conduct Peer Review of Design (Engineering, Quality, Risk, Procurement & Constructability) @ 20%	21	28-Oct-16	18-Nov-16	1
1.4.020	Prepare Peer Review Report	7	19-Nov-16	27-Nov-16	1
1.4.030	Submit Peer Review Report (within 7 days of completion of Peer Review)	0		27-Nov-16	1
PH I.TASK 1.5 Configuration Management		296	01-Mar-16	30-Dec-16	0
1.5.010	Develop Draft Configuration Management Plan (CMP)	28	01-Mar-16	29-Mar-16	96
1.5.020	Submit CMP for Review to NJ TRANSIT	0		29-Mar-16	96



NJ TRANSIT The Way To Go.

Remaining Level of Effort
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NEW JERSEY TRANSIT CORPORATION
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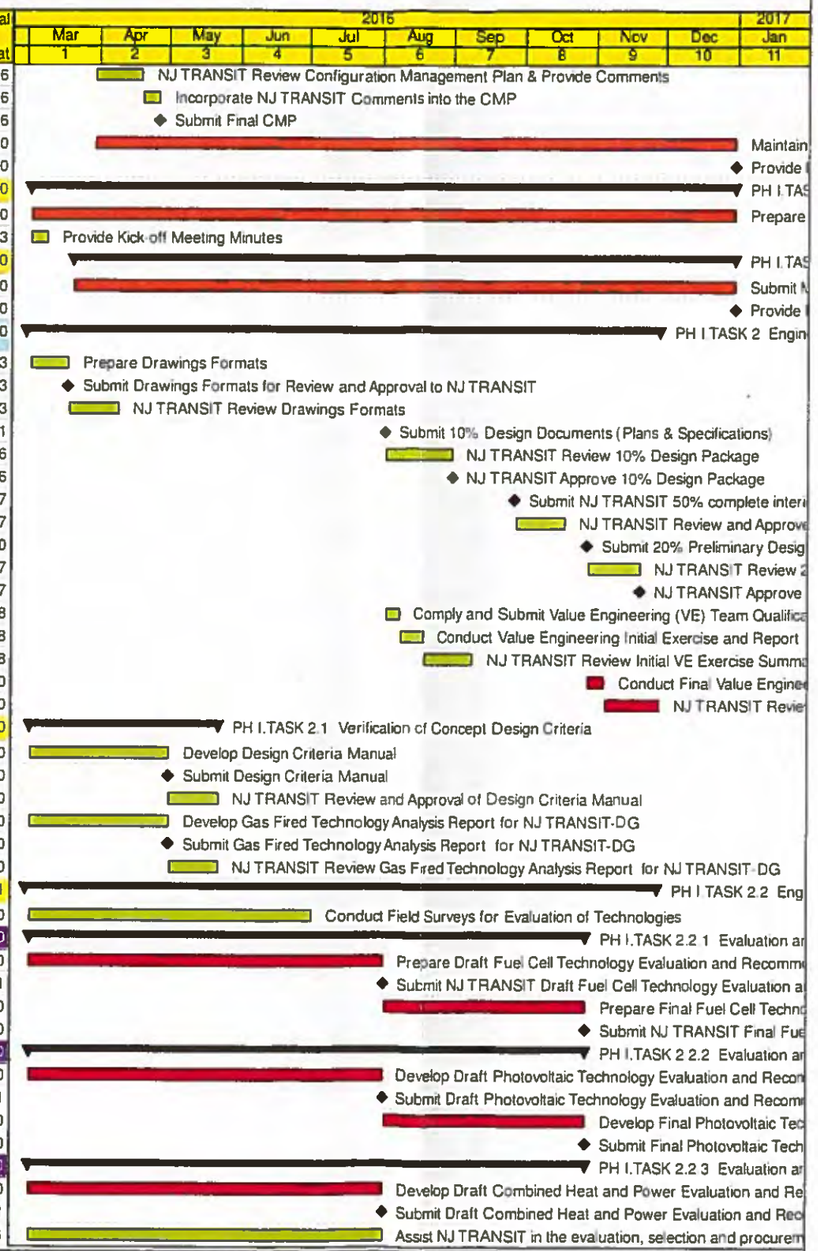
NJ TRANSITGRID PROJECT - DISTRIBUTED GENERATION PHASE I

Activity ID	Activity Description	Original Duration	Start	Finish	Total Float
1.5.030	NJ TRANSIT Review Configuration Management Plan & Provide Comments	21	30-Mar-16	19-Apr-16	96
1.5.040	Incorporate NJ TRANSIT Comments into the CMP	7	20-Apr-16	26-Apr-16	96
1.5.050	Submit Final CMP	0		26-Apr-16	96
1.5.060	Maintain Contract Documents Log - Configuration Management (Primavera Unifier)	268	30-Mar-16	30-Dec-16	0
1.5.070	Provide NJ TRANSIT Complete Configuration Management history, all information with final versions	0		30-Dec-16	0
PH I.TASK 1.6	**Project Meetings**	294	03-Mar-16	30-Dec-16	0
1.6.010	Prepare Progress Meeting Minutes and Interface and Integration Management Meeting Minutes	294	03-Mar-16	30-Dec-16	0
1.6.020	Provide Kick-off Meeting Minutes	7	03-Mar-16	09-Mar-16	143
PH I.TASK 1.7	**Payment Procedures**	276	21-Mar-16	30-Dec-16	0
1.7.010	Submit Monthly Applications of Payment	276	21-Mar-16	30-Dec-16	0
1.7.020	Provide Final Invoice	0		30-Dec-16	0
PH I.TASK 2	**Engineering**	265	01-Mar-16	28-Nov-16	0
2.0.010	Prepare Drawings Formats	16	03-Mar-16	18-Mar-16	113
2.0.020	Submit Drawings Formats for Review and Approval to NJ TRANSIT	0		18-Mar-16	113
2.0.030	NJ TRANSIT Review Drawings Formats	21	19-Mar-16	09-Apr-16	113
2.0.040	Submit 10% Design Documents (Plans & Specifications)	0		01-Aug-16	1
2.0.050	NJ TRANSIT Review 10% Design Package	30	02-Aug-16	31-Aug-16	56
2.0.060	NJ TRANSIT Approve 10% Design Package	0		31-Aug-16	56
2.0.070	Submit NJ TRANSIT 50% complete interim 20% Plans & Specs Review Package	0		26-Sep-16	17
2.0.080	NJ TRANSIT Review and Approve 50% complete interim 20% Plans & Specs Review Package	21	27-Sep-16	18-Oct-16	17
2.0.090	Submit 20% Preliminary Design (Plans & Specifications) Review Package (100% complete)	0		28-Oct-16	0
2.0.100	NJ TRANSIT Review 20% Preliminary Design Plans & Specifications Review Package (100% complete)	21	29-Oct-16	19-Nov-16	7
2.0.110	NJ TRANSIT Approve 20% Preliminary Design Plans & Specifications (100% complete)	0		19-Nov-16	7
2.0.120	Comply and Submit Value Engineering (VE) Team Qualification and Agenda	7	02-Aug-16	08-Aug-16	48
2.0.130	Conduct Value Engineering Initial Exercise and Report	10	09-Aug-16	18-Aug-16	48
2.0.140	NJ TRANSIT Review Initial VE Exercise Summary Report	21	19-Aug-16	09-Sep-16	48
2.0.150	Conduct Final Value Engineering Exercise and Report	7	29-Oct-16	04-Nov-16	0
2.0.160	NJ TRANSIT Review Final VE Exercise Summary Report	21	05-Nov-16	28-Nov-16	0
PH I.TASK 2.1	**Verification of Concept Design Criteria**	80	03-Mar-16	22-May-16	70
2.1.10	Develop Design Criteria Manual	59	03-Mar-16	01-May-16	70
2.1.20	Submit Design Criteria Manual	0		01-May-16	70
2.1.30	NJ TRANSIT Review and Approval of Design Criteria Manual	21	01-May-16	22-May-16	70
2.1.40	Develop Gas Fired Technology Analysis Report for NJ TRANSIT-DG	59	03-Mar-16	01-May-16	70
2.1.50	Submit Gas Fired Technology Analysis Report for NJ TRANSIT-DG	0		01-May-16	70
2.1.60	NJ TRANSIT Review Gas Fired Technology Analysis Report for NJ TRANSIT-DG	21	02-May-16	22-May-16	70
PH I.TASK 2.2	**Engineering and Design**	264	01-Mar-16	27-Nov-16	1
2.2.0.10	Conduct Field Surveys for Evaluation of Technologies	120	03-Mar-16	02-Jul-16	30
PH I.TASK 2.2.1	**Evaluation and Design Application of Fuel Cell Technology**	235	03-Mar-16	28-Oct-16	0
2.2.1.20	Prepare Draft Fuel Cell Technology Evaluation and Recommendation Report	149	03-Mar-16	01-Aug-16	0
2.2.1.30	Submit NJ TRANSIT Draft Fuel Cell Technology Evaluation and Recommendation Report	0		01-Aug-16	1
2.2.1.40	Prepare Final Fuel Cell Technology Evaluation and Recommendation Report	86	02-Aug-16	28-Oct-16	0
2.2.1.50	Submit NJ TRANSIT Final Fuel Cell Technology Evaluation and Recommendation Report	0		28-Oct-16	0
PH I.TASK 2.2.2	**Evaluation and Design Application of Photovoltaic (PV) Technology**	235	03-Mar-16	28-Oct-16	0
2.2.2.10	Develop Draft Photovoltaic Technology Evaluation and Recommendation Report	149	03-Mar-16	01-Aug-16	0
2.2.2.20	Submit Draft Photovoltaic Technology Evaluation and Recommendation Report to NJ TRANSIT	0		01-Aug-16	1
2.2.2.50	Develop Final Photovoltaic Technology Evaluation and Recommendation Report	86	02-Aug-16	28-Oct-16	0
2.2.2.60	Submit Final Photovoltaic Technology Evaluation and Recommendation Report to NJ TRANSIT	0		28-Oct-16	0
PH I.TASK 2.2.3	**Evaluation and Design Application of Combined Heat and Power(CHP) & Procurement of Electric Vehicles**	235	03-Mar-16	28-Oct-16	0
2.2.3.10	Develop Draft Combined Heat and Power Evaluation and Recommendation Report	149	03-Mar-16	01-Aug-16	0
2.2.3.20	Submit Draft Combined Heat and Power Evaluation and Recommendation Report to NJ TRANSIT	0		01-Aug-16	1
2.2.3.50	Assist NJ TRANSIT in the evaluation, selection and procurement of new Electric and Hydrid Electric Vehicles	149	03-Mar-16	01-Aug-16	1



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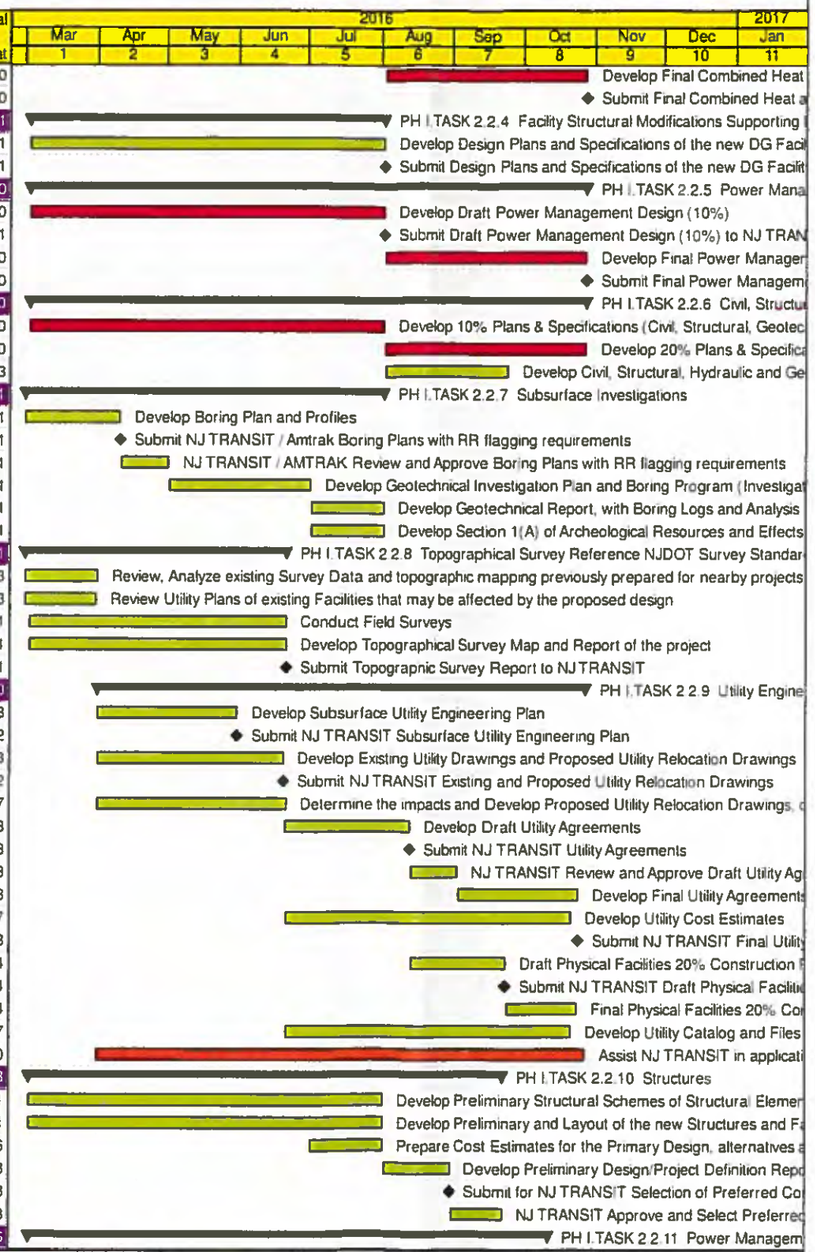
2.2.3.60	Develop Final Combined Heat and Power Evaluation and Recommendation Report	86	02-Aug-16	28-Oct-16	0
2.2.3.70	Submit Final Combined Heat and Power Evaluation and Recommendation Report to NJ TRANSIT	0		28-Oct-16	0
PH I.TASK 2.2.4	Facility Structural Modifications Supporting DG	149	03-Mar-16	01-Aug-16	1
2.2.4.10	Develop Design Plans and Specifications of the new DG Facility mods and additions with associated Electric Power Dist	149	03-Mar-16	01-Aug-16	1
2.2.4.20	Submit Design Plans and Specifications of the new DG Facility mods and additions with associated Electric Power Dist	0		01-Aug-16	1
PH I.TASK 2.2.5	Power Management Design	235	03-Mar-16	28-Oct-16	0
2.2.5.10	Develop Draft Power Management Design (10%)	149	03-Mar-16	01-Aug-16	0
2.2.5.20	Submit Draft Power Management Design (10%) to NJ TRANSIT	0		01-Aug-16	1
2.2.5.50	Develop Final Power Management Design (20%)	86	02-Aug-16	28-Oct-16	0
2.2.5.60	Submit Final Power Management Design (20%) to NJ TRANSIT	0		28-Oct-16	0
PH I.TASK 2.2.6	Civil, Structural, Geotechnical & Hydraulic	235	03-Mar-16	28-Oct-16	0
2.2.6.10	Develop 10% Plans & Specifications (Civil, Structural, Geotechnical & Hydraulic)	149	03-Mar-16	01-Aug-16	0
2.2.6.20	Develop 20% Plans & Specifications (Civil, Structural, Geotechnical & Hydraulic)	86	02-Aug-16	28-Oct-16	0
2.2.6.30	Develop Civil, Structural, Hydraulic and Geotechnical Design Reports for construction	53	02-Aug-16	24-Sep-16	33
PH I.TASK 2.2.7	Subsurface Investigations	151	01-Mar-16	01-Aug-16	1
2.2.7.10	Develop Boring Plan and Profiles	40	01-Mar-16	10-Apr-16	1
2.2.7.20	Submit NJ TRANSIT / Amtrak Boring Plans with RR flagging requirements	0		10-Apr-16	1
2.2.7.30	NJ TRANSIT / AMTRAK Review and Approve Boring Plans with RR flagging requirements	21	11-Apr-16	01-May-16	1
2.2.7.40	Develop Geotechnical Investigation Plan and Boring Program (Investigations)	60	02-May-16	01-Jul-16	1
2.2.7.50	Develop Geotechnical Report, with Boring Logs and Analysis	30	02-Jul-16	01-Aug-16	1
2.2.7.60	Develop Section 1(A) of Archeological Resources and Effects	30	02-Jul-16	01-Aug-16	1
PH I.TASK 2.2.8	Topographical Survey Reference NJDOT Survey Standards	111	01-Mar-16	21-Jun-16	41
2.2.8.10	Review, Analyze existing Survey Data and topographic mapping previously prepared for nearby projects	30	01-Mar-16	01-Apr-16	3
2.2.8.20	Review Utility Plans of existing Facilities that may be affected by the proposed design	30	01-Mar-16	31-Mar-16	3
2.2.8.30	Conduct Field Surveys	109	03-Mar-16	21-Jun-16	41
2.2.8.40	Develop Topographical Survey Map and Report of the project	109	03-Mar-16	21-Jun-16	41
2.2.8.50	Submit Topographic Survey Report to NJ TRANSIT	0		21-Jun-16	41
PH I.TASK 2.2.9	Utility Engineering	207	01-Apr-16	28-Oct-16	0
2.2.9.010	Develop Subsurface Utility Engineering Plan	60	01-Apr-16	31-May-16	3
2.2.9.015	Submit NJ TRANSIT Subsurface Utility Engineering Plan	0		31-May-16	62
2.2.9.020	Develop Existing Utility Drawings and Proposed Utility Relocation Drawings	80	01-Apr-16	20-Jun-16	3
2.2.9.025	Submit NJ TRANSIT Existing and Proposed Utility Relocation Drawings	0		20-Jun-16	42
2.2.9.030	Determine the impacts and Develop Proposed Utility Relocation Drawings, contact affected utility owners	80	01-Apr-16	21-Jun-16	7
2.2.9.040	Develop Draft Utility Agreements	53	21-Jun-16	13-Aug-16	3
2.2.9.050	Submit NJ TRANSIT Utility Agreements	0		13-Aug-16	3
2.2.9.060	NJ TRANSIT Review and Approve Draft Utility Agreements	21	14-Aug-16	03-Sep-16	3
2.2.9.070	Develop Final Utility Agreements	50	04-Sep-16	25-Oct-16	3
2.2.9.080	Develop Utility Cost Estimates	120	21-Jun-16	22-Oct-16	7
2.2.9.090	Submit NJ TRANSIT Final Utility Agreements	0		25-Oct-16	3
2.2.9.100	Draft Physical Facilities 20% Construction Plans	40	14-Aug-16	23-Sep-16	4
2.2.9.110	Submit NJ TRANSIT Draft Physical Facilities 20% Construction Plans	0		23-Sep-16	34
2.2.9.120	Final Physical Facilities 20% Construction Plans	30	24-Sep-16	24-Oct-16	4
2.2.9.130	Develop Utility Catalog and Files	120	21-Jun-16	22-Oct-16	7
2.2.9.140	Assist NJ TRANSIT in applications required to permit rearrangement of utilities and/or secure easements	207	01-Apr-16	28-Oct-16	0
PH I.TASK 2.2.10	Structures	200	03-Mar-16	22-Sep-16	63
2.2.10.10	Develop Preliminary Structural Schemes of Structural Elements	149	03-Mar-16	01-Aug-16	1
2.2.10.20	Develop Preliminary and Layout of the new Structures and Facilities with alternatives	149	03-Mar-16	01-Aug-16	1
2.2.10.30	Prepare Cost Estimates for the Primary Design, alternatives and funding implications	30	02-Jul-16	01-Aug-16	86
2.2.10.40	Develop Preliminary Design/Project Definition Report for final implementation	30	02-Aug-16	31-Aug-16	63
2.2.10.50	Submit for NJ TRANSIT Selection of Preferred Concept	0		31-Aug-16	63
2.2.10.60	NJ TRANSIT Approve and Select Preferred Concept	21	01-Sep-16	22-Sep-16	63
PH I.TASK 2.2.11	Power Management Communications	219	03-Mar-16	12-Oct-16	15



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NJ TRANSITGRID PROJECT - DISTRIBUTED GENERATION PHASE I

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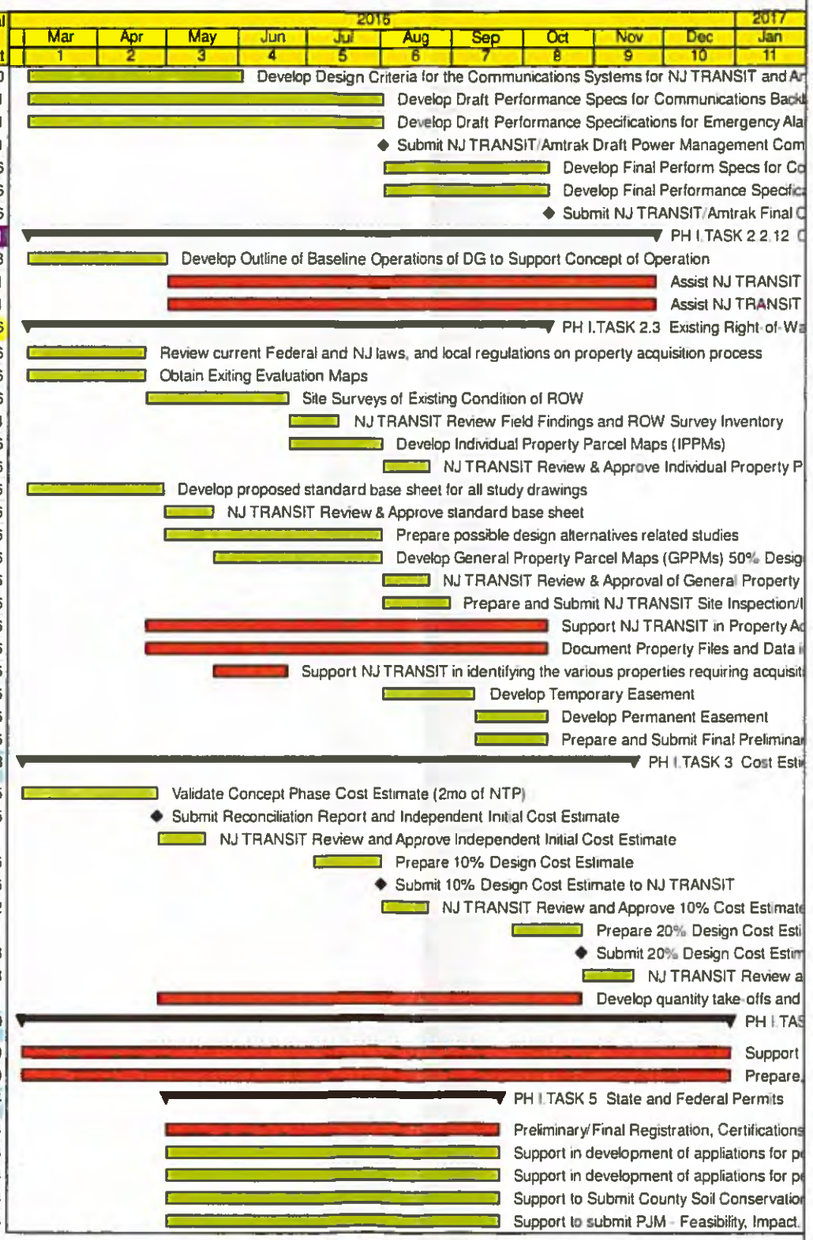
2.2.11.010	Develop Design Criteria for the Communications Systems for NJ TRANSIT and Amtrak	90	03-Mar-16	02-Jun-16	60
2.2.11.020	Develop Draft Performance Specs for Communications Backbone & Power Mmgt Infrastructure	149	03-Mar-16	01-Aug-16	1
2.2.11.040	Develop Draft Performance Specifications for Emergency Alarm Stations, Fire Alarm Systems and Radio Systems	149	03-Mar-16	01-Aug-16	1
2.2.11.060	Submit NJ TRANSIT/Amtrak Draft Power Management Comm Systems Specifications & Cost Estimates	0		01-Aug-16	1
2.2.11.070	Develop Final Perform Specs for Communications Backbone & Power Mgmt Infrastructure	70	02-Aug-16	12-Oct-16	16
2.2.11.090	Develop Final Performance Specifications for Emergency Alarm Stations, Fire Alarm Systems and Radio Systems	70	02-Aug-16	12-Oct-16	16
2.2.11.110	Submit NJ TRANSIT/Amtrak Final Comm Systems Specifications & Cost Estimates	0		12-Oct-16	16
PH I.TASK 2.2.12	Concept of Operation	262	03-Mar-16	27-Nov-16	1
2.2.12.10	Develop Outline of Baseline Operations of DG to Support Concept of Operation	59	03-Mar-16	01-May-16	3
2.2.12.20	Assist NJ TRANSIT for registrations/certifications with regulatory agencies or bodies	203	02-May-16	27-Nov-16	1
2.2.12.30	Assist NJ TRANSIT in evaluating compliance requirements to Currently Enforceable Standards	203	02-May-16	27-Nov-16	1
PH I.TASK 2.3	Existing Right-of-Way (ROW)	219	03-Mar-16	12-Oct-16	16
2.3.010	Review current Federal and NJ laws, and local regulations on property acquisition process	50	03-Mar-16	22-Apr-16	16
2.3.020	Obtain Exiting Evaluation Maps	50	03-Mar-16	22-Apr-16	16
2.3.030	Site Surveys of Existing Condition of ROW	60	23-Apr-16	22-Jun-16	16
2.3.040	NJ TRANSIT Review Field Findings and ROW Survey Inventory	21	23-Jun-16	14-Jul-16	34
2.3.050	Develop Individual Property Parcel Maps (IPPMs)	39	23-Jun-16	01-Aug-16	16
2.3.060	NJ TRANSIT Review & Approve Individual Property Parcel Maps (IPPMs)	21	02-Aug-16	22-Aug-16	16
2.3.070	Develop proposed standard base sheet for all study drawings	58	03-Mar-16	30-Apr-16	16
2.3.080	NJ TRANSIT Review & Approve standard base sheet	21	01-May-16	21-May-16	16
2.3.085	Prepare possible design alternatives related studies	91	01-May-16	01-Aug-16	16
2.3.090	Develop General Property Parcel Maps (GPPMs) 50% Design	70	22-May-16	01-Aug-16	16
2.3.100	NJ TRANSIT Review & Approval of General Property Parcel Maps (GPPMs) 50% Design	21	02-Aug-16	22-Aug-16	16
2.3.105	Prepare and Submit NJ TRANSIT Site Inspection/Inventory Reports and Surveys	30	02-Aug-16	31-Aug-16	26
2.3.120	Support NJ TRANSIT in Property Acquisition	169	23-Apr-16	12-Oct-16	16
2.3.130	Document Property Files and Data input Support of NJ TRANSIT PAECETRAK System	169	23-Apr-16	12-Oct-16	16
2.3.135	Support NJ TRANSIT in identifying the various properties requiring acquisition of rights or easements	31	22-May-16	22-Jun-16	16
2.3.140	Develop Temporary Easement	40	02-Aug-16	11-Sep-16	16
2.3.150	Develop Permanent Easement	30	12-Sep-16	12-Oct-16	16
2.3.160	Prepare and Submit Final Preliminary Assessment Report (GPPMs)	30	12-Sep-16	12-Oct-16	16
PH I.TASK 3	Cost Estimating	257	01-Mar-16	18-Nov-16	8
3.010	Validate Concept Phase Cost Estimate (2mo of NTP)	57	01-Mar-16	27-Apr-16	95
3.020	Submit Reconciliation Report and Independent Initial Cost Estimate	0		27-Apr-16	95
3.030	NJ TRANSIT Review and Approve Independent Initial Cost Estimate	21	28-Apr-16	18-May-16	101
3.040	Prepare 10% Design Cost Estimate	28	05-Jul-16	01-Aug-16	56
3.050	Submit 10% Design Cost Estimate to NJ TRANSIT	0		01-Aug-16	56
3.060	NJ TRANSIT Review and Approve 10% Cost Estimate	21	02-Aug-16	22-Aug-16	72
3.070	Prepare 20% Design Cost Estimate	30	27-Sep-16	27-Oct-16	1
3.080	Submit 20% Design Cost Estimate	0		27-Oct-16	8
3.090	NJ TRANSIT Review and Approve 20% Cost Estimate	21	28-Oct-16	18-Nov-16	8
3.100	Develop quantity take-offs and cost estimates for each of the major items	179	28-Apr-16	27-Oct-16	1
PH I.TASK 4	Federal Environmental Categorical Exclusion (CE)	296	01-Mar-16	30-Dec-16	0
4.030	Support during Development of Federal Environmental Categorical Exclusion	296	01-Mar-16	30-Dec-16	0
4.050	Prepare, as directed, a general Flood Hazard Area Permit Application or an Individual Permit Application	296	01-Mar-16	30-Dec-16	0
PH I.TASK 5	State and Federal Permits	140	02-May-16	21-Sep-16	4
5.0.010	Preliminary/Final Registration, Certifications (All Energy, Railroad, Federal, State, Local Regulatory/Review Agencies)	140	02-May-16	21-Sep-16	4
5.0.020	Support in development of appliations for permits to USACOE, USCG, FERC, NERC and other Federal Agencies	140	02-May-16	21-Sep-16	4
5.0.030	Support in development of appliations for permits to NJDEP Individual Permits & Mitigation Plans	140	02-May-16	21-Sep-16	4
5.0.040	Support to Submit County Soil Conservation (Soil Erosion & Sediment Control Certification) and Site Plan	140	02-May-16	21-Sep-16	4
5.0.050	Support to submit PJM - Feasibility, Impact, Facilities, Interconnection and Energy Resource request Study & Agreements	140	02-May-16	21-Sep-16	4



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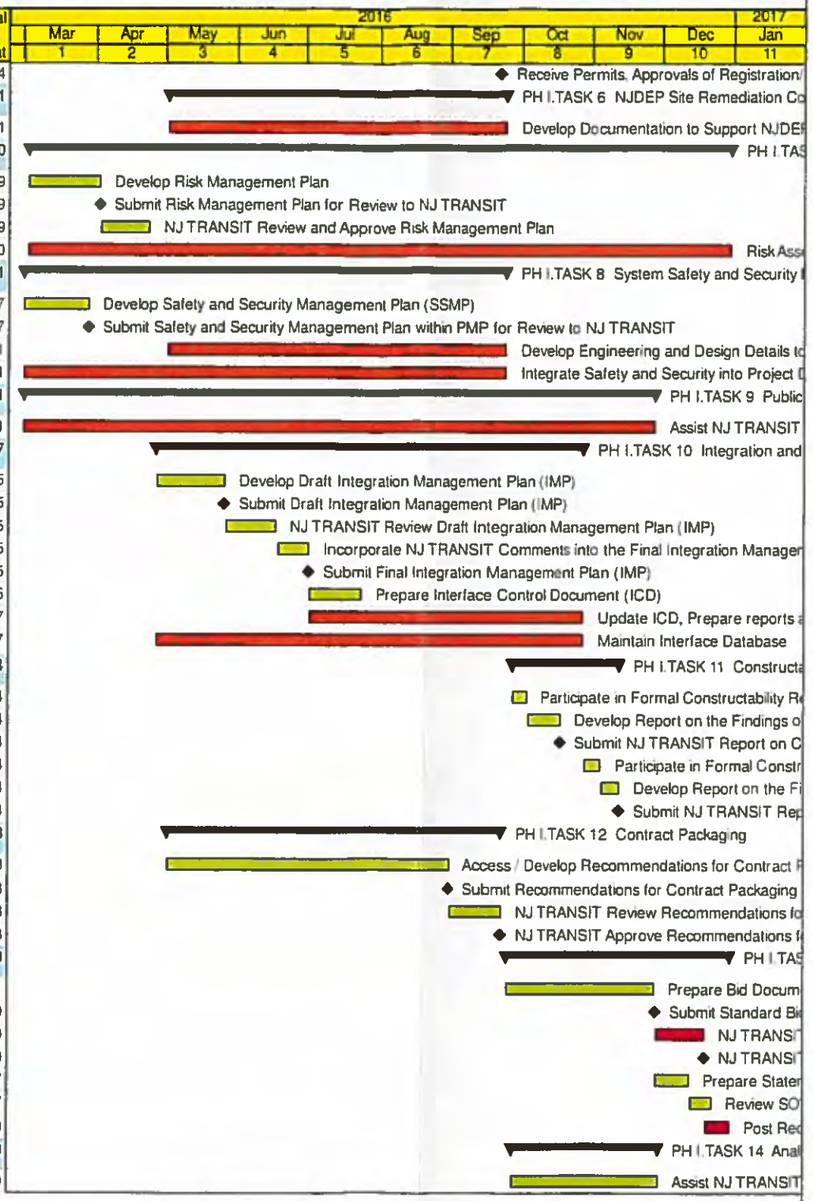
5.0.060	Receive Permits, Approvals of Registration/ Certifications from All Agencies	0		21-Sep-16	4
PH I.TASK 6	**NJDEP Site Remediation Compliance**	143	02-May-16	24-Sep-16	1
6.020	Develop Documentation to Support NJDEP Site Remediation Compliance	143	02-May-16	24-Sep-16	1
PH I.TASK 7	**Risk Management**	294	03-Mar-16	30-Dec-16	0
7.010	Develop Risk Management Plan	30	03-Mar-16	02-Apr-16	99
7.020	Submit Risk Management Plan for Review to NJ TRANSIT	0		02-Apr-16	99
7.030	NJ TRANSIT Review and Approve Risk Management Plan	21	03-Apr-16	23-Apr-16	99
7.040	Risk Assessment, Threat & Vulnerability and Management Process, workshops and meetings, update risk register	294	03-Mar-16	30-Dec-16	0
PH I.TASK 8	**System Safety and Security Management**	204	01-Mar-16	24-Sep-16	1
8.010	Develop Safety and Security Management Plan (SSMP)	27	01-Mar-16	28-Mar-16	97
8.020	Submit Safety and Security Management Plan within PMP for Review to NJ TRANSIT	0		28-Mar-16	97
8.030	Develop Engineering and Design Details to Support NJ TRANSIT Regulatory Compliance	143	02-May-16	24-Sep-16	1
8.040	Integrate Safety and Security into Project Development Process, Develop design Criteria and certifications	204	01-Mar-16	24-Sep-16	1
PH I.TASK 9	**Public Involvement and Agency Coordination**	264	01-Mar-16	27-Nov-16	1
9.010	Assist NJ TRANSIT in Targeted Outreach Effort as Required	264	01-Mar-16	27-Nov-16	1
PH I.TASK 10	**Integration and Interface**	181	27-Apr-16	28-Oct-16	7
10.010	Develop Draft Integration Management Plan (IMP)	30	27-Apr-16	26-May-16	95
10.020	Submit Draft Integration Management Plan (IMP)	0		26-May-16	95
10.030	NJ TRANSIT Review Draft Integration Management Plan (IMP)	21	27-May-16	17-Jun-16	95
10.040	Incorporate NJ TRANSIT Comments into the Final Integration Management Plan (IMP)	14	18-Jun-16	01-Jul-16	95
10.050	Submit Final Integration Management Plan (IMP)	0		01-Jul-16	95
10.055	Prepare Interface Control Document (ICD)	21	02-Jul-16	23-Jul-16	95
10.060	Update ICD, Prepare reports and Interface Management Monthly Meeting Minutes	116	02-Jul-16	28-Oct-16	7
10.070	Maintain Interface Database	181	27-Apr-16	28-Oct-16	7
PH I.TASK 11	**Constructability Reviews**	45	27-Sep-16	12-Nov-16	14
11.010	Participate in Formal Constructability Review @ 50% of Project Engineering (PE)	7	27-Sep-16	03-Oct-16	24
11.020	Develop Report on the Findings of the Constructability Review @ 50% of PE	14	04-Oct-16	18-Oct-16	24
11.030	Submit NJ TRANSIT Report on Constructability Review @ 50% of PE	0		18-Oct-16	24
11.040	Participate in Formal Constructability Review @ 100% of PE	7	29-Oct-16	04-Nov-16	14
11.050	Develop Report on the Findings of the Constructability Review @ 100% of PE	7	05-Nov-16	12-Nov-16	14
11.060	Submit NJ TRANSIT Report on Constructability Review @ 100% of Preliminary Engineering	0		12-Nov-16	14
PH I.TASK 12	**Contract Packaging**	141	02-May-16	22-Sep-16	3
12.010	Access / Develop Recommendations for Contract Packaging and Procurement Strategies Plan	120	02-May-16	31-Aug-16	3
12.020	Submit Recommendations for Contract Packaging and Procurement Strategies Plan	0		31-Aug-16	3
12.030	NJ TRANSIT Review Recommendations for Contract Packaging and Procurement Strategies Plan	21	01-Sep-16	22-Sep-16	3
12.040	NJ TRANSIT Approve Recommendations for Contract Packaging and Procurement Strategies Plan	0		22-Sep-16	3
PH I.TASK 13	**Preparation and Subsequent Support of Contract Bid Documents & Bidding Proce**	92	25-Sep-16	30-Dec-16	0
13.010	Prepare Bid Documents (DG) (incl Bidding Information, Bidding Forms & Special Provisions)	60	25-Sep-16	27-Nov-16	1
13.020	Submit Standard Bid Documents	0		28-Nov-16	0
13.030	NJ TRANSIT Review of Standard Bid Documents	21	29-Nov-16	19-Dec-16	0
13.040	NJ TRANSIT Approval of Standard Bid Documents	0		19-Dec-16	0
13.050	Prepare Statement of Work (SOW)	15	28-Nov-16	12-Dec-16	7
13.060	Review SOW	10	13-Dec-16	22-Dec-16	7
13.070	Post Request for Proposal (RFP) for Bidding	10	20-Dec-16	30-Dec-16	0
PH I.TASK 14	**Analysis of Ancillary Services Market Revenue Opportunities**	60	27-Sep-16	29-Nov-16	30
14.010	Assist NJ TRANSIT to Develop DG Power Generation Revenue Optimization in any PJM Market Services	60	27-Sep-16	29-Nov-16	30



NJTRANSIT The Way To Go.

Remaining Level of Effort
Remaining Work
Critical Remaining Work
Milestone
Summary

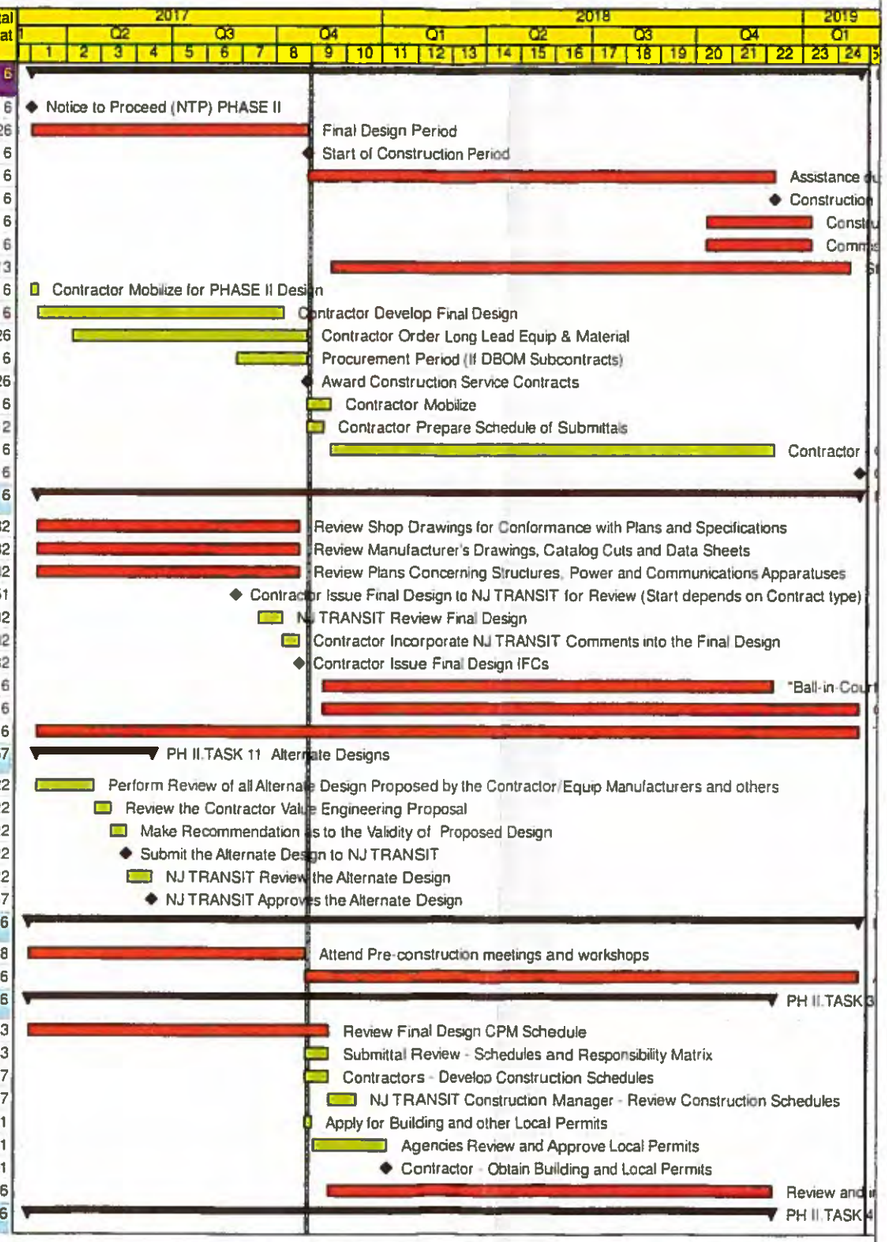
Project Start:01-Mar-16
Project Finish:30-Dec-16
Print Date: 07-Oct-15

AECOM

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO.16-001

NJ TRANSITGRID PROJECT - DISTRIBUTED GENERATION PHASE II

Activity ID	Activity Description	Original Duration	Start	Finish	Total Float
PH II NJ TRANSITGRID- Distributed Generation- Construction Assistance/Engineering		699	01-Mar-17	21-Feb-19	6
S-010	Notice to Proceed (NTP) PHASE II	0	01-Mar-17		6
S-020	Final Design Period	237	01-Mar-17	28-Oct-17	26
S-030	Start of Construction Period	0	29-Oct-17		6
S-040	Assistance during Construction Period	392	29-Oct-17	09-Dec-18	6
S-050	Construction Substantial Complete	0		09-Dec-18	6
S-060	Construction Closeout Period	87	11-Oct-18	10-Jan-19	6
S-070	Commissioning Period	87	11-Oct-18	10-Jan-19	6
S-080	Start-Up & System Testing and Final Field Check-out Period	435	19-Nov-17	13-Feb-19	13
S-090	Contractor Mobilize for PHASE II Design	7	01-Mar-17	07-Mar-17	6
S-100	Contractor Develop Final Design	210	08-Mar-17	07-Oct-17	6
S-110	Contractor Order Long Lead Equip & Material	200	07-Apr-17	28-Oct-17	26
S-120	Procurement Period (If DBOM Subcontracts)	60	28-Aug-17	28-Oct-17	6
S-130	Award Construction Service Contracts	0		28-Oct-17	26
S-140	Contractor Mobilize	20	29-Oct-17	18-Nov-17	6
S-150	Contractor Prepare Schedule of Submittals	14	29-Oct-17	12-Nov-17	12
S-160	Contractor - Construction Window	372	19-Nov-17	09-Dec-18	6
S-170	Construction Completion and Start of Operations	0		21-Feb-19	6
PH II.TASK 1 Shop Drawing Review		692	08-Mar-17	21-Feb-19	6
TK1-010	Review Shop Drawings for Conformance with Plans and Specifications	224	08-Mar-17	22-Oct-17	32
TK1-020	Review Manufacturer's Drawings, Catalog Cuts and Data Sheets	224	08-Mar-17	22-Oct-17	32
TK1-030	Review Plans Concerning Structures, Power and Communications Apparatuses	224	08-Mar-17	22-Oct-17	32
TK1-040	Contractor Issue Final Design to NJ TRANSIT for Review (Start depends on Contract type)	0	28-Aug-17		51
TK1-050	NJ TRANSIT Review Final Design	21	17-Sep-17	07-Oct-17	32
TK1-060	Contractor Incorporate NJ TRANSIT Comments into the Final Design	14	08-Oct-17	22-Oct-17	32
TK1-070	Contractor Issue Final Design IFCs	0		22-Oct-17	32
TK1-080	"Ball-in-Court" Reviews during Construction	378	13-Nov-17	09-Dec-18	6
TK1-090	Chronology of Issues tied to Risk Management approach	448	13-Nov-17	21-Feb-19	6
TK1-100	Tracking and Reviewing Shop Drawings	692	08-Mar-17	21-Feb-19	6
PH II.TASK 11 Alternate Designs		99	08-Mar-17	16-Jun-17	157
TK11-010	Perform Review of all Alternate Design Proposed by the Contractor/Equip Manufacturers and others	50	08-Mar-17	27-Apr-17	122
TK11-020	Review the Contractor Value Engineering Proposal	14	28-Apr-17	11-May-17	122
TK11-030	Make Recommendation as to the Validity of Proposed Design	14	12-May-17	25-May-17	122
TK11-040	Submit the Alternate Design to NJ TRANSIT	0		25-May-17	122
TK11-050	NJ TRANSIT Review the Alternate Design	21	26-May-17	16-Jun-17	122
TK11-060	NJ TRANSIT Approves the Alternate Design	0		16-Jun-17	157
PH II.TASK 2 Technical Meetings and Workshops		699	01-Mar-17	21-Feb-19	6
TK2-010	Attend Pre-construction meetings and workshops	237	01-Mar-17	28-Oct-17	468
TK2-020	Attend construction and procurement contract meetings	462	29-Oct-17	21-Feb-19	6
PH II.TASK 3 CPM Schedule Reviews		629	01-Mar-17	09-Dec-18	6
TK3-010	Review Final Design CPM Schedule	257	01-Mar-17	18-Nov-17	13
TK3-020	Submittal Review - Schedules and Responsibility Matrix	20	29-Oct-17	18-Nov-17	13
TK3-030	Contractors - Develop Construction Schedules	20	29-Oct-17	18-Nov-17	357
TK3-040	NJ TRANSIT Construction Manager - Review Construction Schedules	21	19-Nov-17	11-Dec-17	357
TK3-050	Apply for Building and other Local Permits	7	29-Oct-17	04-Nov-17	331
TK3-060	Agencies Review and Approve Local Permits	60	05-Nov-17	08-Jan-18	331
TK3-070	Contractor - Obtain Building and Local Permits	0		08-Jan-18	331
TK3-080	Review and incorporate to MCS all contractor and Force Account CPM schedules	372	19-Nov-17	09-Dec-18	6
PH II.TASK 4 Construction Progress Meetings		629	01-Mar-17	09-Dec-18	6



NJTRANSIT The Way To Go.

Remaining Level of Effort
Remaining Work
Critical Remaining Work
Milestone
Summary

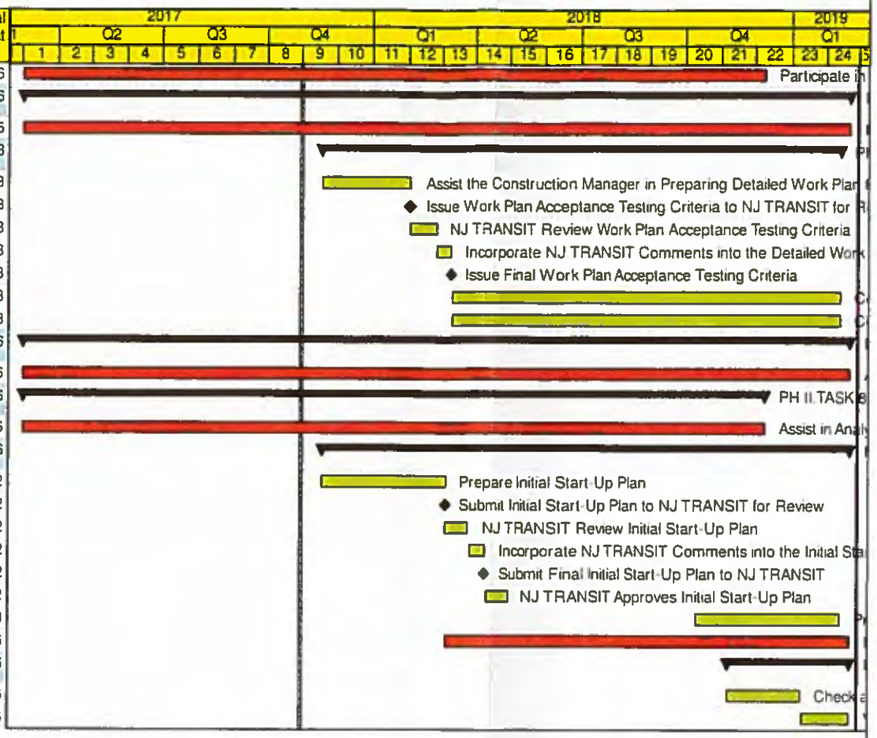
Start date: 01-Mar-17
Finish date: 21-Feb-19
Print date: 07-Oct-15

AECOM

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO.16-001

NJ TRANSITGRID PROJECT - DISTRIBUTED GENERATION PHASE II

Activity ID	Activity Description	Original Duration	Start	Finish	Total Float
TK4-010	Participate in Progress Meetings with NJ TRANSIT, Contractor and project entities	629	01-Mar-17	09-Dec-18	6
PH II.TASK 5	**Risk Management**	699	01-Mar-17	21-Feb-19	6
TK5-010	Maintain Risk Register, Risk Matrix & Incorporate Risk Mitigation Projects. Update RMP	699	01-Mar-17	21-Feb-19	6
PH II.TASK 6	**Systems Coordination and Testing**	435	19-Nov-17	13-Feb-19	13
TK6-010	Assist the Construction Manager in Preparing Detailed Work Plan for Acceptance Testing Criteria	70	19-Nov-17	01-Feb-18	13
TK6-020	Issue Work Plan Acceptance Testing Criteria to NJ TRANSIT for Review	0		01-Feb-18	13
TK6-030	NJ TRANSIT Review Work Plan Acceptance Testing Criteria	21	02-Feb-18	23-Feb-18	13
TK6-040	Incorporate NJ TRANSIT Comments into the Detailed Work Plan Acceptance Testing Criteria	14	24-Feb-18	09-Mar-18	13
TK6-050	Issue Final Work Plan Acceptance Testing Criteria	0		09-Mar-18	13
TK6-060	Conduct Individual Acceptance Testing of each system according to the Work Plan	330	10-Mar-18	13-Feb-19	13
TK6-070	Conduct Comprehensive Testing Program of all NJ TRANSIT-DG equipments, interconnections and control functions	330	10-Mar-18	13-Feb-19	13
PH II.TASK 7	**Dispute Resolution Support**	699	01-Mar-17	21-Feb-19	6
TK7-010	Assist in Dispute Resolutions (preparation of any dispute analysis, reports or other response)	699	01-Mar-17	21-Feb-19	6
PH II.TASK 8	**Change Order Analysis Support**	629	01-Mar-17	09-Dec-18	6
TK8-010	Assist in Analysis of Contractor's Change Orders and Participate in negotiations	629	01-Mar-17	09-Dec-18	6
PH II.TASK 9	**NJ TRANSIT-DG Start-Up, DG Components Support**	442	19-Nov-17	21-Feb-19	6
TK9-100	Prepare Initial Start-Up Plan	100	19-Nov-17	04-Mar-18	172
TK9-110	Submit Initial Start-Up Plan to NJ TRANSIT for Review	0		04-Mar-18	172
TK9-120	NJ TRANSIT Review Initial Start-Up Plan	21	05-Mar-18	25-Mar-18	172
TK9-130	Incorporate NJ TRANSIT Comments into the Initial Start-Up Plan	14	26-Mar-18	09-Apr-18	172
TK9-140	Submit Final Initial Start-Up Plan to NJ TRANSIT	0		09-Apr-18	172
TK9-150	NJ TRANSIT Approves Initial Start-Up Plan	21	10-Apr-18	30-Apr-18	172
TK9-160	Provide Tech Assist as each Major Component of the System is tested, approved and ready for operation	120	11-Oct-18	13-Feb-19	13
TK9-170	Provide support to NJ TRANSIT before and after Initiating Operational Service	342	05-Mar-18	21-Feb-19	6
PH II.TASK 10	**Project Closeout Support**	100	07-Nov-18	21-Feb-19	6
TK10-100	Check all As Built Drawings/ Approved Shop Drawings/Approved Deviations for compliance	60	07-Nov-18	10-Jan-19	6
TK10-110	Verify that the Contractors As built Drawings are in Compliance with the Contract Plans & Specs	40	11-Jan-19	21-Feb-19	6



NJ TRANSIT The Way To Go.

Remaining Level of Effort
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Critical Remaining Work
Milestone
Summary

Start date: 01-Mar-17
Finish date: 21-Feb-19
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AECOM

NJ TRANSIT Contract No. 16-001
AECOM Revised Cost Proposal
Design, Engineering, Construction Assistance and Other Technical Services
for The NJ TRANSITGRID Distributed Generation
March 20, 2016 Rev.1

Distributed Generation	Estimated Effort Hours By Task and Job Classification											Other Direct Charges - Estimated	Estimated Total Hours by Task	Loaded Labor Cost Estimate by Task	Total Cost Estimate (Loaded Labor + ODCs) by Task
Task Description	Project Manager	Deputy Project Manager	Senior Engineer	Engineer	Senior Consultant	Project Specialist	Procurement Specialist	Quality / Safety Manager	Cost Estimator	Non-DBE Subconsultants	DBE Subconsultants				
Direct Labor Rate (Ave. for each Job Classification)	$113.89	$80.00	$66.36	$31.29	$96.44	$107.70	$59.83	$77.59	$89.33	$86.07	$48.55				
AECOM: Billable Rate with 138% OH + 0% Fee, DBE-Subs: Billable Rate with average of 134% OH + 0% Fee, Non-DBE-Subs: Billable Rate with average of 134% OH + 0% Fee	$271.06	$190.40	$156.80	$74.47	$229.53	$256.33	$142.40	$184.66	$212.61	$201.60	$113.74				
	1660	1648	4595	840	916	60	308	120	120	4362	5972	$128,545	20602	$ 3,427,870	$ 3,556,416
Phase I															
Task 1 – Project Management	740	420	446	0	0	0	0	80	0	150	1600	$21,442	3436	$ 571,789	$ 593,231
Task 2 – Engineering	600	800	2995	840	800	0	0	0	0	3066	2781	$74,139	11882	$ 1,977,049	$ 2,051,189
Task 3 - Cost Estimating	60	120	60	0	0	0	0	0	120	0	811	$7,307	1171	$ 194,841	$ 202,148
Task 4 – Federal Environmental Impact Statement (EIS)	0	0	0	0	0	0	0	0	0	0	300	$1,872	300	$ 49,917	$ 51,789
Task 5 – State, Federal Permits and Mitigation	0	0	0	0	0	0	0	0	0	40	200	$1,497	240	$ 39,933	$ 41,431
Task 6 – Site Remediation	0	0	0	0	0	0	0	0	0	0	280	$1,747	280	$ 46,589	$ 48,336
Task 7 – Risk Management	100	188	280	0	0	0	0	40	0	118	0	$4,530	726	$ 120,798	$ 125,328
Task 8 - System Safety and Security Management	0	0	308	0	0	0	0	0	0	160	0	$2,920	468	$ 77,870	$ 80,790
Task 9 – Public Involvement and Agency Coordination	160	80	0	0	0	0	0	0	0	40	0	$1,747	280	$ 46,589	$ 48,336
Task 10 - Integration and Interface	0	0	0	0	0	0	0	0	0	640	0	$3,993	640	$ 106,489	$ 110,482
Task 11 - Constructability Reviews	0	0	506	0	116	0	0	0	0	0	0	$3,881	622	$ 103,494	$ 107,375
Task 12 - Contract Packaging	0	0	0	0	0	0	77	0	0	0	0	$480	77	$ 12,812	$ 13,292
Task 13 - Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	0	0	0	0	0	60	231	0	0	0	0	$1,816	291	$ 48,419	$ 50,235
Task 14 – Analysis of Ancillary Services Market Revenue opportunities	0	0	0	0	0	0	0	0	0	148	0	$923	148	$ 24,626	$ 25,549
Task 15 – As Directed by NJ TRANSIT	0	40	0	0	0	0	0	0	0	0	0	$250	40	$ 6,656	$ 6,905
Phase 1	$ 189,057	$ 131,840	$ 304,958	$ 26,284	$ 88,339	$ 6,462	$ 18,428	$ 9,311	$ 10,720	$ 375,416	$ 289,924	$ 128,545	20,602	$ 785,398	
Phase 2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Total	$ 189,057	$ 131,840	$ 304,958	$ 26,284	$ 88,339	$ 6,462	$ 18,428	$ 9,311	$ 10,720	$ 375,416	$ 289,924	$ 128,545	20,602	$ 785,398	
									134%	$ 503,947	$ 389,337	134%	138%	$ 1,083,849	
										$ 879,363	$ 679,261			$ 1,869,246	
									Profit @0%	$ -	$ -	Profit @0%	Profit @ 0%	$ -	
										$ -	$ -		AECOM	$ 1,869,246	
													Non-DBE Subs	$ 879,363	
													DBE Subs	$ 679,261	
													ODCs	$ 128,545	
													Grand Total	$ [illegible]	

Direct Labor Cost	$ 1,450,737
Indirect Labor Cost	$ 1,977,134
Fee @ 0%	$ -
ODC @ 3 75%	$ 128,545
Grand Total	$ [illegible]

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-1
COST AND FEE FIRM RECAP - TEAM SUMMARY

FIRM	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ Various Rates*	SUBTOTAL	FIXED FEE@ 0%	DIRECT EXPENSES	TOTAL COST
AECOM	10,267	$ 785,398	$ 1,083,849	$ 1,869,246	0%	$ 70,097	$ 1,939,343
PB	800	$ 86,641	$ 133,608	$ 220,249	0%	$ 8,259	$ 228,508
IPERC	547	$ 57,072	$ 60,262	$ 117,334	0%	$ 4,400	$ 121,734
Navigant	1,143	$ 85,916	$ 107,876	$ 193,792	0%	$ 7,267	$ 201,059
GbD	80	$ 5,967	$ 9,248	$ 15,215	0%	$ 571	$ 15,786
JCMS	811	$ 51,644	$ 60,073	$ 111,717	0%	$ 4,189	$ 115,907
AG	681	$ 23,839	$ 32,659	$ 56,498	0%	$ 2,119	$ 58,617
GTS	1,500	$ 62,600	$ 77,693	$ 140,293	0%	$ 5,261	$ 145,554
Radin	780	$ 59,540	$ 92,388	$ 151,928	0%	$ 5,697	$ 157,626
Robinson	600	$ 36,300	$ 53,724	$ 90,024	0%	$ 3,376	$ 93,400
CCMT	1,792	$ 139,821	$ 192,953	$ 332,773	0%	$ 12,479	$ 345,252
Macan Deve	1,600	$ 56,000	$ 72,800	$ 128,800	0%	$ 4,830	$ 133,630
Total	20,602	$ 1,450,737	$ 1,977,134	$ 3,427,870		$ 128,545	$ 3,556,416

* The following overhead rates are used for each firm:

FIRM	OH Rates
AECOM	138.00%
PB	154.21%
IPERC	105.59%
Navigant	125.56%
GbD	155.00%
JCMS	116.32%
AG	137.00%
GTS	124.11%
Radin	155.17%
Robinson	148.00%
CCMT	138.00%
Macan Deve	130.00%

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ Various Rates*	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	3,436	$ 219,536	$ 300,944	$ 520,480	0%	$ 19,518	$ 539,998
2	Engineering	11,882	$ 809,637	$ 1,095,883	$ 1,905,520	0%	$ 71,457	$ 1,976,977
3	Cost Estimating	1,171	$ 82,097	$ 102,098	$ 184,195	0%	$ 6,907	$ 191,103
4	Federal Environmental Impact Statement	300	$ 23,700	$ 36,775	$ 60,475	0%	$ 2,268	$ 62,743
5	State, Federal Permits and Mitigation	240	$ 17,743	$ 27,527	$ 45,271	0%	$ 1,698	$ 46,968
6	Site Remediation	280	$ 21,080	$ 32,710	$ 53,790	0%	$ 2,017	$ 55,807
7	Risk Management	726	$ 62,410	$ 82,001	$ 144,410	0%	$ 5,415	$ 149,826
8	System Safety and Security Management	468	$ 35,235	$ 47,122	$ 82,358	0%	$ 3,088	$ 85,446
9	Public Involvement and Agency Coordination	280	$ 27,606	$ 38,603	$ 66,209	0%	$ 2,483	$ 68,692
10	Integration and Interface	640	$ 62,372	$ 91,604	$ 153,976	0%	$ 5,774	$ 159,750
11	Constructability Reviews	622	$ 50,013	$ 69,018	$ 119,031	0%	$ 4,464	$ 123,495
12	Contract Packaging	77	$ 4,607	$ 6,358	$ 10,964	0%	$ 411	$ 11,376
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	291	$ 20,283	$ 27,990	$ 48,273	0%	$ 1,810	$ 50,083
14	Analysis of Ancilliary Services Market Revenue opporunities	148	$ 11,217	$ 14,084	$ 25,302	0%	$ 949	$ 26,250
15	As Directed by NJ TRANSIT	40	$ 3,200	$ 4,416	$ 7,616	0%	$ 286	$ 7,902
	TEAM TOTALS	20,602	$ 1,450,737	$ 1,977,134	$ 3,427,870		$ 128,545	$ 3,556,416

* The following overhead rates are used for each firm:

FIRM	OH Rates
AECOM	138.00%
PB	154.21%
IPERC	105.59%
Navigant	125.56%
GbD	155.00%
JCMS	116.32%
AG	137.00%
GTS	124.11%
Radin	155.17%
Robinson	148.00%
CCMT	138.00%
Macan Deve	130.00%

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

FIRM: AECOM

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 138%	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	1,686	$ 148,338	$ 204,707	$ 353,046	0%	$ 13,239	$ 366,285
2	Engineering	6,035	$ 431,039	$ 594,833	$ 1,025,872	0%	$ 38,470	$ 1,064,342
3	Cost Estimating	360	$ 30,453	$ 42,025	$ 72,478	0%	$ 2,718	$ 75,196
4	Federal Environmental Impact Statement	-	$ -	$ -	$ -	0%	$ -	$ -
5	State, Federal Permits and Mitigation	-	$ -	$ -	$ -	0%	$ -	$ -
6	Site Remediation	-	$ -	$ -	$ -	0%	$ -	$ -
7	Risk Management	608	$ 49,684	$ 68,564	$ 118,247	0%	$ 4,434	$ 122,682
8	System Safety and Security Management	308	$ 23,159	$ 31,959	$ 55,117	0%	$ 2,067	$ 57,184
9	Public Involvement and Agency Coordination	240	$ 24,622	$ 33,979	$ 58,601	0%	$ 2,198	$ 60,799
10	Integration and Interface	-	$ -	$ -	$ -	0%	$ -	$ -
11	Constructability Reviews	622	$ 50,013	$ 69,018	$ 119,031	0%	$ 4,464	$ 123,495
12	Contract Packaging	77	$ 4,607	$ 6,358	$ 10,964	0%	$ 411	$ 11,376
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	291	$ 20,283	$ 27,990	$ 48,273	0%	$ 1,810	$ 50,083
14	Analysis of Ancillary Services Market Revenue opportunities	-	$ -	$ -	$ -	0%	$ -	$ -
15	As Directed by NJ TRANSIT	40	$ 3,200	$ 4,416	$ 7,616	0%	$ 286	$ 7,902
	FIRM TOTALS	10,267	$ 785,398	$ 1,083,849	$ 1,869,246		$ 70,097	$ 1,939,343

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

FIRM: PB

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 154%	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	150	$ 15,198	$ 23,437	$ 38,635	0%	$ 1,449	$ 40,084
2	Engineering	350	$ 37,324	$ 57,557	$ 94,880	0%	$ 3,558	$ 98,438
3	Cost Estimating	-	$ -	$ -	$ -	0%	$ -	$ -
4	Federal Environmental Impact Statement	-	$ -	$ -	$ -	0%	$ -	$ -
5	State, Federal Permits and Mitigation	-	$ -	$ -	$ -	0%	$ -	$ -
6	Site Remediation	-	$ -	$ -	$ -	0%	$ -	$ -
7	Risk Management	-	$ -	$ -	$ -	0%	$ -	$ -
8	System Safety and Security Management	-	$ -	$ -	$ -	0%	$ -	$ -
9	Public Involvement and Agency Coordination	-	$ -	$ -	$ -	0%	$ -	$ -
10	Integration and Interface	300	$ 34,119	$ 52,615	$ 86,734	0%	$ 3,253	$ 89,986
11	Constructability Reviews	-	$ -	$ -	$ -	0%	$ -	$ -
12	Contract Packaging	-	$ -	$ -	$ -	0%	$ -	$ -
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	78	$ -	$ -	$ -	0%	$ -	$ -
14	Analysis of Ancilliary Services Market Revenue opporunities	-	$ -	$ -	$ -	0%	$ -	$ -
15	As Directed by NJ TRANSIT	-	$ -	$ -	$ -	0%	$ -	$ -
	FIRM TOTALS	878	$ 86,641	$ 133,608	$ 220,249		$ 8,259	$ 228,508

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

FIRM: IPERC

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 105%	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	-	$ -	$ -	$ -	0%	$ -	$ -
2	Engineering	429	$ 44,346	$ 46,825	$ 91,171	0%	$ 3,419	$ 94,590
3	Cost Estimating	-	$ -	$ -	$ -	0%	$ -	$ -
4	Federal Environmental Impact Statement	-	$ -	$ -	$ -	0%	$ -	$ -
5	State, Federal Permits and Mitigation	-	$ -	$ -	$ -	0%	$ -	$ -
6	Site Remediation	-	$ -	$ -	$ -	0%	$ -	$ -
7	Risk Management	118	$ 12,726	$ 13,437	$ 26,163	0%	$ 981	$ 27,144
8	System Safety and Security Management	-	$ -	$ -	$ -	0%	$ -	$ -
9	Public Involvement and Agency Coordination	-	$ -	$ -	$ -	0%	$ -	$ -
10	Integration and Interface	-	$ -	$ -	$ -	0%	$ -	$ -
11	Constructability Reviews	-	$ -	$ -	$ -	0%	$ -	$ -
12	Contract Packaging	-	$ -	$ -	$ -	0%	$ -	$ -
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	-	$ -	$ -	$ -	0%	$ -	$ -
14	Analysis of Ancilliary Services Market Revenue opporunities	-	$ -	$ -	$ -	0%	$ -	$ -
15	As Directed by NJ TRANSIT	-	$ -	$ -	$ -	0%	$ -	$ -
	FIRM TOTALS	547	$ 57,072	$ 60,262	$ 117,334		$ 4,400	$ 121,734

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

FIRM: Navigant

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 125%	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	-	$ -	$ -	$ -	0%	$ -	$ -
2	Engineering	835	$ 62,622	$ 78,628	$ 141,250	0%	$ 5,297	$ 146,547
3	Cost Estimating	-	$ -	$ -	$ -	0%	$ -	$ -
4	Federal Environmental Impact Statement	-	$ -	$ -	$ -	0%	$ -	$ -
5	State, Federal Permits and Mitigation	-	$ -	$ -	$ -	0%	$ -	$ -
6	Site Remediation	-	$ -	$ -	$ -	0%	$ -	$ -
7	Risk Management	-	$ -	$ -	$ -	0%	$ -	$ -
8	System Safety and Security Management	160	$ 12,077	$ 15,164	$ 27,240	0%	$ 1,022	$ 28,262
9	Public Involvement and Agency Coordination	-	$ -	$ -	$ -	0%	$ -	$ -
10	Integration and Interface	-	$ -	$ -	$ -	0%	$ -	$ -
11	Constructability Reviews	-	$ -	$ -	$ -	0%	$ -	$ -
12	Contract Packaging	-	$ -	$ -	$ -	0%	$ -	$ -
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	-	$ -	$ -	$ -	0%	$ -	$ -
14	Analysis of Ancillary Services Market Revenue opporunities	148	$ 11,217	$ 14,084	$ 25,302	0%	$ 949	$ 26,250
15	As Directed by NJ TRANSIT	-	$ -	$ -	$ -	0%	$ -	$ -
	FIRM TOTALS	1,143	$ 85,916	$ 107,876	$ 193,792		$ 7,267	$ 201,059

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

FIRM: Green by Design

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 155%	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	-	$ -	$ -	$ -	0%	$ -	$ -
2	Engineering	-	$ -	$ -	$ -	0%	$ -	$ -
3	Cost Estimating	-	$ -	$ -	$ -	0%	$ -	$ -
4	Federal Environmental Impact Statement	-	$ -	$ -	$ -	0%	$ -	$ -
5	State, Federal Permits and Mitigation	40	$ 2,983	$ 4,624	$ 7,608	0%	$ 285	$ 7,893
6	Site Remediation	-	$ -	$ -	$ -	0%	$ -	$ -
7	Risk Management	-	$ -	$ -	$ -	0%	$ -	$ -
8	System Safety and Security Management	-	$ -	$ -	$ -	0%	$ -	$ -
9	Public Involvement and Agency Coordination	40	$ 2,983	$ 4,624	$ 7,608	0%	$ 285	$ 7,893
10	Integration and Interface	-	$ -	$ -	$ -	0%	$ -	$ -
11	Constructability Reviews	-	$ -	$ -	$ -	0%	$ -	$ -
12	Contract Packaging	-	$ -	$ -	$ -	0%	$ -	$ -
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	-	$ -	$ -	$ -	0%	$ -	$ -
14	Analysis of Ancilliary Services Market Revenue opporunities	-	$ -	$ -	$ -	0%	$ -	$ -
15	As Directed by NJ TRANSIT	-	$ -	$ -	$ -	0%	$ -	$ -
	FIRM TOTALS	80	$ 5,967	$ 9,248	$ 15,215		$ 571	$ 15,786

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

FIRM: JCMS

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 116%	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	-	$ -	$ -	$ -	0%	$ -	$ -
2	Engineering	-	$ -	$ -	$ -	0%	$ -	$ -
3	Cost Estimating	811	$ 51,644	$ 60,073	$ 111,717	0%	$ 4,189	$ 115,907
4	Federal Environmental Impact Statement	-	$ -	$ -	$ -	0%	$ -	$ -
5	State, Federal Permits and Mitigation	-	$ -	$ -	$ -	0%	$ -	$ -
6	Site Remediation	-	$ -	$ -	$ -	0%	$ -	$ -
7	Risk Management	-	$ -	$ -	$ -	0%	$ -	$ -
8	System Safety and Security Management	-	$ -	$ -	$ -	0%	$ -	$ -
9	Public Involvement and Agency Coordination	-	$ -	$ -	$ -	0%	$ -	$ -
10	Integration and Interface	-	$ -	$ -	$ -	0%	$ -	$ -
11	Constructability Reviews	-	$ -	$ -	$ -	0%	$ -	$ -
12	Contract Packaging	-	$ -	$ -	$ -	0%	$ -	$ -
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	-	$ -	$ -	$ -	0%	$ -	$ -
14	Analysis of Ancilliary Services Market Revenue opporunities	-	$ -	$ -	$ -	0%	$ -	$ -
15	As Directed by NJ TRANSIT	-	$ -	$ -	$ -	0%	$ -	$ -
	FIRM TOTALS	811	$ 51,644	$ 60,073	$ 111,717		$ 4,189	$ 115,907

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

FIRM: AG Consulting

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 137%	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	-	$ -	$ -	$ -	0%	$ -	$ -
2	Engineering	681	$ 23,839	$ 32,659	$ 56,498	0%	$ 2,119	$ 58,617
3	Cost Estimating	-	$ -	$ -	$ -	0%	$ -	$ -
4	Federal Environmental Impact Statement	-	$ -	$ -	$ -	0%	$ -	$ -
5	State, Federal Permits and Mitigation	-	$ -	$ -	$ -	0%	$ -	$ -
6	Site Remediation	-	$ -	$ -	$ -	0%	$ -	$ -
7	Risk Management	-	$ -	$ -	$ -	0%	$ -	$ -
8	System Safety and Security Management	-	$ -	$ -	$ -	0%	$ -	$ -
9	Public Involvement and Agency Coordination	-	$ -	$ -	$ -	0%	$ -	$ -
10	Integration and Interface	-	$ -	$ -	$ -	0%	$ -	$ -
11	Constructability Reviews	-	$ -	$ -	$ -	0%	$ -	$ -
12	Contract Packaging	-	$ -	$ -	$ -	0%	$ -	$ -
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	-	$ -	$ -	$ -	0%	$ -	$ -
14	Analysis of Ancilliary Services Market Revenue opporunities	-	$ -	$ -	$ -	0%	$ -	$ -
15	As Directed by NJ TRANSIT	-	$ -	$ -	$ -	0%	$ -	$ -
	FIRM TOTALS	681	$ 23,839	$ 32,659	$ 56,498		$ 2,119	$ 58,617

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

FIRM: GTS

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 124%	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	-	$ -	$ -	$ -	0%	$ -	$ -
2	Engineering	1,500	$ 62,600	$ 77,693	$ 140,293	0%	$ 5,261	$ 145,554
3	Cost Estimating	-	$ -	$ -	$ -	0%	$ -	$ -
4	Federal Environmental Impact Statement	-	$ -	$ -	$ -	0%	$ -	$ -
5	State, Federal Permits and Mitigation	-	$ -	$ -	$ -	0%	$ -	$ -
6	Site Remediation	-	$ -	$ -	$ -	0%	$ -	$ -
7	Risk Management	-	$ -	$ -	$ -	0%	$ -	$ -
8	System Safety and Security Management	-	$ -	$ -	$ -	0%	$ -	$ -
9	Public Involvement and Agency Coordination	-	$ -	$ -	$ -	0%	$ -	$ -
10	Integration and Interface	-	$ -	$ -	$ -	0%	$ -	$ -
11	Constructability Reviews	-	$ -	$ -	$ -	0%	$ -	$ -
12	Contract Packaging	-	$ -	$ -	$ -	0%	$ -	$ -
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	-	$ -	$ -	$ -	0%	$ -	$ -
14	Analysis of Ancilliary Services Market Revenue opporunities	-	$ -	$ -	$ -	0%	$ -	$ -
15	As Directed by NJ TRANSIT	-	$ -	$ -	$ -	0%	$ -	$ -
	FIRM TOTALS	1,500	$ 62,600	$ 77,693	$ 140,293		$ 5,261	$ 145,554

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

FIRM: Radin

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 155%	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	-	$ -	$ -	$ -	0%	$ -	$ -
2	Engineering	-	$ -	$ -	$ -	0%	$ -	$ -
3	Cost Estimating	-	$ -	$ -	$ -	0%	$ -	$ -
4	Federal Environmental Impact Statement	300	$ 23,700	$ 36,775	$ 60,475	0%	$ 2,268	$ 62,743
5	State, Federal Permits and Mitigation	200	$ 14,760	$ 22,903	$ 37,663	0%	$ 1,412	$ 39,075
6	Site Remediation	280	$ 21,080	$ 32,710	$ 53,790	0%	$ 2,017	$ 55,807
7	Risk Management	-	$ -	$ -	$ -	0%	$ -	$ -
8	System Safety and Security Management	-	$ -	$ -	$ -	0%	$ -	$ -
9	Public Involvement and Agency Coordination	-	$ -	$ -	$ -	0%	$ -	$ -
10	Integration and Interface	-	$ -	$ -	$ -	0%	$ -	$ -
11	Constructability Reviews	-	$ -	$ -	$ -	0%	$ -	$ -
12	Contract Packaging	-	$ -	$ -	$ -	0%	$ -	$ -
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	-	$ -	$ -	$ -	0%	$ -	$ -
14	Analysis of Ancilliary Services Market Revenue opporunities	-	$ -	$ -	$ -	0%	$ -	$ -
15	As Directed by NJ TRANSIT	-	$ -	$ -	$ -	0%	$ -	$ -
	FIRM TOTALS	780	$ 59,540	$ 92,388	$ 151,928		$ 5,697	$ 157,626

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

FIRM: Robinson

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 148%	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	-	$ -	$ -	$ -	0%	$ -	$ -
2	Engineering	600	$ 36,300	$ 53,724	$ 90,024	0%	$ 3,376	$ 93,400
3	Cost Estimating	-	$ -	$ -	$ -	0%	$ -	$ -
4	Federal Environmental Impact Statement	-	$ -	$ -	$ -	0%	$ -	$ -
5	State, Federal Permits and Mitigation	-	$ -	$ -	$ -	0%	$ -	$ -
6	Site Remediation	-	$ -	$ -	$ -	0%	$ -	$ -
7	Risk Management	-	$ -	$ -	$ -	0%	$ -	$ -
8	System Safety and Security Management	-	$ -	$ -	$ -	0%	$ -	$ -
9	Public Involvement and Agency Coordination	-	$ -	$ -	$ -	0%	$ -	$ -
10	Integration and Interface	-	$ -	$ -	$ -	0%	$ -	$ -
11	Constructability Reviews	-	$ -	$ -	$ -	0%	$ -	$ -
12	Contract Packaging	-	$ -	$ -	$ -	0%	$ -	$ -
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	-	$ -	$ -	$ -	0%	$ -	$ -
14	Analysis of Ancilliary Services Market Revenue opporunities	-	$ -	$ -	$ -	0%	$ -	$ -
15	As Directed by NJ TRANSIT	-	$ -	$ -	$ -	0%	$ -	$ -
	FIRM TOTALS	600	$ 36,300	$ 53,724	$ 90,024		$ 3,376	$ 93,400

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

FIRM: CCMT

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 138%	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	-	$ -	$ -	$ -	0%	$ -	$ -
2	Engineering	1,452	$ 111,568	$ 153,964	$ 265,531	0%	$ 9,957	$ 275,489
3	Cost Estimating	-	$ -	$ -	$ -	0%	$ -	$ -
4	Federal Environmental Impact Statement	-	$ -	$ -	$ -	0%	$ -	$ -
5	State, Federal Permits and Mitigation	-	$ -	$ -	$ -	0%	$ -	$ -
6	Site Remediation	-	$ -	$ -	$ -	0%	$ -	$ -
7	Risk Management	-	$ -	$ -	$ -	0%	$ -	$ -
8	System Safety and Security Management	-	$ -	$ -	$ -	0%	$ -	$ -
9	Public Involvement and Agency Coordination	-	$ -	$ -	$ -	0%	$ -	$ -
10	Integration and Interface	340	$ 28,253	$ 38,989	$ 67,242	0%	$ 2,522	$ 69,764
11	Constructability Reviews	-	$ -	$ -	$ -	0%	$ -	$ -
12	Contract Packaging	-	$ -	$ -	$ -	0%	$ -	$ -
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	-	$ -	$ -	$ -	0%	$ -	$ -
14	Analysis of Ancilliary Services Market Revenue opporunities	-	$ -	$ -	$ -	0%	$ -	$ -
15	As Directed by NJ TRANSIT	-	$ -	$ -	$ -	0%	$ -	$ -
	FIRM TOTALS	1,792	$ 139,821	$ 192,953	$ 332,773		$ 12,479	$ 345,252

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-2
COST AND FEE TASKS RECAP - TEAM SUMMARY

FIRM: Macan Deve

TASK	DESCRIPTION	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 130%	SUBTOTAL	FIXED FEE @ 0%	DIRECT EXPENSES	TOTAL COST
1	Project Management	1,600	$ 56,000	$ 72,800	$ 128,800	0%	$ 4,830	$ 133,630
2	Engineering	-	$ -	$ -	$ -	0%	$ -	$ -
3	Cost Estimating	-	$ -	$ -	$ -	0%	$ -	$ -
4	Federal Environmental Impact Statement	-	$ -	$ -	$ -	0%	$ -	$ -
5	State, Federal Permits and Mitigation	-	$ -	$ -	$ -	0%	$ -	$ -
6	Site Remediation	-	$ -	$ -	$ -	0%	$ -	$ -
7	Risk Management	-	$ -	$ -	$ -	0%	$ -	$ -
8	System Safety and Security Management	-	$ -	$ -	$ -	0%	$ -	$ -
9	Public Involvement and Agency Coordination	-	$ -	$ -	$ -	0%	$ -	$ -
10	Integration and Interface	-	$ -	$ -	$ -	0%	$ -	$ -
11	Constructability Reviews	-	$ -	$ -	$ -	0%	$ -	$ -
12	Contract Packaging	-	$ -	$ -	$ -	0%	$ -	$ -
13	Preparation and Subsequent Support of Contract Bid Documents and Bidding Process	-	$ -	$ -	$ -	0%	$ -	$ -
14	Analysis of Ancilliary Services Market Revenue opporunities	-	$ -	$ -	$ -	0%	$ -	$ -
15	As Directed by NJ TRANSIT	-	$ -	$ -	$ -	0%	$ -	$ -
	FIRM TOTALS	1,600	$ 56,000	$ 72,800	$ 128,800		$ 4,830	$ 133,630

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-4
PERSONNEL TEAM DETAIL

TASK: SEE BELOW

FIRM: AECOM

TECHNICAL STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
1	Ayokunle Kafi, PE	Project Manager	740	$ 113.89	$ 84,278.60
1	Edward Hrinewski	Deputy Project Manager	420	$ 80.00	$ 33,600.00
1	Peter Gregory, CSP	Quality / Safety Manager	80	$ 61.81	$ 4,944.80
1	Eduardo Gamez, PhD	Senior Engineer	77	$ 67.46	$ 5,194.42
1	Tunc Gundogdu	Senior Engineer	369	$ 55.00	$ 20,320.63
2	Ayokunle Kafi, PE	Project Manager	600	$ 113.89	$ 68,334.00
2	Edward Hrinewski	Deputy Project Manager	800	$ 80.00	$ 64,000.00
2	Frank Russo	Senior Engineer	39	$ 85.00	$ 3,315.00
2	Richard Falcon	Senior Engineer	39	$ 90.00	$ 3,510.00
2	Kenny Pimenta, PE	Senior Engineer	40	$ 60.10	$ 2,404.00
2	Andrew Agopian	Senior Engineer	320	$ 75.43	$ 24,137.60
2	Samuel Monger	Engineer	840	$ 31.29	$ 26,283.60
2	James Buchok	Senior Consultant	800	$ 96.44	$ 77,152.00
2	Damee Choi, PE	Senior Engineer	1,300	$ 52.98	$ 68,874.00
2	Ed Gurtatowski, PE	Senior Engineer	200	$ 74.05	$ 14,810.00
2	Joel Fisch, PE	Senior Engineer	811	$ 80.14	$ 64,993.54
2	April Thomann, PE	Senior Engineer	246	$ 53.76	$ 13,224.96
3	Ayokunle Kafi, PE	Project Manager	60	$ 113.89	$ 6,833.40
3	Edward Hrinewski	Deputy Project Manager	120	$ 80.00	$ 9,600.00
3	Tunc Gundogdu	Senior Engineer	60	$ 55.00	$ 3,300.00
3	Jay Bayersdorfer, PE	Cost Estimator	120	$ 89.33	$ 10,719.60
7	Ayokunle Kafi, PE	Project Manager	100	$ 113.89	$ 11,389.00
7	Edward Hrinewski	Deputy Project Manager	188	$ 80.00	$ 15,040.00
7	Peter Totten, PE	Quality / Safety Manager	40	$ 109.15	$ 4,366.00
7	Eduardo Gamez, PhD	Senior Engineer	280	$ 67.46	$ 18,888.80
8	Carlos Campillo	Senior Engineer	308	$ 75.19	$ 23,158.52
9	Ayokunle Kafi, PE	Project Manager	160	$ 113.89	$ 18,222.40
9	Edward Hrinewski	Deputy Project Manager	80	$ 80.00	$ 6,400.00
11	Frank Russo	Senior Engineer	39	$ 85.00	$ 3,315.00
11	Richard Falcon	Senior Engineer	39	$ 90.00	$ 3,510.00
11	Andrew Agopian	Senior Engineer	40	$ 75.43	$ 3,017.20
11	James Buchok	Senior Consultant	116	$ 96.44	$ 11,187.04
11	Joel Fisch, PE	Senior Engineer	308	$ 80.14	$ 24,683.12
11	April Thomann, PE	Senior Engineer	80	$ 53.76	$ 4,300.80
12	Riad Habib	Procurement Specialist	77	$ 59.83	$ 4,606.91
13	Riad Habib	Procurement Specialist	231	$ 59.83	$ 13,820.73
13	Robert Brownstein	Project Specialist	60	$ 107.70	$ 6,462.00
15	Edward Hrinewski	Deputy Project Manager	40	$ 80.00	$ 3,200.00
TOTAL ESTIMATED HOURS			10,267		

SUPPORT STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
TOTAL ESTIMATED HOURS			-		

TOTAL SALARY (BARE COST)		$ 785,397.67
OVERHEAD @ 138% OF BARE COST		$ 1,083,848.78
SUBTOTAL - SALARY + OVERHEAD		$ 1,869,246.45
FIXED FEE @ 0% OF BARE COST + OVERHEAD		$ -
DIRECT EXPENSES ITEMIZED		
Currently estimated at 3.75% of Bare Cost + Overhead	$ 70,096.74	
TOTAL DIRECT EXPENSES	$ 70,096.74	
TOTAL		$ 1,939,343.20

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-4
PERSONNEL TEAM DETAIL

TASK: SEE BELOW

FIRM: PB

TECHNICAL STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
1	Roger Lemos	Principal Engineer (PB)	150	$ 101.32	$ 15,198.00
2	Bob Fisher	Senior Consultant (PB)	150	$ 113.73	$ 17,059.50
2	Roger Lemos	Principal Engineer (PB)	200	$ 101.32	$ 20,264.00
10	Bob Fisher	Senior Consultant (PB)	300	$ 113.73	$ 34,119.00
TOTAL ESTIMATED HOURS			800		

SUPPORT STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
TOTAL ESTIMATED HOURS			-		

TOTAL SALARY (BARE COST)		$ 86,640.50
OVERHEAD @ 154% OF BARE COST		$ 133,608.32
SUBTOTAL - SALARY + OVERHEAD		$ 220,248.82
FIXED FEE @ 0% OF BARE COST + OVERHEAD		$ -
DIRECT EXPENSES ITEMIZED		
Currently estimated at 3.75% of Bare Cost + Overhead	$ 8,259.33	
TOTAL DIRECT EXPENSES	$ 8,259.33	
TOTAL		$ 228,508.15

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-4
PERSONNEL TEAM DETAIL

TASK: SEE BELOW

FIRM: IPERC

TECHNICAL STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
2	Darrell Massie, PhD, PE	Senior Consultant (IPERC)	120	$ 156.09	$ 18,731.01
2	Aura Lee Keating	Design Team Leader (IPERC)	116	$ 49.08	$ 5,693.59
2	Peter Curtiss, PhD, PE	Principal Engineer 1 (IPERC)	116	$ 117.13	$ 13,586.65
2	Scott Roberts	Principal Engineer 2 (IPERC)	77	$ 82.27	$ 6,334.70
7	Darrell Massie, PhD, PE	Senior Consultant (IPERC)	40	$ 156.09	$ 6,243.67
7	Aura Lee Keating	Design Team Leader (IPERC)	39	$ 49.08	$ 1,914.22
7	Peter Curtiss, PhD, PE	Principal Engineer 1 (IPERC)	39	$ 117.13	$ 4,567.93
TOTAL ESTIMATED HOURS			547		

SUPPORT STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
TOTAL ESTIMATED HOURS			-		

TOTAL SALARY (BARE COST)		$ 57,071.78
OVERHEAD @ 105% OF BARE COST		$ 60,262.09
SUBTOTAL - SALARY + OVERHEAD		$ 117,333.86
FIXED FEE @ 0% OF BARE COST + OVERHEAD		$ -
DIRECT EXPENSES ITEMIZED		
Currently estimated at 3.75% of Bare Cost + Overhead	$ 4,400.02	
TOTAL DIRECT EXPENSES	$ 4,400.02	
TOTAL		$ 121,733.88

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-4
PERSONNEL TEAM DETAIL

TASK: SEE BELOW

FIRM: Navigant

TECHNICAL STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
2	Timothy McClive	Senior Consultant - (Navigant)	120	$ 71.63	$ 8,595.60
2	Edward Dobrowolski	Design/Planning Team Leader (Sr -	75	$ 105.00	$ 7,875.00
2	Robert Zogg	Senior Consultant - (Navigant)	600	$ 71.63	$ 42,978.00
2	Colette Lamontagne	Principal Engineer (Navigant)	40	$ 79.33	$ 3,173.20
8	Timothy McClive	Senior Consultant - (Navigant)	80	$ 71.63	$ 5,730.40
8	Matthew Blizard, PE	Principal Engineer (Navigant)	80	$ 79.33	$ 6,346.40
14	Timothy McClive	Senior Consultant - (Navigant)	68	$ 71.63	$ 4,870.84
14	Matthew Blizard, PE	Principal Engineer (Navigant)	80	$ 79.33	$ 6,346.40
TOTAL ESTIMATED HOURS			1,143		

SUPPORT STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
TOTAL ESTIMATED HOURS			-		

TOTAL SALARY (BARE COST)		$ 85,915.84
OVERHEAD @ 125% OF BARE COST		$ 107,875.93
SUBTOTAL - SALARY + OVERHEAD		$ 193,791.77
FIXED FEE @ 0% OF BARE COST + OVERHEAD		$ -
DIRECT EXPENSES ITEMIZED		
Currently estimated at 3.75% of Bare Cost + Overhead	$ 7,267.19	
TOTAL DIRECT EXPENSES	$ 7,267.19	
TOTAL		$ 201,058.96

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-4
PERSONNEL TEAM DETAIL

TASK: SEE BELOW

FIRM: Green by Design

TECHNICAL STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
5	Adam Zellner	Senior Consultant (GbD)	40	$ 74.58	$ 2,983.38
9	Adam Zellner	Senior Consultant (GbD)	40	$ 74.58	$ 2,983.38
TOTAL ESTIMATED HOURS			80		

SUPPORT STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
TOTAL ESTIMATED HOURS			-		

TOTAL SALARY (BARE COST)		$ 5,966.76
OVERHEAD @ 155% OF BARE COST		$ 9,248.48
SUBTOTAL - SALARY + OVERHEAD		$ 15,215.23
FIXED FEE @ 0% OF BARE COST + OVERHEAD		$ -
DIRECT EXPENSES ITEMIZED		
Currently estimated at 3.75% of Bare Cost + Overhead	$ 570.57	
TOTAL DIRECT EXPENSES	$ 570.57	
TOTAL		$ 15,785.81

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-4
PERSONNEL TEAM DETAIL

TASK: SEE BELOW

FIRM: JCMS

TECHNICAL STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
3	Kevin Meehan	Cost Estimator (JCMS)	811	$ 63.68	$ 51,644.48
TOTAL ESTIMATED HOURS			811		

SUPPORT STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
TOTAL ESTIMATED HOURS			-		

TOTAL SALARY (BARE COST)		$ 51,644.48
OVERHEAD @ 116% OF BARE COST		$ 60,072.86
SUBTOTAL - SALARY + OVERHEAD		$ 111,717.34
FIXED FEE @ 0% OF BARE COST + OVERHEAD		$ -
DIRECT EXPENSES ITEMIZED		
Currently estimated at 3.75% of Bare Cost + Overhead	$ 4,189.40	
TOTAL DIRECT EXPENSES	$ 4,189.40	
TOTAL		$ 115,906.74

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-4
PERSONNEL TEAM DETAIL

TASK: SEE BELOW

FIRM: AG Consulting

TECHNICAL STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
2	Gerardo Aguilera	Engineer (AG-M/WBE)	489	$ 35.00	$ 17,118.78
2	Ajmal Khan, PE	Engineer (AG-M/WBE)	192	$ 35.00	$ 6,720.00
TOTAL ESTIMATED HOURS			681		

SUPPORT STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
TOTAL ESTIMATED HOURS			-		

TOTAL SALARY (BARE COST)		$ 23,838.78
OVERHEAD @ 137% OF BARE COST		$ 32,659.13
SUBTOTAL - SALARY + OVERHEAD		$ 56,497.91
FIXED FEE @ 0% OF BARE COST + OVERHEAD		$ -
DIRECT EXPENSES ITEMIZED		
Currently estimated at 3.75% of Bare Cost + Overhead	$ 2,118.67	
TOTAL DIRECT EXPENSES	$ 2,118.67	
TOTAL		$ 58,616.58

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-4
PERSONNEL TEAM DETAIL

TASK: SEE BELOW

FIRM: GTS

TECHNICAL STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
2	Fredrick Voss, PE, PLS	Principal Engineer (GTS)	1,500	$ 41.73	$ 62,600.25
TOTAL ESTIMATED HOURS			1,500		

SUPPORT STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
TOTAL ESTIMATED HOURS			-		

TOTAL SALARY (BARE COST)		$ 62,600.25
OVERHEAD @ 124% OF BARE COST		$ 77,693.17
SUBTOTAL - SALARY + OVERHEAD		$ 140,293.42
FIXED FEE @ 0% OF BARE COST + OVERHEAD		$ -
DIRECT EXPENSES ITEMIZED		
Currently estimated at 3.75% of Bare Cost + Overhead	$ 5,261.00	
TOTAL DIRECT EXPENSES	$ 5,261.00	
TOTAL		$ 145,554.42

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-4
PERSONNEL TEAM DETAIL

TASK: SEE BELOW

FIRM: Radin

TECHNICAL STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
4	Chitra Radin	Lead Environ Design/Planning (Rad	150	$ 105.00	$ 15,750.00
4	Jane Darcy	Environ Design/Planning (Radin - N	150	$ 53.00	$ 7,950.00
5	Chitra Radin	Lead Environ Design/Planning (Rad	80	$ 105.00	$ 8,400.00
5	Jane Darcy	Environ Design/Planning (Radin - N	120	$ 53.00	$ 6,360.00
6	Chitra Radin	Lead Environ Design/Planning (Rad	120	$ 105.00	$ 12,600.00
6	Jane Darcy	Environ Design/Planning (Radin - N	160	$ 53.00	$ 8,480.00
TOTAL ESTIMATED HOURS			780		

SUPPORT STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
TOTAL ESTIMATED HOURS			-		

TOTAL SALARY (BARE COST)		$ 59,540.00
OVERHEAD @ 155% OF BARE COST		$ 92,388.22
SUBTOTAL - SALARY + OVERHEAD		$ 151,928.22
FIXED FEE @ 0% OF BARE COST + OVERHEAD		$ -
DIRECT EXPENSES ITEMIZED		
Currently estimated at 3.75% of Bare Cost + Overhead	$ 5,697.31	
TOTAL DIRECT EXPENSES	$ 5,697.31	
TOTAL		$ 157,625.53

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-4
PERSONNEL TEAM DETAIL

TASK: SEE BELOW

FIRM: Robinson

TECHNICAL STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
2	Adam Decker, CP	Lead Surveyor (RAS - M/WBE)	600	$ 60.50	$ 36,300.00
TOTAL ESTIMATED HOURS			600		

SUPPORT STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
TOTAL ESTIMATED HOURS			-		

TOTAL SALARY (BARE COST)		$ 36,300.00
OVERHEAD @ 148% OF BARE COST		$ 53,724.00
SUBTOTAL - SALARY + OVERHEAD		$ 90,024.00
FIXED FEE @ 0% OF BARE COST + OVERHEAD		$ -
DIRECT EXPENSES ITEMIZED		
Currently estimated at 3.75% of Bare Cost + Overhead	$ 3,375.90	
TOTAL DIRECT EXPENSES	$ 3,375.90	
TOTAL		$ 93,399.90

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-4
PERSONNEL TEAM DETAIL

TASK: SEE BELOW

FIRM: CCMT

TECHNICAL STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
2	Lyle Rawlings	Project Specialist (CCMT)	692	$ 84.50	$ 58,473.89
2	James Sherman, Esq.	Supervising Engineer (CCMT)	360	$ 66.84	$ 24,064.17
2	Steve Knapp	Senior Consultant (Power Analytics	400	$ 72.57	$ 29,029.79
10	Lyle Rawlings	Project Specialist (CCMT)	300	$ 84.50	$ 25,349.95
10	Steve Knapp	Senior Consultant (Power Analytics	40	$ 72.57	$ 2,902.98
TOTAL ESTIMATED HOURS			1,792		

SUPPORT STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
TOTAL ESTIMATED HOURS			-		

TOTAL SALARY (BARE COST)		$ 139,820.78
OVERHEAD @ 138% OF BARE COST		$ 192,952.68
SUBTOTAL - SALARY + OVERHEAD		$ 332,773.46
FIXED FEE @ 0% OF BARE COST + OVERHEAD		$ -
DIRECT EXPENSES ITEMIZED		
Currently estimated at 3.75% of Bare Cost + Overhead	$ 12,479.00	
TOTAL DIRECT EXPENSES	$ 12,479.00	
TOTAL		$ 345,252.46

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-4
PERSONNEL TEAM DETAIL

TASK: SEE BELOW

FIRM: Macan Deve

TECHNICAL STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
TOTAL ESTIMATED HOURS			-		

SUPPORT STAFF					
TASK	STAFF PERSON/ CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	ESTIMATED HOURS	HOURLY RATE	TOTAL SALARY
1	Katie Donahue	Document Control	1,600	$ 35.00	$ 56,000.00
TOTAL ESTIMATED HOURS			1,600		

TOTAL SALARY (BARE COST)		$ 56,000.00
OVERHEAD @ 130% OF BARE COST		$ 72,800.00
SUBTOTAL - SALARY + OVERHEAD		$ 128,800.00
FIXED FEE @ 0% OF BARE COST + OVERHEAD		$ -
DIRECT EXPENSES ITEMIZED		
Currently estimated at 3.75% of Bare Cost + Overhead	$ 4,830.00	
TOTAL DIRECT EXPENSES	$ 4,830.00	
TOTAL		$ 133,630.00

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-5
STAFFING SCHEDULE BY FIRM

FIRM: AECOM

STAFF PERSON OR CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	HOURLY RATE	TASK 1 HRS	TASK 2 HRS	TASK 3 HRS	TASK 4 HRS	TASK 5 HRS	TASK 6 HRS	TASK 7 HRS	TASK 8 HRS	TASK 9 HRS	TASK 10 HRS	TASK 11 HRS	TASK 12 HRS	TASK 13 HRS	TASK 14 HRS	TASK 15 HRS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 138 %	TOTAL LABOR COST
Ayokunle Kafi, PE	Project Manager	$ 113.89	740	600	60	0	0	0	100	0	160	0	0	0	0	0	0	$ 189,057.40	$ 260,899.21	$ 449,956.61
Edward Hrinewski	Deputy Project Manager	$ 80.00	420	800	120	0	0	0	188	0	80	0	0	0	0	0	40	$ 131,840.00	$ 181,939.20	$ 313,779.20
Peter Totten, PE	Quality / Safety Manager	$ 109.15	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	$ 4,366.00	$ 6,025.08	$ 10,391.08
Peter Gregory, CSP	Quality / Safety Manager	$ 61.81	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 4,944.80	$ 6,823.82	$ 11,768.62
Frank Russo	Senior Engineer	$ 85.00	0	39	0	0	0	0	0	0	0	0	39	0	0	0	0	$ 6,630.00	$ 9,149.40	$ 15,779.40
Richard Falcon	Senior Engineer	$ 90.00	0	39	0	0	0	0	0	0	0	0	39	0	0	0	0	$ 7,020.00	$ 9,687.60	$ 16,707.60
Carlos Campillo	Senior Engineer	$ 75.19	0	0	0	0	0	0	0	308	0	0	0	0	0	0	0	$ 23,158.52	$ 31,958.76	$ 55,117.28
Riad Habib	Procurement Specialist	$ 59.83	0	0	0	0	0	0	0	0	0	0	0	77	231	0	0	$ 18,427.64	$ 25,430.14	$ 43,857.78
Eduardo Gamez, PhD	Senior Engineer	$ 67.46	77	0	0	0	0	0	280	0	0	0	0	0	0	0	0	$ 24,083.22	$ 33,234.84	$ 57,318.06
Robert Brownstein	Project Specialist	$ 107.70	0	0	0	0	0	0	0	0	0	0	0	0	60	0	0	$ 6,462.00	$ 8,917.56	$ 15,379.56
Kenny Pimenta, PE	Senior Engineer	$ 60.10	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 2,404.00	$ 3,317.52	$ 5,721.52
Andrew Agopian	Senior Engineer	$ 75.43	0	320	0	0	0	0	0	0	0	0	40	0	0	0	0	$ 27,154.80	$ 37,473.62	$ 64,628.42
Samuel Monger	Engineer	$ 31.29	0	840	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 26,283.60	$ 36,271.37	$ 62,554.97
James Buchok	Senior Consultant	$ 96.44	0	800	0	0	0	0	0	0	0	0	116	0	0	0	0	$ 88,339.04	$ 121,907.88	$ 210,246.92
Damee Choi, PE	Senior Engineer	$ 52.98	0	1300	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 68,874.00	$ 95,046.12	$ 163,920.12
Ed Gurtatowski, PE	Senior Engineer	$ 74.05	0	200	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 14,810.00	$ 20,437.80	$ 35,247.80
Tunc Gundogdu	Senior Engineer	$ 55.00	369	0	60	0	0	0	0	0	0	0	0	0	0	0	0	$ 23,620.63	$ 32,596.47	$ 56,217.10
Jay Bayersdorfer, PE	Cost Estimator	$ 89.33	0	0	120	0	0	0	0	0	0	0	0	0	0	0	0	$ 10,719.60	$ 14,793.05	$ 25,512.65
Joel Fisch, PE	Senior Engineer	$ 80.14	0	811	0	0	0	0	0	0	0	0	308	0	0	0	0	$ 89,676.66	$ 123,753.79	$ 213,430.45
April Thomann, PE	Senior Engineer	$ 53.76	0	246	0	0	0	0	0	0	0	0	80	0	0	0	0	$ 17,525.76	$ 24,185.55	$ 41,711.31
Total			1686	6035	360	0	0	0	608	308	240	0	622	77	291	0	40	$ 785,397.67	$ 1,083,848.78	$ 1,869,246.45

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-5
STAFFING SCHEDULE BY FIRM

FIRM: PB

STAFF PERSON OR CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	HOURLY RATE	TASK 1 HRS	TASK 2 HRS	TASK 3 HRS	TASK 4 HRS	TASK 5 HRS	TASK 6 HRS	TASK 7 HRS	TASK 8 HRS	TASK 9 HRS	TASK 10 HRS	TASK 11 HRS	TASK 12 HRS	TASK 13 HRS	TASK 14 HRS	TASK 15 HRS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 154%	TOTAL LABOR COST
Bob Fisher	Senior Consultant (PB)	$ 113.73	0	150	0	0	0	0	0	0	0	300	0	0	0	0	0	$ 51,178.50	$ 78,922.36	$ 130,100.86
Roger Lemos	Principal Engineer (PB)	$ 101.32	150	200	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 35,462.00	$ 54,685.95	$ 90,147.95
TOTAL			150	350	0	0	0	0	0	0	0	300	0	0	0	0	0	$ 86,640.50	$ 133,608.32	$ 220,248.82

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-5
STAFFING SCHEDULE BY FIRM

FIRM: IPERC

STAFF PERSON OR CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	HOURLY RATE	TASK 1 HRS	TASK 2 HRS	TASK 3 HRS	TASK 4 HRS	TASK 5 HRS	TASK 6 HRS	TASK 7 HRS	TASK 8 HRS	TASK 9 HRS	TASK 10 HRS	TASK 11 HRS	TASK 12 HRS	TASK 13 HRS	TASK 14 HRS	TASK 15 HRS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 105 %	TOTAL LABOR COST
Darrell Massie, PhD, PE	Senior Consultant (IPERC)	$ 156.09	0	120	0	0	0	0	40	0	0	0	0	0	0	0	0	$ 24,974.68	$ 26,370.77	$ 51,345.45
Aura Lee Keating	Design Team Leader (IPERC)	$ 49.08	0	116	0	0	0	0	39	0	0	0	0	0	0	0	0	$ 7,607.82	$ 8,033.09	$ 15,640.91
Peter Curtiss, PhD, PE	Principal Engineer 1 (IPERC)	$ 117.13	0	116	0	0	0	0	39	0	0	0	0	0	0	0	0	$ 18,154.58	$ 19,169.42	$ 37,324.00
Scott Roberts	Principal Engineer 2 (IPERC)	$ 82.27	0	77	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 6,334.70	$ 6,688.80	$ 13,023.50
TOTAL			0	429	0	0	0	0	118	0	0	0	0	0	0	0	0	$ 57,071.78	$ 60,262.09	$ 117,333.86

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-5
STAFFING SCHEDULE BY FIRM

FIRM: Navigant

STAFF PERSON OR CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	HOURLY RATE	TASK 1 HRS	TASK 2 HRS	TASK 3 HRS	TASK 4 HRS	TASK 5 HRS	TASK 6 HRS	TASK 7 HRS	TASK 8 HRS	TASK 9 HRS	TASK 10 HRS	TASK 11 HRS	TASK 12 HRS	TASK 13 HRS	TASK 14 HRS	TASK 15 HRS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 125 %	TOTAL LABOR COST
Timothy McClive	Senior Consultant - (Navigant)	$ 71.63	0	120	0	0	0	0	0	80	0	0	0	0	0	68	0	$ 19,196.84	$ 24,103.55	$ 43,300.39
Edward Dobrowolski	Design/Planning Team Leader I	$ 105.00	0	75	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 7,875.00	$ 9,887.85	$ 17,762.85
Robert Zogg	Senior Consultant - (Navigant)	$ 71.63	0	600	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 42,978.00	$ 53,963.18	$ 96,941.18
Matthew Blizard, PE	Principal Engineer (Navigant)	$ 79.33	0	0	0	0	0	0	0	80	0	0	0	0	0	80	0	$ 12,692.80	$ 15,937.08	$ 28,629.88
Colette Lamontagne	Principal Engineer (Navigant)	$ 79.33	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 3,173.20	$ 3,984.27	$ 7,157.47
TOTAL			0	835	0	0	0	0	0	160	0	0	0	0	0	148	0	$ 85,915.84	$ 107,875.93	$ 193,791.77

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-5
STAFFING SCHEDULE BY FIRM

FIRM: Green by Design

STAFF PERSON OR CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	HOURLY RATE	TASK 1 HRS	TASK 2 HRS	TASK 3 HRS	TASK 4 HRS	TASK 5 HRS	TASK 6 HRS	TASK 7 HRS	TASK 8 HRS	TASK 9 HRS	TASK 10 HRS	TASK 11 HRS	TASK 12 HRS	TASK 13 HRS	TASK 14 HRS	TASK 15 HRS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 155 %	TOTAL LABOR COST
Adam Zellner	Senior Consultant (GbD)	$ 74.58	0	0	0	0	40	0	0	0	40	0	0	0	0	0	0	$ 5,966.76	$ 9,248.48	$ 15,215.23
TOTAL			0	0	0	0	40	0	0	0	40	0	0	0	0	0	0	$ 5,966.76	$ 9,248.48	$ 15,215.23

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-5
STAFFING SCHEDULE BY FIRM

FIRM: JCMS

STAFF PERSON OR CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	HOURLY RATE	TASK 1 HRS	TASK 2 HRS	TASK 3 HRS	TASK 4 HRS	TASK 5 HRS	TASK 6 HRS	TASK 7 HRS	TASK 8 HRS	TASK 9 HRS	TASK 10 HRS	TASK 11 HRS	TASK 12 HRS	TASK 13 HRS	TASK 14 HRS	TASK 15 HRS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 116 %	TOTAL LABOR COST
Kevin Meehan	Cost Estimator (JCMS)	$ 63.68	0	0	811	0	0	0	0	0	0	0	0	0	0	0	0	$ 51,644.48	$ 60,072.86	$ 111,717.34
TOTAL			0	0	811	0	0	0	0	0	0	0	0	0	0	0	0	$ 51,644.48	$ 60,072.86	$ 111,717.34

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-5
STAFFING SCHEDULE BY FIRM

FIRM: AG Consulting

STAFF PERSON OR CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	HOURLY RATE	TASK 1 HRS	TASK 2 HRS	TASK 3 HRS	TASK 4 HRS	TASK 5 HRS	TASK 6 HRS	TASK 7 HRS	TASK 8 HRS	TASK 9 HRS	TASK 10 HRS	TASK 11 HRS	TASK 12 HRS	TASK 13 HRS	TASK 14 HRS	TASK 15 HRS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 137 %	TOTAL LABOR COST
Gerardo Aguilera	Engineer (AG-M/WBE)	$ 35.00	0	489	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 17,118.78	$ 23,452.73	$ 40,571.51
Ajmal Khan, PE	Engineer (AG-M/WBE)	$ 35.00	0	192	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 6,720.00	$ 9,206.40	$ 15,926.40
TOTAL			0	681	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 23,838.78	$ 32,659.13	$ 56,497.91

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-5
STAFFING SCHEDULE BY FIRM

FIRM: GTS

STAFF PERSON OR CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	HOURLY RATE	TASK 1 HRS	TASK 2 HRS	TASK 3 HRS	TASK 4 HRS	TASK 5 HRS	TASK 6 HRS	TASK 7 HRS	TASK 8 HRS	TASK 9 HRS	TASK 10 HRS	TASK 11 HRS	TASK 12 HRS	TASK 13 HRS	TASK 14 HRS	TASK 15 HRS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 124 %	TOTAL LABOR COST
Fredrick Voss, PE, PLS	Principal Engineer (GTS)	$ 41.73	0	1500	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 62,600.25	$ 77,693.17	$ 140,293.42
TOTAL			0	1500	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 62,600.25	$ 77,693.17	$ 140,293.42

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-5
STAFFING SCHEDULE BY FIRM

FIRM: Radin

STAFF PERSON OR CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	HOURLY RATE	TASK 1 HRS	TASK 2 HRS	TASK 3 HRS	TASK 4 HRS	TASK 5 HRS	TASK 6 HRS	TASK 7 HRS	TASK 8 HRS	TASK 9 HRS	TASK 10 HRS	TASK 11 HRS	TASK 12 HRS	TASK 13 HRS	TASK 14 HRS	TASK 15 HRS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 155 %	TOTAL LABOR COST
Chitra Radin	Lead Environ Design/Plan	$ 105.00	0	0	0	150	80	120	0	0	0	0	0	0	0	0	0	$ 36,750.00	$ 57,024.98	$ 93,774.98
Jane Darcy	Environ Design/Planning	$ 53.00	0	0	0	150	120	160	0	0	0	0	0	0	0	0	0	$ 22,790.00	$ 35,363.24	$ 58,153.24
TOTAL			0	0	0	300	200	280	0	0	0	0	0	0	0	0	0	$ 59,540.00	$ 92,388.22	$ 151,928.22

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-5
STAFFING SCHEDULE BY FIRM

FIRM: Robinson

STAFF PERSON OR CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	HOURLY RATE	TASK 1 HRS	TASK 2 HRS	TASK 3 HRS	TASK 4 HRS	TASK 5 HRS	TASK 6 HRS	TASK 7 HRS	TASK 8 HRS	TASK 9 HRS	TASK 10 HRS	TASK 11 HRS	TASK 12 HRS	TASK 13 HRS	TASK 14 HRS	TASK 15 HRS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 148 %	TOTAL LABOR COST
Adam Decker, CP	Lead Surveyor (RAS - M/V	$ 60.50	0	600	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 36,300.00	$ 53,724.00	$ 90,024.00
TOTAL			0	600	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 36,300.00	$ 53,724.00	$ 90,024.00

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-5
STAFFING SCHEDULE BY FIRM

FIRM: CCMT

STAFF PERSON OR CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	HOURLY RATE	TASK 1 HRS	TASK 2 HRS	TASK 3 HRS	TASK 4 HRS	TASK 5 HRS	TASK 6 HRS	TASK 7 HRS	TASK 8 HRS	TASK 9 HRS	TASK 10 HRS	TASK 11 HRS	TASK 12 HRS	TASK 13 HRS	TASK 14 HRS	TASK 15 HRS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 138 %	TOTAL LABOR COST
Lyle Rawlings	Project Specialist (CCMT)	$ 84.50	0	692	0	0	0	0	0	0	0	300	0	0	0	0	0	$ 83,823.84	$ 115,676.89	$ 199,500.73
James Sherman, Esq.	Supervising Engineer (CCM	$ 66.84	0	360	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 24,064.17	$ 33,208.56	$ 57,272.73
Steve Knapp	Senior Consultant (Power	$ 72.57	0	400	0	0	0	0	0	0	0	40	0	0	0	0	0	$ 31,932.77	$ 44,067.23	$ 76,000.00
TOTAL			0	1452	0	0	0	0	0	0	0	340	0	0	0	0	0	$ 139,820.78	$ 192,952.68	$ 332,773.46

NEW JERSEY TRANSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-003
ATTACHMENT C-5
STAFFING SCHEDULE BY FIRM

FIRM: Macan Deve

STAFF PERSON OR CLASSIFICATION	PROJECT TITLE OR DISCIPLINE	HOURLY RATE	TASK 1 HRS	TASK 2 HRS	TASK 3 HRS	TASK 4 HRS	TASK 5 HRS	TASK 6 HRS	TASK 7 HRS	TASK 8 HRS	TASK 9 HRS	TASK 10 HRS	TASK 11 HRS	TASK 12 HRS	TASK 13 HRS	TASK 14 HRS	TASK 15 HRS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ 130 %	TOTAL LABOR COST
Katie Donahue	Clerical Staff (Macan Deve	$ 35.00	1600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 56,000.00	$ 72,800.00	$ 128,800.00
TOTAL			1600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$ 56,000.00	$ 72,800.00	$ 128,800.00

NEW JERSEY TRAINSIT CORPORATION
REQUEST FOR PROPOSAL NO. 16-001
ATTACHMENT C-1
COST AND FEE FIRM RECAP - TEAM SUMMARY

FIRM	MAN HOURS	TOTAL DIRECT LABOR COST	INDIRECT LABOR COST (OVERHEAD) @ Various Rates*	SUBTOTAL	FIXED FEE@ 0%	DIRECT EXPENSES	TOTAL COST
AECOM	10,267	$ 785,398	$ 1,083,849	$ 1,869,246	0%	$ 70,097	$ 1,939,343
PB	800	$ 86,641	$ 133,608	$ 220,249	0%	$ 8,259	$ 228,508
IPERC	547	$ 57,072	$ 60,262	$ 117,334	0%	$ 4,400	$ 121,734
Navigant	1,143	$ 85,916	$ 107,876	$ 193,792	0%	$ 7,267	$ 201,059
GbD	80	$ 5,967	$ 9,248	$ 15,215	0%	$ 571	$ 15,786
JCMS	811	$ 51,644	$ 60,073	$ 111,717	0%	$ 4,189	$ 115,907
AG	681	$ 23,839	$ 32,659	$ 56,498	0%	$ 2,119	$ 58,617
GTS	1,500	$ 62,600	$ 77,693	$ 140,293	0%	$ 5,261	$ 145,554
Radin	780	$ 59,540	$ 92,388	$ 151,928	0%	$ 5,697	$ 157,626
Robinson	600	$ 36,300	$ 53,724	$ 90,024	0%	$ 3,376	$ 93,400
CCMT	1,792	$ 139,821	$ 192,953	$ 332,773	0%	$ 12,479	$ 345,252
Macan Deve	1,600	$ 56,000	$ 72,800	$ 128,800	0%	$ 4,830	$ 133,630
Total	20,602	$ 1,450,737	$ 1,977,134	$ 3,427,870		$ 128,545	$ 3,556,416

* The following overhead rates are used for each firm:

FIRM	OH Rates
AECOM	138.00%
PB	154.21%
IPERC	105.59%
Navigant	125.56%
GbD	155.00%
JCMS	116.32%
AG	137.00%
GTS	124.11%
Radin	155.17%
Robinson	148.00%
CCMT	138.00%
Macan Deve	130.00%