PMOC REPORT

OP 32C – Project Scope Review

Honolulu Rail Transit Project
Honolulu Authority for Rapid Transportation (HART)
City and County of Honolulu
Honolulu, HI

June 2012 (FINAL)

PMOC Contract Number: DTFT60-09-D-00012
Task Order Number 4: Programmatic
Work Order Number 12: Honolulu Risk Refresh
Project No. DC-27-5181
OPs Referenced: OP 32C

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Length of Time Assigned: Five Years (November 18, 2009 through November 17, 2014)

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

The Honolulu Authority for Rapid Transportation (HART) continues to advance development of its proposed Honolulu Rail Transit Project ("Project"), formerly known as the Honolulu High-Capacity Transit Corridor (HHCTC) Project, in accordance with the Federal Transit Administration (FTA) New Starts requirements. The Project is intended to provide improved mobility in the highly-congested east-west corridor along Oahu's south shore between Kapolei and the Ala Moana Center. The Project would provide faster, more reliable public transportation services than those currently operating in mixed-flow traffic.

FTA assigned Jacobs as a Project Management Oversight Contractor (PMOC) on September 24, 2009, for the purpose of monitoring the Project and providing FTA with "information and well-grounded professional opinions regarding the reliability of the project scope, cost, and schedule" of the Project. That effort continues with this update report, which represents the PMOC's assessment of the Project Scope Method.

1.2 Project Description

The Project is an approximately-20-mile-long elevated fixed guideway rail system along Oahu's south shore between East Kapolei and Ala Moana Center. The alignment is elevated, except for a 0.6-mile at-grade portion at the Leeward Community College station. The proposed investment includes 21 stations (20 aerial and 1 at-grade), 80 "light metro" rail transit vehicles, administrative/operations facilities, surface and structural parking, and maintenance facilities. The grantee plans to deliver the Project in four guideway segments:

- Segment I (West Oahu/Farrington Highway) – East Kapolei to Pearl Highlands (6 miles/7 stations)
- Segment II (Kamehameha Highway) – Pearl Highlands to Aloha Stadium (4 miles/2 stations)
- Segment III (Airport) – Aloha Stadium to Middle Street (5 miles/4 stations)
- Segment IV (City Center) – Middle Street to Ala Moana Center (4 miles/8 stations)

In a recently-announced change, HART now plans to combine Segments III and IV into a single guideway construction contract.

Additional Project information:

- **Additional Facilities:** Maintenance and Storage Facility (MSF) and parking facilities
- **Vehicles:** 80 vehicles, supplied by the Core Systems Contractor (CSC), which is also responsible for systems design and construction and operations. The CSC is a Design-Build-Operate-Maintain (DBOM) contract.
- **Ridership Forecast:** Weekday boardings – 97,500 (2019); 116,300 (2030).
- **Target Revenue Service Date (RSD):** March 2019

1.3 PMOC Scope of Work

Under this Work Order, Jacobs is to provide the following deliverables:

- OP 32A: Project Transit Capacity Review
- OP 32C: Project Scope Review
- OP 32D: Project Delivery Method Review
- OP 33: Capital Cost Estimate Review
- OP 34: Project Schedule Review
- OP 40: Risk and Contingency Review

This report is limited to OP 32C: Project Scope Review.

1.4 Methodology

The PMOC followed the requirements outlined in the *FTA OP 32C – Project Scope Review*, dated May 2010, to assess and evaluate the scope of the project. The FTA expects the PMOC to verify that the scope of the project:

- is represented by the totality of all contract plans and specifications
- is internally consistent
- is defined to a level appropriate for the project development phase
- is consistent with the estimated cost and schedule

The objective of this review is, in the words of OP 32C, "to assess the grantee's definition of the project scope through drawings, specifications, narratives, third party agreements, plans for project delivery, etc., for adequacy and completeness, given the phase." PMOC looked for the documentation's internal consistency, compliance with laws, regulations, and policies, bid-ability and constructability. **See Section 3.3.6--"Completeness of Project Information" and Section 3.3.7 – "Review and Characterization of Project Scope" for PMOC's assessment and analysis of the project scope as presented in the Project's documentation. Section 3.5 – "Conclusion" provides the summary of PMOC's findings.**

1.5 Summary of Findings

The Final Environmental Impact Statement (FEIS) was published on June 25, 2010, and a Record of Decision (ROD) was issued on January 18, 2011. The scope as contained in the project's FEIS and ROD is reflected in the drawings, specifications, estimates, and the Project Management Plan (PMP).

The current design meets the capacity and operational objectives established in the FEIS, although details are subject to modification upon progression of design of the CSC. The only item that changed since the ROD was issued is the total number of vehicles. At the time of the ROD, it was expected that the number of vehicles would be 76, but the BAFO by the selected CSC includes 80 vehicles. That is not change in project scope, however, as the CSC bidders were allowed flexibility in order to meet the ridership projections defined in the CSC Request for Proposals (RFP) document and amendments. Thus, the number of vehicles may change from 76

to 80 and the minimum headway may change from 3 minutes to around 2-1/2 minutes, but the capacity and operational objectives are still met.

Attachment A to ROD, dated January 2011, listed 197 mitigations to which the Project is committed. These mitigations deal with subjects such as real estate acquisitions, easements, relocations, landscaping, design details, protection of historic and environmental sensitive resources, noise abatement, lighting, safety, security, public health, and the treatment of Hawaiian iwi. The grantee is committed to implementing all mitigation measures specified by the ROD and all terms of the Project's Programmatic Agreement (PA), also instituted in January 2011. The grantee has hired a Kako'o Consultant to ensure compliance with the PA.

While the actual implementation of many of the detailed mitigations will not occur until Final Design and construction, the grantee has included requirements for their design in RFPs already issued. Thus, the grantee has contractual assurances that the ROD's requirements will be met.

The grantee and its consultants and contractors are actively working to acquire other necessary permits and approvals from federal, local, and state agencies.

In order to minimize the risk normally related to differing site conditions, the grantee's engineers have conducted adequate site reconnaissance, performed sufficient subsurface investigation and field and laboratory testing, and prepared geotechnical data and baseline reports. Buried structures and utilities have been identified to the extent known. The locations of potentially-contaminated soils have been identified in general.

Much of the work for subsurface investigation will continue as Final Design advances, although a comprehensive geotechnical investigation is essentially complete for the West Oahu/Farrington Highway (WOFH) Design-Build (DB) Contract and is underway for the Kamehameha (KH) DB Contract. For sitework, the drawings and reports show a sufficient amount of project definition.

1.6 Conclusion

The scope of the Project is well-defined and portions of the project are generally at a level of completeness necessary to support an FFGA application. However, it would have been preferable to have more nearly complete designs, particularly for the MSF, stations, systems, and DBB guideway sections. While it is not feasible for a project that has a significant portion that is ready for construction to await completion of final design for those portions that are not ready, it is advisable to acknowledge the project risks in acquiring an FFGA at this time. At a minimum, the grantee should have in place, on the day it receives an FFGA, all the means, methods, tools, and personnel necessary to meet the recommendations in Section 3.6 of this report and all controls it needs to successfully implement the agreed-to project within its budget and schedule.

Nevertheless, using the terms listed in Section 3.1, PMOC found no discrepancies in the Project documentation's internal consistency, compliance with laws, regulations, and policies, bid-ability, and constructability. PMOC did, however, note the following:

- Coordination between the grantee and its various contractors and between different contractors remains one of the foremost challenges of the project.

- Station design must be progressed to create biddable construction packages for all 21 proposed stations.
- Agreements must be completed with all government bodies, public agencies, and utilities affected by the project.
- Procurement activities must adequately address Buy America requirements for escalators and elevators, major system components (>$100,000), rail, steels, and vehicles, as well as Ship America requirements.

1.7 Recommendations

The PMOC recommends the following actions be taken upon receipt of an FFGA:

(1) The grantee's design contractors must complete designs for the MSF, stations, systems, and DBB guideway sections, and the grantee must implement controls that assure that these final designs meet the requirements of the Project as defined in the FFGA.

(2) The grantee must work with the CSC to resolve capacity issues (see OP 32A) and implement project controls to coordinate CSC work with that of other contractors.

(3) The grantee must identify project management staff as planned in order to maintain control of the various concurrent projects.

(4) The grantee must manage the schedule and budget by implementing controls as described in its project management plans throughout construction.

(5) The grantee should place controls on allowable costs for each station and implement cost-saving mitigation measures as soon as necessary to keep the station construction costs in line.

(6) The grantee should complete any unfinished effort to acquire agreements with all affected agencies and begin the process of cooperation that those agreements entail. While most of these agencies have shown a willingness to cooperate with the grantee, nothing can be guaranteed about the success of these relationships until agreements are in place. The FFGA Roadmap includes a list of agreements that is being tracked by the PMOC and the grantee on a monthly basis.

(7) The grantee should continue the process of updating the Project budget and schedule, incorporating information from contracts-in-progress, any accepted cost reduction measures, and from completed tasks as they occur.

(8) The grantee should continue to be proactive in assuring that all of its contractors meet the requirements of Buy America and Ship America.

2.0 INTRODUCTION

The Honolulu Authority for Rapid Transportation (HART) continues to advance development of its proposed Honolulu Rail Transit Project ("Project"), formerly known as the Honolulu High-Capacity Transit Corridor (HHCTC) Project, in accordance with the Federal Transit Administration (FTA) New Starts requirements. The Project is intended to provide improved mobility in the highly-congested east-west corridor along Oahu's south shore between Kapolei and the Ala Moana Center. The Project would provide faster, more reliable public transportation services than those currently operating in mixed-flow traffic.

FTA assigned Jacobs as a Project Management Oversight Contractor (PMOC) on September 24, 2009, for the purpose of monitoring the Project and providing FTA with "information and well-grounded professional opinions regarding the reliability of the project scope, cost, and schedule" of the Project. That effort continues with this update report, which represents the PMOC's assessment of the Project Scope Method.

2.1 Project Sponsor

The City and County of Honolulu ("City") is the overarching FTA grantee. The City's Department of Transportation Services (DTS) and HART have executed a Memorandum of Understanding, which delineates each agency's roles and responsibilities so as not to jeopardize the City's standing as an FTA grantee. HART is responsible for the New Starts grants for the Project and may share responsibilities with DTS for grants using Section 5307 or other FTA funding sources.

2.2 Project Description

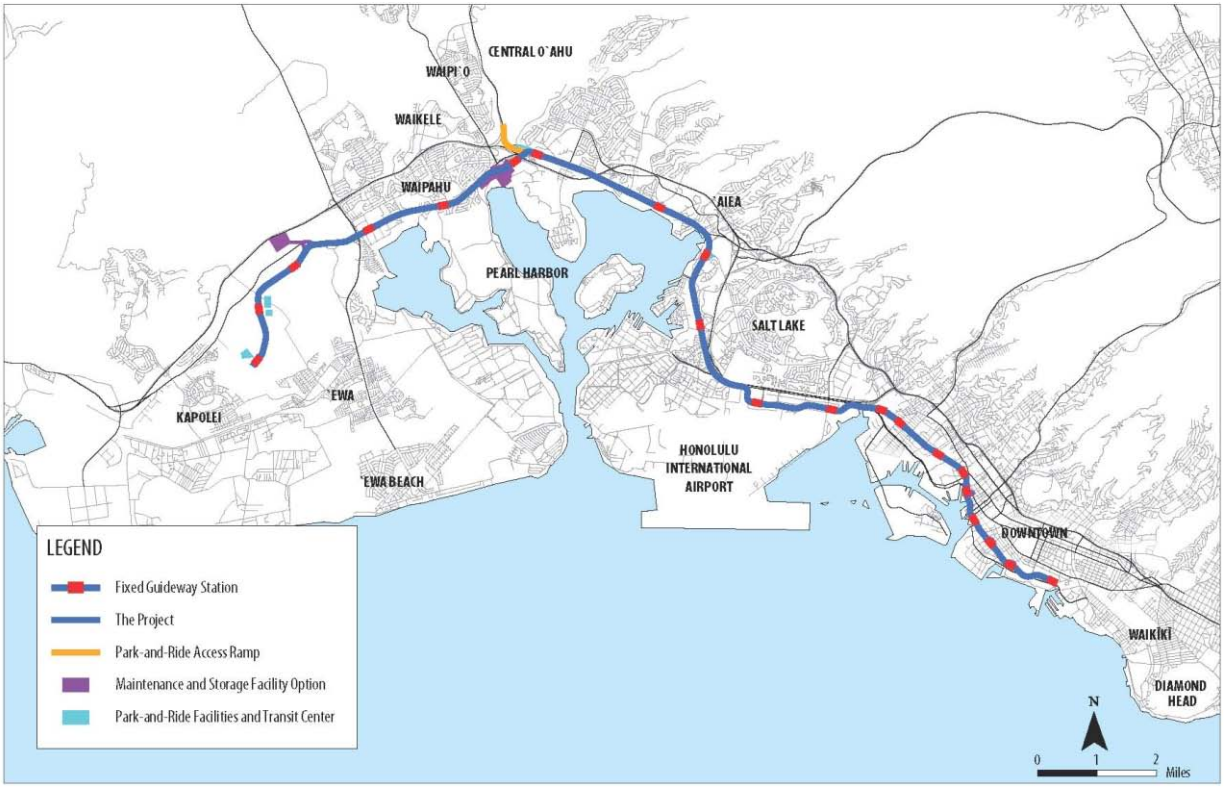
The proposed Project is a 20.5-mile light metro rail line in a grade-separated right-of-way that will provide high-capacity transit service on the island of Oahu from East Kapolei in the west to the Ala Moana Center in the east. The alignment is elevated except for a 0.6-mile at-grade portion adjacent to the Leeward Community College station. In addition to the guideway superstructure and trackwork, major physical elements of the Project include: 21 stations; one maintenance and storage facility; numerous right-of-way parcel acquisitions; and 80 light metro vehicles and associated core systems.

The Project is planned to be delivered in four design and construction segments:

- Segment I (West Oahu/Farrington Highway) – East Kapolei to Pearl Highlands (6 miles/7 stations)
- Segment II (Kamehameha Highway) – Pearl Highlands to Aloha Stadium (4 miles/2 stations)
- Segment III (Airport) – Aloha Stadium to Middle Street (5 miles/4 stations)
- Segment IV (City Center) – Middle Street to Ala Moana Center (4 miles/8 stations)

In a recently-announced change, HART now plans to combine Segments III and IV into a single guideway construction contract.

Figure 1. Project as Identified in FEIS



East Kapolei is the western terminus of the Project. The alignment begins at North-South Road north of Kapolei Parkway. The alignment follows North-South Road in a northerly direction to Farrington Highway where it turns east following Farrington Highway and crosses Fort Weaver Road. The alignment is elevated along North-South Road and along Farrington Highway. The alignment continues in a north-easterly direction following Farrington Highway in an elevated structure. South of the H-l Freeway, the alignment descends to grade as it runs alongside the Maintenance & Storage Facility at the former Navy Drum Site. The alignment continues at-grade to Leeward Community College and then returns to an elevated configuration to cross over the H-l Freeway. North of the Freeway, the alignment turns eastward along Kamehameha Highway. Segment I includes seven stations: East Kapolei, University of Hawaii at West Oahu, Ho'opili, West Loch, Waipahu Transit Center, Leeward Community College and Pearl Highlands.

Segment II carries the alignment from Pearl Highlands to Aloha Stadium, running mostly above the median of Kamehameha Highway. At the highway interchange 'Ewa of the stadium, the alignment crosses over to the mauka side of Kamehameha Highway, in land adjacent to the roadway that is currently used for stadium parking. Segment II includes two stations: Pearl Ridge and Aloha Stadium. East of Aloha Stadium Station, the segment features a third track for temporary train layovers or storage.

The Airport Segment, or Segment III, takes the alignment from Aloha Stadium to Middle Street. This entirely elevated section of the route starts on the mauka side of Kamehameha Highway,

then transitions to the median of that street. As the route proceeds in the Koko Head direction, it leaves Kamehameha Highway to run on the makai side of the elevated H-1 Freeway. At Honolulu International Airport, the alignment swings out over the median of the H-1, then down Aolele Street to a station site adjacent to the main airport terminal. The route then continues Koko Head on Aolele and, eventually, the parallel Ualena Street to Lagoon Drive. At that point, the alignment crosses a corner of Ke'ehi Lagoon Park and threads through another highway interchange to Kamehameha Highway again at Middle Street. Segment III includes four stations: Pearl Harbor, Airport, Lagoon Drive, and Middle Street.

The City Center Segment, Segment IV, is also entirely-elevated as it carries the alignment from Middle Street to the Ala Moana Center. Segment IV features guideway structures above Dillingham Boulevard, Nimitz Highway, Halekauwila Street, Queen Street, and Kona Street. Above Kona Street at the Ala Moana Center Station, the segment includes tail tracks beyond the station to provide operational flexibility and storage. The segment includes eight stations: Kalihi, Kapalama, Iwilei, Chinatown, Downtown, Civic Center, Kaka'ako, and Ala Moana.

The Project also includes one Maintenance & Storage Facility (MSF), two park and ride lots, one park and ride structure and two bus transit centers. The rail vehicles will be fully-automatic and driverless.

The anticipated weekday boardings for the line are as follows:

- 97,500 (in 2019)
- 116,300 (in 2030)

2.3 Project Status

A Locally Preferred Alternative (LPA) was adopted in July 2008. The grantee was provided approval to begin Preliminary Engineering (PE) on October 16, 2009. The Final Environmental Impact Statement (FEIS) was published on June 25, 2010, and a Record of Decision (ROD) was issued on January 18, 2011. FTA granted approval to enter Final Design on December 29, 2011. The grantee is preparing an application for a Full Funding Grant Agreement in accordance with the FTA New Starts requirements.

2.4 Project Budget

The grantee's Base Cost Estimate (BCE), dated June 2012, is $5.122 billion in Year-of-Expenditure (YOE) dollars, including $644 million in allocated and unallocated contingency and $173 million financing costs.

2.5 Project Schedule

Table 1 presents the grantee's target dates for key milestones of this New Starts Project as identified in its Master Project Schedule.

Table 1. Target Milestone Dates

Milestone Description	Grantee Target Date
FTA Award Full Funding Grant Agreement	07-Oct-12
WOFH/KH Revenue Service	27-Jun-16
Airport/City Center Revenue Service (RSD)	10-Mar-19

Note: MPS Data Date of March 30, 2012

2.6 Project Management Oversight Contractor (PMOC)

Under this Work Order, Jacobs is to provide the following deliverables:

- OP 32A: Project Transit Capacity Review
- OP 32C: Project Scope Review
- OP 32D: Project Delivery Method Review
- OP 33: Capital Cost Estimate Review
- OP 34: Project Schedule Review
- OP 40: Risk and Contingency Review

This report is limited to OP 32C: Project Scope Review.

2.7 Evaluation Team

The following table presents the PMOC Evaluation Team and the respective roles associated with the assessment of the Project.

Table 2. PMOC Evaluation Team

Name	Location	Role
Jacobs		
Tim Mantych	St. Louis, MO	Program Manager
Bill Tsiforas	Las Vegas, NV	Task Order Manager
Keith Konradi	St. Louis, MO	Rail Engineering
Bob Niemietz	St. Louis, MO	Structural Engineering
Ahmad Hasan	St. Louis, MO	Geotechnical Engineering
Allan Zreet	Dallas, TX	Architect
Charles Neathery	Dallas, TX	Construction Management, Project Controls, Schedule Risk Assessment
Tim Morris	Dallas, TX	Cost Estimating
Brian Carpenter	Dallas, TX	Cost Estimating, Scheduling
Steve Rogers	Dallas, TX	Cost Estimating
Albert Amos	Austin, TX	Economics
David Nelson	Boston, MA	Operations, Transit Capacity
Tracey Lober	St. Louis, MO	QA/QC
Joe Leindecker	St. Louis, MO	Planning
Virginkar and Associates, Inc.		
Arun Virginkar	Brea, CA	Vehicle Engineer, Buy America
Hal Edris	Spring Grove, PA	Systems Integration Manager
Triunity Engineering Management Inc.		
Jonnie Thomas	Denver, CO	Systems (Communications)
Interactive Elements Inc.		
Dennis Newman	New York, NY	Safety
Dorothy Schulz	New York, NY	Security
LS Gallegos Inc.		
JR Casner	Centennial, CO	Construction Management, QA/QC
OR Colan & Associates		
Bob Merryman	St. Louis, MO	Real Estate
Kowalenko Consulting Group Inc.		
Emma Kowalenko	Chicago, IL	Planning/Environmental
Independent Contractor		
David Sillars	Corvallis, OR	Risk Manager

2.8 Documents Reviewed

Appendix B provides a listing of the project-related documents that were utilized during development of this PMOC Report.

3.0 OP 32D: PROJECT DELIVERY METHOD REVIEW

3.1 Purpose

Per FTA Oversight Procedure 32C, Project Scope Review, the FTA expects the PMOC to verify that the scope of the project:

- is represented by the totality of all contract plans and specifications
- is internally consistent
- is defined to a level appropriate for the project development phase
- is consistent with the estimated cost and schedule

Monitoring scope through the various phases of project development benefits cost control and aids in the management of risks inherent in the design and construction process. The scope was initially established through development of alternatives and the selection of a Locally Preferred Alternative (LPA). At that point, the scope was defined only in general terms; it was not to be fully developed until after the essential completion of the Final Design phase. The ultimate scope is then the one established and funded by the FTA through an FFGA.

The objective of this review is, in the words of OP 32C, "to assess the grantee's definition of the project scope through drawings, specifications, narratives, third party agreements, plans for project delivery, etc., for adequacy and completeness, given the phase." PMOC looked for the documentation's internal consistency, compliance with laws, regulations, and policies, bid-ability and constructability. **See Section 5.3.6 --"Completeness of Project Information" and Section 5.3.7 – "Review and Characterization of Project Scope" for PMOC's assessment and analysis of the project scope as presented in the Project's documentation. Section 5.6 – "Conclusion" provides the summary of PMOC's findings.**

3.2 Methodology

OP 32C provides, in narrative and checklist form, lists of questions that must be answered and requirements that must be met prior to a project's approval to graduation into its next phase of project development. PMOC's process of this review began over three years ago when it was first assigned the oversight role on the Project. That process has continued through site visits, monthly meetings, workshops, review of documents, and continuous monitoring.

This report builds on that ongoing process of project development and attempts to answer, in report form, how well the grantee is meeting the requirements of the FTA and, perhaps more importantly, those of the public and the local constituency that the Project aims to serve.

The grantee is utilizing both traditional (Design/Bid/Build or DBB) and alternative (Design/Build or DB and Design/Build/Operate/ Maintain or DBOM) project delivery methods for the various contracts. The WOFH, Kamehameha Highway, and MSF DB Contracts have received limited NTPs to begin construction under FTA LONPs. The Core Systems DBOM contract is also underway, utilizing pre-award authority granted upon receipt of the project's ROD. The former three are all DB contracts, while the latter, the CSC, is a DBOM-type contract, wherein the contractor is responsible for designing and building the vehicles and the systems-related project elements and for operations and maintenance of the same for a specified

period after the Revenue Service Date (RSD). The two eastern line sections (Airport and City Center) and all of the stations are in or are about to be in Final Design and have not yet been bid for construction, as these are the contracts to be designed and built using the traditional DBB method.

The OPs describe the importance of a good performance specification for projects using alternative contract delivery methods. Through this document, the grantee both specifies the construction contractor deliverables and cedes to the contractor certain of its own rights to make detailed design decisions. Because of the nature of a design-build (or other alternative delivery) contract, changes in scope occurring after contract award can be much more costly than similar changes made during implementation of more traditional DBB contracts.

This review consists of a text description of the findings along with an item-by-item check-off using the checklists and requirements of OP 32C and OP 52 ("Project Scope Review" and "Readiness for FFGA," respectively).

3.3 Review

3.3.1 Changes in Project Scope Since Last Major Milestone

The project has incorporated only minor alignment changes since the project's last major milestone, entry into FD. Other changes have occurred as part of the grantee's Cost Reduction Measures effort, but these involve less significant reductions such as elimination of guideway lighting and selected station-related modifications including reduction in the number of escalators and simplification of station designs. The reconfiguration of the Ala Moana Station is also a notable change, resulting from Value Engineering proposals and the desire to create a simpler, less expensive, and easier-to-expand station at the eastern terminus of the line. Various other changes have been incorporated during the process of Final Design by both DB contractors. The Airport designer has proposed some modifications to the alignment in order to improve constructability and to adapt to roadway changes proposed by the airport.

The grantee has decided to implement a change in scope to add screen doors along all platforms. This approximately $20 million addition is being made for both safety and operational expediency after extensive study. The screen doors eliminate the likelihood of passengers falling onto the track in front of the driverless trains.

3.3.2 Additional Known or Anticipated Changes in Project Scope

The grantee accepted numerous changes proposed by its stations and guideway VE Workshops and a number of Alternative Technical Concepts (ATC's) proposed by DB bidders. The proposed and accepted VE changes include:

(1) Modifications applying to all stations include the development of modular footprint for the station entry / fare gate area and separate ancillary module containing the TCCR and UPS equipment. The modules are intended to separate passenger and ancillary functions and provide a more cost effective approach to these elements. Other changes include reducing platform canopies from 6 to 4 bays; elimination of escalators for risers under 16 feet in height; changing entry

area enclosures from glass to steel mesh; changing stair riser finish at all stations to concrete rather than granite veneer; and using exposed aggregate rather than colored and stamped concrete at station plazas

(2) Modifying Ho'opili Station, reducing its footprint, and delay construction of an overhead pedestrian walkway
(3) Modifying West Loch Station to better connect bus transit area to station entry plaza and reduce building footprints, canopy coverage and number of escalators
(4) Modifying Waipahu Transit Center Station, reducing its footprint, canopy and number of escalators
(5) Modifying Pearlridge Station, moving fare gates and reducing its footprint
(6) Modifying Aloha Stadium Station, revising its stair and escalator orientation, ground floor enclosures, entry point, and bus canopy coverage
(7) Modifying Pearl Harbor Station, minimizing its mauka entrance, and moving its platforms.
(8) Adding elevators and making other improvements to Airport Station
(9) Modifying Middle Street Transit Center Station by reducing concourse bridge width and platform canopy coverage and reconfiguring stair routes and fare gate provisions. This station is also affected by an alignment change proposed by the guideway VE.
(10) Modifying Kalihi Station by adding a concourse, minimizing the station entry area, reconfiguring the platform.
(11) Modifying Kapalama Station by adding a concourse, minimizing the station entry area, reconfiguring the platform.
(12) Modifying Chinatown Station by minimizing the station entry area, and providing for future fare gates at the concourse and platform
(13) Modifying Downtown Station, eliminating concourse, adding pedestrian bridge, providing end loaded platform, and adding emergency stair exit to median
(14) Modifying Civic Center Station by minimizing station entry area.
(15) Modifying Kaka'ako Station by eliminating ground-level enclosures, and minimizing station entry area by channeling to single entry point.
(16) Modifying Ala Moana Station to provide a single center platform and simplified means of access.

The grantee developed preliminary concepts based on the above scope changes and provided direction on cost reduction items to Final Designers through conceptual drawings. An In-Progress submission of the Preliminary Engineering drawings for the Farrington Highway Stations Group (FHSG) dated February 29, 2012 was submitted reflecting the VE cost reduction items illustrated in the conceptual cost reduction documents. The FHSG station drawings reflect a 30% level of completion. These drawings were reviewed by the PMOC and have incorporated all cost reduction measures identified. Drawings were also updated to include platform screen doors as described in 5.3.1 above.

Incorporation of the VE cost reduction items for stations in all other line sections were provided for cost estimating purposes. These drawings are dated March 9. 2012. The drawings consist of architectural plan, section and elevation drawings but do not include other disciplines at this time. The drawings represent a 15% level of completion.

Cost estimates for the In-Progress submittal are reviewed by the PMOC in the OP 33 report, Capital Cost Estimate Review. The revised costs from the advanced design of the Farrington Highway Stations were extrapolated to the remaining station groups to validate the initial conceptual cost applied across all stations. .

ATCs proposed by bidders and accepted by the grantee include:

(1) Using photovoltaic cells on roofs of MSF buildings
(2) Installing Blue Light Stations/Emergency Telephones
(3) Using a mobile data system
(4) Adding train detection
(5) Using the Thales system to prioritize merging train traffic according to the operating schedule
(6) Eliminating wayside indicators
(7) Circuitless secondary tracks
(8) Sliding doors
(9) Plinthless track construction

The grantee also gave conditional approval for other ATCs proposed by DB or DBOM bidders. The implementation of these ATCs is the responsibility and discretion of the winning DB or DBOM contractors, since they are, by definition, alternatives to the design specified by the grantee.

The final VE Report for Stations and the Alternative Technical Concepts (ATC) Report from the DB proposals were provided to the PMOC in October 2010. The final VE Report for the Airport and City Center Guideways was provided to the PMOC in August 2011. These reports included a list of the VE recommendations that the grantee intends to implement. The PMOC has reviewed the final VE report to ensure that the purpose and objectives were met, the findings were adequately summarized, and an action plan was developed. The table below presents the summary of VE results provided by the grantee:

Table 3. Value Engineering and Alternative Technical Concept Proposals

Source	No. of Proposals Received	Estimated Value (M)	No. of Proposals Accepted	Estimated Value (M)
VE Workshop for Stations	30	$318.5	26	$104.1
ATC Proposals – WOFH DB Contract	29	$85.4	13	$60.5
ATC Proposals – KH DB Contract	16	$29.0	7	$18.3
ATC Proposals – MSF DB Contract	11	$16.1	5	$2.7
ATC Proposals – CSC	41	$35.6	15	$15.5
VE Workshop for Airport & City Ctr.	27	$225.6	13	$109.2
TOTAL	**154**	**$710.2**	**79**	**$310.3**

3.3.3 Correlation of Cost Estimate and Schedule to Scope

The cost estimate will require revisions after the awarding of the contracts currently under bid and after inclusion of the many changes acceded to after review of the Stations VE and Design-

Build ATC proposals. Fortunately, many of those cost revisions may be beneficial to the baseline cost of the project, although the grantee may choose to hold those funds in the overall project budget as part of contingency.

From all appearances, the current cost estimate does fairly represent the project scope at the completion of PE; however, it will need to be adjusted per recent bid information as well as any changed conditions or scope revisions that are underway.

The schedule is another issue entirely; since the grantee already has three DB contracts in progress, the PMOC is concerned that delays in issuing NTPs may end up having a detrimental effect on both the final project budget and the project schedule. The project schedule would need to account for the known pending changes in scope, were the DBB contracts already in progress. As most of the changes anticipated are related to station designs and since most of these station designs are not yet under contract, there is no harm to the schedule unless the design contracts were to be delayed until revision of the PE documents, which is unlikely.

3.3.4 Unknown or Uncertain Conditions

Some of the aspects of the Project that could be described as unknown or uncertain match the examples given in the OP 32C guidelines. Real Estate acquisitions, permitting, third-party agreements, and unknown underground or archeological findings are likely to be troublesome at times. There is potential for hazardous materials on the MSF site, but their exact locations, extent of contamination and need for on-site treatment or disposal to off-site locations might not be fully defined until excavations begin on the site. The grantee will need to negotiate, finalize, or update agreements with Hawaii Department of Transportation (HDOT), Honolulu International Airport (HNL), the Federal Aviation Administration (FAA), the Department of Hawaiian Homelands (DHHL), United States Navy (USN), and all the various utility companies. The real estate market, of course, can be very turbulent and can cause unforeseen delays and additional costs, especially if negotiations break down and eminent domain is employed.

The contract documents for the DB contracts stipulate responsibilities of the contractors to stop work in the case of encountering unforeseen hazardous materials or archeological or historical artifacts, but specify fiscal responsibility for those items to the grantee, except in cases where the condition was caused by the contractor's actions.

3.3.5 Likely Changes in Scope

The decision to require platform screen gates at stations could affect a number of contracts, including the CSC, all line section contracts, and all station contracts. The addition of this requirement may also cause the need for careful analysis of operations, as the travel time could be increased due to the need to spot the vehicle doors opposite the platform doors. Train door operation will also be subject to the delays incurred by incorporating platform screen gate interlocks that provide the detection logic required for safe synchronized platform door operations. If that impact is too great, this change could influence fleet capacity and cause a need for additional trainsets during normal operations.

3.3.6 Completeness of Project Information

The completeness of project information varies by contract, with the DB contracts showing a design that has advanced to readiness or near-readiness for construction. Those contracts' designs have been modified due to structural, guideway alignment and profile, and track construction decisions made by the DB contractors. The other line segments reflect the original intent of the grantee but have not progressed far beyond the PE level. The CSC, as a DBOM contract, is defined by a performance specification without the details one would expect and need in a traditional contract.

The drawings for the four line segments present right-of-way plans, drainage plans and details, demolition plans, guideway plans and profiles, typical cross sections, utility plans, roadway plans, signing and striping plans, maintenance of traffic plans, traffic signal plans, street lighting plans, structural drawings, landscaping plans, station drawings, and contact rail installation plans. The WOFH and KHG DB Contracts have progressed beyond the others, since their DB contractors have made revisions to alignments, profiles, track details, roadway design, and structural definitions following receipt of their limited NTPs. PE plans for station contracts have been developed for the Farrington Highway Stations Group incorporating accepted VE items and certain cost reduction proposals. Contracts for development of PE plans for other line sections and station designs are either pending or barely underway.

Through PE plans and performance specifications, the grantee has provided enough project information to fully illustrate the scope, capacity, level of service, functionality, and expected reliability of the completed project. They sufficiently characterize elements of the design and exceed the requirements of a PE design. For achievement of an FFGA, however, it would have been preferable to have more nearly complete designs, particularly for the MSF, stations, systems, and DBB guideway sections. It should be noted that, of the 21 station designs, only the three in the Farrington Highway Stations Group show a PE level of completion that accounts for the accepted VE and cost reduction changes.

3.3.7 Review and Characterization of Project Scope

<u>Consistency with ROD</u>
The Record of Decision was issued on January 18, 2011.

<u>Support Grantee's Typical Level and Quality of Service</u>
Since the grantee's proposed automated light metro rail system is such a significant upgrade from its existing bus-only system, it can fairly be said that the Project exceeds mere "support for the level and quality of (existing) revenue service."

<u>Proprietary Systems and Methods Permit Reasonable Number of Contractors</u>
None of the contracts advertised thus far has had a problem with attracting at least two bidders. Although the DBOM CSC involves proprietary systems, the method of qualification and ultimate making of a "Best and Final Offer" (BAFO) attracted multiple bidders. The line segment and MSF contracts already awarded received interest from a small but sufficient number of capable bidders.

From the onset of the Project, PMOC has contended that the size and type of the Project and the challenge of attracting experienced contracting help either locally or from the mainland are major issues. This, rather than the proprietary systems and methods, is likely to be the force driving down the number of bidders on the contracts advertised to date.

Completeness and Definition of Major Work Details, Dimensions, and Interfaces
Systems elements lack detail in their definition, although the implementation of the CSC has allocated responsibility for creating definition to the contractor. The MSF complex is another area where details (e.g., building layouts, machinery, systems interfaces, earthwork, and track configuration) are either incompletely determined or may be subject to change as the contractor progresses the work.

Interfacing between the various contracts will be a logistical and quality challenge. The project will have one contractor supplying the track material, another designing and building the guideway, another designing the stations for construction by yet another firm, and one more, the CSC contractor, designing, building, and operating both the vehicle and all the systems elements. The PMOC is concerned that changes to the CSC will affect station and MSF designs, which will have an impact on details in a line segment's design, even if that line segment may already be completely designed and under construction.

The two DB line sections have progressed the design to a point where limited construction can begin, while much work still needs to be done in Final Design of the DBB line sections (Airport and City Center) and the stations.

Content, Presentation, Clarity, Cross-Referencing, and Detail of Plans and Drawings
The plans and drawings provided for the Project all provide a suitable level of quality in their presentation, clarity and cross-referencing, although there is room for additional content and detail on the two DBB line sections and the stations. Structural drawings on the DBB contracts appear to be conceptual in nature, as they lack key dimensions and connection details. Station drawings and line section structural drawings need to be fully coordinated with each other to show staging of the work and a clear delineation of interfaces between different contractors.

Definition of Contractors/Grantee Roles and Responsibilities
Through contract documents pending or already in force, the grantee has established definition of grantee and contractor roles and responsibilities in implementing the DB contracts. The grantee has reserved for itself final say in any matters that depart from the project baseline design. In the case of the CSC, the grantee had to cede much more responsibility to the contractor, as the turnkey nature of the project requires that the vehicle, systems, and operations are all fully compatible with each other.

For those parts of the project being implemented by traditional DBB contracting, the responsibility for the design remains with the design engineering/architecture firms that are contracted to produce the Final Design contract documents, while the contractors'

responsibility will be to build to those contract documents. The grantee's responsibility remains one of review and oversight no matter which contracting method is undertaken, although in the traditional method, that process can be more deliberate and the grantee can maintain greater control over the end product.

Constructability

The Project is constructible as designed and organized. For such a massive project, there are certain to be some difficulties and unforeseen circumstances, but the grantee has put controls in place to handle such situations. The greatest challenge is likely to be coordination between the different entities on the project – between those working on different line segments, the MSF, CSC, and the various station contract packages. The CSC, in particular, will be interfacing with all the other contracts, both as a systems and vehicle contractor and as the ultimate operator of the entire transit system.

Systems and Vehicle Design

The RFP Part 1 documents for the CSC were issued on April 8, 2009. RFP Part 2 was issued on August 17, 2009. The PMOC received the RFP Part 2 documents for the CSC on May 12, 2010. Technical and price proposals were received on June 7, 2010, with price proposals valid until December 4, 2010. The grantee held a first meeting with each offeror during the week of August 8, 2010 to address technical and quality components of their respective proposals. Informational meetings with the offerors were also held the week of September 20, 2010. The grantee issued a Request for Best and Final Offers (BAFO) on November 4, 2010. On March 22, 2011, the grantee announced the award of the CSC to Ansaldo Honolulu Joint Venture (AHJV).

Each of the three bidders had Proven System Technology and had provided systems technology in accordance with the specification, including its major critical elements and subsystems such as Automatic Train Control, Traction Power, Security, Communication Infrastructure, and Vehicles.

By its process of choosing a CSC, the grantee has put the final determination of the systems design and vehicle design compatibility in the hands of that entity. It is certain that the technologies used will be compatible with the planned operations of the Project. The OP 32C expectations for "the best performance at a reasonable cost" were the whole premise of the CSC selection process. "Reasonable cost" for anything on this project is a relative term, as the construction of an entirely grade-separated and automated rail line in such a setting will far exceed the cost of most light rail systems. There is greater hope for a system that can realize "best performance," as the grantee's selection of its type of vehicle and guideway are quite appropriate for this corridor.

The PMOC also participated in a workshop on August 31-September 1, 2010 with the grantee, PMC and the GEC to discuss the CSC Terms and Conditions and obtain a general understanding of how the RFP Part II documents were developed. The grantee provided a list of the makeup of the evaluation and technical committees to allow a better assessment of the grantee's approval process.

The PMOC had identified numerous issues and questions related to the systems design that required grantee clarification. The grantee provided responses to the PMOC concerns in February 2012. The PMOC will continue to monitor development of the systems components for the Project to ensure all issues are adequately addressed.

Comparison to Industry Norms

The transit system being installed by the grantee is more akin to a grade-separated elevated heavy rail line or an automated airport people mover than it is to the now-ubiquitous light-rail system that has become prevalent in the US. Vancouver, BC's SkyTrain is the touted example of a North American system more closely related to the Project, while the Copenhagen Metro is the European prototype for the system proposed by Ansaldo Honolulu Joint Venture, the CSC contractor. Both systems have proven to be capable of reliably serving passenger counts in excess of those anticipated in Honolulu.

Findings/Recommendations in Order of Importance

Coordination between the grantee and its various contractors and between different contractors remains one of the foremost challenges of the project. The letting of some contracts much earlier than others could affect the way that subsequent work can be done. Controlling schedule costs in early-issue contracts is a crucial need, since one DB contract is already underway and several others are imminent, even though the project still lacks an FFGA.

Station design must be progressed to create biddable construction packages for all 21 proposed stations. Only three stations (along Farrington Highway) have been designed beyond the PE stage, while most of the others have regressed to a conceptual design status, due to drastic scope changes brought on by cost reduction and value engineering proposals. Implementation of modular design elements is expected to help control costs, but there remains a degree of uncertainty over the universality of their application.

The grantee is in the process of establishing agreements with all government bodies or public agencies affected by the project, including HDOT, FAA, HNL, DHHL, and USN, and with all utilities whose lines parallel or intersect the alignment. Lines of communications will be essential with each of those entities to assure efficient project implementation.

Procurement activities must adequately address Buy America requirements for escalators and elevators, major system components (>$100,000), rail, steel, and vehicles, as well as Ship America requirements.

3.3.8 Scope Review Checklist

The following provides the PMOC assessment of the project scope per OP 32C, Appendix B:

Project Delivery Method, Contract Packaging
1. *Site investigation and geotechnical studies will be available to construction contractors.* The grantee provided bidders site and geotechnical data in the form of Geotechnical Data Reports and Geotechnical Baseline Reports.
2. *The General Conditions, Supplementary Conditions, Division 1 of the Specifications and other contract documents adequately describe, for bidding construction contractors, project site access; schedule; unit prices; provisions for increased and decreased compensation through incentives and liquidated damages; risk allocation as related to unforeseen conditions including geotechnical conditions; the construction contractor's design/engineering scope of work; mobilization costs; cash flow in general including pay schedule; requirements for bonds, insurance, taxes; maintenance and warranty provisions; contractor field management and supervision; socio-economic requirements related to bidding; among other things.* The General Conditions specifications adequately describe all of the above requirements that apply. Geotechnical Baseline Reports for each segment adequately assign risk responsibility and outline how the baseline will be applied to "Differing Site Conditions."
3. *Market conditions are considered* a) *Market conditions for the state/regional/local construction economy for the general contractors/subcontractors on public works and private;* b) *Market conditions for the national construction economy for transit general contractors/subcontractors.* c) *Availability of labor for various trades such as electricians, etc.* d) *Availability of major materials at the bulk commodity level (fuel, cement, steel, copper, plywood/lumber, etc.) and the finished component level (traction power supply and distribution, train control elements, vehicles, microprocessor equipment, etc.)* e) *Availability of construction equipment/sequencing/timeframe requirements for specially designed, or project specific equipment such as cranes, launching girders, pre mix plants, barges, etc.* The Project has considered the market conditions and, for that reason, has expedited the issuance of its DB contracts. The Hawaiian Islands economy will likely always pay a premium for commodities and for specialized labor, particularly if imported, but the grantee has so far been able to contain costs by contracting during a soft economy. There is still a fear that, as the project moves into its later-issued contracts, the economy may have rebounded and commodity/labor costs increased beyond expectations. These are risks to account for in the proper setting of contingencies. There is also the possibility that the specialized construction of the elevated guideway may not attract multiple bidders, which could happen if contractors that were not successful in bidding on the earlier contracts decide that they cannot or choose not to compete with those contractors already engaged in project work. The resultant lack of competition could lead to higher prices on those later contracts.
4. *Accessing and occupancy of project construction sites* Most of the guideway route and, hence, most of the project, is to be built within public street and highway rights-of-way. For that reason, an agreement and a good working relationship and understanding is necessary with the agencies that own and manage those rights-of-way, including HDOT, HNL, Leeward Community College, USN, Ala Moana Center, and other departments within the grantee (City and County of Honolulu) organization. While most of these agencies have shown a willingness to cooperate with the grantee, nothing can be guaranteed about the success of these relationships until agreements are in place. The Final Design Roadmap includes a list of agreements that is being tracked by the PMOC and the grantee on a monthly basis. To date, there have not been

schedule issues associated with such agreements for the WOFH DB Contract. Other properties upon which construction will occur will need to be purchased before they can be occupied; access may be made available before purchase for surveying purposes. One known issue to date was the acquisition of the required property to establish a concrete pre-cast facility, which has been resolved by selection and acquisition of a new site.

5. *Contract packaging and structuring:*

a) *Tradeoffs have been considered between large size contracts which are often more efficient due to coordination and scheduling constraints and small contracts that can attract industry interest and increase the number of bidders. Where small contract packages are used, they have been kept small enough to allow mid-sized contractors to bid without teaming as joint ventures (which tends to yield higher costs);*

Contracts that have been bid or awarded so far have trended toward large contractors, and there have been a limited number of bidders. Remaining contracts for the Airport, City Center, and stations are yet to be advertised (that will follow Final Design in these traditional DBB contracts). Chances for smaller bidders are best in the stations contracts.

b) *Construction industry information sessions have been held after advertisement in industry publications in order to attract regional, national, and international contractors.*

The grantee has held sessions where it has invited contractors to learn about work opportunities resulting from the Project. These have been held in conjunction with the Pacific Resource Partnership and sponsors of other large projects on Oahu. Nearly 100 contractors attended one such session on March 17, 2009.

c) *Timing of major bid activity, within schedule constraints, will be managed to maximize contractor competition, with consideration to other major project(s) status in the region such as highway or redevelopment projects;*

The Project will be the largest single construction project in Oahu during this decade, allowing it first choice of contract scheduling. Other highway or redevelopment projects may well wish to account for the bidding schedule of Project contracts when deciding on their own efforts to maximize contractor competition.

d) *Prequalification of general contractors or subcontractors has been considered to ensure quality, e.g., prequalification for experience with a type of construction, safety record, claims history, etc.*

The grantee has successfully used prequalification for its contracts issued or bid to date, and will do so again for future construction contracts, many of which will require specialized expertise.

e) *"Procurement only" contracts have been minimized, recognizing there is a higher claims risk when the installation contractor does not have full control of the materials.*

No "procurement only" contracts have been proposed to date on the Project. The MSF contractor has the responsibility to procure all trackwork material (rail, special trackwork, and the like), but that includes a great amount of track to be constructed in its own contract. The combination of all trackwork material procurement into one contract allows the project to obtain the best possible price, based on volume, while minimizing the work involved with specifying, approving, handling, welding, and storing trackwork material. It is true that the line section contractors will have to coordinate their work installing track with the availability of that material from another contractor, but that requirement should simplify the work of the line section contractors and should not affect the overall project schedule's critical path.

f) *Third parties:*

i. *Contract packaging for third-party construction contracts has been structured to maximize*

competition;

ii. *Third party procurement contracts have been utilized only where long lead time items will impact project schedule if purchased by construction contractor;*

No third-party contracts have been proposed for the Project.

Design Relative to Site and Geotechnical Conditions

1. *Site investigation*
   a) *pre-construction site reconnaissance visits have been made;*
   b) *Site boundary and existing conditions surveys are complete;*
   c) *Geotechnical investigations are complete;*
      i. *Subsurface exploration or laboratory testing program;*
      ii. *Identification of buried structures and utilities;*
      iii. *Identification of contaminated soils and other hazardous material;*

In order to minimize the risk normally related to differing site conditions, the grantee's engineers have conducted adequate site reconnaissance, performed sufficient subsurface investigation and field and laboratory testing, and prepared geotechnical data and baseline reports. Buried structures and utilities have been identified to the extent knowable. The location of potential contaminated soils has been identified in general.

Much of the work for subsurface investigation will take place or has already taken place during Final Design. For sitework, the FD and PE drawings and reports provide project definition sufficient for an FFGA.

2. *Design in response to geotechnical and other below-grade conditions is appropriate.*
   a) *Structural approach to ground conditions, subsidence, etc. is identified and resolved;*
   b) *Design of the rock support in the station caverns, the crossover caverns, the TBM tunnels, drill/blast tunnels, etc. is appropriate to rock characteristics (fracture planes, hardness and cleavage);*
   c) *Relative to subsurface conditions, selection of building type, foundation, and methods of construction is reasonable;*
   d) *Mass balance diagrams have been completed for vertical alignments on fill or cut;*
   e) *The design appropriately responds to identified buried structures and utilities, contaminated soils and other hazardous material on site, and provision for removal or remediation has been made.*

Geotechnical Data Reports for each segment provide sufficient data for preliminary design of foundations for aerial guideway structures. Project specific detailed geotechnical investigations have been or will be conducted during Final Design to develop enough geotechnical data to complete structural design of stations and other building foundations.

Since the stations will be mostly elevated with no underground construction for support facilities, little rock excavation is required. Adequate geotechnical baseline is provided for the preliminary design of anticipated foundation types.

The amount of borrow or waste material is not defined. Even though the majority of the grading for the project is restricted to one line section and the MSF, there will be some earthwork involved for each of the stations.

Potential contaminated materials have been identified in the proposed MSF area. In the case of contaminated soils and other hazardous material, when encountered on site, the contractors are responsible for stopping work and making plans for removal or remediation at a cost to be borne by the grantee. The grantee is aware of this issue and has included this item in its Risk Contingency Management Plan (RCMP) to account for this risk.

SCC 10 Guideway and Track Elements
Major or critical design decisions are defined, including rehabilitation or reuse of existing infrastructure, structures, facilities, or systems, including, but not limited to the following:
1. *Major or critical work details, structural element dimensions, design interfaces and physical interfaces are complete and well defined in terms of drawings, standards, criteria, specifications and contract package scopes;* Not all critical work details are complete for the two unfinished DBB design contracts, although the final track configuration is expected to closely resemble that shown in the FEIS. Some modifications are possible, such as those already presented to the grantee by the Airport Guideway designer, and these could have an effect on the project's final cost to construct. As these changes are based partly on cost-saving options and partly due to changed conditions encountered during final design, the overall effect on the budget may be either higher or lower than that of the current design.
2. *Structural systems are established and dimensioned to show number of spans, span length, substructure design, etc.; structural elements are advanced beyond simple span design.* The WOFH and KHG segments have advanced structural design elements far beyond simple span layout, to a point where the DB contractors for these line sections may soon begin concrete span fabrication. The WOFH segment has progressed the aerial superstructure design to accommodate construction of the post-tensioned trapezoidal box sections developed during preliminary design. The majority of the spans in this segment are simple spans erected using precast sections with use of a temporary erection truss. They are post-tensioned transversely as well as longitudinally. These simple spans range in length from 65 feet to 145 feet long with a majority of the simple spans having a length of 125 feet. A brief review of the plans for these simple spans indicates that they provide a constructible design that is consistent with the design criteria. Under service load conditions, these sections remain in compression under all combinations of dead and train (live) loads, which enhances the expected life of the structure. In addition to the simple spans, there is a single, five-span continuous unit composed of variable depth trapezoidal cast-in-place sections erected by the balanced cantilever method. The spans in this unit range in length from 213 feet to 343 feet. Review of the details of this unit and the erection and casting plans indicate they are appropriate for this type of construction. Superstructure design plans are also advanced on the KHG segment. These details are similar to those provided for WOFH as the KHG segment also has a post-tensioned simple span trapezoidal box section and a cast-in-place segmental continuous span unit. However, for the KHG segment, the available plans have instances where information necessary for construction is missing, such as the location of post-tensioning for the expansion and deviator sections of the simple spans, superstructure bearing details, and details of the cast-in-place segmental spans. Thus, for the KHG segment, the superstructure plans cannot be considered totally complete and ready for construction. The Airport and City Center DBB contractors are either yet to begin final design or are early in final design; nevertheless, the plans for those sections show the approximate number of spans and the design loading, intended composition, and approximate length of each, although detail and dimensioning are clearly incomplete. The section designers will be required to perform a formidable amount of design to bring these documents up to Final Design expectations. For a project almost entirely built on structure, this status is a significant challenge and inevitable risk.
3. *Work descriptions and definitions used in designs or specifications are consistent and uniformly applied;* PMOC has observed no inconsistencies in the documents prepared to date, but the grantee should be advised to continue to strive for uniformity as details and specifications are added during Final Design.

4. *Trackwork is advanced to a level where single line schematics of the track layout, plan and profile drawings, dimensioned layouts of turnouts and crossovers, and tabulations of track geometry (horizontal and vertical curve data) have been defined; alignment of tunnel structure referenced to the center line of track and base of rail; guideway sections inclusive of tunnel and station cross sections consistently show the distance from centerline of track to critical clearance points such as walls, walkways and edges of platforms;* The trackwork design is advanced to a level consistent with this description. The key factor in trackwork design, however, is the ability to adapt it as requirements of later-developed disciplines become known. It is not unusual for trackwork design, except for miscellaneous details and specifications, to be complete at the time of PE completion. This is useful, in that the other disciplines, e.g., civil, drainage, utilities, structures, systems, architecture and landscaping, can then begin their tasks of Final Design based on the established guideway configuration. It is normal then for the trackwork design to undergo changes to accommodate the needs of those other disciplines.
5. *Special trackwork is adequately defined;* The locations and typical detail drawings for special trackwork are defined.
6. *Tunnels are well defined in terms of access and egress, construction access and laydown, openings for stations, passage chambers, ventilation or emergency access shafts or adits, sections and profiles depicting cross sections of major tunnel features; cross checked to adjacent building foundations and coordinated with the vehicle's dynamic envelope, walkways, lighting, systems elements such as ventilation, communications and traction power and egress.* There are no guideway tunnels proposed for the Project. There is one pedestrian/station mezzanine tunnel to be built by cut and cover method as part of the Leeward Community College Station, but that feature is not part of this category (SCC 10 Guideway and Track Elements).

SCC 20 Stations / SCC 30 Support Facilities
Major or critical design decisions are defined, including rehabilitation or reuse of existing structures, facilities, or systems. Major or critical operational, maintenance (heavy and light, wayside, facilities, and vehicle), fire/life safety, security, and logistics (spares, rebuild, training, documentation) requirements, whether in the existing system or the project, have been defined. Major design decisions are well defined by the project documentation. The system is a new, automated, fully grade-separated light metro transit line that is backed by extensive sets of criteria, specifications, and drawings at this level; those documents cover all those expected aspects plus many that were not mentioned in the OP 32C guidance.
1. *Station and support facility architecture is established. The drawing package consists of site plans, floor plans, longitudinal and cross sections, elevations and details illustrating typical and special conditions; finish schedules;* Station drawings appeared to be well developed for PE, but have not been fully updated since the implementation of recent cost reduction measures and modular designs. Drawing updates for all but the FHSG include only revisions to architectural plans, sections and elevations. The typical set of drawings for each of the 21 stations included plans for parking lots, sidewalks, landscaping, right-of-way, demolition, grading, pavement parking, signing and striping, utilities, foundations, and framing. The drawings also included elevations, equipment layout, and details for vertical circulation. At most stations, these design details will need refreshing before the design can be advanced to final design completion. Modifications applying to all stations include the development of a modular footprint for the station entry/fare gate area and a separate ancillary module containing the TCCR and UPS equipment. The modules are intended to separate passenger and ancillary functions and provide a more cost effective

	approach to these elements. Other changes include reducing platform canopies from six to four bays; elimination of escalators for rises under 16 feet in height; changing entry area enclosures from glass to steel mesh; changing stair riser finish at all stations to concrete rather than granite veneer; and using exposed aggregate rather than colored and stamped concrete at station plazas. The Ala Moana Station has been completely changed, from a three-track station with an entrance building on the makai side to a two-track station with a building on the mauka side and most station services located on the mezzanine level below the center platform. Much detail remains to be added to the drawings and the grantee still must receive concurrence from the shopping center owner, the current owner of all the property for the station. The support facilities in the MSF complex include the Operations and Service Building, the Maintenance of Way Building, the Train Wash Facility, and the Wheel Truing Facility. All of the buildings have been extensively detailed in PE drawings, down to the equipment and furniture level. The MSF DB contractor has progressed the design to the 55% level, according to the grantee, although updated drawings have not been provided to the PMOC. There is still a concern about whether the MSF design will need further modification to accommodate the needs of the CSC.
2. *Within the site context, the building footprints are shown. The relationship of the building to grade and to adjacent facilities is clearly defined, as is provision for pedestrians and bicycles to access the public way from the building. Provision for motorized vehicles is also shown. Access to the buildings and within the buildings complies with ADA.*	The station and support facility drawings meet these requirements. Station integration with proposed new facilities (transit-oriented development) is not defined at this time but is anticipated to advance during Final Design as the project's pedestrian linkages are defined.
3. *Station building floor plans show vertical circulation systems including stairs, elevators, escalators, dimensioned platforms, work bays in maintenance facilities, support spaces for mechanical and maintenance access; agent area, fare gate area, etc.; the building structural system is established and dimensioned. Structural elements are advanced beyond simple span design.*	The station and support facility drawings meet these requirements, although most of the station designs need substantial updates to their PE-level drawings to correspond with the latest concept drawings that resulted from the application of cost reduction and value engineering changes.
4. *Building sections and elevations illustrate the relationship of the station to grade (below, on-grade, elevated structure);*	The station and support facility drawings meet these requirements, although most of the station designs need substantial updates to correspond with the latest concept drawings that resulted from the application of cost reduction and value engineering changes.
5. *Level boarding between the transit vehicle and the boarding platform complies with ADA.*	The system is specified to meet this requirement. It will be crucial to assure that this requirement is met through coordination with the CSC when all the actual vehicle characteristics are known. If the vehicle to be supplied requires some modification to the station dimensions, those changes will have to be made during Final Design of the stations.
6. *Mechanical, electrical and communications systems are described, including station, support facility and track area drainage, piped utilities, heating ventilation and air conditioning, smoke evacuation, power and lighting for the station, fire/life safety including NFPA, security systems, passenger information systems (PIS), fare vending machines, etc.*	The drawings include some plans and diagrams for mechanical, signal, communications, electrical,

drainage, HVAC, power and lighting, but the entire list of items will likely need to be better defined and detailed as Final Design progresses. Items in the communications, signal, and fare collection categories will need to be coordinated with the CSC contractor.
7. *Equipment is shown on floor plans and described in schedules on drawings or specifications;* Equipment rooms and provisions for equipment locations are shown on the floor plans. The MSF DB contractor will eventually provide manufacturer's specifications and shop drawings for equipment to be installed within the MSF. The CSC contractor will procure and install most station equipment (e.g., communications, train control, ticket vending, and entry gates). Coordination will be required between the CSC and other contractors to assure compatibility between designs.
8. *Design interfaces among disciplines are defined on drawings, in standards, design criteria, specifications and contract package scopes.* There are clear lines of demarcation for work in one contract and work to be done by an adjacent contractor. As the design progress, it will be doubly important to continue to make these distinctions and to assure that the work is done most efficiently in the manner as shown on the drawings. If certain work is better done by another contractor (to avoid having to remove or replace elements already in place, for example), the work division should be adjusted. As previously mentioned, interfaces between the systems and facility designers and builders must be carefully coordinated as design and construction or equipment installation proceed.

SCC 40 Sitework and Special Conditions
Major drainage facilities, flood control, housing types, street crossings, traffic control, and utilities are defined and physical limits and interfaces are identified, based upon site-specific surveying with digitized data integrated into alignment base mapping plan and profile drawings. The Project defines all of these elements in its line section drawings, which are based on digitized base mapping plans and profiles. Since it uses an elevated guideway almost exclusively, the Project has little adverse effect on drainage or flooding. Drainage from the elevated guideway structure is channeled to downspouts, which either feed into storm drains or disperse water onto green space over splashblocks. Where the alignment crosses streams, it usually does so within the limits of a single span, so even its piers do not inhibit stream flow. Plans for street crossings, except within the MSF, are all for streets going under the guideway. Roadway plans are supplemented by traffic control plans and staged detour drawings. Utilities appear to be completely identified, although detailed design of relocations has not been completed.
Major or critical design decisions are defined, including rehabilitation or reuse of existing structures, facilities, or systems, including, but not limited to the following:
1. *Refer to Design Relative to Site and Geotechnical Conditions above;* The PE design of the two DBB line sections (WOFH and KHG) as presented does not differentiate between differing site and geotechnical conditions. The guideway construction is very much standardized, except for a handful of locations where longer spans are required to navigate the route over infrastructure already in place, such as where long flyover bridges are used to cross over limited access highways. The existing limited access roadways are essentially left in place and the guideway profile is adjusted to go over them. Any differing geotechnical conditions will be accounted for during the evaluation of the project-specific geotechnical investigation and during Final Design. This has already occurred on the two DB line sections, WOFH and KHG.

2.	*Structural elements for retaining walls and other site structures are advanced in design.* For the two on-going DBB line section designs (Airport and City Center), structural elements are designed in a cursory manner – by size and type, but not in detail and dimension. Connections, rebar locations, and other structural detail design will be developed during Final Design. The structural design of the WOFH line section is nearly complete, and that of the KHG line section is progressing toward completion.
3.	*Major or critical work details, structural element dimensions, design interfaces, and physical interfaces are complete and well defined in terms of drawings, standards, criteria, specifications, and contract package scopes.* More detail is required during Final Design of the KHG, Airport, and City Center guideway sections, particularly regarding structures and physical interfaces.
4.	*Mass balance diagrams complete for vertical alignments on fill or cut are supported by complete site-specific surveys and soil investigations;* PMOC did not observe the presence of a mass balance diagram. Due to the nature of the guideway (mostly elevated), most of the significant grading to be done is in or near the MSF. The question then becomes, not how to move earth material from one end of the job to the other, but rather, just how much borrow or spoil will result from the construction. Ecologically, of course, it would be best if the project's earthwork was in approximate balance, unless a known source (for borrow) or destination (for excess soil) is available. The grantee's contractors, through their determination of means and methods, will need to account for the movement of borrow or spoil during Final Design.
5.	*The presence of buried structures, utilities, and contaminated soils which may have to be backfilled or which would otherwise be unavailable for backfilling, has been taken into account;* The possibility of unexpected underground structures, utilities, contaminated soils, and archaeological artifacts has been accounted for in setting of procedures and/or specifications.
6.	*Adequate construction access;* Access on public rights-of-way will be controlled in part by the agencies in charge of the streets or highways that the guideway is affecting. Access on private property is not allowed until the real estate in question is acquired or an easement is granted. The more congested parts of the corridor – Airport and City Center -- have not yet been prepared for bid; construction access will clearly be more difficult in these line segments. This must be addressed in the general provisions of those future construction contracts.
7.	*Access and staging areas are defined.* The DB contractors are to determine access and staging areas for their own line segments, but the DBB contracts may be served by pre-establishment of those sites by the grantee and its GEC. They are not currently available. The WOFH DB Contractor now intends to utilize an existing facility in the West Kalaeloa Business Park for pre-casting and prestressing of the concrete guideway segments. This facility replaces the GPRM Prestress site that was identified in the ROD. With receipt of FTA's LONP 2A on May 17, 2012, the contractor should now be able to finalize an agreement to use the West Kalaeloa site prior to the anticipated start date of June 2012 for pre-casting and prestressing of concrete guideway segments.

SCC 50 Systems
1. *System (Wayside and Facilities), Trackwork (Running and Special)and Vehicle (revenue and non-revenue) descriptions, functionalities, reliabilities, technologies (level identified and cost effectiveness known) and performances are defined. Major equipment (for the control room, substations , crossings, tunnel ventilation and traction power) is well defined and identified in terms of specifications, bills of materials, standard drawings and specifications, general arrangements and standard details, and single line drawings (similar to industry process and instrumentation diagrams, high level logic design).* Much of the systems design will be determined by the CSC as that contractor proceeds with its final design. By using a DBOM contract for vehicles, systems, and operations, the grantee has transferred responsibility to that contractor for most of the systems design, construction, installation, and testing. The grantee did express its requirements for the system in its bid documents for the CSC, but the CSC contractor will have some leeway in the actual definition of the systems. The result will be a state-of-the-art system that is tailored to the actual vehicle being used. The Train Control requirements identified in the CSC RFP Part 2 documents detail the functional requirements for turnkey services, including the design, manufacture, installation, and testing for an Automatic Train Control (ATC) system on the Project system.
2. *Signaling and Train Control* a) *Operations analysis has determined the most efficient location of interlockings based on track layout, headways, train lengths, braking tables as well as requirements of each interlocking and its control limits.* Operations analyses have been used in determining interlocking locations and requirements. Further operations analysis has been completed by the CSC contractor as part of its proposal documentation, to determine final track circuit locations, control limits and operational timing of interlockings. It is likely that as the design progresses through Final Design, additional operational analysis will be required to further refine the operational parameters and more closely address the phased incremental delivery of revenue services. Guideway interlockings, crossovers, and turnouts will be provided with an Automatic Train Protection (ATP) function to allow trains on adjacent tracks to traverse the interlocking areas safely, whether for straight routing or for crossing from one track to another. The ATP will prevent the automatic or remote manual unlocking and movement of track switches until the train has cleared the interlocking. The Project uses Number 10 double and single crossovers, Number 10 turnouts for the east and west yard leads, Number 8 turnouts for yard transfer track leads and Number 15 turnouts for some future extensions. The Project uses Number 6 turnouts for the yard. Maximum speed in the yard is 10 mph. Maximum rated diverge move speeds are 20 mph for Number 8 equilateral and Number 10 turnouts except that, where the civil design imposes restrictions, a switch layout may be modified such that it must be rated for a lower turnout speed. Trains approaching switches set for a diverging move will reduce their speed under control of the ATP system such that the train speed does not exceed the rated speed for the turnout when the head end of the train enters the switch. The restricted train speed will be maintained by the ATP system until the last car of the consist is clear of the switch area of the turnout, conditional on any affiliated civil restrictions with the switch area. b) *Track plans have been sufficiently developed to define and identify vertical grades, horizontal and vertical curves, elevation, station platforms, switch point stationing, rail bonding and connection requirements as well as typical track circuit drawings.* The drawings sufficiently detail the track plans, grades, horizontal and vertical curves, elevations,

station platforms, and switch point stationing. The subsequent determination of signal requirements will dictate rail bonding, connection requirements and track circuitry. This work will be done by the CSC with some coordination between it and the line section designers or contractors to assure that the proper infrastructure is in place to meet the system's needs.

c) *Site specific requirements are defined (for signal structural work) and location drawings for signal enclosures*

Signal structures are not defined in the line section drawings. These will need to be incorporated after the CSC determines locations for signal enclosures. Per the Core Systems Design-Build-Operate-Maintain Design Criteria, wayside route indicators for interlockings are to be installed between the rails. This will require a high level of coordination between contracts and disciplines and may escalate costs.

In the CSC RFP Part 2 Plans, housings for signal equipment are shown to be of weathering steel or aluminum construction and will be equipped with shelves, racks, doors, and all associated hardware to properly secure the equipment. The house will be double insulated to reduce transfer of heat. Signal equipment housings will be pre-wired and prefabricated to the greatest possible extent. To facilitate maintenance, all racks will be accessible both front and back (hinged racks are permitted for wall mounted racks). Aisle way and /or rack spacing in signal houses and relay rooms will measure at least three feet between equipment. Cases will be made of aluminum, fiberglass, or stainless steel and equipped with neoprene sealing gaskets. Houses and cases will be grounded. The junction boxes are to be fiberglass or plastic with a captive hinged cover and sealing gaskets. Any openings for air circulation will be screened to prevent animal or insect incursion.

d) *Central instrument rooms (CIR), central instrument huts (CIH), central instrument locations (CIL), relay rooms; locations and sizes as well as room layouts (relay, termination, central instrument, power) are identified and defined.*

Some effort was made to show signal equipment within the Operations and Service Building in the MSF contract PE drawings. The assumptions made in determining the size and location of this equipment will be subject to final review by the CSC contractor and subsequent changes by the MSF contractor. Similar work will be necessary at many of the stations, where space is set aside for non-descript systems functions. The project has provided a room at each station that is to be used exclusively as a local systems equipment room. The concept of using these train control and communications rooms (TCCR) has been adopted as part of the overall systems integrated design solution, which forms the basic structure for the service control implementation.

e) *Signal cable routing methodology as well as power supply and distribution are identified and defined*

It is not currently clear how the signal and power supply cables will be integrated into the design of the guideway structures.

The train control system will support main line operations at 2-minute, 35- second headways between terminals, with maximum operating speed of 55 mph. End-of-line terminals are to be designed to accommodate the ultimate capacity of the System. Stations will have equipment rooms with space for wayside train control apparatus. OCC service controllers will have the capability to monitor and control train movements on the mainline and on MSF ready/layover tracks, but vitality will reside in field equipment.

The power distribution system will be such as to provide redundant power to operational critical equipment. Critical equipment will include UPS equipment, transfer switches and multiple, redundant power supplies. The UPS will have a two-hour capacity minimum. An outlet is also to be available for a connection to a portable generator. All power will be of a quality to assure safe and reliable operation of the train control equipment. All transformers and rectifiers will be rated to operate with a load at least 25% greater than the maximum circuit design load to which they are

applied. Surge arresters and equalizers will be used on electronic equipment to protect against damage caused by lightning and electrical transients. A definitive comprehensive redundancy/backup plan for both AC and DC power will be needed to determine the final requirements of this provision. This must be addressed during Final Design. The Project has already taken some steps to initiate this requirements definition by introducing some level of provision in the specs during the BAFO phases of the CSC procurement.

f) *Software and interface requirements (to facilities, existing system, and other system elements) are identified and defined*

The new transit system control systems are being proposed as near 95% turnkey solution/implementation as there are no existing systems currently in place with which they will interface. There are a number of discrete interfaces that exist between system components that can be considered "inclusive" or internal to the new set of subsystems being delivered, which are already completely defined.
There may be a requirement during the Final Design phase to examine external (to the transit control system) systems interface requirements, such as data and voice radio systems.

All interfaces have been adequately identified at this stage of design development. As the design progresses through Final Design, any external interfaces will be further refined and defined in more detail through a comprehensive set of interface control documents (ICD), specifying critical and non-critical interfaces existing both internally and externally to the new transit system. The required level of software integration will be determined from the ICDs, and the coding requirements and functional specifications for those interfaces developed as necessary.

g) *Maintenance, testing and training requirements are identified and defined (factory acceptance, site acceptance, field integration, start up, etc.)*

Equipment will be functionally tested at the supplier's or vendor's facility. Upon completion of installation, equipment is to be fully tested as integral components of systems to verify proper operation as designed.

3. *System Description*

a) *Built-in-place substations are identified, numbered and located with approximate spacing along the system route, ratings (MW) as well as the details (e.g. three-phase nominal 12.47–13.2 kV distribution circuit [Hawaiian Electric Company (HECO)]) and any exceptions.*

Substations are identified, numbered, and located at approximately a mile or mile-and-a-half spacing along the system route. Final determination of the substation and GBS locations, spacing, and ratings will be performed by the CSC using a load flow study calculation of the rail electrification network and a computer based simulation model to validate the quantities and ratings of the substations, gap breaker stations and the locations indicated in the RFP Part 2 Plans. TPSS facilities serve the purpose of transforming the 12.47 kV or 11.5 kV ac power from the Hawaiian Electric Company (HECO) utility system to a nominal 750 VDC system voltage, which is then distributed to the contact rail system. TPSS facilities include medium voltage ac switchgear, rectifier transformers, traction rectifiers, dc switchgear, and auxiliary equipment and devices as indicated in the RFP Part 2 Plans. Details of the exact incoming voltage will be established by HECO once the TPSS locations have been finalized by the grantee and the CSC.

b) *Nominal (full-load Vdc) project voltage is identified and basis of design and choice of project nominal voltage relative to system voltage is identified, voltage drop minimization, maximization of vehicle propulsion system performance, and train regeneration issues have been addressed.*

Nominal voltage for operations has been identified as 750 V dc. The CSC will be responsible for calculating voltage drops, maximizing vehicle propulsion system performance, and addressing train regeneration issues.

The Train Electrification System (TES) simulation model will resolve many of the electrical network dynamic needs, accounting for train movements and using a resolution of one second as the minimum time interval.

For the given train operations plan, the simulation analysis will consider operations with different dispatch times from the terminal stations, resulting in all possible timing offsets between trains moving in opposite directions. The analysis will account for the worst-case minimum train voltages and maximum RMS currents possible for the specified headways.

c) *Overhead contact system (OCS) is defined including conductor sizes relative to existing parts of system, as well as any supplementary parallel feeders to meet design requirements for substation out of service scenario.*

The Project will not use OCS since the vehicles will travel on an elevated guideway and rail vehicles will be powered from a contact rail system (third rail) as indicated in the CSC RFP Part 2 Plans. The sizing and characteristics of the conductor rail may have been pre-determined by the GEC, as this requirement has become part of the MSF in supplying the conductor rail. Unless the materials are not currently specified and fixed, the CSC will need to interface with the MSF supplier to ensure that the correct conductor rail is specified.

d) *AC Switchgear type (i.e. indoor, metal clad vacuum circuit type breaker, etc.), ratings (i.e., 15 kV, 500 MVA, etc.), relay protections provided (Phase overcurrent protection, Ground overcurrent protection, Negative sequence voltage relay, Rectifier overload relay, AC lock-out relay, etc.)*

The 15-kV class AC switchgear will be of the metal-clad, draw-out type. The AC circuit breakers will be vacuum type, 500 MVA class minimum, suitable for the available utility voltage and short circuit current. Details of the relay protection system will be determined by the CSC.

e) *Traction Power Transformer type (i.e. vacuum pressure impregnated dry type, etc.), ratings (i.e., 1110 kVA 65°C rise at 100% load, three phase, 60 Hz., ANSI and NEMA standards for extra heavy-duty service).*

All traction power substations will have one transformer-rectifier unit. The main components of the transformer-rectifier unit (TRU) will be rectifier transformer, traction rectifier, and interface transformer. The latter is required only in case of a diode rectifier.

The rectifier transformer will be three-winding, dry type, convection cooled, with one primary and two secondary windings suitable for double-way rectification per ANSI Circuit 31. The transformer is to be furnished with no-load taps providing for +/- 2.5% and +/- 5% transformation ratio adjustments relative to the neutral tap. The rectifier transformer is to be housed in a NEMA 1 indoor enclosure and installed as part of the substation equipment lineup.

The traction rectifier will be silicon diode based type, connected in accordance with Circuit 31 of ANSI Standard C34.2, to deliver a 12-pulse, double-way output.

The rectifier will be installed in a freestanding metal enclosure, and shall be air-cooled by natural convection.

The TRU rating will be in accordance with an extra heavy-duty traction load cycle defined as follows: After reaching a steady state temperature, the TRU shall run at 150% of its rated load for two hours. During this two-hour period, five equally spaced loads of 300% shall be imposed on the unit for a one-minute duration each. At the end of the two-hour cycle, a 450% load shall be imposed for 15 seconds. At the end of this duty cycle, there shall be no damage to the TRU or any of its components, and the equipment temperature shall be within acceptable limits.

The traction rectifier will be designed to provide the full power rating in case of failure of one diode in each bridge of the rectifier.

Safety interlocks will be provided for the transformer and rectifier doors, automatically de-energizing the equipment if opened.

f) *Power rectifiers are matched and assemblies capable of providing a stated output such as "twelve pulse, 825 VDC output at rated 100% load with the overload capabilities as specified in NEMA RI-9 for extra heavy-duty traction service." Harmonics in the utility power lines and the interference voltages due to residual ripple issues have been addressed in the design.*

System equipment is designed to avoid being adversely affected by radiated or conducted electromagnetic or electrostatic interference from trains or fixed sites and other electric/electronic equipment on or near public transit areas, including, but not limited to, the following: Trains operating within the guideway, fixed site equipment, cellular telephones, mobile radios, incidental (spurious) radiation equipment, ignition noise, lighting fixture, electrical power system transients, vehicular systems, and electrostatic discharge.

g) *DC Switchgear basis of design and choice of switches, busses and feeder breakers is identified and equipment list is complete.*

The grantee has identified switchgear requirements, but the CSC will provide final resolution of the equipment list after that contract is awarded and NTP is given.

The DC switchgear will be metal-enclosed type with safety enhancements, including automatic shutters on the stationary contacts of the DC circuit breakers. The maximum operating voltage of the DC switchgear will be 1000 V DC.

DC circuit breakers will be specifically designed for DC transit service and will be used to provide fault clearing and isolation capability for the substations and contact rail sections.

The DC circuit breakers will be single-pole, metal-enclosed, draw-out type, rated for 800 V dc nominal, and with maximum operating voltage of 1,000 V dc. The circuit breaker will be high-speed type, with short circuit interrupting capability per applicable IEEE standards.

DC feeder circuit breakers will be equipped with direct-acting instantaneous over-current release, load measuring, and automatic re-closure relaying. Transfer trip between adjacent traction power facilities will also be provided.

h) *Programmable Logic Controller (PLC) system, if provided, integrates and controls intercubicle functions and provides control, monitoring, and data logging at each substation.*

Programmable Logic Controllers (PLC) or microprocessor based devices, Multifunction Protective Relays (MFPR) furnished under this Contract will require external computers to reprogram the application software or change device settings. The CSC Contractor is to provide two sets of the required programming equipment, including all hardware, software, software license accessories, and related instruction manuals and label all software program versions to be used.

Interior equipment consisting of PLC, LCD Screen, and MFPR and all other components required to support the TPSS and GBS operation is to operate without performance degradation while operating within the parameters identified within the specifications. The equipment and devices inside traction power facilities will be designed and rated for operation at 122 degrees Fahrenheit ambient temperature.

i) *Substation grounding system basis of design and choice of separate AC and DC ground mats as well as stray current monitoring or testing, lightning arresters and protective relays and fault current*

contribution from the AC equipment to the DC equipment issues and utility system faults have been addressed.

Ground test stations, located near the opposite ends of the TPSS and GBS, will be provided for testing of the equipment ground grid. RFP Part 2 Plans.

All DC switchgear cubicles, and the rectifier enclosure, are to be isolated from the ground and bonded to a common copper ground bus connecting them to the substation ground mat through a protective device. The protective device may be either of the high-resistance or low-resistance grounding type. In either case, the protective device will detect positive-to-enclosure faults, upon which the entire facility shall be de-energized. It will also detect "enclosure grounded" type faults, upon which an alarm shall be raised.

For lightning and associated Isoceraunic Conditions, the design includes lightning protection of the TPSS and GBS for a seven-thunderstorm-days-per-year isoceraunic zone in accordance with UL 96 A – Lightning Protection, and NFPA 780 lightning protection requirements. The HECO medium voltage underground and open power supply cables and the Track Running Rail will be provided with properly coordinated lightning arresters as required in the CSC RFP Part 2 documents.

j) Minimum voltage at the pantograph is identified and the basis is established for locations during the sustained project headways with substations operating, or with "..." substations out of service. If substations are required, under-voltage conditions are identified with one substation out of service and the operation plan identifies mitigation measures.

The Project will not use pantographs since the vehicles will travel on an elevated guideway and rail vehicles will be powered from a contact rail system (third rail) as indicated in the CSC RFP Part 2 Plans.

The positive side will comprise a contact rail system, and positive DC feeders connecting the contact rail system to the substations and gap breaker stations. The negative side will comprise running rails, track impedance bonds (if necessary, depending on the train control system), cross-bonds, and negative return feeders connecting the running rails to the substations.

The contact rail will be top-running with electrical resistance not exceeding 0.002 ohms/1000ft at 20 degrees Celsius. The contact rail will be able to carry 4,000 amperes continuously with temperature rise not exceeding 45 degrees Celsius above ambient air, assuming 2 ft/sec wind velocity.

The CSC will determine the minimum acceptable train voltage based on calculations and load flow analysis that is performed to meet the requirement needed when one TPSS is out-of-service.

k) Overhead Contact Systems (OCS)

Not applicable.

4. Major or critical design decisions are defined, including rehabilitation or reuse of existing structures, facilities or systems, including but not limited to the following:

a) Pre-construction, site reconnaissance, geotechnical and soil resistivity surveys are complete;

These surveys will be completed during Final Design, although reconnaissance and geotechnical studies have been on-going activities.

b) Ground subsidence and structural protections issues have been resolved;

In the aerial structure guideway sections, potential subsidence can be addressed by foundation modifications. However, the cost of such modifications cannot be fully addressed until final

geotechnical investigations are complete.

c) *Structural elements are advanced beyond simple span design, or simply supported.*

The WOFH and KHG segments have advanced structural design elements beyond simple span layout, to a point where the DB contractors for these line sections may soon begin concrete span fabrication. The WOFH segment has progressed the aerial superstructure design to accommodate construction of the post-tensioned trapezoidal box sections developed during preliminary design. The majority of the spans in this segment are simple spans erected using precast sections with use of a temporary erection truss. They are post-tensioned transversely as well as longitudinally. These simple spans range in length from 65 feet to 145 feet long with a majority of the simple spans having a length of 125 feet. A brief review of the plans for these simple spans indicates that they provide a constructible design that is consistent with the design criteria. Under service load conditions, these sections remain in compression under all combinations of dead and train (live) loads, which enhance the expected life of the structure. In addition to the simple spans, there is a single, five-span continuous unit composed of variable depth trapezoidal cast-in-place sections erected by the balanced cantilever method. The spans in this unit range in length from 213 feet to 343 feet. Review of the details of this unit and the erection and casting plans indicate they are appropriate for this type of construction.

Superstructure design plans are also advanced on the KHG segment. These details are similar to those provided for WOFH as the KHG segment also has a post-tensioned simple span trapezoidal box section and a cast-in-place segmental continuous span unit. However, for the KHG segment, the available plans have instances where information necessary for construction is missing, such as the location of post-tensioning for the expansion and deviator sections of the simple spans, superstructure bearing details, and details of the cast-in-place segmental spans. Thus, for the KHG segment, the superstructure plans cannot be considered totally complete and ready for construction.

The Airport and City Center DBB contractors are either yet to begin final design or are early in final design; nevertheless, the plans for those sections show the approximate number of spans and the design loading, intended composition, and approximate length of each, although detail and dimensioning are clearly incomplete. The section designers will be required to perform a formidable amount of design to bring these documents up to Final Design expectations. For a project almost entirely built on structure, this status is a significant challenge and inevitable risk.

5. *Major or critical work details; structural element dimensions, design interfaces and physical interfaces are complete and well defined in terms of drawings, standards, criteria, specifications and contract package scopes.*

The WOFH segment design is essentially complete and the KHG segment design is underway, although still lacking certain superstructure information. For the Airport and City Center guideway segments, not all critical work details are complete and structural element dimensions are generally incomplete. Increased descriptions and definitions are required at interface points between the various contracts. Those two DBB segments remain at or barely above the PE level and each will require significant effort before those line sections' guideway design can be finalized. Nevertheless, the work done to date on those segments provides a project definition that exceeds what is normally expected at the end of PE. Significant coordination between different disciplines and contracts using the same space must be maintained throughout Final Design in order to avoid redesign and additional cost.

SCC 60 ROW, Land and Existing Improvements
1. *The real Estate Acquisition and Management Plan is complete. Real Estate documents and drawings identify the full takes, partial takes, easements and other right, possible eminent domain actions.*

The Real Estate Acquisition and Management Plan (RAMP) was accepted for entry into Final Design by the FTA on February 8, 2011.
2. *Site surveys include property lines and identify structures for building, site features, utilities; surface improvements such as streets and rights-of-way.* Project documentation provides sufficient detail to define properties, structures, utilities, and other site improvements along the right of way.
3. *The real estate information and survey information is fully coordinated with drawings of structures for guideways and buildings, site features, utilities, streets, railroads, transitways, construction easements, site access, and staging areas.* Real estate information is fully coordinated with the design as shown on the preliminary engineering drawings.

SCC 70 Vehicles
Vehicle (revenue and non-revenue) descriptions, functionalities, reliabilities, technology and performances are defined and drawn to the upper level of assembly, major equipment, (and) general arrangements of cabin and cab:
1. *System Functional Description has been developed and advanced to include the following:* a) *Definition of the subsystems that constitute the overall system* b) *Description, graphic depiction of each interface between subsystems* c) *Description of how each subsystem will meet the requirements of the specification.* The vehicle requirements identified in the CSC RFP Part 2 documents detail the functional requirements for vehicle characteristics, performance, reliability, and maintainability. These definitions include critical vehicle dimensions, aesthetic design, ADA compliance, supply voltages, noise & vibration levels, ride quality, acceleration/braking, weight, and subsystem Mean Distance between Component Failure (MDBCF) and Mean Time to Repair (MTTR). The functional requirements for vehicle critical subsystems such as carbody, trucks, couplers, doors, communications, lighting, propulsion, braking, and HVAC are also defined. In addition to describing interfaces between vehicle subsystems, interfaces between the vehicle and the project system interfaces are also defined. These include trackwork and alignment details, wheel-to-rail interface, traction electrification requirements, automatic train control interfaces, vehicle / shop interfaces, wireless LAN / high speed data link interfaces, and vehicle static and dynamic envelopes vis-à-vis station and other alignment clearances. Much of the vehicle detail design will be determined by the CSC as that contractor proceeds with its design. By using a DBOM contract, the grantee has transferred responsibility to that contractor for most of the vehicle design, manufacturing, assembly, and testing. The grantee did express its requirements for a service-proven vehicle in its bid documents for the CSC, but the CSC will have some leeway in the actual definition of the vehicle subsystems.
2. *Materials specifications have been developed and advanced to include lists of qualified materials, such as brake shoe composition, electrical components, refrigerants, lubricants, cleaners, paints/coatings, wiring, etc.* Material specifications are described in respective subsystem functional requirements; examples include: Electrical coupler contact block fabricated of a non-hygroscopic insulating material; passenger side windows of laminated, clear safety glass; interior lighting to utilize LEDs; high

efficiency disposable, pleated media filters for HVAC; etc. Additionally, requirements for materials compliance are specified with mandatory codes & standards (e.g. ADA, ASHRAE, ANSI, ASCE, ASME, ASTM, APTA, IEEE, NFPA, UL, and MIL).
3. Testing requirements have been developed and advanced to include the following: *a) High level Test Program Plan for both production and on-site acceptance should be underway (including requirements for factory inspection and testing, First Article and Pre-shipment inspections, static and dynamic testing and conditional acceptance).* *b) Maintenance and Training Requirements should be defined and identified, including development of maintenance and training requirements for new system elements.* Much of the vehicle detail testing will be determined by the CSC. By using a DBOM contract, the grantee has transferred responsibility to that contractor for most of the vehicle testing. The grantee did express its requirements for a high level Test Program Plan in its bid documents for the CSC. The CSC is required to prepare a Verification, Test, and Acceptance (VTA) Plan for grantee's approval. It will identify VTA organization, qualified personnel, and assigned responsibilities for all test planning, scheduling, performance, analyses, review of data, and reporting efforts. This plan will not only describe vehicle inspections & performance/acceptance testing, but will also define software verification and vehicle integration with the system elements involving trackwork, electrification, automatic train control system, and communications equipment. By using a DBOM contract, the grantee has transferred responsibility to that contractor for all of the vehicle maintenance and training. The grantee did express its requirements for the needed maintenance and training in its bid documents for the CSC. These include preparation of a maintenance plan, maintenance manuals, training plan & program, safety & security programs, emergency plan, failure management, dependability monitoring and epidemic failures, and spares provisioning.

SCC 80 Professional Services
1. The roles and responsibilities of (the) grantee's professional consultants (design, engineering, and construction management) may be distinguished from (the) grantee's own professional staff and manual labor. When (the) grantee's manual labor, equipment, and facilities are used to facilitate construction or to assist in construction of the project, a Force Account Plan and cost estimate should be provided. The division of work in alternative delivery contracts properly obligates the DB contractors for both construction and design support during construction. For traditional DBB contracts, the grantee itself or its own representatives will perform these CM and design support functions. Force account work will need to be identified in later versions of the project estimate.
2. Cost associated with construction – building contractors' management, labor, indirect costs, overhead, profit, and construction insurance should not be included in SCC 80 but in SCC 10 through 50 as appropriate. Cost estimates should conform to this allocation of cost. Compliance with this guidance has been confirmed based on a review of the Project estimate.

3.4 Additional Questions and Answers

Following initial review of this document by FTA, PMOC has added this section to answer specific questions regarding the level of completion and adequacy of the project documentation.

> *Does the project cover the design criteria, standards, and specifications and are they sufficiently complete at this stage of the project?*

PMOC concludes that the project documentation, in the form of design criteria, standards, design drawings, specifications, and reports, is at varying levels of completion. The WOFH segment is ready for construction and the KHG segment is nearing that state, while the other guideway segments and, particularly, the stations, require significant amounts of design development, which is not typical at this stage of the project (FFGA request).

What is PMOC's overall assessment of the project drawings, both as to completeness and quality of presentation and did PMOC identify any technical issues that require resolution?

PMOC believes the project drawings are complete, readable, clear, and understandable in what they present. The Airport and City Center Guideway Segments are proceeding from their PE level of development, while the station designs as presented do not currently reflect even that stage of design. The major technical issue with the drawings is the need to bring the station designs up to the level required for reliable estimating, particularly in response to the grantee's identification of further cost-saving changes to the stations. There are some technical issues that remain to be settled, as described in the Conclusions section of this report.

What is PMOC's assessment of the project's Value Engineering program? How many recommendations were received, how many does the grantee intend to implement, and what savings are expected to result?

The grantee sponsored VE workshops on station design and Airport and City Center Guideway design. The grantee also benefited from a program of ATCs, which have been received from bidders on the project's DB and DBOM contracts. To date, the grantee has accepted or conditionally accepted 79 of 154 such VE and ATC proposals, with an estimated value of up to $310 million in net savings. Such savings, of course, depend on the actual implementation of the changes and may be affected by the "conditions" in the "conditionally accepted" category and the amount of overlap between similar VE or ATC proposals. PMOC does not expect the savings or the implementation percentage to meet the projected totals, but does feel that the efforts were effective in at least inducing serious study of the project's assumptions.

What is PMOC's assessment of the design of the aerial guideway and the appropriateness, constructability, and cost effectiveness of its cross section, height and location of columns, and depth and design of footings and foundations?

The use of a precast, post-tensioned concrete box (single-cell) superstructure to support both tracks of the alignment provides a very good structural solution for the aerial guideway, if a single structural system is to be universally used for the alignment. It provides an economical and constructible design that can be applied for span lengths from 100 feet to 200 feet, which will be adequate for about 80% of the aerial guideway spans. This is especially the case where the use of simple spans erected with use of a temporary underlying truss can be utilized. Where site

conditions preclude this type of construction, alternate superstructure systems employing full span length units may be used to advantage. Other exceptions to the general use of the precast, post-tensioned simple span box would be for certain stream and highway crossings where longer spans are required. The open single cell box provides a relatively safe path for inspection of the superstructure and allows for strengthening, where required, by the addition of post-tensioning strands. This type of superstructure through this range of span lengths also allows for the employment of single columns founded on single large-diameter drilled shaft deep foundations for substructure support, except where the area beneath the pier must remain open. In that case, straddle type piers using two support columns may be necessary.

Similar to the superstructure, the proposed large diameter drilled shaft deep foundations provide an economical and constructible system for the aerial guideway if a single system of support is needed. Using a single drilled shaft instead of piling with a pile cap should limit disruption to adjacent properties during construction. Regarding column height, PMOC agrees with the guideway VE study that concluded that the guideway profile could be lowered and the height of columns reduced with a relaxation of certain alignment criteria, thereby reducing construction and operating costs and lessening the visual impact of the guideway on the community.

If it is not necessary to employ a single superstructure type, the use of alternate superstructure types for the Airport and City Segments such as prestressed, concrete girders should be investigated as a potential alternate. As suggested by the recent guideway VE study, use of prestressed, pre-cast girders with a cast-in-place deck could be more cost-effective, given site congestion and access issues. With the use of somewhat shorter spans (80' – 90'), multiple spans could be erected simultaneously without having to use an erection truss or gantry. This VE alternative was rejected by the grantee in the interest of uniformity and since further study showed that the financial advantages were not as great as the VE study first suggested.

Are the grantee's geotechnical design reports adequate?

Geotechnical Data Reports and Geotechnical Baseline Reports are provided for Segments 1 and 2. Geotechnical data reports and foundation technical memorandums are provided for Segments 3 and 4. The data, geotechnical interpretations, and the geotechnical parameter baselines provided for these segments are adequate for preliminary engineering design and conceptual cost estimates for various foundation types. The data and analyses are preliminary in nature, but adequate to limit or minimize any cost risk. The design/build contractor for any segment or Final Design consultant for the design-bid-build segments will require additional detailed geotechnical investigation to verify preliminary data, to independently take ownership of any and all recommendations included in the reports, and to develop new designs.

Preliminary geotechnical information provided for the MSF included only Geotechnical Data Reports. This information is not adequate for the design. At a minimum, a foundation technical memorandum should have been provided to

minimize risk. Detailed geotechnical investigation will be required to verify preliminary data and to prepare Final Design for foundations and flat works. The DB contractor will be responsible for acquiring and applying additional required geotechnical information. This can be completed during Final Design.

Are the grantee's station design drawings satisfactorily complete and acceptable, considering the phase of the project? Do the drawings reflect compliance with the Americans with Disabilities Act (ADA)?

PE Drawings dated September through December 2009 and the February 2012 In-Progress Submission for the FHSG provide sufficient level of detail for PE and conceptual cost estimates. The drawings for the remaining station contracts will require significant changes to address numerous review comments, cost reduction items and further refinement to "right size" the facilities as these proposed modifications were developed after completion of the PE Phase. These modifications will be completed during Final Design.

The station structures appear to be in compliance with ADA; however, site development was not to sufficient detail at PE to verify site compliance in terms of handicapped parking, accessible paths, grades, and curb ramps. Note that while the facilities may meet ADA, local community "buy-in" is often required to satisfy the local mobility impaired community. The station designers, and ultimately, the grantee, will need to take responsibility to ensure the completed station complexes comply with all federal legislation, including meeting ADA Requirements. This can be accomplished during Final Design.

What is the PMOC's assessment of the systems design for the fully automated driverless train operation, considering review of the CSC RFP, CSC workshop proceedings, design specifications, track configuration, headways, etc.?

<u>Service Level Performance Capability</u>

The CSC has identified certain inherent weaknesses in the original general design concept and has modified the train control design accordingly. One such modification was the introduction of the AFOIIC subsystem, to address accurate platform stopping and platform interlock dwell time rationalization. Further development of the train control system introduced the absolute permissive block (APB) operation, creating virtual interlocking sites to improve headways and provide for additional degraded mode functionality.

The CSC has successfully advanced this system over time and extended the underlying coded track based technology platform very effectively and sufficiently to maximize its potential. With increasingly greater demands placed upon system capacity and service performance metrics, the PMOC has some concern that the system may now be seen to be developed near to its limits and will not be able to meet the contractual performance requirements and any further

demands imposed by future line extensions and capacity upgrades. PMOC recommends that the grantee, with its CSC and MSF contractors, determine the performance requirements of an ATO yard and correlate them with proposed and future demand during Final Design.

Proven Technology and Keeping Pace with Industry

The specifying and use of "proven technology" always comes at a premium. Utilizing older established equipment that has proven to be reliable over many years of successful operational service often means using outdated technology. With today's focus on the importance of service performance and the rate of development and rollout of new control system standards and technologies, system solutions simply cannot keep pace with the rate of new and rapid technological advances. In this constantly technologically evolving climate, transit operators often find that new equipment becomes obsolete before reaching its natural or original design life expectancy.

The CSC has specified a composite distributed train control system based on traditional fixed block jointless track circuit technology that is dynamically velocity data encoded. Although proven to be safe and reliable in operation, flexible in configuration, and robust in nature, it is limited in its capability for future enhancement. As an example, the proposed system utilizes outdated standard interfaces such as IEEE RS232 asynchronous serial communications ports, where new Commercial off-the-Shelf (COTS) systems use improved USB 2.0+ and IEEE 802.1x RF WIFI interface ports. Since current leading edge computer hardware is not backwards-compatible with these older interfaces, there may also be some currently unidentified compatibility issues to resolve.

The CSC offered, for the same price, the option of an alternative train control system utilizing a more recently introduced "state-of-the-art" design solution and commercially accepted technology called Communications-Based Train Control (CBTC). This system solution, although it cannot be represented as "proven technology," adds significantly more scope for future enhancement, inherently more flexibility in the physical layer (installed infrastructure) to accommodate changes, and provision for better cost-effective future upgrades. Radio block-centered (RBC) CBTC is now being accepted and adopted by the global transit industry as the ERTMS (European Rail Traffic Management System), and in the U.S. as the preferred platform for PTC. A CBTC moving block implementation can more ably absorb any additional required changes necessary to keep pace with future changes in technology, operating protocols, regulatory requirements, performance metrics and industry standards.

As CBTC solutions gain more common acceptance and, over time, become fully "proven" as a technology, operators will gain more comfort in choosing them as a preferred option. It may be pertinent to investigate this option further and

evaluate the longer-term benefits of implementing this more modern train control design solution option.

System Implementation

The majority of the train control and interrelated subsystems and interfaces offered by the CSC have been proven by various installations currently operating on many international transit systems. Each target implementation has its own nuances and specifics that make it unique, as would be the case with the Project.

Although a great deal of the configuration called for in the requirements has been previously designed and proven, some new subsystems and interfaces that are required have not. It is important that these new subsystems are integrated at the correct level and that they provide for optimal operability in terms of safety, functionality, and automation.

Train Control Assessment Synopsis

The CSC has offered a centrally operated distributed train control system that meets the baseline functional and technical requirements of the desired system as specified by the grantee. Specific aspects of this composite set of subsystems have been modified and refined to align with the needs of this specific target implementation as required for the Project.

A more advanced and modern CBTC option has been offered by the CSC to the grantee at no additional cost. However, this is not presented as "proven technology" at this time, and as such, cannot meet the grantee design requirements as currently specified. The PMOC suggests that the grantee evaluate this alternative solution proposed by the CSC to determine if any long-term benefits can be realized over the original technology offered.

Although the proposed system purports to be satisfactory in terms of meeting the key baseline requirements outlined by the grantee about the physical infrastructure and assets utilized, the PMOC has concern regarding the design solutions' overall level of operability, front end automated functionality and service performance capability. The PMOC suggests further work to examine more closely the ability of the proposed system to meet the performance expectations of each operating line segment as it opens into revenue service, and determine the full peak service capacity, phased (partial) operating capability, and limitations to future system upgrades. The PMOC also recommends further work to fully define and evaluate the full operational and performance requirements of the MSF working in ATO and its relationship and impact to proposed mainline services and the system level operations plan. PMOC's OP32A review contains a more detailed performance and operations synopsis.

It is essential to determine the most appropriate, safe, and effective methodology of interfacing new Project specific subsystems to the offered proven train control base system provision. The correct application of safety-related subsystems at the highest level of automation is very desirable. The PMOC recommends that the grantee review this area for optimal functionality as part of its due diligence.

The PMOC has identified numerous issues and questions related to the systems design that require grantee clarification. These items were identified during a review of the selected proposal and will need to be resolved during Final Design. A future workshop will be held to discuss these issues.

List documents that are acceptable or that still need to be revised in order to move the project into the next phase, a Full Funding Grant Agreement and construction.

Since the proposed FFGA is anticipated prior to completion of final design, PMOC cannot list all the documents that are not provided but would normally be provided prior to a project meeting this milestone. Virtually all the PE drawings for the Airport and City Center Guideway Segments and all the station design packages need to be developed to 100% Final Design status. Final design needs to be completed for the MSF and the KHG contracts, and the CSC needs to be advanced from proposal-level to ready-to-build level of design and/or procurement.

3.5 Conclusion

The scope of the Project is well-defined and portions of the project are generally at a level of completeness necessary to support an FFGA application. However, it would have been preferable to have more nearly complete designs, particularly for the MSF, stations, systems, and DBB guideway sections. While it is not feasible for a project that has a significant portion that is ready for construction to await completion of final design for those portions that are not ready, it is advisable to acknowledge the project risks in acquiring an FFGA at this time. At a minimum, the grantee should have in place, on the day it receives an FFGA, all the means, methods, tools, and personnel necessary to meet the recommendations in Section 3.6 of this report and all controls it needs to successfully implement the agreed-to project within its budget and schedule.

Nevertheless, using the terms listed in Section 3.1, PMOC found no discrepancies in the Project documentation's internal consistency, compliance with laws, regulations, and policies, bid-ability, and constructability. PMOC did, however, note the following:

- Coordination between the grantee and its various contractors and between different contractors remains one of the foremost challenges of the project.
- Station design must be progressed to create biddable construction packages for all 21 proposed stations.
- Agreements must be completed with all government bodies, public agencies, and utilities affected by the project.
- Procurement activities must adequately address Buy America requirements for escalators and elevators, major system components (>$100,000), rail, steels, and vehicles, as well as Ship America requirements.

3.6 Recommendations

The PMOC recommends the following actions be taken upon receipt of an FFGA:

(1) The grantee's design contractors must complete designs for the MSF, stations, systems, and DBB guideway sections, and the grantee must implement controls that assure that these final designs meet the requirements of the Project as defined in the FFGA.

(2) The grantee must work with the CSC to resolve capacity issues (see OP 32A) and implement project controls to coordinate CSC work with that of other contractors.

(3) The grantee must identify project management staff as planned in order to maintain control of the various concurrent projects.

(4) The grantee must manage the schedule and budget by implementing controls as described in its project management plans throughout construction.

(5) The grantee should place controls on allowable costs for each station and implement cost-saving mitigation measures as soon as necessary to keep the station construction costs in line.

(6) The grantee should complete any unfinished effort to acquire agreements with all affected agencies and begin the process of cooperation that those agreements entail. While most of these agencies have shown a willingness to cooperate with the grantee, nothing can be guaranteed about the success of these relationships until agreements are in place. The FFGA Roadmap includes a list of agreements that is being tracked by the PMOC and the grantee on a monthly basis.

(7) The grantee should continue the process of updating the Project budget and schedule, incorporating information from contracts-in-progress, any accepted cost reduction measures, and from completed tasks as they occur.

(8) The grantee should continue to be proactive in assuring that all of its contractors meet the requirements of Buy America and Ship America.

APPENDICES

Appendix A: List of Acronyms

A	Ampere
AA	Alternatives Analysis
AACE	Association for the Advancement of Cost Engineering
AC	Alternating Current
ACT ID	Activity Identification
ADA	Americans with Disabilities Act
AHJV	Ansaldo Honolulu Joint Venture
ANSI	American National Standards Institute
APB	Absolute Permissive Block
APS	Adjusted Project Schedule
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	ASTM International, nee, American Society for Testing and Materials
ATC	Alternative Technical Concept
ATC	Automatic Train Control
ATO	Automatic Train Operation
BAFO	Best and Final Offers
BCE	Base Cost Estimate
BEA	Bureau of Economic Analysis
BFMP	Bus Fleet Management Plan
BLS	Bureau of Labor Statistics
BOS	Basis of Schedule
BRF	Beta Risk Factor
BRIC	Brazil, Russia, India and China
CBTC	Communications-Based Train Control
CC	Community College
CE&I	Construction Engineering and Inspection
CER	Cost Estimating Relationship
CIH	Central Instrument Hut
CIL	Central Instrument Location
CIR	Central Instrument Room
CMP	Configuration Management Plan
CMS	Document Management System
COTS	Commercial off-the-Shelf
CPI	Consumer Price Index
CPM	Critical Path Method
CPP	Contract Packaging Plan
CPS	Construction Project Schedule
CPS	Current Probable Schedule
CSC	Core Systems Contract
DB	Design-Build
DBB	Design-Bid-Build
DBEDT	Hawaii Department of Business Economic Development and Tourism
DBOM	Design-Build-Operate-Maintain
DC	Direct Current
DEIS	Draft Environmental Impact Statement
DHHL	Department of Hawaiian Homelands
DOT	United States Department of Transportation
DTS	Department of Transportation Services

ECP	▪	Environmental Condition of Property
EDC	▪	Engineering Design Consultant
EIS	▪	Environmental Impact Statement
ENR	▪	Engineering News Record
ERTMS	▪	European Rail Traffic Management System
EUM	▪	Estimate Uncertainty Model
FAA	▪	Federal Aviation Administration
FAQ	▪	Frequently Asked Questions
FD	▪	Final Design
FEIS	▪	Final Environmental Impact Statement
FF	▪	Finish-Finish
FFGA	▪	Full Funding Grant Agreement
FMOC	▪	Financial Management Oversight Consultant
FS	▪	Finish-Start
ft	▪	Foot
FTA	▪	Federal Transit Administration
FY	▪	Fiscal Year
GBS	▪	Gap Breaker Station
GDP	▪	Gross Domestic Product
GEC	▪	General Engineering Consultant
GET	▪	General Excise Tax
GPRM	▪	Great Pacific Rocky Mountain
HART	▪	Honolulu Authority for Rapid Transportation
HDOT	▪	Hawaii Department of Transportation
HECO	▪	Hawaiian Electric Company
HHCTC	▪	Honolulu High Capacity Transit Corridor
HHCTCP	▪	Honolulu High Capacity Transit Corridor Project
HNL	▪	Honolulu International Airport
HVAC	▪	Heating, Ventilating, and Air Conditioning
ICD	▪	Interface Control Document
IEEE	▪	Institute of Electrical and Electronics Engineers
IPS	▪	Integrated Project Schedule
IRM	▪	Impacted Risk Model
KH (or KHG)	▪	Kamehameha Highway (or Kamehameha Highway Guideway)
kW	▪	Kilowatt
LCD	▪	Liquid Crystal Diode
LONP	▪	Letter of No Prejudice
LPA	▪	Locally Preferred Alternative
LV	▪	Low Voltage
M&I	▪	Manufacture and Install
MDBCF	▪	Mean Distance between Component Failure
MFPR	▪	Multifunction Protective Relay
MIL	▪	Military Specification
MOS	▪	Minimum Operating Segment
MOT	▪	Maintenance of Traffic
mph	▪	Miles Per Hour
mphps	▪	Miles Per Hour Per Second
MPS	▪	Master Project Schedule
MS	▪	Microsoft
MSF	▪	Maintenance and Storage Facility
MSS	▪	Master Summary Schedule
MTTR	▪	Mean Time to Repair
MVA	▪	Mega Volt Ampere
MW	▪	Megawatt
NBER	▪	National Bureau of Economic Research
NEMA	▪	National Electrical Manufacturers Association

NEPA	▪	National Environmental Policy Act
NFPA	▪	National Fire Protection Association
NGD	▪	Negative Grounding Device
NTP	▪	Notice to Proceed
O&M	▪	Operations and Maintenance
OBS	▪	Organizational Breakdown Structure
OCC	▪	Operations Control Center
OCIP	▪	Owner Controlled Insurance Program
OCS	▪	Overhead Contact System
OD	▪	Original Duration
OD	▪	Original Duration
OP	▪	Oversight Procedure
PA	▪	Programmatic Agreement
PB	▪	Parsons Brinckerhoff
PE	▪	Preliminary Engineering
PHF	▪	Peak Hour Factor
PLA	▪	Project Labor Agreement
PLC	▪	Programmable Logic Controller
PMBOK	▪	Project Management Institute's Body of Knowledge
PMC	▪	Project Management Support Consultant
PMO	▪	Project Management Oversight
PMOC	▪	Project Management Oversight Contractor
PMP	▪	Project Management Plan
PPI	▪	Producer Price Index
QA/QC	▪	Quality Assurance/Quality Control
QMP	▪	Quality Management Plan
RA	▪	Risk Assessment
RAM	▪	Responsibility Assignment Matrix
RAMP	▪	Real Estate Acquisition and Management Plan
RBC CBTC	▪	Radio Block-Centered Communications-Based Train Control
RCMP	▪	Risk and Contingency Management Plan
RFMP	▪	Rail Fleet Management Plan
RFP	▪	Request for Proposals
rms	▪	Root Mean Squared
ROD	▪	Record of Decision
ROW	▪	Right-of-Way
RSD	▪	Revenue Service Date
RTD	▪	Rapid Transit Division
SBS	▪	Schedule Breakdown Structure
SCC	▪	Standard Cost Category
SF	▪	Start-Finish
SOA	▪	State Oversight Agency
SS	▪	Start-Start
SSCP	▪	Safety and Security Certification Plan
SSMP		Safety and Security Management Plan
TC	▪	Train Control
TC&C	▪	Technical Capacity and Capability
TCCR	▪	Train Control and Communications Room
TCRP	▪	Transit Cooperative Research Program
TES	▪	Train Electrification System
TPM	▪	Office of Program Management
TPSS	▪	Traction Power Substation
TRB	▪	Transportation Research Board
TRU	▪	Transformer-Rectifier Unit
TVM	▪	Ticket Vending Machine
UH	▪	University of Hawaii

UHERO	▪	University of Hawaii Economic Research Organization
UL	▪	Underwriters Laboratories
UPS	▪	Uninterruptible Power Supply
US	▪	United States of America
USB	▪	Universal Service Bus
USDOT	▪	United States Department of Transportation
USN	▪	United States Navy
V	▪	Volt
UITP	▪	International Association of Public Transport and
UTO	▪	Unattended Train Operation
VDC	▪	Volts, Direct Current
VE	▪	Value Engineering
VTA	▪	Verification, Test, and Acceptance
WBS	▪	Work Breakdown Structure
WOFH	▪	West Oahu/Farrington Highway
YOE	▪	Year of Expenditure

Note: The above list includes all acronyms identified in the various OP deliverables.

Appendix B: Documents Reviewed

Document	Rev. No.	Date
Management Plans/Administrative		
Final Environmental Impact Statement (FEIS)	-	25-Jun-10
Programmatic Agreement (PA)	-	18-Jan-11
Record of Decision (ROD)	-	18-Jan-11
Project Management Plan (PMP)	4.1	Feb-12
Quality Management Plan (QMP)	1	05-Feb-12
Real Estate Acquisition and Management Plan (RAMP)	5	31-Jan-12
Bus Fleet Management Plan (BFMP)	3	Mar-12
Rail Fleet Management Plan (RFMP)	0.1	Mar-12
Safety and Security Management Plan (SSMP)	3A	28-Feb-12
Safety and Security Certification Plan (SSCP)	2A	01-Mar-12
Configuration Management Plan	0.2	07-eb-12
Staffing and Succession Plan	4	09-Feb-12
Operating Plan	0.1	Mar-12
Force Account Plan	0.3	05-Jan-12
Mitigation Monitoring Program	0	15-Mar-12
Interface Management Plan	0.1	17-Jan-12
Risk Contingency Management Plan	Pending	Pending
Contract Packaging Plan	2	19-Mar-12
Claims Avoidance Plan	0.1	24-Jan-12
Construction Management Plan (CMP)	0.1	03-Feb-12
Contract Resident Engineer Manuals (DB & DBOM)	0.1	Feb-12
Contract Resident Engineer Manual (DBB)	A	15-Feb-12
1.PP-01 – Procedures Index	0	15-Mar-12
1.PP-02 – Procedure Development Process	0.1	12-Mar-12
1.PP-03 – Standard Terms, definitions, and Acronyms	0.1	12-Mar-12
1.PP-04– Baseline Documents Revision and Control	0.1	12-Mar-12
1.PP-05 – Identification of Badge Policy	0.1	15-Mar-12
2.PA-01 – Security Sensitive Information (SSI)	0.1	12-Mar-12
2.PA-02 – Procurement Control	0.1	12-Mar-12
2.PA-03 – Email Management	0.1	12-Mar-12
2.PA- 04- Project Wide Document Control	0.1	12-Mar-12
2.PA-05 – Project Library	0.1	12-Mar-12
2.PA-06 – Community Relations and Media Contacts	0.1	12-Mar-12
2.PA-07 – RTD Training Procedure	0.1	12-Mar-12
2.PA-08 – Policy for Safeguarding Protected Information	0.1	12-Mar-12
3.PM-01 – Contract Management System	1.1	14-Mar-12
3.PM-04 – Public Information Communication	0.1	15-Mar-12
3.PM-05 Meeting/Minutes	2.1	12-Mar-12
4.PC-02 – Project Management Control	0.1	15-Mar-12
4.PC-03 – Project Progress Reports	0.1	15-Mar-12
4.PC-04 – Program Scheduling	0.1	15-Mar-12
4.PC-05 – Project Accounting	0.1	12-Mar-12
4.PC-06 – Cost Estimating	0.1	12-Mar-12
4.PC-07 – Cost Control	0.1	12-Mar-12
4.PC-08 – Risk Management	0.1	12-Mar-12
4.PC-09 – Contingency Management	1	15-Mar-12
5.CA-01 – Contract Administration	0.1	15-Mar-12
5.CA-02 – Contract Change Management	0.1	14-Mar-12

Document	Rev. No.	Date
5.CA-03 – Contractor Progress Payments	0.1	13-Mar-12
5.CA-04 – Contractor Progress Reports	0.1	13-Mar-12
5.CA-05 – Contract Change Orders	0.1	13-Mar-12
5.CA-06 – Contract Closeout	0.1	13-Mar-12
5.CA-07 – Claims and Disputes Resolution	0.2	14-Mar-12
5.CA-08 – CACO and Contract Amendment Procedure	0	14-Mar-12
6.CM-01 – Submittal Procedure	1.1	14-Mar-12
6.CM-02 – RFI Procedure	2.1	14-Mar-12
6.CM-03 – RFC Procedure	0.2	14-Mar-12
6.CM-05 – Interface Management and Coordination Procedure	0.1	12-Mar-12
7.GA-01 – Board – Staff Interaction	0	17-July-11
7.GA-04 – Petty Cash Fund	0	17-July-11
7.GA-06 - Travel	0	17-July-11
7.GA-07 – Preparation of Board Materials	0	20-July-11
Technical		
Design Criteria		
Chapter 1 – General		15-Mar-12
Chapter 2 – Operations		15-Mar-12
Chapter 3 – Environmental Considerations		15-Mar-12
Chapter 4 – Track Alignment and Vehicle Clearances		14-Feb-12
Chapter 5 – Trackwork		15-Mar-12
Chapter 6 – Civil		15-Mar-12
Chapter 7 – Traffic		15-Mar-12
Chapter 8 – Utilities		15-Mar-12
Chapter 9 – Structural		15-Mar-12
Chapter 10 – Architecture		10-Feb-12
Chapter 11 – Landscape Architecture		15-Mar-12
Chapter 12 – Passenger Vehicles		10-Feb-12
Chapter 13 – Traction Electrification		15-Mar-12
Chapter 14 – Train Control		15-Mar-12
Chapter 15 – Communications and Control		15-Mar-12
Chapter 16 – Fare Vending		15-Mar-12
Chapter 17 – Corrosion Control		15-Mar-12
Chapter 18 – Maintenance & Storage Facilities (MSF)		14-Feb-12
Chapter 19 – Facilities Mechanical		15-Mar-12
Chapter 20 – Facilities Electrical		15-Mar-12
Chapter 21 – Fire and Intrusion Alarm Systems		15-Mar-12
Chapter 22 – Elevators and Escalators		15-Mar-12
Chapter 23 – Fire/Life Safety		15-Mar-12
Chapter 24 – Systems Assurance		10-Feb-12
Chapter 25 – System Safety and Security		15-Mar-12
Chapter 26 – Sustainability		14-Feb-12
HART Directive Drawings		3-Nov-10
HRTP Standard Specifications		15-Feb-12
West Oahu/Farrington Station Highway Final Design Drawings		Various
Geotechnical Data Report (WOFH)		27-Mar-09
Supplement to Geotechnical Data Report (WOFH)		15-May-09
Geotechnical Baseline Report (WOFH)	2.0	Aug-09
Kamehameha Highway Interim Design, Advanced Interim Design, and Final Design Drawings		Various
Kamehameha Highway Segment Geotechnical Baseline Report	1.1	07-May-10
Kamehameha Highway Geotechnical Data Report		16-Feb-10

Document	Rev. No.	Date
Kamehameha Highway Geotechnical Data Report Addendum		7-May-10
Airport Preliminary Engineering Drawings, Volumes 1-3		1-Oct-10
Airport Geotechnical Data Report		8-Feb-10
Airport Fixed-Guideway Foundation Technical Memorandum		6-Feb-10
City Center Preliminary Engineering Drawings, Volumes 1-4		6-Oct-10
City Center Geotechnical Data Report		26-Feb-10
City Center Fixed-Guideway Foundation Technical Memorandum		26-Feb-10
East Kapolei Station Updated Design Plans		9-Mar-12
UH West Oahu Station Updated Design Plans		9-Mar-12
Hoopili Station Updated Design Plans		9-Mar-12
West Loch Station In-Progress Submission		29-Feb-12
Waipahu Transit Center Station In-Progress Submission		29-Feb-12
Leeward Community College Station In-Progress Submission		29-Feb-12
Pearl Highlands Station Updated Design Plans		9-Mar-12
Pearlridge Station Updated Design Plans		9-Mar-12
Aloha Stadium Station Updated Design Plans		9-Mar-12
Airport Station Group Updated Design Plans		9-Mar-12
Dillingham Station Group Undated Design Plans		9-Mar-12
Kaka'ako Station Group Updated Design Plans		9-Mar-12
Ala Moana Station Updated Design Plans		9-Mar-12
Guideway Superstructure Study – Summary Report		22-May-08
Structures Workshop Summary Report		7-10-Jan-08
Systems Workshop Presentation		22-Aug-08
Transportation Technical Report		1-Aug-08
Construction Workshop Frequently Asked Questions (FAQ)		12-Jun-08
Construction Workshop Presentation		12-Jun-08
Environment Condition of Property, NAVFAC (Navy Drum Site)		Mar-09
Final Evaluation of Project Delivery Options		2-Nov-06
Fixed Guideway Fleet Sizing Report		Jun-09
Value Engineering – Stations Report		Sep-10
Value Enhancement Summary Report		Sep-10
Contracts		
West Oahu/Farrington Highway Design-Build – RFP, Addenda, Proposal and Contract Documents		Various
Kamehameha Highway Design-Build – RFP, Addenda, Proposal and Contract Documents		Various
Maintenance and Storage Facility Design-Build – RFP, Addenda, Proposal and Contract Documents		Various
Core Systems DBOM – RFP, Addenda, Proposal and Contract Documents		Various
General Conditions of Design-Build Contracts, Honolulu		Feb-09
Financial/Cost		
FFGA Capital Cost Estimate Basis and Assumptions		9-May-12
FFGA Main Worksheet – Build Alternative		14-May-12
FFGA Cash Flows Worksheet		14-May-12
FFGA HRTP SCC Cost Workbook		14-May-12
HART Capital Cost by Contract by SCC Workbook		20-Mar-12
Price Proposals (post bid) Kiewit WOFH		11-Nov-09
Price Proposals (post bid) Kiewit MSF		16-Mar-11
Price Proposals (post bid) Kiewit Kamehameha		16-Mar-11
Price Proposals (post bid) Ansaldo Core Systems		16-Mar-11
General Excise and Use Tax in Hawaii		16-Feb-06
Schedule		

Document	Rev. No.	Date
HRTP Baseline Progress Schedule REV.04.xer		13-Jun-12
HART FFGA BASELINE PMOC Review.plf		13-Jun-12
Basis of Schedule 062012.pdf (Rev 3.0)	3.0	20-Jun-12

Note: The above list includes all key documents reviewed by the PMOC for preparation of the various OP deliverables.