Technical Memorandum

District 3 Bay County Advanced Traffic Management System Phase II Project

Project Systems Engineering Management Plan

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Final

Prepared for:

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List of Acronyms

ATMS ..... Advanced Traffic Management System
CFP ..... Cost Feasible Plan
ConOps ..... Concept of Operations
CPM ..... Critical Path Method
DMS ..... Dynamic Message Sign
FDOT ..... Florida Department of Transportation
FHWA ..... Federal Highway Administration
ID ..... Identification
ITS ..... Intelligent Transportation System
IV&V ..... Independent Verification and Validation
MTR ..... Minimum Technical Requirement
NTP ..... Notice to Proceed
O&M ..... Operations and Maintenance
PERT ..... Project Evaluation and Review Technique
PITSA ..... Project Intelligent Transportation System (ITS) Architecture
PSEMP ..... Project Systems Engineering Management Plan
QM ..... Quality Management
RITSA ..... Regional Intelligent Transportation System (ITS) Architecture
RTVM ..... Requirements Traceability Verification Matrix
SEMP ..... (Florida's Statewide) Systems Engineering Management Plan
SEP ..... Systems Engineering Process
SITSA ..... Statewide Intelligent Transportation System (ITS) Architecture
TMC ..... Transportation Management Center
TSP ..... Technical Special Provision

1. Document Overview

This document is the project systems engineering management plan (PSEMP) for Phase II of the Bay County Advanced Traffic Management System (ATMS) project. A PSEMP is a plan that helps manage and control a project utilizing systems engineering processes.

The document is organized as follows:

- *Section 2 — Need for a PSEMP*
- *Section 3 — Applicable Documents*
- *Section 4 — Applicable Systems Engineering Processes*
- *Section 5 — Project Management and Control*

2. Need for a Project Systems Engineering Management Plan

The Federal Highway Administration (FHWA) requires[1] states that desire federal assistance in deploying intelligent transportation system (ITS) projects to use a systems engineering process to qualify for financial assistance. The PSEMP documents the tasks to be performed for the coordination and control of ITS deployments of communication systems, devices needed for advanced traveler information systems (ATIS), and devices needed for ATMS along major routes. *A guide to writing a PSEMP*[2] is used as a reference guide in the creation of this PSEMP.

2.1 Project Identification

Project Name: Bay County ATMS Phase II

Financial Project Identification (ID): 408412-4-52-01

2.2 Purpose and Scope

This document serves as the PSEMP for Phase II of the Florida Department of Transportation (FDOT) District 3 Bay County ATMS project. It provides planning guidance for the technical management, procurement, installation, and acceptance of Phase II of the Bay County ATMS project, which includes the deployment of the latest ITS technology to improve surface transportation efficiency.

[1] *Title 23, Code of Federal Regulations (CFR), Part 940 — Intelligent Transportation System Architecture and Standards* (January 2001). Available online at: http://www.ops.fhwa.dot.gov/its_arch_imp/index.htm.

[2] *Writing a Project Systems Engineering Plan (September 2006). Available online at:* http://floridaits.com/SEMP/Files/PDF_Report/060929-PSEMP-V4.pdf

The Bay County ATMS will be constructed in multiple phases and has been financed primarily by a series of Federal ITS earmarks and matching funds provided by stakeholders consisting of FDOT, Bay County Public Works, Bay County Traffic Engineering, Bay District Schools, and the City of Panama City. A critical step in implementing an ATMS within the Panama City / Bay County region was the installation of a communications backbone network that would allow for the integration of traffic signals (county and cities) to a hybrid centrally controlled computer signal system, as well as integration of the ATMS into the Hathaway Bridge Incident Management System (IMS) and other aspects of a total ITS system. To this end, a Design-Build contract, also coined the Phase I effort (FP ID: 408412-1-52-01), for the installation of the fiber optic communication network was developed and advertised in October 2005. FDOT contracted with World Fiber Technologies to design and construct Phase I of the project. World Fiber Technologies subcontracted the system design to Genesis Group, the fiber optic splicing and testing was performed by Corning Cable Systems, and TransCore provided overall project management. The Notice to Proceed (NTP) was issued on March 9, 2006 and the initial phase of the project was completed in May 2007.

Phase I created two separate fiber optic backbone cable systems along designated routes in Bay County. These separate conduit and fiber optic cable plants will be utilized as the backbone in future projects to connect elements of the Bay County ATMS system, as well as provide the communication backbone to support the Bay District Schools communications technology initiatives. This includes integration of Bay District Schools with emergency services for improved emergency management communication during emergency shelter operations. Bay District Schools will also be utilizing their fiber optic backbone for their Distance Learning Program.

Phase II of the Bay County ATMS will consist of installing CCTV cameras; upgrading the traffic signal controllers in Bay County and Panama City along the fiber optic cable routes; and renovating the existing Traffic Engineering Department facility to serve as the Transportation Management Center (TMC). The ATMS will also be integrated with the existing Hathaway Bridge ITS components and TMC software will be selected for controlling the arterial traffic signals and CCTV cameras. The Phase II project proposes to use the FY 2004 and 2005 grants toward system integration with existing and planned ITS components, and purchase of system hardware and software. The Phase II project will be implemented through a competitive bidding process administered by the Florida Department of Transportation.

Four alternate scopes of work were incorporated into the Phase II Contract Documents in order to provide greater flexibility in meeting project budgetary goals. The Department has assigned Contract award priority for the Scope Alternates as follows:

First Priority.....Alternate A

Second Priority.....Alternate B

Third Priority.....Alternate C

Fourth Priority.....Alternate D

The Department intends to award the Contract to the responsible bidder with the lowest bid for the highest priority Scope Alternate for which the Department determines funds are available. The scope of each alternate is briefly described below. They are shown and described in more detail in the plans set for each alternate scope of work.

- **Alternate A**: Full scope as described in project plans.
- **Alternate B**: Same as Alternate A with a majority of the system detection deleted as shown in the plans. The remaining detectors would function as count stations.
- **Alternate C**: Same as Alternate A with the following deleted: all system detectors, the pole-mounted to base-mounted cabinet conversions, and certain TS-2 cabinet replacements.
- **Alternate D**: Same as Alternate A with the following deleted: all proposed system detectors, the pole-mounted to base-mounted cabinet conversions, certain proposed TS-2 cabinets, and eight CCTV cameras.

Further details regarding the project can be obtained by reviewing other documents, such as the *Bay County ATMS Phase II Project Concept of Operations* (*ConOps*), et cetera.[3]

[3] Florida Department of Transportation, *Intelligent Transportation Systems – Bay County Advanced Traffic Management System Phase II Project – Concept of Operations, Version 2* (April 2005). The project *ConOps*, along with other project documentation, is available online at http://floridaits.com/ATMS.htm.

2.3 Technical Project Summary Schedule

Project Kick-off: November 2004

CCTV Location Verification Site Visits: March 2005 to August 2005

TMC Layout and Modifications: August 2005

30% Plan Preparation: April 2004 to November 2005

90% Plan Preparation: November 2005 to January 2007

100% Plan and Specification Preparation: January 2007 to August 2007

Final Plan and Specification Preparation: August 2007 to December 2007

Project Letting Date: March 2008

Construction: Starting July 2008

* The Contract time for construction on this project under Scope Alternate A is 410 calendar days.

* The Contract time for construction on this project under Scope Alternate B is 395 calendar days.

* The Contract time for construction on this project under Scope Alternate C is 325 calendar days.

* The Contract time for construction on this project under Scope Alternate D is 320 calendar days.

Final Acceptance: September 2009 for Scope Alternate A

August 2009 for Scope Alternate B

May 2009 for Scope Alternate C

April 2009 for Scope Alternate D

2.4 Relationship to Other Plans

Phase II of the Bay County ATMS project is identified in the regional ITS architecture (RITSA). Phase I of the Bay County ATMS was successfully completed in May 2007 and the Phase II project is not dependent on the successful completion of any other plans.

2.5 Relationship to Florida's Ten-Year ITS Cost Feasible Plan

The *Ten-Year ITS Cost Feasible Plan* (*CFP*) is a 10-year program and resource plan that identifies ITS projects in the overall context of Florida's ITS Corridor Implementation Plans.[4,5] It represents a commitment of state- and District-managed funds over a 10-year period to provide ITS funds in a coordinated statewide program to develop ITS infrastructure on Florida's major intrastate highways. As previously mentioned, the Bay County ATMS project is funded primarily with federal earmark funds and is not included in the *Ten-Year ITS CFP*. The Department is developing an arterial ITS deployment plan and the Bay County ATMS project will be consistent with that plan.

2.6 Relationship to the Florida Statewide Intelligent Transportation System Architecture

The Bay County ATMS Phase II project is included in the District 3 RITSA, which was developed as part of the original *Statewide ITS Architecture* (*SITSA*).[6] The specific market packages that were selected from the RITSA are described in *Section 4.1*.

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[4] More information regarding the FDOT's *Ten-Year ITS CFP* is available online at http://www.dot.state.fl.us/TrafficOperations/ITS/Projects_Deploy/Ten-Year_CFP.htm. The current *Ten-Year ITS CFP*, revised in August 2006, is available online at http://floridaits.com/cfp_maintenance.htm.

[5] The FDOT's ITS Corridor Implementation Plans are available online at http://www.dot.state.fl.us/TrafficOperations/ITS/Projects_Deploy/Ten-Year_CFP.htm, under the Legacy Documentation link.

[6] More information regarding the original *SITSA* is available online at http://www.consystec.com/html/florida/default.htm. More information regarding the current *SITSA* is available online at http://www.consystec.com/florida/default.htm.

2.7 Relationship to Other "On-project" Plans

Phase I of the Bay County ATMS was successfully completed in May 2007 and the Phase II project is not dependent on the successful completion of any other plans.

3. Applicable Documents

The following documents, of the exact issue shown, form a part of this document to the extent specified herein. In the event of a conflict between the contents of the documents referenced herein and the contents of this document, this document shall be considered the superseding document.

National ITS Architecture *Version 5.0*	United States Department of Transportation 400 Seventh Street, Southwest Washington, D.C. 20590 http://www.dot.gov/
Bay County RITSA Bay County Intelligent Transportation Systems Architecture Technical Memorandum No. 4 Task D- Develop ITS Architecture June 2001	TEI Engineers and Planners, Inc. 5110 Eisenhower Boulevard, Suite 200 Tampa, FL 33634
SITSA	Information on SITSA is available on line at http://www.consystec.com/florida/default.htm

4. Applicable Systems Engineering Processes

Key systems engineering processes that will be used for Phase II of the Bay County ATMS project include:

- Developing the project ITS architecture (PITSA)
- Creation of high-level requirements
- Creation of detailed requirements
- Technical reviews
- Risk identification, assessment, and mitigation
- Creation of the requirements traceability verification matrix (RTVM)
- System testing, integration, and acceptance planning

4.1 Developing the Project Intelligent Transportation System Architecture

The project is identified in the RITSA. The market packages that have been selected from the RITSA to develop the PITSA include:

- ATMS01 – Network Surveillance
- ATMS03 – Surface Street Control
- ATMS06 – Traffic Information Dissemination
- ATMS08 – Incident Management
- ATMS18 – Road Weather Information System (RWIS)

4.2 Creation of High-level Functional Requirements

The high-level functional requirements have been developed for this project and are contained in the *Bay County ATMS Phase II Project ConOps*.

4.3 Creation of Detailed Requirements

The Bay County ATMS Phase II project is a low-bid project. The final plans, detailed specifications and technical special provisions have been submitted to FDOT District 3 for review and were finalized on December 4, 2007.

4.4 Technical Reviews

The following items have been provided during the design period:

1. *Arterial Signal Control Integration, February 17, 2005:*

This memorandum was provided to identify the scenarios of coordination of arterial signal controller software package with Statewide TMC Software, SunGuide™ Software. This memorandum also identifies the protocols of ITS devices which are supported by SunGuide software; client – server options; and software deployment options and requirements.

2. *Bay CO. ATMS Phase I Fiber Optical Cable (FOC) Splice Diagram and Optical Time Domain Reflector (OTDR) Spec Memorandum, May 11,2005:*

The purpose of this memorandum is to provide guidance regarding the Phase I FOC splice diagrams and ensure coordination/compatibility with the Phase II design. The OTDR specification was also provided for the procurement of FOC testing equipment.

3. Bay *CO Network Design Recommendation: Gig –E vs. Fast –E Memorandum, April 12, 2006*

The purpose of this memorandum is to provide District 3 with an answer as to whether the "innovative aspect" proposed by one of the Phase I Design-Build Firm (DBF) bidders is an alternative that is more appropriate for the Bay County ATMS than PBS&J's design. To review, a Phase I DBF bidder proposed using hardened Gigabit Ethernet (Gig-E) switches for all of the project's roadside equipment (traffic signals, CCTVs, DMS, and RWIS). This differs from the Fast Ethernet (100Mbps or Fast-E) solution that PBS&J was planning.

4. *Signal Controller Matrix Specification Writing Version, December 20, 2006*

The memorandum was provided as a functional matrix to evaluate the current signal controllers in the market.

5. *Bay Co ATMS Phase II Final Specification Package, Technical Special Provisions, December 4, 2007:*

These two submittals are final design specification packages.

The Bay Co ATMS II project is a low-bid project. The contractor shall use the final packages to contract and deploy field devices.

4.5 Risk Identification, Assessment, and Mitigation

The following is an assessment of risks that could affect the successful completion of the project on schedule. These risks will be supplemented by a risk matrix provided by the selected contractor.

- **Local Utility Coordination —** The subsurface utility engineering (SUE) for Phase II of the Bay County ATMS was conducted during the design phase. Coordination with the existing utility companies will be critical to the project schedule.

  The category of this risk is low. To mitigate the risk, constant communication must be established between the construction contractors, the FDOT Operations Center personnel supervising the construction, and the local utility companies.

- **Coordination with Bay County ATMS Phase I as –built plans —** The final Phase II package has been coordinated with the Bay County ATMS Phase I as-built plans.

  The risk is low. To mitigate this risk, constant communication must be established between the FDOT manager responsible for supervising the ATMS Phase I project and the contractor of ATMS Phase II project.

- **Traffic Signal Controller Software integration with Legacy Devices: —** Bay County has several legacy devices that need to be integrated into this Phase II project with the selected signal control software package. The legacy devices include CCTVs and a RWIS on the Hathaway Bridge, and three existing DMSs on arterials.

  The risk is moderate. To mitigate the risk, the FDOT manager needs to provide/direct the bidders to review the legacy device/protocols information before and during the pre-bid proposal meetings.

4.6 Creation of the Requirements Traceability Verification Matrix

A Requirements Traceability Verification Matrix (RTVM) is being developed for this project. *Appendix A* shows this RTVM.

The RTVM has been filled with requirements from the ConOps. The Construction Engineering and Inspection (CEI) company needs to provide performance measure metrics to evaluate/track the contractor and its sub-contractors performance and schedule.

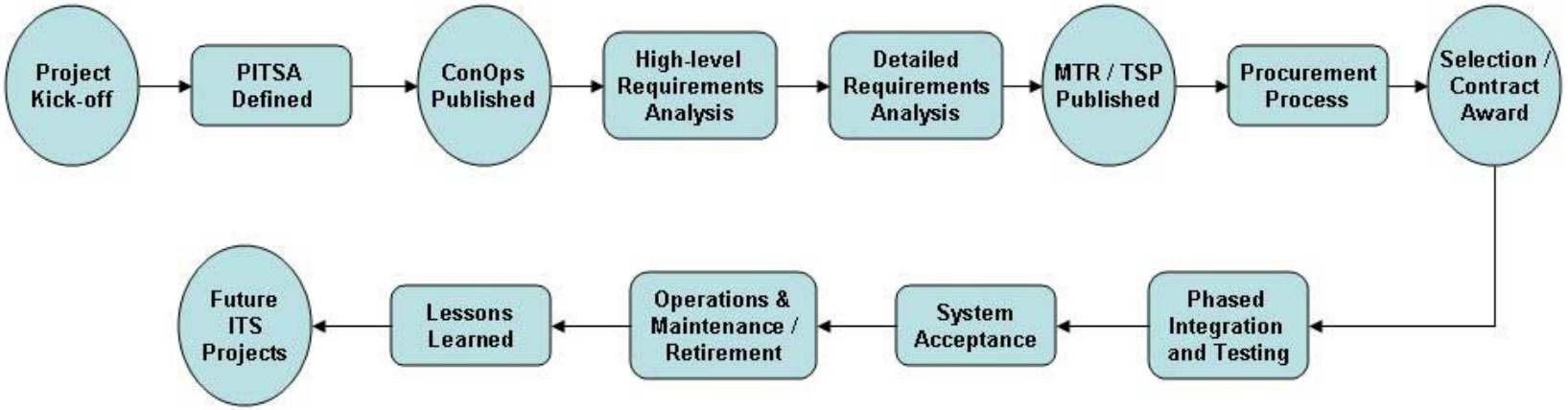
4.7 System Testing, Integration, and Acceptance Planning

The contractor shall conduct factory acceptance testing and field demonstration test prior to any installation. The contractor shall develop a comprehensive series of test plans for each device to determine that the devices are correctly installed and meet the requirements. All the details are identified in *Technical Special Provisions (TSP) Section 611: Acceptance Procedures.*

5. Project Management and Control

Figure 5.1 shows stages for an ITS project. The ITS Project Manager's responsibility begins with project kickoff and ends with O&M. There will be various people and organizations that help throughout this process. The Systems Engineer will typically select the RITSA market packages to define the PITSA. The Consultant will typically perform duties including, but not limited to, the high-level requirements analysis to publication of the MTRs/TSPs. The District office will be responsible for the procurement process, and selection and award of the contract. A Consultant will perform construction/installation, which will be supervised by the Construction Project Manager on behalf of the ITS Project Manager. System acceptance will be supervised by the District office or an independent verification and validation (IV&V) team. The Bay County Public Works department will take over operations and maintenance after the system has been accepted.

Figure 5.1 – Intelligent Transportation System Project Stages



The following areas will be covered in this section:

- Organizational structure;
- Managing the schedule with a project evaluation and review technique (PERT) chart, and the critical path method (CPM);
- Procurement management;
- Risk management;
- Subcontractor management;
- Monthly project status reviews;
- Quality management (QM);
- Systems acceptance;
- Operations and maintenance, upgrade, and retirement; and,
- Lessons learned.

5.1 Organizational Structure

Figure 5.2 shows the project organization structure.

The FDOT Central Office is funding the General Consultant to provide the 100% design of Bay CO ATMS Phase II project and provided the following support through FDOT Central Office:

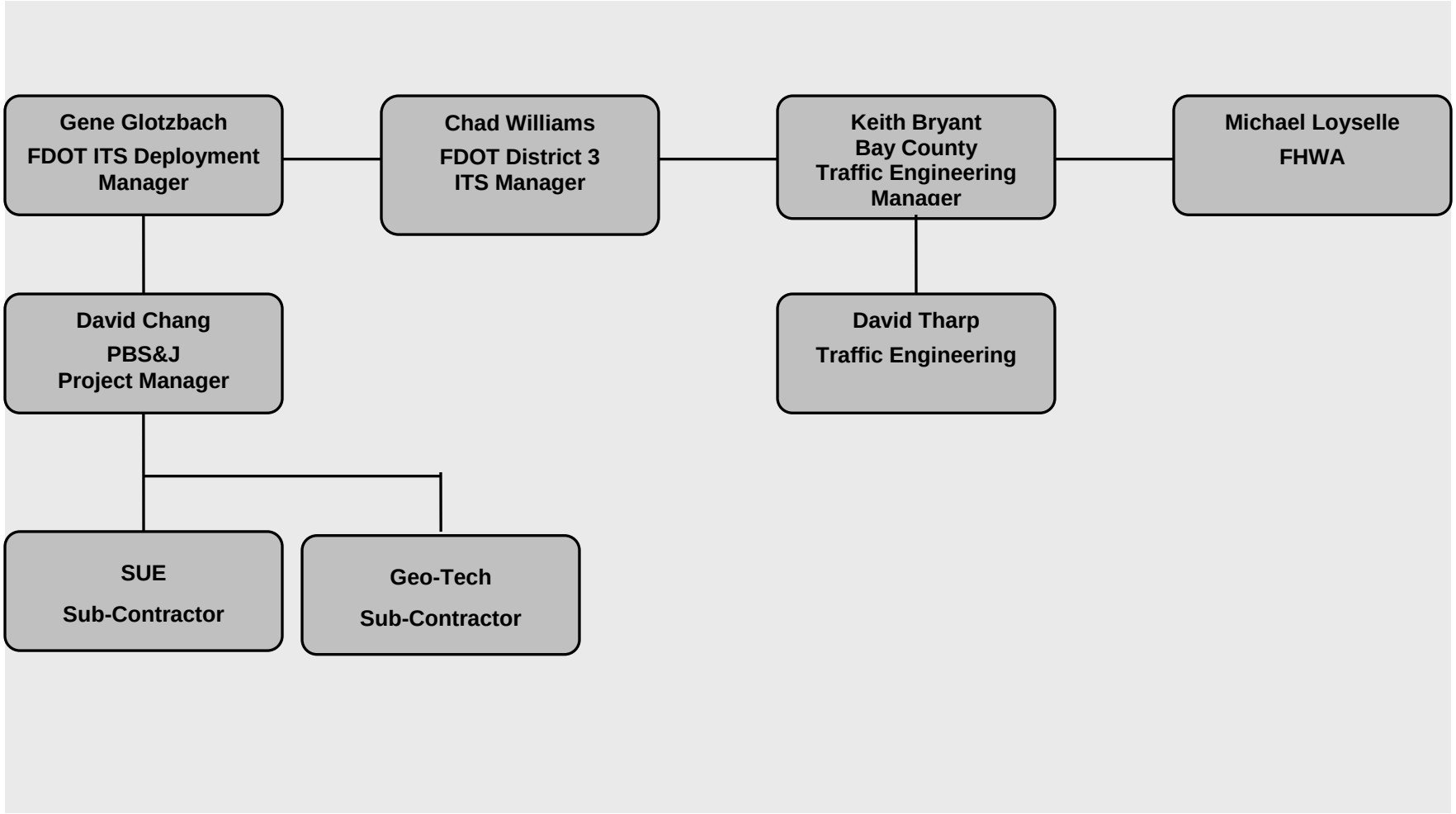
- Conduct site visits to identify CCTV locations and ascertain conditions of signal controller cabinets as well as the Hathaway Bridge legacy devices;
- Coordinate with Bay County ATMS Phase I contractor;
- Conduct SUE services through its sub contractor;
- Conduct geotechnical services for CCTV pole locations;
- Development of Final Specifications and Technical Special Provisions; and
- Development of Final Plans.

FDOT District 3 is involved, as the Phase II ATMS Project is going to be deployed in Bay County.

The Bay County Traffic Engineering Office is involved as the stakeholder who will operate and maintain the ATMS once the project is deployed.

The Federal Highway Administration is involved to ensure compliance with Rule 940 and make sure the remaining Federal Earmarks are authorized.

Figure 5.2 — Bay County ATMS Phase II Deployment Project Organization Structure



5.2 Managing the Schedule with the Project Evaluation and Review Technique and the Critical Path Method

The Bay County ATMS Phase II has four Scope Alternates with four corresponding schedules. The high-level schedule milestones are discussed in *Section 2.3* which were approved by District 3 Scheduling Engineer, Jimmy Miller on November 14, 2007. The detailed schedules with critical paths can be made available in the Bay County ATMS II final packages. The Phase II CEI contractor will use the schedule corresponding to the selected Scope Alternate in order to monitor/evaluate the construction.

5.3 Procurement Management

The Contractor shall procure the contractual items to comply with the *Final Specifications Package and Technical Special Provision.* The CEI contractor will work for the FDOT to manage the procurement.

5.4 Risk Management

Besides the risks identified in *Section 4.5*, the selected contractor will provide a risk management plan to the FDOT for review and approval.

5.5 Subcontractor Management

The selected contractor will be responsible for managing any subcontractor that may be needed for the project. The selected contractor will provide a subcontractor management plan to the FDOT for review and approval.

5.6 Monthly Project Status Reviews

During the design period, PBS&J has conducted several project meetings including:

- January 20, 2006: 30% Plans review meeting;
- February 16, 2007: 90% Plans review meeting; and,
- May 22, 25, and 29, 2007: Scope Alternatives teleconferences.

All the meetings are provided with Agenda items and meeting minutes.

Once the Bay County ATMS II project contract is signed, the FDOT will schedule monthly project status reviews with the selected contractor throughout the contract process. At the review meetings, items such as project schedule, cost, action items, et cetera, will be discussed in detail and documented.

5.7 Quality Management

The selected contractor will provide a quality assurance plan to the FDOT for review and approval. The CEI contractor will work with the FDOT to evaluate the quality of the project deployment.

5.8 Systems Acceptance

The selected contractor is responsible for providing a system acceptance test plan to the FDOT for review and approval. The procurement document will describe in detail the contents of the system acceptance test plan.

After the contractor has performed the acceptance test, the final inspection of the system will be performed by the FDOT in the presence of an authorized contractor representative.

The FDOT will prepare a final acceptance test report based on the results of the systems acceptance test and final system inspection. Once the contractor has addressed all comments and deficiencies noted in the final acceptance test report to the satisfaction of the FDOT project manager, the FDOT will issue a formal notification of system acceptance. At this point, the FDOT will assume system ownership, and the contractor will become responsible for hardware and software warranty and maintenance.

5.9 Operations and Maintenance, Upgrade, and Retirement

The selected contractor will prepare an O&M plan that will be reviewed and approved by the FDOT prior to system implementation. The O&M plan will include the policies and procedures that will be utilized to address: all scheduled and unscheduled maintenance responses for all hardware and software; communications links and networks; power supplies; and processing systems. The plan should also detail any upgrade or retirement activities that may be required during the contractual period.

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5.10 Lessons Learned

The Bay County ATMS II project has been developed for more than two years. The challenges are the coordination among the stakeholders and schedules. The comments from each design review meeting have been tracked and documented. The system engineering process can help the project owners to evaluate project performance and issue tracking to ensure all the project requirements are met.

Appendix A

Requirements Traceability Verification Matrix

Federal Aid Project Number:
ITS3 005 A

APPENDIX A

FINANCIAL PROJECT NUMBER(S): 408412-4-52-01

Req ID	Document and Section	Section Heading	Requirement Summary	Verification Method	Test Case	Compliant? Yes / No / Partial / NA
CONCEPT OF OPERATIONS (ConOps)						
1-1	3.2	Transportation Management Center Software	The TMC software will allow operators to control the CCTV system, provide incident management responses through DMS Activision, and control traffic signals.	Functional		
1-2	3.2	Transportation Management Center Software	The TMC software will allow the operator to monitor the current traffic conditions as displayed on the video wall. The TMC software will also be integrated with the Hathaway Bridge Project's ITS components, including the DMS units, CCTV cameras, and RWIS station.	Functional		
1-3	3.2.1.1	Center-to-field Device Control	At minimum, the TMC software must be able to control the field devices, including CCTV cameras, DMS units, RWIS units, detectors, and signal controllers.	Functional		
1-4	3.2.1.1	Center-to-field Device Control	The system operator at the TMC will have the ability to pan, tilt and zoom the CCTV cameras and monitor video received. The pan-tilt-zoom (PTZ) control function will be performed using a joystick or mouse. The system will enable the operator to assign incoming full-motion color video to the intended display devices.	Functional		
1-5	3.2.1.1	Center-to-field Device Control	The system will be able to communicate with cameras from various CCTV manufacturers and permit the addition of cameras from different manufacturers. The TMC software will be compatible with National Transportation Communications for ITS Protocol (NTCIP) standards specified for CCTV camera controls.	Functional		
1-6	3.2.1.1	Center-to-field Device Control	The TMC software will provide DMS control for operators to respond to incidents and provide traveler information. The sign message library will be user-selectable and user-definable for the operator.	Functional		
1-7	3.2.1.1	Center-to-field Device Control	The system will be able to communicate with signs from various DMS manufacturers and permit the addition of signs from different manufacturers. The TMC software will communicate using the NTCIP standards specified for DMS via a driver library.	Functional		
1-8	3.2.1.1	Center-to-field Device Control	The TMC software will provide traffic responsive algorithms to process data from the field and select signal timing patterns from a library.	Functional		
1-9	3.2.1.2	Reporting Feature	The TMC software will support the importing and exporting of data to and from traffic simulation/modeling software to assist in traffic operations. Data to be exchanged will include, but not limited to, detector data.	Functional		
1-10	3.2.1.3	Base Map - Geographic Information System Map	The software will support a geographic information system (GIS) interface importing and exporting of map features. The system must be compatible with the ArcView and ArcInfo GIS software programs.	Functional		
1-11	3.2.1.4	Alert Feature	The TMC software will support alarm events and allow them to be prioritized by the operator as to type of alert. At a minimum, the alert types will include e-mail, pop-up, and paging.	Functional		
1-12	3.2.1.5	Traffic Simulation Software	The TMC software will be compatible with various traffic simulation software programs, including importing/exporting data, and will provide time-space diagrams.	Functional		
1-13	3.2.1.6	Database	The TMC software will support a data archiving capability to allow retrieval and sharing of data that may be used for planning, designing, and performance measures. The data to be collected and archived will include, but not be limited to, traffic volume, speed, occupancy, and classification.	Functional		
2-1	4	Closed-Circuit Television Systems	A CCTV system field installation will include a camera contained in a weatherproof enclosure, a positioning device for PTZ functions, a camera pole with cabinet, and cable to transfer the video from the CCTV cabinet to the FOC backbone.	Functional		
2-2	4	Closed-Circuit Television Systems	Other components at the site would include a managed field Ethernet switch (MFES) and digital video encoder, along with power supplies and transient surge suppression devices to protect the equipment.	Functional		
2-3	4.1	Closed-Circuit Television Camera Requirements	The camera must provide both color and black-and-white (B&W) images with automatic switch cover from color to B&W under low light conditions. Some of the other standard camera features will include auto focus and auto iris. The camera should be Internet Protocol (IP)-addressable and the CCTV system should be NTCIP compliant.	Functional		
2-4	4.4	Closed Circuit Television Locations	Cameras will be located as close as half-mile apart in areas that experience recurrent backups, traffic congestion, or have high accident rates.	Functional		