

16 INTELLIGENT TRANSPORTATION SYSTEM (ITS)

16.1 General

The purpose of the ITS is to improve traveler safety, improve traffic efficiency by minimizing congestion, mitigate the impact of Incidents, and minimize traffic-related environmental impacts.

The elements of the ITS shall include detection for traffic management, roadway weather information systems (RWISs), closed-circuit television (CCTV) cameras for Incident verification and monitoring, and dynamic message signs (DMSs).

The ITS shall include all communications, electrical power, and supporting infrastructure to provide a complete, fully operational ITS that is ready to be integrated and controlled by INDOT Traffic Management Center (TMC).

All components of the system will be controlled and operated by INDOT TMCs in Gary and Indianapolis.

Design-Build Contractor shall provide a warranty for all installed equipment for at least one year or in accordance with INDOT's Standard Specifications, whichever is greater. The warranty periods shall begin on the date of Final Acceptance.

Design-Build Contractor shall design and construct the ITS components in accordance with the applicable requirements of the PPA Documents, including Project Standards, this Section 16 and its Attachment 16-1 (Unique Special Provisions); Governmental Approvals; and applicable laws.

Design-Build Contractor shall meet with INDOT to confirm details on ITS work elements. Meetings shall be held at the Gary TMC, 7701 East Melton Road, Gary, Indiana 46403. The contact person is Jessica Kruger, (219) 938-2019.

16.2 Performance Requirements

All material and equipment provided shall be compatible with existing Department ITS deployments to ensure a seamless integration with existing systems. The system shall be consistent with published State and federal ITS architectures, as well as the National Transportation Communications for ITS Protocol (NTCIP).

System design and construction shall maintain the operation of the existing ITS within the Project limits throughout the duration of the Work unless otherwise noted in these requirements.

The ITS shall provide accommodation for routine system maintenance with no impact to normal traffic operations. The ITS shall provide adequate features for the safety of maintenance personnel, including widened access shoulders, level maintenance platforms, and safety guide railings or traffic barriers if within clear zones.

16.3 Design and Construction Requirements

16.3.1 Design Consultant Pre-qualification for ITS Work

Prior to beginning Work, Design-Build Contractor shall have an INDOT pre-qualified consultant perform the design work for the following work type:

10.5 Intelligent Transportation System Design

16.3.2 Power Requirements

Design-Build Contractor shall coordinate with Utility providers to deliver metered alternating current (AC) power to all ITS and communications equipment installed or modified under this Project. Design-Build Contractor shall be responsible for all Work, materials, and costs required to obtain and maintain power, including application and coordination with the Utility provider.

16.3.3 ITS Equipment

Design-Build Contractor shall submit to INDOT for approval a preliminary and final ITS layout, including the quantity and location of the ITS elements, communication network diagrams, ITS location plan sheets, and dimensioned layout sheets illustrating horizontal and vertical plan locations, ITS elements, support structures, and construction materials. Design-Build Contractor shall in advance submit material cut sheets to INDOT for approval prior to ordering.

Clearances between ITS devices and other non-ITS infrastructure shall comply with all applicable requirements, and the location of ITS equipment shall accommodate safe access for routine maintenance activities.

16.3.4 ITS Operations

All ITS elements with the potential to be in the public view shall be under the control of INDOT TMC. Design-Build Contractor shall not activate any display, broadcast, or other message without prior coordination with the TMC.

16.3.5 ITS Work Elements

16.3.5.1 Materials

Design-Builder shall furnish all materials for ITS work elements.

16.3.5.2 Detectors

Design-Build Contractor shall design, furnish, and install vehicle detectors at CCTV camera locations. Detector installations along I-65 shall include the new CCTV camera installations and three existing CCTV camera locations:

1. At 101st Avenue
2. At US 231
3. At SR 2

The detectors shall be wireless in-pavement sensor detection system, microwave radar, or microloop technology. Design-Build Contractor shall confirm the detector type at each location with INDOT prior to beginning work. The detectors shall provide vehicle volumes, speeds, user-defined classes, and occupancies by lane in user-defined intervals (typically 2 minutes to 15 minutes). All traffic data shall be transmitted continuously to INDOT TMC. Detectors shall connect to an Aries Field Processor (AFP) provided by Design-Build Contractor in INDOT field cabinet for communications back to the TMC, where the detector field data will be integrated into the existing vehicle detection system for traffic monitoring and management.

An existing Automatic Traffic Recorder (ATR) detector installation is located just north of the 93rd Avenue overpass. Design-Build Contractor shall maintain the existing ATR cabinet in place and shall provide new loop and piezo cards and all materials needed to accommodate the additional travel lane and to restore operations due to construction impacts. New electronic equipment shall be from the same manufacturer as the existing equipment for compatibility. Splicing of sensor leads or loops wires shall not be allowed except in detector housings or handholes. Any modification to the existing pavement surface shall require the replacement of all loops and piezo sensor arrays and appurtenances. If the existing cabinet cannot remain in place, the entire existing installation shall be replaced with a new installation with all new materials. The new installation shall include new loops and piezo sensors for all existing and additional lanes. A new equipment cabinet shall be provided beyond the outside shoulder in the vicinity of the existing cabinet to be removed. The existing cabinet and equipment shall be delivered to INDOT.

16.3.5.3 Roadway Weather Information System

Design-Build Contractor shall provide a roadway weather information station to provide weather and roadway condition monitoring. The anticipated location of the RWIS station is the I-65/US 231 interchange. Design-Build Contractor shall coordinate the final location with INDOT. Design-Build Contractor shall design, furnish, install, and test the new roadway weather information station to provide a complete and operational RWIS.

16.3.5.4 CCTV Cameras

Design-Build Contractor shall design, furnish, install, and test permanent CCTV cameras, field equipment and control center equipment necessary to integrate cameras and detectors into the existing system. CCTV cameras and support towers shall be installed along I-65 at four locations. CCTV cameras shall be installed on towers at a minimum height of 60 feet above the roadway surface. CCTV camera locations along horizontal roadway curves shall be installed on the outer side of the horizontal curve to maximize viewing distance. Two pan-tilt-zoom cameras shall be installed on the support tower at each location. The anticipated locations are listed below. Design-Build Contractor shall confirm these locations with INDOT prior to beginning work.

1. At 113th Avenue
2. At 137th Avenue
3. At 163rd Avenue
4. At 217th Avenue

Design-Build Contractor shall install the CCTV camera sites as advance work prior to any roadwork that involves lane closures. The CCTV cameras shall be fully operational with communications to the INDOT Traffic Management Centers (TMCs) in Gary and Indianapolis. Remote video and control for these CCTV cameras shall be provided at the two TMCs to enable monitoring of traffic conditions in the construction zone and to serve as permanent CCTV camera sites after construction is completed.

16.3.5.5 Dynamic Message Signs (DMSs)

Design-Build Contractor shall design, furnish, install, and test permanent DMSs to provide traffic information on I-65. The overhead DMSs and support structures shall be located at critical approaching and departure locations along I-65. The anticipated locations are listed below. Design-Build Contractor shall confirm these locations with INDOT prior to beginning work.

1. SB I-65 near 101st Avenue (Mile 250.4)
2. NB I-65 north of 217th Avenue (Mile 235.7)

Design-Build Contractor shall install the DMS as advance work prior to any roadwork that involves lane closures. The DMS shall be fully operational with communications to the INDOT Traffic Management Centers (TMCs) in Gary and Indianapolis. Remote monitoring and control for these DMS shall be provided at the two TMCs to enable disseminating travel information to motorists about the construction activities and to serve as permanent DMS after construction is completed.

16.3.5.6 Travel Time Signs (TTS)

Design-Build Contractor shall design, furnish, install, and test permanent TTSs to provide travel time to downstream destinations along I-65. The TTS and support structures shall be located at two locations along I-65. The anticipated locations are listed below. Design-Build Contractor shall confirm these locations with INDOT prior to beginning Work on the TTSs.

1. SB I-65 near 53rd Avenue (Mile 256.4). Downstream Destinations: US 231, 9 miles and SR 2, 16 miles.
2. NB I-65 near 137th Avenue (Mile 245.6). Downstream Destinations: US 30, 7 miles and I-80/94, 14 miles.

Design-Build Contractor shall install the TTS prior to any roadwork that involves lane closures. The TTS shall be fully operational with communications to the INDOT Traffic Management Centers (TMCs) in Gary and Indianapolis. Remote monitoring and control for these DMS shall be provided at the two TMCs to enable disseminating travel time information to motorists during construction activities and to serve as permanent TTS after construction is completed.

16.3.6 Communication System

All permanent, final backbone communications shall be via fiber optic connections. The new fiber shall be 192-strand, single-mode fiber-optic cable. The new fiber shall extend to the new ITS field device locations and to all existing ITS devices via fiber drop cables, and the new trunk fiber shall be fusion spliced to existing INDOT fiber cable. Design-Build Contractor shall submit to INDOT the final list of all the devices to be connected to fiber and details on the fiber strands in each cable, and INDOT will provide the fiber assignments. All added permanent devices (e.g.,

CCTV towers, DMS, TTS) shall be connected to the backbone communications cable in the final condition. Design-Build Contractor shall provide temporary communications in advance to enable the operation of the ITS field devices during construction. ITS field devices shall be operational prior to any roadway that involves lane closures. Communications shall be maintained throughout construction and remain in a permanent installation condition after construction is complete.

Fiber-optic communications cable exists within the project corridor. The existing fiber north of US 231 (Mile 247.5) is anticipated to be impacted by the road construction. Design-Build Contractor shall provide new fiber northward from US 231 to the accommodate communications for the new TTS near 53rd Avenue (Mile 256.4) and all the new and existing ITS devices within this section. A new fiber cabinet shall be provided at the I-65/US 231 interchange to house the fusion splices between the existing fiber and the new northern fiber. The existing fiber from approximately US 231 (Mile 247.5) to SR 2 (Mile 240) shall be maintained. Design-Build Contractor shall install a fiber optic cable extension to the south for the final condition to accommodate communications for the new DMS and CCTV tower near 217th Avenue (Mile 235.7). Fiber communications shall provide redundant communications paths. Fiber communications redundancy via separate cables in separate conduits is preferred; redundancy via separate fiber strands within the same fiber cable shall be provided at a minimum. The fiber tie-in location for the southern fiber extension is the communications shelter in the northeast quadrant of the I-65/SR 2 interchange. The Design-Build Contractor shall provide new above-ground fiber cabinets to store, splice, and terminate the new fiber at the north and south termini. The new final conduit and fiber shall be installed near the right-of-way line to minimize risk from damage due to roadway construction. Design-Build Contractor shall assess the existing conditions and propose, with supporting reasons, the side of I-65 for conduit/cable installation. Bridge crossings shall be specifically addressed in the proposal, which shall include a description of the method of installing conduit and cable passing such crossings. The proposed method shall incorporate a means of maintaining communications connectivity through roadway and bridge construction work.

Design-Build Contractor shall coordinate the design with INDOT to tie in new and existing ITS devices to the permanent fiber along I-65. The final design must include redundant communications to each device using two pairs of fibers in the existing trunk cables along I-65. Design-Build Contractor shall be responsible for all design, furnishing, and installation of all fiber-optic cabling and infrastructure, including splicing and interconnection to existing facilities. All ITS communications shall be aggregated at one or more existing field communication hubs. Design-Build Contractor shall furnish and install additional communications equipment at the existing field communication hubs to accommodate the additional ITS equipment installed in this Project.

16.3.7 Existing Fiber

Design-Build Contractor shall locate all existing fiber optic cables, and shall determine any conflicts prior to construction. Existing record plans are available in the Reference Information Documents (RID). Design-Build Contractor shall propose an initial solution to identified conflicts and work with INDOT to develop a final solution. The Design-Build Contractor shall discuss this with INDOT ITS representatives at the initial project kick-off meeting.

16.4 Integration and Testing Requirements

Design-Build Contractor shall conduct installation testing during construction to ensure that the devices perform per the manufacturer's specifications. Design-Build Contractor shall provide to INDOT for review and comment test plans and test results. Test plans shall be provided 30 days prior to installation and test results within 10 days after installation. Vendor-unique software or hardware used to verify proper operation of the ITS or used to troubleshoot the ITS may be used by Design-Build Contractor. Design-Build Contractor shall provide this vendor unique software or hardware to INDOT with the Construction Documents.

Design-Build Contractor shall also furnish INDOT with any special or unique test equipment that is required to maintain and/or test the system within 30 days of installation. All spare equipment shall meet the requirements set forth in the applicable sections of the Technical Provisions.

Tests shall be scheduled to allow a representative from INDOT to witness the test. INDOT shall be notified a minimum of 72 hours prior to the commencement of each test.

Additionally, Design-Build Contractor shall provide INDOT 72 hours of advance notification for the anticipated disruption of any services. Concealed work (including underground) shall be tested by Design-Build Contractor and witnessed by INDOT prior to covering.

Instruments used by Design-Build Contractor shall be regularly and accurately calibrated and maintained in good working condition. Test reports shall include copies of documentation (calibration reports or tags) demonstrating calibration within six months of the start of testing. Design-Build Contractor shall provide all test instruments.

Design-Build Contractor shall test the installation of each component/subsystem to ensure the component/subsystem is properly installed and is operational. The component/subsystem test procedure may be vendor-supplied acceptance test procedures. Design-Build Contractor shall use the component test plan to verify the component has been correctly installed and is operational.

Each subsystem and communication path shall be operated without any failures for a period of no less than 30 calendar days prior to Final Acceptance. Any failures during the 30-calendar-day period shall be repaired by Design-Build Contractor and restart the 30-calendar-day period for the system. Design-Build Contractor shall be responsible for configuring the equipment. INDOT will provide the configuration parameters required to interface with existing systems. These parameters include multilink trunks, split multilink trunking groups, inter switch trunk links, virtual local area network creation and associated IP addressing, open shortest path first routing protocol, protocol independent multicast routing protocol, and Internet group management protocol snooping. INDOT will provision the network equipment with the unique system network parameters. At the good faith discretion of INDOT, pre-installation testing may be repeated as part of the Final Acceptance by INDOT. Final Acceptance by INDOT will occur when testing concludes and all components and subsystems perform as an integrated system.

Design-Build Contractor shall develop and submit for review and comment test plans and test procedures for each component and each subsystem. As a minimum, the test plans shall define Design-Build Contractor's planned approach, the desired results of each test, and steps for resolving out-of-spec conditions. As a minimum, the test procedures shall specify the step-by-step process for connecting to test equipment, reading the test equipment, and recording the

results. Further, the test procedures shall contain forms to be used in recording results during actual testing. Test plans and test procedures shall be submitted no later than 120 days after the Design Documents are approved. Testing may not commence without INDOT's approval of the test plans and procedures.

Design-Build Contractor shall accurately record and report the methods of testing, times, and dates of the test; the calibration dates of test equipment; witnesses to the test; and the results of the test. When systems are tested in segments, a separate and complete report is required for each segment. INDOT shall have a minimum of five days to review the test report. Final Acceptance shall not occur until a satisfactory review of the test report has been completed and all other requirements of the PPA Documents have been satisfied.

16.5 Deliverables

Deliverables, a non-exhaustive list of which is set forth in the table below, shall be submitted in accordance with the schedule set forth below, in both electronic format and as hardcopies. Acceptable electronic formats include current versions of Microsoft Word, Microsoft Excel, and Adobe Acrobat (PDF), unless otherwise indicated.

Drawings shall be submitted in PDF format on 3 CDs or DVDs. These Submittals shall also include drawings in the current version of MicroStation.

Deliverable	Submittal Schedule	TP Section
Draft ITS layout	Design Review	16.3.3
Final ITS layout	Design Review	16.3.3
Camera locations layout	Design Review	16.3.5
Drill shaft installation plan	Design Review	Attachment 16-1 (USP, CCTV)
Special or unique test equipment	Prior to Final Acceptance	16.4
Proof of training for fiber-optic testing	Prior to fiber testing	Attachment 16-1 (USP, ITS Communications System)
Cable pulling plan	10 Business Days prior to installation	Attachment 16-1 USP, ITS Communications System)
Fiber-optic operation and maintenance documentation	Prior to Final Acceptance	Attachment 16-1 (USP, ITS Communications System)
Test plans	120 days after Design Document approval	16.4
Testing date, time, and location	Three days before performing test	16.4
Test results	Within 10 days of performing the test	16.4