



Florida Department of Transportation

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DENVER J. STUTLER, JR.
SECRETARY

January 17, 2006

Mr. Donald Davis
Program Operations Engineer
Federal Highway Administration
545 John Knox Road, Suite 200
Tallahassee, Florida 32303

Re: Office of Design, Specifications
Section 782
Proposed Specification: 7820000D01

Dear Mr. Davis:

We are submitting, for your approval, two copies of a proposed Supplemental Specification for Intelligent Transportation Systems – Video Equipment.

This change was proposed by Gene Glotzbach of the Traffic Operations Office to develop Standard Specifications for the Intelligent Transportation System components.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via Email to SP965DB or duane.brautigam@dot.state.fl.us.

If you have any questions relating to this specification change, please call Duane F. Brautigam, State Specifications Engineer at 414-4110.

Sincerely,

Signature on File

Duane F. Brautigam, P.E.
State Specifications Engineer

DFB/ft

Attachment

cc: General Counsel
Florida Transportation Builders' Assoc.
State Construction Engineer

**INTELLIGENT TRANSPORTATION SYSTEMS – VIDEO EQUIPMENT
(REV 10-20-05)**

Page 766. The following new Section is added after Section 781:

**SECTION 782
INTELLIGENT TRANSPORTATION SYSTEMS
VIDEO EQUIPMENT**

782-1 CCTV Camera.

782-1.1 Description. Furnish and install a *closed-circuit television (CCTV)* camera at the location(s) shown on the plans. Ensure that the installed equipment provides *unobstructed* video images of the roadway, traffic, and other current conditions around a roadside CCTV field site; *that it responds to camera control signals from the operator*; and that the *video* images can be transmitted to remote locations for observation.

782-1.2 Materials.

782-1.2.1 Camera: Furnish a CCTV camera that is compatible with the current version of the Department's SunGuideSM Software System, *and any other camera operating software indicated on the plans or in the contract documents.* Ensure that the CCTV camera allows remote control of camera pan, tilt, and zoom functions via the Department's SunGuideSM Software System user interface. Use either a dome-type or external positioner-type CCTV camera assembly. Ensure that the appropriate type is used at the location(s) shown on the plans.

Ensure that the camera produces National Television System Committee (NTSC) composite video output of 1 volt peak-to-peak (Vp-p) *at 75 ohms (Ω)*. In addition, ensure the camera provides the following features and capabilities:

1. Day (color)/night (monochrome) switchover and iris control, with user-selectable manual and automatic control capabilities.
2. Minimum resolution of 470 horizontal and 350 vertical TV lines.
3. Ability to produce clear, detailed, and usable video images of the areas, objects, and other subjects visible from a roadside CCTV field site. Ensure that video produced by the camera is free from transfer smear, oversaturation, and any other image defect that negatively impacts image quality under all lighting and weather conditions in both color and monochrome modes.
4. User-selectable automatic gain control (AGC) that is peak-average adjustable to 30 decibels (dB).
5. A minimum signal-to-noise ratio of 50 dB.
6. Automatic color balance that references the white areas of the scene through the lens.
7. ~~User selectable gamma settings of 0.45 and 1.0.~~
8. An automatic electronic shutter that is user selectable from 1/60 to 1/10,000 of a second.

98. A digital signal processor that provides a minimum 10x digital zoom.

109. Programmable azimuth and compass display with ability to display pan and tilt position with a 1 degree resolution.

Furnish a CCTV camera that provides titling and masking features, including, but not limited to, programmable camera title, programmable preset titles for each preset position, and programmable privacy zones. *Ensure that programmable titles are a minimum of 18 characters per line.*

782-1.2.2 Lens: Ensure that the CCTV camera has a minimum 22x motorized optical zoom lens with automatic iris. Ensure that the lens is capable of automatic and manual focus and iris control ~~and has a minimum focal length of 0.14 to 3.2 inches [3.7 to 81.3 millimeters (mm)]~~. Ensure that the lens depth of field provides a clear image of roadside areas under all lighting conditions and *that the lens* has a maximum aperture of at least f/1.6.

782-1.2.3 Pan/Tilt Mechanism for Dome Type Cameras: Ensure that dome type CCTV cameras include an integrated pan/tilt mechanism capable of providing 360-degree continuous pan with a minimum 90-degree tilt range (i.e., 0 to -90 degrees); provide variable speed control; have a preset position return accuracy of ± 0.36 degree, or less than 0.10% or better; support a minimum of 64 presets; support a minimum of eight tours, each with a minimum of 32 presets; and support a minimum of eight programmable blackout zones.

Ensure that the positioner within the dome type CCTV camera has a minimum automatic pan speed of 240 degrees per second to a preset camera position; that maximum manual pan and tilt speeds are programmable; that the maximum manual pan speed range is adjustable from 1 degree to 240 degrees per second; and that maximum manual tilt speed range is adjustable from 1 degree to 90 degrees per second.

782-1.2.4 Pan/Tilt Mechanism for External Positioner Type Cameras: Ensure that external positioner-type CCTV cameras include a pan/tilt mechanism capable of providing 360-degree continuous pan with a minimum 150-degree tilt range (i.e., -90 to +60 degrees); provide variable speed control; have a preset position return accuracy of ± 0.36 degree, or less than 0.10% or better; and support a minimum of 32 presets.

782-1.2.5 Communication: Ensure that the CCTV camera supports the NTCIP 1205 *v1.08* communication protocol *as implemented in the SunGuide software*. *Ensure that the camera* ~~and~~ is capable of communication with other devices using EIA-232 or EIA-422/485 at a rate of 9600 bps. *Ensure that the CCTV camera supports the communication links shown in the plans.*

782-1.2.6 Electrical Specifications: Ensure that the CCTV camera *system* operates using a nominal input voltage *at the cabinet* of 120 volts alternating current (VAC). Ensure that the camera *power supply* will operate with ~~in~~ an input voltage *range* from 89 to 135 VAC.

Ensure that the CCTV camera and positioner operate at 24 VAC or 10 to 28 volts of direct current (VDC). If the camera or any camera-related ancillary device requires ~~nominal input voltage of less than 120 VAC~~ *operating voltages other than these, then* provide an appropriate voltage converter. Ensure power consumption does not exceed 125 watts.

782-1.2.7 Mechanical Specifications: *Provide camera housings and hardware that are white in color or as noted in the plans.*

Ensure that the camera housing has a sunshield to reduce the solar heating of the camera. Ensure that the total weight of dome type CCTV cameras (including the housing, sunshield, and all internal components) is less than 17.0 pounds. Ensure that the lower dome of the camera housing is distortion free clear plastic. Ensure that the upper dome of the camera housing is light in color.

Ensure that pressurized dome-type housings are capable of pressurization at 5 pounds per square inch (psi) [34.5 kilopascals (kPa)] using dry nitrogen, that they have a low-pressure alarm feature, and carry a NEMA 4X/IP-67 rating.

If a nonpressurized dome-type housing enclosure is used, ensure that the unit is vented with a thermostat-controlled, 24-volt DC heater and blower. Ensure that the nonpressurized enclosure has a NEMA 4/IP-66 rating.

Ensure that the total weight of external positioner-type CCTV cameras (including housing, sunshield, all internal components, and external pan and tilt mechanism) is less than 35 pounds.

782-1.2.8 Environmental Specifications: Ensure that the CCTV camera ~~will~~ performs all ~~of the~~ required functions during and after being subjected to an ambient operating temperature range of -30° to 165° F [-34° to 74° C] as defined in the environmental requirements section of the NEMA TS 2 standard. Verify that the CCTV camera manufacturer certifies ~~their~~ *its* device has successfully completed environmental testing as defined in the environmental requirements section of the NEMA TS 2 standard.

Ensure that the housing protects the camera and ~~all~~ other internal components from rain, dust, corrosive elements, and typical conditions found at a roadside environment. Verify that the CCTV camera, mounting hardware, and any other camera-related material that is exposed to the environment can withstand sustained wind of 110 mph with a 30% gust factor.

782-1.3 Installation Requirements: Install the CCTV camera in the field on a prestressed concrete or steel strain pole at a roadside location. Design, furnish, and install the pole according to the requirements of Section 641 or Section 649, as depicted in the Design Standards, and as shown in the plans.

Furnish and install the power supplies, local control equipment, and any other camera-related field electronic equipment, *and transient voltage surge suppressors* within a pole- or base-mounted, lockable cabinet as shown in the plans and in accordance with Section 676. Ensure that the cabinet protects these electrical and electronic devices from rain, dust, dirt, and other harmful elements of nature.

Furnish and install all power, video, and data cables necessary to provide connection points for camera video and PTZ control signals within the cabinet. Furnish and install any and all ancillary equipment required to provide a complete and fully operational CCTV camera. Verify that all wiring meets NEC requirements where applicable.

Permanently mount the CCTV camera to the camera pole or other support structure as shown in the plans. Ensure that data and video cables from the pole or support structure to the camera are routed inside the mounting hardware and protected from exposure to the outside environment.

Coat the exterior of the dome-type enclosure's lower half with a clear, rain repellent product prior to final acceptance.

782-1.4 Testing

782-1.4.1 General: Subject the equipment covered by these specifications to design approval tests (DATs) and field acceptance tests (FATs). Develop and submit a test plan for DATs and FATs to the Engineer for ~~consideration~~ review and approval. Ensure that the test plans demonstrate each and every functional requirement specified for the device or system under test.

The Engineer may accept certification by an independent testing laboratory in lieu of the DATs to satisfy the requirement that certain features and functions have been witnessed and documented as performing satisfactorily. Arrange and conduct the tests and satisfy all inspection requirements prior to submission for the Engineer's inspection and acceptance.

The Engineer reserves the right to witness all DATs and FATs. Compare all test results with their corresponding specifications. Complete the tests within five calendar days *from the initiation of the testing process*.

782-1.4.2 Field Test Requirements: *Perform local field operational tests at CCTV field sites according to the following:*

- 1. Verify that physical construction has been completed as specified in the plans.*
- 2. Verify the quality and tightness of ground and surge protector connections.*
- 3. Verify proper voltages for all power supplies and related power circuits.*
- 4. Verify all connections, including correct installation of communication and power cables.*
- 5. Verify that the video signal from the camera is present and of consistent quality at all connection points between the camera, the cabinet, and any video devices therein.*
- 6. Exercise pan, tilt, zoom, and focus in all directions and execute a minimum of 3 other unique programming commands to ensure that the communication link between the cabinet and the camera is functioning properly.*

782-2 Video Display Equipment.

782-2.1 Description. Furnish and install video display equipment as shown in the plans.

782-2.2 Materials.

782-2.2.1 General: Use video display equipment that can display analog, digital, and other images associated with the operation of the transportation management center (TMC). These types of images include, but are not limited to:

1. Closed-circuit television (CCTV) video images, including feeds from other TMCs.
2. Video vehicle detection (VVD) system images.
3. System infrastructure mapping images.

4. *Graphical user interfaces from computers running typical TMC applications.* ~~Central software images.~~

5. Weather mapping images.

6. Television broadcasts.

7. Digital video discs (DVDs), videocassette recordings, or other video storage media.

Provide equipment, mounting hardware, cabling, and other video display components that are compatible with each other. Ensure that all equipment and materials furnished and installed are reviewed and approved by the Engineer.

Use display devices of the types shown in the plans. The display types described herein include a video wall display, a flat panel display, and a cathode ray tube (CRT) display.

782-2.2.2 Video Display Control System: Provide a video display control system that enables the operator to control and manage the display of video and computer-generated graphics on the display equipment connected to the system, as well as provide selection and switching of multiple sources for display, including video streams available on the TMC Ethernet network. Ensure that the display control system allows an operator to control all displays from the same workstation that is used for the SunGuide operator interface. Ensure that the video display control system is capable of decoding and displaying streaming MPEG-2 video feeds.

Use a video display control system capable of simultaneously displaying a minimum of 32 video windows, each containing streaming video at a minimum resolution of 720 x 480 pixels and frame rate of 30 frames per second (fps). Ensure that the system allows any display window to be sized from 1/32 of the total display area up to the total display area, and any size in between. Total display area is defined as the total screen size provided by a video wall display, a flat panel display, or a CRT display.

Ensure that the video display control system hardware is designed to be rack mounted and secured in an EIA 19-inch equipment rack. Ensure that any system incorporating personal computer (PC) hardware utilizes current microprocessor technology and commercial, off-the-shelf components, including random access memory (RAM), hard disk drive(s), and network interface card(s) sufficient to provide the functional requirements of the system.

782-2.2.2.1 Display Control Software: Provide display control software that enables multiple operators to control all features and functions of the video display control system. These features and functions include, but are not limited to, selection of video sources for display; adjusting the size, location, and layout of video and other graphic information the system displays; and system configuration and setup. Ensure that the control software is able to operate a video wall composed of multiple display components as though it were a single, high-resolution display.

Use display control software that is compatible with the Department's SunGuideSM Software System and the published interface control documents (ICDs) that describe its subsystem interfaces.

Ensure that software applications use the Simple Object Access Protocol (SOAP) standards to perform specific functions and to access the features within the control system's architecture.

782-2.2.2.2 Inputs and Outputs: Use a video display control system that supports and displays a variety of video and data inputs simultaneously, including composite and component NTSC video, DVI, VGA, SVGA, and Super eXtended Graphics Array (SXGA) computer graphics. Ensure that all inputs and outputs can be controlled by an operator in order to display any or all of this information on any number of display devices within the system. Ensure all inputs and outputs can be sized with and without constrained proportions across multiple screens and moved at will around any display area and combination of displays.

Ensure that the video display control system is expandable and scalable to support any combination of inputs and outputs. Provide the video display control system with a minimum configuration of 8 composite video inputs, 4 component (RGB) video inputs, 8 SXGA inputs, and 8 DVI inputs, as well as network connections, decoders, and associated hardware and software required to display 32 inputs simultaneously at a minimum resolution of 720 x 480 pixels and a frame rate of 30 fps, or as shown in the plans. Provide the video display control system with a minimum configuration of 4 composite video outputs, 2 component (RGB video outputs), 4 SXGA outputs, and 4 DVI outputs, or as shown in the plans. Ensure the video display control system can be expanded to accommodate at least 128 discreet inputs and outputs.

Ensure that a single input can be routed to multiple displays simultaneously and that multiple inputs can be routed to a single display simultaneously *for viewing in separate windows*. Ensure that all inputs and outputs are synchronized by the video display control system and that switching between inputs or outputs does not cause displayed images to unlock, roll, or otherwise exhibit visible distortion.

782-2.2.2.2.1: Analog Video: Ensure that the video display control system is able to accept S-video, composite, and component video sources, and can digitize these signals for manipulation and display on any display device attached to the system. Ensure that all analog video inputs utilize BNC connectors.

Ensure that analog video sources can be displayed within their own windows, and can be resized up to or beyond their native resolution to conform to the wall display size.

782-2.2.2.2.2 Digital Video: Ensure that the video display control system is able to accept ~~DVI~~ *digital video* sources, and can manipulate and display these signals on any display attached to the system. Ensure that all digital video ~~inputs-outputs~~ utilize ~~BNC-DVI~~ connectors.

Ensure that each MPEG video stream can be displayed within its own window, which shall be freely movable and sizable up to or beyond its native resolution to conform to the wall display size.

782-2.2.2.2.3 RGB Video: Include an analog input that enables the TMC operator to project an exact copy of his or her workstation desktop display on the video wall display. *Ensure that analog RGB inputs allow native* ~~Provide no less than a dual input unit that allows two analog RGB inputs-images~~ up to 1,280 by 1,024 pixels at 60 Hz to be displayed on the video wall.

Ensure that RGB inputs are sizable up to or beyond their native resolution to conform to the wall display size.

782-2.2.2.2.4 Streaming Media: Ensure that the video display control system can ~~accept up to 4~~ *display a minimum of 32* compressed video

streams simultaneously in MPEG-2 over TCP/UDP/RTP over IP and supports multicasting as defined in Version 2 of the Internet Gateway Message Protocol (IGMP). Ensure that the ~~streaming video support is flash upgradeable~~ *video display control system can be upgraded to also* accept MPEG-4 and H.264 ~~when they become available~~. Ensure that the MPEG video input interface is, at minimum, a 10/100-megabit per second network port *per every 15 streams*.

782-2.2.2.2.5 Primary Display Output: Use a video display control system that can process the various signal input types to be viewed, such as the RGB feeds from monitor outputs and streaming video feeds. Ensure that the unit provides direct digital streaming video through cable feeds using a digital video decoder. Ensure that the video display control system provides the layout definitions for each signal to be displayed and saves the predefined layouts. Ensure that the video display control system also permits switching of the predefined layouts and accepts external alarm triggers to change the layouts.

Include output capacity with sufficient memory and processing speed to provide fast rendering of video and image displays. Ensure that the output has, at a minimum, a dual digital visual interface (DVI) connector that allows a digital connection of 1,280 horizontal pixels by 1,024 vertical pixels or greater resolution. Ensure that the color depth is a minimum of 24 bits per pixel. If the projection device requires an analog signal, then breakout cables may be used to convert the DVI output connector to a HD15 analog RGB connector.

782-2.2.2.2.6 Secondary Display Output: Provide an integrated, secondary display system that accepts multiple layouts and signal types, such as video, RGB, or serial data interface (SDI), for use on a single integrated display at the operator workstation. Use a secondary display system consisting of the video display control system and the display device.

782-2.2.3 Video Wall Display: Furnish and install a video wall display consisting of tiled, rear projection video displays *cubes* arranged in a ~~matrix~~ *wall*, as shown in the plans, together with a video display control system.

Ensure that the video wall display is capable of producing, at a minimum, a large-scale, high-resolution video image having accurate color rendition, sufficient image brightness, and a high contrast ratio, as described in *Subsection 782-2.3*. Ensure that the display system provides access to serviceable components for repair and replacement of electronics, lamps, and optical components without removing the device from service for a period longer than 30 minutes.

Integrate the individual projection units in a single, seamless display capable of projecting a continuous image across the entire active display area provided, under the complete control of the TMC operators from their individual shared workstations.

Source all major wall display components from a single provider or manufacturer to ensure that the various devices are compatible with each other and able to function together as an integrated display.

Ensure that the individual video images exhibit a uniformity of color quality across the multiple displays. Ensure that colors are displayed evenly across the video wall, and that the video wall maintains uniform brightness characteristics from one video display unit to the next in the tiled display, with no degradation in color or

brightness uniformity over time. Ensure that the video wall display provides features that allow physical and electronic alignment of the separate high-resolution display units that comprise the wall.

782-2.2.4 Video Wall Support Structure: Furnish and install an aluminum or steel-frame structure capable of supporting the rear projection video display units as mounted and stacked to form the matrix for the video wall display. Ensure that the support structure consists of stackable projection modules delivering a one-to-one relationship between the number of projectors and the number of screens. Ensure that this structure maintains a consistent maximum horizontal and vertical spacing of 0.04 inch [1 mm] between adjacent display units in the video wall matrix.

Fabricate the support structure specifically to ensure that a continuous, accurate image is projected on the screens without any distortion or unused screen space. Ensure that no observable distortions are present in the installed video wall display due to normal building vibration. Ensure that each completed structure is enclosed such that there is no ambient light effect on the screen from behind the display.

Ensure that the components of the individual video modules can be serviced without disturbing the integrity of the entire video wall display.

782-2.2.5 Rear Projection Video Display: Use rear projection video displays that are suitable for digital video wall applications in mission-critical TMCs where video wall image quality, operational reliability, and serviceability objectives as stated in this specification can be achieved.

Use rear projection video displays capable of displaying a minimum of a single or quad-split, four-paned CCTV camera video image. Ensure that each video display can be independently controlled from any of the central operator or shift supervisor workstations, and that each video display can be integrated with additional video units to form a single video display, or a virtual desktop where video windows can be positioned and resized by the operator.

~~Ensure that each unit incorporates a diagonal, black bead screen with a two-piece fresnel lenticular lens or non-reflective, wide-angle glass to ensure maximum brightness uniformity across the video wall display.~~

Ensure that the rear projection video display facilitates lamp replacement without the need to readjust the image being projected on the screen.

Ensure that the rear projection video displays' intensity is sufficient to ensure effective and comfortable viewing by TMC operations personnel under normal lighting conditions, subject to approval by the Department. Ensure that the unit's display engine produces a minimum light output of 550 ANSI lumens.

Ensure that the rear projection video units have the following minimum features and characteristics:

1. Screen brightness achieved by a combination of projection techniques and screen materials, so that the video display has a minimum brightness measurement of 130 candelas per square meter (cd/m²) across the outside viewing surface of the projection screen.
2. Brightness uniformity that meets or exceeds 80 percent across the display unit, as measured using a photometer.
3. An ultra high-pressure metal halide lamp with a minimum of 100 watts or a high-pressure mercury lamp to ensure consistent brightness uniformity across the screen.

4. A multilamp optical engine provided in which a redundant second lamp will be activated when the first lamp fails. Ensure that the backup lamp activation ~~can~~*can be* accomplished with no reduction in screen light output performance. Provide indication of lamp status.

5. The redundant lamp replacement modes shall be either (1) the “hot standby” mode in which the second lamp is already burning and takes over in no more than a 2-second interval; or (2) the “cold standby” mode in which the second lamp is off and must be turned on and allowed to reach full light output during a “cold swap” interval that shall not exceed 30 seconds.

6. A display module that utilizes modular component architecture to permit service or replacement of serviceable parts without removing the projection engine.

7. Each unit shall be completely enclosed and light tight, with fixed panels for access to the lamp, power supply, and projection engine.

782-2.2.6 Flat Panel Display: Furnish and install a flat panel display unit to reproduce video and computer graphics information for personnel in the TMC control room. Ensure that the device displays, at a minimum, a high-resolution, distortion-free image of that maintains a consistent level of illumination across the entire screen area. Ensure that it has the following minimum features and characteristics:

1. Display control through the use of a control connection using a 9-pin D-sub connector.

2. Capability for independent control from any of the operator workstations, shift supervisor workstations, or other approved shared central workstations.

3. Maximum cabinet dimensions of 24 inches [0.61 m] high by 41 inches [1.03 m] wide by 4 inches [10.2 centimeters (cm)] deep, *or as shown in plans*.

4. Weight not to exceed 65 pounds [29.5 kilograms (kg)].

5. Ability to be installed on the face of a standard wall or flush mounted within the wall system.

782-2.2.7 CRT Display: Provide a CRT color video monitor able to display single or quad-split, four-paned CCTV camera video images. Ensure that each CRT display is capable of desktop (i.e., shelf) or wall-mounted installation.

A TV set is not an acceptable video monitor.

782-2.2.8 Cabling: Furnish each video display component with all required appurtenances, including all the necessary cables, with proper length and connectors for power and communication, as defined by the manufacturer. *Ensure that cabling conforms to applicable EIA/TIA standards*. Size the power cables to meet NEC requirements. Provide communication cables from each video display component to the network communication devices that are appropriate for and compatible with the technology employed (e.g., fiber optic, twisted pair, or coaxial), and meet the minimum size and bandwidth specifications the manufacturer requires.

Provide all cabling of adequate length, along with the compatible connectors and any ancillary equipment necessary to fully interconnect the video components and display control systems needed to achieve the functions required. Label all cables at both ends, as approved by the Engineer.

782-2.2.9 Electrical Specifications: Provide equipment that operates on 120 VAC at a frequency of 60 Hz. *Furnish a transformer or other necessary means of power conversion* for any device that requires ~~an power source input other than this~~ voltage ~~and-or~~ frequency, ~~furnish the necessary means of conversion.~~

Conduct TMC field reviews to examine the electrical distribution panels allocated for various equipment items and the electrical schedules for each. Make any changes, additions, or corrections to the electrical panels, wiring, outlets, and connectors that may be deemed necessary to adequately power all of the equipment proposed for a video display project at the intended location, subject to the approval of the Engineer. Make any changes to the building's electrical wiring in accordance with applicable codes and permits, and with the NEC. Have any modifications to an existing building's wiring or the video wall electrical wiring plans signed and sealed by a Specialty Engineer, as defined in Section 1-3.

782-2.3 Performance Specifications: Use only display devices meeting the following minimum requirements.

	CRT Display	Flat Panel Display			Rear Projection Video Display
Type	Cathode ray tube	Direct view LCD	Plasma	DLP or LCD	
Size	(dependent on TMC design, as shown in plans)				
Resolution	450 horizontal TV lines (Y/C input); 1,600 x 1,200 pixels with 85-Hz horizontal refresh rate	1600 x 1200 / 1280 x 768 pixels; 16.7 million colors	1280 x 768 pixels; 16.7 million colors	1024 x 768 pixels	
Aspect Ratio	4:3	4:3	16:9	16:9	4:3
Viewing Angle	—	170 degrees horizontally and vertically	160 degrees horizontally and vertically	160 degrees horizontally and vertically	160 degrees horizontally and vertically
Half Gain Angle	—	—	—	—	±40 degrees horizontally and vertically
Contrast Ratio	—	500:1	600:1	600:1	600:1
Screen Brightness *	—	250 cd/m ²	450 cd/m ²	400 cd/m ²	130 cd/m ²
Lamp Life	—	—	—	—	8,000 hrs. (avg.)
Video Inputs	NTSC compliant. Input A/B: Loop-through	Analog/digital via 15-pin D-sub (HD-15) connector;	Composite video (NTSC, PAL) on RCA connector; S-	Composite video (NTSC, PAL) on RCA connector; S-	Composite video (NTSC, PAL) on BNC; S-video

	BNC with composite 1 volt peak-to-peak, sync negative, and automatic 75-ohm termination. Horizontal and vertical linearity within $\pm 7\%$.	DVI-D connector.	video (NTSC, PAL compliant) on mini 4-pin connector; analog/digital via 15-pin D-sub (HD-15) connector; DVI-I connector.	video (NTSC, PAL compliant) on mini 4-pin connector; analog/digital via 15-pin D-sub (HD-15) connector; DVI-I connector.	(NTSC, PAL) on mini DIN 4-pin connector; RGB via 15-pin HD D-sub connectors; DVI-D connectors.
Environmental	32° to 104°F [0° to 40°C]. Operating humidity: 0 to 90%.	32° to 104°F [0° to 40°C]. Operating humidity: 10 to 90%.	32° to 95°F [0° to 35°C]. Operating humidity: 20 to 80%.	32° to 95°F [0° to 35°C]. Operating humidity: 20 to 80%.	32° to 95°F [0° to 35°C]. Operating humidity: 20 to 80%.
Power Requirements	120 VAC at 60 Hz	120 VAC at 60 Hz	120 VAC at 60 Hz	120 VAC at 60 Hz	120 VAC at 60 Hz
* Measured using a photometer.					

782-2.4 Installation Requirements: Do not proceed with any part of the procurement, construction, or installation of the video display equipment until the construction plans and materials are approved by the Engineer. Provide the Engineer with submittal documentation including the manufacturers' product specification sheets and a detailed description of each item's function, as well as a compliance matrix that confirms all equipment meets or exceeds the requirements of these specifications.

Configure each video display unit to provide individual, independent control from each operator workstation.

Create the video wall display by arranging individual video display units in a framework or apparatus that creates the video wall configuration as shown in the plans. Ensure that the finished video wall provides a single, apparently seamless display area. Ensure that adjacent individual display units are aligned physically and electronically so that image content stretched across multiple monitors align within ± 2 lines of horizontal and vertical resolution.

Ensure that all rear projection video unit controls are accessible at all times when the devices are permanently installed. Ensure that installation and positioning does not conceal or limit access to any display unit controls at any time during active use.

Follow proper ventilation and cooling procedures for the equipment installed, as determined by the equipment manufacturers. Provide electrical requirements and power distribution units and/or power supplies for the video display components on an as-needed basis.

782-2.5 Testing.

782-2.5.1 General: Submit a detailed system acceptance test plan to the Engineer for review and approval. Prepare a test plan that covers all areas of system

function described in this section, and that is developed according to the various equipment manufacturers' recommendations.

Check and test the satisfactory operation of all video display components upon completion of the equipment's installation. At minimum, include in the video display system test the testing of each color video monitor type, each secondary display output at workstations, each rear projection video display unit, and the video wall display's image alignment and control functions.

782-2.5.2 Observation Period: Subject the video wall display to a 90-day operational observation period, during which time the Contractor shall perform any and all maintenance, recalibration, system checking, and display modifications required by the Engineer. *The Engineer has the option to require a restart of the observation period if a major system flaw or failure occurs.*

782-3 Guaranty Provision.

782-3.1 General: Ensure that CCTV cameras and video display equipment furnished, assembled, or installed *have a manufacturer's warranty covering defects in assembly, fabrication, and materials for a minimum of* ~~are warranted by the manufacturer against defects for a period of no less than~~ three years from the date of final acceptance *by the Engineer in accordance with 5-11 of all work to be performed under the Contract. If the manufacturer's warranties for the components are for a longer period, those longer period warranties will apply.*

Replace any CCTV camera part or equipment found to be defective during the warranty period at no cost to the Department within 10 calendar days of notification by the Engineer.

Ensure that the *manufacturer's warranties on CCTV cameras and video display equipment are fully* ~~balance of this warranty is~~ transferable from the Contractor to the Department ~~upon the expiration of the Contractor's one-year warranty period covering materials and workmanship, as detailed in Section 611-5.2.~~

Because the video wall display system is a mission-critical part of the TMC, the warranty and maintenance period shall apply to the entire system and its associated subsystems, and shall include the following tasks:

1. Replace any operational support supplies used during this warranty period at no additional cost to the Department, including the operational support supplies used for repairs made due to lightning damage.

2. Conduct regularly scheduled preventive maintenance every six months for the initial one-year period.

3. For service and repairs *during and* beyond the warranty period, designate either the video wall display system Contractor, the equipment dealer, or the manufacturer's field technician as the representative responsible for providing this ongoing support to the TMC.

4. Allow no more than 24 hours to elapse between the time of the Department's notification that a repair is needed and the time repair commences.

782-3.2 Operational Support Supplies: Furnish a supply of replacements for all video wall display parts that might reach the end of their useful life or require replacement within the warranty period. Provide operational support supplies upon delivery and prior to acceptance of the video wall display system.

Assemble the operational support supply kit according to the wall display and associated subsystem manufacturer recommendations, but ensure that it contains at least one unit of each system component that may require replacement during the warranty period, including printed circuit boards and projection lamps. Submit the operational support supply kit for review and approval of the Engineer.

782-4 Method of Measurement.

782-4.1 General: Measurement for payment will be in accordance with the following tasks.

782-4.2 Furnish and Install: The Contract unit price for each CCTV camera or video display device or system, furnished and installed, will include furnishing, placement, and testing of all equipment and materials, and for all tools, labor, operational software package(s) and firmware(s), supplies, support, personnel training, shop drawings, documentation, and incidentals necessary to complete the work.

The video display equipment shall be measured as each major system component is furnished, installed, made fully operational, and tested in accordance with this specification or as directed by the Engineer.

782-4.3 Furnish: The Contract unit price per CCTV camera or video display device or system, furnished, will include all equipment specified in the Contract Documents, plus all shipping and handling costs involved in delivery as specified in the Contract Documents.

782-4.4 Install: The Contract unit price per CCTV camera or video display device or system, installed, will include placement and testing of all materials and equipment, and for all labor, equipment, hardware, and incidentals necessary to complete the work. The Engineer will supply the equipment specified in the Contract Documents.

782-5 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

- Item No. 782-1- CCTV camera; – each.
- Item No. 782-2- Video Display – each.

**INTELLIGENT TRANSPORTATION SYSTEMS – VIDEO EQUIPMENT
(REV 10-20-05)**

Page 766. The following new Section is added after Section 781:

**SECTION 782
INTELLIGENT TRANSPORTATION SYSTEMS
VIDEO EQUIPMENT**

782-1 CCTV Camera.

782-1.1 Description. Furnish and install a closed-circuit television (CCTV) camera at the location(s) shown on the plans. Ensure that the installed equipment provides unobstructed video images of the roadway, traffic, and other current conditions around a roadside CCTV field site; that it responds to camera control signals from the operator; and that the video images can be transmitted to remote locations for observation.

782-1.2 Materials.

782-1.2.1 Camera: Furnish a CCTV camera that is compatible with the current version of the Department's SunGuideSM Software System, and any other camera operating software indicated on the plans or in the contract documents. Ensure that the CCTV camera allows remote control of camera pan, tilt, and zoom functions via the Department's SunGuideSM Software System user interface. Use either a dome-type or external positioner-type CCTV camera assembly. Ensure that the appropriate type is used at the location(s) shown on the plans.

Ensure that the camera produces National Television System Committee (NTSC) composite video output of 1 volt peak-to-peak (Vp-p) at 75 ohms (Ω). In addition, ensure the camera provides the following features and capabilities:

1. Day (color)/night (monochrome) switchover and iris control, with user-selectable manual and automatic control capabilities.
2. Minimum resolution of 470 horizontal and 350 vertical TV lines.
3. Ability to produce clear, detailed, and usable video images of the areas, objects, and other subjects visible from a roadside CCTV field site. Ensure that video produced by the camera is free from transfer smear, oversaturation, and any other image defect that negatively impacts image quality under all lighting and weather conditions in both color and monochrome modes.
4. User-selectable automatic gain control (AGC) that is peak-average adjustable to 30 decibels (dB).
5. A minimum signal-to-noise ratio of 50 dB.
6. Automatic color balance that references the white areas of the scene through the lens.
7. An automatic electronic shutter that is user selectable from 1/60 to 1/10,000 of a second.
8. A digital signal processor that provides a minimum 10x digital zoom.

9. Programmable azimuth and compass display with ability to display pan and tilt position with a 1 degree resolution.

Furnish a CCTV camera that provides titling and masking features, including, but not limited to, programmable camera title, programmable preset titles for each preset position, and programmable privacy zones. Ensure that programmable titles are a minimum of 18 characters per line.

782-1.2.2 Lens: Ensure that the CCTV camera has a minimum 22x motorized optical zoom lens with automatic iris. Ensure that the lens is capable of automatic and manual focus and iris control. Ensure that the lens depth of field provides a clear image of roadside areas under all lighting conditions and that the lens has a maximum aperture of at least f/1.6.

782-1.2.3 Pan/Tilt Mechanism for Dome Type Cameras: Ensure that dome type CCTV cameras include an integrated pan/tilt mechanism capable of providing 360-degree continuous pan with a minimum 90-degree tilt range (i.e., 0 to -90 degrees); provide variable speed control; have a preset position return accuracy of ± 0.36 degree, or less than 0.10% or better; support a minimum of 64 presets; support a minimum of eight tours, each with a minimum of 32 presets; and support a minimum of eight programmable blackout zones.

Ensure that the positioner within the dome type CCTV camera has a minimum automatic pan speed of 240 degrees per second to a preset camera position; that maximum manual pan and tilt speeds are programmable; that the maximum manual pan speed range is adjustable from 1 degree to 240 degrees per second; and that maximum manual tilt speed range is adjustable from 1 degree to 90 degrees per second.

782-1.2.4 Pan/Tilt Mechanism for External Positioner Type Cameras: Ensure that external positioner-type CCTV cameras include a pan/tilt mechanism capable of providing 360-degree continuous pan with a minimum 150-degree tilt range (i.e., -90 to +60 degrees); provide variable speed control; have a preset position return accuracy of ± 0.36 degree, or less than 0.10% or better; and support a minimum of 32 presets.

782-1.2.5 Communication: Ensure that the CCTV camera supports the NTCIP 1205 v1.08 communication protocol as implemented in the SunGuide software. Ensure that the camera is capable of communication with other devices using EIA-232 or EIA-422/485 at a rate of 9600 bps. Ensure that the CCTV camera supports the communication links shown in the plans.

782-1.2.6 Electrical Specifications: Ensure that the CCTV camera system operates using a nominal input voltage at the cabinet of 120 volts alternating current (VAC). Ensure that the camera power supply will operate with an input voltage ranging from 89 to 135 VAC.

Ensure that the CCTV camera and positioner operate at 24 VAC or 10 to 28 volts of direct current (VDC). If the camera or any camera-related ancillary device requires operating voltages other than these, provide an appropriate voltage converter. Ensure power consumption does not exceed 125 watts.

782-1.2.7 Mechanical Specifications: Provide camera housings and hardware that are white in color or as noted in the plans.

Ensure that the camera housing has a sunshield to reduce the solar heating of the camera. Ensure that the total weight of dome type CCTV cameras (including the housing, sunshield, and all internal components) is less than 17.0 pounds. Ensure that the

lower dome of the camera housing is distortion free clear plastic. Ensure that the upper dome of the camera housing is light in color.

Ensure that pressurized dome-type housings are capable of pressurization at 5 pounds per square inch (psi) [34.5 kilopascals (kPa)] using dry nitrogen, that they have a low-pressure alarm feature, and carry a NEMA 4X/IP-67 rating.

If a nonpressurized dome-type housing enclosure is used, ensure that the unit is vented with a thermostat-controlled, 24-volt DC heater and blower. Ensure that the nonpressurized enclosure has a NEMA 4/IP-66 rating.

Ensure that the total weight of external positioner-type CCTV cameras (including housing, sunshield, all internal components, and external pan and tilt mechanism) is less than 35 pounds.

782-1.2.8 Environmental Specifications: Ensure that the CCTV camera performs all required functions during and after being subjected to an ambient operating temperature range of -30° to 165° F [-34° to 74° C] as defined in the environmental requirements section of the NEMA TS 2 standard. Verify that the CCTV camera manufacturer certifies its device has successfully completed environmental testing as defined in the environmental requirements section of the NEMA TS 2 standard.

Ensure that the housing protects the camera and other internal components from rain, dust, corrosive elements, and typical conditions found at a roadside environment. Verify that the CCTV camera, mounting hardware, and any other camera-related material that is exposed to the environment can withstand sustained wind of 110 mph with a 30% gust factor.

782-1.3 Installation Requirements: Install the CCTV camera in the field on a prestressed concrete or steel strain pole at a roadside location. Design, furnish, and install the pole according to the requirements of Section 641 or Section 649, as depicted in the Design Standards, and as shown in the plans.

Furnish and install the power supplies, local control equipment and any other camera-related field electronic equipment, and transient voltage surge suppressors within a pole- or base-mounted, lockable cabinet as shown in the plans and in accordance with Section 676. Ensure that the cabinet protects these electrical and electronic devices from rain, dust, dirt, and other harmful elements of nature.

Furnish and install all power, video, and data cables necessary to provide connection points for camera video and PTZ control signals within the cabinet. Furnish and install any and all ancillary equipment required to provide a complete and fully operational CCTV camera. Verify that all wiring meets NEC requirements where applicable.

Permanently mount the CCTV camera to the camera pole or other support structure as shown in the plans. Ensure that data and video cables from the pole or support structure to the camera are routed inside the mounting hardware and protected from exposure to the outside environment.

Coat the exterior of the dome-type enclosure's lower half with a clear, rain repellent product prior to final acceptance.

782-1.4 Testing:

782-1.4.1 General: Subject the equipment covered by these specifications to design approval tests (DATs) and field acceptance tests (FATs). Develop and submit a

test plan for DATs and FATs to the Engineer for review and approval. Ensure that the test plans demonstrate each and every functional requirement specified for the device or system under test.

The Engineer may accept certification by an independent testing laboratory in lieu of the DATs to satisfy the requirement that certain features and functions have been witnessed and documented as performing satisfactorily. Arrange and conduct the tests and satisfy all inspection requirements prior to submission for the Engineer's inspection and acceptance.

The Engineer reserves the right to witness all DATs and FATs. Compare all test results with their corresponding specifications. Complete the tests within five calendar days from the initiation of the testing process.

782-1.4.2 Field Test Requirements: Perform local field operational tests at CCTV field sites according to the following:

1. Verify that physical construction has been completed as specified in the plans.
2. Verify the quality and tightness of ground and surge protector connections.
3. Verify proper voltages for all power supplies and related power circuits.
4. Verify all connections, including correct installation of communication and power cables.
5. Verify that the video signal from the camera is present and of consistent quality at all connection points between the camera, the cabinet, and any video devices therein.
6. Exercise pan, tilt, zoom, and focus in all directions and execute a minimum of 3 other unique programming commands to ensure that the communication link between the cabinet and the camera is functioning properly.

782-2 Video Display Equipment.

782-2.1 Description: Furnish and install video display equipment as shown in the plans.

782-2.2 Materials:

782-2.2.1 General: Use video display equipment that can display analog, digital, and other images associated with the operation of the transportation management center (TMC). These types of images include, but are not limited to:

1. Closed-circuit television (CCTV) video images, including feeds from other TMCs.
2. Video vehicle detection (VVD) system images.
3. System infrastructure mapping images.
4. Graphical user interfaces from computers running typical TMC applications.
5. Weather mapping images.
6. Television broadcasts.
7. Digital video discs (DVDs), videocassette recordings, or other video storage media.

Provide equipment, mounting hardware, cabling, and other video display components that are compatible with each other. Ensure that all equipment and materials furnished and installed are reviewed and approved by the Engineer.

Use display devices of the types shown in the plans. The display types described herein include a video wall display, a flat panel display, and a cathode ray tube (CRT) display.

782-2.2.2 Video Display Control System: Provide a video display control system that enables the operator to control and manage the display of video and computer-generated graphics on the display equipment connected to the system, as well as provide selection and switching of multiple sources for display, including video streams available on the TMC Ethernet network. Ensure that the display control system allows an operator to control all displays from the same workstation that is used for the SunGuide operator interface. Ensure that the video display control system is capable of decoding and displaying streaming MPEG-2 video feeds.

Use a video display control system capable of simultaneously displaying a minimum of 32 video windows, each containing streaming video at a minimum resolution of 720 x 480 pixels and frame rate of 30 frames per second (fps). Ensure that the system allows any display window to be sized from 1/32 of the total display area up to the total display area, and any size in between. Total display area is defined as the total screen size provided by a video wall display, a flat panel display, or a CRT display.

Ensure that the video display control system hardware is designed to be rack mounted and secured in an EIA 19-inch equipment rack. Ensure that any system incorporating personal computer (PC) hardware utilizes current microprocessor technology and commercial, off-the-shelf components, including random access memory (RAM), hard disk drive(s), and network interface card(s) sufficient to provide the functional requirements of the system.

782-2.2.2.1 Display Control Software: Provide display control software that enables multiple operators to control all features and functions of the video display control system. These features and functions include, but are not limited to, selection of video sources for display; adjusting the size, location, and layout of video and other graphic information the system displays; and system configuration and setup. Ensure that the control software is able to operate a video wall composed of multiple display components as though it were a single, high-resolution display.

Use display control software that is compatible with the Department's SunGuideSM Software System and the published interface control documents (ICDs) that describe its subsystem interfaces.

Ensure that software applications use the Simple Object Access Protocol (SOAP) standards to perform specific functions and to access the features within the control system's architecture.

782-2.2.2.2 Inputs and Outputs: Use a video display control system that supports and displays a variety of video and data inputs simultaneously, including composite and component NTSC video, DVI, VGA, SVGA, and Super eXtended Graphics Array (SXGA) computer graphics. Ensure that all inputs and outputs can be controlled by an operator in order to display any or all of this information on any number of display devices within the system. Ensure all inputs and outputs can be sized

with and without constrained proportions across multiple screens and moved at will around any display area and combination of displays.

Ensure that the video display control system is expandable and scalable to support any combination of inputs and outputs. Provide the video display control system with a minimum configuration of 8 composite video inputs, 4 component (RGB) video inputs, 8 SXGA inputs, and 8 DVI inputs, as well as network connections, decoders, and associated hardware and software required to display 32 inputs simultaneously at a minimum resolution of 720 x 480 pixels and a frame rate of 30 fps, or as shown in the plans. Provide the video display control system with a minimum configuration of 4 composite video outputs, 2 component (RGB video outputs), 4 SXGA outputs, and 4 DVI outputs, or as shown in the plans. Ensure the video display control system can be expanded to accommodate at least 128 discreet inputs and outputs.

Ensure that a single input can be routed to multiple displays simultaneously and that multiple inputs can be routed to a single display simultaneously for viewing in separate windows. Ensure that all inputs and outputs are synchronized by the video display control system and that switching between inputs or outputs does not cause displayed images to unlock, roll, or otherwise exhibit visible distortion.

782-2.2.2.2.1: Analog Video: Ensure that the video display control system is able to accept S-video, composite, and component video sources, and can digitize these signals for manipulation and display on any display device attached to the system. Ensure that all analog video inputs utilize BNC connectors.

Ensure that analog video sources can be displayed within their own windows, and can be resized up to or beyond their native resolution to conform to the wall display size.

782-2.2.2.2.2 Digital Video: Ensure that the video display control system is able to accept digital video sources, and can manipulate and display these signals on any display attached to the system. Ensure that all digital video outputs utilize DVI connectors.

Ensure that each MPEG video stream can be displayed within its own window, which shall be freely movable and sizable up to or beyond its native resolution to conform to the wall display size.

782-2.2.2.2.3 RGB Video: Include an analog input that enables the TMC operator to project an exact copy of his or her workstation desktop display on the video wall display. Ensure that analog RGB inputs allow native images up to 1,280 by 1,024 pixels at 60 Hz to be displayed on the video wall.

Ensure that RGB inputs are sizable up to or beyond their native resolution to conform to the wall display size.

782-2.2.2.2.4 Streaming Media: Ensure that the video display control system can display a minimum of 32 compressed video streams simultaneously in MPEG-2 over TCP/UDP/RTP over IP and supports multicasting as defined in Version 2 of the Internet Gateway Message Protocol (IGMP). Ensure that the video display control system can be upgraded to also accept MPEG-4 and H.264. Ensure that the MPEG video input interface is, at minimum, a 10/100-megabit per second network port per every 15 streams.

782-2.2.2.2.5 Primary Display Output: Use a video display control system that can process the various signal input types to be viewed, such

as the RGB feeds from monitor outputs and streaming video feeds. Ensure that the unit provides direct digital streaming video through cable feeds using a digital video decoder. Ensure that the video display control system provides the layout definitions for each signal to be displayed and saves the predefined layouts. Ensure that the video display control system also permits switching of the predefined layouts and accepts external alarm triggers to change the layouts.

Include output capacity with sufficient memory and processing speed to provide fast rendering of video and image displays. Ensure that the output has, at a minimum, a dual digital visual interface (DVI) connector that allows a digital connection of 1,280 horizontal pixels by 1,024 vertical pixels or greater resolution. Ensure that the color depth is a minimum of 24 bits per pixel. If the projection device requires an analog signal, then breakout cables may be used to convert the DVI output connector to a HD15 analog RGB connector.

782-2.2.2.2.6 Secondary Display Output: Provide an integrated, secondary display system that accepts multiple layouts and signal types, such as video, RGB, or serial data interface (SDI), for use on a single integrated display at the operator workstation. Use a secondary display system consisting of the video display control system and the display device.

782-2.2.3 Video Wall Display: Furnish and install a video wall display consisting of tiled, rear projection video display cubes arranged in a wall, as shown in the plans, together with a video display control system.

Ensure that the video wall display is capable of producing, at a minimum, a large-scale, high-resolution video image having accurate color rendition, sufficient image brightness, and a high contrast ratio, as described in Subsection 782-2.3. Ensure that the display system provides access to serviceable components for repair and replacement of electronics, lamps, and optical components without removing the device from service for a period longer than 30 minutes.

Integrate the individual projection units in a single, seamless display capable of projecting a continuous image across the entire active display area provided, under the complete control of the TMC operators from their individual shared workstations.

Source all major wall display components from a single provider or manufacturer to ensure that the various devices are compatible with each other and able to function together as an integrated display.

Ensure that the individual video images exhibit a uniformity of color quality across the multiple displays. Ensure that colors are displayed evenly across the video wall, and that the video wall maintains uniform brightness characteristics from one video display unit to the next in the tiled display, with no degradation in color or brightness uniformity over time. Ensure that the video wall display provides features that allow physical and electronic alignment of the separate high-resolution display units that comprise the wall.

782-2.2.4 Video Wall Support Structure: Furnish and install an aluminum or steel-frame structure capable of supporting the rear projection video display units as mounted and stacked to form the matrix for the video wall display. Ensure that the support structure consists of stackable projection modules delivering a one-to-one relationship between the number of projectors and the number of screens. Ensure that this

structure maintains a consistent maximum horizontal and vertical spacing of 0.04 inch [1 mm] between adjacent display units in the video wall matrix.

Fabricate the support structure specifically to ensure that a continuous, accurate image is projected on the screens without any distortion or unused screen space. Ensure that no observable distortions are present in the installed video wall display due to normal building vibration. Ensure that each completed structure is enclosed such that there is no ambient light effect on the screen from behind the display.

Ensure that the components of the individual video modules can be serviced without disturbing the integrity of the entire video wall display.

782-2.2.5 Rear Projection Video Display: Use rear projection video displays that are suitable for digital video wall applications in mission-critical TMCs where video wall image quality, operational reliability, and serviceability objectives as stated in this specification can be achieved.

Use rear projection video displays capable of displaying a minimum of a single or quad-split, four-paned CCTV camera video image. Ensure that each video display can be independently controlled from any of the central operator or shift supervisor workstations, and that each video display can be integrated with additional video units to form a single video display, or a virtual desktop where video windows can be positioned and resized by the operator.

Ensure that the rear projection video display facilitates lamp replacement without the need to readjust the image being projected on the screen.

Ensure that the rear projection video displays' intensity is sufficient to ensure effective and comfortable viewing by TMC operations personnel under normal lighting conditions, subject to approval by the Department. Ensure that the unit's display engine produces a minimum light output of 550 ANSI lumens.

Ensure that the rear projection video units have the following minimum features and characteristics:

1. Screen brightness achieved by a combination of projection techniques and screen materials, so that the video display has a minimum brightness measurement of 130 candelas per square meter (cd/m²) across the outside viewing surface of the projection screen.
2. Brightness uniformity that meets or exceeds 80 percent across the display unit, as measured using a photometer.
3. An ultra high-pressure metal halide lamp with a minimum of 100 watts or a high-pressure mercury lamp to ensure consistent brightness uniformity across the screen.
4. A multilamp optical engine provided in which a redundant second lamp will be activated when the first lamp fails. Ensure that the backup lamp activation can be accomplished with no reduction in screen light output performance. Provide indication of lamp status.
5. The redundant lamp replacement modes shall be either (1) the "hot standby" mode in which the second lamp is already burning and takes over in no more than a 2-second interval; or (2) the "cold standby" mode in which the second lamp is off and must be turned on and allowed to reach full light output during a "cold swap" interval that shall not exceed 30 seconds.

6. A display module that utilizes modular component architecture to permit service or replacement of serviceable parts without removing the projection engine.

7. Each unit shall be completely enclosed and light tight, with fixed panels for access to the lamp, power supply, and projection engine.

782-2.2.6 Flat Panel Display: Furnish and install a flat panel display unit to reproduce video and computer graphics information for personnel in the TMC control room. Ensure that the device displays, at a minimum, a high-resolution, distortion-free image of that maintains a consistent level of illumination across the entire screen area. Ensure that it has the following minimum features and characteristics:

1. Display control through the use of a control connection using a 9-pin D-sub connector.

2. Capability for independent control from any of the operator workstations, shift supervisor workstations, or other approved shared central workstations.

3. Maximum cabinet dimensions of 24 inches [0.61 m] high by 41 inches [1.03 m] wide by 4 inches [10.2 centimeters (cm)] deep, or as shown in plans.

4. Weight not to exceed 65 pounds [29.5 kilograms (kg)].

5. Ability to be installed on the face of a standard wall or flush mounted within the wall system.

782-2.2.7 CRT Display: Provide a CRT color video monitor able to display single or quad-split, four-paned CCTV camera video images. Ensure that each CRT display is capable of desktop (i.e., shelf) or wall-mounted installation.

A TV set is not an acceptable video monitor.

782-2.2.8 Cabling: Furnish each video display component with all required appurtenances, including all the necessary cables, with proper length and connectors for power and communication, as defined by the manufacturer. Ensure that cabling conforms to applicable EIA/TIA standards. Size the power cables to meet NEC requirements. Provide communication cables from each video display component to the network communication devices that are appropriate for and compatible with the technology employed (e.g., fiber optic, twisted pair, or coaxial), and meet the minimum size and bandwidth specifications the manufacturer requires.

Provide all cabling of adequate length, along with the compatible connectors and any ancillary equipment necessary to fully interconnect the video components and display control systems needed to achieve the functions required. Label all cables at both ends, as approved by the Engineer.

782-2.2.9 Electrical Specifications: Provide equipment that operates on 120 VAC at a frequency of 60 Hz. Furnish a transformer or other necessary means of power conversion for any device that requires another voltage or frequency.

Conduct TMC field reviews to examine the electrical distribution panels allocated for various equipment items and the electrical schedules for each. Make any changes, additions, or corrections to the electrical panels, wiring, outlets, and connectors that may be deemed necessary to adequately power all of the equipment proposed for a video display project at the intended location, subject to the approval of the Engineer. Make any changes to the building's electrical wiring in accordance with applicable codes and permits, and with the NEC. Have any modifications to an existing

building's wiring or the video wall electrical wiring plans signed and sealed by a Specialty Engineer, as defined in Section 1-3.

782-2.3 Performance Specifications: Use only display devices meeting the following minimum requirements.

	CRT Display	Flat Panel Display			Rear Projection Video Display
Type	Cathode ray tube	Direct view LCD	Plasma		DLP or LCD
Size	(dependent on TMC design, as shown in plans)				
Resolution	450 horizontal TV lines (Y/C input); 1,600 x 1,200 pixels with 85-Hz horizontal refresh rate	1600 x 1200 / 1280 x 768 pixels; 16.7 million colors	1280 x 768 pixels; 16.7 million colors		1024 x 768 pixels
Aspect Ratio	4:3	4:3	16:9	16:9	4:3
Viewing Angle	—	170 degrees horizontally and vertically	160 degrees horizontally and vertically	160 degrees horizontally and vertically	160 degrees horizontally and vertically
Half Gain Angle	—	—	—	—	±40 degrees horizontally and vertically
Contrast Ratio	—	500:1	600:1	600:1	600:1
Screen Brightness *	—	250 cd/m2	450 cd/m2	400 cd/m2	130 cd/m2
Lamp Life	—	—	—	—	8,000 hrs. (avg.)
Video Inputs	NTSC compliant. Input A/B: Loop-through BNC with composite 1 volt peak-to-peak, sync negative, and automatic 75-ohm termination. Horizontal and vertical linearity	Analog/digital via 15-pin D-sub (HD-15) connector; DVI-D connector.	Composite video (NTSC, PAL) on RCA connector; S-video (NTSC, PAL compliant) on mini 4-pin connector; analog/digital via 15-pin D-sub (HD-15) connector; DVI-I connector.	Composite video (NTSC, PAL) on RCA connector; S-video (NTSC, PAL compliant) on mini 4-pin connector; analog/digital via 15-pin D-sub (HD-15) connector; DVI-I connector.	Composite video (NTSC, PAL) on BNC; S-video (NTSC, PAL) on mini DIN 4-pin connector; RGB via 15-pin HD D-sub connectors; DVI-D connectors.

	within $\pm 7\%$.				
Environmental	32° to 104°F [0° to 40°C]. Operating humidity: 0 to 90%.	32° to 104°F [0° to 40°C]. Operating humidity: 10 to 90%.	32° to 95°F [0° to 35°C]. Operating humidity: 20 to 80%.	32° to 95°F [0° to 35°C]. Operating humidity: 20 to 80%.	32° to 95°F [0° to 35°C]. Operating humidity: 20 to 80%.
Power Requirements	120 VAC at 60 Hz	120 VAC at 60 Hz	120 VAC at 60 Hz	120 VAC at 60 Hz	120 VAC at 60 Hz
* Measured using a photometer.					

782-2.4 Installation Requirements: Do not proceed with any part of the procurement, construction, or installation of the video display equipment until the construction plans and materials are approved by the Engineer. Provide the Engineer with submittal documentation including the manufacturers’ product specification sheets and a detailed description of each item’s function, as well as a compliance matrix that confirms all equipment meets or exceeds the requirements of these specifications.

Configure each video display unit to provide individual, independent control from each operator workstation.

Create the video wall display by arranging individual video display units in a framework or apparatus that creates the video wall configuration as shown in the plans. Ensure that the finished video wall provides a single, apparently seamless display area. Ensure that adjacent individual display units are aligned physically and electronically so that image content stretched across multiple monitors align within ± 2 lines of horizontal and vertical resolution.

Ensure that all rear projection video unit controls are accessible at all times when the devices are permanently installed. Ensure that installation and positioning does not conceal or limit access to any display unit controls at any time during active use.

Follow proper ventilation and cooling procedures for the equipment installed, as determined by the equipment manufacturers. Provide electrical requirements and power distribution units and/or power supplies for the video display components on an as-needed basis.

782-2.5 Testing.

782-2.5.1 General: Submit a detailed system acceptance test plan to the Engineer for review and approval. Prepare a test plan that covers all areas of system function described in this section, and that is developed according to the various equipment manufacturers’ recommendations.

Check and test the satisfactory operation of all video display components upon completion of the equipment’s installation. At minimum, include in the video display system test the testing of each color video monitor type, each secondary display output at workstations, each rear projection video display unit, and the video wall display’s image alignment and control functions.

782-2.5.2 Observation Period: Subject the video wall display to a 90-day operational observation period, during which time the Contractor shall perform any and all maintenance, recalibration, system checking, and display modifications required by the Engineer. The Engineer has the option to require a restart of the observation period if a major system flaw or failure occurs.

782-3 Guaranty Provision.

782-3.1 General: Ensure that CCTV cameras and video display equipment furnished, assembled, or installed have a manufacturer's warranty covering defects in assembly, fabrication, and materials for a minimum of three years from the date of final acceptance by the Engineer in accordance with 5-11 of all work to be performed under the Contract. If the manufacturer's warranties for the components are for a longer period, those longer period warranties will apply.

Replace any CCTV camera part or equipment found to be defective during the warranty period at no cost to the Department within 10 calendar days of notification by the Engineer.

Ensure that the manufacturer's warranties on CCTV cameras and video display equipment are fully transferable from the Contractor to the Department.

Because the video wall display system is a mission-critical part of the TMC, the warranty and maintenance period shall apply to the entire system and its associated subsystems, and shall include the following tasks:

1. Replace any operational support supplies used during this warranty period at no additional cost to the Department, including the operational support supplies used for repairs made due to lightning damage.

2. Conduct regularly scheduled preventive maintenance every six months for the initial one-year period.

3. For service and repairs during and beyond the warranty period, designate either the video wall display system Contractor, the equipment dealer, or the manufacturer's field technician as the representative responsible for providing this ongoing support to the TMC.

4. Allow no more than 24 hours to elapse between the time of the Department's notification that a repair is needed and the time repair commences.

782-3.2 Operational Support Supplies: Furnish a supply of replacements for all video wall display parts that might reach the end of their useful life or require replacement within the warranty period. Provide operational support supplies upon delivery and prior to acceptance of the video wall display system.

Assemble the operational support supply kit according to the wall display and associated subsystem manufacturer recommendations, but ensure that it contains at least one unit of each system component that may require replacement during the warranty period, including printed circuit boards and projection lamps. Submit the operational support supply kit for review and approval of the Engineer.

782-4 Method of Measurement.

782-4.1 General: Measurement for payment will be in accordance with the following tasks.

782-4.2 Furnish and Install: The Contract unit price for each CCTV camera or video display device or system, furnished and installed, will include furnishing, placement, and testing of all equipment and materials, and for all tools, labor, operational software package(s) and firmware(s), supplies, support, personnel training, shop drawings, documentation, and incidentals necessary to complete the work.

The video display equipment shall be measured as each major system component is furnished, installed, made fully operational, and tested in accordance with this specification or as directed by the Engineer.

782-4.3 Furnish: The Contract unit price per CCTV camera or video display device or system, furnished, will include all equipment specified in the Contract Documents, plus all shipping and handling costs involved in delivery as specified in the Contract Documents.

782-4.4 Install: The Contract unit price per CCTV camera or video display device or system, installed, will include placement and testing of all materials and equipment, and for all labor, equipment, hardware, and incidentals necessary to complete the work. The Engineer will supply the equipment specified in the Contract Documents.

782-5 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

- | | |
|-----------------|-----------------------|
| Item No. 782-1- | CCTV camera – each. |
| Item No. 782-2- | Video Display – each. |