Florida Department of Transportation

RICK SCOTT
GOVERNOR

605 Suwannee Street
Tallahassee, FL 32399-0450

ANANTH PRASAD, P.E.
SECRETARY

July 26, 2011

Monica Gourdine
Program Operations Engineer
Federal Highway Administration
545 John Knox Road, Suite 200
Tallahassee, Florida 32303

Re: Office of Design, Specifications
Section 782
Proposed Specification: 7820202 ITS - Video Equipment

Dear Ms. Gourdine:

We are submitting, for your approval, two copies of the above referenced Supplemental Specification.

The changes are proposed by Gene Glotzbach to update the specification to current approval and interoperability requirements for equipment and remove references to obsolete CRT technology.

Please review and transmit your comments, if any, within two weeks. Comments should be sent via Email to SP965RP or rudy.powell@dot.state.fl.us.

If you have any questions relating to this specification change, please call Rudy Powell, State Specifications Engineer at 414-4280.

Sincerely,

Signature on File

Rudy Powell, Jr., P.E.
State Specifications Engineer

RP/ft
Attachment
cc: Calvin Johnson, Chief Civil Litigation
Florida Transportation Builders' Assoc.
State Construction Engineer

INTELLIGENT TRANSPORTATION SYSTEMS – VIDEO EQUIPMENT.
(REV ~~11-10-10~~*5-31-11*) ~~(FA 1-24-11) (7-11)~~

SUBARTICLE 782-2.2.1 (of the Supplemental Specifications) is deleted and the following substituted:

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.~~

SUBARTICLE 784-2.2.2 (of the Supplemental Specifications) is deleted and the following substituted:

782-2.2.2 Video Display Control System: *Furnish a Video Display Control System listed on the APL. Ensure that the* ~~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 *all* ~~streaming MPEG-2~~ video *streams produced by encoders* ~~*that are*~~ *listed on the APL.* ~~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. ~~Use only equipment from manufacturers listed on the FDOT Traffic Engineering Research Laboratory's Vendor Manufacturing Process Qualification List.~~

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 SunGuide® Software System ~~and the published interface control documents (ICDs) that describe its subsystem interfaces~~.

Ensure that the display control software provided includes a non-proprietary Software Development Kit (SDK) including, but not limited to, an application programming interface (API) that describes interfaces and protocols which can be used to integrate system features and functions with third-party applications.

~~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.

SUBARTICLE 782-2.2.5 (of the Supplemental Specifications) is deleted and the following substituted:

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.~~

3~~4~~. A multi-lamp optical engine *must be provided for rear projection video units that do not use Light Emitting Diodes (LEDs) for illumination. Multi-lamp optical engines must* provide~~d in which~~ a *failover feature whereby a* ~~redundant~~ second lamp~~-~~ *can* ~~will~~ be *automatically* activated when the first lamp fails. Ensure *displays with multi-lamp optical engines* ~~that the backup lamp activation can be accomplished with no reduction in screen light output performance. P~~*p*rovide indication of lamp status.

4~~5~~. *Multi-lamp optical engines must include*~~The redundant lamp replacement modes shall be either~~ (1) *a*~~the~~ "hot standby" mode in which *failover to* the second lamp ~~is already burning and~~ takes ~~over in~~ no more than ~~a 2~~*two*~~-~~ second*s* ~~interval;~~ *and*~~or~~ (2) *a*~~the~~ "cold standby" mode in which *failover* ~~the second lamp is off and must be turned on~~ and ~~allowed~~*the time for the display* to *return to* ~~reach~~ full light output ~~during a "cold swap" interval that shal~~*does*~~l~~ not exceed 30 seconds.

5~~6~~. A display module that utilizes modular component architecture to permit service or replacement of serviceable parts without removing the projection engine.

6~~7~~. Each unit shall be completely enclosed and light tight, with fixed panels for access to the lamp, power supply, and projection engine.

SUBARTICLE 782-2.2.6 is deleted and the following substituted:

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~~*and* 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~~*1*. ~~Maximum cabinet d~~*D*imensions of 24 inches high by 41 inches wide by 4 inches deep, or as shown in plans.

~~4~~*2*~~. Weight not to exceed 65 pounds *or as shown in plans*.~~

~~5~~*2*~~3~~. Ability to be installed on the face of a standard wall or flush mounted within the wall system.

SUBARTICLE 782-2.2.7 is deleted and the following substituted:

~~**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*7* **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~~*8* 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.

SUBARTICLE 782-2.3 is deleted and the following substituted:

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

	Flat Panel Display			Rear Projection Video Display
Type	Direct view LCD		Plasma	DLP or LCD
Size	*(dependent on TMC design, as shown in plans)*			
Resolution	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	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	Analog/digital via 15-pin D-sub (HD-15) connector; DVI-D 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 (NTSC, PAL)

		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.	on mini DIN 4-pin connector; RGB via 15-pin HD D-sub connectors; DVI-D connectors.
~~Environmental~~*Operating Temperature and Humidity*	32° to ~~104~~*95*°F~~]~~. ~~Operating humidity: 1~~*2*0 to ~~9~~*8*0%.	32° to 95°F. ~~Operating humidity: 2~~0 to 80%.	32° to 95°F. ~~Operating humidity: 2~~0 to 80%.	32° to 95°F. ~~Operating humidity: 2~~0 to 80%.
Power Requirements	120 VAC at 60 Hz	120 VAC at 60 Hz	120 VAC at 60 Hz	120 VAC at 60 Hz
** Measured using a photometer.*				

INTELLIGENT TRANSPORTATION SYSTEMS – VIDEO EQUIPMENT. (REV 5-31-11)

SUBARTICLE 782-2.2.1 (of the Supplemental Specifications) is deleted and the following substituted:

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.

SUBARTICLE 784-2.2.2 (of the Supplemental Specifications) is deleted and the following substituted:

782-2.2.2 Video Display Control System: Furnish a Video Display Control System listed on the APL. Ensure that the video display control system 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 all video streams produced by encoders listed on the APL..

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.

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 SunGuide® Software System. Ensure that the display control software provided includes a non-proprietary Software Development Kit (SDK) including, but not limited to, an application programming interface (API) that describes interfaces and protocols which can be used to integrate system features and functions with third-party applications.

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.

SUBARTICLE 782-2.2.5 (of the Supplemental Specifications) is deleted and the following substituted:

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. A multi-lamp optical engine must be provided for rear projection video units that do not use Light Emitting Diodes (LEDs) for illumination. Multi-lamp optical engines must provide a failover feature whereby a second lamp can be automatically activated when the first lamp fails. Ensure displays with multi-lamp optical engines provide indication of lamp status.

4. Multi-lamp optical engines must include (1) a "hot standby" mode in which failover to the second lamp takes no more than two seconds and (2) a "cold standby" mode in which failover and the time for the display to return to full light output does not exceed 30 seconds.

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

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

SUBARTICLE 782-2.2.6 is deleted and the following substituted:

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

1. Dimensions of 24 inches high by 41 inches wide by 4 inches deep, or as shown in plans.

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

SUBARTICLE 782-2.2.7 is deleted and the following substituted:

782-2.2.7 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.

782-2.2.8 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.

SUBARTICLE 782-2.3 is deleted and the following substituted:

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

	Flat Panel Display			Rear Projection Video Display
Type	Direct view LCD		Plasma	DLP or LCD
Size	(dependent on TMC design, as shown in plans)			
Resolution	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	16:9	16:9	4:3
Viewing Angle	170 degrees	160 degrees	160 degrees	160 degrees

	horizontally and vertically	horizontally and vertically	horizontally and vertically	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	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.
Operating Temperature and Humidity	32° to 95°F. 20 to 80%.	32° to 95°F. 20 to 80%.	32° to 95°F. 20 to 80%.	32° to 95°F. 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
* Measured using a photometer.				