

SECTION 28 23 00 – CLOSED CIRCUIT VIDEO SYSTEMS (CCVSs)

1.01 SUMMARY:

- A. ^{A17}**Scope:** Scope of work shall be in accordance with Paragraph 1.01 D. of Section 01 81 26 (Communications, Control, Safety, and Security Systems), as required for real-time surveillance as part of the Works.^{A17} Such surveillance shall include alarm verification, person identification, process monitoring, other physical security purposes, and vessel traffic surveillance. This Section of the Employer's Requirements shall be read in conjunction with the Sections listed in Table 28 23 00-1.

B. **Related Sections:**

Table 28 23 00-1: Related Sections	
1.	Section 01 81 26 - Communications, Control, Safety, and Security Systems.
2.	Section 11 52 23 - Video Walls.
3.	Section 25 11 00 - Data Processing Equipment.
4.	Section 26 33 00 - Direct Current Equipment.
5.	Section 26 50 00 - Lighting (refer to climbing stairs and concrete poles).
6.	Section 27 10 00 - Structured Cabling Systems for Communications Inside Plant.
7.	Section 27 11 16 - Cabinets, Racks, Frames, and Enclosures.
8.	Section 28 13 00 - Access Control Systems.
9.	Section 28 13 53 - Security Access Detectors.
10.	Section 28 16 00 - Intrusion Detection Systems.
11.	Section 28 16 43 - Perimeter Security Systems.
12.	Section 28 16 46 - Vehicular Control Systems.
13.	Section 28 23 19 - Video Recording Systems.
14.	Section 28 31 00 - Fire Alarm Systems for Buildings.
15.	Section 28 50 00 - Evacuation Systems.
16.	Section 28 60 00 - Attendance Control Systems.
17.	Section 33 82 00 - Cabling for Underground Communications Outside Plant

1.02 REFERENCE:

- A. **Applicable Publications:** Refer to Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), Paragraph 1.02.

B. **Background Information:**

- Vertical wiring of CCVS cameras installed on top of high mast lighting poles of existing locks use a composite cable that winds and unwinds as the light fixture and camera assembly is raised or lowered. Video is carried in a coaxial cable.
- ^{A9}Main video switching and CCVS control equipment at Employer SCCs is Honeywell Video VideoBloX Matrix System.^{A9}

- ^{A10}3. Camera control and display software is Windows XP based 360° Integration Software (www.360surveillance.com) Camaleon v4.7.9. It handles hybrid IP/analog video, client-to-multiple server and server-to-server architecture, as well as multi-purpose windows allowing the control of live video and viewing of site maps.
4. Low light level analog video cameras are typically Bosch (ex Burle), Panasonic, and Pelco Esprit models.
5. Thermal cameras at canal entries are ISAP Cyclops KP-D590 with 400, 500, and 1,500 mm lenses for thermal and color ranges up to 11.27 km (7 miles) and 6.44 km (4 miles), respectively.^{A10}

1.03 REQUIREMENTS:

A. General Requirements:

1. General:

- a. The Contractor shall meet all applicable requirements of Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), Paragraph 1.03.
- b. All CCVS equipment and designs shall be previously reviewed by the Employer’s Representative, with participation of the Employer’s “División de Protección y Respuesta a Emergencias” (OPP) considering current Employer standards for security video systems at the time of installation.
- c. CCVSs shall be suitable for continuous operation and color displays.
- d. All 120 VAC power outlets for CCVS equipment and components shall be provisioned with a backup power source to permit continuous operation of every CCVS system.
- e. CCVSs shall be capable of being controllable by a remote system and local users.
- f. All CCVS users shall be dynamically programmed and partitioned to view and control video signals from specific camera groups. Also, such users shall be able to view video signals from everyone else’s CCVS system cameras, and shall be inhibited from controlling units outside their area of responsibility.
- g. Local matrixes shall accept a minimum of six keyboard connections, be capable of 32 monitor outputs, and have an expansion capacity of 50% of cameras installed.

- h. Display H:V aspect ratio shall be either 4:3 (NTSC style) or 16:9 (HDTV style).
 - i. Time to reach desired presets in cameras with pan / tilt / zoom (PTZ) shall not exceed one second.
 - j. ^{A17}For video transmission in digital media, no less than 8 Mbps of bandwidth shall be reserved for transmission of each applicable CCVS camera and video source. Such sources shall operate at no less than 2 Mbps. ^{A17}
 - k. Video signals shall be converted to fiber optic signal very close to CCVS cameras with media converters external to cameras.
 - l. ^{A8}Note that this Contract does not require integrating new CCVSs with existing ones in old locks. ^{A8}
- 2. **The Employer's Closed Circuit Video Systems (CCVSs):** ^{A8}The Contractor shall furnish five separate but not totally isolated CCVSs for different purposes. ^{A8} ^{A9}CCVSs may share amplification, distribution, and transmission equipment. ^{A9}
 - a. **OPP CCVS Systems:**
 - 1) OPP shall be provided with two CCVS systems configured, partitioned, and optimized for physical security of the whole locks complexes.
 - 2) In each complex, one CCVS shall be setup for local operations and viewable from all guard booths in the locks complex, and the second one shall be for remote viewing from the Security Control Center (SCC) at Corozal West Building 741 and Gatun Building 40.
 - 3) OPP CCVSs shall be capable of associating alarms from intrusion detection systems (IDSs) and perimeter security systems (PSSs or fence intrusion detection systems (FIDSs)) for visual verification purposes.
 - 4) ^{A19}In addition to standard visible light cameras, OPP CCVS systems shall have infrared (IR) or thermal cameras with PTZ covering all approach navigation channels. ^{A19}
 - b. **“División de Esclusas y Mantenimiento de Instalaciones” (OPE) CCVS System:** The Contractor shall provide a CCVS for OPE optimized to view the locks operations.
 - c. **“División de Operaciones de Tránsito” (OPT) CCVS System:** The Contractor shall provide a CCVS for OPT, optimized to view the transiting vessels from the Marine Traffic Control Center (MTCC).

- d. **Web Cameras:** One webcam shall be furnished for each locks complex, with PTZ and web enabled controls.

3. **Coordination and Interoperability:**

a. **General:**

- 1) The Contractor shall coordinate with the Employer's Representative the location of lighting poles, including high mast lighting (HML), to minimize the number of required poles and towers for CCVS cameras.
- 2) New equipment shall be compatible with existing CCVSs and SAN equipment indicated below.
- 3) OPP CCVSs shall interoperate with the following:
 - a) Access control systems (ACSs), refer to Section 28 13 00 (*Access Control Systems*), and
 - b) Attendance systems refer to Section 28 60 00 (*Attendance Control Systems*).

b. **CCVS Equipment:**

- 1) CCVS equipment shall interoperate with various existing CCVS devices. These may include cameras, domes, monitors, multiplexers, PTZ drives, remote control systems, video distribution amplifiers, and video switchers.
- 2) These items were manufactured by the following:
 - a) Bosch Burle Philips (www.burlecctv.com), Lancaster, USA.
 - b) Honeywell Video's Javelin Electronics (www.honeywellvideo.com), Louisville, KY, USA.
 - c) Pelco (www.pelco.com), Clovis, CA, USA.
 - d) Vicon Industries (www.vicon-cctv.com), Hauppauge, NY, USA.

B. **Items to be Provided:**

- 1. Accessories, including copper and fiber optic cables, camera housings, camera mounting brackets, head mounts, fixed and motorized lenses, masts, media converters, and surge protectors for data and video.
- 2. Cameras.

3. Video control devices, including control keyboards, data distributors, PTZ controllers, PTZ drives, and PTZ motors.
4. Video display devices, including 533 mm (21 inch) or larger liquid crystal display (LCD) video monitors. For OPP, there shall be at least 6 monitors in each guard house.
5. Video processing devices, including video distribution amplifiers, video encoders, and video matrix switchers. Video motion detection and video multiplexing functions shall be provided.

C. **Equipment and Materials:**

1. **Cabinets:** Units for web servers shall be in accordance with Section 27 11 16 (*Cabinets, Racks, Frames, and Enclosures*), sized as required.

2. **Cables:**

- a. **General:**

- 1) Cables shall be furnished as required.
 - 2) Cables for cameras on HML shall be suitable for moving the cameras up and down.
 - 3) Control cables for all cameras shall meet original equipment manufacturer specifications.

- b. **Coaxial Cables:**

- 1) Coax cables shall be 75 Ohms type and 100 percent shielded.
 - 2) Coax cables for CCVS cameras on high mast lighting shall be of hybrid or composite construction, and suitable for the expected winding/unwinding frequency.

- c. **Fiber Optic Cables:** Shall be in accordance with Section 33 82 00 (*Cabling for Underground Communications Outside Plant*).

- d. ^{A17}**Unshielded Twisted Pair (UTP) Cables:** Shall be in accordance with Section 27 11 00 (*Structured Cabling Systems for Communications Inside Plant*).^{A17}

3. **Cameras:**

- a. **General:** All fixed and movable CCVS cameras shall have the following or better characteristics:

- 1) CCVS cameras shall be color type adequate for day operation, and black and white for night operation at low light levels.

- 2) Video output shall be 1.0 V_{pp}, NTSC composite, 75 Ohms with BNC connector, ^{A17}or digital signal via Ethernet port with RJ-45 connector, or optical signal via fiber optic connector. ^{A17}
 - 3) ^{A9}Units shall have a resolution of no less than 3 megapixels, or 520 lines for color and 570 lines for black and white. ^{A9}
 - 4) Signal to noise ratio shall be 50 dB or better.
 - 5) Format shall be 8.5 mm (1/3 inch) or ^{A11}smaller. ^{A11}
 - 6) Cameras shall stabilize video by minimizing the effects of movement, including wind effects on HML poles and radio towers.
 - 7) ^{A19}Cameras shall operate with winds up to 145 km/h (90 mi/h), and gusts up to 209 km/h (130 mi/h). ^{A19}
 - 8) Cameras shall have good color rendition during night operation with illumination systems specified on Section 26 50 00 (*Lighting Systems*).
 - 9) ^{A17}The Employer strongly prefers high resolution network type cameras with progressive scan, but accepts ITU-T H.264 compliant MPEG-4 cameras with Advanced Video Coding (AVC).
 - 10) Cameras shall operate on 12 VDC, 24 VAC, or Power over Ethernet (PoE). ^{A17}
 - 11) ^{A19}Unless otherwise specified, CCVS cameras shall be standard type and for visible light.
- b. **Fixed Standard Cameras:** Shall have the following or better characteristics: ^{A19}
- 1) Capability for auto back focus ^{A17}(ABF). ^{A17}
 - 2) ^{A17}Minimum ^{A17} illumination of 0.5 lux (0.05 fc) at F1.2 (color mode); 0.06 lux (0.006 fc) at F1.2 (black and white (B&W) mode).
 - 3) Shall utilize digital noise reduction (DNR) and back light compensation.
- c. ^{A19}**Movable Standard Cameras:** Shall have the following or better characteristics: ^{A19}
- 1) Pressurized integrated optics ^{A17}cartridge. ^{A17}

- 2) ^{A17}Minimum ^{A17} illumination of 0.005 lux at ½ sec shutter (color), 0.015 lux at 1/60 sec shutter (B&W), 0.0005 lux at ½ sec shutter (B&W).

- 3) Programmable power-up mode.

d. ^{A19}Infrared or Thermal Cameras:

- 1) Units shall have either two thermal sensors and two lenses, or a single thermal sensor meeting optical specifications with a variable lens. In either case, cameras shall be cooled and have PTZ capabilities.
- 2) Units shall be adequate for use whenever there is no daylight and shall have the following or better characteristics:

TABLE 28 23 00-1: INFRARED OR THERMAL CAMERA CHARACTERISTICS			
Detection-Recognition-Identification (DRI) Range	2.3m x 2.3m Objects		Detection at 5.8 km Recognition at 1.6 km
	1.8m x 0.5m Persons		Identification at 800 m
Focus			Automatic and manual
Image Processing			Automatic gain control (AGC)
			Non-uniformity correction (NUC), pixel related
			Digital detail enhancement (DDE)
			Flat field correction (FFC)
Operating Modes			“White Hot” and “Black Hot”, user selectable
Resolution	Spatial instantaneous field of view (IFOV)		1.1 mrad or less with 35 mm lens
			0.27 mrad or less with 140 mm lens
	Standard		320 x 240 pixels
Sensitivity or Performance			< 80 mK
Spectral Range			7.5 to 13 um
Viewing Field	2 Lens Option		20° horizontal x 15° vertical with 35 mm lens
			5° horizontal x 3.75° vertical with 140 mm lens

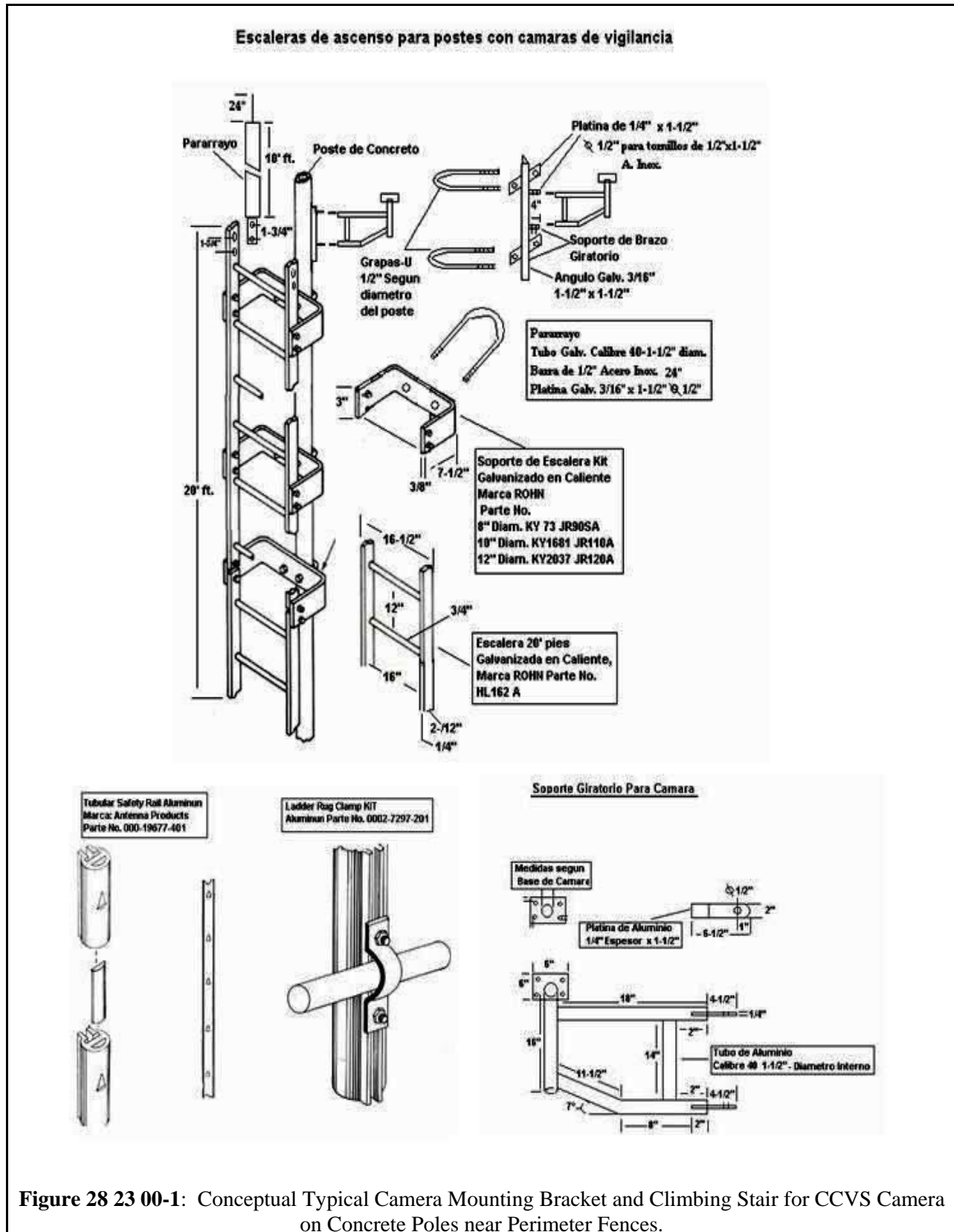
- 3) Thermal cameras with two sensors and two lenses shall be capable of merging two fields of vision into a single foveal type video. ^{A19}

4. Camera Housings:

a. General:

- 1) Housings shall be a dust and water tight dome or cylinder box, pressurized with dry nitrogen to protect camera and optics against corrosion. ^{A17} All camera housings for use in exteriors shall be weatherproof (IP 66, NEMA 4X, or better). ^{A17}

- 2) Units shall have fill and overpressure valves, ^{A17}low pressure alarm, ^{A17} thermal insulation, and a sunshield.
 - b. **Housings for Fixed Cameras:**
 - 1) Units shall be NEMA 6 type and meet the requirements of IEC 60529 for IP 67.
 - 2) Housing connector shall be SOURIAU 85107E2016P, 16 pin jam nut, or equal.
 - c. **Housings for Movable Cameras:**
 - 1) Housings shall be NEMA 4X type and meet the requirements of IEC 60529 for IP 66.
 - 2) Units shall have a remotely controlled windshield wiper with programmable delay and shut-off.
 - 3) If possible, a remotely controlled washer.
5. **Camera Lenses:**
 - a. **General:** Lenses for movable cameras shall have auto-focus and auto-iris, both with separate manual overrides.
 - b. **Fixed Lenses:** Focal length shall be manually variable between 4 mm and 12 mm or higher optical zoom, and shall consider distance from the cameras to the objects to be viewed remotely as well as object size.
 - c. **Zoom Lenses:** Zoom lenses shall have a focal length of up to 250 mm and 24X or better optical zoom. Where provided, digital zoom of 10X or better is required.
6. **Camera Masts:**
 - a. Masts shall have a safety climbing ladder meeting all applicable requirements of 29 CFR 1910.165 and 29 CFR 1926 (OSHA), except when mounted on a high mast lighting (HML) pole.
 - b. Minimum height shall be 6 m (20 ft) above ground.
7. **Camera Mounting Brackets:** Shall be as illustrated on Figure 28 23 00-1, or better.



8. **Climbing Ladders:** Shall be as illustrated on the above Figure 28 23 00-1, or better.
9. **Concrete Poles:** Shall be in accordance with Section 26 50 00 (*Lighting Systems*).
10. **Control Keyboards:** Shall be as required for PTZ operations and camera selection.
11. **Control Matrixes:** Each matrix shall have the capability of keyboard, user camera, and monitor partitioning.
12. **Lightning Protectors:** Units shall be TVSSs in accordance with Section 26 43 13 (*Transient Voltage Surge Suppressors*).
13. **Media Converters:**
 - a. Units shall be provided to convert C CVS camera signals between electrical (coaxial cable) and optical (fiber optic cable), and vice-versa, as required.
 - b. Transmit modules shall be provisioned surface mount type with power supply and patch cords for each camera source.
 - c. Receive modules at communication/equipment rooms shall be hot swap to fit in standard 483 mm (19 inch) rack enclosures to be provisioned complete with redundant fanned power supply, lightning surge protector, patch cords and local area network (LAN) connectivity for remote administration.
 - d. Patch panels shall be provided as required for media interconnections.
14. **Pan/Tilt/Zoom (PTZ) Drives:**
 - a. **General:** Units shall have the following or better characteristics:
 - 1) Integral multi-protocol ^{A10}(TIA-422 D and P)^{A10} receiver/driver.
 - 2) Proportional pan/tilt.
 - 3) Digital position and zoom control and feedback via ^{A10}TIA-422 D and P (or better) protocol.^{A10}
 - 4) Capability of handling ASCII codes and dry contacts for programmable logic controller (PLC) controlled presets.
 - 5) 64 programmable presets with labels.
 - 6) Variable pan speed range of 0.1-100°/second.

- 7) 360° continuous pan rotation.
- 8) ^{A19}Pan preset speed of 100° per second in 80 km/h (50 mi/h) winds and 50° per second in 145 km/h (90 mi/h) winds. ^{A19}
- 9) +33° to -83° tilt range.
- b. **PTZ Drives for Locks Operation (OPE) Cameras:** Cameras for OPE CCVS shall have presets programmed in the corresponding process control system's (PCS) PLC to view vessels.
- c. **PTZ Drives for Vessel Traffic Management (OPT) Cameras:** Shall include alarm and relay input / output (I/O) modules.
- 15. **Pan/Tilt/Zoom Controllers:** Units for OPE, OPP, OPT, and web cameras shall be identical for standardization purposes.
- 16. **Video Encoders for Physical Security (OPP):**
 - a. Encoders shall convert composite analog input to MPEG4 digital format compatible with existing DVtel video recording system used in Canal protection security system.
 - b. The Contractor shall include all necessary licenses to operate the digital video encoders in the digital recording system.
- 17. **Video Display:** Video display at locks machinery control system (LMCS) control rooms shall be in a video wall in accordance with Section 11 52 14 (*Video Walls*).
- 18. **Video Distribution Amplifiers (VDAs):** Shall be furnished as required.
- 19. **Video Monitors (VMs):** VMs shall be LCD type and have 533 mm (21 inch) or slightly larger color screen.
- 20. **Video Motion Detectors (VMDs):**
 - a. VMD functionality shall be furnished for each camera in OPP CCVS for local use.
 - b. Note that the OPP CCVS system for remote storage already has this function via existing video recording system.
- 21. **Video Multiplexors:** Shall be furnished as required to view multiple cameras in a single video monitor.
- 22. **Video Matrix Switchers:** Shall include video annotation or titling feature to identify camera in monitors, ^{A11}and shall allow the operators to call any camera to any video monitor. ^{A11}

23. **Web Servers:** Servers for web cameras shall be in accordance with Section 25 11 00 (*Data Processing Equipment*).

24. **(deleted)**

D. Installation:

1. **Camera Masts:** Shall be grounded.
2. **Camera Mounting Brackets:** Shall be installed near the top of concrete poles used for perimeter illumination, below lamps, and perpendicular to the climbing stair, as illustrated on Photographs 28 23 00-1 and -2.



Photograph 28 23 00-1: Typical camera mounting bracket installation



Photograph 28 23 00-1: Close-up of typical camera mounting bracket installation

3. **CCVS Cameras (general):**
 - a. CCVS cameras shall never be located so that anyone can see password typing in any device requiring secure login.
4. **CCVS Cameras for Security Surveillance (OPP):**
 - a. ^{A19}In general, standard CCVS cameras for OPP shall be installed to cover control equipment or machinery room entrances, control room entrances, control rooms, and perimeter fences.^{A19} The Employer strongly prefers having OPP CCVSs operable as soon as possible.
 - b. ^{A19}At equipment rooms, all OPP CCVS cameras shall have a video feed to a digital video codec as required.^{A19}

- c. For perimeter coverage, a fixed camera shall be installed at intervals not to exceed 122 m (400 feet) on each side (east and west) of locks complexes. An integrated color/day/night PTZ drive camera package shall be installed after each group of three consecutive fixed cameras along the fence lines.
- d. All perimeter cameras shall be installed on a mast or pole at 6 m (20 feet) above ground. These masts or poles shall be installed at 6 m (20 feet) from the perimeter fence, inside the protected area.
- e. ^{A19}A standard CCVS camera with PTZ shall be installed in every entrance to the facility at no more than 6 m (20 feet) of it and 1,524 mm (5 feet) from the fence. ^{A19}
- f. A standard CCVS camera with PTZ shall be installed at the center position near each chamber of the locks between the chamber and the basins. ^{A19} These cameras shall be installed in the high masts lights (HML).
- g. ^{A19}No less than two integrated color, cooled IR or thermal cameras with PTZ drive shall be installed at the north and south ends of each locks complex at locations that optimize viewing of the approach navigation channels. These areas are expected to be very dark at nighttime.
- h. A fixed standard CCVS camera shall be installed in each entrance to the facility with a clear view of the entry vehicle and conductor.
- i. A set of fixed standard CCVS cameras shall be installed at each vehicular access point, with a clear view of the vehicle license plate entering and leaving the installation.
- j. A set of fixed standard CCVS cameras shall be installed at each extreme of the locks rolling gates to monitor vehicular transit over the gates. ^{A19}
- k. All conduits shall be of a minimum diameter of 51 mm (2 inch), and unless otherwise specified shall be installed underground. Separate conduits shall be used for video/data signal and power feeds.
- l. All PTZ cameras shall have a serial coupler for two separate control signals, one from the video matrix and the other from the digital transmission/recording system.

5. CCVS Cameras for Locks Operation (OPE):

- a. CCVSs for OPE shall include one camera per rolling gate pair, for a total of 8 cameras per locks complex for rolling gate (RG) monitoring purposes. In the case of redundant RG pairs, the cameras shall be located in opposite walls of the locks chamber (four on each side).
- b. CCVSs for OPE shall also include the following cameras: one upstream for ocean side (on the future 4th locks side), and two downstream for lake side (one on each side).

- c. Camera for rolling gates shall be mounted on the HML mast nearest the corresponding rolling gate, or a pole, as required for a clear and complete view of the gates.
6. **Cameras for Vessel Traffic Management (OPT):** ^{A19} Shall include one for each approach, and one for panoramic view. ^{A19}
7. **Control Keyboards:** Shall be furnished for every CCVS operator at the corresponding locations.
8. **Media Converters:** Shall be installed in an enclosure containing patch panel, power supply, and lightning surge protector.
9. **Monitoring Stations for OPP:**
 - a. Complete monitoring stations shall be installed at each guard booth and guard house of the third set of locks complexes.
 - b. Monitoring stations shall have a minimum of six analog color CCVS monitor displays of no less than 533 mm (21 inch), a control keyboard, an ACS computer terminal, refer to Section 28 13 00 (*Access Control Systems*), and a PSS annunciator panel, refer to Section 28 16 43 (*Perimeter Surveillance Systems*) with mimic board.
10. **Mounting Brackets with Head Mounts:** Shall be installed along most of the length of concrete poles, as illustrated on Photograph Nos. 28 23 00-1 and -2.
11. **Surge Protectors:** Shall be in accordance with Section 26 43 13 (*Transient Voltage Surge Suppressors*).
12. **Video Monitors (VMs):** In order to allow operators to see the equipment of the process concerned by each step of the operation, at least one VM shall be installed at the following locations:

	<u>Location</u>	<u>Monitors</u>	<u>Viewing Interest</u>
a.	Each guard booth	4 per booth	Safety and security
b.	Each local/remote control panel in each machinery room	1 per complex site	Operations
c.	Each telecommunications equipment room, in ground floor of main control buildings	1 per room	Operations, safety, and security

13. **Video Switchers:** As a minimum, a switcher shall be installed in telecommunications equipment rooms in main control buildings.
14. **Web Cameras:** Web cameras shall be in a location looking upstream near the sea, on the side of the future 4th locks lane: west side for Pacific and east side for Atlantic.

15. **Web Servers:** Shall be cabinet mounted.
16. **(deleted)**
- ^{A9}17. **Video Encoders:** May be placed as close as possible to C CVS cameras or built-in so that video distribution, presentation, and transmission may be all digital. ^{A9}

1.04 DESIGN CRITERIA/SYSTEM PERFORMANCE:

A. General:

1. **Problem to be Solved:** C CVSs shall solve the following business needs:
 - a. Provide means to remotely validate safety and security issues with real time images 24 hours a day.
 - b. ^{A11}Provide maps for camera selection. ^{A11}
2. **Restrictions to be Considered:**
 - a. Fiber optic cables are unacceptable and considered too fragile and inadequate for vertical wiring application in C CVS cameras mounted on high mast lighting poles.

B. Design Criteria:

1. ^{A19}C CVS systems shall be designed following the best industry practices for safety and security, including the applicable ASIS guidelines. ^{A19}
2. Depending on C CVS design, +24 VDC may be required from the systems of Section 26 33 00 (*Direct Current Equipment*).
- ^{A8}3. OPP SCC at Corozal West 741 shall have PTZ control and viewing capability for cameras in two OPP C CVS systems in the Pacific Locks complex, as well as view-only rights for all other OPE and OPT C CVS cameras and webcamera(s) there. Likewise, OPP SCC at Gatun 40 shall have PTZ control and viewing capability of cameras in two OPP C CVSs in the Atlantic Locks complex, as well as view-only rights for all other C CVS cameras there. ^{A8}

C. System Performance:

1. C CVS systems shall provide visual validation of operational, safety, and security status.

1.05 SUBMITTALS: The following shall be submitted for substantiation purposes:

- A. **Design:** The following shall be in accordance with Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), Paragraph 1.05 D.:
 - 1. Calculations, including attenuation, bandwidth requirements, lens sizing, and system availability.
 - 2. Critical path method (CPM) diagram, with monthly updates.
 - 3. Descriptive literature.
 - 4. Drawings, including camera locations and viewing angles.
 - 5. Protection methods for corrosion, electrostatic discharge (ESD), fungus/humidity, lightning/surge, power distortion and harmonics, radio frequency interference / electromagnetic interference (RFI/EMI), thermal, and vibration.
 - 6. Quality assurance and control plans.
 - 7. Specifications.
- B. **Re-Submittals Just Prior to Purchasing Materials:** All items in subparagraph A. above that have changed from original submittal shall be resubmitted in a design conference in accordance with Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), Paragraph 1.05.
- C. **Upon Receipt of Shipped Items in Panama:**
 - 1. Instruction manuals for administration, installation, maintenance, and operation.
 - 2. Packing lists.
- D. **Prior to Issuance of Taking-Over Certificate:**
 - 1. As-built drawings,^{A17} including all applicable IP addresses.^{A17}
 - 2. List of recommended spare parts.
 - 3. Software licenses.
 - 4. Test reports.
 - 5. Training services.

1.06 QUALITY ASSURANCE: Shall include the following in accordance with Section 01 81 26 (*Communications, Control, Safety, and Security Systems*), Paragraph 1.06:

- A. Factory quality control tests (FQCT).
- B. Training services for no less than twenty persons from Employer's Personnel for the maintenance and operation of all the equipment installed for security operations.

- C. Final field inspection tests (FFIT).
- D. Warranty.

END OF SECTION

^{A19}**THIS PAGE NOT USED**^{A19}