Engineering Standard

SAES-T-555   24 July 2012

IP Based Closed-Circuit Television (CCTV)

Document Responsibility: Communications Standards Committee

Saudi Aramco DeskTop Standards

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1   Scope

This standard establishes the requirements for the design and installation of CCTV system used to support plant operations, Industrial security and other users. Examples of CCTV uses include monitoring process area, oil and gas wells, and security perimeter.

Commentary Note

> *Detection and Assessment System (IDAS) and Long Range Detection and Assessment System (LRDAS) camera implementations are exempted from this standard*

2   Conflicts and Deviations

Any deviations, providing less than the mandatory requirements of this standard require written waiver approval as per Saudi Aramco Engineering Procedure SAEP-302.

3   References

The selection of material and equipment and the design, construction, maintenance, and repair of equipment and facilities covered by this standard shall comply with the latest edition of the references listed below, unless otherwise noted.

3.1   Saudi Aramco References

Saudi Aramco Engineering Procedures

SAEP-99	*Process Automation Networks and Systems Security*
SAEP-302	*Instructions for Obtaining a Waiver of a Mandatory Saudi Aramco Engineering Requirement*

Saudi Aramco Engineering Standards

SAES-B-055	*Plant Layout*
SAES-B-068	*Electrical Area Classifications*
SAES-P-100	*Basic Power System Design Criteria*
SAES-T-887	*Telecommunications: Electrical Coordination - Protection*
SAES-T-911	*Telecommunication Conduit System Design*
SAES-T-916	*Telecommunications Building Cable Systems*
SAES-T-928	*Telecommunications - OSP Buried Plant*
SAES-Z-010	*Process Automation Networks*

3.2   Industry Codes and Standards

National Electrical Manufacturers Association

NEMA ICS 6   *Enclosures for Industrial Controls and Systems*

NEMA 250   *Enclosures for Electrical Equipment (1000 Volts Maximum)*

National Fire Protection Association

NFPA 70 - 2005   *National Electrical Code (NEC)*

4   Definition, Word Usage, Abbreviations

4.1   Definition

IP camera: It is a camera that has an IP address and complies with the standard Internet Protocol (IP).

Encoder: A device that convert analog video signal to digital signal.

Multi-channel Encoder: It is an encoder that is capable of connecting to more than one camera. It provides more than one BNC connection for analog cameras to connect to.

VCR: Video Cassette Recorder is a type of video tape recorder that uses removable videotape cassettes containing magnetic tape to record audio and video so it can be played back later.

Video Matrix Switcher: A device for switching more than one camera, VCR, and other analog based CCTV devices to more than one monitor (screen), VCR, and video printer.

CCTV Component: is the different type of product that makes the whole CCTV system.

Distributed Control System (DCS): A process control system that is composed of distinct modules. These modules may be physically and functionally distributed over the plant area. The distributed control system contains all the modules and associated software required to accomplish the regulatory control and monitoring of a process plant.

Process Automation Network (PAN): It is a plant wide network interconnecting Process Control Networks (PCN) and provides an interface to the WAN. A PAN does not include proprietary process control networks provided as part of a vendor's standard process control system.

NTSC: National Television System Committee (NTSC) is an American committee that sets the standards for analog color television as used in the United State, Canada, Japan, and some other counties.

Frame: Refers to a composition of lines that make one TV frame. In NTSC TV system, one frame is composed of 525 lines. There are 30 frame/second in NTSC system.

Bandwidth: In digital communications, describes the amount of data that can be transmitted over a channel in bits-per-seconds.

Day/Night Camera: Day/Night camera means it can capture video in both day and night time. In low light conditions, day/night camera switches from color to black and white.

Video Compression: It refers to reducing the quantity of data used to represent video images with the goal of retaining as much of the original's quality as possible. Compressed video can effectively reduce the bandwidth required to transmit digital video.

MPEG-4: It stands for Moving Picture Experts Group which is a standard for audio and video compression.

JPEG: It stands for Joint Photographic Experts Group which is a group that has recommended a compression algorithm for still digital image.

Motion JPEG: In motion JPEG, individual images are captured and compressed into JPEG still image forma then they are made available as continuous flow of images to be viewed.

Resolution: It is a measure of the ability of a camera to reproduce fine detail. The higher resolution, the more details can be seen.

Lux: Light unit for measuring illumination. It is defined as the illumination of surface when the luminous flux of lumen falls on the area of 1 cm^2. It is also known as lumen per square meter.

Luminance: It refers to the video signal information about the scene brightness. The color video picture contains two components, luminance (brightness and contrast) and the chrominance (hue and saturation).

Iris: A means of controlling the size of the lens aperture and therefore the amount of light passing through the lens.

Auto Iris: An automatic method of varying the size of a lens aperture in response to change in the scene illumination.

PTZ: It stands for Pan, Tilt and Zoom. Pan refers to rotating the camera around Z-axis. Tilt refers to rotating the camera around the X-axis. Zoom refers to Y-axis movement of the motorized optical lens.

Camera Access Switch (CAS): It is the Ethernet switch where the cameras or encoders are terminated. It is located in the nearest plant facility building to the cameras or encoders.

Latency: It is the time required for an image captured by the camera to be presented to CCTV user on CCTV monitor (screen).

Quality of Service (QoS): It refers to resource reservation control mechanisms. It can provide different priority to different users or data flows, or guarantee a certain level of performance to a data flow. Quality can be, for instance, a maintained level of bandwidth, low latency, no packet losses, etc.

Differentiated Services (DiffServ): It is network architecture that specifies a simple, scalable and coarse-grained mechanism for classifying, managing network traffic and providing quality of service (QoS) guarantees on IP networks.

Unicast: It is the sending of information packets to a single destination.

Multicast: It is the delivery of information to a group of destinations simultaneously using the most efficient strategy to deliver the messages over each link of the network only once, creating copies only when the links to the destinations split.

Midspan: Midspans are power injectors that stand between a regular Ethernet switch and the powered device to provide PoE functionality.

Management Information Base (MIB): It is a type of database used to manage the devices in a communications network. It comprises a collection of objects in a (virtual) database used to manage entities (such as routers and switches) in a network.

Spanning Tree Protocol: It is layer-2 protocol that ensures loop free topology for any Local Area Network (LAN).

Redundant Array of Independent Disk (RAID): It is data storage schemes that divide and/or replicate data among multiple hard drives. RAID arranges hard drives in such a way that the operating system sees them as one large logical hard disk. It set up spans data over multiple hard disk drives with enough redundancy so that data can be recovered if one disk fails.

Contrast: A common term used in reference to the video picture dynamic range. It is the difference between the darkest and the brightest part of the image.

Media Converter: It is a device that converts between different types of transmission media (cable). It is used to convert from Unshielded Twisted Pair (UTP) cable to fiber optic cable and vice versa. Media converters also are referred to as media transceivers, media translators, or media filters.

4.2   Abbreviations

CCTV: Closed Circuit Television

CCTV VMS: Closed Circuit Television Video Management System

MPEG: Moving Picture Experts Group

JPEG: Joint Photographic Experts Group

CCR: Central Control Room

IR: Infrared

UTP: Unshielded Twisted Pair

PoE: Power over Ethernet

SNMP: Simple Network Management Protocol

VLAN: Virtual Local Area Network

PAS: Process Automation System

PAN: Process Automation Network

LDAP: Lightweight Directory Access Protocol

NVR: Network Video Recorder

DAS: Direct Attached Storage

NAS: Network Attached Storage

UPS: Uninterruptible Power Supply

STP: Spaning Tree Protocol

SCADA: Supervisory Control and Data Acquisition (SCADA) System

MPLS: Multiprotocol Label Switching

5   CCTV System Design Basis and Consideration

5.1   General CCTV System Requirements

5.1.1   CCTV system shall include (but not limited to):

- IP camera or analog camera.

- Video encoder for the analog camera. It shall be Ethernet based.

- Ethernet network switch.

- CCTV Video Management System (CCTV VMS).

- Video Storage.

- Screens.

5.1.2   It is not recommended to use VCR, video matrix switcher, and analog monitor.

5.1.3   The user department is the custodian and the owner of the CCTV system and the information provided by the CCTV system.

5.1.4   All CCTV system components shall be based on open standard and shall be easily integrated with open standard platform and Ethernet TCP/IP based system.

5.1.5   CCTV system can be interfaced to PCS systems such as DCS and SCADA system, when required.

5.1.6   CCTV system for plant operation may be connected to Saudi Aramco corporate network or PAN network.

5.1.7   CCTV system shall be capable of transmitting and recording video at full NTSC frame rate of 30 frames per second with the ability to adjust different frame rates by CCTV system administrators and operators.

5.1.8   The CCTV system shall transmit real-time video.

5.1.9   It is highly recommended that CCTV system is designed to provide video motion detection to reduce network bandwidth usage. If implemented, video motion detection shall be done at the camera/encoder level.

5.1.10   CCTV system shall be designed for high performance, flexibility, and scalability. It shall allow adding CCTV components without significant change to the existing CCTV system infrastructure.

5.1.11   CCTV system shall allow for simultaneous recording and variable playback speed.

5.1.12   CCTV field components shall be capable of operating in environmental conditions listed in Appendix A.

5.1.13   CCTV camera should provide day/night functionality in outdoor environment.

5.1.14   The CCTV system shall support both MPEG-4 compression or higher and Motion JPEG compression.

5.1.15   CCTV IP camera shall support DHCP and IGMPv2 and v3.

5.1.16   It is recommended that CCTV VMS is installed in a secure network zone and in a location with a controlled physical access.

5.2   **Bandwidth and Storage Requirements Study**

Bandwidth and storage requirements study are required to determine the needed bandwidth and storage. These requirements shall be calculated and determined by the system designer for the whole system in the design stage. The study shall consider the factors listed in Sections 5.3.1 and 5.3.2.

5.3   **System Design Considerations and Criteria**

The following factors shall be considered when designing the system:

5.3.1   **Bandwidth**

The following parameters affect bandwidth design requirements of CCTV system and shall be considered in the system design phase:

- Required image resolution. The higher the resolution, the more bandwidth is required.

- Required compression type and ratio. You may consider that Motion JPEG requires more bandwidth than MPEG-4.

- Frame rate.

- Complexity of the scene.

- System redundancy.

5.3.2   **Storage**

The needed storage shall be determined based on the following:

- Number of cameras.

- Number of hours per day the camera will be recording.

- How long the data must be stored.

- Whether the system uses motion detection recording, scheduled recording or continuous recording.

- Frame rate.

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- Used compression technique.

- Required image quality and complexity.

- The following formula might be used to calculate storage needs for Motion JPEG:

  o Storage/Hour = Image size x frames per second x3600/1000000 MB/hr

  o Storage/Day = (Storage/Hour) x Hours of Operation per day/1000 GB/day

  o Storage Need = (Storage/Day) x Required Days of Storage GB

- The following formula might be used to calculate storage needs for MPEG-4:

  o Storage/Hour = (Bit Rate / 8) x 3600/1000000 MB/hr

  o Storage/Day = (Storage/Hour) x Hours of Operation per day/1000 GB/day

  o Storage Need = (Storage/Day) x Required Days of Storage   GB

5.3.3 Scalability

Future expansion (if any) shall be considered and planned for during the design phase.

5.3.4 Frame Rate Control

The system shall allow for frame rate control. It shall be possible to raise and lower the frame rate. The system shall allow for sending video with different frame rate to different recipients.

5.3.5 Lighting

5.3.5.1   An assessment shall be made to evaluate how lighting will affect the quality of the image. Existing light shall be evaluated to determine the need for additional external light source.

5.3.5.2   Ensure that the lighting level is adequate. At least 5 lux shall be used to capture good quality images.

5.3.5.3   In areas where lighting level falls below 5 lux, external light source such as electrical lamp or day/night camera shall be used as specified in 5.3.5.4 and 5.3.5.5 of this standard.

5.3.5.4   Electrical lamps shall be added when there is no enough light to capture good quality colored image. However, if it is acceptable by user's department to have black and white image/video, then a day/night camera should be used in low light and nighttime conditions. The day/night camera will produce color image if there is enough light while it will produce black and white image in low light and dark conditions.

5.3.5.5   In cases where the use of electrical lamp sources is restricted, a day/night camera shall be used. If needed, IR illuminator shall be used in conjunction with the day/night camera to further enhance camera's ability to produce high quality video in low light and night time conditions.

5.3.5.6   Ensure that the lighting is even and minimizes shadows for indoor cameras. Several lower powered, widely spaced lights should be used instead of using one bright light.

5.3.5.7   Electrical lamps shall be mounted so that they don't damage or weaken the image quality. When it is possible, the light sources shall be positioned above the camera.

Commentary Note:

> *An auto iris lens is recommended to be used with outdoor cameras to regulate how much light is received, to optimizes the image quality and to protects the image sensor from being damaged by strong sunlight.*

5.3.6   **Video Resolution**

5.3.6.1   The resolution of the displayed image shall be selectable from CIF (352 x 240 pixel), 2CIF (704 x 240 pixel), and 4CIF (704 x 480 pixel). IP camera shall also support VGA and XVGA resolution to allow for displaying video on standard personal computer screens.

5.3.6.2   Interlaced scanning or progressive scanning may be used.

5.3.6.3   If interlaced scanning is used, de-interlaced shall be used to eliminate the jaggedness for better view

5.3.6.4   Aspect ratio of 4:3, 16:9, or 16:10 shall be used based on user's preference.

6   CCTV/IP Camera Network Architecture and Requirements of CCTV System Network Connectivity

6.1   CCTV/IP Camera System Network Connectivity Structure

6.1.1   The network connecting CCTV system components shall be IP-based Ethernet network.

6.1.2   Prior written approval shall be obtained from IT CE&TSD manager for any CCTV system installation on Saudi Aramco corporate network.

6.1.3   The following shall be considered when connecting the CCTV system to the PAN network.

• CCTV traffic shall be logically separated from control traffic within PAN by assigning CCTV traffic to a separate VLAN.

• Control system traffic shall have higher priority than CCTV traffic.

6.1.4   Traffic entering the corporate IP/MPLS backbone from the uplink port of non-IT switches shall be limited to 100 Mbps, excess traffic will be dropped. This traffic class is currently guaranteed 15% of the bandwidth on any core-facing interface on the corporate IP/MPLS backbone.

6.1.5   All CCTV traffic shall be mapped to dedicated video VLAN if the CCTV system is directly connected to an IT-managed switch.

6.1.6   IP Camera traffic shall be guaranteed a maximum of 15% of the uplink bandwidth of the IT access switch that connects directly to the corporate IP/MPLS Core Propvider Edge Ruter.

6.1.7   All CCTV networking components shall have a corporate static IP address obtained from IT CE&TSD.

6.1.8   For Remote Sites (Bulk Plants, AFOs, etc.) that are connected through a leased IP-VPN or DDN circuits, no more than 10% of the leased circuits link bandwidth shall be consumed by IP camera traffic, provided that at least 20% of the bandwidth will be available prior to adding the Camera traffic.

6.1.9   The IP based video shall be accomplished by one of the below two ways:

• Use of IP based camera which is highly recommended.

• Analog camera with IP based Ethernet encoder. The use of analog

camera shall be limited to cases where the required camera's function and operation can't be provided by an IP based camera.

6.1.10   The IP cameras or the encoder shall be connected to an Ethernet switch; hereinafter called Camera Access Switch (abbreviated CAS). The CAS shall be located.

- At the nearest facility building to the cameras. Or

- At the camera site when the camera is installed in a remote location such as oil and gas well sites.

The CAS may be a switch dedicated for CCTV system, an IT switch, or a PAN switch.

The IP camera and the encoder can be connected to the CAS via UTP, multi-mode fiber, single mode fiber, or wireless link.

6.1.11   The type of the cable connecting the camera/encoder shall be determined based on the distance from the IP camera or the encoder to the CAS.

6.1.12   The CAS switch shall have the required Ethernet interface ports to connect to the IP cameras or encoders.

6.1.13   When using analog camera, it is recommended that the encoding function and the media conversion function, when used, are integrated and provided by single device (one box).

6.1.14   It is recommended to install the encoder in junction box mounted next to the camera.

6.1.15   The IP camera interface and encoder interface to the CAS shall be 10/100 Mbps Ethernet interface. If the encoder aggregate more than one camera channel (multi-channel encoder), then it shall interface to CAS via 100/1000 Ethernet interface.

6.1.16   The uplink of CAS to the PAN shall be 100/1000 Mbps interface.

6.1.17   The uplink of the CAS to Saudi Aramco corporate network shall be 100/1000 Mbps interface.

6.1.18   CCTV Video Management System (CCTV VMS) shall be used to view live video and to play back recorded and stored (archived) video.

6.2   **Requirements of the Network Carrying CCTV Traffic**

The requirements of the network carrying CCTV traffic are as follow:

6.2.1   Network carrying CCTV traffic shall have latency less than 200 ms to allow for accurate PTZ positioning and controlling.

6.2.2   The network shall support Quality of Service (QoS) according to the best industry practice to implement traffic control and packet priority.

6.2.3   The network shall support unicast and multicast stream.

6.2.4   It is recommended that network be able to deliver power to IP cameras and encoders using PoE technology. Power over Ethernet (PoE) as in IEEE 802.3af shall be used in such case.

6.2.5   The network shall support:

- IEEE 802.1D bridging capability and loop detection.

- IEEE 802.1Q tagged VLANs.

- IEEE 802.1p traffic prioritization for multiple Quality of Service levels.

- IEEE 802.1w rapid spanning tree with fast link support.

- IEEE 802.3ad link aggregation support.

- IGMP snooping for IP Multicast support.

- Multicast network traffic.

- Non-blocking configuration capable of simultaneous wire-speed switching across all ports.

- SNMP v3 or higher

7   CCTV Video Management System (CCTV VMS)

7.1   General Requirements

7.1.1   The CCTV video Management System (CCTV VMS) shall be one of the below two options:

- Standalone modular software based that runs on of the shelf open standard hardware platform (PC/server). The hardware components of the open standard platform shall be selected to obtain required performance.

- Integrated hardware-software platform where the software is pre-configured on the hardware.

Commentary Note:

> *When this standard refers to CCTV VMS server, it means the integrated hardware-software platform or the PC that hosts the CCTV Video Management software.*

7.1.2   CCTV VMS shall be based on client server architecture.

7.1.3   CCTV VMS shall provide administration, installation and configuration, operation of CCTV devices and shall administer access rights and privileges to these devices.

7.1.4   Both the integrated hardware-software CCTV VMS and modular software based CCTV VMS shall provide the following functions, but not limited to:

1.   Central management, configuration, system monitoring and control of the entire system.

2.   System security and central user management.

3.   Network video recording capability.

The modular software based CCTV VMS may provide each of the above function in separate software modules but it shall allow for the installation and running of these modules on one PC/server.

7.1.5   CCTV VMS shall be the interface between IP cameras or encoders and the viewing clients for CCTV traffic management and access authorization. The video stream from IP cameras and encoder is then sent to CCTV user after the user is authorized through the CCTV VMS.

7.1.6   If required by plant organization, CCTV VMS shall enable video to be integrated with Process Automation Systems (PAS) such as Distributed Control System (DCS) and SCADA system.

7.1.7   CCTV VMS server shall be capable of recording video stream for a minimum period of 72 hours.

7.1.8   CCTV VMS shall be able to run antivirus software for viruses scan.

7.2   **CCTV VMS Redundancy**

CCTV VMS is recommended to be in a redundant configuration so that if the main CCTV VMS fails, the system immediately automatically fails over to the backup server. In a case of redundant CCTV VMS configuration, the following shall be considered:

- The backup CCTV VMS shall be continuously synchronized with the master CCTV VMS server to ensure that it is always up to date and ready for fail over when required. When the master CCTV VMS server is restarted after fail over, it shall automatically resynchronize with the backup server.

- The date and time on both servers shall be synchronized to ensure that all date and times associated with event in the database are consistent in between servers.

- No loss of CCTV functionality shall occur after fail over.

7.3   User Management and Security

7.3.1   The video stream from IP cameras and encoder shall be sent to user after the user is authorized through the CCTV VMS.

7.3.2   The CCTV VMS connected to Saudi Aramco corporate network shall be LDAP compatible for integration with user account management system such as Saudi Aramco corporate Active Directory. It shall provide the ability to control access through Saudi Aramco corporate active directory allowing for users authentication based on user accounts and group membership.

7.3.3   The CCVT VMS connected to PAN network shall comply with authentication and authorization, users account, and system access requirements established in SAEP-99.

7.3.4   Access to CCTV system connected to PAN network from Saudi Aramco corporate network shall comply with plant network security requirements mandated in SAEP-99 and SAES-Z-010.

7.3.5   The CCTV VMS shall require a user name and password that determine the level of authorization as being a user or administrator of the video management system.

7.3.6   Password used to access CCTV system shall always be encrypted.

7.3.7   CCTV VMS shall provide logging capabilities. All users' action shall be recorded in a log file.

7.3.8   All exported recording and exported audit log shall be digitally signed to prove origin of the recording and audit log and to ensure that exported recording and audit log have not been altered or tampered with. CCTV VMS shall provide a default digital certificate for signing the exported recording and audit log and shall allow administrator to supply Saudi Aramco PKI generated certificate.

7.3.9   A visual indication shall be provided to show if the exported recording
and audit log have been altered or tampered with.

7.3.10   Access to CCTV system resources shall be individually controlled per
user group.

7.3.11   CCTV VMS shall allow CCTV administrator to create, edit, or delete
user groups and users at any time.

7.3.12   CCTV VMS shall allow CCTV administrator to set different
authorization levels or privileges for users.

7.3.13   CCTV VMS shall provide group configuration where users only see
devices for which they have access to.

7.3.14   CCTV VMS shall be configurable to allow users to view certain
cameras and deny them from viewing the other cameras. Users shall
only see CCTV cameras and devices for which they have been
assigned the corresponding authorization.

7.4   **Video View and Operation Requirements**

7.4.1   CCTV Video Management System shall be capable of recording,
analyzing, and playing back video.

7.4.2   Video Management System shall be capable of providing users access
to video streams via web browser or Windows client.

7.4.3   CCTV VMS shall be capable of searching recorded video based on
date and time.

7.4.4   It is recommended that Video Management System supports event
management and motion detection.

7.4.5   CCTV Video Management System shall support simultaneous viewing
and recording of live video from multiple cameras.

7.4.6   CCTV Video Management System shall provide continuous recording
mechanism, on alarm and video motion detection recording
mechanism, and scheduled recording mechanism.

7.4.7   CCTV Video Management System shall enable system administrator
or system support professional to set the recording frame rate of
selected cameras.

7.4.8   CCTV Video Management System shall support camera management.

It shall allow system administrator to administer and mange camera.

8   Recording and Monitoring

8.1   It is highly recommended that recording be motion triggered recording or scheduled recording for specified period of time. Continuous recording is discouraged.

8.2   Centralized video recording or decentralized recording approach may be used.

8.3   In centralized recording, video streams of less than 72 hours may be recorded on dedicated internal hard drives in CCTV VMS server. If it is required to keep recorded video for more than 72 hours then it shall be moved to the CCTV storage and archive system. If video storage and archiving is not required then recorded video older than 72 hours shall be deleted.

9   CCTV Storage and Archiving System

9.1   Video Storage and archiving system shall be used to keep recorded video for more than 72 hours.

9.2   When video storage and archiving system is required, it shall be based on industry standard of the shelf hardware.

9.3   CCTV Video storage and archiving shall be provided by one of the following ways:

- Direct Attached Storage (DAS) where additional external hard disk is attached to the CCTV VMS server for storage.

- Network Attached Storage (NAS) where the storage is separated from the CCTV VMS server.

9.4   Storage and archiving redundancy, if required, shall be provided by hardware based RAID (Redundant Array of Independent Disk) with separate RAID controller.

10   CCTV System Installation

10.1   **General Consideration**

10.1.1   The CCTV system components installed in hazardous (classified) areas as defined by the approved area classification drawing shall meet the criteria set forth in SAES-B-055 and SAES-B-068 for classified areas.

10.1.2   The classification shall be performed using the Class I/Zone/Group

method per SAES-B-068.

10.1.3   Classified CCTV equipment shall not be used in non-classified area unless the vendor's standard product offering is supplied as classified device with no additional cost.

10.1.4   The CCTV equipment installed in classified areas shall be rated and labeled for use in classified locations. They shall be certified to operate in the required classified location.

10.2   Mounting and Housing

10.2.1   Weather proof and vandal proof housing shall be provided for cameras installed outdoors or in relatively hostile environment. See environmental conditions listed in Appendix A.

10.2.2   Camera shall be placed on stable support to minimize camera movement. In outdoors installation, sturdy mounting equipment shall be used to avoid vibration caused by strong winds. Supports shall be rigidly embedded in a foundation to resist vibration.

10.2.3   Camera mount shall be designed to support the maximum weight of camera and enclosure assemblies.

10.2.4   Direct sunlight shall be avoided since it blinds the camera and reduces the performance of the image sensor. When it is possible, the camera shall be positioned with the sun shining from behind the camera.

10.2.5   To avoid having too much contrast caused by viewing too much of the sky with outdoor cameras, the cameras shall be adequately mounted high above the ground using a pole if needed.

10.2.6   It is recommended that CCTV camera is mounted so that dead zone is minimized.

10.2.7   Poles and supports shall be properly grounded.

10.2.8   Enclosures/housing in severe corrosive environments shall be stainless steel NEMA Type 4X or IEC 60529 Type IP66.

10.2.9   Housing shall be large enough to mount the camera and its auxiliary components and to provide easy access for maintenance.

10.2.10 Appropriate spacing between the camera and adjacent surfaces or structure shall be left to facilitate access to the camera for maintenance services.

10.3   **Cabling**

10.3.1   CCTV network shall use standard network cables. Acceptable cable type shall be:

- UTP CAT 6a or better.

- Multimode and single mode fiber optic cable.

- If an analog camera is used, then it shall be connected to the encoder using RG 59, RG 11, or RG 6 Coax cable.

10.3.2   Outdoor industrial grade Ethernet cable shall be used for outdoor camera with proper housing/conduit.

10.3.3   A media converter (transceiver) may be used to convert between the different communication cables. However, it is recommended to eliminate the use of media converter, whenever possible.

10.3.4   CCTV cabling shall confirm to SAES-T-911 and SAES-T-928 for outdoor installations and confirm to SAES-T-916 for indoor installations.

10.4   **PTZ Control**

10.4.1   In case of IP camera, the PTZ control signal shall be sent through the UTP cable of the IP camera with the video signal. A separate cable for PTZ control shall be unacceptable for IP camera.

10.4.2   If analog camera is used, a separate cable (RS232, RS422, or RS485) may be used for PTZ control from the encoder to the analog camera. However, it is recommended to have PTZ control signal carried on the Coax cable (In-Coax PTZ control) with the video signal.

10.5   **Power Supply**

CCTV electrical power requirements shall comply with SAES-P-100 and SAES-T-887.

If the distance from IP camera to CAS is less than 100 m, it is recommended to supply power to the IP camera over the UTP cable using Power over Ethernet (PoE) technology as defined in IEEE 802.3af to simplify installation and provide cost savings. IP camera will receive power from PoE-enabled Ethernet switch or Midspan through the same UTP cable that transmits data and video. If PoE is used, the camera shall be PoE enabled.

10.6   **Labeling**

10.6.1   CCTV system components and wiring shall be labeled and numbered.

10.6.2   Labels utilized shall be permanent type and shall be designed for the intended use. The painting of numbers on panels or equipment shall not be acceptable.

10.6.3   The use of embossed stick-on labels shall not be acceptable.

Revision Summary

30 November 2011   New Saudi Aramco Engineering Standard.
24 July 2012   Editorial revision to change the primary contact.

Appendix A

CCTV system components shall operate continuously without damage, miss-operation, or data corruption under the environmental conditions listed below.

1.   Temperature

Indoor Air Conditioned [2]	Outdoor Sheltered [1][2][3]		Outdoor Unsheltered [2][3]
Maximum	35°C (95°F)	70°C (158°F)	80°C (176°F)
Minimum	10°C (50°F)	-10°C (14°F)	-10°C (14°F)

Notes:

1)   "Sheltered" refers to permanent, ventilated enclosures or buildings, or permanently fixed sunshades with a top and three sides.

2)   For semiconductors and any other instrumentation devices which dissipate internal heat, an additional 15°C shall be added to the above temperatures. An example, for "indoor air conditioned" installation, the equipment must perform at 35 + 15 = 50°C. Similarly, for the "outdoor unsheltered" case, the equipment shall be designed for a maximum operating temperature of 65 + 15 = 80°C.

3)   For the outdoor installations only, the designer can take credit for forced or passive cooling to eliminate or reduce the 15°C heat rise. For example, if vortex coolers are used, the heat removal capacity of the coolers may be subtracted from the generated heat. No more than 15°C reduction in temperature will be given as credit. The designer shall substantiate his claim by providing the support data and calculations.

2.   Humidity

Indoor humidity design basis shall be 20% to 80% relative humidity.

Outdoor design basis shall be 5% to 95% relative humidity (non-condensing).

3.   Dust Concentration

Usual airborne dust concentration is 1 mg/m³. During sandstorms, dust concentrations may reach 500 mg/m³.

Particle sizes are as follows: 95% of all particles are less than 20 micrometers. 50% of all particles are less than 1.5 micrometers.

Equipment which is not enclosed or hermetically sealed, but is situated outdoors offshore or outdoors near-shore shall be protected against corrosion and operational failure due to wind-borne sea water spray and the accumulation of wetted salt (sodium chloride).

Near-shore is defined as within one kilometer from the shoreline of the Arabian Gulf and within three kilometers from the shoreline of the Red Sea.