Learning Objectives

After completing this module, you should be able to:

• Explain the role of alarm communication and display (AC&D) in a security system
• Recognize the key aspects and functions of AC&D systems
• Recognize AC&D system implementation considerations
INFCIRC/225/Revision 5

- 4.11 The operator should assess and manage the physical protection interface with safety and nuclear material accountancy and control activities in a manner to ensure that they do not adversely affect each other and that, to the degree possible, they are mutually supportive.
- 4.30 A permanently staffed central alarm station should be provided for monitoring and assessment of alarms, initiation of response, and communication with the guards, response forces, and facility management...
- 5.36 A permanently staffed central alarm station should be provided for monitoring and assessment of alarms, initiation of response and communication...

INFCIRC/225/Revision 5 (cont’d)

- 4.33 A 24 hour guarding service and response forces should be provided to counter effectively any attempted unauthorized removal. The central alarm station personnel and off-site response forces should communicate at scheduled intervals...
- 4.32 Dedicated, redundant, secure and diverse transmission systems for two way voice communication between the central alarm station and the response forces should be provided for activities involving detection, assessment and response...
- 4.47 Provisions, include redundancy measures, should be in place to ensure that the functions of the central alarm station in monitoring and assessment of alarms, initiation of response and communication can continue during an emergency
Role of Alarm Communication and Display

• Alarm communication and display (AC&D) system
  ▪ Transmits alarms signals from electronic devices and systems to a monitoring station
  ▪ Displays the information to an operator for action
• Collects and displays data from PPS
  ▪ Alarm system (intrusion detection)
  ▪ Entry control (access control)
  ▪ Assessment (video assessment and surveillance)

Role of Alarm Communication and Display (cont’d)

• Human / machine interface, which provides
  ▪ Overall status of site security system
  ▪ Mechanism for operator input
• Supports communication with others
  ▪ Guards and response forces
  ▪ Emergency personnel
  ▪ System administrator and maintenance personnel
  ▪ Site personnel
AC&D Key Aspects and Functions

Data Collection → Alarm Communication → Data Interpretation → Alarm Display → Operator

- **Data Collection**: Move data from point to point.
- **Alarm Communication**: Provide security-related information to a human operator.
- **Alarm Display**: Communicate with others and interface with AC&D systems.
- **Operator**: Move data from point to point.

**Alarm Communication – Data Collection – Alarm Data**

- **Alarm Data**
  - **Intrusion Detection**
    - Interior and exterior sensors
    - Duress
  - **Entry Control**
    - Forced open – intrusion alarm
    - Held open
    - Access denied
  - **System Integrity**
    - Tamper alarms, line supervision
    - State of health, loss of power
    - Loss of video
    - Other system outages (network, UPS unavailable, system status)
Alarm Communication – Data Collection – Entry Control Data

- **Entry Control**
  - Enrollment Station
  - Portal (door, turnstile, gate)
- **Data**
  - Credential
  - PIN
  - Biometrics
  - Door status
  - Area alarm states (access/secure)

Alarm Communication – Data Collection – Video Management Data

- **Data**
  - Live video
  - Video storage
    - Continuous recording
    - Video “clips”
      - Operator selected
      - Automatic – Zone in alarm
      - Automatic – Pre- and post-alarm for zone in alarm
- **Video Management System Control**
  - Camera to Monitor Selection
  - Pan-tilt-zoom control
  - Video storage and retrieval
Alarm Data to Central Alarm Station

- How does all this information get from the field . . . to the Alarm Station?

Alarm Communication – Data Communication – Field Connections

- Components may be connected directly to the AC&D system
- Alarm, entry control, and video devices may be connected to field panels, which are connected to communications network, which is connected to the AC&D system
Alarm Communication – Data Communication – Wire Features

- **Wire**
  - Uses electricity (voltage, current)
    - Twisted-pair cable (for example “Cat 6”)
    - Coaxial Cable
  - Disadvantages
    - Distance limits - signal degradation due to line loss (resistance)
    - Affected by lightning and grounding and other sources of electromagnetic radiation

- **Coaxial cable**
  - 25-pin, RS-232 connector
  - Cat 6 connector
  - Coaxial cable

Alarm Communication – Data Communication – Optical Fiber Features

- **Optical Fiber**
  - Uses light
  - Used for longer distances
  - More immune to grounding, lightning, and noise problems
  - Very high speed
    - 100 times faster than coaxial cable
    - 1000 times faster than twisted pair
  - Disadvantages
    - Unforgiving installation requirements
    - Cost for equipment and installation
Alarm Communication – Data Communication – Wireless Features

- **Wireless**
  - Used when cannot install wire or fiber
  - Uses radio or microwave frequency
  - Disadvantages
    - Susceptible to interception
    - Susceptible to jamming
  - Not for use as primary communications in high security applications
Alarm Communication – Data Communication – Tree Network Topology

- Hybrid: Combination of star and line networks
- Hierarchical: Root node with branches
- Failure modes: “branches” or “leaves” may become isolated

![Tree Network Topology Diagram]

Alarm Communication – Data Communication – Tree Network Topology with Redundancy

- Redundant root (or core) nodes
  - Distribution level nodes connected to both root nodes
  - Access level nodes may also connect to two distribution level nodes
- Very reliable and robust, but expensive
- Failure modes: Access level may become isolated

![Redundant Tree Network Topology Diagram]
Alarm Communication and Display

Alarm Communication – Data Communication – Tree Topology with Redundancy Diagram

AC&D Key Aspect - Alarm Display

Data Collection \(\rightarrow\) Alarm Communication \(\rightarrow\) Data Processing \(\rightarrow\) Alarm Display \(\rightarrow\) Operator

Move data from point to point

Provide security-related information to a human operator

Communicate with others and interface with AC&D systems
Alarm Display – Data Processing

• Types of AC&D systems
  ▪ Annunciator panels – with or without processing
  ▪ Independent systems
  ▪ Integrated systems

Alarm Display – Data Processing (cont’d.)

• Types of AC&D Systems
  ▪ Independent Systems – many systems, many displays
  ▪ Integrated System – many systems, one display
Alarm Display – Data Processing – Data Management

- Data is managed by
  - Either the alarm station operator or the system
  - Independent systems
    - Collects
    - Stores
    - Displays
  - Integrated systems
    - Alarm integration with entry control
    - Alarm integration with video
    - Entry control integration with video

- Which type of system is better for the operator?

Alarm Display – Data Presentation

- Display Types - Examples
  - Annunciator panels (indicator lights)
  - Geographic map (mimic) displays
    - Annunciator-type
    - Computer graphics (touchscreen)
  - Computer monitor displays (both text and graphics)
Alarm Display – Data Presentation – Annunciator Panel

Alarm Display – Data Presentation – Geographic Map – Annunciator Type
Alarm Communication and Display

Data Presentation – Computer Monitor Graphics Display

Data Collection
Data Communication
Data Processing
Data Presentation
Data Interpretation
Alarm Communication
Alarm Display
Action
Operator

AC&D Key Aspect – Operator

Move data from point to point

Provide security-related information to a human operator

Communicate with others and interface with AC&D systems
Operator – Data Interpretation

• Who is your Operator?
  • Guards?
  • Response Force?
  • Contractor?
Operator – Data Interpretation – Human / Machine Interface

- How should the information be presented?
- How should the equipment be arranged at the operator’s workstation?
- How does the operator interface with the system?
- What information should be presented to the operator?
- How much information should be presented?
- When should the information be presented?

Operator – Data Interpretation – Ergonomic Console

[Diagram showing ergonomic console with dimensions and angles]
Operator – Data Interpretation – Ergonomic Arrangement

Distance to the Right and Left of Seat Reference Point (cm)

-65 -62 -59 -56 -53 -50 0 13 26 39 52 65

Distance Above Seat Reference Point (cm)

-91 -78 -65 -52 -39 -26 -13 0 13 26 39 52

Auxiliary Controls
Secondary Controls
Primary Controls

Operator – Data Interpretation – Console Configuration Example

Surveillance Video
Video System Monitor displaying recorded images of alarmed sector
Video System Monitor displaying live image - operator selected
Auxiliary Monitor
Alarm System Monitor displaying text information of alarm
Alarm System Monitor displaying location of alarm on map
Communication to others - phone, intercom, and radio
Operator System Interface - keyboard and mouse
Operator – Data Interpretation – Console
Configuration Example with Two Operators

Operator – Data Interpretation – Information
to Display

- Overall System Status
- Site layout, including alarm zone status
- Alarm System
  - Alarm Annunciation: “lights,” audio, map, text
  - Location of the alarm
  - What sensor is in alarm
  - Time of the alarm
- Video Monitor Displays
  - Live video
  - Assessment video
  - Surveillance video
- Entry Control Displays
  - Entry control alarm events
  - Entry logs
- Network Communication Status
Operator – Data Interpretation – When to Display Information

- Examples
  - Always
    - Zone status – Secure or access
    - Alarm status – No alarm, alarm, alarm reset, alarm acknowledged
    - Site layout – With or without zone status
    - System status, including status of back up systems and power
    - Operators logged into system, including system administrator
  - Upon Alarm
    - Alarm location and time (map and/or text)
    - Video of alarm zone
  - When Requested
    - Alarm history
    - Procedural instructions
    - Entry control information
    - Event surveillance

Operator – Action

- What actions might an Operator take for:
  - Alarm Monitoring and Control?
  - Alarm Assessment and Surveillance?
  - Entry Control
  - Communication with others?
Operator – Action – Training

- Operators must be trained to use the system and take appropriate action
- Written operating procedures
  - Define roles and responsibilities
  - Define actions during
    - Normal operations
    - Incidents
    - Modifications
  - Test procedures to ensure operators are not overloaded
  - Train to the procedures

Implementation Considerations

- Primary Design Consideration
  - Availability – Ability of the security system to perform required functions, over the life of the system.
  - May be expressed as:
    \[
    \text{Availability} = \frac{\text{Uptime}}{\text{Uptime} + \text{Downtime}}
    \]
Implementation Considerations (cont’d.)

- How long do you think it is acceptable for a security system to be “down” (not functional)?

- If the system is “down” 4 hours per month, or 48 hours per year, then the availability is 99.45%

- If the system is “down” for 24 hours per month, or 288 hours per year, then the availability is 96.7%
Implementation Considerations (cont’d.)

- Two Implementation Considerations
  - Reliability
  - Maintainability

Implementation Considerations – Reliability

**Reliability:** The ability of an item to perform a required function under given environmental and operational conditions, for a stated period of time.

- Select reliable equipment
  - Quality components
  - Rated for environment
- Eliminate failure modes
- Include appropriate redundancy
- Design for system integrity
  - Security
  - Physical protection
Implementation Considerations – Reliability – Redundancy

- Redundancy allows components to fail without catastrophic consequence
  - Backup equipment
    - Power - Emergency generators and uninterruptible power supplies
    - Redundant / Redundant and diverse system servers
    - Duplicate / Duplicate and diverse AC&D consoles and workstations
    - Network communication capacity
    - Double sensor coverage
    - Install spare capacity

Redundant - two or more
Redundant and Diverse - two or more, in geographically separate locations

Implementation Considerations – Reliability – System Integrity

<table>
<thead>
<tr>
<th>Deny Access to Equipment</th>
<th>Deny/Detect Access to Information</th>
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</thead>
<tbody>
<tr>
<td>Physically protect equipment</td>
<td>Control access to system</td>
</tr>
<tr>
<td>• Location of components</td>
<td>• Intrusion detection and surveillance for system components, including spare parts</td>
</tr>
<tr>
<td>• Installation techniques</td>
<td>• Passwords / Privileges</td>
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<tr>
<td>Administratively protect equipment</td>
<td>Implement secure network features</td>
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<tr>
<td>• 2 person rule</td>
<td>• Isolate system</td>
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<td>• Port Control</td>
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<td>• Encryption</td>
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Deny/Detect Access to Information
Implementation Considerations – Maintainability

**Maintainability:** The ability of a system to be retained in or restored to a state in which the system can perform required functions when scheduled or unscheduled maintenance is performed

- Monitor Performance
  - Periodic inspections and tests
- System Documentation
  - Vendor manuals
  - As-built drawings
  - Site configuration

Implementation Considerations – Maintainability – Efficient Replacement/Repair

- End-of-Life planning
- Component failure
  - Modular design for rapid replacement
  - Back up system software and configuration files
  - Disaster recovery processes and procedures
    - Document
    - Practice
- Availability of Resources
  - Trained maintainers
  - Spare parts
    - Compatible parts
    - Correct tools
  - Funding
Summary

- The role of the AC&D is to
  - Collect and display data from the PPS
  - Provide the human / machine interface
  - Support communication to others
- The key aspects and functions of the AC&D systems are:
  - Alarm communication
  - Alarm display
  - Operator
- AC&D implementation considerations include:
  - Availability: 24 hours a day, 7 days per week
  - Reliability: Reliable equipment, eliminate failure modes, includes redundancy, and system integrity
  - Maintainability: Monitor performance, efficient replacement and repair, availability of resources and system documentation