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## 1.0 PURPOSE AND APPLICABILITY

This standard operating procedure (SOP) outlines the quality assurance and quality control actions associated with the operation and maintenance of automatic visibility monitoring camera systems.

Documenting visibility or visual events and trends is an important aspect of evaluating existing or potential impairment in Class I and other visibility-sensitive areas. Photography is an efficient way to document these events and trends and is an effective method of communicating visual relationships to decision-makers and to the public. Self-contained, automatic camera monitoring systems or time-lapse video monitoring systems are easily installed and operated. Camera-based monitoring, referred to as scene monitoring, is an effective, economical component of any visibility monitoring program.

An automatic camera visibility monitoring station takes 35 mm slides or high-resolution digital images of a selected vista at user-selected times throughout the day. The station can also be outfitted with an 8 mm time-lapse camera or an SVHS time-lapse recorder to record the dynamics of visibility events. Day-to-day variations in visual air quality captured on 35 mm color photographic slides, digital images, 8 mm color movie film, or SVHS videotape can be used to:

- Document how vistas appear under various visual air quality, meteorological, and seasonal conditions. Scene characteristics include observer visual range, scene contrast, color, texture, and clarity.
- Record the frequency that various visual air quality conditions occur (e.g., incidence of uniform haze, layered haze, or weather events).
- Provide a quality assurance reference for collocated measurements.
- Determine the visual sensitivity of individual areas or views to variations in ambient air quality.
- Identify areas of potential impairment.
- Estimate the optical properties of the atmosphere under certain conditions.
- Provide quality media for visually presenting program goals, objectives, and results to decision-makers and to the public.
- Provide support data for the computer image modeling of potential impairment.
- Support color and human perception research.

Slides, digital images, movie film, and videotape, however, do not provide quantitative information about the cause of visibility impairment. Aerosol and optical properties of the atmosphere must be independently monitored where cause and effect relationships are required.

In addition to visibility monitoring, time-lapse video systems can be used for a variety of other purposes, including:

- Environmental monitoring such as wildlife, waterflow, and source monitoring.
- Security monitoring for remote industrial sites and storage depots.
- Construction monitoring for building sites or highway and bridge construction.
- Event monitoring for remote weather documentation or highway and airport conditions.
- Recreation monitoring for ski areas and river rafting.

The automatic camera system maintenance quality assurance program consists of three (3) major categories:

- Routine Site Operator Maintenance Procedures  
Routine servicing and scheduled maintenance is carried out by site operators on a routine basis.
- Troubleshooting and Emergency Maintenance Procedures  
Identifying and troubleshooting system malfunctions is carried out by site operators, a field specialist, and/or data coordinator, as required.
- Biannual Laboratory Maintenance Procedures  
Intercomparison studies of film exposure, data collection, and equipment operations is carried out on an ongoing basis. Functional instrument checks, exposure calibrations, system lubrication, and preventative maintenance are carried out on a biannual basis.

A variety of camera monitoring configurations exist. Manufacturers change their model lines frequently as outdated models are discontinued and new models are introduced. Over the years, a variety of different camera and time-lapse systems have been applied to monitor visibility. Many of these systems still actively take visibility photographs in operational monitoring networks. This SOP is, therefore, supported by a series of monitoring configuration-specific technical instructions (TIs), as described in Section 4.0.

## **2.0 RESPONSIBILITIES**

### **2.1 PROJECT MANAGER**

The project manager shall coordinate with the site operator, his/her supervisor, field specialist, and data coordinator concerning the schedule and requirements for routine maintenance or specific troubleshooting needs.

### **2.2 FIELD SPECIALIST**

The field specialist shall:

- Coordinate with the site operator, his/her supervisor, project manager, and data coordinator concerning the video monitoring schedule and requirements for routine maintenance or specific troubleshooting needs.

- Train the site operator in all phases of camera or video system maintenance.
- Provide technical support to the site operator via telephone to assure high quality site visits for video monitoring systems.
- Resolve problems reported by the site operator regarding video monitoring systems.
- Document all technical support provided to the site operator regarding video monitoring systems.

### **2.3 DATA COORDINATOR**

The data coordinator shall:

- Coordinate with the site operator, his/her supervisor, project manager, and field specialist concerning the schedule and requirements for routine maintenance or specific troubleshooting needs.
- Verify that scheduled visits are performed and notify the site operator if he/she fails to make a scheduled visit.
- Identify possible camera or video system malfunctions and contact the site operator to schedule system troubleshooting visits.
- Review all site documentation completed by the site operator for accuracy and completeness, and file all documentation and correspondence.
- Provide technical support to the site operator via telephone to identify and resolve system problems. Document all technical support given to the site operator.
- Resolve problems reported by the site operator.
- Enter the results of all performed procedures into the site-specific Quality Assurance Database.
- Supply the site operator with all necessary monitoring supplies.
- Coordinate the replacement and repair of all system components and support hardware.
- Coordinate all aspects of biannual camera and video system maintenance.
- Document all capital instrumentation changes and maintain inventory records in the Air Resource Specialists, Inc. (ARS) Purchase Order/Inventory Database.

### **2.4 SITE OPERATOR**

The site operator shall:

- Coordinate with the site operator, his/her supervisor, project manager, and field specialist concerning the schedule and requirements for routine maintenance or specific troubleshooting needs.

- Schedule regular site maintenance visits and perform all procedures described in the instrument-specific TIs associated with this SOP.
- Thoroughly document all procedures on the Visibility Monitoring Status/Assessment Sheet or Time-Lapse Video Monitoring Status/Assessment Sheet and mail the white copy of the sheet to the data coordinator.
- Report any noted inconsistencies immediately to the data coordinator or field specialist.
- Schedule biannual maintenance with the data coordinator.

### **3.0 REQUIRED EQUIPMENT AND MATERIALS**

#### **3.1 SITE VISIT EQUIPMENT**

Site operators will maintain all necessary equipment and spare parts to accommodate routine, field, and emergency maintenance of the automatic camera and video systems. If required, factory-authorized maintenance and repair of monitoring equipment will be coordinated by ARS. Equipment and spare parts generally required to support routine servicing and on-site troubleshooting and emergency maintenance include the following:

- Voltmeter
- Spare camera and timer batteries for 35 mm and 8 mm camera systems
- Various size and type screwdrivers
- Adjustable wrench
- Keys for enclosure and any padlocks
- Watch
- Optical cleaning supplies
- Site operator's manual
- Pen or pencil
- Grease pencil
- Film rolls or SVHS videotape cassettes
- Padded mailing envelopes

A variety of cameras and monitoring configurations exist. Specific backup equipment requirements for each site will vary with the system configuration. Configuration-specific TIs detail the required equipment and materials for each site type. ARS has established service agreements with local factory-authorized repair facilities for Canon, Contax, Olympus, Minolta, Yashica, Panasonic, and Sony manufactured products. These facilities are capable of providing prompt and thorough testing, preventive maintenance, and repair services, as described in Section 4.3.

## **3.2 INVENTORY**

It is imperative that all capital instrumentation changes made as a result of routine and biannual maintenance be thoroughly documented and maintained in the ARS Purchase Order/Inventory Database. Any on-site equipment changes made should be documented by the site operator on a Visibility Monitoring Status/Assessment Sheet or on a Time-Lapse Video Monitoring Status/Assessment Sheet. Specific model and serial number items tracked are discussed further in the instrument-specific troubleshooting and emergency maintenance TIs (see Section 4.2).

## **4.0 METHODS**

This section includes three (3) subsections:

- 4.1 Routine Site Operator Maintenance Procedures
- 4.2 Troubleshooting and Emergency Maintenance Procedures
- 4.3 Biannual Laboratory Maintenance Procedures

Methods and procedures described in these subsections are summarized in Figure 4-1.

Site operators are trained and supplied with a Site Operator's Manual for Automatic Visibility Monitoring Camera Systems. This manual contains standard operating procedures and technical instructions applicable to the specific camera or video monitoring equipment located at the site. Additional manufacturers' instructions booklets and pertinent maintenance documentation forms are also provided.

### **4.1 ROUTINE SITE OPERATOR MAINTENANCE PROCEDURES**

Routine servicing schedules are based on the number of photographs or images taken each day. A common 35 mm camera monitoring schedule includes taking three photographs a day at 0900, 1200, and 1500. Assuming this monitoring schedule, site operators service the camera approximately every 10 days to change film, check the performance of the camera(s), clean the system components, and perform scheduled preventive maintenance. A common 8 mm or time-lapse video monitoring schedule includes monitoring continuously (e.g., 1 frame per minute) during the daylight hours of 0800 through 1800. Assuming this monitoring schedule, site operators service the camera approximately every 7 days (8 mm cameras) or 14 days (video systems), to change film, check the performance of the camera(s), clean the system components, and perform scheduled preventive maintenance.

Regular servicing and the identification and documentation of film rolls or videotapes are essential. During each routine site visit, the operator will thoroughly document all pertinent data collection information, any maintenance performed, and any equipment or monitoring inconsistencies on the Visibility Monitoring Status/Assessment Sheet or Time-Lapse Video Monitoring Status/Assessment Sheet. Completed sheets are mailed with each roll of film or videotape. If operator entries on the sheet indicate that further action is necessary, immediate corrective action will be taken by the data coordinator.

## **Automatic Camera System Field Quality Control Procedures**

**Regular Maintenance** performed at each film or videotape change:

- Inspect overall system and clean shelter window.
- Verify that film or videotape advanced and settings are correct.
- Rewind and remove film or videotape (complete film canister or videotape label).
- Load new film or videotape (complete film canister or videotape label).
- Inspect and clean camera lens.
- Check system batteries or time-lapse system power source.
- Check camera and databack settings.
- Check timer and time-lapse system alarm settings.
- Photograph film documentation board.
- Verify proper camera alignment.
- Verify system operation.
- Complete status/assessment sheet:
  - Document any equipment or monitoring discrepancies found.
  - Document all servicing or maintenance actions performed.
  - Describe weather conditions.
  - Describe visibility conditions.
- Close and lock enclosure.
- Mail film or videotape and the white copy of the completed status/assessment sheet to ARS.

**Scheduled Maintenance** performed as scheduled or as required:

- Change 35 mm databack batteries annually.
- Change 35 mm camera batteries every 6 months.
- Change 35 mm and 8 mm timer batteries every 6 months.
- Return time-lapse recorder annually for factory-authorized servicing.

**Unscheduled Maintenance** performed as required:

- If the operator notes a problem, he/she calls or notifies the field specialist and/or data coordinator. If ARS notes a problem, the data coordinator calls the site operator.
- The site operator, in communication with ARS, applies troubleshooting and emergency maintenance procedures.
- If necessary, ARS express mails a replacement system to the site.
- The site operator replaces the system and returns the malfunctioning unit to ARS.

Figure 4-1. Automatic Camera System Field Quality Control Procedures.



Throughout the monitoring effort, ARS and site operators maintain close personal communication. Operators are encouraged to call or notify ARS if they have any questions or problems. A data coordinator and/or field specialist is available during normal business hours (0800-1700 MST) to provide telephone assistance to site operators. A telephone answering/message system operates during non-business hours. ARS may be reached at the following telephone numbers:

Telephone: 970/484-7941  
Fax: 970/484-3423

Instrument-specific routine site operator maintenance procedures are provided in detail in the following TIs:

- TI 4120-3100 *Routine Site Operator Maintenance Procedures for 35 mm Automatic Camera System - Canon EOS 630*
- TI 4120-3110 *Routine Site Operator Maintenance Procedures for 35 mm Automatic Camera System - Contax 167MT*
- TI 4120-3120 *Routine Site Operator Maintenance Procedures for 35 mm Automatic Camera System - Contax 137 MA*
- TI 4120-3130 *Routine Site Operator Maintenance Procedures for 35 mm Automatic Camera System - Olympus OM2N*
- TI 4120-3140 *Routine Site Operator Maintenance Procedures for 35 mm Automatic Camera System - Pentax PZ-20*
- TI 4120-3150 *Routine Site Operator Maintenance Procedures for 35 mm Automatic Camera System – Pentax ZX-10*
- TI 4120-3200 *Routine Site Operator Maintenance Procedures for 8 mm Automatic Camera System - Minolta XL 401/601*
- TI 4120-3210 *Routine Site Operator Maintenance Procedures for 8 mm Automatic Camera System - Minolta D12*
- TI 4120-3650 *Routine Site Operator Maintenance Procedures for SVHS Time-Lapse Video Camera System at DNPP – Sony SSC-S20 Camera, Panasonic AG-6740 SVHS VCR, and Panasonic CT1384Y Monitor*
- TI 4120-3655 *Routine Site Operator Maintenance Procedures for SVHS Time-Lapse Video Camera System at Garner Hill – Sony SSC-S20 Camera, Pelco PT1250 Series Pan/Tilt, RWI 30CM Microwave Antenna, and Panasonic CT1384Y Monitor*
- TI 4120-3660 *Routine Site Operator Maintenance Procedures for SVHS Time-Lapse Video Camera System at HCCP – Panasonic AG-6740 SVHS VCR and Sony Monitor*

## 4.2 TROUBLESHOOTING AND EMERGENCY MAINTENANCE PROCEDURES

Maintaining a monitoring camera system includes prompt detection and emergency maintenance when the system fails to function properly. The troubleshooting and emergency maintenance process should progress as outlined below to ensure ongoing, consistent data collection.

- A system malfunction is detected by the site operator during routine maintenance of the system or by the data coordinator during review of processed film or videotape.
- The site operator applies defined troubleshooting procedures to test the system and notifies the data coordinator of his/her findings. The data coordinator attempts to diagnose the problem and suggest specific action. The operator initiates the corrective action, tests the system, and again notifies the data coordinator of his/her findings.
- If the system appears to be operating normally, the operator returns it to service and visits the site periodically before the next regularly scheduled visit.
- When a camera-related or video recording problem cannot be identified or resolved by the site operator, or if the site operator is not available to address the malfunction, the data coordinator ships a complete backup system to the site as quickly as possible. Site operators exchange the equipment and ship the malfunctioning unit to ARS for evaluation and repair.
- The operator documents all problems, troubleshooting, and corrective actions on the Visibility Monitoring Status/Assessment Sheet or Time-Lapse Video Monitoring Status/Assessment Sheet. The documentation should include:
  - Date of noted malfunction
  - Actual or estimated amount of data loss
  - Steps taken to test the system components
  - Corrective action taken
  - Current operational status
- All troubleshooting and emergency maintenance communications documentation will be retained in the site-specific Quality Assurance Database for future reference. The data coordinator will continue to monitor processed film for reoccurrences or resolution of the problem.

Instrument-specific troubleshooting steps are provided in detail in the following TIs:

- TI 4120-3300      *Troubleshooting and Emergency Maintenance Procedures for 35 mm Automatic Camera System - Canon EOS 630*
- TI 4120-3310      *Troubleshooting and Emergency Maintenance Procedures for 35 mm Automatic Camera System - Contax 167MT*

- TI 4120-3320      *Troubleshooting and Emergency Maintenance Procedures for 35 mm Automatic Camera System - Contax 137 MA*
- TI 4120-3330      *Troubleshooting and Emergency Maintenance Procedures for 35 mm Automatic Camera System - Olympus OM2N*
- TI 4120-3340      *Troubleshooting and Emergency Maintenance Procedures for 35 mm Automatic Camera System - Pentax PZ-20*
- TI 4120-3350      *Troubleshooting and Emergency Maintenance Procedures for 35 mm Automatic Camera System – Pentax ZX-10*
- TI 4120-3400      *Troubleshooting and Emergency Maintenance Procedures for 8 mm Automatic Camera System - Minolta XL 401/601*
- TI 4120-3410      *Troubleshooting and Emergency Maintenance Procedures for 8 mm Automatic Camera System - Minolta D12*
- TI 4120-3750      *Troubleshooting and Emergency Maintenance Procedures for SVHS Time-Lapse Video Camera System at DNPP – Sony SSC-S20 Camera, Panasonic AG-6740 SVHS VCR, and Panasonic CT1384Y Monitor*
- TI 4120-3755      *Troubleshooting and Emergency Maintenance Procedures for SVHS Time-Lapse Video Camera System at Garner Hill – Sony SSC-S20 Camera, Pelco PT1250 Series Pan/Tilt, RWI 30CM Microwave Antenna, and Panasonic CT1384Y Monitor*
- TI 4120-3760      *Troubleshooting and Emergency Maintenance Procedures for SVHS Time-Lapse Video Camera System at HCCP – Panasonic AG-6740 SVHS VCR and Sony Monitor*

### **4.3 BIENNIAL LABORATORY MAINTENANCE PROCEDURES**

Internal quality assurance of automatic camera equipment is based primarily on visual review of developed film or videotape. Film/videotape handling and review procedures are fully discussed in SOP 4305, *Collection of Scene Monitoring Photographs, Film, and Videotape*. Alignment, exposure, and data collection efficiency can all be assessed from developed film or videotape. Any noted problems will initiate corrective action. Using quality site operators, verification of system performance and correction of identified problems can be successfully accomplished. On rare occasions when unresolvable problems persist, a field specialist will visit a site to repair, reconfigure, or reinstall a malfunctioning system, and will retrain the site operator.

Ongoing review of film, videotape, and site operator identified problems often initiates corrective actions. Servicing of all cameras and support systems is performed by mailing replacement parts and/or systems to the site operators and repairing those components returned by the site operators. Operational camera systems are biannually cycled out of the monitoring network. Shelters remain in place and the cameras and timers are cycled for laboratory maintenance.

Automatic camera and video system maintenance is normally provided by local factory-authorized repair facilities capable of performing the following:

- Cleaning, lubrication, and adjustment of all 35 mm or 8 mm camera components
- Automatic exposure calibration checks
- Ambient/cold testing of:
  - Current draw
  - Shutter speed and curtain travel time
  - Automatic exposure meter readout
  - Film transport
- Lens focus checks (and disabling of the soft focus mechanism in Canon 135 mm lenses)
- Battery and camera cabling integrity checks and necessary repair
- Timer circuitry checks
- Cleaning the VCR's head drum assembly, pinch roller, and capstan
- Checking the VCR's back tension and take-up torque
- Checking and adjusting videotape path
- Checking VCR play and rewind performance

Additional preventive maintenance performed on each serviced system includes:

- Camera system battery replacements
- Timer system battery replacements
- Lens cleaning
- Operational testing

Instrument-specific routine and annual laboratory maintenance procedures are provided in detail in the following TIs:

- TI 4120-3500      *Biannual Laboratory Maintenance Procedures for 35 mm Automatic Camera Systems*
- TI 41420-3510    *Biannual Laboratory Maintenance Procedures for 8 mm Automatic Time-Lapse Camera Systems*