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QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTATION SERIES	
TITLE	**SCENE MONITORING QUALITATIVE DATA REDUCTION**
TYPE	**STANDARD OPERATING PROCEDURE**
NUMBER	**4420**
DATE	**OCTOBER 1993**

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1.0 PURPOSE AND APPLICABILITY

This standard operating procedure (SOP) outlines the steps of scene monitoring qualitative data reduction. It serves as a guide to assure quality data from automatic camera and video monitoring stations.

Documenting visibility 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 visibility relationships to decision-makers and to the public. Self-contained, battery-powered, automatic camera visibility monitoring systems or time-lapse video monitoring systems are easily installed and operated at any location. Camera-based monitoring, referred to as scene monitoring, is an effective, economical component of any visibility monitoring program.

Day-to-day variations in visual air quality captured on 35 mm color photographic slides, 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 computer image modeling of potential impairment.
- Support color and human perception research.

Slides, 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 affect relationships are required.

The following technical instructions (TIs) provide detailed information regarding scene qualitative data reduction:

- TI 4420-5000 *Qualitative Scene Coding and Data Reduction of 35 mm Color Slides*

- TI 4420-5010 *Qualitative 8 mm Time-Lapse Movie Film Review*
- TI 4420-5050 *Qualitative Time-Lapse Videotape Review for the Healy Clean Coal Project*

2.0 RESPONSIBILITIES

2.1 PROJECT MANAGER

The project manager shall:

- Provide overall coordination of the slide, film, or videotape review process.
- Provide technical assistance if required, in the interpretation of slide, film, or videotape images during the qualitative review process.
- Review all slide, film, or videotape documentation for completeness and accuracy.

2.2 DATA COORDINATOR

The data coordinator shall:

- Perform Stage-1 videotape continuity review.
- Complete an Operational History Log for each videotape.

2.3 DATA TECHNICIAN

The data technician shall:

- Perform 35mm slide coding.
- Create digital code files.

2.4 DATA ANALYST

The data analyst shall:

- Oversee film reduction.
- Review and verify 35 mm slide codes.
- Perform initial 8 mm film qualitative review.
- Perform Stage-2 qualitative videotape review.
- Prepare qualitative review tables.
- Coordinate with research/project scientist regarding review results.
- Oversee preparation and finalize qualitative review discussions.

2.5 RESEARCH/PROJECT SCIENTIST

The research/project scientist shall:

- Perform secondary 8 mm film qualitative review.
- Perform Stage-3 qualitative videotape review.
- Coordinate with the data analyst regarding review results.
- Oversee all qualitative review stages.
- Prepare initial qualitative review discussions.

3.0 REQUIRED EQUIPMENT AND MATERIALS

3.1 REQUIRED EQUIPMENT AND MATERIALS FOR 35 MM SLIDES

Equipment and materials used to code and validate 35 mm photographic slides include:

- Processed 35 mm slides.
- Slide Condition Code Sheets.
- A light table.
- A hand-held magnifying lens.
- An IBM PC-compatible 386/486 computer system with VGA monitor.
- A computer printer.
- ARS software; SS program, HAZE program.

3.2 REQUIRED EQUIPMENT AND MATERIALS FOR 8 MM TIME-LAPSE FILM

Equipment and materials used to review and validate 8 mm time-lapse movie film include:

- Processed 8 mm time-lapse movie film rolls.
- An 8 mm movie projector.
- Time-Lapse Camera Visibility Monitoring Status/Assessment Sheets.
- Master Logs.
- Supplemental meteorological data (if applicable).

3.3 REQUIRED EQUIPMENT AND MATERIALS FOR SVHS TIME-LAPSE VIDEOTAPE

Equipment and materials used to review and validate SVHS time-lapse videotape include:

- SVHS videotape cassettes.
- An SVHS video cassette player.
- A review monitor.
- Time-Lapse Video Monitoring Status/Assessment Sheets.
- Operational History Logs.
- Supplemental meteorological data, on-site observer comments, etc. (if applicable).

4.0 METHODS

This section includes the following three (3) subsections:

4.1 35 mm Slide Coding and Data Reduction
4.2 8 mm Time-Lapse Film Review
4.3 SVHS Time-Lapse Videotape Review

4.1 35 MM SLIDE CODING AND DATA REDUCTION

Not all 35 mm slides undergo the coding process. Slides are only coded if summaries of observed slide conditions are required by the contracting agency. Each photographic slide designated for coding is visually reviewed, chronologically numbered, and assigned a two-digit slide condition code. These qualitative slide condition codes are assigned by the data technician and are verified by the data analyst. The codes document the visual conditions present on each slide, and include observed hazes, plumes, weather conditions or unusable or missing observations.

Coding is normally performed at the end of a season on all slides collected during the season. Each valid slide is viewed on a light table with the naked eye and a hand-held magnifying lens. Codes are recorded directly on the slides and later entered into site-specific digital files. Digital files are used to prepare qualitative summaries of observed haze types and can be searched in a variety of ways to fulfill specific data reports. Slide coding and qualitative summary procedures are detailed in TI 4420-5000, *Qualitative Scene Coding and Data Reduction of 35 mm Color Slides.*

4.2 8 MM TIME-LAPSE FILM REVIEW

Qualitative film review only occurs when a summary of specific information captured on 8 mm time-lapse film is required. For example, this type of qualitative review could be required to support an EIS or other regulatory review process. Film undergoing qualitative film review is closely reviewed for general weather conditions and for the presence/absence of atmospheric anomalies. This review provides a preliminary indication of the types of visual effects observed within the individual vistas.

Original 8 mm film is reviewed primarily for anomaly identification and evaluation. Chronological review tables and comprehensive discussions of any observed anomalies are prepared. It is recommended that original 8 mm film be reviewed. Review of 8 mm film transferred to videotape is also possible, however, loss of image resolution and overall quality is likely to occur in any second-generation film or video product. Film review and procedures are detailed in TI 4420-5010, *Qualitative 8 mm Time-Lapse Movie Film Review.*

4.3 SVHS TIME-LAPSE VIDEOTAPE REVIEW

Qualitative review of time-lapse videotape is generally performed in three stages. Stage-1 is a continuity review and problem resolution; videotapes are reviewed to verify proper camera and system component operation, proper exposure and alignment, and correct operating period. Stage-2 review includes documenting weather conditions and identifying observed visual anomalies or events of interest to the monitoring program. Stage-3 review includes evaluation of these observed anomalies or events. Detailed descriptions of the anomaly are then prepared and include related data, general weather conditions, a discussion of the dynamics of observed anomalies, and a conclusion.

For a detailed description of videotape review procedures, see TI 4305-4050, *Collection, Processing, and Handling of Time-Lapse Videotapes for the Healy Clean Coal Project*.

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1.0 PURPOSE AND APPLICABILITY

This technical instruction (TI) describes 35 mm slide coding and qualitative data reduction procedures. This TI is referenced in SOP 4420, *Scene Monitoring Qualitative Data Reduction*, and specifically describes:

- 35 mm slide coding procedures for observed meteorological conditions.
- 35 mm slide data reduction for preparation of qualitative analysis summaries.

2.0 RESPONSIBILITIES

2.1 PROJECT MANAGER

The project manager shall provide overall coordination of the coding and data reduction procedures.

2.2 DATA ANALYST

The data analyst shall:

- Oversee slide coding.
- Review and verify slide codes assigned by the data technician.
- Run qualitative summary program software.
- Verify qualitative summary tables.

2.3 DATA TECHNICIAN

The data technician shall:

- Perform slide coding.
- Create digital code files.

3.0 REQUIRED EQUIPMENT AND MATERIALS

Equipment and materials used in coding and reducing 35mm photographic slides include:

- Processed 35 mm slides
- Slide Condition Code Sheet
- Light table
- Hand-held lens
- IBM PC-compatible 386/486 computer system with VGA
- Printer
- ARS software; SS program, HAZE program

4.0 METHODS

This section includes the following two (2) subsections:

4.1 35 mm Slide Coding
4.2 35 mm Slide Data Reduction

4.1 35MM SLIDE CODING

Not all 35 mm slides undergo the coding process. Slide coding is performed only if summaries of observed slide conditions are required by the contracting agency. Condition codes qualitatively identify weather conditions, observed hazes or plumes, and unusable or missing observations. They are useful for summarizing observed conditions over defined time periods, or in searching for specific observed visibility conditions. Each valid slide that is coded is viewed on a light table with the naked eye and an eight-power, hand-held lens. Criteria used to assign the two-digit code for each slide are presented in Figure 4-1. Codes are recorded directly onto the top center of the slide frame with pencil (see Figure 4-2). The site abbreviation and slide number are also placed on top of the slide frame during the collection, processing, and handling process (refer to TI 4305-4000, *Collection, Processing, and Handling of 35 mm Slide Film*). The codes are later entered into site-specific digital files.

Digital files are created after all slides from a season are coded. Each file contains codes from one site for one season. Standard monitoring seasons are defined as:

Season	Months	Season Code
Winter	(December, January, and February)	1
Spring	(March, April, and May)	2
Summer	(June, July, and August)	3
Fall	(September, October, and November)	4

An IBM PC-compatible computer and the SS program are used to create digital files. Files are named in the format SITEYYS.SQO, where SITE is the site abbreviation, YY is the year, and S is the season code. The files include site abbreviation, slide number, date, time, target number, slide condition code, and quality assurance codes; an example digital file is presented as Figure 4-3.

Digital files are created in the SS program (type **SS** at the DOS prompt). The user must first initialize or create a file within the SS program with the commands **SQO** (to enter and operate in the "qualitative only" mode) and **INIT** (to initialize a file). The program then prompts the user for the following information: operator initials, file name, site code, targets used, slide pattern, time codes used, and slide number increment. Figure 4-4 is an example computer screen display during the initialization process.

After initializing a file, the user must then enter the command **TA**. The system will prompt for: slide number, two-digit slide condition code, time code, day, month, and year. Each slide entry will result in the system asking the user if the slide information should be accepted, reentered, or rejected. Figure 4-5 is an example computer screen display during the entry process. When the digital file is complete, type **EXIT** to leave the SS program.

SLIDE CONDITION CODE KEY

SKY CONDITIONS

0 No clouds	No clouds visible anywhere in the sky.
1 Scattered clouds < half of sky	Less than one-half of the sky has clouds present.
2 Overcast > half of sky	More than one-half of the sky has clouds present.
3 Haze concealing scene	Atmospheric haze conditions are such that determination of the sky value is impossible.
5 Weather concealing scene	Clouds or precipitation are such that determination of the sky value is impossible.
8 Observation cannot be determined	Observation cannot be determined due to extreme exposure inconsistencies, lens (or window) condensation, misalignment, or view obstructed by a foreign object.
9 No observation	No observation taken.

LAYERED HAZE

0 No layered haze	No layered haze boundary (intensity of coloration edge) is perceptible.
1 Ground-based layered haze only	Only a single-layered haze boundary is perceptible with the haze layer extending to the surface.
2 Elevated layered haze only	An elevated layered haze with two boundaries is perceptible; e.g., horizontal plume.
3 Multiple haze layers	More than a single ground-based or elevated haze layer is perceptible. This can be multiple ground-based layers or a combination of both.
5 Weather concealing scene	Clouds or precipitation are such that determination of the presence of layered hazes is impossible.
9 No observation or cannot be determined	To be used with sky condition of 9 or if a layered haze value cannot be determined due to reasons other than weather.

NOTE: It is possible to have a sky condition of 5 and still see a layered haze in the scene.

Figure 4-1. Slide Condition Code Key.

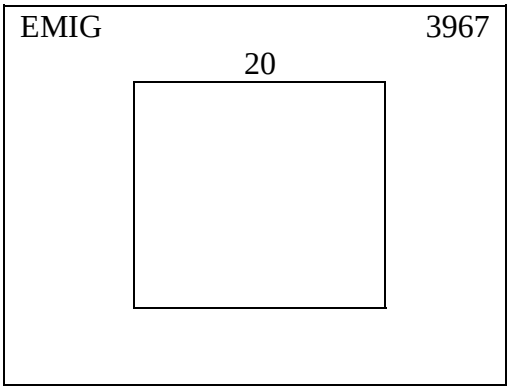

Figure 4-2. Example Slide With Codes.

Column Number

```
          1         2         3         4         5         6
12345678901234567890123456789012345678901234567890123456789012345678901234

EMIG 396793101211**20 0 0   0 0  0.000 0.000902901162520DGBG64*
EMIG 396793101212**20 0 0   0 0  0.000 0.000902901162544DGBG64*
EMIG 396893101221**20 0 0   0 0  0.000 0.000902901162611DGBG64*
EMIG 396893101222**20 0 0   0 0  0.000 0.000902901162640DGBG64*
EMIG 396993101231**20 0 0   0 0  0.000 0.000902901162707DGBG64*
EMIG 396993101232**20 0 0   0 0  0.000 0.000902901162725DGBG64*
```

Columns	Data
1-4	Site abbreviation
5-9	Slide number
10-15	Slide date (year/month/day)
16	Slide time code (1 = 0900, 2 = 1200, 3 = 1500 Local Time)
17	Slide target number
18-19	(Not used)
20-21	Slide condition code
22-45	(Not used)
46-51	Date codes entered (year/day/month)
52-57	Time codes entered (hour/minute/second)
58-60	Data technician initials
61-64	(not used)

Figure 4-3. Key to the Scene Qualitative Only (.SQO) Data File.

2-Digit Code .SQO Slide Analysis ARS-SQO- 64
Green
SS>>

Operator initials, 3 required: **JDY** (initials of individual entering data)
Data file name (.SQO will be added): **GILA933** (see Section 4.1)
Location code, 4 characters (SITE): **GILA** (see Figure 4-3)
Targets to use (1 2 3 4 5): **1** (see Figure 4-3)
Slide pattern (1): **1** (1 if targets are all on same slide)
Time codes to use (1 2 3): **1 2 3** (see Figure 4-3)
Slide number increment (1): **1** (number increments by one)

*New data file GILA933.SQO created

Figure 4-4. Example Initialization Screen in the SS Program.

Slide number, press ESC to quit (1050):
Year (93):

	CURRENT	PREVIOUS
Site code.....	GILA	GILA
Slide number.....	1050	1049
Date of photograph.....	93 8 11	93 8 11
Time and target.....	2 1	1 1
Scene visibility code....	21	10
Slide, scene contrast.....	0 0	0 0
Sky direct.....	0	0
Clear value.....	0	0
Time of scan.....	12:10:28	12:10:23

*Slide OK? ([Y]es/[R]edo/[N]o scan/[?]help)

Figure 4-5. Example Coding-Entry Screen in the SS Program.

4.2 35 MM SLIDE DATA REDUCTION

Digital files are used to prepare a qualitative summary of observed haze types. Using an IBM PC-compatible computer and the HAZE program, the user is prompted for the following information: number of months to process, the specific months to process, time period for the processing (title), whether to process on a monthly or seasonal basis, file name (.SQO), and the target numbers to process.

The summary is then printed; an example qualitative haze summary table is presented as Table 4-1. When distinct haze layers are visible, they are categorized as ground-based, elevated, or simultaneous ground-based and elevated hazes. All cases where no distinct haze layer occurs are classified as uniform hazes. Cases where the scene is not visible due to haze or weather are also noted. Refer to TI 4520-5000, *Scene Monitoring Reporting of 35 mm Color Slides (IMPROVE Protocol)*, for more detailed discussions of data reporting.

Table 4-1

Example Qualitative Slide Analysis Table

Target	Month	Total Observa-tion	Uniform Haze	Ground-Based Layered Haze	Elevated Layered Haze	Multiple Layers	Target Con-cealed by Haze	Target Concealed by Weather
POWDER HILL	JUN	88	76	1	0	0	3	11
	JUL	93	82	0	1	0	0	10
	AUG	92	81	1	0	0	13	10
	TOTAL	273 (100%)	239 (88%)	2 (1%)	1 (0%)	0 (0%)	16 (6%)	31 (11%)