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1967

J3 SYSTEMS ANALYSIS STUDIES

JULY 1967

(TOP SECRET [redacted]

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J-3 DEVELOPMENT GOALS

Improved Product Quality

.Increased scale through lower mean altitude (95 NM).

.Improved dynamic balance.

.Selectable exposure control.

.Increased command flexibility.

Increased Coverage Access

.Extend active mission duration.

Increased Coverage at Low Altitude

.Standard base film - 7.0m sq. mi.

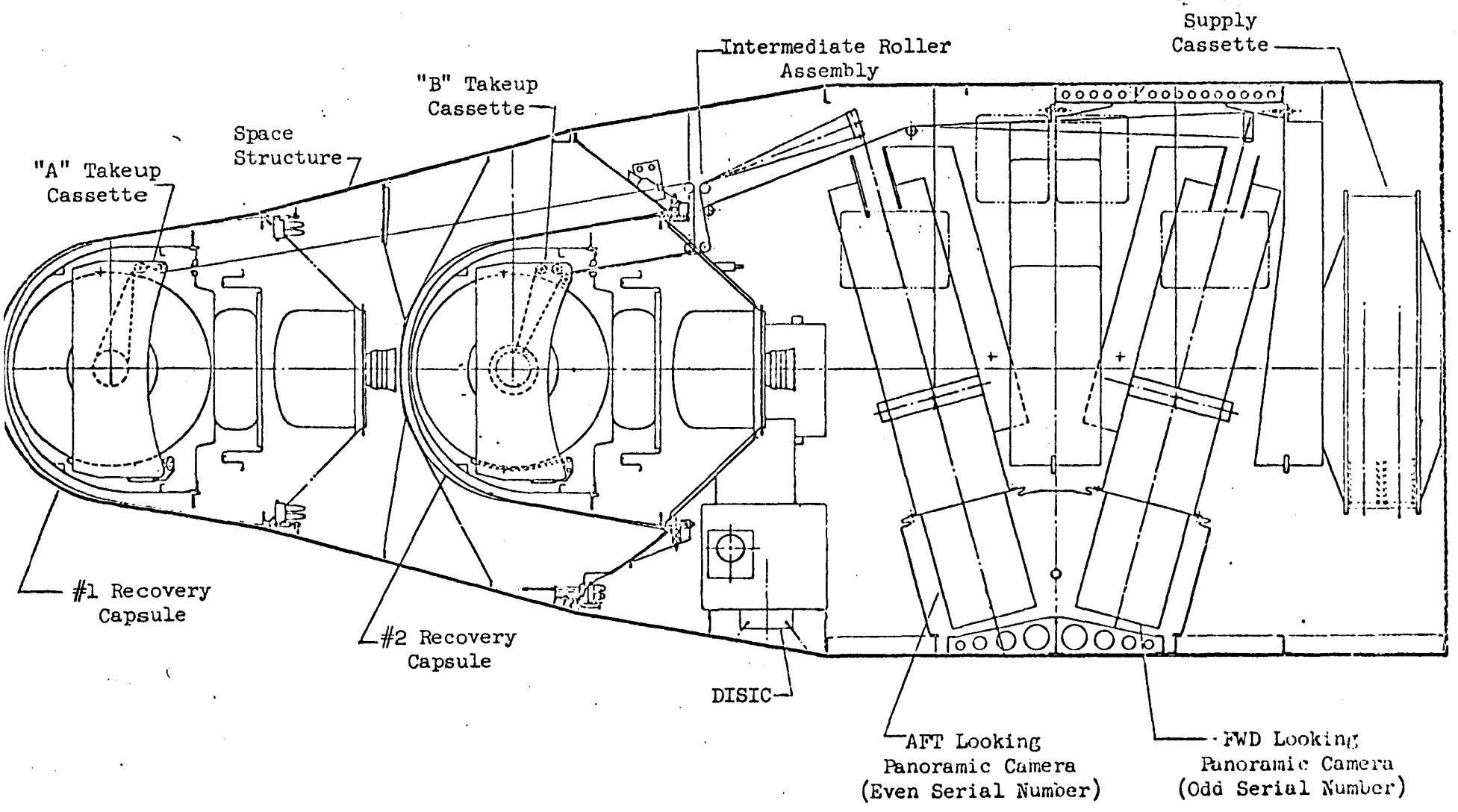
.UTB - 10.5m sq. mi.

Improved Stellar/Index Performance

.Increased scale and resolution of index photo (new lens).

.Increased operational flexibility by dual stellar capability.

.Provide independent programming for mapping.



J-3 SYSTEM INBOARD PROFILE

[redacted]

ALONGTRACK IMAGE BLUR - MICRONS

VEHICLE AND INTERFACE	TYPE	BLUR	BASIS
ORBIT MATCH ERROR	R	2.23 COS Θ	3 %
V/h COMMAND VOLTAGE	R	2.23 COS Θ	3 %
ROLL ATTITUDE	R	0.72 SIN Θ	34.3 MIN
ALIGNMENT	F		
PITCH ATTITUDE	R	0.49 COS Θ	43.4 MIN
ALIGNMENT	F		
PITCH RATE	R	0.10 COS Θ	0.004°/SEC
YAW RATE	R	0.10 SIN Θ	0.004°/SEC
TERRAIN HGT VAR	R	0.36	3,000 FT.

CAMERA	TYPE	BLUR	BASIS
VIBRATION	R	2.0	ASSUMPTION
SERVO ERROR	R	2.23 COS Θ	3 %
IMC ERROR (CAM)	F	2.23 COS Θ	3 %
UNCOMPENSATED IMC	S	1.85 *	FORMAT WIDTH
LENS DISTORTION	S	0.013 COS Θ *	5 M @ EDGE

[redacted]

* AT EDGE OF FORMAT

NOTE: 80 N.M. - 2.44 M SEC EXP. - 3 σ

[redacted]

CROSSTRACK IMAGE BLUR - MICRONS

VEHICLE & INTERFACE	TYPE	BLUR	BASIS
ROLL ATTITUDE AND ALIGNMENT	R, F	0.18 $\sin^2\theta$	34.3 MIN
YAW ATTITUDE AND ALIGNMENT	R, F	1.14 $\cos^2\theta$	51.6 MIN
PITCH ATTITUDE AND ALIGNMENT	R, F	0.43 $\sin 2\theta$	43.4 MIN
ROLL RATE	R	0.12	0.005°/SEC
YAW RATE	R	0.03 $\cos 2\theta$	0.004°/SEC

CAMERA	TYPE	BLUR	BASIS
VIBRATION	R	2.0	ASSUMPTION
NODAL POINT LOC.	F	0.22	±0.001"
I.M.C. CROSS-COUPLING	F	0.11	5 MIN. MISALIGNMENT
CROSSTRACK I.M.	S	9.8 $\sin 2\theta$	UNCOMPENSATED
LENS DISTORTION	S	0.83 *	5 MICRONS AT EDGE
FILM LIFT	S	1.11	0.005" FILM LIFT

[redacted]

* AT EDGE OF FORMAT

NOTE: 80 N.M. - 2.44 M/SEC EXP-3 [redacted]

BLUR AND GROUND RESOLUTION

ALONG PRINCIPAL AXIS

	ALONG TRACK		ACROSS TRACK	
	0°	30°	0°	30°
80 NAUTICAL MILES				
BLUR MICRONS	3.28	3.01	2.64	11.0
GROUND RESOLUTION FT.	6.3	7.2	6.1	12.9
100 NAUTICAL MILES				
BLUR MICRONS	2.52	2.23	1.79	8.57
GROUND RESOLUTION FT.	7.6	8.7	7.3	14.2

NOTE: 2.44 M/SEC. EXP.-3404-2:1 CON-2 5

[redacted]

J-3 SYSTEMS ANALYSIS STUDIES

I. Determine Operational Resolution.

II. Analyze Performance of System.

III. Photographic Analysis.

IV. Geometric Stability Analysis.

V. DISIC Subsystem Evaluation.

VI. Systems Capability Evaluation.

[redacted]

I. OPERATIONAL RESOLUTION

A. Corn Target Utilization

1. Deploy targets and make photometric measurements. (SPPF)
2. Photograph targets on engineering passes. (R.O.)
3. Visually determine resolution by examining target images on original negative. (ITEK)
4. Trace target images on microdensitometer. (ITEK)
5. Process edge-traces to determine resolution. (ITEK)
6. Compare visual and computer resolutions. (ITEK)

B. Edge-Trace Analysis

1. Select man made edges for evaluation. (NPIC)
2. Trace edges on microdensitometer. (SPPF)
3. Normalize amplitudes of edge-traces. (SPPF)
4. Process edge-traces to determine resolution. (ITEK)

[redacted]

Processing of Edge-Traces

Two Techniques are to be Utilized

A. MTF Technique

B. Correlation Technique

Comments

A. MTF Technique

.Well known and extensively used.

.Provides rough estimate of resolution.

B. Correlation Technique

.New and untested method.

.Does not depend on assumptions.

.Expected to be more accurate than MTF technique.

[redacted]

[redacted]

II. SYSTEM PERFORMANCE ANALYSIS

A. Analyze Data to Evaluate System Anamolies. (LMSC)

.Telemetry Data.

.SRV Tape Recorder Data.

.Ephemeris.

B. Prepare Data Analysis Report. (LMSC)

1. Vehicle Guidance Error Signals.
2. FMC Programmer Output.
3. Panoramic Camera Tachometer Feedback Voltage.
4. Center of Format Switch Output.
5. Temperatures of Film Rails.
6. YAW Programmer Output.

[redacted]

[redacted]

C. Correlate System Data with Photography Where Low Resolution and/or Malfunctions were Observed. (ITEK)

1. Panoramic Imagery

.Measure on a comparator coordinates of rail holes, time marks, and nod dots (when available).

.Process coordinates to determine time and FMC motion as functions of SCAN angle.

.Analyze results to establish panoramic camera FMC and SCAN rates.

2. DISIC Imagery

.Examine visually to detect weather fronts or haze.

[redacted]

III. PHOTOGRAPHIC ANALYSIS

A. Image Quality

B. Exposure

C. Reproduction

D. Atmospherics

[redacted]

A. Image Quality

1. Subjective evaluation of mission MIP frame. (NPIC)

2. Comparison of MIP frame to resolution analysis results (Corn targets, edge-traces). (ITEK)

3. Comparison of MIP frame to system MTF curve obtained from edge-trace analysis by MTF technique. (ITEK)

4. Comparison of MIP frame to MIP frames of previous missions (J3 and J1) (same target and scale). (ITEK)

5. Review original negative for camera performance anomalies. (ITEK)

6. Review original negative for system light leaks or anomalies with SLP data head, clock output and/or tracking. (LMSC)

[redacted]

B. Exposure Analysis

1. Target Exposure Analysis (NPIC)

.Trace COMOR high priority list (HPL) targets.

.Determine D_{min} and D_{max} for each target.

.Determine effects of exposure on target image quality.

.Specify optimum exposure for each target.

.Compare optimum exposure of target to optimum exposures of same target for previous missions.

2. Frame Exposure Analysis [redacted]

.Determine D_{min} and D_{max} for each frame.

.Provide exposure recommendations for area coverages.

3. Exposure Correlation (ITEK)

.Correlate exposure data and prepare recommendations for operational utilization of exposure control device.

[redacted]

C. Reproduction Evaluation

1. Prepare processing and duplication report. [redacted]
2. Trace COMOR high priority targets on original negative and duplicating positive. (NPIC)
3. Analyze processing and duplication of operational materials. (NPIC)
4. Trace corn step wedge on original negative and duplicating positive. (ITEK)
5. Analyze processing and duplication of engineering materials. (ITEK)
6. Evaluate tone reproduction on engineering materials. (ITEK)
7. Recommend processing, printing and duplication procedures for maximum information presentation to photointerpreter. (NPIC)

[redacted]

D. Atmospherics Analysis

1. Determine exposure gray scale of corn step wedge from panoramic original negative. (ITEK)
2. Prepare corn photometric measurements report. (SPPL)
3. Determine loss of contrast for corn targets due to haze. (ITEK)
4. Measure LATD from DISIC original negative. (NPIC)
5. Measure D_{min} and D_{max} from DISIC original negative. [redacted]
6. Determine atmospheric haze and transmission. (ITEK)
7. Determine albedo characteristics versus geographic location. (ITEK)
8. Determine percentage of cloud cover for specific target areas versus time of the year. (ITEK)

[redacted]

IV. GEOMETRIC STABILITY ANALYSIS

A. Internal Geometry Analysis (ITEK)

1. Determine incidence of anomalous conditions.
2. Determine stability of photographic geometry under normal conditions.
3. Determine effect of anomalous conditions on photographic geometry.

B. Relative Geometry Analysis (ITEK)

1. Determine operational stereo convergence angle.
2. Determine operational horizon-optics orientation to panoramic camera.
3. Determine operational panoramic DISIC relative orientation.

[redacted]

REPORTING - SECTIONS I THRU IV

CR-1, 2, 3, AND 4

.One report on each flight.

.Reports to be classified TKH.

.Reports to be published by ITEK (Boston) not later than 6 weeks following flight.

.Inputs required by ITEK not later than 3 weeks following flight.

J-3 SYSTEM EVALUATION REPORT

.Final summary report to be compliled by ITEK and reviewed by participating groups prior to publication.

.Target date for compilation August 1968.

.Target date for publication September 1968.

[redacted]

INPUTS REQUIRED AT ITEK FOR PUBLICATION
OR CR-1 THRU CR-4 REPORTS

FROM [redacted]

1. Domestic original negative and first generation duplicate positive.
2. Processing and duplication report.
3. Unprocessed "A" bucket film from on pad runs.
4. D_{min}/D_{max} report PAN frames.
5. D_{min}/D_{max} report DISIC frames.

FROM LMSC

1. Data analysis report (TM, tape recorder, etc.)
2. Light leak reports.
3. System anomaly report (SLP clock, etc).
4. Mission flight report and ephemeris.

[redacted]

FROM SPPF

1. Corn target description, deployment, and photometric measurements.
2. Edge traces measurements.
3. Edge traces analysis.
4. 10X and 40X enlargements of edges traced.

FROM NPIC

1. Subjective evaluation of MIP frame.
2. 40X enlargements from MIP frame.
3. Density traces of high priority targets from original negative and duplicate positive.
4. 10X enlargements of areas traced.
5. Target exposure analysis report.

FROM ITEK DAC

1. Internal geometry analysis report.
2. Relative geometry analysis report.

[redacted]

V. DISIC SUBSYSTEM EVALUATION

A. Stellar Camera (NPIC)

.Format Fiducials and Reseau

.Auxilliary Data Presentation

.Stellar Field Recorded

.Anamolies Observed

B. Index Camera (NPIC)

.Format Fiducials and Reseau

.Auxilliary Data Presentation

.Resolution

.Intelligence Value

.Geodetic Value

.Anamolies Observed

C. Relative Orientation and Stability of Calibration (NPIC)

[redacted]

VI SYSTEM CAPABILITY EVALUATION

.Perform tests on systems CR-1 thru CR-4.

.Evaluate J-3 System photographic performance utilizing various films, filters and exposures.

.Establish baseline for work with future systems.

[redacted]

CR-1 SYSTEM

GOALS

.Demonstrate reliability and operational control of exposure/filter devices.

.Determine effects of exposure and filtration on target contrast and image quality.
(3404 Film)

.Examine optimum exposure control.

.Examine optimum filter selection.

.Examine potential use of SO 230 film for DISIC terrain.

FILM LOADING

Camera	Film (Footage)	Prime Filter	Alt Filter
FWD Looking	3404 (16000)	W/23A	W/25
AFT Looking	3404 (16000)	W/21	W/23A
DISIC Terrain	3400 (1800) SO230 (200)	W/12 W/12	

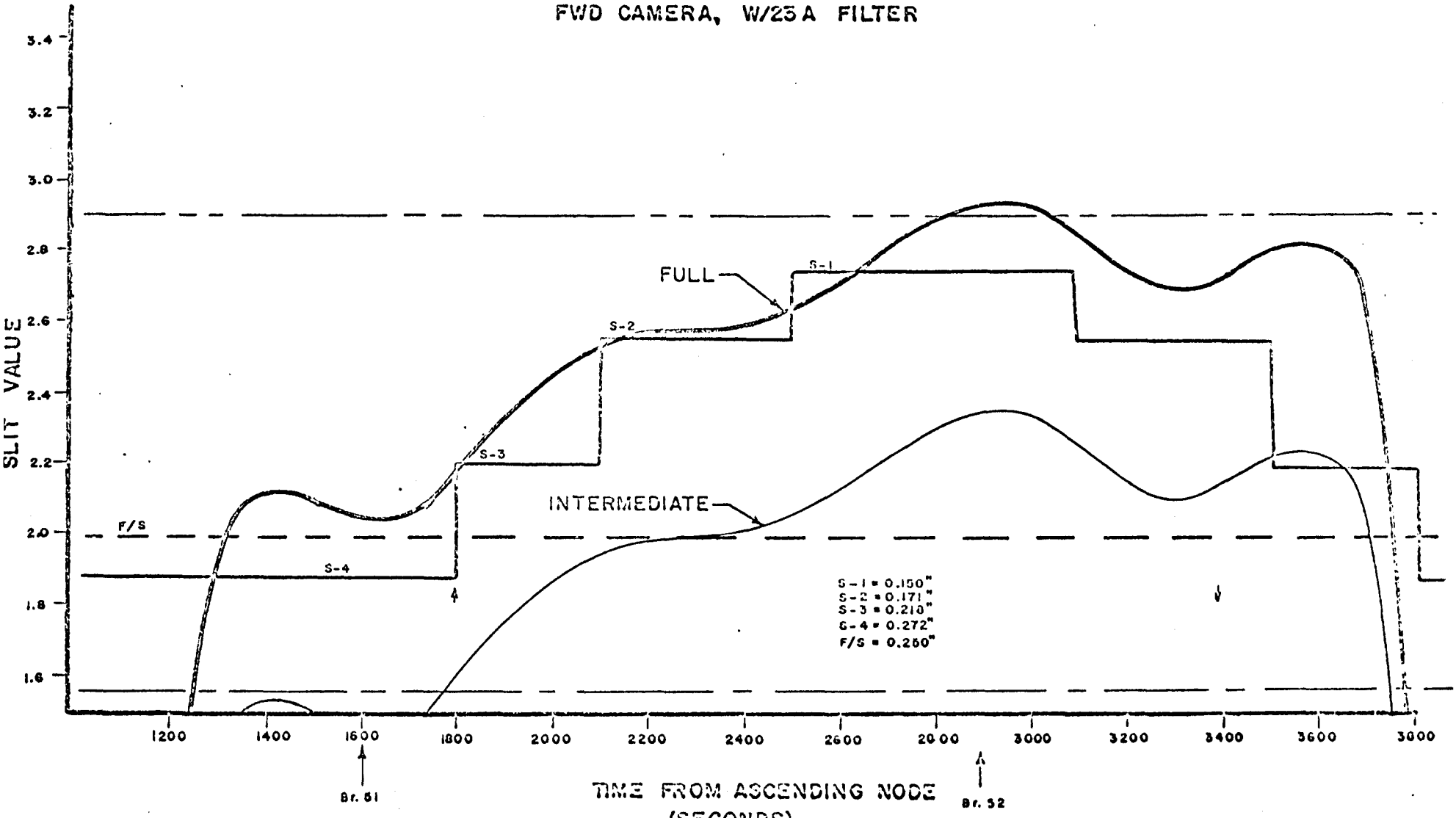
REPORTS

1. "Exposure Control" (ITEK)
2. "Filtration" (ITEK)
3. "DISIC use of SO 230" (NPIC)

[redacted]

CR-1 SLIT-WIDTH PROFILE

FWD CAMERA, W/25A FILTER

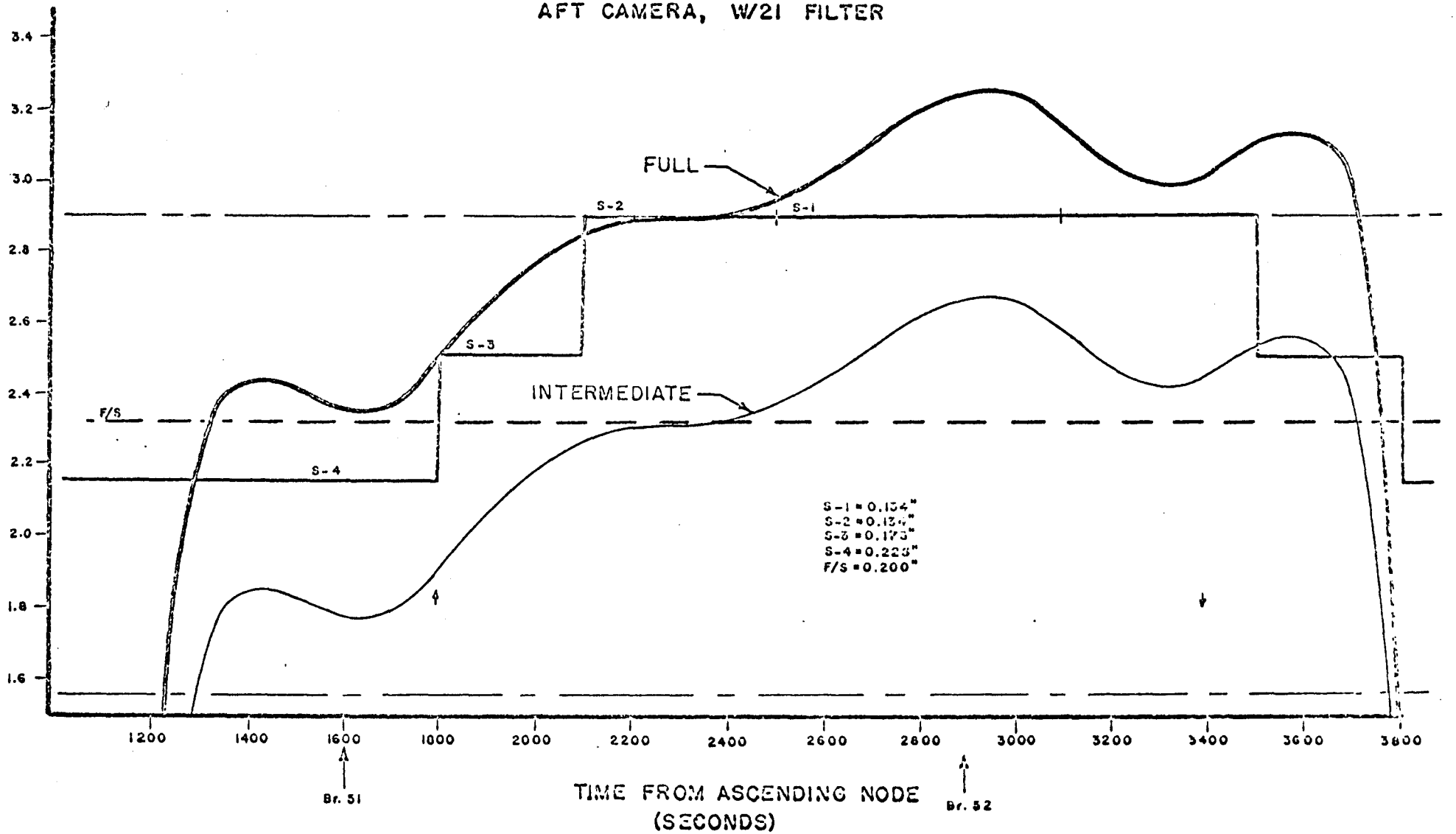


[redacted]

[redacted]

CR-1 SLIT-WIDTH PROFILE

AFT CAMERA, W/21 FILTER



[redacted]

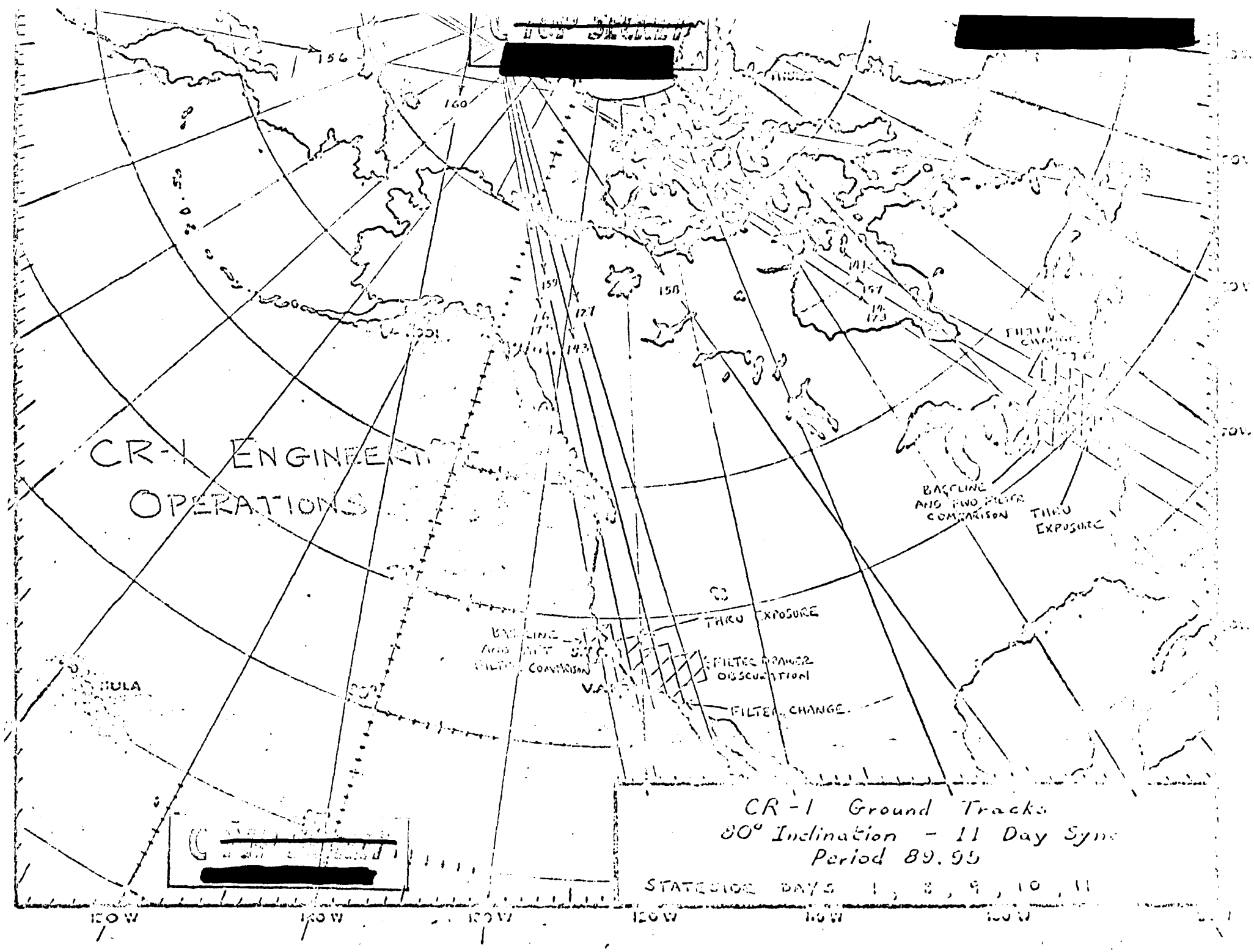
[redacted]

CR-1 PAN CAMERA

FILTER AND EXPOSURE PROGRAMMING

Day 1	Revs 14 & 16	Initial Baseline with nominal slit and filter (W23A /FWD/ and W21 /AFT/).
Day 8	Rev 127	Filter drawer obscuration test.
Day 9	Revs 141 & 143	Comparison of primary and alt filters with filter change during operation.
Day 10	Revs 157 & 159	Through exposure test using slit control.
Day 11	Rev 173	Final baseline alt filter in forward camera (W25) prime filter in AFT camera (W21).
Day 11	Rev 175	Final baseline primary filter in FWD camera (W23A) alt filter in AFT camera (W23A).
Day 13		Primary filters with fixed slit used with DISIC SO 230 film.
Day 14		Alternate filters with fixed slit used with DISIC SO 230 film.

All other operations will be with primary filters and exposure control unless otherwise requested by SOC.


CR-1 ENGINEERING
OPERATIONS
BASELINE AND FWD PRIOR COMPARISON
THRU EXPOSURE
FILTER CHANGE
CR-1 Ground Tracks
80° Inclination - 11 Day Sync
Period 89.95
STATION DAYS 1, 8, 9, 10, 11

[redacted]

CR-1 ENGINEERING EVALUATION

SUGGESTED CORN DEPLOYMENT

DAY	REV	LAT.	LONG.	LAT.	LONG.
1	14	43 00 N	78 35 W	40 20 N	78 55 W
		(Buffalo, N. Y.)		(Johnstown, Pa.)	
1	16	38 10 N	122 35 W	37 20 N	122 05 W
		(Hamilton AFB)		(Moffett NAS)	
8	127	36 20 N	144 45 W		
		(Nellis AFB)			
9	141	44 35 N	75 10 W	41 10 N	73 45 W
		(Canton, N.Y.)		(Westchester Co. Airport)	
9	143	37 25 N	117 15 W	33 50 N	117 30 W
		(Bishop, Calif.)		(March AFB)	
10	157	41 15 N	77 00 W	39 10 N	75 30 W
		(Williamsport, Pa.)		(Dover, AFS)	
10	159	37 55 N	121 15 W	34 55 N	120 25 W
		(Stockton, Calif.)		(Santa Maria, Calif.)	
11	173	43 00 N	78 35 W	40 20 N	78 55 W
11	175	38 10 N	122 35 W	37 20 N	122 05 W

[redacted]

DISIC - CR-1

Exposures Available - 1/500 sec.; 1/250 sec.

Exposure control programmed for days 1-12 with change at appx 20° solar elevation.

High resolution film evaluation on terrain camera requires 1/250 exposure. Experiment programmed for days 13 + 14. Mission duration of less than 12 days will result in under exposure of the SO 230 film.

Revs Programmed for DISIC SO 230.

Day 12	Revs 185 - 192
Day 13-14	Revs 201 - 224

[redacted]

CR-2 SYSTEM

GOALS

.Demonstrate operational effects of additive bicolor.

.Evaluate system performance using SO 230.

.Evaluate system performance using ITEK special filter.

FILM LOADING

Camera	Film (Footage)	Prime Filter	Alt Filter
FWD Looking	3404 (15000)	W/25	ISF
	SO 230 (1000)	W/25	ISF
AFT Looking	3404 (14500)	W/21	W/57
	SO 230 (1500)	W/21	W/57

REPORTS

1. "BICOLOR" (ITEK)
2. "SPECIAL FILTRATION" (ITEK)
3. Film Evaluation and Processing Report SO 230 [redacted]
4. System Response SO 230 (ITEK)
5. User Evaluation SO 230 (NPIC)

[redacted]

CR-3 SYSTEM

GOALS

- Evaluate system performance using SO-380 film, UTB.
- Determine effects of polarizing filters on satellite photography.
- Investigate possible image quality improvements by using polarizing filters at low solar elevations.

FILM LOADING

Camera	Film (Footage)	Prime Filter	Alt Filter
FWD Looking	3404 (15000)	W 25	Polarizer (HN 38)
	SO 380 (1500)	W 25	
AFT Looking	3404 (15000)	W 21	Polarizer (HN 38)
	SO 380 (1500)	W 21	

REPORTS

1. Polarizer Report (ITEK)
2. Film Evaluation and Processing Report SO 380 [redacted]
3. System Response SO 380 (ITEK)
4. User Evaluation SO 380 (NPIC)

[redacted]

CR-4 SYSTEM

GOALS

.Evaluate potential value of CORONA night photography.

.Evaluate system performance using SO-180 film.

.Determine usefulness of infrared color film (SO-180) for civilian and military applications.

FILM LOADING

Camera	Film (Footage)	Filter
Forward Looking	3404 (14000)	W/23A
	SO-180 (1600)	W/15 + W/96
AFT Looking	3404 (15300)	W 21
	SO 340 (400)	None

REPORTS

1. Night Photography (ITEK)
2. Infrared Color Photography (ITEK)
3. Film Evaluation and Processing Report SO 340 [redacted]
4. Film Evaluation and Processing Report SO 180

[redacted]

RELATED STUDIES

Low Gamma Processing

SO 230 Film for J-1 Useage

User PG Evaluations