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CORONA

[redacted]
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Ad Hoc Committee for J-3 Systems Capabilities
Minutes for Meeting #3
Date: 6 March 1968
Location: National Photographic Interpretation Center
Prepared by: [redacted]
Attendees: [redacted]

[redacted]--Bi-Color Summary

[redacted] A review of the entire bi-color history and test program was given by [redacted] The following is a summary of the briefing given the Committee:

Original Justification for Bi-Color

1. To produce high-resolution "color" using black and white film.

2. To produce color without interfering with the photointerpreters normal job.

3. Investigate multi (bi) spectral aspects; i.e. using two filters for spectral discrimination.

Work To Date

A summary of the work to date was given:

1. Several engineering operations were taken on CR-2 (1102). These used red (W/25) and green (SF-05) filters.

2. An attempt to photograph several nuclear facilities in the Western U.S. with mission 1102 was mostly unsuccessful due to the weather.

3. Several evaluation tasks were laid on various organizations to evaluate the bi-color use; namely:

a. NPIC to evaluate the PI quality of the green vs. red record.
b. ITEK to make the best bi-color prints possible.

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4. The results of these evaluations were as follows:

a. The NPIC evaluations were reported in [redacted]. Both objective and subjective analysis was performed. The major conclusion was, "The general conclusion of the photointerpreters is that the majority of the requirements levied on the J-3 system could be answered with photography generated in the bi-color mode because when used in stereo, the two records compliment each other. In addition, the over-all information content of the photography exposed through the green filter is comparable to an average J-1 mission."

b. ITEK showed several of their bi-color samples. These were all made from the orthoprinted dupes. This gives best registration. The samples were the best bi-color ever made from a panoramic camera.

5. The results of a Kodak study on uranyl nitrate reflectance was reviewed. This study was undertaken at the suggestion of OSI personnel who have an interest in the location of nuclear product facilities in the Sino-Soviet Bloc. Uranyl nitrate is a characteristic deposit. The results are attached (Attachment 1). These results indicated that for maximum spectral separation a blue, and red or orange filter would be best. [redacted] had ITEK look at this combination from the system performance aspect. In this regard, this combination is not acceptable due to a predicted performance of approximately 30 1/mm (high contrast). [redacted] then pointed out that it was possible that the OSI requirement could be answered by the original bi-color concept since the red/green filter combination would produce yellows as yellow.

Summary

[redacted] suggested three alternate conclusions that the Committee could recommend, namely:

a. More study is required on the bi-color technique.

b. More domestic tests are needed.

c. Bi-color is feasible and there is no technical or photo-interpreter reason why it cannot be done operationally.

After much discussion among the group, the Committee decided on conclusion (c) above; that is, that there is no technical reason why operational bi-color should not be taken if COMIREX so desires.

[redacted]-CR-3 Operations Plan

Filters Planned		Filter Factor
Forward looking	W-25 primary	3
	W-12 alternate	1 1/2
Aft looking	W-21 primary	2
	SF-05 alternate	2 1/2

1. Engineering Operation

Filter change from W-12 to W-25 with slit change from narrow to wider respectively

SF-05/W-25	4 ops (30 frames each)
Mono	2 ops (17 frames each)
	4 ops (12 frames each)

Mono operations were tested after mission termination on CR-1 and the end of the second bucket on CR-2. It appears that smear goes away about the 8th frame after mono start-up. Mono operations on CR-3 are to determine for certain the amount of film waste attributable to start-up smear.

Vehicle health checks are normally run every other day. Usually 12-15 frames are consumed by each check. The engineering operations listed above will replace health checks.

2. Estimated Engineering Film Usage

Preflight	100 frames
A bucket	137 frames
Health/Mono (60)	
W-12 to W-25 (60)	
SF-05 & W-25 (17)	
B bucket	137 frames
(Same distribution as A bucket)	

Considering thin base film, the percentage of film devoted to engineering is roughly 374/6150 = 6.1%. A 1500 ft. (per camera) tag on test strip of UTB will be flown on CR-3 and will raise the total footage slightly thereby reducing the percent above. Tebo is striving to keep engineering usage to about 5%;

therefore, minor modification to the engineering plan above may result.

Specific Engineering Targets for bi-color comparison are:

Primary--Kermac Nuclear Fuel Corporation, Grants, New Mexico.

Secondary--Climax Uranium Corporation, Grand Junction, Colorado.

[redacted]-Summary of SO-180 and SO-340 Corona Marking

Results of the chamber tests with QR-2 are summarized in Attachment 2.

Both SO-180 (IR) and SO-340 (High Speed Night) were marked very badly at internal camera pressures and at pressures less than one micron. The marking was edge to edge and continuous throughout the format.

There appeared to be a relatively free window at 20 microns on both materials. The width of this window has not yet been ascertained.

As the pressure approaches 160 microns, the corona level is significantly reduced, disappearing entirely on SO-180 and becoming very light on SO-340.

Discussion--Future Experiments

CR-3

The Committee recommends bi-color operations against specific requirements with two engineering targets for comparison. UTB has been fully tested to the satisfaction of AP and ITEK. Test strips of SO-380 (UTB) will be flown.

CR-4

A night test with SO-340 is presently planned. This may be changed to a 3400 sun line test pending the outcome of a 3400 test on [redacted] in March and the results of continued corona marking tests on SO-340.

A test strip of SO-180 is also scheduled. Test targets were discussed, but will await final selection until the next Committee meeting.

CR-5

Tentative plans are to fly a 500-foot test strip of SO-121 color on this mission. Kodachrome II will not be ready for the CR-5 flight.

Kodachrome II is still being evaluated as a Red Dot EKIT test. No machines are presently available to process 70 mm Kodachrome II. Also, it will take 6 to 8 months to get Kodachrome II on thin Estar base with pelloid backing. It is estimated that 12-15 months will be required to develop a processing capability. Until that time, 70 mm will be split and processed through the commercial 35 mm processors. A Kodachrome II test strip will be scheduled in about 8 months.

CR-6

[redacted] stated that the Shift Register is planned for CR-6; therefore, CR-8 was selected as the earliest time for a through focus test. CR-8 is scheduled to fly before CR-7.

For Revised Test Plan See Attachment 3.

[redacted]-Three Questions for Committee Consideration

1. Is it possible to cut selected portions of KH-4 mission material and to low gamma process it? [redacted] and Alkofer agreed that a test bed now in operation may be useable, but the jury rig used previously has been dismantled. Assuming that the test bed could be used only 100-150 feet could be handled at a time.

2. What is being done about a slower speed higher resolution 3404? Alkofer will check.

3. Would high resolution black and white IR be useful for crop analysis? Committee generally negative--would rather wait for SO-180 results.

The meeting was concluded with the following action items:

1. [redacted] will see if any development of half speed 3404 is underway.

2. [redacted] will determine status of the low gamma processing equipment.

3. [redacted] was asked by [redacted] to analyze the type 3400 film that is to be exposed on [redacted]. The purpose of the analysis is to determine the association of density recorded and ground illumination.

4. [redacted] was asked to accumulate information regarding the use of color film in the T-1 tracker camera. Since the scale of the tracker photography is close to that of the CORONA camera system, it is expected to lend insight to the usefulness of small scale color photography.

5. [redacted] will locate USIB document that specifies the priority of crop analysis.

6. [redacted] is to locate VELA Uniform reports.

Reviewed by: [redacted]

Minutes Approved: [redacted]
Chairman

Attachment 1 to
[redacted]

Dear [redacted]

We have made the practical test suggested by [redacted], using a number of filter combinations.

Unfortunately, it looks as if two filters above 500 mμ cannot be used because the differences in spectral reflectance are not great enough to discriminate with broad-band filters.

Nevertheless, it does look like the combination of a 47B+2E, used with either a 21 or a 25, will give good discrimination, even including the effects of the atmosphere. Our spectral model indicates that, for the haze which most frequently occurs, and the two records given an exposure such that high reflectance neutrals will be equal in density, the LogE separation between the 2E and 21 filter combination will still be about .15 units (a density difference of about .4).

The effect of varying degrees of haze will be less than we had originally expected, since the spectral reflectance of the uranyl nitrate in crystalline form is apparently higher below 500 mμ than the absorption spectra we looked at originally. We are enclosing the spectral reflectance values for the crystal sample we measured.

The filter factor for the 2E+47B combination is in excess of 10. However, practical tests indicate a factor of 8 is adequate to allow first-class data reduction. The exposure scale is so compressed that even a little less exposure would probably be possible. We will examine this problem a little more closely.

I am sending this information to [redacted] at your request. Should you have further questions, please contact me.

[redacted]

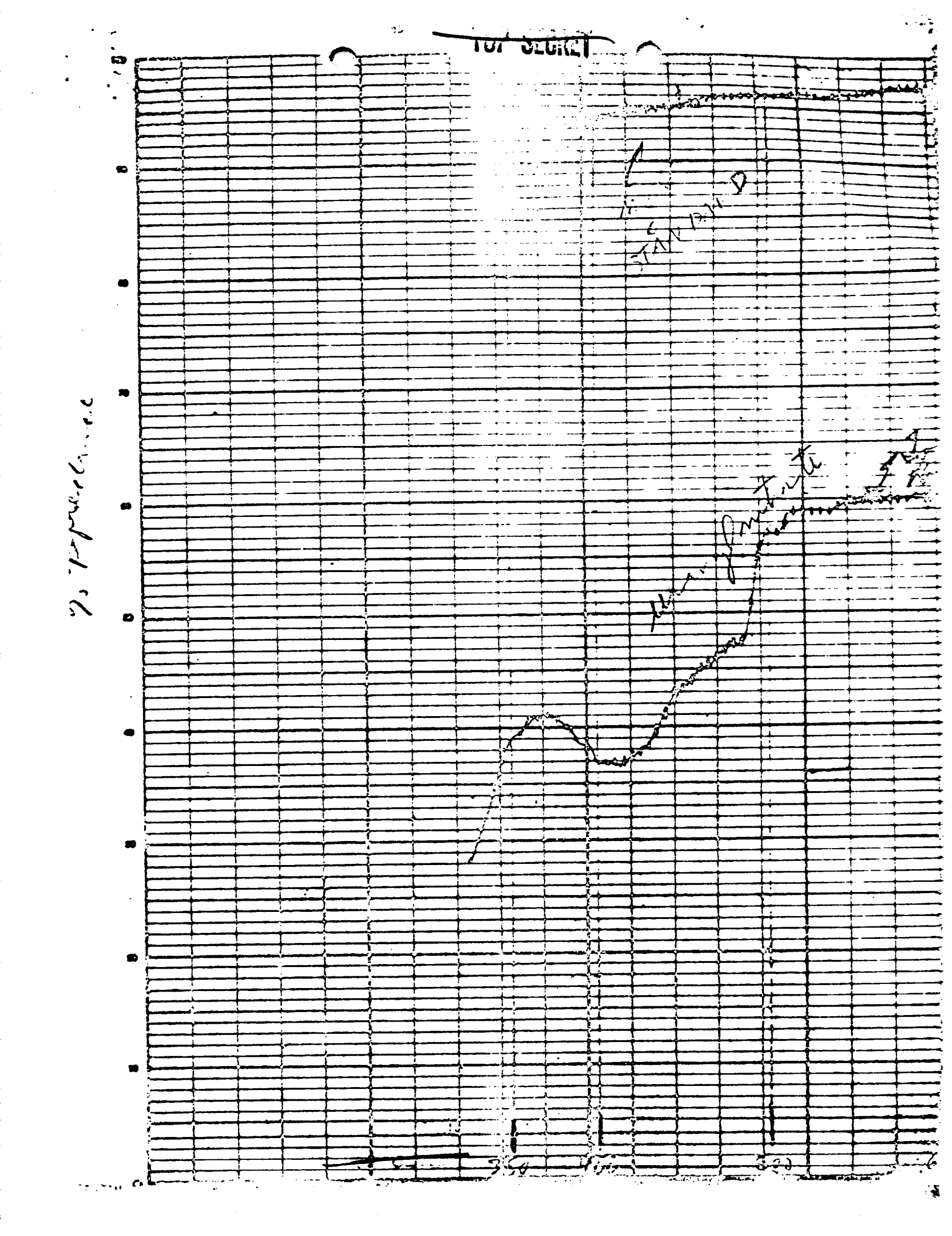
Encl.

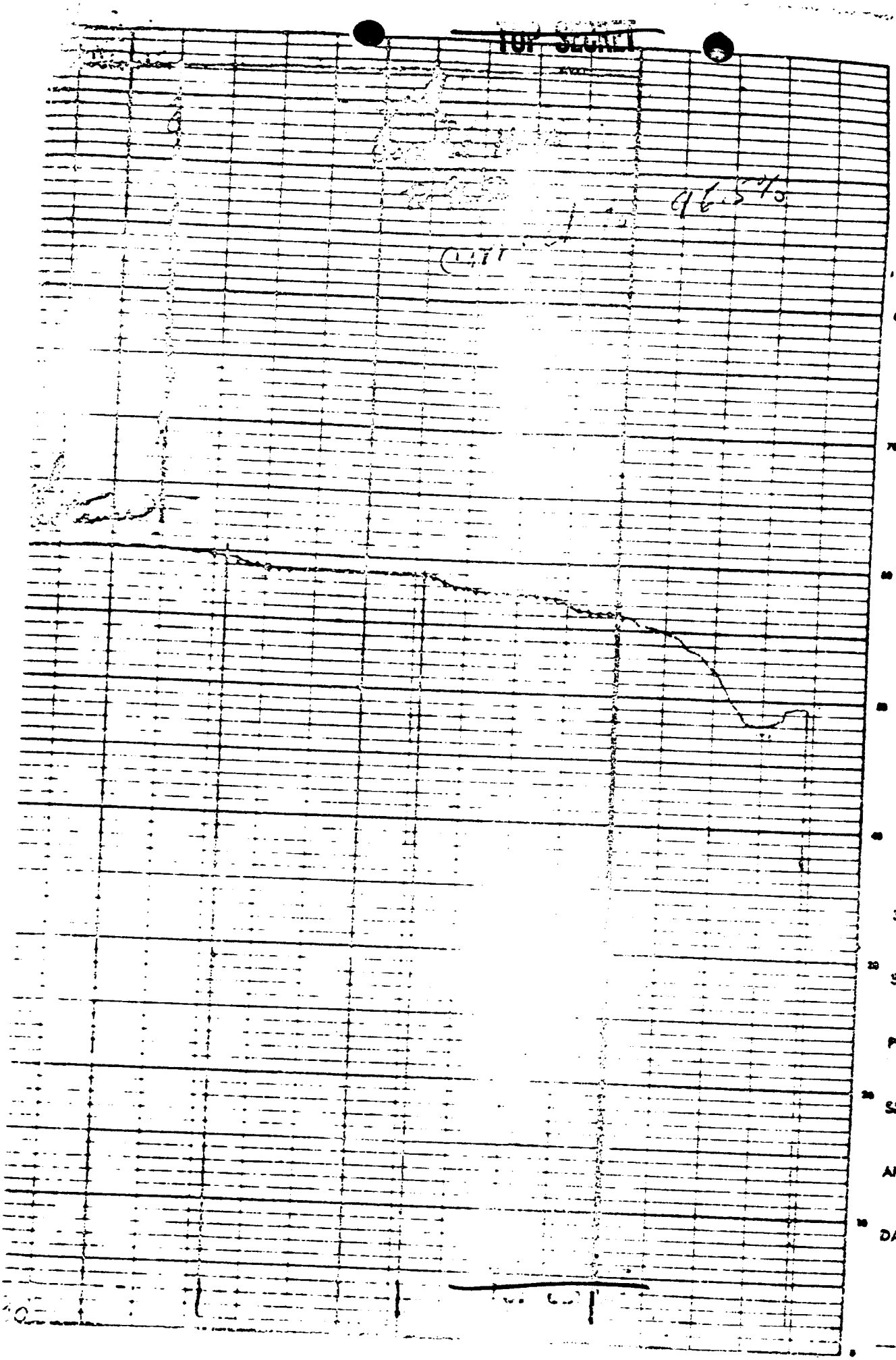
[redacted]

Uranyl Nitrate

REFL	VAL	350 →							900	
.425	.429	.442	.443	.445	.441	.433	.422	.415	.400	2613 REFL
.397	.396	.394	.394	.402	.404	.409	.422	.437	.454	REFL
.461	.467	.475	.477	.485	.492	.498	.498	.534	.584	REFL
.600	.598	.608	.618	.620	.621	.621	.620	.623	.625	REFL
.625	.625	.624	.624	.624	.623	.624	.626	.626	.628	REFL
.626	.625	.625	.625	.625	.625	.625	.624	.624	.624	REFL
.624	.624	.623	.623	.623	.623	.623	.623	.623	.623	REFL
.620	.619	.615	.615	.613	.612	.611	.611	.611	.611	REFL
.611	.611	.611	.611	.611	.611	.611	.611	.611	.611	REFL
.609	.609	.603	.600	.600	.600	.598	.598	.598	.597	REFL
.597	.596	.595	.595	.592	.585	.584	.582	.582	.581	REFL
.581										REFL

Reflectance values are corrected for the Mg O standard - they run horizontally fr
350 mu to 900 mu in increments of 5mu.




TOP SCALE
SAMPLE
INST. No. IR4
EXCITATION
EMITTANCE
REF.
SCALE
SENS.
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SLIT
ANALYST
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TEST No.

Attachment 2 to

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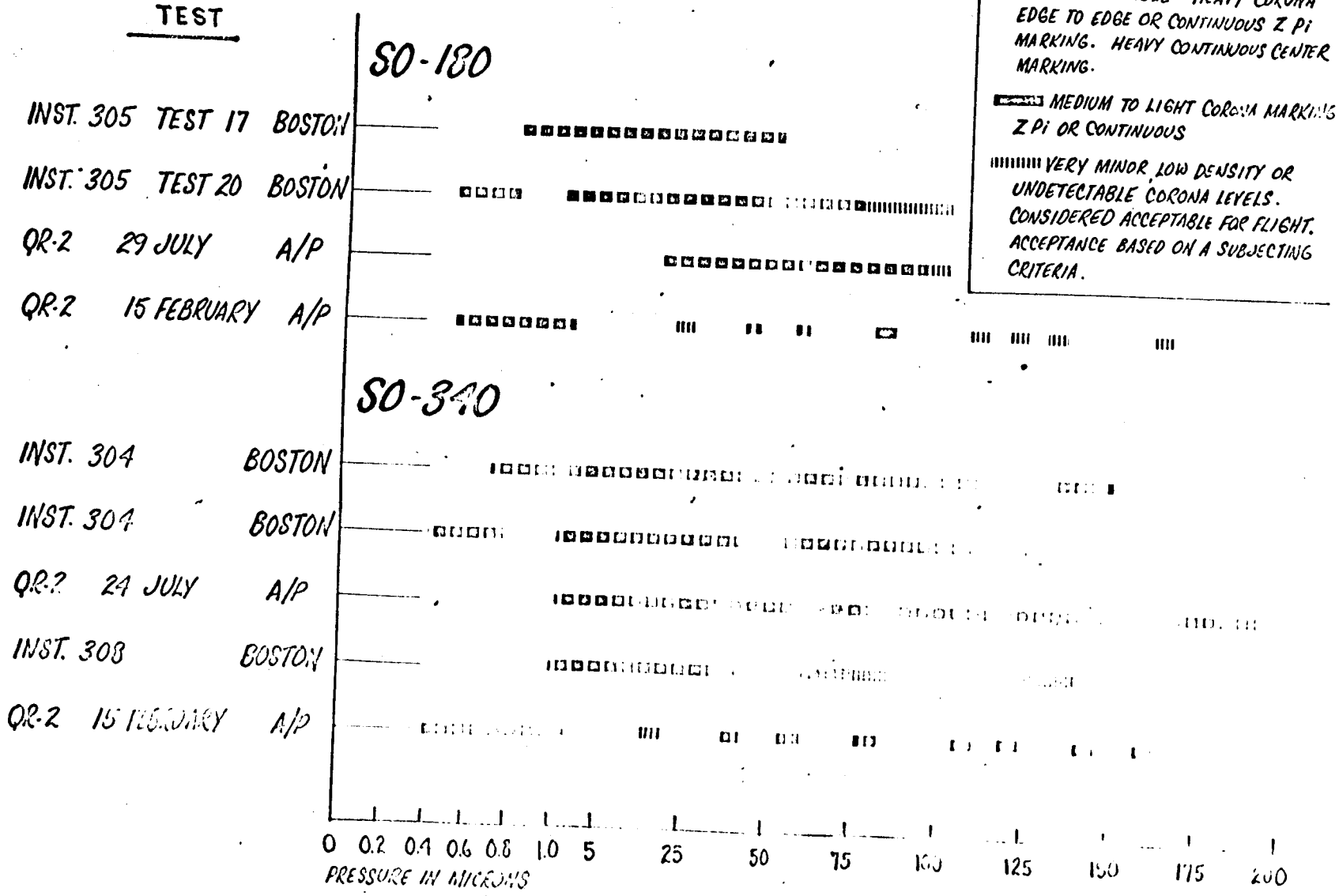
SUMMARY OF SO-180 & SO-340 CORONA MARKING



CURRENT PLANS FOR SYSTEMS CAPABILITY EFFORT
6 MARCH 1968

FLIGHT	TEST	DESCRIPTION
CR-1	FILTER EXPOSURE	21, 23A, 25 1-1/3 STOP RANGE; DENSITY COMPARISON
CR-2	BISPECTRAL POLARIZER SO-230	W/25 + SF-05 POLOCOAT, 20° ANGLE "FASTER" 3404 TYPE FILM
CR-3	BISPECTRAL WIDE BAND FILTER SO-380	W/25 + SF-05, OPERATIONAL WRATTEN NO. 12 ULTRA THIN BASE FILM
CR-4	SO-180 SO-340*	COLOR INFRARED FILM NIGHT (TRI-X EMULSION)

TENTATIVE

CR-5	SO-121	COLOR
CR-6	POLARIZER	WINTER, PROPER AXIMUTH
CR-8**	THROUGH FOCUS	STEPPED GLASS FILTER

*3400 SUN LINE TEST MAY BE SUBSTITUTED.

**CR-8 SCHEDULED AHEAD OF CR-7

1. FILTER EVALUATION

- BASIC OBJECTIVE: SEE WHAT DIFFERENCES OCCUR IN OPERATIONAL PHOTOGRAPHY WITH THE WRATTEN NO. 12, 21, 23A, AND 25 FILTERS

A. SUBJECTIVE EVALUATION

B. MTF ANALYSIS OF IMAGE QUALITY

C. TRADEOFF BETWEEN EXPOSURE TIME AND ATMOSPHERI

2. EXPOSURE ANALYSIS

- BASIC OBJECTIVE: DETERMINE:

1. IF SLIT CHANGED PROPERLY
2. IF WE EXPOSE PROPERLY
3. COMPARISON BETWEEN TARGETS AND TERRAIN DENSITIES

A. SUBJECTIVE EVALUATION

B. DENSITY VERSUS FREQUENCY ANALYSIS

C. EXPOSURE ANALYSIS WITH HIGH PRIORITY TARGETS

D. COMPARISON OF TARGETS AND TERRAIN DENSITIES

3. BISPECTRAL PHOTOGRAPHY

- BASIC OBJECTIVE: TEST THE OPERATIONAL FEASIBILITY OF OBTAINING BISPECTRAL PHOTOGRAPHY FROM MISSION PHOTOGRAPHY

A. SUBJECTIVE ANALYSIS OF TARGETS WITH RESPECT TO TONAL DIFFERENCES, (NPIC)

B. OBTAIN GOOD BISPECTRAL PRINTS

C. IMAGE QUALITY ANALYSIS OF SF-05 IMAGERY

D. TEST BEST METHOD OF OBTAINING BISPECTRAL IMAGES

4. POLARIZER FILTER

- BASIC OBJECTIVE: DETERMINE THE EFFECTIVENESS OF A POLARIZER AS A HAZE-CUTTING FILTER

  A. IMAGE QUALITY ANALYSIS

  B. ATMOSPHERIC EFFECTS AS A FUNCTION OF SOLAR ALTITUDE AND AZIMUTH

  C. DETERMINE EFFECTIVE FILTER FACTOR

  D. SUBJECTIVE ANALYSIS OF TONAL RENDITION

5. SO-230

- BASIC OBJECTIVE: COMPARE SO-230 WITH 3404 IN AN OPERATIONAL MISSION

  A. FILM SENSITOMETRIC CHARACTERISTICS (FOG, GAMMA, SPEED, FILTER FACTORS)

  B. FILM IMAGE QUALITY ANALYSIS (MTF, RESOLUTION)

  C. SUBJECTIVE EVALUATION OF FLIGHT FILM

  D. SYSTEM RESOLUTION

  E. TONE REPRODUCTION COMPARISON

6. SO-380

- BASIC OBJECTIVE: TEST SO-380 IN THE SYSTEM

  A. FILM SENSITOMETRIC CHARACTERISTICS (FOG, GAMMA, SPEED, FILTER FACTORS)

  B. FILM IMAGE QUALITY ANALYSIS (MTF, RESOLUTION)

  C. SUBJECTIVE EVALUATION OF FLIGHT FILM

  D. SYSTEM RESOLUTION (MTF/AIM)

  E. LAB CHAMBER TESTS

  F. LIMITED DIMENSIONAL STABILITY ANALYSIS

7. SO-180

- BASIC OBJECTIVE: OBTAIN MISSION PHOTOGRAPHY WITH CAMOUFLAGE COLOR FILM
  - A. SUBJECTIVE ANALYSIS OF INFORMATION CONTENT
  - B. TONE REPRODUCTION ANALYSIS
  - C. RELATIVE IMAGE QUALITY (RESOLUTION, MICROPHOTOGRAPHS)

8. NIGHT PHOTOGRAPHY

- BASIC OBJECTIVE: DETERMINE IF ACTIVITY CAN BE DETECTED AT NIGHT
  - A. SUBJECTIVE ANALYSIS
  - B. STATIC ANALYSIS
  - C. THEORETICAL ANALYSIS OF NIGHT DETECTION CAPABILITY