EXRAND-D-31

10 DEC 1970

MEMORANDUM FOR: Chairman, COMIREX

SUBJECT : National Imagery Exploitation Research and Development Objectives

REFERENCE : a. COMIREX-D-31.1/1, 26 April 1968
b. COMIREX-D-31.1/2 Tab B, 10 September 1968

1. The Exploitation Research and Development Subcommittee of COMIREX has recently completed the revised EXRAND Objectives for Research and Development which are attached for COMIREX approval and community distribution.

2. The EXRAND Objectives have now been completely staffed through elements of the agencies represented on EXRAND. It is an updated work which will be reviewed annually by EXRAND members. A special Technical Task Team appointed by EXRAND has also reviewed and contributed to these Objectives. The attached Objectives supersede those which were written in 1968 and forwarded to the community by Reference A.

3. The EXRAND representatives are unanimous in recommending that these Objectives receive wide distribution within the exploitation community and that they be used wherever they can be of value; for example, the Objectives can be used as a basis for defining requirements or in preparing an organization's R&D projects list and also for guidance in preparing R&D budgets for the decade of the 1970's. Note that the Objectives look to the future and provide for the 1970-1980 time period.

4. These Objectives, along with the EXRAND Third Annual Report: "Consolidated R&D Projects FY-71 and FY-72", will provide valuable documents for use of the entire exploitation community.

5. Reference B provided definitions and rationale for use in assigning priorities to EXRAND Objectives. This definitions paper generally is still valid although it needs updating to include color materials and VHR/UHR.

6. Forty copies of the attachment are provided for distribution.

[redacted]

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Colonel, USAF
Chairman, EXRAND

Attachment:
As Stated (40 cys)

7 December 1970

PROPOSED
NATIONAL IMAGERY EXPLOITATION RESEARCH AND
DEVELOPMENT OBJECTIVES

A. General Objective

1. Under the provisions of DCID 1/13, the Exploitation Research and Development Subcommittee (EXRAND) of the USIB Committee on Imagery Requirements and Exploitation (COMIREX) has prepared this Objectives Document for the 1970-1980 time period to unify and guide the Research and Development activities of those facilities participating in the National Tasking Plan.

2. The intelligence community must insure that the cost of supplying the information needed to support National policy decisions is held to a minimum. This creates a situation with many potential tradeoffs between accuracy, speed, completeness, need, capability and cost. Exploitation efficiency is the key to the appropriate mix of these elements. Within this objective, the following principles must be directly addressed in exploitation R&D plans:

a. Accuracy and reliability near one-hundred percent.

b. Speed of response equal or faster than the collection time.

c. Completeness sufficient to answer all reconnaissance EEI's.

d. Clear understanding of man-machine relationships in visual perception and in the extraction of information from imagery [redacted]

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B. Specific Objectives

1. High Volume, Large-Scale Imagery Exploitation

a. Objective: Develop imagery exploitation techniques and related equipment which will provide an efficient and timely capability for exploiting great volumes of large-scale imagery which will result from future long focal-length, narrow viewing-angle collection systems.

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b. Rationale: The developers of future collection systems have indicated that the trend in improving reconnaissance systems will continue in a direction which will produce large volumes of relatively large scale imagery having very high ground resolution. The result of this trend is that the volume of imagery to be exploited will increase in direct proportion to the increases in focal length and the reduction in the angle of view. These huge quantities of large-scale imagery present severe problems to efficient, timely exploitation processes. Thus, it will be necessary to develop significantly new approaches to exploitation techniques, including the automation of major portions of the tasks involved, if any reasonable available force of image interpreters is to be able to exploit these large volumes of imagery in an efficient and timely manner.

2. National Multispectral Information Data Base

a. Objective: To develop and maintain an advanced integrated multispectral data base system to support the production of a timely, accurate, collated finished intelligence product at the national and departmental levels throughout the 1970's.

b. Rationale: Substantial improvement in the timeliness and efficiency in the future imagery exploitation system requires real-time accessibility to both data and multispectral imagery-retrieval records to insure effective exploitation support of national and departmental needs.

3. Duplicating Equipment and Emulsions

a. Objective: To provide easy to use duplicating materials and related equipment.

(1) Continue development of film emulsions with emphasis on reversal materials with quality of image recording equal to or better than emulsions in use today.

(2) Develop duplication equipment for use at the imagery exploitation station. This equipment must be capable of producing film or paper reproductions at contact or enlarged scale from the original. Equipment must be designed for ease of operation by the image interpreter to permit rapid selection and reproduction of selected imagery and reduce material handling problems.

(3) Develop non-silver duplicating media for all major aspects of image duplication including line and continuous tone. This material must be equal in performance to silver materials and less costly to utilize. Dry processing is an important collateral objective.

b. Rationale: The conventional silver halide continuous-tone reproduction process, now universally used, requires considerable time, cost, specialized manpower, complex equipment, and extensive logistical support. Prior and current R&D studies directed toward the development of a rapid-access, dry photographic material have produced emulsions with very high resolutions and require only heat for development. This development produces positive images from negative, and vice versa. Studies indicate that a practical reversal reproduction system can be developed which can produce an image with the same polarity as that of the original.

4. Exploitation of Imagery in Both Selected Area and Roll Form

a. Objective: Develop systems to produce and utilize Selected Area Duplicates (SAD) and Selected Target Prints (STP) either in composite rolls or separate pieces of cut film (chips).

b. Rationale: The vastly increased volumes of film programmed for new acquisition systems indicate that some changes in the initial duplication process must be made. Such changes will doubtless limit total reproduction copies for search and evaluation purposes and provide selective copies for surveillance read-out which are keyed to areas of responsibility and/or specific targets. These limited reproductions may be in composite rolls or specific cut film (chip) forms. Thus, the R&D effort must provide adequate techniques and equipment for the most efficient production and use of both chips and roll film. The very circumstances of when and how best to utilize each of these imagery forms must be investigated. Roll film may maintain a position of importance in initial screening, scanning, and in the early phases of exploitation; if so, then the techniques and equipment for producing, viewing, handling and storing it must be improved and further automated. The place of chips as a reference material appears to be assured, thus, the processes of rapidly and efficiently producing

medium quality chips, storing and retrieving them, and displaying them for comparative use in relation to other imagery must be improved and automated. If high quality, exploitation type chips are to find a place in improving and increasing efficiency of detailed analysis, breakthroughs in the technology of reproducing imagery without loss and in a reasonably efficient manner must be made. It appears that the best possibilities for improving efficiency and timeliness in image exploitation lie in significant improvements in the interrelated use of all of these types of imagery records. It also appears that, regardless of the final size of chips which result from the R&D Program, the CODIB concept of proportionality should receive serious consideration.

5. Target Change Detection

a. Objective: Develop devices and techniques which will assist the imagery analyst in detecting significant changes to a target which has been photographed repeatedly.

b. Rationale: The increasing volume of reconnaissance materials demands an acceleration in the exploitation process. One means of acceleration is to provide the imagery analyst with semi-automatic aids which will assist him by performing routine, redundant, and time consuming tasks such as the detection of changes to a previously interpreted target.

6. Semi-Automatic Reporting

a. Objective: Develop an effective and efficient interface with the National Base of Imagery Derived Information (NBIDI) for use by the image interpreter.

b. Rationale: Imagery, line drawings and sketches will be included in third phase reporting into the NBIDI. Formats and information content for third phase reporting are now being developed by the Exploitation Subcommittee and National Imagery Data Base Working Group. These formats will be designed primarily to be human-readable but they will also be, to the extent practical, machine-processable for reporting through computer-based files. Effective interface with the NBIDI by the image interpreter for inputs must be provided.

7. Near Real-Time Data Extraction System

a. Objective: The objective is to provide the equipment and techniques for a near real-time exploita-

tion to efficiently and accurately exploit near real-time imagery inputs in the 1970's.

b. Rationale: The potential uses of near real-time imagery acquisition, transmission and delivery dictate the need for major automation efforts to achieve increased imagery exploitation efficiency in all phases of the future operational exploitation process.

8. Image Manipulation and Transmission

a. Objective: Develop devices and techniques which will fully exploit target signature transmissions, including manipulation of the electronic signals.

(1) Development of recorder-processor viewer (RPV) with ultra-high resolution output.
(2) Development of equipment to manipulate and analyze the electronic target signature data.
(3) Development of broad band, high frequency (200-500 megahertz) recording devices.

b. Rationale : Future reconnaissance systems which are now in the planning stage are being designed to utilize electro-optical systems with real-time or near real-time transmission of target signature data to the reconnaissance interpretation facility. Real-time or near real-time transmission of electronic signals will insure immediate availability of intelligence data for Cold War crisis management. Since the target data will be transmitted in an electrical form, considerable information of intelligence value may be gained by electrically manipulating the signals to enhance and identify the target signature data.

9. Multi-Spectral Exploitation

a. Objective: Develop the equipment and techniques needed to fully exploit the spectral signature of targets. Exploratory and advanced development efforts are required to produce equipment for use in the 1970's to give the necessary capabilities to fully exploit the multi-spectral imagery.

b. Rationale: High-altitude reconnaissance has used silver halide photography almost exclusively to record spatial image variations. However, this photography produces imagery that represents radiance fluctuations as averaged in the emulsion over a wide wavelength band. Such photography ignores a characteristic of the

object that may contain as much information as the spatial and tonal variations--its spectral reflectance or emission. Multi-spectral collection and exploitation techniques may make it possible to detect and identify objects that may otherwise go unnoticed.

10. Coding Imagery

a. Objective: To devise a system and recommend techniques and procedures to allow machine correlation between various imagery records and ground coordinates.

b. Rationale: The speed and accuracy of first and second phase exploitation may be increased through the use of a technique to provide rapid correlation of different imagery records with each other and with ground and map coordinates. This coding system may be utilized to correlate Inertial Navigation Systems, previous coverage, ephemeris data, magnetic tape recording, Elint data and other sensors.

11. Film Base Reclamation, Silver Recovery, and Pollution Control

a. Objective: Develop or select efficient, standard, pollution-controlled systems for the disposal of large volumes of classified photographic film materials, the reclamation of the film base and the recovery of silver from the film emulsion. (NOTE: Developments of non-silver photographic systems are applicable to this objective.)

b. Rationale: U.S. intelligence collection systems produce an increasingly high volume of imagery which is normally duplicated in multiple copies on materials having estar polyester, cellulose acetate butyrate, or triacetate bases. When this imagery becomes obsolete or further storage is impractical due to space limitations, the residual materials must be reclaimed in a manner which eliminates any chance of security compromise. Existing disposal devices and techniques are considered to be inefficient and, in general, lack capability to recover silver from the film emulsion.

12. Mensuration

a. Objective: Develop equipment and procedures for imagery measurement to accommodate projected imagery collection systems with emphasis on speed and simplicity of operation.

b. Rationale: Mensuration, at all levels of accuracy, is an integral part of interpretation and should be per-

formed by both the Image Interpreter and Photogrammetrist. Routine measurements for identification and analysis are a necessary part of the inductive reasoning process performed by the interpreter, while measurements for reeports having calculated statistical accuracies must be derived by specialists in mensuration.

13. Stereo Viewing

a. Objective: Develop display device suitable for viewing large quantities of black and white and color stereo imagery, in a wide range of formats and scales, and capable of accommodating the distortions inherent in projected collection systems. Emphasis should be placed on optical efficiency and simplicity and reliability of operation.

b. Rationale: Stereo viewing is vital to imagery interpretation and mensuration. Complex or "busy" images, such as camouflaged targets, industrial plants, construction sites, etc., benefit most from stereo viewing but most targets can be analyzed and identified satisfactorily through perspective and shadow relationships in a monocular mode. The real need, therefore, is to have a stereo viewing capability which can be quickly brought into use when monocular relationships in the image fail to form accurate spatial relationships in the mind of the interpreter. Accurate vertical measurements, of course, require conjugate stereo images and mensuration viewers in order to perform the necessary geometric solutions.

14. Imagery Evaluation

a. Objective: To develop procedures and techniques for systematic evaluation of image quality resulting from operational reconnaissance missions, using both subjective and objective methods, and including dissemination to appropriate collection and exploitation activities.

b. Rationale: Monitoring the performance of active camera systems, particularly when new or recently modified, requires a periodic analysis of operational imagery and subsequent feed-back to system designers. This applies to both reconnaissance satellite and airborne collection systems. Systematic analysis of the resulting imagery can also be used to evaluate the performance of the collection platform as well as the camera system. The evaluation results are also of value to the image interpreter as a measure of the potential information content of a given image. Considerable research must

be accomplished to develop objective and subjective techniques which are capable of analyzing the various factors affecting image quality. Such techniques must be sensitive to changing conditions throughout a mission. Specialized equipment must also be developed, to support the various image evaluation techniques, such as micro-densitometers, comparators, and special viewing equipment.

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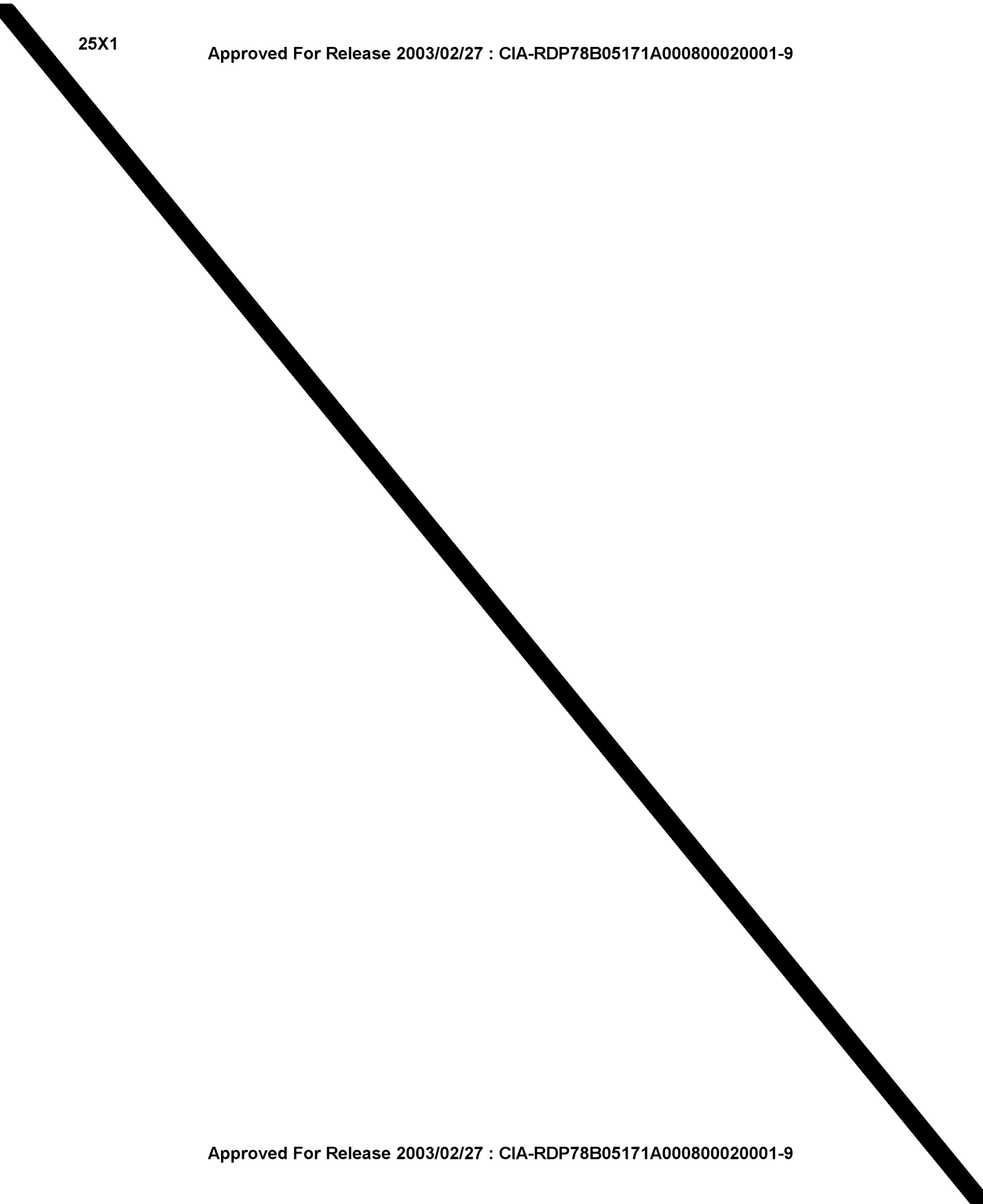

Approved For Release 2003/02/27 : CIA-RDP78B05171A000800020001-9

Attachment 1
EXRAND-M-38

Special Briefing -- 18 November 1970

Future Color Materials Projects -- Exploitation R&D

Why do we have a Research and Development Color Program???

R&D in NPIC has two major responsibilities:

a. To provide hardware and techniques for use today

b. To anticipate the questions that need to be answered to build hardware for use tomorrow

What are some of these questions???

- Is the IEG copy of the color dupe the same color as the IAS copy?
- Why do I see this red tone better through this microscope?
- How long can I leave this ON in the enlarger without fading the dyes?
- How do I design a comparator to get good measurements on color film?
- How am I going to match the color on the DP with an opaque Munsell chip?
- What ground resolution in color does this camera system give us?
- How does PI performance in color differ from black and white?
- Why aren't the lab prints the same color as I see on the film?
- What targets do you want flown in color?
- What kind of eye testing do you want done on PI applicants?
- What type of light source do you want to specify for light tables?

- How do you get an MTF for color film? What does it mean?
- How many colors does the PI have to be able to discriminate?
- If the original is shifted in color balance, how do you want the duplicate processed?

To answer and anticipate other questions of this type, we have an R&D program.

We began in FY-70 with some basics to start to define the problem:

STANDARDS	Calibration of APSD color Micro-densitometer
	Specification of standards for color image quality
	Standard color vocabulary
TRAINING	Defining training needs
MENSURATION	Evaluation of present mensuration systems for color
	Study of film stability during mensuration

The present status of the 1971 program is shown on the following graphic. These programs are in a dynamic status and are modified and updated frequently. Tentative levels of effort for FY-72 are shown for those projects in the FY-71 plan but do not represent the entire FY-72 effort.

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FY-1971 COLOR PROGRAM

HUMAN FACTORS

Color Imagery Interpretation Performance Analysis
Color Training Program Development (continued)
Subjective Color Image Quality Assessment Study
Color Imagery Intelligence Value Study

IMAGE ANALYSIS

Color Image Quality Evaluation System Development

IMAGE INTERPRETATION INSTRUMENTS AND TECHNIQUES

Color Control Cell Development
Color Imagery Interpretation Instrumentation Study
Microscope Colorimeter Development
Development of Laboratory Controlled Imagery

REPRODUCTION

Dry Processed Color Reproduction Material Development
Film Color Stability Study
Color Densitometer Development
Color Technology Implementation

TEST AND EVALUATION

Color Photo Reproduction Analyzer Development
Colorimetric Target Development

SECRET

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CRITERIA USED TO SELECT THOSE COLOR SYSTEMS THAT MIGHT BE USED FOR A COLOR VOCABULARY

- How would the color of a target by designated in this color system?
- Can this color designation system by used in its present form for both color prints and transparencies?
- Is this a continuous or a discrete color designation system?
- Can the color of a target by measured or designated independently of the areas surrounding it?
- Do adequate standards exist for this color system and can they be maintained in the typical laboratory?
- How are differences in color determined and specified in this color system?
- Are the color designations in this color system independent of the viewer and the viewing conditions he used?
- Can the color designations in this system be transformed to other color systems?
- Would the Sponsor be required to use specialized and complex equipment if this color system were selected?
- Can the source or target conditions be inferred by inverting the color designation in this color system?
- Can an area averaged color be measured or designated by using this color system?
- Is there a relationship between this color system and color vision?
- Can target signatures be catalogued according to the color designations generated by this color system?
- How much difficulty would be experienced by the members of the Sponsor's staff in learning to use this color system?
- How many different organizations and professions presently use this color system?

- Can all of the potential colors that would be recorded on the film be designated by this color system?

- How would the color designation of a target be made or determined?

EXRAND-A-39
8 December 1970

EXPLOITATION RESEARCH AND DEVELOPMENT AGENDA

PLACE: NRTSC Conference Room
Suitland, Maryland

TIME: 0900

DATE : Wednesday, 16 December 1970

THIRTY-NINTH MEETING

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1. Welcome. [redacted] USN, Host to EXRAND

2. Special Briefing.

   NRTSC's Digital Image Processing

3. Approval of Minutes.

4. Announcements.

   a. Presentations to COMIREX -- [redacted] 25X1
   b. End of Year report -- [redacted] 25X1
   c. Comments from members

5. Old Business.

   a. Report by Chairman, Technical Task Team
   b. Report by Chairman, Procurement Coordinating Team
   c. Tabling by members of recommended items for CY 1971 EXRAND program.

6. Tour of NRTSC.

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7. [redacted] Christmas Message.

8. Adjourn for 1970: Success to EXRAND 1971!

[redacted] 25X1

Executive Secretary, EXRAND