DRAFT

25X1

Given to [redacted] as recommended R&D cover memo to 5 year plan 9 DEC 1969

The R&D program must provide the techniques and equipment which will allow NPIC to meet its exploitation obligations in an efficient and timely manner. These obligations are ever-changing because of changing targets and report requirements being levied upon the existing reconnaissance systems and the advent of new systems such as the [redacted] 25X1

The challenge of the R&D effort is to provide technology and equipment inventory to allow NPIC to meet these obligations without a substantial increase in manpower and facilities. The objectives of the attached five-year R&D plan can be described briefly as follows:

a. To insure Center capacity to efficiently handle, process, copy, store and retrieve imagery materials both for present and future systems.

b. To find ways to make the imagery interpretation process more efficient, less costly and speedier without avoiding drugery and tedium.

c. To develop equipment procedures to extract maximum detail from imagery.

d. To preform the necessary investigations to push state-of-the-art in fields directly related to imagery exploitation and procedures.

3 December 1969
4 December 1969 (R-1)
RED Draft

1. OVERHEAD PHOTOGRAPHY/IMAGERY INTERPRETATION PROCESS RESEARCH

A. Program Objective (FY-69/76). To develop the capability to define, evaluate, optimize and augment the imagery interpretation process.

Rationale. The Center's image interpretation and photogrammetric processes, and consequently its basic mission, are fundamentally dependent on the unique visual, perceptual and cognitive capabilities and limitations of its human resources. Objective definition and evaluation of these processes will enable more appropriate and effective management decisions concerning both R&D and operational programs as they relate to changes in requirements, imagery systems, exploitation equipment, procedures and organization. A prime example of the function of this information is in the identification of those areas where automation will provide significant improvements in operational efficiency--another is in the definition of the intelligence yield of the interpretation process on new imaging systems such as [redacted] 25X1

25X1 [redacted]

1. Data Base Objective (FY-69/76). Establish and maintain a data base of the skills of the Center's imagery exploitation personnel.

Rationale. This data base is required to judiciously determine and implement necessary improvements in the exploitation process of present (conventional) imagery, and to plan for the effective exploitation of future imagery systems.

2. Automation Objective (FY-71/76). Identify potential applications of automated and semi-automated exploitation systems.

Rationale. A thorough understanding of the human exploitation processes will provide information which can be applied to the development of machine capabilities to augment productivity in the face of increasingly greater demands for services.

3. Image Quality Assessment Objective (FY-69/76). Develop psychophysical procedures for assessing image quality.

Rationale. There is a continuing need to establish the psychophysical relations between current and future imaging systems in order to optimize the design of acquisition and display systems.

4. Equipment Design Objective (FY-69/76). Develop and promote application of human factors state-of-the-art principles to the design of photoexploitation equipments.

Rationale. The limitations and capabilities of the Center's human resources must be considered in the design specifications of exploitation hardware in order to effect maximum system performance.

B. Program Progress.

1. Data Base.

a. A series of photo interpretation and photogrammetry performance measures were developed and/or administered during FY-1969 to establish a frame of reference for future evaluations of the significance of changes in equipment and/or procedures.

b. A statistically significant improvement in general target search was shown to have occurred from 1967 to 1969, which verified the significance of an organizational change.

c. Twelve weeks of training for novice photo interpreters in the Offutt Defense Sensor Interpretation and Applications Training Program were found to be roughtly equivalent to 2½ years of on-the-job experience for photo interpretation reasoning ability. This resulted in a decision to send all new PI recruits to this training program.

d. Mensuration accuracy statements were refined by means of an intensive statistical analysis of operational research data--providing the first definitive accuracy evaluation statement in association with NPIC official dimensional reports.

e. A preliminary validation of an Agency administered PI selection battery to be used in evaluating PI applicants will be completed early in 1970.

f. A PI target knowledge inventory will be completed by early 1970. A cross section of targets typically read out by area specialists were selected as test items in an evaluation of identification performance. Results will indicate which type targets should be included in a pilot training program to be developed during FY-1970.

g. Results of a community wide [redacted] intelligence yield ev25X1tion program (monitored by NPIC and jointly funded by NPIC and DOD components) will be forthcoming in the spring of 1971.

2. Automation.

a. A five year projection of the possible role of automated collateral storage and retrieval systems for use by photo-interpreters and collateral support personnel was developed.

b. A preliminary evaluation of a new semi-automated text and graphics display system will be conducted in terms of its potential application to photointerpretation, collateral support, graphics and text display and manipulation.

3. Image Quality Assessment.

a. Preliminary psychophysical relations between photography and line-scan imagery resolution requirements were established by comparing the exploitation of photographs and line-scan images of the same ground-order-of-battle target models.

b. The above study will be replicated utilizing real ground-order-of-battle targets for validation purposes.

4. Equipment Design.

a. A comprehensive literature review of line-scan interpretation research was conducted.

b. The PI Equipment Human Engineering Design Guide, a document summarizing basic physiological and engineering information applicable to the design of imagery exploitation hardware, was updated by inclusion of sections specific to acoustics and comparators.

c. Approximately 250 articles on imagery exploitation research were reviewed and included in the Imagery Interpretation

Bibliography. Those relevant to NPIC operations were abstracted and included in the state-of-the-art review.

d. A number of industrial and government research facilities were contacted in search of relevant state-of-the-art information.

e. Several European studies indicated that the convergence angle of microscope eyepieces might influence visual performance. Since the CENTER employs a variety of optical instruments, many of which were designed with high convergence angles, preliminary research was conducted on the effect of convergence angle upon photointerpretation performance. The results are not yet conclusive, but there are sufficient indications of excessive ocular accommodative activity to warrant continuation of the research.

f. The PI Equipment Human Engineering Design Guide will be further updated and republished during FY-1970.

g. The literature review and site visits discussed above will continue. Unaided stereo projection display possibilities and unconventional imagery exploitation state-of-the-art will be emphasized.

h. Research will continue on microscope convergence angle, and an investigation of the effects of microscope field-of-view on PI performance will be designed.

C. Program Plans

1. Alternatives. This R&D program area is one which is particularly susceptible to division into a large number of discrete tasks which provides a number of options for its management. The level of in-house effort is limited by personnel ceilings, so this variable is essentially fixed.

Contracting each separate task on a competitive basis to individual local qualified firms would provide the lowest contractual costs for accomplishment of the program objectives, but the level of administration required exceeds the Center's capacity. This is particularly true if the program is to be systematically oriented and the projects appropriately integrated.

Using a single prime contractor would cost more contractually but would relieve the administrative burden of processing each task through a complete management approval cycle and the contractor could provide the necessary support for systematizing and integrating the program. The technical and philosophical limitations imposed by the single contractor route keeps this from being a clear choice for accomplishing this program.

2. Approaches Selected. We have selected a hybrid approach utilizing the services of a major contractor in the areas of his capability and supplementing this with satellite contracts for specific tasks where specific capabilities are known to exist and/or significant cost reductions can be appreciated without compromising the program.

Supplementing both of these two sources is a considerable in-house effort utilizing both NPIC and Headquarters psychologists and other medical staff personnel. A major aspect of the in-house effort is accomplished through the utilization of a Technology Integration Check-Out Facility, developed under this program, which is used for gathering interpreter performance data under controlled conditions. The following paragraphs describe specific approaches for each of the major objectives.

a. Data Base. The long-range research objectives of the Imagery Interpretation Research Program are to remain responsive to the priority needs of the operational components of the CENTER. It is intended that future exploitation oriented research topics evolve as they have in the past--the production groups take stock of their critical skills on an annual basis, and in coordination with this program, select those skills which appear to require immediate improvement or which should be developed in preparation for advanced hardware or procedural changes. If the request is compatible with NPIC resources, a research plan is developed and implemented to evaluate the current skill level; where applicable, performance under simulated conditions of advanced technology are also evaluated. On the basis of the research findings, a decision is then made by the operational group initiating the request to maintain the status quo, or to seek assistance in improving the skill level. Training programs

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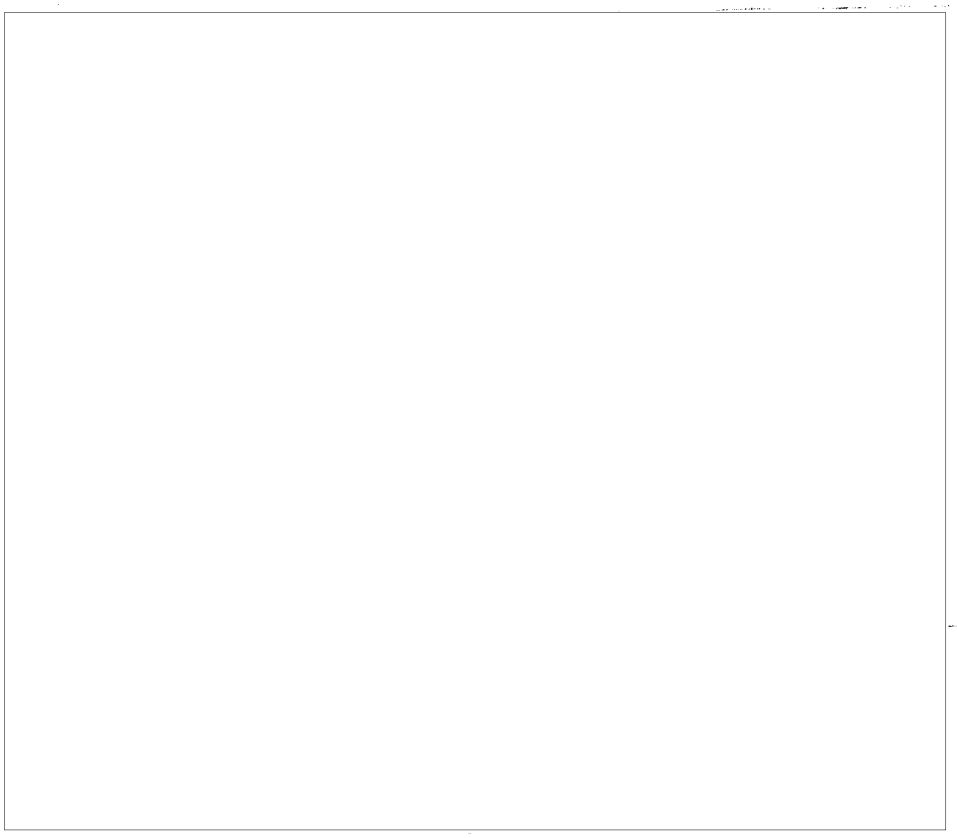

c. Image Quality Assessment.

(1) Acquisition System Parameters.

FY-70/76. Collection of exploitation data on intelligence information extraction as a function of image quality will continue. Such data gathering must be target, requirement, and sensor specific, and must produce results which will enable future acquisition system planners to devise objective design specifications, based upon known user NRO 25X1 image quality needs. Line-scan

will be emphasized earliest in the program, with [redacted] to follow as each [redacted] becomes appropriate. 25X1

(2) Display System Parameters.

FY-70/76. Research efforts will be concerned with an objective determination of quality requirements of imagery in anticipation of new acquisition system products for display and exploitation. Interpreter information needs will be the primary criterion. Consideration of line-scan [redacted] displays will occur earliest in the program, with succeeding studies to be dependent upon subsequent acquisition system developments. 25X1 NRO 25X1

(3) Image Manipulation.

FY-70/76. Continuing support shall be provided to the Image Analysis and Manipulation Program efforts to define optimum image processing procedures. Image quality tradeoffs based upon user needs must be objectively designated, and where feasible, artificial manipulations of image rendition may be found appropriate if exploitation efficiency is demonstrated to be enhanced.

d. Equipment Design.

(1) Relevant R&D Advances.

FY-70/76. Efforts will be made to maintain cognizance of human factors research results and their potential.

application to CENTER requirements. Emphasis will be on research and information assemblage in support of decisionmakers anticipating CENTER environment alternatives. Techniques for upgrading the performance of CENTER human resources will also be priority targets for consideration.

(2) Human Engineering Design Guide.

FY-70/76. This document will be updated with revised human engineering design data as available, and with new bodies of information as required to support new system developments. The Guide will be maintained for the Intelligence Community as a central source of human engineering design specifications for image exploitation hardware development.

D. Resources. Summary of R&D Funds required for the Imagery Interpretation Process Research Program. 25X1

5 December 1969

RED Draft

2.1
3.0. IMAGERY INFORMATION TECHNOLOGY

A. Program Objective. Investigation and implementation of the advanced technology necessary to develop an integrated, automated system for storage, retrieval, manipulation and display of imagery, imagery information, collateral graphics, and reporting graphics in the interpretation and reporting cycles of the exploitation process.

Rationale. It is incumbent upon NPIC to develop equipment, techniques and perform display studies which will result in a degree of automation of the exploitation and reporting process consistant with cost and manpower effectiveness. The purpose of this effort is to provide the information base to make prudent decisions in this area. The advent of the new acquisition systems such as the [redacted] make suc 25X1 an effort seem mandatory. Even if this ~~was~~ were not the case, a reappraisal of the manner in which information is handled in the exploitation process considering advancements in technology certainly seems in order.

Recent studies have revealed that considerable time is spent by interpreters in all phases of exploitation in searching for materials and in consultation with others in an effort to obtain needed information. For example, consultation consumes 20 to 30 percent of an interpreters time and searching for materials requires 10 to 15 percent of the time. Other tasks such as referring to maps and preparing reports also require large portions of time. Other personnel such as editors, graphics personnel, and collateral support personnel also spend time in assisting the interpreter in obtaining informa-

tion and in manipulating this information. Of course, the end product of these search and manipulation routines is the photo intelligence report.

One reason NPIC's information handling problem is so vast is because of the complex and variable nature of this information. It varies from textual information which can conveniently be stored in a computer through graphics and low resolution photography. to At the top end of the scale ~~is~~ high resolution photography, that stores the maximum amount of information per square inch of any commercially available recording material.

The advent of new acquisition systems will only compound this already frustrating situation. If imagery is to be interpreted in a shorter time frame and in a more efficient manner then it is incumbent that NPIC develop equipment and techniques and perform display studies. These actions will result in a degree of automation of the exploitation and reporting process and will assist in reducing manpower requirements to interpret and ~~to~~ report on each target.

25X1 [redacted] make it imperative to rapidly refer to maps, previous imagery, line drawings and other collateral. Support personnel will likewise be under more pressure to rapidly update such collateral and to have it readily available. The preparation of text and graphics for photo intelligence reports is likewise time consuming and requires considerable manpower to accomplish.'

This program will attempt to develop versatile systems that can assist various operational personnel in performing ~~numerous~~ many of these tasks.

1. Objective (FY-70/71). To develop automated off-line interactive display and layout display consoles for the rapid interchange of imagery information between the interpreter and supporting elements.

   Rationale. Imagery information exchange between interpreters, intelligence analysts, editors, and graphics analysts is currently performed manually--a process which is time-consuming and not the most efficient. The prototype, automated consoles would be operationally tested in order to more fully assess their potential for improving the efficiency of the exploitation process.

2. Objective (FY-71/72). Investigate the basic technologies that will be required to implement contingency plans to handle the imagery in various chip forms.

   Rationale. Several contingency plans have been put forth on the handling and reproducing [redacted] material, prepare plans to handle or reproduce this material in chip or roll form. 25X1

   Efforts will also be made to correlate the information from [redacted] 25X1 various acquisition systems onto one display. [redacted] could be displayed simultaneously. 25X1

3. Objective (FY-72/73). Based on the degree of success of the prototype interactive display and layout consoles, to develop improved models for operation on-line to the central computer.

Rationale. If the off-line consoles prove valuable in actual operations, an on-line system will have greatly increased capability by access to the large central data base.

4. Objective (FY-74/76). To integrate the imagery information system with the textual information system (IIS).

Rationale. Since textual, image, and graphical information are closely interwoven throughout the exploitation process, it will be much more efficient to combine the software and hardware into one integrated information storage and retrieval system.

5. Objective (FY-73/76). Develop a digital system for automatically correlating imagery information of the same target which has been selected and input by the photo interpreter. The results of this correlation will provide the interpreter with analytical data based on comparisons and weighting factors inherently available from the circumstances and sensor characteristics for each of the input images.

Rationale. The requirement to compare many different types and dates of imagery to assist in the analysis of target characteristics and activity status becomes more and more complex as the variations in the acquisition systems increase. A natural development arising from the proposed information handling systems would be to automate portions of this comparison and analysis task.

B. Program Progress. Several in-house studies have been devoted to understanding and defining the problem. The Automatic Reporting Techniques and Equipment Study, TICOF studies and the Advanced

Editing Systems Evaluation Teams have all looked at aspects of the Imagery Information Technology Program.

One contractual effort has been to develop some programs and techniques to demonstrate the feasibility of a cathode ray tube graphics system. Results to date have shown that such a system has promise of solving some exploitation and reporting problems. Three dimensional line drawings can be displayed and rotated on the cathode ray tube face. Text and graphics can be easily created, changed or edited.

Objectives have been determined for the development of a system to display text and graphics on a cathode ray tube. Provisions are to be made for the future modifications of such a system to allow the projection of continuous tone imagery onto the screen. Objectives have also been specified for another system that can display multiple images from chips of current and past coverage and from microforms of maps and other collateral.

A contract was awarded in FY-69 for a Chip Implementation Study. This will present the center with several alternative plans for chip system development based on predicted acquisition systems and imagery read/out requirements.

C. Program Plans.

1. Alternatives. One alternative is to attempt to store all imagery information on magnetic tape or similar storage media. This approach has the advantage of allowing the manipulation of such information by digital or analog techniques. The main disadvantage is that it requires a virtually impossible storage requirement.

Another alternative is to store all imagery information on microform imagery (chips, microfiche, etc.). This has an advantage of reducing storage space requirements but a disadvantage of not allowing the information to be manipulated.

One obvious alternative is to do nothing in this area and proceed with the present in-house equipment complement and make the best

of it. Considering the available technology, this does not seem to be judicious. Within the next year or so, sufficient information should be available from our present and planned efforts to allow judgments to be made to the degree of automation that should be considered or implemented.

2. Selected Approach. The selected approach is to combine the advantages of the first two alternatives. Those types of information that can most advantageously and economically be stored on magnetic tape or similar storage media will be so stored and will have the added advantage of being manipulated by analog or digital techniques. Those types of information that can be stored on microform more economically and which require little or no manipulation will be stored and viewed on a separate system. Eventually these two systems may be combined.

In the latter part of FY-70, plans will be made to implement a Chip System to accommodate the amount and type of material to be provided by the [redacted] system. In the following fiscal years (71-75) equipment will be provided to efficiently handle chips and other forms of imagery material. 25X1

Great emphasis will be made from FY-72/76 to automate reporting and display methods, to expand the ability for rapid access to collateral material, and to introduce advanced imagery handling equipment. In FY-71/72, efforts to correlate various acquisition

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system imagery onto one display will be aimed at preliminary feasibility studies with the objective of future equipment development based on the successful indications of such studies.

25X1

2. Manpower. An increase in programming capability will probably be required from FY-71 forward.

4 December 1969 (R-2)
RED Draft

3. OVERHEAD PHOTOGRAPHY/IMAGE ANALYSIS AND MANIPULATION

A. Program Objective (FY-69/76). To develop the capability to precisely define, evaluate, and manipulate the physical properties of various imagery systems including [redacted] as they become significant sources of strategic intelligence.

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25X1

25X1

Rationale. Imagery is the basic raw material input to the Center. The Center's mission is to "refine" this imagery into narrative information selected for pertinence to specific intelligence requirements. The required information is often at the limit of the response and/or the storage capacity of the imagery system and it may be obscured. The intelligence is generally perishable. Defining and understanding the physical properties of the imagery provides keys to the development of equipment and processes for compensating for the obscuration and making this information more readily available to the interpreter--thereby helping to assure the completeness and timeliness of the Center's primary function.

1. Image Analysis Objective (FY-70/76). Develop improved image quality measurement and specification capability that correlates objective and subjective performance criteria.

Rationale. Present objective image evaluation techniques do not correlate adequately with subjective judgments of quality which has caused confusion in the mission evaluation process. In the case of equipment design, viewing devices, for example, cannot now be built with assurance that they will meet the

interpreter requirements. Consequently, the design and subsequent analysis of image producing systems is less a science and more an art than is desirable. The photo-optical image evaluation program will provide a capability to objectively detect, specify, and measure system performance in terms which are reconcilable with subjective judgment. While these problems have been attacked in the past, they have not been resolved and the added complexity of evaluating [redacted] is a predictable requirement for the near future. 25X1 25X1 NRO

2. Image Manipulation Objective (FY-69/74). To achieve an operational image manipulation system with the capability of compensating various image degrading factors occurring during acquisition and/or processing.

Rationale. Numerous factors such as atmospheric haze, low sun angle, defocus, and image smear may occur during a given mission which degrade the imagery and thereby limit the interpreters' capability to respond to the Center's read-out requirements. Some of these factors such as low sun angle occur over extended periods in certain target areas. Image manipulation is intended to provide means to compensate for these and other image degrading effects in order to render such images more readily and completely interpretable.

3. Unconventional Imaging Systems Objective (FY-71/76). Determine the fundamental parameters, techniques, and equipment necessary

to realize the intrinsic information potential of unconventional imaging systems including [redacted] 25X1 etc. in order to specify the quality of this imagery and to enhance it as required.

Rationale. NPIC imagery sources are not restricted to conventional photography and, with the advent of [redacted] 25X1 systems with or without [redacted] the exploi25X1 tion of unconventional imagery will play an increasingly significant role in the Center's operations. The development and execution of this program will assure the capability to extract the maximum amount of information from these new systems. It will also establish a flexible base from which to proceed to other new systems as yet undefined, while maintaining continuity of developments, definitions, and relationships with conventional systems.

B. Program Progress.

1. Image Analysis. Three contracts have been concluded during this period. One was a study that defined the present state-of-the-art in photo-optical image evaluation; it recommended a general approach to finding a solution to the problem of relating subjective quality estimates to objective measurements. The second sought to apply the theory developed and establish basic conditions for evaluating optical components. The third contract developed general requirements for microdensitometric analysis of photo-

25X1 graphic imagery--[redacted] Collectively, these 25X1 NRO

contracts have taken a first step, identifying the areas where further effort will be best directed. From them has come the development of a comprehensive series of projects that will lead to the accomplishment of the long range objectives.

2. Image Manipulation.

(a) Digital Image Manipulation Systems are being evaluated and developed under contract. A very significant proportion of the required software development has been accomplished. Numerous investigations and evaluations of the required image input and display systems have been performed. Image enhancement has been accomplished on images degraded by defocusing, image motion and simulated atmospheric effects in the laboratory. Experiments have been designed and tested to obtain objective measure of the intelligence value of such enhanced imagery--preliminary results are very favorable.

(b) Analog (Optical) Image Manipulation is being investigated in-house with contractor support. Hardware is being assembled and experiments are being designed and performed. If some of the image enhancement techniques considered under the digital system can be accomplished by Analog methods, it appears that significant savings in time and cost will result.

(c) Photographic Image Manipulation consisting of unsharp masking by the "ring smear" technique is being investigated under

contract; an equipment breadboard has been constructed which is being used to conduct experiments intended to define the significance of unsharp masking as an image enhancement technique.

(d) Electronic Enhancement. A program is being developed in-house to consider the potential of electronic techniques for enhanced imagery. Various pieces of equipment and technical proposals are currently under evaluation.

(e) Digital Imagery Enhancement (In-House). A plan has been established and work is underway to provide an in-house capability for digital enhancement of operational imagery on the basis of knowledge gained through the digital image manipulation contract. Appropriate hardware and software are under development. Best methods of attack are being determined; extensive coordination with ORD and NPIC/PSG/AID is being performed in order to assure the required computer support. Site preparation is being performed and personnel requirements have been determined.

(f) Operational Enhancement System. A time phased plan for evolution from experimental to operational status is under development; requirements for input/output devices and computer support are being defined. Organizational responsibilities, personnel requirements, and locations for equipment are being considered.

3. Unconventional Imaging Systems. A literature research has been initiated and state-of-the-art capabilities are being investigated. Some limited feasibility experiments have been performed with existing equipment, utilizing Analog, Digital and Photographic processes. Development of the overall program is in the planning stage.

C. Program Plans.

1. Image Analysis.

(a) Alternatives.

(1) Retain and refine the present objective measurements and expand the subjective evaluation phase by more carefully explaining to the P.I. the nature of the judgments he makes.

(2) Establish a program of basic research designed to quantify the fundamental physical and psychophysical interrelationship. On the basis of these results, develop practical mission oriented evaluation procedures and equipment.

(3) Implement an integrated program to optimize existing procedures, while developing new objective evaluation techniques. As a parallel effort, psychophysical studies will be initiated to provide a basis for determining the correlation between subjective and objective evaluation parameters.

(b) Approach Selected

(1) The third alternative offers the greatest pay-off at the least risk and is therefore selected. Alternative two would provide the firmest scientific foundation with the lowest level of risk; however, it would cost considerably more and require too much time to be practical. The first alternative is the least attractive in that it has the highest risk and would not allow consideration of the new evaluation procedures available.

(2) Milestones.

i. FY-72: Completion of study of evaluation techniques

ii. FY-73: Objective measure identified

iii. FY-74: Subjective experiment complete, testing procedures developed

iv. FY-75: Correlation procedures determined

v. FY-76: Operational implementation

2. Image Manipulation

(a) Alternatives

(1) Evolve from in-house systems.

(2) Request contractual development and installation.

(3) Issue requirement for performance of these operations under external contract.

(4) Fully depend on the efforts of other exploitation community components for development of this technology.

(b) Approach Selected

(1) Establish in-house capability in the preceding areas.

(2) Develop in-house systems from in-house work.

(3) Request contractual support if and where needed.

(4) Milestones.

i. July 1970: In-House DIM capability established.

ii. Feb 1970: In-house AIM capability established.

iii. June 1970: In-house PIM capability established.

iv. End FY-72: Determine the best operational applications for digital, optical, electronic, and photographic enhancement techniques.

v. FY-73: Operational equipment requirements determined and contract for development initiated.

vi. FY-74: Personnel and organizational requirements determined.

vii. FY-75: System turned over to operational personnel for primary routine use.

viii. FY-76: Integration into organizational structure accomplished.

3. Unconventional Imaging Systems.

(a) Alternatives.

(1) Employ only in-house resources--build onto existing equipment and techniques.

(2) Rely solely on contractual support.

(3) Develop existing equipment and techniques internally, enlist contractual support where appropriate.

(4) Rely solely on other exploitation components to develop necessary technology.

(b) Approach Selected

(1) Develop equipment and techniques internally, and enlist contractual support where needed.

(2) Milestones.

i. FY-71: Establish needs and priorities

ii. FY-71: Program definition

iii. FY-72: Program execution

iv. FY-73: Report

v. FY-74/75: Integrate into operational environment

vi. FY-76: Recommendations

D. Resources

1. Image Analysis.

(a) Funding--totalling [redacted] 25X1

(b) Support from and coordination with TSSG/RED/ATB/HFS

(c) Coordination with and support from TSSG/APSD

(d) Computer support (quantity and source to be determined)

2. Image Manipulation.

(a) Funding required, FY-70 through FY-76, [redacted] 25X1

(b) PI support from IEG

(c) Computer support

i. Initial phase of in-house work to be supported by DD/S&T/ORD has been coordinated

ii. Further work requirements to be determined

(d) In-house personnel to manage projects and run equipment

(e) FY-74-75: Additional personnel to man operational facility (estimate for (4))

3. Unconventional Imaging Systems.

(a) Contractual support totalling [redacted] over a six year perio 25X1 is anticipated.

(b) In-house equipment and man-hours will be required.

(c) Coordination with TSSG/RED/ATB/EIS and TSSG/APSD will be necessary.

(d) Computer support will be required, source and quantity as yet undetermined.

25X1

4Dec69
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4. OVERHEAD PHOTOGRAPHY/IMAGE INTERPRETATION INSTRUMENTS AND TECHNIQUES

A. Program Objective (FY-69/76). To provide NPIC imagery interpreters with the instrumentation required to accomplish their assignments in the required time and performance levels.

Rationale. Two basic factors in the present and future NPIC exploitation operations dictate the requirements for image interpretation equipment development. The first is to make information available from the imagery which the interpreter could not perceive without the assistance of equipment specifically designed for this process. This type of situation required the development of stereoscopes, tube magnifiers, stereomicroscopes, light tables, anamorphic eyepieces, etc. The second is to assist the interpreter in such a way that he is able to perform at the required level more efficiently. Equipment developed in response to this type of requirement are special manual and/or motorized film drive devices, advanced stereo-rhomboid arms, elevating light tables, projected scale micrometers, PI comparators, etc.

25X1

[redacted]

it is incumbent upon NPIC to be prepared to exploit their products. This objective is addressed to the potential requirement for imagery interpretation equipment needed for exploitation of these products.

3. Operational Improvement Objective (FY-69/76). Provide equipment required to significantly improve interpretation operations.

   Rationale. Advances in technology and improved exploitation concepts originating with operational personnel provide direct and indirect requirements for interpretation equipment modifications and development even though no other factors indicating the need for a change are present.

4. Automatic Target Recognition Objective (FY-69/76). Provide support to interpretation operations by automating those aspects which are most tedious, relatively trivial, and time-consuming for the human. Rationale for this project will be covered with the sub-objectives which follow.

   a. FY-69/70. Objective - to develop a fully automatic Target Indexing Device (TID) for use on high volume collection systems [redacted] and to maintain a sustaining research effort on related Automatic Target Recognition (ATR) techniques. 25X1

      Rationale - In order to cope with the increasing output of future high-volume collection systems, it is imperative to automate those tasks that are tedious, repetitive, and time-consuming. The TID will expedite the Phase II exploitation of photographic missions and possibly provide a capability for mission reprogramming and accurate determination of the percent of cloud cover per mission.

b. FY-71/72. Objective - to develop the capability to automatically and rapidly scan imagery for man made objects and to investigate the feasibility of applying ATR techniques to [redacted] 25X1

Rationale - the capability to machine-scan photographic coverage of large areas of relatively sterile imagery and indicate only those portions containing man-made objects will greatly reduce PI time spent in search operations. With [redacted] the possible application of ATR techniques to solve such problems as cloud and/or detail screening and target identification by operating directly on electornic signals could greatly reduce data handling and interpretation time. 25X1

qq

c. FY-73/74. Objective - to develop machine capability to rapidly rescan for specific types of targets and to develop techniques to determine change detection.

Rationale - The rescanning of numerous missions for start of missile site construction, initial operations, etc., constitute a very time-consuming operation that could be alleviated by developing an automatic rescanning capability. Automation of the change detection function could be a significant time saver by eliminating the need for analysts to look at any target except those showing significant change.

d. FY-75/76. Objective - to further apply techniques developed in previous phases to permit the fabrication of a device that can automatically and rapidly detect, identify, and count objects for order-of-battle.

Rationale - This development would result in significant time savings by automating the tedious and time-consuming order-of-battle compilation. This development

would be another "module" leading eventually to an integrated automatic target system that could relieve the analyst of those important but very time-consuming operations and permit the bulk of this time to the specialized and detailed analysis for which machines are not suited.

B. Program Progress.

1. 1540 Light Table. A special light table designed to provide specific accommodations for interpretation of [redacted] imagery will be in production in the latter half of CY-70. The entire community has placed a joint procurement order for this device. 25X1

2. Advanced Stereo Rhomboids. This attachment for the standard stereomicroscope will provide performance and separation required for viewing [redacted] roll film in stereo. 25X1

3. Digitized Measuring Light Table. This device is a standard PI light table fitted out with an automatic digitizing system to facilitate target location and mensuration. It was developed in response to specific requests and suggestions made by operational personnel.

4. Twin Stage On-Line PI Comparator. This recently developed device will provide the PI with an automated mensuration comparator capability competitive in accuracy to the more complex equipment used by photogrammetrists.

5. Automated Stereoscanner. This equipment will provide automatically correlated stereoscanning of roll film from [redacted] and other major acquisition systems. It will be initially used to evaluate the intelligence extraction significance and the operational feasibility of automated stereoscanning. 25X1

6. Automated Target Indexing Device. This prototype equipment will be delivered to NPIC in the latter part of CY 1970. Demonstrations of an earlier breadboard indicate that this device will be capable of automatically evaluating the cloud status of target imagery at the rate of 100 feet per minute--thus promising to relieve NPIC interpreters of one of their most menial and time-

C. Program Plans.

1. Alternatives. One significant alternative to the present approach to imagery interpretation equipment development would be along the lines of system development as opposed to component development. The recommended approach to to the [redacted] Exploitation System is a case in point. However, the process of changing the conceptual approach to an existing operational system is not as readily accomplished and not necessarily appropriate. Before the system approach would be feasible, there should be a management consensus that the existing ad hoc system is so outmoded and inefficient that such an undertaking is justified.

25X1

2. Approach Selected. Since the system oriented concept does not appear feasible at this time, the content of this program is determined by a number of fundamental factors that ultimately combine to produce pressure for development support. All these factors are too numerous to cite here but the following are representative examples:

a. acquisition system characteristics,

b. intelligence requirements,

c. knowledge of the imagery interpretation process gained from that portion of the R&D programs,

d. knowledge of the physical properties of imagery gained from that portion of the R&D program,

e. observations and concepts provided by operational personnel,

f. procedural changes introduced by management,

g. limitations in space, funds and/or manpower.

Any one of these factors may be altered in such a way that a significant interpretation equipment development requirement may result. More frequently various combinations

of them produce both the requirement and the general specifications for the equipment performance characteristics. On such a basis the following milestones for our present program were evolved:

25X1

a. Mid FY-71. [redacted] interpretation equipment in operational status.

b. FY-71. Image comparison stereoviewer developed.

c. FY-72. Automated Stereoscanner perfected.

25X1

d. FY-72. Wide Field Stereoviewer developed.

[redacted]

The following table summarizes the milestones for this program including the various ATR modules.

25X1

[redacted]

69 70 71 72 73 74 75

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9 December 1969
RED DRAFT
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V. OVERHEAD PHOTOGRAPHY/REPRODUCTION

A. Objective (FY-69/76). Develop efficient imagery reproduction systems as required for acquisition system products and operational requirements.

Discussion. The NPIC exploitation process requires numerous copies of selected imagery in excess of those routinely provided by the primary processing facility. Studies presently underway indicate that the number of routinely produced copies will be further reduced in the future due to extremely significant increases in the volume of the original take resulting from the [redacted] system. It also appears 25X1
that a relatively limited number of reproductions of [redacted] 25X1
will be provided. In addition to these impending increases for imagery reproduction services in the Center, it appears that capability for reproduction of unconventional imagery forms such as [redacted] 25X1
25X1 [redacted] will be required by the end of the planning period. The objective of this program is to provide the Center with reproduction systems that will most efficiently provide the quantity and quality of reproductions required to support the Center's exploitation operations and the responsibility to serve the community under the National Tasking Plan.

1. Black and White Reproduction Systems Objective (FY-69/76). Improve black and white photography reproduction systems in terms of performance, operating efficiency and economy.

Discussion. Present black and white reproduction systems require a relatively large amount of personnel, space, complex equipment, time and supplies. There is considerable potential for improvement here if a simpler system for developing the image could be produced without reducing the quality of the image. Until very recent times all attempts to accomplish such improvement over the conventional silver halide process seemed doomed to fail the quality criterion. In recent times, however, numerous monochrome imaging systems have been developed which show promise of a significant breakthrough--among them are dry-silver, free-radical, and the improved diazo process. With each of these systems only heat is required to develop the image. Other areas where refinements may be required are in the automation of the printing and enlarging equipment including the selection and coding of target-oriented duplicates. 25X1

2.

3. [redacted]

B. Program Progress.

1. Dry Silver. The Center has been funding dry silver materials research and development contracts since FY-65. The fruits of this development are now beginning to pay off. Paper and film materials of good quality are near production. Equipment to print and process these materials are also being developed.

As a result of a cost sharing-no fee research and development contract, the [redacted] is investing in the quality and quantity pilot plant production of negative acting reproduction films for reconnaissance photography. Contact printing and photo

25X1

enlarging paper are presently entering the contractor pilot plant scale-up production, with some improvement in photo speed. The photo enlarging paper should be available by 30 June 1970. A dry-heat processed diazo (no ammonia) has been developed to provide an immediate positive-to-positive reproduction capability for the PI's. This material is in pilot plant production. A processor for this material is scheduled for delivery in December 1969. The ultimate positive-to-positive reconnaissance reproduction material is still in research and, as such, has the associated research risks.

However, the pay-off potential of this material is great. A versatile, high-quality, positive-acting reproduction system will allow virtual elimination of useless negatives and inter-negatives.

Special processing equipment for this dry process material has also been developed. As of now a step-and-repeat printer with a hot air knife processor has been assembled and is in operation as support of the materials development. High speed processors for roll film and paper have also been fabricated and are in a 6- to 12-month T&E program at the present time. In addition, a sheet film hot air knife processor and a 40-inch wide enlarging paper processor are being assembled and are scheduled for delivery in June 1970.

As a result of the promise of these experimental model developments, it is expected that in FY-70 prototype developments will

be initiated to produce a dry diazo printer and an enlarger reader printer. This equipment will be used in the PI area to facilitate their function.

C. Program Plans.

1. Alternatives. There is considerable conjecture concerning the potential benefits of dry heat processed photo reproduction. The conventional silver halide system has been the undisputed leader for such a long period. Considerable research investments could be saved if the present approach is accepted as adequate. However, advances in the understanding of the interactions of light and matter show promise of a break-through and it appears that the dry process will not only be much simpler and less expensive but also of higher quality.

The unconventional reproduction systems will doubtless be developed in conjunction with their respective acquisition systems but it is doubtful that the characteristics of the operation and the end-product will be suitable for NPIC exploitation operations. If better coordination between the collection and acquisition system developers can be effected, it should be possible to assure that the first reproduction system would be the right reproduction system.

2. Selected Approach. As is apparent from the Program Progress a heavy emphasis has been placed in the development of the dry silver materials and the associated reproduction equipment. At

the same time the free-radical and R/S processes are being closely watched. Our expectation through the present program is to develop a dry-photo reproduction system in the following time frame.

a. Negative to Positive Film - FY-71

b. Negative to Positive Enlarging Paper - FY-71

c. Heat Paper Processor - FY-71

d. Positive to Positive Diazo and Heat Processor - FY-70

e. Positive to Positive Film - FY-73

25X1
NRO

f. [redacted]

g. Unconventional Reproduction Systems - FY-76

[redacted] 25X1

5. OVERHEAD PHOTOGRAPHY/REPRODUCTION

A. Program Objective (FY-69/76). Investigate that work and equipment development necessary to provide NPIC with advanced reproduction technology and to permit efficient production of new-film copies at a quality commensurate with the original imagery.

Rationale. This program is required if the NPIC reproduction capability (both [redacted]) is to incorporate the technology advances which will allow the reproduction functions to be performed with a minimum loss of detail, expediently and economically from a cost and manpower point of view. 25X1 25X1 NRO

1. Dry Silver Objective (FY-69/76). Develop high-quality dry-process reconnaissance reproduction capability for black and white materials to equal or exceed that of present wet chemical materials:

a. FY-70 to FY-72. Continue development work to achieve an increased quality in dry photo process material.

b. FY-70 to FY-74. Develop new lines of reproduction equipment to make the dry photo process material available in normal operations. Produce paper and film processors, reader/printers, and diazo-type printers for use by the interpreter, as well as the Photo Lab personnel.

Rationale. The further development of dry process materials will permit the Center to gradually program the replacement of a number of rather inefficient wet chemical processes. This should reduce to a minimum the amount of space assigned to chemical mix facilities, tank farms and wash tanks, etc.; [redacted] 25X1 NRO

25X1 [redacted] It will speed up the production of briefing boards and target delineation prints by decreasing the processing and drying time in the Photo Lab. Even more important, the development of a positive-to-positive (reversal film) will permit the photointerpreter to

utilize photographic enhancement techniques on a routine basis within their normal work stations. Things like file copies, work prints and varied density cuts will now be made quickly and efficiently by the PI thus speeding up the exploitation process.

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NRO

2. [redacted]

25X1

3. Conventional Reproduction Objective.

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NRO

a. Begin in FY-71 to develop an automated step-and-repeat contact printer for rapid production of [redacted]

b. Begin in FY-71 to develop methods and equipment for production and handling film chips or cut film (smaller than full frame).

Rationale.

a. [redacted]

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NRO

[redacted]

b. As the current Chip Implementation Investigation (FY-69/70) progresses, certain areas for research and development will appear; some of the probable areas are printers, processors, viewers for [redacted] reproduction, and handling. Storage and retrieval, transmission, and associated handling problems, as pertains to NPIC, will also be investigated. 25X1 NRO

B. Program Progress.

1. Dry Silver. The Center has been funding dry silver materials research and development contracts since FY-65. The fruits of this development are now beginning to pay off. Paper and film materials of good quality are near production. Equipment to print and process these materials are also being developed.

As a result of a cost sharing-no fee research and development contract, the [redacted] is investing in the quality and quantity pilot plant production of negative acting reproduction films for reconnaissance photography. Contact printing and photo enlarging paper are presently entering the pilot plant scale-up production, with some improvement in photo speed. The photo enlarging paper should be available by 30 June 1970. A dry heat processed diazo (no ammonia) has been developed to provide an immediate positive-to-positive reproduction capability for the PI's. This material is in pilot plant production. A processor for this material is scheduled for delivery in December 1969. The ultimate positive-to-positive reconnaissance reproduction material is still in research and, as such, has the associated research risks. However, the pay-off potential of this material is great. A versatile, high-quality, positive-acting reproduction system will allow virtual elimination of useless negatives and inter-negatives. 25X1

Special processing equipment for this dry process material has also been developed. As of now a step-and-repeat printer with a hot air knife processor has been assembled and is in operation as support of the materials development. High speed processors for roll film and paper have also been fabricated and are in a 6- to 12-month T&E program at the present time. In addition, a sheet film hot air knife processor and a 40-inch wide enlarging paper processor are being assembled and are scheduled for delivery in June 1970.

As a result of the promise of these experimental model developments, it is expected that in FY-70 prototype developments will be initiated to produce a dry diazo printer and an enlarger reader printer. This equipment will be used in the PI area to facilitate their function.

C. Program Plans.

1. Alternatives.

a. Dry Silver. The alternative is to follow the conventional, wet-chemical process which is expensive, time- and space-consuming, and presents considerably greater logistical problems.

25X1
NRO

b. [redacted]

2. Approaches Selected.

a. Dry Silver. The immediate plan is to develop material and equipment to reproduce operational imagery material at a quality equal to conventional photo lab processing.

NRO

b. [redacted] 25X1

c. Conventional Reproduction Development (FY-71/76). The specific plan here will be a function of the pending decisions on chip implementation within NPIC, [redacted] requirements, and the impact of new acquisition systems.

25X1 NRO 25X1

[redacted]

6. OVERHEAD PHOTOGRAPHY/MENSURATION

A. Program Objective (FY-70/72). To develop the capability to more precisely and more efficiently measure images for subsequent conversion to accurate ground dimensions and to more accurately define mensuration errors in order to optimize mensuration techniques, photogrammetric measuring equipment, and mensuration accuracy statements contained in intelligence reports.

Rationale. Accurate measurements are an intrinsic element of the imagery exploitation process. They often serve as key factors in the basic identification of targets imaged on the film and provide an essential data base fundamental to any quantitative, detailed, technical analysis based upon data extracted from recorded imagery.

1. Technological Base Objective (FY-69/76). Perform basic and applied research in precise mensuration so as to develop a technological base for use in developing future measuring equipment. Investigate, evaluate, and develop the basic components of measuring systems to determine the best light sources, optical systems, reticles, controls, and measuring engines necessary to optimize future mensuration equipment. Isolate and evaluate mensuration error sources, and improve the precision of mensuration accuracy statements to further improve the intelligence reporting process.

Rationale. Mensuration instruments are extremely expensive to produce; their cost is directly related to their accuracy. As a consequence, they should be no more accurate than necessary to perform their intended function. In order to determine this fundamental accuracy level, we must have a thorough technical knowledge of the mensuration error process, and we must optimize individual components of the measuring system so that the component will not be the "weak link" in the total

system. This same technological data base is a necessary input to further refinement of the dimensional error statements contained in NPIC quantitative reports. These error statements govern the confidence an analyst can place in the validity of a stated dimension.

2. Equipment for Photogrammetrist Objective (FY-70/76). Develop both general purpose and highly sophisticated ultra-precise mensuration instruments for use by photogrammetrists. Major emphasis will be upon stereo mensuration, lowering the cost of production units, and designing for high reliability and easy maintainability. Early efforts will be directed toward developing medium accuracy equipment to fill an existing gap between the ultra-precise and coarse accuracy measuring instruments currently available and in adapting our present instruments to efficiently utilize [redacted] 25X1

Rationale. The photogrammetrist requires more versatile, sophisticated instrumentation than the PI in order to perform his detailed, complex mensuration analysis. These equipments will incorporate the very best techniques and components developed through our studies and research as a part of our growing technological base. Special emphasis will be required for stereo mensuration in order to improve our ability to measure heights. Large inputs of [redacted] 25X1 may present future problems in the areas of viewing optics, multiple layer films and specialized distortions. Modification will have to be investigated.

3. Equipment for Photointerpreters Objectives (FY-71/76). Develop semi-sophisticated measuring instruments for use by imagery interpreters in their own work spaces during everyday operations. Toward this end, we will produce

equipment, such as measuring stages, digitized light tables, etc., that can be utilized for rapid, comparative-type measurements made during normal imagery exploitation operations, making sure that future equipments are adaptable to 25X1 and that current equipment is modified to accept it. Highly reliable, maintenance free equipment is essential and a definite development goal.

Rationale. Many comparative-type and non-critical measurements can be, and have been, performed by the photointerpreters, thereby speeding up the imagery exploitation process. With the advent of high volume acquisition systems, this measuring process could cut heavily into our available PI man-hours which are already in short supply. As a consequence, this process must be made as efficient and rapid as possible. Maximum automation is a specific goal, with high reliability to reduce the amount of down time.

4. Automation of Mensuration Objective (FY-71/76). Identify potential applications of automation to the mensuration process and implement the most promising applications. One area of considerable promise is a semi-automation of the mensuration pointing process by combining the better features of a comparator and a microdensitometer into a single versatile piece of equipment.

Rationale. Pointing--placing the reference point on the extremes of the image to be measured--is a tedious and time-consuming manual operation. This is particularly true with low contrast imagery where the edges are difficult to define. In these areas a microdensitometer can help define the edges automatically, and probably more accurately, thus expediting the entire measurement process.

B. Program Progress. There has been considerable progress toward these objectives to date. In ~~1973~~ 1970, under multiple year funding, a precision stereo comparator will be completed

and delivered to the Center. This instrument is intended for ultra-precise work by the photogrammetrists and incorporates many advanced features such as .5 micron accuracy, automatic correlation of the stereo imagery, and the capability to use roll film on large format stages, i.e., the original negative for maximum fidelity.

A digitized light table for use by the interpreter has been developed under FY-69 funding. This instrument will undergo operational testing during the next few months. This instrument is connected on-line to the Center's 494 computer and will permit immediate readout of either ground dimensions or film coordinates from roll film while the film is still on a normal, operational PI light table.

FY-69 and FY-70 funds were utilized to support certain critical in-house studies of mensuration errors and how they effect our mensuration procedures and equipment. The information thus gained will be utilized as a foundation for future studies and for the future development of advanced mensuration instrumentation.

Utilizing FY-68 funding, a PI on-line comparator was produced for use by the photointerpreter. This is a stereo instrument for measuring stereo images on cut film chips and is designed for use in detailed interpretation. It can be used to measure heights and is on-line to the Center's centralized UNIVAC 494 computer. It is a medium precision instrument with accuracy in the 2 micron region.

C. Program Plans.

1. Technological Base.

a. Alternatives.

(1) The majority of the work on mensuration error analysis could be done in-house, utilizing operational personnel when, and if, man-hours

are available. This approach has major disadvantages because it could tie up key operational personnel and/or delay the research effort so much that the technical answers acquired are too late to effect contemporary equipment designs.

(2) The major portion of mensuration error analysis could be contracted out. The major disadvantage is that specific tasks related to this analysis still require major inputs of man-hours from operational personnel.

(3) The hybrid approach would perform certain key tasks, requiring large operational inputs, in-house while contracting for support in the other areas. Major disadvantage is that a rather high degree of coordination would be required.

b. Approaches Selected. The hybrid approach is selected. We will attempt to obtain the advantages of both systems, while minimizing the obvious coordination problems by very intensive monitoring.

2. Equipment for the Photogrammetrist.

a. Alternatives. There is little alternative here. We either continue, as programmed in our objectives, or we accept current equipment as being adequate and stop the development of advanced prototypes. We would then concentrate on modifications to existing equipment.

b. Approach Selected. Continue to develop advanced measuring equipment concentrating on high reliability and reasonable cost with maximum operational efficiency as stated in our objectives. To not seek these advances in efficiency would leave the Center

at the mercy of major inputs from sophisticated, new acquisition systems and in the position of possibly not being able to perform our mission.

3. Equipment for the Photointerpreter.

   a. Alternatives.

      (1) To develop new instruments as projected by our objectives.

      (2) To have the photogrammetrists make all the measurements.

   b. Approach Selected. Approach one was selected since approach two appears unrealistic since it would increase duplication, require an increased T/O, and materially slow down the over-all exploitation process.

4. Automation of Mensuration.

   a. Alternatives.

      (1) Continue to utilize conventional techniques and equipment to measure subliminal images and thereby accept the inherent losses in accuracy and in time spent trying to accurately point on images with ill defined edges.

      (2) Attempt to develop equipment and techniques to implement a more sophisticated and scientific approach to the problem.

   b. Approach Selected. To not select approach two is to be ultimately out distanced by the technology of future acquisition systems. Furthermore, option two has the inherent promise of increasing the quality and speed of our measurements with some possible future savings in manpower.

 SECRET 5 December 1969

RED Draft

7. OVERHEAD PHOTOGRAPHY/TEST AND EVALUATION

A. Program [illegible] (FY-69 [illegible]). To develop the capability in terms of techniques and equipment required to test and evaluate and define the significance of equipment and techniques pertinent to NPIC imagery exploitation operations.

Rationale. The rapidly advancing technology of imagery acquisition systems and intelligence analysis techniques produces a commensurate pressure for technological development of NPIC exploitation operations. Exploitation equipment and techniques which are developed in response to this pressure are generally of such an advanced nature that processes for specifying and measuring their performance are non-existant or at best poorly defined. The absence of these processes limits their evaluation in large part to subjective judgments. The objective of this program is to identify the situations in which such knowledge, techniques and equipment are lacking, anticipate the need , and develop whatever is required to objectively evaluate the particular advanced technology in order to establish its net worth to NPIC operations. Information derived from the subsequent test and evaluation processes will not only identify which new developments should be considered by management for incorporation into Center operations, but will also provide knowledge and guidelines to the R&D effort which will result in more meaningful and appropriate performance specifications for new development requirements.

B. Program Progress. The T&E development program is in the first stages of formalization, however there are several accomplishments to date which are noteworthy.

1. Accuracy Limits. A study has been performed to define the accuracy limits for dimensional comparators of conventional design. Information from this study was used to evaluate the performance specifications postulated for the High Precision Stereo Comparator being developed under the Mensuration Program. It has also been used in establishing the test procedures that will be used in evaluating the comparator performance.

2. Simulated Imagery. Special imagery simulating the characteristics of systems such as the [redacted] but which has been carefully calibrated, is being developed to test the performance of the High Precision Stereo Comparator (HPSC) and the Automated Stereoscanner (AS). 25X1

3. Test Plans. Detailed test plans have been developed to assure that the testing of these two devices (HPSC and AS) is comprehensive and meaningful. Since there is no precedent for either of the devices, much of the test design required original work. These test plans include the operational significance as well as the technical performance aspects of the equipment.

4. Calibration Device. Due to the high order of accuracy (1 micron with .2 micron least count) for the HPSC a special calibration device will be developed in FY-70 in order to test and calibrate the HPSC.

5. Dry Silver. Special consultation arrangements have been made with the National Bureau of Standards to develop sensitometric and resolution test equipment for the "dry silver" photo reproduction materials being developed at [redacted] As a part of this project a special sensitometric processor will be developed in FY-70. 25X1

6. Resolution Test Target. The present most satisfactory method of evaluating the resolution performance of optical components and systems is by a qualified technologist reading a resolution test target displayed through the optics. A special resolution target will be developed in FY-70 which will increase the objectivity of this testing process.

C. Program Plans.

1. Alternatives. The need for thorough and technologically sound test and evaluation of R&D products is well-established; however, the requirement becomes even more evident as the R&D becomes more complex and less directly relatable to existing operations. This type of evolution is typical to the maturation of an R&D program--NPIC's is no exception. Accordingly an Engineering Support Division has been established at NPIC to accomplish the test, evaluation and maintenance operations required for the information, techniques and equipment products of the NPIC R&D program.

Staffing of this Engineering Support Division is currently limited so that development of the special advanced techniques

and equipment required for some of the T&E operations is beyond their capacity. An alternative would be to increase that staffing and perform more of this T&E development work in-house.

2. Selected Approach. In view of the inherent limitations on the number of in-house personnel who can be assigned to the T&E task, a contractual support program for the development of the highly specialized equipment and techniques required for test and evaluation of advanced exploitation equipment has been established.

The milestones of this program will be in terms of timely provision of the required equipment and techniques to the Engineering Support Division. The evidence will be in terms of objectively conclusive T&E results and reports being accomplished. Some of the more significant development products that will require special T&E equipment and techniques are as follows:

a. FY-70/72. Dry silver photo materials.

b. FY-71. High Precision Stereo Comparator.

c. FY-71/72. Automated Stereoscanner.

d. FY-71. Target Indexing Device.

e. FY-71. Image Comparison Microstereoscope.

f. FY-72. Ultra Violet Rear Projection System.

g. FY-72. Wide-Field High Power Stereomicroscope.

h. FY-73/76. [redacted] 25X1 NRO

i. FY-73/76. Image Manipulation Equipment.

25X1 [redacted]

k. FY-74/76. Advanced Information Display Systems.

l. FY-74/76. Automated Mensuration System. 25X1

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Research and Engineering Division

Program Narratives

I. Accomplishments. TSSG/RED accomplishments are generally covered within the RD&E program submission and as such will not be reiterated here. There are, however, a number of accomplishments related to the in-house activities of the Reconnaissance Systems Branch and the Exploratory Laboratory of the Advanced Technology Branch--integral elements of the Research & Engineering Division--which are not covered in this submission. These accomplishments are as follows:

A. Reconnaissance Systems Branch

1. The Reconnaissance Systems Branch developed a short time pad, or camera exposure burst, technique in support of NRO/SOC. This technique provided the intelligence community with 24% more targets acquired per [redacted] mission-- at no increase in cost. 25X1

2. The Branch provided full-time participation in a CIA effort related to the planning for the development and exploitation of a [redacted] 25X1

3. Branch personnel developed a quick-reaction method of determining the correct positions of missed targets for use in subsequent acquisition programs. Utilizing this system, the number of targets missed has been radically reduced.

4. "Standing Prerequisites for the Exploitation of Collection Systems", a definitive specification was prepared and distributed.

5. The Branch supplied, to operations at [redacted] detailed 25X1
requirements for future [redacted] emphemerides such as the MCD. 25X1

 [redacted] 25X1

6. RSB completed guideline studies regarding sun angle/exposure requirements that have provided superior vehicle programming operations.

25X1 7. A preliminary [redacted] manual was written and distributed to the community.

8. The Reconnaissance Systems Branch succeeded in establishing

25X1 NPIC [redacted] altitude requirements through COMIREX for implementation by the NRO.

B. Exploratory Laboratory.

1. The Laboratory has demonstrated a system of ultraviolet radiation and special photoprocessing which can be utilized to monitor potential sources of unauthorized disclosure of classified information. Our laboratory experiments with these techniques proved that reconnaissance film, with the photographic emulsion stripped off, still retained latent classified information capable of being reconstituted by special techniques. This was also true of standard viewgraph backing materials. The need was demonstrated for controlled disposal of these wastes to ensure tight security.

2. Equipment to establish a photometric standard was successfully designed and built in order to achieve a consistent measure of light table brightness. Copies of this instrument are calibrated by the Exploratory Laboratory and then supplied as GFE to vendors for determining if light tables conform to procurement specifications.

3. In-house experimentation proved that a technique for directly viewing an original negative as a positive image--suggested by a contractor--was totally unsuitable for NPIC requirements. This knowledge terminated consideration of

25X1 a [redacted] R&D program to develop a prototype.

4. An exploratory experiment indicated that for image detail of less than 50 microns in size, Dual Gamma and Trenton processing both produce the same mensuration results. This had been an area of considerable speculation.

5. Sixty-seven individual grid patterns of four different geometries were produced in support of the [redacted] Stereo- 25X1 comparitor Project. These high-precision units serve to calibrate the optical components of this equipment and will be utilized in its acceptance checks.

6. Laboratory derived knowledge provided APSD with factual data on the use of matte particles in aerial films. Exploratory Laboratory produced photomicrographs of microtomed film slices gave additional insight into the problem created by particle interference when reconnaissance imagery is viewed under very high magnifications.

II. Program Plans.

A. Statement of DDI Objectives. Develop equipment and techniques to improve the efficiency of imagery exploitation.

B. Statement of NPIC Objectives.

1. Research, Development & Engineering Management Support.

a. Provide research, development, and engineering support to the Center's imagery exploitation effort and to the other elements of the imagery exploitation community to the extent of the Center's capability.

b. Maintain a laboratory staff and facility that undertakes research in the photosciences and identifies new areas for development and engineering.

c. Provide technical coordination and liaison with the developers of new acquisition systems and provide the Center's operational components with information on the nature and impact of future reconnaissance systems upon Center operations.

d. Promote coordinated equipment procurement programs as a means of cost-savings.

e. Apply an R&D project management system which establishes an effective means of needs analysis, contractor selection, project justification, and monitoring.

C. Discussion of Objectives.

1. Requirements. In addition to the obvious requirement for the development of appropriate technology to support current operations, the systematic and efficient exploitation of a broadening spectrum of reconnaissance imagery dictates the continuing development of an extensive family of advanced equipments, materials, and techniques keyed to the specific handling requirements imposed by the collection systems themselves. NPIC attempts, through the Reconnaissance Systems Branch, to maintain an awareness of, and a responsiveness to, the exploitation implications contained in the imagery from progressively more advanced and diverse acquisition systems. Because of the complex technology involved, NPIC often must become an integral part of the system development team during its early stages. At the same time, we are in a unique position to evaluate and predict the impact and effectiveness of technical changes occurring in reconnaissance technology. Thus, NPIC's research and development must not only accommodate current and impending changes in the imagery inputs to the Center, but must also provide the means to "feed back" to imagery suppliers those objective data and analyses which will tend to upgrade both the quality of the product and the efficiency of the subsequent imagery exploitation process.

Under NSCID 8 and the National Tasking Plan, NPIC has an additional responsibility to provide research and development support to, and to promote joint procurement programs with, other members of the intelligence community currently engaged in National-level imagery exploitation. Because these members work with the same collection products, it is expected that this requirement can be met without the creation of additional programs. Through the mechanism of the Exploitation Research and Development Subcommittee of COMIREX (EXRAND), these efforts are thoroughly discussed and appropriately scaled to specific community needs before they are permitted to become candidates for Center implementation. 25X1

D. Method of Approach. Primarily because of over-all funding limitation, NPIC has, in the past, found it necessary to emphasize short-range, quick-pay-off projects at the general expense of longer range programs which would have provided a more systematic approach to the development of new exploitation systems, equipment, materials, and techniques, while at the same time, advancing the over-all state-of-the-art. This approach has generally been able to provide the Center with essential exploitation equipments, while at the same time, providing reasonable economy. This approach worked for three primary reasons; first, the earlier acquisition systems, while state-of-the-art, were not overly sophisticated by today's standards; second, there was so much initial work to be done--so many items of equipment of known parameters which had to be developed; and third, the Center was in a period of somewhat unrestricted growth--when a difficult problem arose, more manpower was applied.

The situation has changed; the new acquisition systems are highly sophisticated and are becoming more so; most basic equipments of known parameters have been built; and the Center now has fixed personnel resources. With this change in situation, it appears realistic that our RD&E approach also change.

We are now entering an era in which there will be inputs from a growing number of extremely complex acquisition systems. This era will require a corresponding broad systems approach to the development of exploitation equipment. With this over-all increase in sophistication, the technical unknowns will rapidly expand producing corresponding increases in the technical risks and the development costs involved. In order to minimize these technical risks and reduce development costs to acceptable levels, NPIC must develop a very systematic and pragmatic approach. First, we must judiciously establish a broad technological foundation based upon a sound research program consisting of prudent studies and selected feasibility breadboarding. We must, at the earliest possible moment in the development cycle,

isolate the component areas of maximum technical risk and establish solutions prior to implementing total systems which may still contain fundamental weaknesses. We must establish multiple-phased programs with prudent milestones and numerous key check points, while at the same time providing an effective R&D management system designed to make maximum utilization of these tools. This is both a methodical and practical approach; however, it is both time-consuming and expensive; nevertheless, in the long run, it will ultimately prove to be cheaper.

Our FY-72/76 R&D projection is based upon anticipated needs in individual program categories. There are assumptions made which may, or may not, prove valid later on. However, the over-all approach is to develop a balanced program with some effort directed toward each category, using the best judgements and estimates now available, and subsequently, scaling the total R&D program to a reasonable level.

Stemming from efforts currently underway, an integrated exploitation system will have evolved early in the FY-72/76 period which will provide a foundation for subsequent research and development concepts. Data from the PI Process Research and Image Analysis and Manipulation programs, for example, will be readily available to locate and define the most significant areas requiring future research and development and will provide specific performance requirements. By the middle or end of this period, automated assistance will be available from the Imagery Interpretation Instruments and Techniques program to provide a significant part of the administrative and collateral information required for exploitation processing on a [redacted] basis. This will include image quality manipulation and evaluation, automatic target location, automatic target changes, current correlated colateral data, and analysis of existing and new data inputs by the interpreter. During the latter half of the planning period, equipment will be developed for appropriate utilization of various forms of unconventional and restored imagery and [redacted] reporting, which will, in

25X1 25X1 25X1 25X1

provide the technical basis for integrating and absorbing into Center operation any radically different imagery inputs from a [redacted] system, which is expected to have considerable impact on the utilization of imagery for intelligence purposes. 25X1

E. Alternatives Considered.

a. One obvious alternative is a continuation of research and development at about our current levels. Conservatively, if we specify one or more of the newly-emphasized, major program areas as being beyond NPIC's compass, and if the National-level exploitation effort is willing to pick up the slack, significant increments could be taken out of the Agency budget picture altogether.

At the other extreme, it would be quite possible to project that the total research and development effort in imagery exploitation--directed toward strategic purposes--could be put under NPIC's direction. This would appear counter-productive, however, in that NPIC does not have either the physical base nor the total operational perspective necessary to perform all the work for all potential users.

Another alternative is that we could encourage a climate in which NPIC's research and development depends to some extent on outside funding, DOD, [redacted] ACDA, etc. This course has the advantage of centralizing talent and resources, but in a practical sense, it requires both initiative and cooperation on the part of other agencies above and beyond contemporary expectations. It may be that by utilizing a system approach, rather than a project-oriented approach, we can make this a practical proposition, inasmuch as direct project control then becomes an unimportant aspect as long as the definition of the final objective is mutual among the sponsors. 25X1

25X1

[redacted]

b. Risks Involved. NPIC has of necessity begun a transition away from the emphasis on "short-term, quick pay-off" projects; since, this "short-term" approach cannot be pursued indefinitely. Most of the obvious projects have been investigated or developed, and while such projects will always have a high priority, we can readily foresee that we can no longer obtain significant major technical accomplishments without first establishing significant preliminary groundwork. The effect of this change will be to reduce risks over the long haul at a relatively modest increase in cost, and perhaps more important, to allow for the insurance of eventual success in over-all programs which are built up of numerous, individual, small projects which are, in themselves, inherently risky.

F. Coordination. NPIC will continue to conduct coordination of research and development activities in accordance with established Agency procedures, and through the mechanism of EXRAND, which provides a unique focal point for exchanges of information. There will be no lessening of the coordinating and up-dating activity NPIC pursues through the dissemination of equipment catalogs and R&D News Notes.

G. Resources Required. In line with the increased level of technology to be developed within the planning period and with changes in the technical areas of emphasis, it will be necessary to expand our technical resources in certain critical areas, such as electro-optics, electronics, and computer technology. The extent to which this will take place will be a direct function of NPIC involvement in future collection systems such

25X1

During the five-year period, a higher level of research and development funds will be needed to pay the costs of phased development contracts with private industry and for other service contracts applicable to modification of equipment on hand, to provide individual consulting services, and for satisfying immediate operational needs.

25X1

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FY-71

Component TSSG/RED

Object Class 11

Planning Level $ _____ (Thousands)

PPBS Discussion Comments during review of 29 Dec

Date 8 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Crucial	Psychologist	GS-13	1	[redacted] recommended will be to use contractor help + hopefully graduation consultation services from ONS - will not strive for slot	25X1 Expanding requirements in the area of human factors research, primarily directed toward in-house support to our operational components, will require the addition of another psychologist to our staff. He will be used primarily for performing in-house data reduction and developing experimental designs with respect to vision studies, PI Test Batteries, and in support of TICOF and other human factors programs.
Crucial	Photo-Scientist	GS-13	1	[redacted] feels he cannot justify this in light of APSD personnel requests when system goes operational	25X1 During FY-70 we began laying a foundation for an expanded program in image analysis, image manipulation, and image restoration in an attempt to lay a broad technical foundation for future R&D programs. Our expanding efforts in this area require the addition of one (1) photo-scientist to help the presently overworked personnel currently assigned to the Imagery Technology Section.
Crucial	Supervisory Photo-Technologist (DC, Advanced Technology Branch)	GS-14	1	This slot shows in FY 71 RED allocation. They please Roots position here. Also GS-13 we lost has been restored. (Present thoughts are this 13 will go to ATS) Because of above no additional will be made for this slot.	With the increased emphasis in image manipulation and analysis and imagery interpretation research starting in FY-70 and continuing through FY-76, the Advanced Technology Branch will expand from its current level of 13 to 15. A Deputy Chief will be needed in order to efficiently direct the efforts of this number of technical people because of the diverse nature of the functions incorporated under this branch. These functions cover a broad spectrum of both contractual and in-house projects in the areas of image manipulation, image analysis, image reconstruction, human factors research, human engineering, and the physiology of vision. This is in addition to the extensive scientific investigations of our in-house Exploratory Laboratory.

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FY-72 - 76

Component TSSG/RED

Object Class 11

Planning Level $ _____
(Thousands)

Date 8 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Crucial	Electro-Optical Engineers	GS-13	2 * (1) FY-72 (1) FY-73		25X1 These engineers will be required to implement the expanding exploitation systems required to efficiently interpret [redacted] programs which will be coming to fruition during the planning period.
Crucial	Optical-Physicist	GS-14	1 FY-72	This slot will be required if [redacted] on again - That's the case -	The growing sophistication of the complex optical systems required for current and future viewing and mensuration systems -- required 25X1xploit the imagery from every more complex acquisition systems-- dictates that we must expand our technical expertise in the area of optical design and fabrication. This position for an Optical - Physicist is in direct response to that requirement.
~~Advantageous~~	~~D&E Technician~~	GS-08	1 FY-72	Rejected	Needed to relieve the Physical Scientist from routine time consuming tasks in order to make them more productive.
Crucial	Physical Scientist (E.E.)	GS-13/14	1 * FY-72		Needed to phase in on real time R&D. Man should have strong background in information theory.

25X1tional ADP Personnel have been requested but are not a part of this exhibit. They are included in the ADP Annex.

25X1 4 people asked for in ADP area
2 ~~needed~~ required because of [redacted]
2 because of Advanced System complexity
at [redacted] meeting pitch to get AID to provide these to us on loan ∴ no personnel requests necessary in FY 72 + 1 in FY 73

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FY-71

Component TSSG/RED

Object Class 11

Planning Level $
(Thousands)

Date 8 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Crucial	Electro-Optical Physicist	GS-14	1	(4 positions required if NPIC gets Phase I charge (2) needed if Phase II + III ops only	25X1 25X1 A physicist will be needed to support the Systems Research Branch in the area of [redacted] This area of Research & Development will grow to major proportions during the FY-72 - 76 time frame and will require the acquisition of specialized technical talent in the area of [redacted]
Crucial	Secretary-Steno	GS-06	1	[redacted] claims we'll have to take this out of present NPIC ceiling allocation.	25X1 A secretary-steno will be required to support the efforts of the above additional people being added to the Division.
				1	NOTE: These personnel have been requested in FY-71 in order that we may recruit and train them to a functioning level during the FY-71 period so that they will be ready to plan and implement a considerably expanded R&D budget during the time frame of FY-72 - 76.

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FY - 72

25X1

Component TSSG/RED

Object Class 26 Supplies

Planning Level $ [redacted]
(Thousands)

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Crucial	Electrical Supplies			[redacted]	Replacements for worn out components. Parts for in-house fabricated experimental equipment. (Tubes, Transistors, Transformers, Relays, etc.) 25X1
Crucial	Mechanical and Optical Supplies				Replacements for worn out or broken components. Components for experiments (lens flanges, shutters, simple lenses, mirrors, filters, etc.)
Crucial	Chemical Supplies				Replacement items required to service the Center and to conduct R&D effort.
Crucial	Replacement parts for Chemical Instrumentation				To cover replacement lamps and columns for the atomic absorption and gas chromatograph instruments respectively.
Crucial	Photographic Supplies (Film, paper, chemicals)				Essential replacement of items required to service the Center and conduct R&D effort.

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FY - 73

Component TSSG/RED

Object Class 26 Supplies

Planning Level $ [redacted]
(Thousands)

25X1

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Crucial	Electrical Supplies			[redacted]	25X1 Replacements for worn out components. Parts for in-house fabricated experimental equipment. (Tubes, Transistors, Transformers, Relays, etc.)
Crucial	Mechanical and Optical Supplies				Replacements for worn out or broken components. Components for experiments (lens flanges, shutters, simple lenses mirrors, filters, etc.)
Crucial	Replacement parts for chemical instrumentation				To cover replacement lamps and columns for the atomic absorption and gas chromotograph instruments respectively.
Crucial	Chemical Supplies				[redacted] -- Replacement items required to service the Center and to conduct R&D effort.
Crucial	Photographic Supplies (Film, Paper, Chemicals)				Essential replacement of items required to service the Center and conduct R&D effort.

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FY - 74

Component TSSG/RED

Object Class 26 Supplies

Planning Level $ [redacted]
(Thousands)

25X1

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Crucial	Electrical Supplies			[redacted]	25X1 Replacements for worn out components. Parts for in-house fabricated experimental equipment. (Tubes, Transistors, Transformers, Relays, etc.)
Crucial	Mechanical and Optical Supplies				Replacements for worn out or broken components. Components for experiments (lens flanges, shutters, simple lenses mirrors, filters, etc.)
Crucial	Photographic Supplies (Film, Paper, Chemicals)				-replacement of items required to service the Center and conduct R&D effort.
Crucial	Chemical Supplies				Replacement items required to service the Center and to conduct R&D effort.
Crucial	Replacement parts for Chemical Instrumentation				To cover replacement lamps and columns for the atomic absorption and gas chromotograph instruments respectively.

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FY - 75

Component TSSG/RED

Object Class 26 Supplies

Planning Level $ [redacted]
(Thousands)

25X1

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Crucial	Electrical Supplies			[redacted]	25X1 Replacements for worn out components. Parts for in-house fabricated experimental equipment. (Tubes, Transistors, Transformers, Relays, etc.)
Crucial	Mechanical and Optical Supplies				Replacements for worn out or broken components. Components for experiments (lens flanges, shutters, simple lenses mirrors, filters, etc.)
Crucial	Replacement parts for Chemical Instrumentation				To cover the replacement lamps and columns for the atomic absorption and gas chromatograph instruments respectively.
Crucial	Photographic Supplies (Film,Paper, Chemicals)				Essential replacement of items required to service the Center and conduct R&D efforts.
Crucial	Chemical Supplies				Replacement items required to service the Center and to conduct R&D effort.

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FY - 76

Component TSSG/RED

Object Class 26 Supplies

Planning Level $ _____
(Thousands)

25X1

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Crucial	Electrical Supplies				25X1 acements for worn out components. Parts for in-house fabricated experimental equipment. (Tubes, Transistors, Transformers, Relays, etc.)
Crucial	Mechanical and Optical Supplies				Replacements for worn out or broken components. Components for experiments (lens flanges, shutters, cimple lenses mirrors, filters, etc.)
Crucial	Replacement parts for chemical instrumentation				To cover replacement lamps and columns for the atomic absorption and gas chromotograph instruments respectively.
Crucial	Photographic Supplies (Film, Paper, Chemicals)				Essential replacement of items required to service the Center and conduct R&D effort.
Crucial	Chemical Supplies				Replacement items required to service the Center and to conduct R&D effort.

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FY-72

Component TSSG/RED

Planning Level $ [redacted]
(Thousands)

25X1

Date 5 December 1969

Object Class 25 Site Preparation

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
25X1 Desirable	Card punch/line printer	[redacted]	1	[redacted]	25X1 Install this item in the EL area on-line to the NPIC computer.

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FY-- 72 - 76

Component TSSG/RED

Object Class 26 Supplies

Planning Level $ [redacted]
(Thousands)

25X1

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Crucial	Paper and steno supplies			[redacted]	25X1 FY-72 FY-73 FY-74 FY-75 FY-76

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FY-72

Component TSSG/RED

Object Class 31 Equipment

Planning Level $ [redacted] (Thousands)

25X1

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Crucial	Forced draft oven		1		25X1 [redacted] has no facility for heating experimental specimens in a precise fashion. The forced draft feature of this unit will provide such capability in the useful temperature range of 40° -- 200°C.
Crucial	Laser		1		Blue Green laser to allow direct readout of the Analog Image Manipulation system. The initial experiments are being done with existing Red lasers which were adequate for experimentation but pose severe limitations for routine use.
Crucial	Large Optical Flats Large Diameter Good Quality Lenses		12 4		Required to extend the small format results of the Analog Image Manipulation program to larger format for routine operational use. The increase in area would be approximately 35X.
Crucial	Microscope Breadboard Set		1		Required to breadboard a special microscope which utilizes the techniques developed in the Analog Image Manipulation program.
Crucial	Monochromator, Special Photomultiplier for Gamma Photometer and Calibrated source		1		25X1 With the acquisition of these accessories spectral-radiometric readings can be made of small areas on [redacted] From this information CIE coordinates could be determined and imaged [redacted] could be exactly defined. 25X1
Essential 25X1 NRO	[redacted]		1		This device would provide direct CIE coordinates from [redacted] samples and larger area photography. This would be necessary for determination of [redacted] reproduction of specific objects. 25X1 NRO
Essential 25X1 NRO	[redacted]		1		These chips would serve as input sources in determing [redacted] of photographic materials. 25X1 NRO
Crucial	High Quality Sensitometer		1		This device would be capable of producing accurate, repeatible exposures in film so processing could be monitored and film evaluated under a white light exposure.

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FY-72

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Component TSSG/RET

Object Class 31 Equipment

Planning Level (Thousands) $ Total included on attached sheet.

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Essential	25X1 NRO		1		This is a temperature controlled processor for rapid development of material. 25X1 NRO 25X1 25X1
Desirable	Card punch/line printer		1		This will enable EL personnel to obtain a listing of R&D information, which has been stored on punch cards, for various NPIC components.
Crucial	Digitized Macrodensitometer for Computer Input		1		This device would produce computer compatible density data that could be manipulated for curve plotting, gamma measurement and statistical analysis for R&D.
Essential	Desk top computer Olivetti		1		Present laboratory calculators do not have sufficient capability to do very many of the tasks required to reduce experimental data. They can't be programmed to handle complex equation. This instrument is also needed to help in the reduction and analysis of in-house Human Factors data.
Crucial	Micro Camera		1		Needed to produce high quality reticles and resolution targets.
Crucial	Un-Conventional Processors		1		If we are to evaluate non-conventional photographic materials, we will need the proper equipment to precisely expose and process these materials. Since it is not known which materials will be available at what time, K is allowed each year to provide the necessary equipment. Cost includes processors for two types of materials.
Desirable	Ultrasonic Cleaner		1		To get sufficient cleanliness for vacuum coating and AIR.
Desirable	Thickness Gauge		1		Needed to increase the labs capability to deposit optical coatings accurately.

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FY - 73

Component TSSG/RED

Object Class 31 Equipment

Planning Level $ [redacted] (Thousands)

25X1

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
25X1 Crucial	Non-Conventional Processor	[redacted]	2	[redacted]	25X1 Continuation and improvement in EL's capabilities for evaluating non-conventional photographic materials.
25X1 Crucial	[redacted] Experimental equipment				During the next two years [redacted] systems will be a reality. This expenditure will provide equipment for basic experimentation with imagery so acquired.
Essential	Misc. Interference Filters		15		These filters allow precise exposure of narrow wavelength bands as would be necessary to isolate individual layers of [redacted] 25X1 NRO
Essential	NuArc Printer Lamp		1		To work with interference filters above.
Crucial	Laser		1		Existing lasers will be beyond their life expectancy and replacement be more practical. The only relatively new laser will be in use in a specific program. The others will all be vintage 1965 or older.

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FY-74

Component TSSG/RED

Object Class 31 Equipment

Planning Level $ [redacted] (Thousands)

25X1

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
25X1rucial	[redacted] Experimental Equipment				25X1 To expand the capability for basic experimentation and analysis of the output of [redacted] systems.
25X1 Crucial	Sensitometric Processor		1		Continuation and improvements in the EL's capabilities for evaluating non-conventional photographic materials.
Essential	Replacement Filters (interference)		7		Filters are delicate and are easily broken; therefore, replacements must be available.
Essential	Replacement Munsell Chips		1		Chips will be handled and are easily damaged. Replacements must then be available.
Essential	[redacted] 25X1 NRO		1		Modified light source filters if a new standard "D" source is established.

17

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FY - 75

Component TSSG/RED

Object Class 31 Equipment

Planning Level (Thousands) $ [redacted] 25X1

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
25X1 Crucial	[redacted] Experimental Equipment			[redacted]	25X1 expand the capability for basic experimentation and analysis of the output of [redacted] systems.
Crucial	Sensitometric Processor				25X1 Continuation and improvements of the Laboratory's capabilities in evaluating non-conventional photographic materials.
Essential	Ektamatic Processor		1		25X1 25X1 vice for stabilization print and film processing for rapid access work. 25X1 NRO
Essential	[redacted]		10		Needed for measuring resolution of various [redacted]
Essential	[redacted] 25X1 NRO		1		Recalibration of equipment, and modification of available equipment will be needed to update standards, etc.

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FY-76

Component TSSG/RED

Object Class 31 Equipment

Planning Level $ [redacted] (Thousands)

25X1

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
25X1rucial	[redacted] Experimental Equipment				25X1 To expand the capability for basic experimentation and analysis of the output of [redacted] systems.
Crucial	Improvements to Sensitometric Processor				25X1 Continuation and improvement in EL's capabilities for evaluating non-conventional photographic materials.
Essential 25X1	Misc. Photo-Equipment in support of [redacted] systems				Photographic Apparatus(processing, exposing, etc.) will need modification to be used in combination with CRT type imagery.

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FY - 72 -- 76

Component TSSG/RED

Object Class 41 Grant Program

Planning Level $ [redacted] (Thousands)

25X1

Date 5 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Crucial	RIT Grant Program			[redacted]	25X1 W25X1 provide low cost senior and graduate level research investigators in the fields of photo-physics and photo-chemistry and other areas of mutual interest. Planned for the [redacted] level for each of the years FY-72 -- 76.

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FY-71

Component TSSG/RED

Object Class 21

Planning Level $ _____
(Thousands)

Date 9 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Critical	Travel (FY-71)			$	25X1 This travel is required to: 1. Monitor Research & Development contracts for the purpose of assuring contractor compliance with technical and contractual specifications and successful delivery of the final product desired. It is an essential element of Research & Development management; 2. Review current Government and industrial R&D efforts and determine contractor capabilities and their knowledge of the state-of-the-art; and 3. Provide technical coordination and liaison with the developers of new acquisition systems to obtain information for the Center's Research & Development effort and for the operational components, on the nature and impact upon the Center's operations of changes in reconnaissance technology; 4. Contact professional consultants to discuss existing and anticipated problems and attend professional meetings and seminars for the purpose of expanding the technical and managerial capabilities of assigned scientific and engineering personnel. Travel for items (1), (2), and (3) is considered to be Priority I, critical. Travel for item (4) is considered to be Priority 2, advantageous. This item is small and makes up only 5 per cent of RED's total travel costs.

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FY-72 - 76

Component TSSG/RED

Object Class 21

Planning Level $ _____
(Thousands)

Date 8 December 1969

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments
Critical	Travel (FY-72) Travel (FY-73) Travel (FY-74) Travel (FY-75) Travel (FY-76)				25X1 This travel is required to: 1. Monitor Research & Development contracts for the purpose of assuring contractor compliance with technical and contractual specifications and successful delivery of the final product desired. It is an essential element of Research & Development management; 2. Review current Government and industrial R&D efforts and determine contractor capabilities and their knowledge of the state-of-the-art; and 3. Provide technical coordination and liaison with the developers of new acquisition systems to obtain information for the Center's Research & Development effort and for the operational components, on the nature and impact upon the Center's operations of changes in reconnaissance technology; 4. Contact professional consultants to discuss existing and anticipated problems and attend professional meetings and seminars for the purpose of expanding the technical and managerial capabilities of assigned scientific and engineering personnel. Travel for items (1), (2), and (3) is considered to be Priority I, critical. Travel for item (4) is considered to be Priority 2, advantageous. This item is small and makes up only 5 per cent of RED's total travel costs.

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