

Ret to
[Redacted Box]

29 December 1960

III. Information Processing and Exploitation

Background

The NPIC Research, Development and Engineering effort primarily supports the Center in carrying out the responsibilities assigned to it by the approved JIRG recommendations. Additionally, in accordance with NSCID No. 8, it serves the imagery exploitation community as a whole. The COMERAM Subcommittee on Exploitation Research and Development provides a forum for exchange of information among the agencies concerned with respect to their imagery R&D programs; NPIC can also call upon the subcommittee for advice and recommendations as appropriate.

Objectives

The broad objectives of the Center's ^{RDTE} program for the next five years are:

- to increase the efficiency of the exploitation process and the quality of the product;
- to improve the Center's capability and capacity to receive, reproduce, store and retrieve imagery and imagery-related materials.

- to develop concepts for exploitation of new imagery acquisition systems and to develop the equipment and procedures necessary to the implementation of these concepts.

Implicit in these objectives is the aim of enabling the Center to perform more and better work without significant increases in manpower.

3. Imagery

a. Overhead Photography

b) Imagery Interpretation Research/Human Factors

Objective: To develop an understanding of the specific inherent or acquired human characteristics involved in the various aspects of the imagery exploitation process and to apply that understanding to such activities as recruitment and training of personnel, modification of procedures, redesign of equipment, alteration of working environment, and adaptation of personnel to exploitation of new systems (e.g. [redacted])

25X1

25X1

Progress

1) A comparison of the achievements and skills of analysts receiving on-the-job training and of those who attended the 12-week Defense Sensor Interpretation and Application-Training Program clearly showed the superior benefits of the Defense training program; as a result,

all new Imagery analysts are scheduled for this program.

2) A preliminary validation of an Agency-administered Imagery interpretation test battery for use in evaluating applicants was made, and development of an Imagery Analyst Target Knowledge Inventory was initiated. This inventory

will serve as the basis for developing an in-house training course to supplement the Defense Training Program.

c) Comparative tests to measure the performance of imagery analysts and photogrammetrists were designed and administered; the results showed that imagery analysts could satisfactorily perform a number of mensuration tasks which had previously been thought to require the services of a skilled photogrammetrist.

d) A Technology Integration Check-Out Facility has been developed for gathering imagery analyst performance data under controlled conditions.

Program Plans

During FY 1970 the development of the supplementary in-house training program should be completed. Research to determine the effect of the convergence angle of optical instruments on visual performance will be *continued* ~~initiated~~ in FY 1970 and completed in FY 1972. During FY 1971-73, the "human engineering" aspects of exploiting [redacted] will be examined, with a view to utilizing the findings in the development of procedures and equipment for exploiting this type of film. By FY 1973, the basic system design for [redacted] [redacted] is expected to be sufficiently firm and detailed.

the progress 3 years program mentioned should be included

*Insert * attached*

25X1

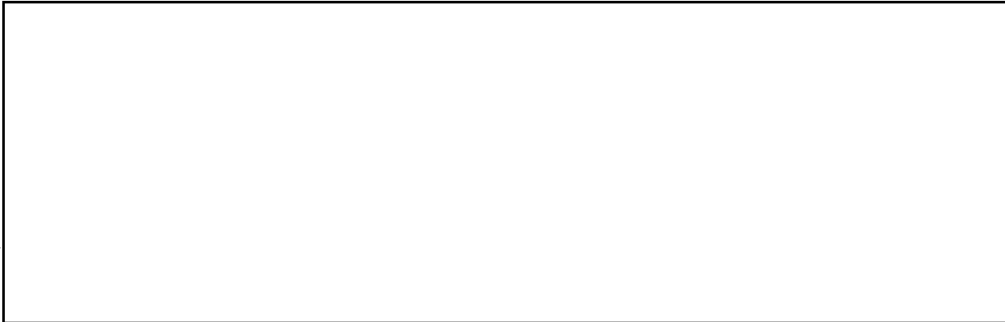
25X1

25X1

as to permit identification and investigation of some
of the human characteristics which will affect exploita-
tion of A large degree of flexibility is inherent
in this project, since many areas of human-equipment,
human-imagery and human-human interface which affect
the efficiency and quality of imagery interpretation
can not be recognized in advance of actual experience.

25X1

25X1



"A"

(e) Utilizing a five-year projection approach, the functions of the imagery analyst and collateral support officer were analyzed to determine possible areas of applicability for automation of manual operations.

(f) In the future, photographic imagery may well be supplemented for analysis purposes by line-scan imagery (cathode ray tube). An elementary study was undertaken to determine the level of resolution of line-scan imagery, as compared with photographic imagery, deemed necessary for exploitation by the imagery analyst.

(g) A review of articles pertaining to imagery exploitation research was conducted, and those relevant to Center operations were abstracted. Contacts were established with industrial and governmental research and development facilities for the purpose of obtaining, on a continuing basis, human factors information pertinent to exploitation equipment design. The PI Equipment Human Engineering Design Guide, a summary of physiological and engineering information applicable to the design of imagery exploitation hardware, was updated by inclusion of specific sections pertaining to acoustics and comparators.

(h) Recent studies have indicated that the convergence angle of microstereoscope eyepieces might influence visual performance; preliminary research was undertaken to determine the effect of the convergence angle of optical instruments on visual performance.

C. Imagery

1. Overhead Photography

a. Imagery Interpretation Research/Additive Info

Objective: To identify and evaluate the unique or additive information extractable from [redacted] other unconventional imagery and determine the quality of imagery needed to meet requirements for this information.

25X1

Progress: In FY 1969 a project was initiated to obtain

[redacted] together with the corresponding ground truth information. This effort will correlate ground truth with the imagery obtained, and provide data which should enable conclusions to be drawn as to the additive or complementary information

which an [redacted] could provide, as compared with black and white imagery. In-house studies on the intelligence value of [redacted] were begun in FY 1969.

25X1

Program Plans: During FY 1971 and 1972, the studies of

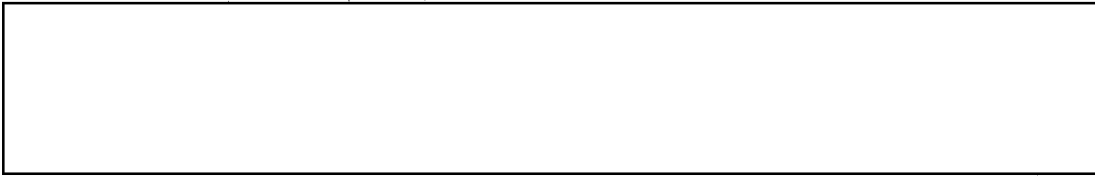
[redacted] will continue with emphasis on various selected target types and on the level of resolution needed to meet requirements for additive information. ~~During~~ ^{starting in} FY 1974, the in-house study of [redacted] will be supplemented

25X1

25X1

by contextual studies directed toward precise
determination of the which are most significant
in reading out certain types of targets and meeting
selected requirements. During ^{the time frame} ~~FY 1973-1975~~ studies
will be initiated on ^{other} ~~other~~ unconventional systems

ILLEGIB



C. Imagery

1. Overhead Photography

B. Imagery Information Technology

Objective: For obvious reasons, the consumers of imagery-derived information wish to have such information made available to them with the minimum possible delay. At present, however, the processes of reporting information derived from imagery and of updating data files, graphics, and collateral files are cumbersome and time consuming. The objective of this project is to develop and have in operation by FY 1976 a cost effective, integrated automated system for storage, retrieval, manipulation and display of imagery, information derived from imagery, collateral materials and graphics used in the analysis and reporting cycles of the exploitation process. This system will have the capability for on-line editing of both textual and graphic material.

Progress: Certain portions of the proposed integrated system have been or are being developed. NPIC has an Integrated Information System (IIS) now operational, which provides the photo-interpreter, on an automated and primarily off-line basis, with existing imagery-derived and collateral data on any given target with

which he may be concerned. Parts of the National Data Base of Imagery-Derived Information (NDB) are now maintained on an automated basis (Installations Data File, Measurement Parameters File, and Exploitation Products Data File.) Various aspects of the man-machine interface involved in an automated information system have been investigated as part of the Imagery Interpretation Process Research Project. A completed contractual effort comprising the development of certain computer programs and techniques, has demonstrated the feasibility of a cathode ray tube graphics and textual display system.

Program Plans: A study contracted for in FY 1969 will be completed in FY 1971 and provide NPIC with several alternative plans for using Photo-Chips as an informational medium and to assist in the exploitation and reporting processes. In FY 1970-71, prototype, automated on-line textual and graphic display consoles embodying an editorial capability will be developed and operationally evaluated. During this phase, advantage will be taken of any applicable developments underway in ORD. Based upon evaluation of these prototypes, operational models will be developed as required in FY 1972-73. Amalgamation and integration of the overall system is planned to take place in the FY 1974-76 time period.

Alternatives: In view of the intensive activity and rapid pace of developments in the field of information management, storage and retrieval both in private industry and government, consideration was given, as an alternative, to postponing action by NPIC in the expectation that a suitable system would become available and could be obtained at less expense. In view of NPIC's unique requirements, however, it is believed highly unlikely that any system meeting them would become available during the next five or six years. NPIC will, however, be alert to developments elsewhere in government and in industry, to take advantage of any equipment or techniques applicable to this project.

Resources

FY 1969 1970 1971 1972 1973 1974 1975 1976

3. Imagery

1. Overhead Photography

c. Image Analysis and Manipulation/Standards

Objective: There ^{are} ~~is~~ in general use today ^{criteria} ~~a set of~~ objective standards by which the quality of conventional imagery and the efficiency of various optical and photographic equipment are measured. ^{Practical} ~~The~~ application of these standards, however, often brings results which do not ^{correlate} ~~coincide~~ with the "subjective" judgments of photo-interpreters who are concerned with the effectiveness of imagery and ^{exploitation} ~~equipment~~ in conveying information. ~~data~~
The objective of this ^{program} ~~project~~ is to identify and correlate objective and "subjective" criteria and standards, and to develop a revised set of objective standards for evaluating ^{the} quality and efficiency of ^{imagery : exploitation} ~~film~~ and equipment from an intelligence point of view.

Progress: A contract study completed in FY 1969 has analyzed the present state of the art in photo-optical image evaluation and recommended a program of fundamental and applied research to establish a ^{quantitative} ~~qualitative~~ relationship between the most promising of the objective measures of merit and subjective quality criteria developed through ^{extensive} ~~psychological~~ experiments.

Program Plans: In FY 1970, a contract study will be completed which seeks to establish the basic conditions for evaluating optical components, applying the recommendations previously developed on the relationship of subjective and objective criteria. During ~~the same year~~ another study will be completed establishing requirements for microdensitometric analysis of black and white photography for use in objective assessment of quality. Other milestones are: FY 1972, complete the study of objective evaluation techniques; FY 1974, complete the study of subjective evaluation measures; FY 1975, determine the correlation procedures for relating objective and subjective evaluation.

25X1

Alternatives: Objective evaluation of photography involves an understanding of the basic, fundamental and theoretical nature of imagery, on which relatively little significant research has been accomplished. ^{f.d.s} Similarly little fundamental research has been done on the mechanism of subjective evaluation. The two obvious alternatives, therefore, are (1) limit work in these areas to the pace of fundamental research taking place in the scientific community or (2) embark on a thorough and extensive program of fundamental research. NPIC has rejected both

alternatives in favor of a pragmatic approach, relying largely on outside basic research, but supplementing it with contractual studies in specific areas of particular concern to the Center's activities.

Resources:

FY 1969 1970 1971 1972 1973 1974 1975 1976

3. Imagery

a. Overhead Photography

1. Image Analysis and Manipulation/Image Enhancement

Objective 1: To develop by FY 1976 an integrated operational image manipulation system with the capability to compensate for image-degrading factors which occur during acquisition and/or processing of conventional imagery by digital, optical, photographic or electronic techniques at the option of the photo-interpreter.

Progress: The techniques of optical, photographic and electronic manipulation are fairly well understood and are now being applied on a limited scale to conventional imagery by NPIC. Fundamental research in the area of digital manipulation, using non-operational photography and experimental computer programs is proceeding satisfactorily.

*Insert
attached*

Program Plans: During FY 1970-71, experiments will be undertaken in NPIC on digital enhancement and restoration of operational photography, utilizing computer programs already developed and equipment made available by ORL. In-house experimentation on optical, photographic and electronic manipulation techniques will continue. By FY 1972, it is anticipated that the operational

-X-

applications of all four techniques can be determined and evaluated. During FY 1973-75 the necessary equipment for an integrated operational system will be developed.

Resources:

FY 1969 1970 1971 1972 1973 1974 1975 1976

~~-X-~~

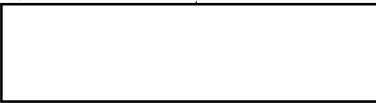
X
2. Image Manipulation

The capabilities of digital, optical, and photographic manipulation systems are being explored by the Center with contractor support. Preliminary results of experiments designed to extract additional intelligence of value from degraded imagery through a digital process are favorable. The evaluation of results in each system will determine the maximum payoff to be gained by (1) the application of one of the above systems, (2) establishing a capability in each system to be applied selectively against specific conditions, and (3) development of a hybrid system to incorporate the relative advantages of more than one system. Time-phased plans are under development for evolution from experimental to operational status. As part of the manipulation effort, imagery enhancement techniques for improving degraded portions of film are being explored and developed for digital and electronic modes.

C. Imagery

1. Overhead Photography

d. Image Interpretation Instruments and
Techniques/ETR



ILLEGIB

Objective: To develop by FY 1974 a capability for automatically recognizing, counting ^{and} ~~and detecting changes~~ ^{man-made objects} ~~and also detecting changes in target complex status,~~ in man-made objects on black and white imagery.

Program: Investigations into the feasibility of developing ~~the~~ ^{human} capability were initiated late in FY 1966.

As a result of these studies, it was decided that the first concrete step should be the fabrication of a Target Inboxing Device which would provide automatically a yes or no decision as to whether a specified target is or is not cloud covered. In FY 1969, the feasibility of two ^{techniques} techniques for cloud screening -- an optical and an electronic ^{method} -- was demonstrated. Of the two approaches, the optical could be more immediately developed into a working system, while the electronic technique ^{was of the highest priority} offered greater potential for further development ^{to perform target recognition and counting functions.} to perform target recognition and counting functions.

After a careful review early in FY 1970, it was decided:

- (a) a system using the optical technique, but improved to provide cloud cover data both for specific targets

and general area coverage, should be fabricated and delivered to NPIC for test and evaluation; (b) an

improved electronic ~~screening breadboard~~^{system} to perform both cloud screening modes should be ~~built and~~^{modified by}

demonstrated. ~~and general demonstration and experimental~~

Program Plan: The optical cloud screening device will be delivered to NPIC early in FY 1971. Late in FY 1971

the electronic breadboard should be completed ~~and demonstrated~~

Dependent upon the results of experimentation with the electronic device, a capability to automatically

identify man-made objects on imagery ~~should~~^{will} be established

by the end of FY 1972. Techniques for automatically detecting target changes and scanning for specific types

of targets should be developed by FY 1974.

Resources:

FY 1969 1970 1971 1972 1973 1974 1975 1976

C. Imagery

1. Overhead Photography

d. Image Interpretation Instruments and Techniques, [redacted]

25X1

Objective: It is anticipated that during the latter half of the planning period there will be a significantly increased use of [redacted] in overhead reconnaissance. The objective of this project is to develop the equipment needed to exploit effectively and economically the increased volume of these types of imagery.

25X1

Progress: The limited amount of [redacted] currently being received provides some experience with the practical problem involved in its exploitation. Studies are now underway with respect to [redacted] at different resolutions.

25X1

replace with [redacted]

25X1

Program Plan: By the end of FY 1971, sufficient experience and data will have been acquired to permit the development during FY 1972 of basic [redacted] interpretation equipment. During FY 1973, special [redacted] interpretation equipment and experimental [redacted] interpretation equipment will be developed.

25X1

25X1

25X1

Resources

FY 1969 1970 1971 1972 1973 1974 1975 1976

PROGRESS: The limited amount of high resolution [redacted] film currently received has already provided some basic experience with the practical problems involved in the exploitation of [redacted] imagery. A [redacted] program has been formulated and is currently being reviewed by Center management. Many of the key areas requiring immediate R&D action will be isolated and corrective action initiated in FY-70. Studies are now underway with respect to [redacted]

25X1

25X1

ILLEGIB
ILLEGIB

3. Imagery

a. Aerial Photography

1. Image Interpretation Instruments and Techniques/Modifications

Objective: To develop modifications and improvements in existing imagery interpretation equipment.

Progress: When new equipment becomes operational, additional development or modification needs are frequently surfaced, sometimes arising from practical working experience with the equipment, sometimes resulting from concepts originating with imagery analysts. Over the past years, AFIC has maintained a fairly steady effort in modifying and improving imagery analysis equipment on hand.

ILLEGIB

ILLEGIB

Program Plan: A general level of effort is planned for this project.

Specific modifications and improvements will be undertaken as the need for or advantages of them are identified.

Resources:

FY 1969 1970 1971 1972 1973 1974 1975 1976

c. Imagery

1. Overhead Photography

d. Imagery Interpretation Instruments and Techniques/
Conventional Equipment Development and Modifications

Objective: To develop modifications and improvements in existing imagery interpretation equipment and to initiate new equipment developments as required for efficient imagery exploitation.

Progress: When new equipments become operative, additional development or modification needs are frequently surfaced, sometimes arising from practical working experiences with the equipment and sometimes resulting from new concepts originating with imagery analysts. Over the past years, NPIC has maintained a fairly steady effort in modifying and improving imagery analysis equipment on hand and initiating new equipment developments as determined necessary for efficient imagery exploitation. Examples of the above are the following:

a. An automated stereo scanner ^{under} development ~~is~~ is designed to permit automatic stereo scanning of roll film. It will be used to evaluate the operational feasibility and value of scanning in stereo.

b. A digitized light table for use by the imagery analyst has been developed under FY-70 funding. This equipment will allow the PI to perform certain mensuration functions without using complex equipment.

c. 1540 Light Table was designed and developed for efficient exploitation of [redacted] 25X1

d. Stereo Rhomboids required for viewing [redacted] in stereo are under development. 25X1

e. The development of new objective and measuring eye pieces has increased the flexibility of our high powered stereo viewers.

f. In FY-70 *developments will be initiated for* better film drives and light sources will be developed to retrofit to our present operational light table complex. *& other similar equipment.*

Program Plan: A systematic and pragmatic continuing level of effort is planned for this program. Specific equipment developments, modifications and improvements will result from operational requirements and experiences with new equipment and changes in acquisition inputs.

Resources:

FY-1969 1970 1971 1972 1973 1974 1975 1976

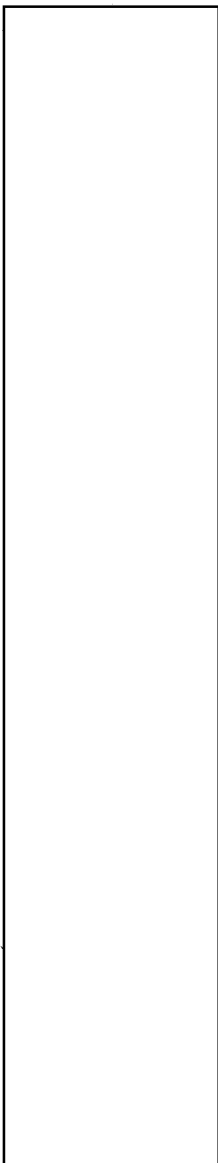
c. Imagery

1. Overhead Photography

a. Reproduction/Dry Processing

Objective 1: Dry process reproduction of image materials offers a number of advantages over conventional wet processing methods, including savings in space, elimination of handling of bulk chemicals, greater flexibility and speed, and reduction in the amount of silver used. The objective of the NPIC effort in the field is to develop by FY 1972 a satisfactory dry process operational system applicable to black and white imagery, and by FY 1976, a system applicable to other types of imagery.

Progress: Dry diazo film and paper capable of good quality positive to positive reproduction have been developed and will be available in quantity during FY 1970. Diazo, however, meets NPIC needs only in part, primarily because it is not possible to alter or adjust the ~~contrast~~ ^{contrast} with diazo film and paper. ^{This means that the original grey levels} Dry silver paper has reached a commercially useable level of development, ^{which has} and by FY 1971 should meet NPIC's quality requirements. ^{Zoll} film dry processors ^{has recently been developed} have been developed and are now in use. ^{the process of evaluation}



Program Plans: By FY 1971, development of two types of dry-film processors will be completed, a 12 inch processor for use by individual PI's in making density cuts and transparent file copies and a 40 inch processor for making enlargements. By the end of FY 1972, development of a satisfactory dry silver positive acting film should be completed. During FY 1971 and 1972, it is probable that requirements for additional new processing equipment will be identified and developmental work initiated. In FY 1972, the feasibility of applying dry processing to other types of imagery (e.g.) will be examined. If feasibility studies are favorable, work in this direction will be initiated in FY 1973.

for steps to get Po, has print from a

which would require only one step

Resources

FY 1969	1970	1971	1972	1973	1974	1975	1976
---------	------	------	------	------	------	------	------

25X1

C. Imagery

1. Overhead Photography

e. Reproduction/Wet Processing

Objective 1: At least through FY 1976 and perhaps beyond, it will be necessary for NPIC to retain ~~a~~ ^{effective} ~~considerable~~ wet film processing capability, ⁱⁿ order to deal with and other unconventional film and ^{to} meet certain ^{highly} specialized reproduction needs. It is unlikely that industry will develop equipments for commercial uses which will meet all the ^{uniquely high} standards of resolution, speed and flexibility required for intelligence exploitation. It is NPIC's objective to adopt, ^{modify} and upgrade, where possible, commercial equipment to meet its requirements, and to develop ^{new} ~~its own~~ equipment

in those cases where commercial equipment is unavailable ^{or totally inadequate} ^{necessity} ^{strict} ^{standards} to our ^{employment}

Progress: Because of the very limited ^{and highly} experimental ^{nature} ~~employment~~ of unconventional imagery ^{utilized} in

overhead reconnaissance up to the present, NPIC is ^{currently} using standard commercial equipment.

Program Plans: In view of the ^{vastly improved resolution capabilities of modern} likelihood that use of ^{color} ~~color~~ film will be expanded with the advent of the ^{the} 25X1

late in FY 1971, it is planned to up-grade NPIC's

25X1

capability for processing beginning early in

FY 1971. ^{1/10/71} Development of equipment for processing ^{and printing}

25X1

 ^{is contained} ~~will be~~ initiated in FY 1972.

Resources:

FY 1969 1970 1971 1972 1973 1974 1975 1976

3. Imagery

1. Overhead Photography :

a. Mensuration

Objective: To improve the precision of mensuration accuracy statements and the efficiency of the mensuration process. This involves isolating and defining the relative and absolute values of those factors which contribute to mensuration error, minimizing their effects, and automating certain aspects of the process. Error factors can relate to the source material, the collection vehicle, the mensuration equipment, and the operator.

by developing the necessary equipment

Progress: A high-precision stereo comparator, now in late stages of development, will be delivered in FY 71. Mensuration equipment for

efficient use by the imagery analyst on both cut and roll film ~~is also~~ *has been delivered and is currently under going extensive test & evaluations,* in the later stages of development. In-house studies were made to identify

the various sources of mensuration errors; this information will be *utilized*

as a foundation for further study of their effect upon mensuration procedures and equipment *and should result in superior specifications for future mensuration equipment.*

Program Plans: Continuing in FY 1971, in-house study, supplemented by contractual assistance, will be directed toward further understanding of mensuration error factors. Effort will be expended toward developing medium-accuracy stereo mensuration equipment to fill a current gap between ultra-precise and course-accuracy instruments and toward adapting instruments

for color materials. Emphasis will be placed upon automation of mensuration *task on the development of* and quick response, high reliability, and easily maintained mensuration

instruments. Efforts will be made to combine the better features of a manual comparator and a microdensitometer
Resources: *in a single versatile instrument for help in measuring marginal images.*

FY 1969 1970 1971 1972 1973 1974 1975 1976

C. Imagery

1. Overhead Photography

g. Test and Evaluation

Objective: NPIC has developed or has under development equipment and instruments of a high degree of sophistication and accuracy. *Due to their unique nature, few* There are ~~no~~ devices or techniques available which are capable of determining the functional acceptability (i.e. fulfillment of contract specifications) of some of these *highly specialized* equipments when they are delivered by the manufacturer. The objective of this effort is to develop the required instrumentation, techniques and standards to make such determination, when they are not available from industry.

Progress: Over the past few years, NPIC has developed

a small in-house Test and Evaluation Laboratory, ~~where~~ *where* ~~these~~ *towards establishing standards* efforts have been supplemented by contractual assistance *which* ~~is~~ *will lead to* the development of specialized test equipment and

techniques. During FY 1969, arrangements were made with the National Bureau of Standards *design and* to develop resolution test equipment *use in evaluating* for the dry process reproduction materials now under development. As part of this effort, a special sensitometric processor is being *considered for development* ~~developed~~ in FY 1970. During FY 1970, a special target is being

developed for use in making objective measurements of the performance of optical components.

~~to be used.~~

Program Plans: During FY 1972 and 1976, special calibration devices will be developed and performance evaluation standards established for the High Precision

Stereo Comparator and the Automated Stereoscanner.

microstereoscope, Dry Silver materials and equipment, light tables, resources and equipment for producing and viewing slides.

FY 1969 1970 1971 1972 1973 1974 1975 1976

SECRET

(When Filled In)

Component _____

Planning Level \$ _____
(Thousands)

Date _____

Object Class _____

Priority	Item	Unit Price	Quantity	Total Price	Justification/Comments

SECRET

(When Filled In)

UNCLASSIFIED	CONFIDENTIAL	SECRET	
OFFICIAL ROUTING SLIP			
TO	NAME AND ADDRESS	DATE	INITIALS
1	File - 5 year plan		
2			
3			
4			
5			
6			
ACTION	DIRECT REPLY	PREPARE REPLY	
APPROVAL	DISPATCH	RECOMMENDATION	
COMMENT	FILE	RETURN	
CONCURRENCE	INFORMATION	SIGNATURE	
Remarks:			
<p>This is a copy of the R+D 5 year plan after modification by [redacted]. My suggested modifications were not forwarded to [redacted]. [redacted] has seen this & altho sympathetic with our position did not want to pass the suggestions on.</p>			
FOLD HERE TO RETURN TO SENDER			
FROM: NAME, ADDRESS AND PHONE NO.			DATE
			JAN 1973
Approved For Release 2005/11/21 : CIA-RDP78B05171A000500010008-6			
UNCLASSIFIED	CONFIDENTIAL	SECRET	

25X1

25X1

25X1

BEST COPY

Available