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DEPARTMENT OF THE AIR FORCE
MANNED ORBITING LABORATORY, SYSTEMS PROGRAM OFFICE (OSAF)
AF UNIT POST OFFICE, LOS ANGELES, CALIFORNIA 90045



19 FEB 1968

MEMORANDUM FOR GENERAL STEWART

SUBJECT: Special Materials Support Requirements for MOL

The manned MOL flights, as currently baselined, will support not only the early development of the unmanned automatic flights, but also will provide for the evolution of techniques to enhance qualitatively and quantitatively the value of the intelligence collected. All flights, manned and unmanned, require precise knowledge of the location of each aiming point. To realize the further enhancement of collected intelligence possible in manned flights, it will be necessary to train flight crews, utilizing special stimulus materials, and to provide them with target cues for use on board the spacecraft.

We have worked for some time with specialists in this field, and we have completed our assessment of what will be required for the orderly and timely development of this segment as a system. Key to the systematic accomplishment of this task is the development of a Master Chip File (Attachment 1) which consists of highly controlled master photographic negative chips of each designated MOL-DORIAN target installation. These chips will constitute the primary reference source materials for the identification and location of MOL-DORIAN aiming points, and they will also be the master negative from which the operational cuing target materials and cue-derived training materials will be produced.

We are now at the point where increased support will be required in the actual preparation of the special materials we need. The capabilities of the several agencies which could furnish this support have been evaluated, and we have concluded that we should continue utilization of ACIC for this purpose. As you are aware, ACIC does possess an extensive technical capability and much experience in similar support activities. ACIC is also currently providing stimulus materials support for our mission simulators. An increased role would constitute a significant expansion of ACIC's current support; however, it would consolidate this type of support within a single government agency and eliminate the need to coordinate the activities of several agencies.

Providing the required support involves several functions which require long lead times. The preparation of a Master Chip File, for example, will require approximately 28 months. ACIC is willing to

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assume the responsibility for providing the support if they are assigned the task through AFNIN channels. ACIC personnel have briefed Gen Thomas and he has given his tentative approval. In order to assure support of a first manned launch in August 1971, we should initiate a request for increased ACIC effort by the end of FY68.

ACIC proposed to Gen Thomas that all funding for additional ACIC manpower be handled in the same manner as is presently employed in funding ACIC support to currently operating NRO projects, i.e., through DIAMC funding. If manpower funding is accomplished in that manner, direct program funding by MOL would be required only to develop and procure program-peculiar equipment and software necessary to produce the cues and cue-related materials. ACIC estimates that this can be accomplished for a total of approximately \$1.5 million, equally allocated over FY's 1969, 1970, and 1971.

Attached is a study which develops in more detail our current status and our considerations for effort needed in the future. I believe we are now ready to commit to the additional effort I have described. I would appreciate your views on this matter. Should you agree with my conclusions, I will ask Col R. S. Buchanan to assist you in the preparation of any necessary correspondence or documentation needed to get these activities under way.

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Special Materials
Support for MOL-
DORIAN Manned
Missions

J. S. Blymaier
J. S. BLEYMAIER
Major General, USAF
Deputy Director, MOL

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ATTACHMENT 1

SPECIAL MATERIALS SUPPORT

FOR

MOL-DORIAN MANNED MISSIONS

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INTRODUCTION

The current MOL-DORIAN system design baseline includes the essential equipment, equipment operating procedures, and software requirements which will permit the flight crew to demonstrate its ability to enhance the performance effectiveness of the MOL-DORIAN system. However, other essential support requirements must be identified and satisfied in order to assure an adequate demonstration. The use of the flight crew members in MOL-DORIAN mission operations will require more preparation (flight crew training and simulation activities) and support (special materials, etc.) than would be required for an unmanned and purely automatic photographic reconnaissance satellite system. This attachment has been prepared to cover only that portion of the essential support requirements which pertain to reference/stimulus materials, i.e., cues, cue-derived materials, and other associated materials.

MATERIALS SUPPORT REQUIREMENTS

Cues

MOL-DORIAN system development activities have identified the need for reference/stimulus target materials and other information (cues) for on-board use by the flight crew during pre-pass study and active pass activities. The MOL-DORIAN system design baseline has provided for the procurement of the equipment and related software and techniques, but the actual materials support (including the equipment, techniques, and software necessary to prepare and produce the materials) is not presently provided for.

The cues must be capable of providing an acceptable means of assisting the individual flight crew members in rapidly identifying and locating designated reconnaissance targets (referred as "aiming points" in MOL-DORIAN operations planning). Because of the limited time available for cue viewing by the crew members, the cues must be provided in a manner that will permit automated retrieval and presentation to the crew members at the exact times they are required during the mission.

It is assumed that MOL-DORIAN aiming point designations will be established in advance by the appropriate agencies of the intelligence community, and it further is assumed that the designated aiming points for any MOL-DORIAN manned mission will be identified some reasonable point in time prior to the scheduled launch of the flight vehicle for

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that mission. It is recognized that there might be exceptions based upon near real time intelligence information requirements; however, such exceptions cannot accurately be predicted and included in the determination of cuing requirements for any single mission. Target priority, on the other hand, reflects the selective urgency (assigned by the intelligence community) to the need for information on a particular designated target. Although initial priorities can be expected to be assigned prior to the launch of any manned MOL-DORIAN mission, it can also be expected that such priorities will change during the course of the mission as the intelligence community or the mission ground control elements exercise their prerogatives to change priorities on a near real time basis in response to changes in the relative urgency of the need for certain types of intelligence information. Therefore, in order to provide the capability to respond to continuous mission direction from the ground, it is anticipated that the orbiting vehicle will carry sufficient cues to cover all aiming points identified in the designated MOL-DORIAN target list for each mission.

Information supplied for planning purposes indicates that there will be some 4,000 to 5,000 designated potential target installations against which the manned MOL-DORIAN vehicles could be employed on any single mission. Intelligence community activities conducted in an attempt to convert the installation figures into specific MOL-DORIAN targets (aiming points) have resulted in an estimate that there will be between 13,000 and 14,000 designated potential aiming points against which the manned MOL-DORIAN vehicles could be employed on any single mission. Operational evaluation of the cue requirement has determined that two separate types of cuing target materials (1.5 nautical mile field of view for pre-pass study, 3.0-5.0 nautical mile field of view for active pass operations) are required, that more than one aiming point can normally be accommodated on an individual cuing target material product, and that some duplication of identical products will be required due to orbital factors and the limitations of the available cuing target material retrieval and presentation equipment. Since it is visualized that a complete and independent set of these cuing target materials will be provided for each crew member, two complete sets of these materials, consisting of approximately 10,000 individual products per set, are planned to be carried in the orbiting vehicle during each manned mission.

Cue-Derived Materials

In addition to the on-board cuing target materials, other reference/stimulus target materials (cue-derived materials), produced from the identical source products as used in producing the on-board materials,

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will be required to support formal flight crew target study and simulation activities. These materials must be prepared so as to provide an exact representation of what will be provided by the on-board retrieval and presentation equipment. Therefore, each type of cue-derived materials must be prepared and produced in sufficient quantities to cover all the potential target installations and aiming points designated for the MOL-DORIAN system. Also, the preparation and production process must provide the capability for continuous updating of these materials during the long formal training period preceding each manned mission.

Other Associated Materials

Other special reference/stimulus materials included in the overall requirement to support the flight crew target study training and simulation activities are: (1) special materials to support mission simulator development activities; and (2) the reference/stimulus materials to support mission simulator training activities at Vandenberg Air Force Base.

Categories of Materials Support Required

The Systems Program Office (SPO) at Los Angeles AFS has identified the following basic categories of reference/stimulus materials support required to support MOL-DORIAN manned operations (detailed requirements, as currently identified by the SPO, are contained in Appendix A):

1. Materials to support development of MOL-DORIAN hardware and procedures, including:
 - a. Airborne Vehicle Equipment (AVE)
 - b. Simulation equipment, including:
 - (1) Engineering Development Simulator (EDS)
 - (2) Mission Development Simulator (MDS)
 - (3) Mission Module Simulation Equipment (MMSE), the mission simulator which will be located in the OTEF at Vandenberg AFB
2. Materials to support simulation training at Vandenberg AFB
3. Materials to support flight crew target study training at Vandenberg AFB
4. Materials to support on-orbit operations.

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BACKGROUND

The need for on-board cues was recognized as an essential requirement in the development of the initial operational concept for manned MOL-DORIAN missions. As a result, the system design baseline and procurement contracts included provision for the development of airborne vehicle and simulator hardware, procedures, and software necessary to provide a visual cuing capability for the manned/automatic MOL-DORIAN vehicles.

The initial simulator development planning included the requirement to develop effective methods of providing cuing and other reference/stimulus materials for use in simulation activities. Materials support for the simulator development activities were provided through contracts (Data Corporation) and by support agreements with government agencies that possessed the requisite technical and other capabilities to provide such support. The major responsibility was assigned to the USAF Aeronautical Chart and Information Center (ACIC) under the existing funding for the support of operating NRO projects. ACIC has been providing both technical assistance and materials support to the program in response to requirements established by the SPO.

Because of their active participation in the simulator development activities, and also because of their extensive experience in the target and simulation materials area, ACIC was approached by the SPO (Jul 1967) for advice on the development, preparation, and production of the on-board cues and related materials. ACIC responded by making recommendations to the SPO and to AFNIC (Sep 1967). SPO personnel conducted an extensive evaluation of the ACIC recommendations, giving priority consideration to technical feasibility, management effectiveness, and cost. An independent evaluation of the ACIC recommendations was also conducted by AFNIC. The findings and conclusions of these two separate and independent evaluations were almost identical. Both evaluations concluded that:

1. The overall responsibility for the support should be assigned to a single government agency within the intelligence community.
2. The establishment of a new operational facility (facilities, equipment, skilled manpower, etc.) specifically for the purpose of performing the materials support preparation and production function for the MOL-DORIAN system would neither be practical nor cost effective.
3. Among the government agencies considered for providing the MOL-DORIAN materials support function, ACIC was the only logical candidate. This was based upon ACIC's:

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- a. Unique technical skills and experience, both direct and collateral, in similar types of materials support activities.
- b. Existing capability in the following areas:
 - (1) Research and development.
 - (2) Mensuration and cartographic.
 - (3) Graphics presentation.
 - (4) Available source material (either available at ACIC, or ACIC has rapid access to such material).
 - (5) Modern photographic laboratory.
 - (6) Modern reproduction facility.
 - (7) Editorial and quality control.
 - (8) ADP and automation.
 - (9) Facility space, and central location of facility for servicing both East Coast and West Coast activities.
 - (10) Broad community mission in related areas.
 - (11) Personnel stability and continuity.
 - (12) Established program for handling sensitive materials and protecting the security of the materials and their purpose.
- c. Current participation in the MOL-DORIAN development activities and current commitment to provide a considerable portion of the required reference/stimulus materials support.

4. Because of the long lead times to develop certain program-peculiar aspects of the materials support, the assignment of the responsibility should be made immediately.

PROPOSED APPROACH FOR RESOLVING THE MATERIALS SUPPORT PROBLEM

The following is the approach proposed by the SPO for resolving the MOL-DORIAN special reference/stimulus materials support problem:

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1. That immediate action be taken to assign the overall responsibility for materials support (as identified in Appendix A) to ACIC.

a. The support must be formally requested through AFNIN.

b. AFNIN is aware of the requirement, and Gen Thomas has tentatively agreed for ACIC to assume the support responsibility providing formal request for the support is submitted to AFNIN.

2. That the formal request for the support, as well as any subsequent negotiations relative to the assignment of the responsibility to ACIC, be based upon the following ground rules:

a. Funding for the ACIC support should be accomplished in the following manner:

(1) AFNIN fund for all activities other than development and procurement of program-peculiar special equipment and software.

(2) AFNIN funding be handled through same channels as currently followed in funding for ACIC support of current operating NRO projects, i.e., through DIAMC (Sentinel Pad) funding channels.

(3) SPO fund for and procure all program-peculiar special equipment and the software associated with that equipment.

(a) Probable program-peculiar special equipment requirements have been estimated by ACIC to consist of:

1 Master photo chip printer

2 Master photo chip file and retrieval system

3 Cue strip printer

4 Cue cassette loading equipment

(b) ACIC estimates that total funding requirement of the SPO should not exceed \$1.5 million, with the funding spread equally over fiscal years 1969, 1970, and 1971.

(c) ACIC to provide technical support to the SPO for equipment development and procurement activities.

(d) Equipment procurement be handled in a manner similar to the procurement of the reformatting equipment previously procured for ACIC by the SPO to support the EDS development activities.

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b. ACIC will be provided sufficient additional program clearances to enable them to discharge the support responsibility in an effective manner.

(1) Additional clearances would be required only for those key personnel who would possess a "must need to know" concerning the actual purpose of the materials produced.

(2) Existing product clearances will be adequate for the majority of ACIC personnel handling the materials as they will not have a "need to know" relative to either the purpose of the materials nor their program association.

c. ACIC will be responsive only to the SPO for materials support requirements.

(1) This would not affect the current ACIC relationship with AFNIN, nor would it restrict or curtail normal liaison and communication with other participating agencies and organizations (see Appendix B).

(2) The SPO would develop the requirements on the basis of operational direction received through the channels established for directing the operational activities of the MOL-DORIAN system.

- 2 Appendixes
1. Appendix A, Support Materials Rqmts
 2. Appendix B, Special Materials Spt Responsibility Schematic

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APPENDIX A

SUPPORT MATERIALS REQUIREMENTS

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1.0 MATERIALS SUPPORT RESPONSIBILITY

The materials support responsibility, currently envisioned for assignment to ACIC, would consist of technical assistance and procurement, development, preparation, and production support (as appropriate) to meet the requirements established by the SPO for:

1.1 Special Equipment

This would consist of providing the technical support necessary to enable the SPO to procure the additional program-peculiar special equipment and related software required for the production of MOL-DORIAN support materials. This will represent a development effort because there are no existing equipments available which will meet the reduction/resolution retention, orientation, computer language identification, and speed requirements necessary to provide the MOL-DORIAN support. This effort will require considerable lead time in order to develop, manufacture, install, checkout, and establish the operational capability of the program-peculiar special equipment.

1.2 Master Chip File

1.2.1 Description

This is a program-peculiar requirement having application to both manned/automatic and automatic systems operations. The file will consist of highly controlled master photographic negative chips of each designated MOL-DORIAN target installation. These chips will constitute the primary reference source materials for the identification and location of MOL-DORIAN aiming points, and they will also be the master negatives from which the operational cuing target materials and cue-derived training materials will be produced. Each chip will contain a very thin superimposed Reseau grid which will permit the accurate location of any point on the chip in terms of grid coordinates, and, through relatively simple computer software routines, these grid coordinates will be converted to geographic and geodetic coordinates (as appropriate) of the highest possible accuracy commensurate with available earth location data.

1.2.2 Relationship to National Data Base

The current planning for the development of a National Data Base (NIETB) does not include this capability, and the officials concerned with that effort have stated that the preparation of the master chips would be a program-peculiar requirement which must be accomplished by the

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SPO in conjunction with other system development activities. These officials recognize, however, that once the file is developed it could constitute a valuable addition to the NIETB. Duplicate copies of the master chips could be distributed to the target nomination and selection agencies within the intelligence community to serve as a common reference for target identification and location activities pertaining to other advanced high resolution photographic reconnaissance activities.

1.2.3 A Major Effort Requiring Long Lead Time

The initial preparation of the file will constitute the major element of the entire materials support responsibility. The technical processes involved will require a large expenditure of manhours and will represent the longest lead time constraint. ACIC estimates that this task will require 28 months for completion.

1.3 Cue Materials

This will consist of providing:

- a. Training cue materials for use in the mission simulator at the OTEF, Vandenberg AFB.
- b. Operational mission cue materials for use:
 - (1) In mission readiness simulations at the OTEF.
 - (2) During on-orbit mission operations.

1.4 Cue-Derived Training Materials

This will consist of providing:

- a. Photographic prints of actual cue imagery for use in target study.
- b. 35 MM positive slides of actual cue imagery for use in target recognition and other target study applications.
- c. Other cue imagery training materials (as may be determined).

1.5 Mission Simulator Development Reference/Stimulus Materials

This will consist of providing:

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a. Cue stimulus materials to support mission simulator development activities (ACIC is currently responsible for this support).

b. Other photographic reference/stimulus materials to support mission simulator development activities (ACIC is currently responsible for this support).

1.6 Mission Simulator Training Materials

This will consist of providing photographic reference/stimulus materials (other than cues) for mission simulator training to be conducted at the OTEF, Vandenberg AFB (this is a continuation of the current ACIC responsibility to provide similar types of materials for mission simulator development activities).

1.7 Maps, Charts, and Related Materials Support

Although no specific requirements for this support have been identified, it is assumed that a certain amount of this support will be required. This function, however, would be a procurement function only (providing materials that have already been produced) instead of a production function.

2.0 GENERAL REQUIREMENTS

2.1 Master Chip File

a. To establish and maintain a library containing the approved source materials for the production of cues and cue-derived materials.

(1) Approved source material to consist of highly controlled photographic negative chips.

(2) Library to consist of an archival copy of all approved chips.

(3) The chips should:

(a) Cover all installations identified in the most current target listing applicable to the MOL-DORIAN system.

(b) Be prepared from the best available or most appropriate photographic imagery. Where photographic imagery is not available, the chips should be photographic negatives of the best available or most appropriate graphic substitute for photographic imagery.

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(c) Be updated on a continuing basis in response to program experience, more accurate or appropriate subsequent materials, and changing requirements.

(d) Provide the capability to reflect seasonal variations for the same installation when practical or appropriate.

(e) Contain thin superimposed Reseau grids to provide a means for accurate location of points on the chips relative to an approved geodetic reference system.

b. To provide the capability for:

(1) Producing tabular inventory listings at periodic intervals to identify current status of the file, and distributing the tabular inventory listings to appropriate agencies within the intelligence community.

(2) Providing instructions and computer routines to permit other agencies to rapidly and accurately convert chip grid coordinates into geographic or geodetic coordinates.

2.2 Preparation, Production, and Distribution Capability

To maintain a capability, consisting of skilled personnel and high speed, automated equipment (both general purpose and program-peculiar special), to provide the preparation, production, and distribution necessary to satisfy MOL-DORIAN support materials requirements. This would include:

a. Capability to transform available photographic imagery (master cue chips and other imagery) and imagery substitutes into final products for use in:

(1) Ground simulation equipment development and mission simulator training activities.

(2) Flight crew target study training.

(3) On-orbit operations.

b. Capability for rapid update and revision to permit:

(1) Maximum exploitation of new photographic source materials.

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(2) Operational flexibility during mission preparation activities, i.e., ability to accommodate/incorporate revised targeting up to just prior to the scheduled launch of a specific MOL-DORIAN manned mission.

c. Capability to duplicate and distribute copies of master cue chips to appropriate agencies within the intelligence community.

3.0 TECHNICAL REQUIREMENTS AND CHARACTERISTICS

3.1 Special Equipment

Specific technical requirements will be established jointly by ACIC and the SPO.

3.2 Master Chip File

Specific technical requirements will be established jointly by ACIC and the SPO.

3.3 Cue Materials

The following is a condensed listing of the technical requirements and characteristics relative to the cue materials and the cue retrieval and presentation equipment based upon the current system design requirements baseline, procurement activity, and operational concept:

a. Cues will be prepared on thin based 16 MM sprocketless film having a 12.7 MM circular data format and being capable of retaining approximately 120 line pairs/MM at from 10 to 1 to 6 to 1 contrast range.

b. The 12.7 MM data format will be projected on a rear-illuminated 6.5 inch screen with the capability of retaining approximately 12 line pairs/MM on the projected image.

c. The 12.7 MM data format will be used for two different scales in order to provide an approximate 3.0-5.0 nautical mile field of view (NM FOV) and a 1.5 nautical mile field of view.

(1) The 3.0-5.0 NM FOV cues will be displayed to the crew members during the active passes.

(2) The 1.5 NM FOV cues, which will be produced only on an "as required" basis, will be used in conjunction with the 3.0-5.0 NM FOV cues

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for pre-pass target study. They will provide a capability for more detailed study of certain special targets than could be accomplished with the 3.0-5.0 NM FOV cues.

d. Multiple targets (aiming points) will be contained, whenever possible, on a single 3.0-5.0 NM FOV cue; however, the aiming points must be contained within the central portion of the cue so as to leave a 3,000 ft band around the target centers to compensate for system pointing inaccuracies. Estimates derived from current development target model activities indicate that there will be an average of approximately 2.5 aiming points per 3.0-5.0 NM FOV cue.

e. The 3.0-5.0 NM FOV cues will have annotations to differentiate between the aiming points contained on a common cue. This will permit rapid identification of the programmed aiming point through correlation of symbols on the alpha numeric display and the cue presentation.

f. Each cue will be encoded with a binary coded digit (BCD) bit configuration to permit automated identification and selection by the on-board computer. To minimize the uplink requirements for target loading operations, cue identifications will be identical to the associated aiming point identifications.

g. Cues are to be packaged in 16 MM film cassettes (4" x 8" x 1") which can be manually changed by the flight crew members while on orbit. Each cassette will contain approximately 200 feet (4096 frames) of 2.5 mil sprocketless film and will weigh 1.5 pounds. Because of the limited number of cues that can be contained in any single cassette, the cues must be arranged on the film in a predetermined manner which will, through a minimum number of cassette changes, satisfy the search and access requirements for the entire mission. The ordering of the film must also be capable of absorbing allowable deviation in flight inclination angle as well as probable injection errors.

h. Estimated cue requirements for a single mission have been based upon a system development target model derived from current national collection requirements. This model contains approximately 13,500 different aiming points. Allowing for multiple aiming points, this would result in a requirement for approximately 7,000 different 3.0-5.0 NM FOV cues. It has also been estimated that approximately 1,000 different cues would constitute the upper limit requirement for the 1.5 NM FOV cues, resulting in a total requirement of approximately 8,000 different cues per mission. Allowing for overlap between the coverage contained in the several cassettes required to cover the total cue requirement for a mission, i.e., duplications of the same cues, it is estimated that as many as 10,000 cues might have to be prepared for each flight crew member for each mission. In addition, complete sets of cues will be required for use in the ground simulation equipment.

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i. For proper cue orientation, all cues should be oriented to their proper azimuth considering the target latitude and assuming an orbit inclination of 85 degrees.

3.4 Cue-Derived Training Materials

As presently envisioned, these will consist of 9" x 9" photographic prints and 35 MM positive slides derived from cue source materials and duplicating the actual cues that will be used during on-orbit operations.

3.4.1 Photographic Prints

The photographic prints will contain a circular image area of 6.5 inches in diameter and be an image approximating the image actually presented to the crew members by the cue retrieval and presentation equipment in the orbiting vehicle.

3.4.2 Positive Slides

The 35 MM positive slides will contain the identical imagery as that of the photographic prints.

3.5 Mission Simulator Development Reference/Stimulus Materials

Specific technical requirements are currently being developed by joint SPO and ACIC participation.

3.6 Mission Simulator Training Materials

Specific technical requirements to be jointly established by the SPO and ACIC when the mission simulator development progress reaches a point that will permit establishment of reliable requirements.

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APPENDIX B

SPECIAL MATERIALS SUPPORT RESPONSIBILITY SCHEMATIC

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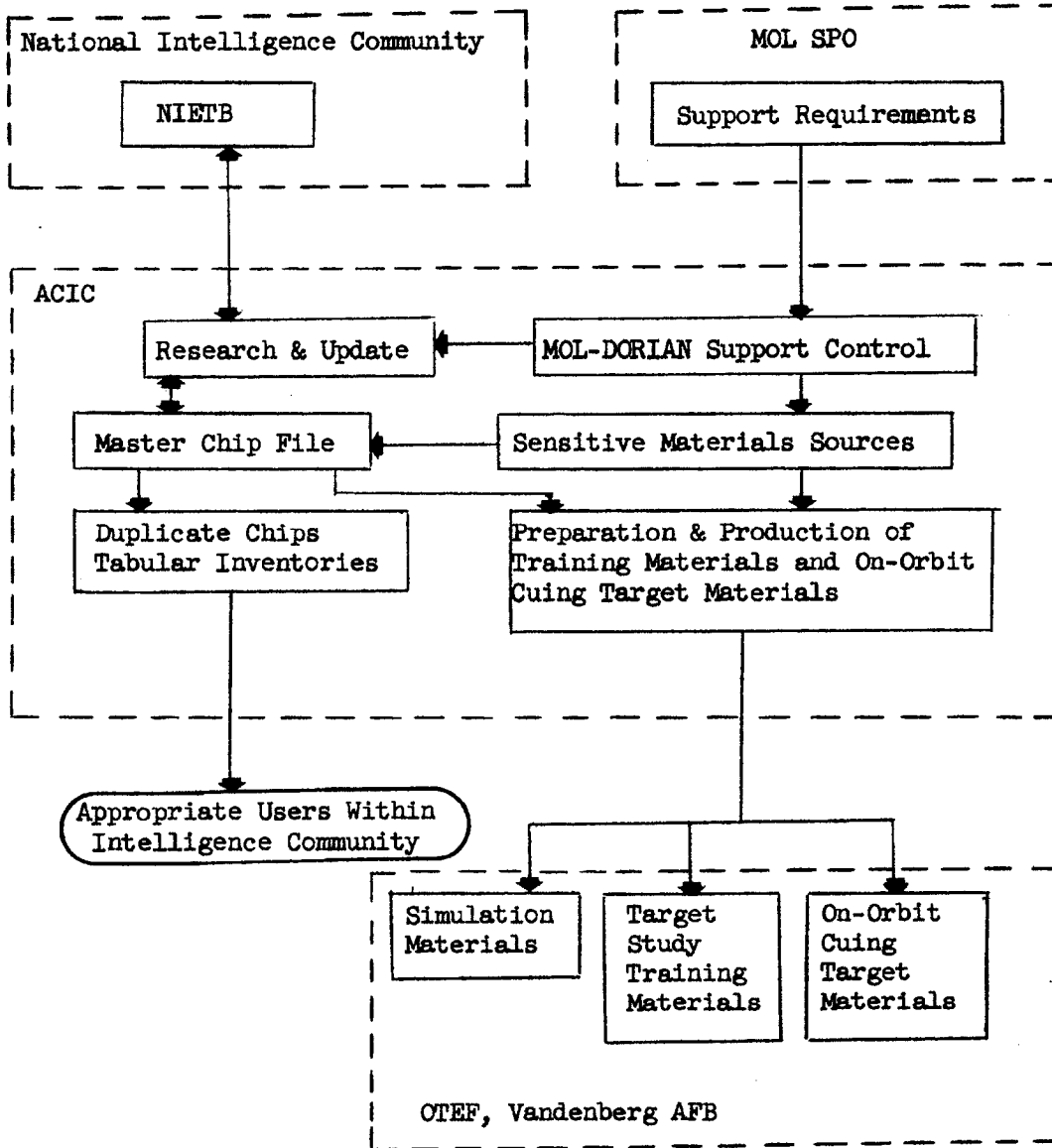
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