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24 May 1979

MEMORANDUM FOR MR. J. D. HILL

SUBJ: Annex D to the Shuttle Mission Operations Task Force Evaluation Report (SMOTE)

1. The attached document, subject as above, details and substantiates NRP requirements. It is being made available at this time to meet the immediate needs of DOD and the Air Staff to baseline NRP requirements to the PD-42/OMB STS Mission Operations Study and justification for the USAF Mission Element Need Statement (MENS) defining the DOD Shuttle mission operations requirements.

2. It should be recognized that this is a preliminary document and used accordingly. The final "NRP Requirements For Space Transportation System Flight Operations," is still in preparation and will be submitted for DNRO approval and dissemination on 22 June 1979. This should provide ample time for accomplishing any additional staffing that may be necessary in meeting the OMB deadline of 1 August 1979.

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Annex D to SMOTE

JOHN E. KULPA, JR
Major General, USAF
Director

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ANNEX D
NRP REQUIREMENTS FOR SPACE TRANSPORTATION SYSTEM FLIGHT OPERATIONS

24 May 1979

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ANNEX D

NRP REQUIREMENTS

FOR

SPACE TRANSPORTATION SYSTEM

FLIGHT OPERATIONS

24 May 1979

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PREFACE

In response to the direction set forth in National Space Policy (PD/NSC-42) to review and formulate a strategy for the utilization of the Space Transportation System (STS), this document sets forth the requirements of the National Reconnaissance Program to employ the STS in supporting its foreign intelligence collection operations. Guiding this review is the explicit recognition that a significant percentage of the United States' capability to conduct foreign intelligence is via space systems, and that in the mid-1980s the STS will become the nation's sole means of gaining access to the space media from which foreign intelligence activities are conducted.

The National Reconnaissance Office has conducted this review of workload, security and control requirements from the 1980s to the mid-1990s to assure that appropriate STS mission planning and operations resources will be available for National Reconnaissance Program operations.

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SUMMARY AND CONCLUSIONS

In the mid-1980s, the space Shuttle will become the sole means of gaining access to space from which a major portion of this nation's foreign intelligence activities are conducted. This report sets forth the mission management control required by the National Reconnaissance Program (NRP) to employ the Shuttle for these activities, presents the NRP's potential Shuttle workload, and specifies the security framework needed for flight planning, readiness and control.

Two employment concepts characterize the range of options for using the Shuttle for NRP missions: (1) use the Shuttle analogous to expendable launch vehicles for payload delivery only and/or (2) fully exploit the features of the Shuttle, particularly the role of man, in the conduct of space operations. The "payload delivery" employment concept is representative of pre-1975 NRO policy whereby the principal concern was the transitioning of NRP payloads to the Shuttle. As Shuttle development milestones were passed, a restructured NRO policy evolved from recognition that continuation of a "payload delivery" employment concept was no longer a necessary or preferred strategy from both (a) a cost efficiency viewpoint if the United States is to extract maximum benefit from the sixteen billion dollars invested in the Shuttle program; and (b) an effectiveness viewpoint recognizing that the nation is increasing its utilization of the space medium and therefore is becoming more dependent upon space systems as key instruments of national security. The updated NRO policy which has been in effect since 1978 has as a goal full exploitation of the Shuttle. New space systems (e.g. [redacted] now in various stages of development reflect a commitment toward this goal. Greater consideration is being given to responding to crises, unanticipated events, contingency operations, and R&D missions.

The payload/Shuttle interfaces for this employment concept are, by necessity, much more complex than "payload delivery." For example, Mission Controllers and Payload Specialists must not only be familiar with the Orbiter but must also be thoroughly proficient with the payload. Missions will have to be planned, coordinated, rehearsed and conducted as an integrated operation. Traditional booster operations, and other activities associated with the booster, can no longer be decoupled from payload operations as the payload/launch vehicle interactions become more dynamic and increase in number and complexity.

By contrast, the controlled mode concept of mission control, which evolved in 1977, had as one of its key assumptions the "payload delivery" employment concept only, whereby interfaces between the Shuttle and the payload were kept simple, and on-orbit operations completely decoupled. It also recognized there was not sufficient time, facilities nor expertise available within the DOD to develop a capability to control NRO/DOD Shuttle flights upon which NRO/DOD payloads were manifested.

However, the issue of statutory responsibilities for mission control remains. The controlled mode imposes compromises on the time-tested procedures for conducting NRO space operations. The key to the NRO's high success rate has been its ability to exercise control over all aspects of the mission including planning, rehearsals, simulations of anomalies, launch preparation, launch and recovery operations so that there is unity of purpose, coordinated action by all mission participants, and strict adherence to operations security procedures.

As the NRO moves toward the goal of "full exploitation," mission control problems will be exacerbated relative to the controlled mode way of operating. Missions become more dynamic as the Orbiter assumes a role as a base station for construction or military operations, as a spacecraft mission platform, as a responsive vehicle for contingency and crisis support, and a flexible means for coping with unscheduled or unforeseen events. Clear boundaries between the payload and the Orbiter diffuse as additional and more complex on-orbit functions enter the workload. This diffusion gives rise to the need to plan, simulate and conduct the mission as an integrated operation. The control infrastructure will also be impacted by the volume of the workload and the need to coordinate and schedule all NRO mission activities in response to national requirements. Positive control and authority to interrupt other activities becomes an essential element so that the Shuttle system can be as responsive as possible.

Thus, mission control for an STS employment concept directed toward full exploitation encompasses all facets of Shuttle flight planning and operations. For NRP missions this requires authority and responsibility to:

a. Approve, arrange for and supervise STS flight preparations to include payload and flight schedules, mission planning, preflight profiles, rehearsals, simulations and training

b. Exercise supervision over prelaunch and on-orbit operations

c. Approve key manpower positions affecting intelligence and operations, as well as personnel selection and assignment authority

d. Approve, exercise and control contingency operations to include preflight and prelaunch operational and readiness rehearsals

e. Establish security requirements for all intelligence related space operations

An analysis of NRP workload for the STS was made for the FY-81 to FY-95 time period. The analysis addressed not only payload delivery missions included in the current DOD space mission model but for the first time addressed STS exploitation opportunities -- i.e., [redacted] contingency support, retrieval, repair and service, on-orbit construction, and a menu of R&D program opportunities ranging from component tests through prototype demonstration systems. Specific conclusions are:

a. The NRP workload is not properly estimated in the current mission model, which is essentially payload-delivery oriented.

b. According to the latest programmatic and schedule information [redacted] NRP payload delivery and [redacted] are scheduled prior to FY-85: [redacted]

c. Contingency workload in support of crisis operations is significant and probably understated because the full potential exploitation of the STS is not yet understood. Maintaining readiness for such missions represents additional workload.

d. Projected NRP R&D workload includes a few dedicated flights, but most are ride-share candidates. R&D workload will be superimposed upon the scheduled NRP and DOD workload.

e. Because of lack of experience, requirements for repair, servicing and retrieval are probably understated by the programs surveyed.

f. On-orbit construction when it occurs significantly impacts on-orbit time requirements.

Workload estimates in this review provide a conservative basis from which to project flight planning, flight readiness and flight control requirements for national programs. Significantly, this workload must be carried out in a secure environment, including compartmentation of key aspects, in order to protect sensitive sources, methods and capabilities.

An analysis was made of NRP security needs for STS flight planning, flight readiness and flight control. While no program has yet gone through the complex steps involved, a description of tasks outlined in the Mission Operations Plan for the DOD Space Transportation System Program was used by each program to assess security needs in each of twenty-one activities. Wherever these necessary tasks are accomplished, NRP activity will require significant compartmented security. Being a requirements analysis, this study did not address specific measures to meet the compartmented or collateral security requirements identified. The characteristics of STS operations which tend toward, if not demand, compartmented security are:

a. When mission, payload, capability and modus operandi of national programs is revealed.

b. When payload operations require extensive coordination with STS flight control.

c. When STS on-board computers support NRP payloads

d. When non-nominal payload conditions occur and Payload Specialists must interact extensively with ground support personnel

e. When basic Orbiter data is mission, capability, identity or modus operandi revealing

f. When payload data is available through the Orbiter

g. When general and special crew training procedures and equipment contain indicators of the mission or operations.

In summary, this report details NRP mission and management control needs, projected workload and security requirements for the STS. Together with other DOD needs, this information forms the requirements base from which to analyze NRP/DOD Shuttle operations control options for the 1980s and beyond.

INTRODUCTION

In response to the direction set forth in National Space Policy (PD/NSC-42) to review and formulate a strategy for the utilization of the Space Transportation System (STS) this document sets forth specific requirements of the National Reconnaissance Program to employ the STS in supporting its foreign intelligence collection operations. In particular, the requirements for mission control, workload and security are addressed to assure that appropriate STS mission planning and operations resources will be available for National Reconnaissance Program operations from the 1980s to the mid-1990s. Guiding this review is the explicit recognition that a significant percentage of the United States' capability to conduct foreign intelligence is via space systems, and that in the mid-1980s the STS will become the nation's sole means of gaining access to the space medium from which foreign intelligence activities are conducted.

Shuttle Employment Concepts

There are essentially two employment concepts which characterize the range of options for using the Shuttle for NRO missions: (1) use the Shuttle analogous to expendable launch vehicles for payload delivery only and (2) fully exploit the features of the Shuttle, particularly the role of man, in the conduct of space operations. The "payload delivery" employment concept is representative of pre-1975 NRO policy whereby the principal concern was the transitioning of NRO payloads to the Shuttle. It did not reflect any attempt to exploit the Shuttle which at that time would have been premature considering the early state of Shuttle development. As the Shuttle development effort proceeded and a number of milestones were passed, a restructured NRO policy evolved from recognition that continuation of a "payload delivery" employment concept was no longer a necessary or preferred strategy from both (a) a cost efficiency viewpoint if the United States is to extract maximum benefit from the sixteen billion dollars invested in the Shuttle program; and (b) an effectiveness viewpoint recognizing that the nation is increasing its utilization of the space medium and therefore is becoming more dependent upon space systems as key instruments of national security. The updated NRO policy which has been in effect since 1978 has as a goal full exploitation of the Shuttle. A number of new space systems [redacted] which are now in various stages of development reflect a commitment toward this goal.

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Historically, the NRO's STS "payload delivery" employment concept was structured so that all interfaces between the spacecraft and the Shuttle be as simple as possible and that a dual compatible launch capability either from the Shuttle or an expendable launch vehicle be maintained as a hedge against Shuttle technological or developmental shortcomings. The "payload delivery" employment concept also continued the satellite design philosophy of the expendable launch vehicle era which incorporates as basic tenents extensive subsystem redundancy, significant simulated on-orbit ground testing and selection of highly reliable, long-lived components.

The "full exploitation" employment concept recognizes that man can influence the overall probability of mission success by conducting post-launch functional checks of spacecraft after it experiences a launch environment (e.g., 10 - 20% of the Space Test Program workload has experienced failures almost immediately after achieving orbit), by servicing the spacecraft or by repairing it on-orbit as necessary. Combined with the reusable/retrievable feature of the STS, which in itself is required for manned spaceflight, manned interaction offers an avenue for returning the spacecraft to earth for refurbishment or extensive repair as warranted by the on-orbit situation. It is the ability of man to interact with the payload after it experiences the launch environment that could result in a completely different design philosophy for spacecraft and potentially could yield reductions in both the time required to develop space systems and the life cycle costs. For example, subsystems can be modularized to facilitate on-orbit servicing and repair (e.g. Multi-Mission Spacecraft); critical prototype subsystems can be tested on-orbit [redacted] thereby reducing the amount of ground component testing and total system development time; and the Shuttle itself can be used as a mission vehicle substituting for the spacecraft bus itself (e.g. ZEUS, thereby reducing the design complexity and cost of a dedicated spacecraft. [redacted]

To capitalize on these features, the payload/Shuttle interfaces for this employment concept are, by necessity, much more complex than "payload delivery." For example, mission controllers and payload specialists must not only be familiar with the Orbiter but must also be thoroughly proficient with the payload. Missions will have to be planned, coordinated, rehearsed and conducted as an integrated operation. Traditional booster operations, and

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other activities associated with booster operations, can no longer be decoupled from payload operations as the payload/launch vehicle interactions become more dynamic, increase in number and complexity, and crew safety becomes a foremost consideration.

Concepts for Mission Control

In spite of the recent activities to design NRO space systems which are more fully Shuttle optimized and to establish a Shuttle payload specialist program for NRO applications, the one area that has not kept pace with the progress made in these other areas is the requirement for mission control over STS flight operations in support of the "full exploitation" employment concept. The controlled mode concept of mission control, which evolved in 1977, had as one of its key assumptions the "payload delivery" employment concept whereby the interfaces between the Shuttle and the payload were kept simple and on-orbit operations completely decoupled. Fundamental in the evolution of the controlled mode concept was the recognition that, even if the NRO/DOD were not constrained by resources, there was not sufficient time nor facilities and expertise available within the DOD to develop a capability to control NRO/DOD Shuttle operations separate from NASA activities prior to the initial Shuttle flights upon which NRO/DOD cargo was manifested. Moreover, at the time, the DOD Mission Model (Rev 7) forecast that only two NRO missions would require STS launch support prior to 1985.

However, the issue of statutory responsibilities for mission control remains. The controlled mode imposes some compromises on the time-tested procedures which have evolved for conducting NRO space operations. For example, care must be exercised to ensure that mission control capabilities and functional procedures are structured so that the potential for miscommunications of technical parameters, and the loss of training proficiency (e.g. generic mission simulations) created by heretofore compartmented functions now requiring sanitization and operations at the Secret level be minimized. In the past, the key to the NRO's high success rate has been its ability to exercise control over all aspects of the mission including planning, rehearsals, simulations of anomalies, launch preparation, launch and recovery operations so that there is unity of purpose, coordinated action by all mission participants, and strict adherence to operations security procedures. Any significant departure or erosion in the current modus operandi could impact the ability of the NRO to respond in its traditional timely and effective manner to national security requirements.

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As the NRO moves toward the goal of "full exploitation," mission control will exacerbate relative to the controlled mode way of operating as Missions become more dynamic in direct relation to the degree which the Orbiter assumes a role as a base station (e.g. on-orbit construction), as a spacecraft mission platform, as a responsive vehicle for contingency and crisis support and a flexible means of coping with unscheduled or unforeseen events. Clear boundaries between the payload and the Orbiter diffuse as additional and more complex on-orbit functions enter the workload. This diffusion gives rise to the need to plan, simulate and conduct the mission as an integrated operation. It is counter-productive in terms of flight safety and mission success to create a situation where the Orbiter is attempting to accomplish one set of functions while the payload operations are performing another unrelated set. Moreover, personnel assigned Orbiter control functions must become more familiar with the characteristics of the payload and functionally participate in the conduct of the mission including, in some cases where the Orbiter is used as a mission platform, collection of intelligence data. Control over operations security practices and procedures for all facets of the mission is essential to protect sensitive sources and methods, and will come to the forefront of planning and operations in the "full exploitation" mode.

The control infrastructure will also be impacted by the volume of the workload and the need to coordinate and schedule all NRO mission activities in response to national requirements. If the Orbiter is to be used as a mission platform to respond to crisis or used for other unforeseen contingencies (e.g., a disabled satellite), proficiency must be maintained in all facets of the operation and the control infrastructure must be able to energize contingency packages, and ensure their orderly flow through a milieu of other planning, rehearsal, training and flight preparation activities that would be simultaneously on-going as part of the day-to-day operations within the Shuttle system. Positive control and authority to interrupt other activities becomes an essential element so that the Shuttle system can be as responsive as possible. Moreover, flight planning and Shuttle exploitation activities which are associated with mission control functions must be coordinated among the various NRO programs to facilitate the development of payload-man-Orbiter performance envelopes and to identify useful problem-solving techniques during contingency operations (e.g. servicing or repairing a disabled satellite).

In order to achieve a more flexible operating posture, increase collection effectiveness, and capitalize on the features of the Shuttle which could potentially lead to reductions in the time required to develop space systems and their life cycle costs, the NRO will require a control infrastructure different from that which already exists in the controlled mode concept.

Figure 1 contrasts the degree of mission control required over activities. For NRP missions, the necessary control must encompass all facets of Shuttle flight planning and operations.

FIGURE 1

DEGREE OF MISSION CONTROL NEEDED TO SUPPORT EMPLOYMENT CONCEPTS

MISSION CONTROL ACTIVITIES	EMPLOYMENT CONCEPTS: PAYLOAD DELIVERY	EMPLOYMENT CONCEPTS: FULL EXPLOITATION
o DYNAMIC MISSION PLANNING, DIRECTION, OPERATIONS ACTIVITIES	LOW	HIGH
o PAYLOAD/ORBITER INTERFACE CONTROL o NUMBER OF INTERFACES o COMPLEXITY	LOW	HIGH
o SYSTEM RESPONSE TIME AND READINESS CONTROL o CRISIS o OTHER EXOGENOUS EVENTS	LOW	HIGH
o MAINTAINING TRAINING PROFICIENCY FOR CONTINGENCIES	LOW	HIGH
o OPTIMIZATION OF PAYLOAD-MAN-ORBITER PERFORMANCE ENVELOPES	LOW	HIGH
o COMPLEXITY OF MAINTAINING AND PROMOTING OPERATIONS SECURITY PRACTICES o TECHNOLOGY BASE o ORBITAL POSTURE	LOW	HIGH

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WORKLOAD

Prior to this review, the DOD space mission, model, including the latest revision (Rev 8), was the sole planning document for estimating DOD's flight operations requirements for the STS. The space mission model is a carry over from the expendable launch vehicle era when it was used as a planning tool for booster procurement and reflected only payload delivery requirements. With the single exception of [redacted] (ZEUS) missions*, the latest space mission model for STS usage continues to reflect only nominal payload delivery requirements and does not address workload requirements which more fully exploit the capabilities of the STS. The failure to depict future workloads which take advantage of the capabilities of the Orbiter and man in space can lead to a serious underestimation of DOD needs for the STS and associated flight planning, readiness and control functions.

A dichotomy with respect to STS mission planning was painted in the management section above. In most prior planning, the STS was viewed only as a booster and the payloads would be designed to minimize interfaces with the shuttle. As the pace of activities to transition NRP and DOD payloads to the shuttle has accelerated, recognition of the shuttle's potential as a mission platform has grown. Studies were made of how to exploit the presence of man in space, how to exploit and enhance the STS itself, and to determine requirements for military payload specialists. If these programs are followed even in part, a new expanded definition of STS workload in flight operations planning, readiness and control needs to be developed. The workload presented below assumes exploitation of the STS beyond delivery of free flying payloads. Further, it reflects direction to employ the STS in the [redacted] program.

<u>TYPES OF WORKLOADS</u>. The STS can be exploited beyond its capability for taking payloads into space. The full range of potential applications or workload categories for the use of the STS are defined below.**

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* Denoted as Support Mission V and included in the DOD space mission model (Rev 8).

** A task team on "Future Space Transportation Needs" in response to the Presidentially-directed crosscut review of the FY1980 budget has focused on future enhancement options for the STS. The enhanced capabilities will permit more efficient accomplishment of currently planned missions or the capability to conduct others. However, any new tasks or missions can be cast into the basic workload categories established in this report.

Payload delivery is the delivery and injection of payloads into orbit. This function includes on-orbit checkout of payloads and return of those not able to be repaired by the crew.

Retrieval is the capture of orbiting payloads or objects from orbit using the STS in order to perform a specific activity.

Repair/service are two similar activities associated with retrieval. Repair is the activity which involves repairing or replacing spacecraft components rendering them operable again so that the spacecraft may function as designed. Service is the activity of replenishing by refueling, recharging or changeout of marginal modules.

Construction is the building or erection of a variety of large space structures using the STS as the base station for assembly and construction activity.

Orbiter [redacted] use the Orbiter as the platform for military, intelligence and R&D tasks. This includes payloads affixed to the Orbiter with or without using the Orbiter crew or on-board payload technicians.

UTILITY OF THE WORKLOAD. Some lessons learned regarding space system reliability during the last two decades differ from theoretical expectations devised at the beginning of the space age. The majority of system failures are booster failures* or "infant failures" because they occur at initial turn-on or early in a system's operations. Subsequent launches and system reliability statistics generally reflect lessons learned from early program failure. The failure rate of parts during orbital life once they have survived "infant mortality" has been far lower than original expectations. As a consequence, satellites which survived boost and "infant mortality" phases are much longer-lived than Mean Mission Durations (MMD's) estimates.** The backlog of DSP and transit spacecraft and the long-lived [redacted] spacecraft are cases in point. With the advent of a reliable Orbiter system booster and payload specialists for on-orbit checkout and repairs, the major sources of overall mission failure should be significantly reduced. Lack of critical satellite coverage, such as after a fairly recent DSCS II launch failure, will be obviated.

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*Of a sample of 92 high altitude satellite launches, 20 boosters failed. Of the subsequent 20 satellite failures during the satellites' lifetime, eight were TWT's and five electrical all in one program. Rand WN-9551-PR, Rand Spacecraft Acquisition Study, August 1976.

**Based on Rand and TRW reports and briefings

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In addition, spacecraft sensors or systems may use more capable but higher risk technologies in the STS era knowing that on-orbit access for repair can be designed into a spacecraft. Some present spacecraft are destroyed by deboosting when their film is expended or other expendables are depleted. New generations of spacecraft could be serviced with film, fuel, batteries, etc., from the Orbiter. An electronic "block change," such as changing SIGINT frequency coverage could also be accomplished. [redacted] Periodic refurbishment of such systems would be possible from the STS.

The construction of large antenna structures in space or assembly of propulsive systems for orbit maneuver or for taking payloads beyond geosynchronous altitudes enhances US capability and flexibility to perform many DOD/NRO missions in space. [redacted]

<u>EXPANDED WORKLOAD IMPLICATIONS</u>. From a workload standpoint Payload Delivery of free flyers represents nearly all of the activity incorporated in the present mission model. Repair and Service and Retrieval represents additional workload since mission time and extensive planning, preparation and training would be necessary. An important caveat is that satellites must be <u>designed</u> for repair and service consistant with safety and human factors in the space environment. Likewise much remains to be done to <u>design</u> satellites for retrieval and to develop the necessary techniques, procedures and equipment. The economics of these operations have yet to be fully assessed. But we can assume that if improved and larger duration maneuvering units are procured man's EVA capabilities and time on orbit will be extended. Training, planning and control of these activities will have to be factored into overall workload considerations. In about a decade, experience may

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* Rand WN-9551-PR OPCIT.

permit construction and assembly of large structures in space, a workload involving several Shuttle loads of cargo and several days in orbit for assembly.

However, the most significant near-term additive workload consideration is the Orbit Platform activity. The duration of these missions (whose payloads are returned with the Orbiter) range anywhere from one day to perhaps three weeks. This category includes both operational and R&D payloads. The [redacted] ZEUS, and R&D programs are examples which exploit this concept. This type of activity allows for payload optimization by designing for manned interface to provide optimal or flexible system collection, and system repair or servicing. A payload could be built to use STS self-contained expendables or equipment thereby reducing costs and/or payload complexity.

FORECASTING OF WORKLOAD

Considerable uncertainty accompanies any STS workload projection. The principal problem is that plans must attempt to convey STS usage in a 1980's environment based on a 1970's perspective and without benefit of any operational experience with the STS. We consider both scheduled and contingency workload.

Scheduled workload includes planned launch and deployment of payloads, planned retrievals, planned repair and service and planned [redacted] Construction missions are always in the planned category. Flight planning, readiness and control are accomplished on a routine, preplanned, non-crisis basis insofar as possible.

Contingency mission workload includes launch on demand which can have significant schedule impact when it occurs. The priority for national programs stated in National Space Policy (PD/NSC-37) may dictate that cargo be launched on the next available Orbiter. Contingency workloads are difficult to define for several reasons. The first is the magnitude and number of contingency events, such as international crises, which cannot be forecast with certainty.* For estimation purposes, this problem may be handled statistically; i.e., based upon historical trends, one might expect from three to six international crises per year involving the political use of military forces short of ground conflict which could require on-demand launches. Secondly, and probably more importantly, some space systems with significant utility for crisis support

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* "Force Without War," Brookings Institute, 1978; and "A Generation of Crises: 22 Sketches of U.S. Interventions Since World War II; Rand Corp. 1972

such as [redacted] ZEUS and [redacted] systems are still in the definition phase. As development proceeds, planning for their availability and use in times of crisis will become better defined. Further, space may become the arena for early hostilities. [redacted] and emergency replacement could be significant. The contingency workload is very likely understated.

The priority and nature of the contingency workload will require that planning, training/rehearsals, and control personnel and systems be current and exercised regularly.

While the contingency workload is expected to fall most heavily in the [redacted] workload category, contingency workload can be anticipated in the payload delivery (replace upon failure), retrieval, and repair/service categories as well.

STS WORKLOAD ESTIMATES

The System Program Offices in Programs A, B, and C estimated their STS-related workload requirements based upon the following assumptions: full exploitation of the STS will proceed; payloads will experience evolutionary changes to optimize payload/payload specialist/STS interactions; and STS flights will be conducted on a routine basis. The summarization of these estimates is shown in Tables 1 through 4. These inputs include "approved" programs which appear in the DOD Space Mission Model (Rev 8) and programs which have not been formally approved such as R&D demonstrations or advanced versions of present systems.

Table 1 displays STS workload for the Eastern Launch Site (ELS) at Kennedy Space Center and the Western Launch Site (WLS) at Vandenberg AFB. The appropriate support mission (SM I through SM V) is used to permit ready comparison with the launch-oriented STS portion of the DOD Space Mission Model, Revision 8. In this breakout, missions requiring a dedicated Shuttle launch indicate NO in the Ride Share column. Payloads to be launched which are potential ride share candidates have a YES in the Ride Share column. To be consistent with the mission model counting procedure, each is counted once.

The missions presented in Table 1 are consistent with the President's FY-80 approved program through FY-1985, the outyear implications of that program through 1991. The forecast from FY-1992 through FY-1995 generally continues patterns established in earlier years. Table 1 shows a break at FY-1991 in order to facilitate comparison with the NRP inputs, dated 13 Feb 79, to Revision 8 of the DOD Space Mission Model (see Table 5). Table 1 may be directly compared with Table 5, the NRO STS Mission Model (Rev 8). The specific STS Rev 8 differences between Table 1 and Table 5 are as follows:

PROGRAM	TABLE 1	FY
[redacted]		
[redacted] ZEUS*	[redacted]	84
Net Difference (Table 5 - Table 1)		
Total Table 1 (Delivery [redacted]		
Total Table 5 (Rev 8)		

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*NOTE: TABLE 1 shows ZEUS as a pallet program [redacted] with two missions from ELS and 1 mission from WSL each year. This is consistent with current program planning. TABLE 5 shows ZEUS [redacted] with 3 missions each year from WLS.

Note the NRO STS Mission Model (Rev 8) numbers have been corrected from those reflected in Table 1 of the SAFSP Shuttle Requirements Report (Preliminary) 10 May 1979. The number of payloads in 1986, 1987 and 1989 change from [redacted] These changes reflect adjustments to be made in the FY-81 program.

Note further that three programs [redacted] scheduled in the FY-1987 time frame and beyond show retrieval activity projected to be accomplished on the same STS mission which deploys a like spacecraft. While the scheduled number of STS flights is not increased thereby, this does represent an increased STS planning, training and readiness, and operational control workload.

As it is necessary to display STS workload requirements for NRP missions at the DOD SECRET level for integration with other DOD workload, Support Mission designations are used to identify requirements without reference to NRP programs. Table 5 breaks out NRP programs by support mission and indicates the first Shuttle launch for each program at KSC or VAFB as appropriate. All subsequent launches are on the Shuttle. Table 6 presents the sanitized launch model corresponding to Table 5. This input is combined with inputs from other DOD programs to construct the DOD Space Mission Model which is provided for reference as Table 7.

A word of caution in interpretation of STS launch requirements is in order. In all tables displaying launch-oriented workload, some potential for ride sharing is suggested. For example, see the "total Shuttle flights" line for ESL and WLS in Table 7. Since detailed compatibility of payloads can only be determined on a case-by-case basis and cannot be assessed at this time, any total Shuttle launch flight numbers should be viewed with caution. The totals by fiscal year in Tables 1 and 5 must be understood as payloads for delivery into orbit plus [redacted] This number is clearly an upper bound on scheduled Shuttle launches. Because of ride sharing, the real number of Shuttle launches to meet scheduled requirements will likely be less. The policy for NRP payload ride sharing is that NRP programs will consider ride sharing with other NRP programs and with DOD programs consistent with technical compatibility and maintenance of program security.

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A similar caveat applies to mission sharing , i.e., the compatibility of accomplishing more than one type of workload on a single STS flight. The retrieval of a payload following delivery of a similar payload is an example for which mission compatibility was assumed in Table 1. Retrieval, repair and service operations in conjunction with a payload delivery or [redacted] could become very complicated because of specialized equipment for these tasks which would need to be carried by the Shuttle. Hence, mission compatibility can only be assessed on a case-by-case basis, cannot be determined at this time, and will only be possible when essential program security can be maintained throughout the mission.

In support of the OMB-directed study of Space Transportation System Flight Control Requirements, NRP STS workload in sanitized form was transmitted to SAMSO for inclusion in the consolidated STS workload forecast and security baseline. That submittal is inclosed as Attachment 2. Table 1 of Attachment 2 can be directly compared with Table 1 in the main body of this report.

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Table 2 displays NRP potential contingency STS workload. It includes applicable programs currently shown in the DOD Space Mission Model. Additionally, an [redacted] ZEUS contingency missions from either ELS or Vandenberg. The [redacted] programs both are protecting for one contingency delivery/retrieval mission or one repair/service mission each year. For planning purposes, these are shown in alternate years commencing in FY 85. Since contingency workload on each of the programs shown may or may not occur in any given year, an estimated range of one to three contingency support missions is shown for each year. Similarly, the number of contingency operations which might occur through 1991 is conservatively estimated as 3 to 10.

Contingency workload is not presently incorporated in the DOD Space Mission Model. Table 2 of Atch 2 directly corresponds to Table 2 of the main body of this report and transmitted contingency requirements for use in the OMB study.

Table 3 presents NRP potential R&D workload for the STS. No NRP R&D workload is presently incorporated in the DOD Space Mission Model. The R&D workload encompasses both program/project oriented R&D and a sustaining program of brassboard, subsystem, and component testing. While not all items on this agenda of R&D activities will come to pass, a non-trivial fraction will be carried out. If successful, they could result in new capabilities and be reflected in scheduled or contingency workload in the outyears. Some new systems may replace or lessen the need for present systems. Such possibilities are not reflected in Tables 1 or 2 above since to do so would be unduely speculative and perhaps imply analyses which have not been done, for example preferred mixes of imagery, SIGINT, or crisis support assets. Each R&D project is briefly described in accompanying footnotes.

Some potential R&D projects could involve on-orbit construction beginning in the 1990 time frame. We envision dedicated shuttle flights, extensive RMS and EVA activity, and usually multiple launches to support construction of a single system. Mission duration is difficult to predict at this time because of uncertainties in payload size and weight, orbiter support services and kits, and orbiter station keeping needs. For purposes of this report, a typical construction mission is assumed to use one flight for station keeping with a MOL-type life support system in the cargo bay to support the construction crew for several days to a few weeks. One or two other dedicated flights would deliver hardware to orbit.

The shuttle cargo bay characterization experiments to potentially start in FY-81 and the integration system experiments in the FY-83, 84 and 85 period derive from studies, conceptual designs and limited hardware tests conducted or now underway. For example, BYEMAN [redacted] is defining instrumentation and experiments to characterize the cargo bay environment so as to provide more comprehensive design criteria for other NRP payloads transitioning to the shuttle. The integrated system experiments can be developed to meet the schedule depicted in Table 3 if a commitment to the particular experiment is made in FY-80 with appropriate funding in subsequent years. Therefore, schedules shown are possible and realistic given program go-aheads but must be understood as potential workload not approved at this time.

On average, 3-4 subsystem experiments per year are expected commencing in FY-86. These experiments will capitalize on man in space as an experimenter to demonstrate technology and to test, checkout, and space test subsystem hardware. A range of 3-9 component tests per year are anticipated. These component tests are typically lightweight (up to 250 pounds) sealed cannisters of about five cubic feet volume. Each is accessible by four commands from the payload specialist. Component tests are compatible with NASA's

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"getaway special" space tests for experimenters advertised for $10,000. While subsystem and component tests will be ride-share, space available shuttle cargo, they nonetheless represent important workload in integration, crew activity planning and training, and operational support. Table 3 in Atch 2 summarizes potential R&D workload devoid of program specific detail so it can be used for workload planning by the SAMSO and NASA.

Table 4 summarizes all potential STS workload in scheduled, contingency, and R&D (dedicated, ride-share, and small package ride-share). The potential range of NRP activity is shown for each fiscal year. The small package (space available, ride-share) and subsystem R&D is displayed separately at the bottom. With the exception of scheduled workload, a range of activity through FY-91 is shown. The scheduled workload is essentially captured in the present DOD Space Mission Model but all other contingency and R&D workload is not. Because of uncertainties in demand for contingency support, the cumulative total through FY-91 is not additive across columns but rather is our estimate of the range of contingency support over the seven year period. Similarly, the range of all scheduled, contingency and R&D workload is not always directly additive in each fiscal year column. Instead, a deflated range of activity is displayed which in our judgement accounts for uncertainties in contingency demand and R&D program starts.

The STS workload presented herein can provide a basis to forecast demand for flight planning, flight readiness, and flight control activities, personnel and facilities. This input when combined with other DOD space program workload is the forcing function to drive support requirements. In this document, no attempt has been made to analyze or derive transformation functions which relate the forcing function to specific task loadings on facilities, training devices, personnel, control rooms, orbiters, ADP equipment, time on orbit, etal. That essential task is the next step.

Because of mission sharing and ride-sharing, projections of total shuttle days on orbit are frought with considerable uncertainty. A two day duration might typify free-flyer payload delivery with an additional day if a retrieval of a like payload is accomplished on the same mission. Repair, servicing or retrieval missions would likely require about two on-orbit days per satellite contacted. On orbit duration of a typical ZEUS mission is 21 days. At three scheduled ZEUS missions per year and potential contingency missions whose duration could approach 21 days, the use of the STS in a [redacted] represents a significant portion of DOD's on-orbit requirement.

In the late 1980s, follow-on operational versions of several R&D systems designed for contingency support will operate in the [redacted] and potentially increase Shuttle on-orbit time. As noted earlier, contingency workload could be understated because the full potential for the STS as a mission platform to support crisis and wartime needs is not clear at present.

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CONCLUSIONS

The NRO workload is not properly estimated in the current mission model, which is essentially payload-delivery oriented.

Contingency workload in support of crisis operations is significant and probably understated because the full potential exploitation of the STS is not yet understood and readiness of crews for these missions must be maintained.

Projected NRP R&D workload includes a few dedicated flights but most are ride-share candidates. R&D workload will be superimposed upon the scheduled NRP and DOD workload.

Three NRP payload delivery and [redacted] are scheduled prior to FY-85: [redacted] in FY-82, another in FY-83, and an [redacted] in FY-83.

Because of lack of experience, requirements for repair/servicing and retrieval are probably understated by the programs surveyed.

On-orbit construction when it occurs significantly impacts on-orbit time requirements.

Workload estimates in this review provide a conservative basis from which to project flight planning, flight readiness and flight control requirements for national programs.

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DoD SPACE MISSION MODEL (FY 1977 - 1991) (U) 5 MARCH 1979

TABLE 7

LAUNCH MODEL

REVISION 8

PROGRAM	FY 78	79	80	81	82	83	84	85	86	87	88	89	90	91	TOTAL
USE SHUTTLE AT ELS*															
(U) DSCS	1	1	2	1	$\boxed{1}$	1	1	1	0	0	1	1	0	1	12
~~(S)~~ SDS (NO IUSs)	1	1	1	0	0	$\boxed{2}$	0	1	1	0	1	1	0	1	10
~~(S)~~ DSP	0	1	1	0	1	1 $\boxed{1}$	0	1	1	0	0	1	1	1	10
(U) GPS	2	4	1	1	3	2 $\boxed{0}$	2	4	4	4	2	2	2	2	36
~~(S)~~ ~~(S)~~ ~~(S)~~ [redacted]															
(U) STP ASCENT SHARED	0	1	0	0	$\boxed{**}$	0	1	**	**	**	**	**	**	**	2**
(U) TRANSIT					$\boxed{**}$	**									0**
(U) FSC	1	1	1	2											5
(U) NATO III/IV	0	1					$\boxed{**}$	**	0	**					1**
~~(S)~~ NFCS (SSS)											$\boxed{2}$	1	0	0	3
~~(S)~~ DSSS											$\boxed{1}$	1	1	1	4
(U) TOTAL ELS (INCL EXPENDABLES)	9	11	7	5	6	10	6	9	7	5	9	9	5	7	105
(U) TOTAL SHUTTLE FLTs					(2)	(5)	(6)	(9)	(7)	(5)	(9)	(9)	(5)	(7)	(64)
IUSs					(1)	(3)	(6)	(8)	(6)	(5)	(8)	(8)	(5)	(6)	(56)
USE SHUTTLE AT VLS															
(U) DMSP	1	1	2	1	0	1	1	1	1	0	1	1	1	1	13
~~(S)~~ ~~(S)~~ [redacted]															
(U) STP ASCENT SHARED	0	1	0	1	0	0	**	**	**	**	**	**	**	**	2**
(U) TRANSIT	1	1	2	1	0	0	**	**	**	**	**	**	**	0	5**
~~(S)~~ [redacted]															
~~(S)~~ DSSS/LASS										2	2	0	1	2	7
(U) TOTAL VLS (INCL EXPENDABLES)	6	6	8	5	4	5	6	6	4	7	8	7	6	9	87
(U) TOTAL SHUTTLE FLTs							(2)	(6)	(4)	(7)	(8)	(7)	(6)	(9)	(49)
TOTAL	15	17	15	10	10	15	12	15	11	12	17	16	11	16	192

*PRIOR TO TRANSITION TO SHUTTLE SOME PROGRAMS ARE LAUNCHED AT VANDENBERG AFB, CA.
**STP, TRANSIT, NATO IV, SM IV, AND 6M V SHUTTLE LAUNCHES (40) WILL SHARE SHUTTLE FLIGHTS WITH OTHER MISSIONS.
□ 1st SHUTTLE LAUNCH FROM KSC
○ 1st SHUTTLE LAUNCH FROM VAFB

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SECURITY

INTRODUCTION

Space systems are now being described at the highest national level as the most valuable and dependable source of foreign intelligence for the United States. In addition, adaptations and modifications are underway to provide real-time intelligence from space systems to military commands and the battlefield environment. The continued availability of satellites for accurate and timely intelligence has become crucial for critical diplomatic and defense decisions.

A vast amount of evidence has been compiled on the Soviet efforts to defeat the effectiveness of the United States' space-based intelligence collection efforts. The focus of this program is to employ deception and to camouflage, cover up and conduct activities out of range, sequence or scope of the U.S. space/intelligence systems. In support of these operations a well-developed satellite alert system is in effect. Generally, the total program is referred to by the U.S. Intelligence Community as the Cover, Camouflage and Deception Program (CC&D). By understanding system missions' operational capability and deployment strategy, scenes can be contrived, decoys employed, spurious electronic signals issued and disinformation fed through collected communication channels to mislead national planners and military commanders to wrong decisions. In recognition of the critical relationship between success in keeping the intelligence methods and sources from the target state and the continued success of the collection mission, the principal objective of NRO security is to reduce the effectiveness of Soviet CC&D against the NRP collection program.

The employment of the Space Transportation System (Shuttle) and supporting systems, if properly approached and secured, offers the opportunity to counter the effects of Soviet CC&D through more imaginative space operations and better security than now exists. The Shuttle itself will provide a standard launch cocoon enabling the obscuration of all payloads. To capitalize on these opportunities, BYEMAN compartmentation and the day-to-day intelligence standards of security must be incorporated as an integral part of the Shuttle/NRP mission operations, flight planning and preparations activity. Inherent in these procedures are strict access and observation control of all mission-revealing information and activity. Considering the long-term investment in each space intelligence collection system, a short fall in security would not be prudent.

Protecting system capabilities involves safeguarding information which reveals:

Missions and Mission Elements

Design Capabilities and Limitations

Actual/Demonstrated Capabilities and Limitations

System Vulnerabilities and Measures Taken to Enhance Survivability

Products, i.e., Raw Processed Data and Analyses

Further, protecting system capabilities involve denying, delaying and misdirecting enemy countermeasures.

Protecting system modus operandi involves safeguarding information which reveals:

Tasks, Tasking Priorities, Tasking Response

Synergisms Between Systems, System Dependencies

Operations Concept as Designed and as Implemented

Deployment Strategy, Schedule, Pipeline Response

System Status

Ground Station Missions and Capabilities

Support Systems

Security is used to create and enhance a protected environment for the conduct of NRP space operations. This includes:

Support Favorable International Relations

[redacted]

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Legitimacy of Space Systems

Physical Electromagnetic, Communications, Operations and Personnel Security

Public Information

ATCH 1

Protection of Relationships/Associations between U.S. government organizations, and between government organizations, contractors and individuals

NRP security is developed and carried out within the above framework. In this study, NRP security needs were analyzed in the framework of STS operations as described next.

METHODOLOGY

Each NRP program develops appropriate security classification guidance covering all aspects of its development and operation including both sensitive compartmented activities and less sensitive non-compartmented activities such as some launch base and range support for which DOD collateral security provides adequate protection. In this review, the study team and the program offices identified information, operations and procedures involved in shuttle flight planning, flight readiness and flight control which require security protection. Basic criteria for determining the classification of any item of information derive from the need to protect sensitive sources and methods and thereby enhance the effectiveness of NRP space systems as discussed above.

STS flight operations wherever conducted will involve Flight Planning, Flight Readiness and Flight Control activities. These activities are based on the successful pattern followed by NASA on the APOLLO and SKYLAB missions. While no program has fully gone through the steps leading to a STS launch, a comprehensive description of the tasks expected in each activity has recently been published as the Mission Operations Plan for the DOD Space Transportation System Program, SAMSO-LV-0020, Jan 1979. The detailed descriptions in this document were not available to all system program offices at the time of this survey, but very brief, generalized descriptions of the twenty-one functions included in-flight planning, readiness and control were provided. Each program was asked to assess the highest security level required to conduct program specific tasks in each of the twenty-one functions. Each was asked to indicate why this security level was necessary. This data enables estimation of the security envelope needed by each program and by the NRP as a whole for these activities.

The initial inputs received from the program offices surveyed reflected not only the different needs of the

HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY

~~TOP SECRET~~

individual programs but also suggested that the program offices had different interpretations of the tasks and information needs of each of the 21 functions. That depth of insight can only be gleaned from study of the comprehensive LV-0020 document or extensive personal experience with manned spaceflight operations planning. In the opinion of the NRP STS requirements study team, the programs have probably tended to underestimate security needs because they lacked full appreciation of the extent to which sensitive program data permeates the flight operations planning, readiness and control process. As a result, the study team developed more detailed descriptions of each of the 21 functions for review by the program offices. The results of the second security assessment are shown in Table 8. The detailed descriptions, Attachment 1 to this Annex, are provided for reference.

SECURITY REQUIREMENTS ASSESSMENT

Table 8 summarizes the highest security level assessed by each program as necessary to accomplish each of the tyenty-one functions. A requirement for sensitive compartmented information means that TOP SECRET or SECRET BYEMAN information is involved in that activity. In rare instances, SI/TK information may be involved.

The security requirements shown are independent of where the activity is to take place, i.e., in a DOD Shuttle Operations Center, at Johnson Space Center, at a contractor's facility or at any other government facility. Further, no effort has been made to assess <u>how</u> the requirement might be met at any given facility. Alternatives to satisfy these requirements at various locations are to be addressed in the OMB-directed study of alternative shuttle control options.

Table 9 summarizes NRP STS security requirements by workload class for each of the 21 functions comprising the flight planning, readiness and control elements. In some instances a range of security requirements is shown to reflect differences in program needs or that one or more levels are believed necessary. The overall NRP requirement is stated in the last column. The abbreviation TSC standing for TOP SECRET Compartmented means a TOP SECRET BYEMAN, SECRET BYEMAN or rarely, SI/TK information is required for that function. The term TSC is used to convey this meaning to the non-BYEMAN, non-compartmented world. Table 5 in Attachment 2 corresponding directly to Table 9 here was used to transmit the overall highest security requirements from SAFSP to SAMSO/LV for use in analyzing shuttle operation control needs.

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TABLE 9

STS SECURITY REQUIREMENTS BASELINE - SUMMARY

STS MISSION OPERATIONS ELEMENT	WORKLOAD CLASS					
*FLIGHT PLANNING	DEPLOY	PALLET	RETRIEVAL	REPAIR & SERVICE	CONSTRUC-TION	OVERALL REQUIRE-MENT
1. Flight Feasibility Analysis	TSC	TSC	TSC	TSC	TSC	TSC
2. Payload Flight Support Requirements Development	S→TSC	S→TSC	S→TSC	S→TSC	S→TSC	TSC
3. STS Utilization Planning (Payload Mix, Flight Assignment)	S→TSC	S→TSC	S→TSC	S→TSC	S	TSC
4. STS Flight Design	S→TSC	S→TSC	S→TSC	S→TSC	TSC	TSC
5. Upper Stage Flight Design	N/A→TSC	N/A	N/A	N/A	N/A→TSC	TSC
6. Flight Crew Activities Planning	S→TSC	S→TSC	S→TSC	S→TSC	TSC	TSC
*FLIGHT READINESS						
1. Flight Data File Preparation	S→TSC	S→TSC	S→TSC	S→TSC	TSC	TSC
2. SSV On-Board Digital Data Load Preparation	S→TSC	S→TSC	S→TSC	S→TSC	TSC	TSC
3. Upper Stage On-Board Digital Data Load Preparation	N/A→TSC	N/A	N/A	N/A	N/A→TSC	TSC
4. Flight Crew Training	S & TSC	S & TSC	S & TSC	S & TSC	S & TSC	S & TSC
5. SSV Flight Operations Support Personnel Training	S	S→TSC	S→TSC	S→TSC	TSC	TSC
6. Payload Flight Operations Support Personnel Training	TSC	TSC	TSC	TSC	N/A→TSC	TSC
7. Integrated Rehearsals and Simulations	S→TSC	S→TSC	S→TSC	S→TSC	TSC	TSC
*FLIGHT CONTROL						
1. SSV Flight Operations Planning	S	S→TSC	S→TSC	S→TSC	S→TSC	TSC
2. Payload Flight Operations Planning	TSC	TSC	TSC	TSC	TSC	TSC
3. SSV Prelaunch Operations	S	S	S	S	S	S
4. Payload Prelaunch Operations	S	S	S	S	S	S
5. SSV Flight Operations Support (launch, on-orbit, recovery)	S→TSC	S→TSC	S→TSC	S→TSC	S	TSC
6. Payload Flight Operations Support	TSC	TSC	TSC	TSC	TSC	TSC
7. SSV Operations Post-Flight Analysis	S	S→TSC	S→TSC	S→TSC	S→TSC	TSC
8. Payload Operations Post-Flight Analysis	TSC	TSC	TSC	TSC	TSC	TSC

* Ref: DOD STS Mission Operation Plan (SAMSO/LV-0020, Jan 79)

KEY: S = DOD SECRET
TSC = TOP SECRET Compartmented
N/A = Not Applicable

→ Indicates Range of Requirement
& Indicates both security levels are required

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DISCUSSION

In this section we draw some general observations regarding security needs specified by NRP programs and projects. We shall also present a few detailed examples to illustrate why compartmented security is required. Lastly, having surveyed the NRP projects and summarized their security needs with respect to space shuttle planning and operations, we draw out some characteristics of operations on the shuttle which tend toward, if not demand, compartmentation.

Consider Tables 8 and 9. In general, NRP programs require compartmented security to conduct Flight Planning because a great deal of program information which reveals mission, operations, identity or capability of the spacecraft is exposed up to four years prior to launch. NRP programs will need compartmented facilities including appropriate computers, analysis and engineering aids, simulators and crew activity planning capabilities. While some aspects of STS flight design may be done at the DOD Secret level, most require compartmented security protection because of sensitive program-specific information. There is essentially no difference in security requirements for the flight planning functions across the five categories of NRP workload. Differences between the overall NRP security requirement and the security needs of specific programs are usually caused by program-specific items such as upper stages or the amount of crew interaction.

Overall, NRP programs require compartmented security to adequately conduct Flight Readiness functions. We found essentially no differences in security requirements across the workload categories from payload delivery to construction. Flight data files used by the crew will necessarily contain compartmented data; hence, areas in which they are prepared must be compartmented. The digital data loads for the SSV and any upper stage may contain compartmented information if the computers on the SSV or upper stage support checkout or operations of NRP payloads. Mission specific software and data loads for these computers must be developed in compartmented areas. While much flight crew training can be generic, a great deal of payload specialist training will necessarily be program specific, hands-on work with the real hardware or computer-aided simulations using the real parameters. The missions are too important to do otherwise.

Flight Readiness element requires the most intensive security environment, especially with regard to providing **realistic training for flight** crew proficiency and man/machine compatibility. This is the arena where engineering concepts, procedural approaches, techniques and individual flight crew member abilities are tested and evaluated. Actual payload hardware/procedures must be tested to measure capabilities, establish timelines, and explore contingency situations. Work-around methods to satisfy security requirements could jeopardize mission success if proper familiarity is not achieved during flight simulations/rehearsals. Fully compartmented simulation/rehearsal techniques are mandatory for the portions of the flight directly related to or interactive with the payload. Flight operations support personnel in many cases must receive very specific program training to adequately understand and properly support NRP operations. Payload support operations personnel at the STC and coordination personnel at the SSV flight control center require compartmented training.

Compartmented security is required to adequately conduct Flight Control functions for NRP programs. Flight Control functions are easiest for deployable free-flyers. If events always proceeded nominally, then DOD Secret could suffice for this type of workload. However, the use of the Payload Specialist and the Orbiter avionics and computer for troubleshooting or operations drives toward compartmentation because of the presence of program specific information.

Turning finally to the flight control elements, SSV pre-launch activities are often adequately protected at the DOD Secret level since payloads are essentially inert at this time and most activities are of a readiness nature. The security level required for SSV flight operations support of NRP programs varies depending on the particular program. In general, the greater the crew interaction with the payload and the more frequently the Orbiter itself must support the payload operation through maneuvers of all kinds, the greater is the need for compartmented security. In particular, reaction to and resolution of an Orbiter or a payload system anomaly will require close coordination between Flight Control and Payload Operations personnel. An Orbiter problem can affect payload tasking, delay payload deployment or threaten payload health, while a payload problem could require changes to Orbiter flight schedule, attitude, power system or even threaten Orbiter health. A coordination process which requires security workarounds becomes unacceptable when Orbiter/crew/payload interaction is great. In all cases, compartmented areas are needed for on-orbit payload support operations. Most post-flight assessments of STS performance can be conducted at the DOD Secret level, but some may require compartmented protection.

Some generalized security requirements emerged. [redacted] A second common area is data displays. Many payload related displays will be strictly compartmented. Common Orbiter displays available in flight control rooms and multi-purpose support rooms will have to be reviewed that mission-revealing information is properly protected.

The software build and verification process is not well understood by DOD and few programs have made any plans to exploit the Orbiter's computers. The feasibility of isolating one of the Orbiter's general purpose computers has been analyzed by IBM.* They determined that currently-available measures in the Orbiter's data processing system would provide at least three levels of depth in system-to-system isolation for security. The software build and verification of such capabilities would likely be compartmented.

(b)(1)
(b)(3) 10 USC ┴ 424

CHARACTERISTICS WHICH TEND TOWARD COMPARTMENTATION IN STS OPERATIONS

Several factors to the extent each is present in Flight Planning, Flight Readiness and Flight Control activities demand or push toward specially compartmented security for that activity. Table 10 lists these factors. The first factor, discussed in the Introduction to the Security Section of this report, provides the fundamental basis for classification. The remaining factors were not themselves used as criteria to judge whether or not compartmented security is needed. Rather, these factors emerge as independent explanations and descriptions of those situations wherein compartmented STS flight operations have been found to be necessary employing fundamental criteria for classification of program information.

The mere presence of one or more of these explanatory factors does not of itself always guarantee that compartmented security must be implemented. In some instances lower levels of classification can provide adequate protection. Factors 8 and 9, although not explicitly addressed here, will require compartmented information. Each of these factors is discussed briefly below:

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*Orbiter Avionics Software Integration Study: Analysis of Orbiter Systems to Meet MASE Requirements RES 78-11-1, IBM Federal Systems Div, Houston, TX, 17 Apr 1979

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TABLE 10

CHARACTERISTICS OF STS OPERATIONS WHICH TEND TOWARD REQUIRING COMPARTMENTED SECURITY

1. When mission, payload, capability and modus operandi of national programs is revealed

2. When payload operations require extensive coordination with STS flight control

3. When STS on-board computers support NRP payloads

4. When non-nominal payload conditions occur (Payload Specialists)

5. When basic Orbiter data is mission, capability, identity or modus operandi revealing

6. When payload data is available through the Orbiter

7. When general and special crew training procedures and equipment contain indicators of the mission or operations

8. When the STS and crew are directly involved in crisis support, compartmented operations or military support

9. When the STS and crew are involved in space defense operations

10. Past experience suggests there are other reasons not yet discovered

1. MISSION/PAYLOAD IDENTIFY/CAPABILITY/MODUS OPERANDI REVEALING DATA

Information revealing the above must be appropriately protected. Certain information which directly reveals the above for a specific NRP program is compartmented. Other information less directly revealing may nonetheless be classified because it is an indicator which combined with other information may reveal the above. In each case, specific tradeoffs are made considering security risk, cost of protection, operational factors, etc. Wherever this information is contained, it must be protected appropriately; e.g. software, people, data bases, displays, voice comm, simulators, rehearsals, hardware, classrooms, etc.

POTENTIAL USERS — ALL NRP PROGRAMS

AREAS AFFECTED —
TRAINING
FLIGHT CONTROL ROOM (FCR)
MULTI-PURPOSE SUPPORT ROOM (MPSR)
COMPUTERS
DISPLAYS
SIMULATORS
SOFTWARE DEVELOPMENT LABORATORY (SDL)
DATA BASES & FILES
DOCUMENTATION

2. WHEN PAYLOAD OPERATIONS REQUIRE EXTENSIVE COORDINATION/ INTERACTION WITH STS FLIGHT CONTROL

When NRP payload operations, rendezvous, retrieval and servicing activities, controlled from the DOD POCC reqiire very frequent and extensive coordination and interaction with the MCC controlling the SSV, then it becomes imperative that the MCC FCR be fully capable of compartmented discussions and exchanges with the DOD POCC. Compartmented support in real-time or near real-time for the STS could be critical to mission success. Coordination between the FCR and POCC is enhanced if they can communicate at the compartmented level on compartmented programs. When coordination between the FCR and POCC is minimal or on a relaxed timeline, the need for a compartmented FCR and associated MPSR and flight support is decreased.

POTENTIAL USERS — Palletized Payloads; Retrieval, Repair & Service Operations

AREAS AFFECTED —
FCR
MPSR
DISPLAYS
VOICE
TELEMETRY (TLM)

~~TOP SECRET~~

HANDLE VIA BYEMAN CONTROL SYSTEM ONLY

3. USE OF STS ON-BOARD COMPUTERS FOR NRP PAYLOAD SUPPORT

In the future, payloads will take advantage of the capabilities of the STS on-board computers to enhance the flexibility and power of R&D experiments, payload operations, and troubleshooting. The STS Orbiter computers are accessible through the Mission Control Center. Hence, all their data is available throughout the MCC. This data could be compartmented data. If so, compartmented security throughout the MCC would be required for protection of downlinked telemetry, displays and command generation.

POTENTIAL USERS	R&D experiments Troubleshooting of all payloads
AREAS AFFECTED	TLM Processor Software Dev Lab (command generation) FCR Displays

4. WHEN NON-NOMINAL PAYLOAD CONDITIONS OCCUR

When non-nominal conditions are encountered with any NRP payload, the payload specialist and other crewmembers will troubleshoot the problem and attempt repairs. Coordination, discussion and specific supplemental data (to include text and graphics) may need to be passed between the crew, the POCC and probably the FCR. In the future it is probable that TV pictures will be transmitted to the POCC and MCC to aid ground experts in troubleshooting the problem with the crew. If the problem goes beyond "normal" troubleshooting procedures, compartmented information would probably need to be exchanged. Even though links are encrypted, the protection of the compartmented data within MCC would be necessary. An alternative approach would be double encrypt all data (compartmented voice and data) so as to keep the MCC completely out of the compartmented troubleshooting loop. This is probably unacceptable from a mission control standpoint.

POTENTIAL USERS	All NRP programs for Troubleshooting
AREAS AFFECTED	Voice (Comm crew-ground) Text & Graphics Displays (Video & Console) FCR (VOICE) DOD POCC (Compartmented Security already provided)

5. WHEN BASIC ORBITER DATA IS MISSION/CAPABILITY/IDENTITY/ OR MODUS OPERANDI REVEALING

When NRP payloads particularly those which use the Orbiter as a mission platform may find that Orbiter data available in the SSV downlinked TLM is itself mission revealing. Examples include characteristic power drain, program - specific maneuvers, and precise attitude stabilization which are available in telemetry or the state vector. In the current JSC baseline for DOD operations, this information is intended to be protected at the DOD Secret level, but some NRP programs may require a higher classification.

POTENTIAL USERS	Any Payload requiring precision pointing
AREAS AFFECTED	TLM Processing Computers Computers Displays FCR Network Comm Data Quality Monitoring MPSR

6. WHEN PAYLOAD DATA IS AVAILABLE THROUGH THE ORBITER

This situation is not normally a security problem for DOD payloads whose data is encrypted before passing to the STS payload data interleaver for encryption again before downlinking. In this case payload data after its first decryption at the MCC remains encrypted and is passed through to the DOD POCC. If a payload did not provide its own encryption or if the Payload Specialist's voice is not passed through the payload's encryption, compartmented information could be present at the MCC after decryption.

POTENTIAL USERS	All Payload Specialist Voice None presently for Payload Data
AREAS AFFECTED	TLM Computer Displays TLM Recorders FCR MPSR

7. WHEN GENERAL AND SPECIAL CREW TRAINING PROCEDURES AND EQUIPMENT CONTAIN INDICATORS OF THE MISSION OR OPERATIONS

Crewmembers, especially Payload Specialists, will require facilities where procedures, techniques, man-machine interfaces, timelines, troubleshooting methods, etc., can be developed and verified for each NRP payload. The full range of contingency payload conditions and payload/Orbiter interfaces must be explored and rehearsed by the crew before flight readiness can be certified. Crews must train with the real hardware and participate in full-up simulations involving payload tasking and control activities and generation of real or high fidelity payload data. To do less is to fail to exploit the crew capabilities, provide improper or misleading training or readiness assessments, and potentially jeopardize the mission.

NEED FOR SECURITY PROTECTION

In this final section we provide several examples of sensitive NRP payload data and operating procedures.

Sensitive program information must be protected far ahead of the launch date for a particular system. It has been shown that knowledge of the mass properties of a satellite, useage schedule for expendables, etc., can be used to derive an accurate physical description. This information, together with actual or estimated deployment parameters permits assessments of the satellite's performance and mission. The referenced report concludes that the high correlation to mission type makes payload mass properties highly revealing.

Knowledge of antenna diameter and orbital parameters alone permits estimates of the azimuthal resolution of an orbiting radar. Advanced knowledge of capability enables an adversary time to develop strategy and countermeasures to defeat or exploit the systems. The time required to conceive and implement camouflage, cover and deception programs is often times less than we require to develop, test and field an operational space-based synthetic aperture radar for intelligence collection.

Visual data on NRP satellites must be protected because it permits estimation of key parameters, such as antenna size and frequency, both key parameters in system gain calculations. When combined with orbital parameters and estimates of receiver

*Mass Properties Correlation, BIF-107W-42003-77, 13 Oct 77

~~TOP SECRET~~

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sensitivity, the minimum signal strength collectible by the system can be judged. Such knowledge could enable an adversary to design his telemetry transmitters for low power operation to preclude effective collection of test range data on new missile systems.

Knowledge of physical properties or visual pictures of a satellite allows estimation of frequency coverage. This knowledge permits an adversary to plan emission control procedures for use when the satellite is in view.

General and special crew training and procedures can be very clear indicators of satellite mission and operation. The crew must train on realistic simulators, with the actual hardware, and interface with operational organizations. The mission-specific training hardware/software and patterns of crewmember activities require protection since they reveal not only mission but are schedule indicators since typical Shuttle activity planning timelines have been published openly.

Crew activity timelines, even devoid of mission specific details, may be combined with externally derived Orbiter position data from space tracking sensors to make estimates of areas of interest over which U.S. payloads are operating and thereby indicate tasking patterns or call attention to an overlooked area. Further, Orbiter attitude and positioning in conjunction with certain Payload Specialist operations or Orbiter telemetry data; e.g., power drain could indicate a photoreconnaissance mission.

Orbital parameters and launch times of NRP payloads require protection far in advance of launch dates. Some missions by their very nature require specific parameters (e.g. sun angle, inclination, period orbital altitude) which over a period of time become characteristic signatures of those missions. Surprise can and has paid big dividends in collections. The early intelligence take before the adversary has time to sort out the mission of the newly-launched payload and implement CCD activity is usually the most valuable. Similarly, knowledge of orbital parameters and even gross schedule information enables correlation with past activity and divulges replenishment strategy.

Tight effective security permits us to capitalize on surprise, take advantage of cover opportunities provided by similar missions, and delay, confuse and misdirect enemy countermeasures.

STS FLIGHT OPERATIONS DEFINITIONS*

- FLIGHT PLANNING
- FLIGHT READINESS
- FLIGHT CONTROL

NOTICE REGARDING SECURITY
MARKING OF THIS APPENDIX

Information in this Attachment has been extracted from the unclassified document Mission Operations Plan for the DOD Space Transportation System Program, SAMSO-LV-0020, dated January 1979. However, these extracts were annotated to assist NRP program offices (and subsequent readers) in making assessments of the security levels required to carry out various Shuttle flight planning, readiness and control activities. Any annotations and comments involving the terms NRP, NRO, or BYEMAN cause the page to be marked TOP SECRET/BYEMAN or SECRET/BYEMAN.

*Mission Operations Plan for the DOD Space Transportation System Program, SAMSO-LV-0020, Jan 79

The following information has been extracted from the Mission Operations Plan for the DOD Space Transportation Program, SAMSO-LV-0020, Jan 1979, a comprehensive roadmap and description of activities expected to be involved in the flight planning, readiness and control of DOD missions using the Shuttle. These extracts were prepared to give the program offices (and subsequent readers) insight into each of the activities involved so they may begin to appreciate workload implications, agencies involved, and security concerns which arise in each.

NOTE: The Mission Operations Plan (SAMSO-LV-0020) as base-lined assumes JSC as the Shuttle Planning and Control Center so activities and events presented typify that flow. The reader should keep this in mind when reviewing the following extracts. However, nearly all the activity presented is generic and must be accomplished somewhere, i.e., at DOD, contractor, or NASA facilities as may be determined.

In the following extracts, the symbol "oo" is occasionally used to flag attention to those activities considered likely to involve compartmented information.

FLIGHT PLANNING FUNCTIONS

Flight Planning Functions include:

1. Flight feasibility analysis
2. Payload flight support requirements development
3. Utilization planning (of the STS)
4. STS flight design
5. Upper stage flight design
6. Flight crew activity planning

Each function is described in greater detail below so assessments of the security level necessary for each can be made:

1.1 The Flight Feasibility Analysis function performs the planning, technical analyses and interagency coordination to eliminate any serious questions about the capability of the STS to support user flight requirements. It begins up to four years prior to launch and ends with completion of the spacecraft preliminary design review. Program data is revealed throughout the supporting agency structure (e.g., to SAMSO/LV, AFSCF, launch bases, and NASA) as necessary agreements and documentation to establish program support. Data included is:

Spacecraft Data and Flight Objectives, Schedules
Interface Requirements Documents
STS Flight Requirements, Constraints and Assumptions
Design Reference Missions
Contingency Analysis Guide
Spacecraft PDR Data
Mission Interface Verification Plan

Some key outputs of this function are:

An Interface Requirements Document including:

Ground Operations
Flight Operations
Spacecraft Subsystems
Security
Environment

A Mission Interface Verification Plan

A Flight Feasibility Review and Spacecraft PDR

STS Mission Plan, including requirements, constraints and assumptions like:

Launch Windows
Orbit Parameters
On-orbit Operations
Contingencies
Launch on Demand
Crew Activities

1.2 Payload Flight Support Requirements Document. This function prepares requirements for support from DOD and NASA organizations that perform flight operations; agreements for flight operations integration (Payload Integration Plan); agreements for NASA flight operations support; agreements for AFSCF flight operations support. Satisfaction of these requirements is determined through:

Flight Operations Review (FOR)	(NASA)
Independent Readiness Review (IRR)	(DOD)
Flight Readiness Reviews (FRR)	(NASA)

The Flight Operations Section of the Payload Integration Plan includes:

Mission Operations
Preliminary Mission Scenario
Orbital Requirements and Payload Control Parameters
Operational Requirements and Constraints
Prelaunch

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(cont'd on next page)

Ascent
On-orbit
Entry
Post Landing
Flight Operations
Flight Design
Crew Activity Planning
Training
Flight Operations Control
Command and Control Support

(b)(1)
(b)(3) 10 USC 424

The seven PIP Annexes below are prepared. They say what SAMSO, the SPO and the NASA (JSC) will do and what the SPOs requirements are:

oo <u>Flight Planning</u> - covers flight design data, crew activities. This could be payload and mission-revealing!

oo <u>Flight Operations Support</u> - covers payload decision points, communications and data management, natural environment support, ground controlled payload operation and procedures.

oo <u>Training</u> - this provides a schedule and description of payload unique training activities and facility needs.

oo <u>Command & Data</u> - defines specific payload commands and measurements for any transmissions via Orbiter data links.

<u>NOTE</u>: If you use [redacted] to contact your P/L while on the STS, you need this; if you only use the STC, you don't. <u>POCC Requirements</u> - for DOD programs the STC is the POCC.

oo <u>Orbiter Crew Compartment</u> - this includes detailed descriptions of payload items stowed in the crew compartment -- Will your Payload Specialist have troubleshooting tools or special EVA gear? This Section also defines nomenclature of payload assigned controls and displays in the aft flight deck. deck.

oo <u>Payload Data Package</u> - this Annex requires payload programs to provide detailed payload characteristics, such as their sequence of mass properties, configuration drawings of major elements, RF transmitter characteristics, and payload functional data.

1.3 <u>Utilization Planning of the STS</u>

This function performs the technical analyses, planning and coordination necessary to determine a compatible grouping of payloads, to obtain flight assignment, and to participate in the Cargo Integration Review.

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Ascent
On-orbit
Entry
Post Landing
Flight Operations
Flight Design
Crew Activity Planning
Training
Flight Operations Control
Command and Control Support

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- Payload Data Package - this Annex requires payload programs to provide detailed payload characteristics, such as their sequence of mass properties, configuration drawings of major elements, RF transmitter characteristics, and payload functional data.

Utilization Planning of the STS

This function performs the technical analyses, planning and coordination necessary to determine a compatible grouping of payloads, to obtain flight assignment, and to participate in the Integration Review.

If your payload requires a dedicated STS flight, this step is no problem -- we simply reserve a flight for your payload.

- oo If you require less than the full bay, you will have to reveal your spacecraft parameters to permit ride-sharing studies -- parameters like weight, volume, size, moments, power requirements, contamination, deployment sequences, operations sequences, electromagnetic capability, thermal needs, launch windows, sun angles, orbit parameters, etc. Any other ride-share candidate must likewise share such data with you.

- oo DOD plans to do its own cargo integration using its Payload Integration Contractor. However, if NRP cargo and any non-DOD cargo such as NASA or commercial cargo are considered for ride-sharing, procedures will have to be developed to protect NRP information.

1.4 STS Flight Design

In this function, SSV flight designs to satisfy cargo requirements are developed. The SSV flight design includes the trajectory, ground tracks, attitude and pointing timelines, and consumables useage profiles for the SSV plus the relative motion of free-flyer spacecraft while in the vicinity of the Orbiter.

Function Inputs:

1. STS Preliminary Mission Plan: Spacecraft Feasibility, Revision 1.
2. PDR Trade Studies (Flight Operations)
3. PDR Minutes
4. Flight Requirements (IRD or ICD)
5. Upper Stage Preliminary Flight Design
6. Preliminary System Analyses Results
7. CDR Minutes
8. Mission Interface Verification Plan
9. Payload Mixing Report
10. FID (Flight Operations)
11. Upper Stage Conceptual Flight Design
12. Summary Payload Crew Activity Plan
13. Summary Crew Activity Plan
14. PIP Annex for Flight Planning
15. Upper Stage Operational Flight Design
16. Detailed Payload Crew Activity Plan
17. Detailed Crew Activity Plan
18. LOD Plan

Function Outputs:

1. STS Preliminary Mission Plan: Payload (Basic, Revision 1 and Revision 2)
2. Data for PIP Annexes
3. STS Preliminary Mission Plan: Cargo
4. Conceptual Mission Plan (Basic and Revision 1)
5. SSV Conceptual Flight Design
6. Operational Mission Plan
7. SSV Operational Flight Design

1.5 Upper Stage Flight Design (Applicable to some Programs)

If an upper stage has been assigned to the spacecraft, vehicle-specific data can be used in this design. The flight design also includes variation of the parametrics in order to determine a range of operation for the flight.

oo The data involved in this function is clearly program specific

1.6 Flight Crew Activity Planning

This function develops crew procedures and crew activity timelines to be performed by the flight crew during flight. This function covers crew activity planning after the cargo is baselined at the CIR. Prior to this period, crew activity planning is performed as part of the STS flight planning for the payload and cargo using standardized crew activity profiles or timelines rather than detailed analyses.

The crew activity plan defines how the flight will be flown by the crew. It contains the schedule of crew activities and relates them to ground support activities. Steps in crew activity planning include:

oo Developing an integrated summary crew activity plan prior to the FOR.

oo Developing execute data (crew procedures, reference data, time references, etc.).

NOTE: The crew planning includes activities to be done by their flight operations support personnel on the ground.

FLIGHT READINESS FUNCTIONS

The Flight Readiness element is composed of functions related to the preparation and training required for a flight. These functions are:

1. Flight Data File Preparation
2. SSV On-board Digital Data Load Preparation
3. Upper Stage On-board Digital Data Load Preparation
4. Flight Crew Training
5. SSV Flight Operations Support Personnel Training
6. Payload Flight Operations Support Personnel Training
7. Integration Rehearsals/Simulations

The Flight Data File (FDF) is the total onboard set of documentation and other operational aides for the flight crew.

The SSV/FDF contains components that will be used for STS operations including payload activation, deployment and deactivation.

The Payload FDF contains components required for the operation of a payload itself during the on-orbit phase of SSV operations. For some SAFSP payloads, where the deployment is straightforward and similar to standard DOD payloads, a separate payload FDF may not be required. In these cases, most probably a DOD Secret/ mission specific input would be generated for the FDF file by SAMSO/LV. In some cases however, the activation/deactivation and deployment sequences may be complex or the flight crew may have some other intervening non-related function to accomplish during the middle of a particular deployment, or a reiterative unique process may be required for deployment. Then a separate/peculiar FDF would be required. This could be conceivably generated by SAMSO/LV as DOD/SECRET or by SAFSP as BYEMAN depending on the degree to which the file would be mission revealing.

The typical components within the FDF are as follows:

- o Orbit Operations Checklist
- oo Rendezous Book
- o Deploy Checklist
- o Retrieve Checklist
- oo EVA Checklist
- oo Payload Checklist
- oo Payload Schematics
- oo Payload Malfunction Procedures
- oo Payload Crew Activity Plan
- oo Payload Operations Summary
- oo Payload Operations Reference Data
- o Payload Operations Cue Card
- o Star Charts

The components indicated by "oo" are items most likely to require "BYEMAN" security.

The SSV On-board Digital Data Load (ODDL) preparation consists of all data loaded into two (2) redundant mass memory units of the SSV data processing system. It consists of computer programs (code) and the flight dependent data (I-loads) that specify a particular flight. The mass memory software contains the following software elements:

o Primary Avionics Software System (PASS)
o Pass Inbedded Software
o Backup Flight Software
o GPC System Software Loader/Self Test Program (SSL/STP)
o Display Electronics Units (DEU)
o Space Shuttle Main Engine (SSME)
oo Display Text and Graphics
oo Test Control Supervisor Sequences
oo Payload Data Interleaves (PDI)
oo Telemetry Format Loads (TFL)

Flight specific requirements, for both code and data, are implemented by NASA into a baseline SSV MMU by either a patching process or completely rebuild with classified I data. Any necessary on-pad changes are accomplished by patching process. NASA has the responsibility for generating the SSV ODDL and SAMSO/LVO for reviewing prior to certification. The elements indicated with "oo" may contain specific payload data that is mission revealing.

<u>NOTE</u>: Present plans are to use the STC for all DOD payload commanding and checkout. The payload is interrogated directly from the SCF ground stations. However, you should recognize that Payload Specialists will accompany all NRP payloads for troubleshooting or payload operation. The Orbiter computer (processor and mass memory) and payload interrogation equipment will likely be used since they are standard equipment. Program specific, possibly BYEMAN data, will be resident in the SSV computer -- hence, accessible to the ground. As an alternative, each NRP program would have to provide their own space qualified hardware for this task.

The Upper Stage On-board Digital Data (ODDL) Load consists of the total contents (program code and mission data values) of the upper stage avionics memory prior to any processing by the upper stage flight computer. The preparation responsibility for the upper stage ODDL for DOD mission belongs to SAMSO/LV. For SAFSP missions, the data within the Upper Stage ODDL is considered BYEMAN.

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CONTROL SYSTEM ONLY

Flight crew training encompasses the classroom and simulation training of the STS flight crew (Commander, Pilot and Mission Specialist). The planning, developing, managing and operating functions for the training programs and supporting facilities includes the analysis of operator tasks, preparing training aid materials, defining facility requirements, and the scheduling of execution of training exercises for the full crew complement (primary and backup) for a specific flight.

For a given flight phase or sequence, the training operations are scheduled so that the flight crews and appropriate SSV flight operations support personnel together receive workbook lessons first, then simulator training, integrated rehearsals/simulations, etc. Due to different training and security requirements, the Pilot, Commander, Mission Specialist and Payload Specialist, plus appropriate flight operations support personnel, may undergo different flight phase training at the same time. In general, common training requirements will be accommodated in conjunction with the generalized NASA training program. Flight specific training for the SSV flight crew, payload flight crew, and SSV FOSP that emphasizes Orbiter payload interactions instead of detailed payload operations will require a DOD Secret or a Top Secret compartmented environment depending on the extent of interaction and the amount of information disclosed that is directly mission revealing. This training would normally acquaint the flight crews and SSV FOSP to payload specific requirements and constraints. It will emphasize flight unique configurations and requirements for stowage, TV and photography, and crew system subsystems; altitude and translation maneuvers; deployment; ascent, abort, deorbit, entry and prelaunch operations; planning techniques; flight data organization; and EVA operations, if required. The Shuttle Mission Simulator (SMS) presents payload flight dynamics and systems parameters in a real-time environment, is utilized by the SSV and payload flight crew for flight specific training rehearsals/simulations. The SMS security environment required for SAFSP programs will vary from DOD Secret, Top Secret SI/TK, to a BYEMAN environment. While ascent and reentry simulations are less sensitive (they do require your payload mass properties, moments, etc.), the on-orbit simulation may need to be compartmented depending upon what is revealed by payload visual access through simulated views, payload operation or deployment activities, etc.

<u>Integrated rehearsals/simulations</u> are the final level of SSV flight dependent training. All relevant flight elements, including SSV and payload flight crew, SSV flight operations support teams and communication and data networks. These rehearsals/simulations verify procedures and timelines which involve the members of the STS flight crew, payload flight crew, and the SSV FOSP, and demonstrate crew and FOSP efficiency. One or more flight crew perform SSV flight operations from the simulator and the SSV flight operations support personnel (FOSP) participate

from their assigned console positions. The communications network is simulated. Normal and alternate flight simulations scenarios will probably be accommodated with a "DOD Secret" environment. However, contingency scenarios especially with regard to a specific payload; i.e., deployment, EVA, or retrieval could necessitate a higher level of security.

FLIGHT CONTROL FUNCTIONS

The Flight Control element is composed of functions related to the prelaunch, flight, and post-flight operations for the SSV and payload.

1. SSV Flight Operations Planning - covers the tasks which ensure that the Orbiter Mission Control Center (MCC) is properly configured to support flight operations. In particular, this function will:

   a. Define and implement flight peculiar MCC modifications

   b. Configure MCC consoles and displays

   c. Configure the communications and tracking network

   d. Prepare Operations Documentation

   e. Update flight rules

   f. Define and support validation of nominal and contingency flight support procedures and techniques

   g. Define and validate MCC external and internal interface

   h. Prepare and validate operations data

   i. Configure the operations data base.

2. Payload Flight Operations Planning - covers the tasks which ensure that the Payload Operations Control Center (POCC) is properly configured to support payload mission operations. The POCC is assumed to be located at the AFSCF and does not include payload operations outside the vicinity of the STS. This function involves the following tasks:

   Establish Mission Control force
   Prepare DOD STS Orbital Support Plan Annex
   Procure new systems to support payload operations
   Prepare Payload Test Program Planning Schedule

(cont'd on next page)

Prepare STS Test Operations Order Annex E
Prepare Cargo Element Orbital Operations Handbook
Prepare Payload Orbital Test Plan
Prepare Payload Flight Support Plan
Prepare Payload Telemetry Modes
Generate Payload Command Messages
Schedule Network Support for Payload Operations
Prepare Pass Plans

3. SSV Prelaunch Operations - includes all activities beginning with countdown and concluding at Solid Rocket Booster (SRB) ignition. During prelaunch operations the SSV flight operations support personnel are performing the following activities:

a. Verifying the SSV and payloads configuration and status

b. Monitoring consumables loading

c. Verifying internal, POCC (STC), and tracking network communications and operational support status.

d. Monitoring terminal countdown

e. Verifying landing sites operational status.

f. Providing telemetry and command communication

g. Configuring in-house data processing systems

h. Updating and verifying SSV mass properties

4. Payload Prelaunch Operations - includes those activities performed by the POCC which are necessary to ensure the operational readiness of the AFSCF support systems and to confirm the payload health and status. The Remote Vehicle Checkout Facility (RVCF) at KSC supports the transmission of command and telemetry data between the launch site and the STC. A similar function is performed at Vandenberg AFB. Activities included in this function include:

a. Payload prelaunch checkout

b. Payload launch countdown support

The security level required for this function is dependent upon how much payload command and telemetry data is classified; if classified, is it securely transmitted/received? is there a program requirement for or a system weakness that permits access to this data by SSV ground support personnel?

5. SSV Flight Operations Support - includes all activities performed by the SSV ground support system beginning with SRB ignition and ending with crew egress after Orbiter landing. These activities include:

a. Trajectory monitoring and navigation support

b. SSV systems monitoring and failure detection

c. Contingency and abort analyses

d. External Tank (ET) and SRB impact prediction

e. Real-time flight replanning

f. Inflight anomaly analysis

g. Vehicle configuration recommendations

SSV Flight Operations covers the following general phases:

Launch Operations - SRB ignition through orbit insertion. The SSV, MCC activities in support of this phase include:

a. Predict and identify abort situations

b. Provide vehicle configuration recommendations

c. Compute trajectory support data to verify vehicle performance.

The use of the on-board computer for payload activities and the access of its data to the ground network will be a major detriment in establishing the security requirements for this function.

Orbital Operations - Orbital injection to vehicle reentry preparation. During this phase, SSV ground support elements provide flight-related communications, systems and trajectory monitoring, data retrieval, flight planning, and operations resources management. The crew activities included in the Payload Operations Support Function (see below) are performed during this phase. The interaction of Orbiter and payload support activities, interfaces and resources will be decisive in determining security requirements.

Reentry and Landing Operations - Vehicle reentry preparations through crew egress after Orbiter landing. During this phase, the crew is preparing the Orbiter and its payloads for reentry. The ground support elements provide the crew with trajectory, meteorological, and support facilities status information relative to primary, secondary, and contingency landing sites. The ground support elements provide the following:

a. Weather updates and ground navigation aid status

b. Systems monitoring and failure detection

c. Verify landing site navigation aid updates

d. Assist crew in performing manual reentry and landing

6. Payload Flight Operations Support - consists of all activities performed by the POCC supporting the payload mission during the period from SRB ignition through crew egress. These activities may actually conclude with deployment for freeflyer payloads. These activities include:

a. Mission direction

b. Health and status monitoring

c. Tracking and telemetry processing

d. Orbit determination

e. Mission data receipt and descrimination

Payload Flight Operations covers the same phases as SSV Flight Operations.

Launch Operations - The POCC monitors the health and status of the payload if this information is handwired across the interface to the Orbiter avionics. The downlink data is received via either: (1) Orbiter FM data to MILA (at KSC), to the RVCF, to the STC, to the POCC, or (2) interleaved Orbiter/payload telemetry data to GSTDN (Ground Spaceflight Tracking and Data Network) to Goddard, to JSC, to the STC, to the POCC.

On-Orbit Operations - After injection, a number of different payload related options can be performed. These include:

a. Pre-deployment -- all Orbiter and payload preparations required prior to exposing the payload to the space environment

b. Checkout and deployment of freeflyer -- all Orbiter and payload activities associated with release of the payload. During this period, the SSV crew or the POCC will perform payload checkout, coordinate activities with the SSV MCC, determine Go/No-Go decisions for deployment, and execute the payload deployment sequence.

c. Post Deployme - After payload release, ıe crew will reconfigure the Orbiter and maneuver it away from the payload. The POCC continues to monitor health and status via its own link or through the Orbiter avionics relay capability. Upon completion of the last deployment related activity, the POCC assumes total control of the payload.

d. Pallet Checkout and Operation - The Payload Specialist crew and/or the POCC will perform all activities associated with the checkout and on-orbit operation of the payload. This can be accomplished through payload dedicated avionics (Orbiter autonomous), through the Orbiter avionics (telemetry and command systems), or by the on-board data processing capabilities (computer and avionics). The security requirements for this function will be dictated by the degree to which the SSV and payload flight and ground systems are physically and operationally integrated.

e. Repair/Service/Retrieval of a Free-flyer -- The rendevous and mating activities associated to perform a repair/service/retrieval mission will require greater crew involvement and increased use of Orbiter flight and/or ground support services. The potential for EVA is also greater. These activities will be closely monitored by the ground support teams and will very possibly require BYEMAN communication and data interfaces.

f. Reentry and Landing Operations - - The crew and/or the POCC will prepare the payload for reentry and landing.

7. SSV Operations Postflight Analysis -- This function analyzes the SSV mission operations support, develops means and ways to improve this support, provides raw and processed SSV data for performance and operations evaluations. The activities involved include:

a. Assimilate and distribute SSV anomaly reports.

b. Process and reduce NASCOM communications and tracking data

c. Disseminate telemetry data to users

d. Perform flight crew and flight operations support debriefing

e. Perform orbit and trajectory reconstruction

f. Evaluate overall flight performance

g. Update simulation models and data base

HANDLE VIA BYEMAN
CONTROL SYSTEM ONLY

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8. Payload Operations Postflight Analysis -- This function analyzes the effectiveness of the payload flight operations support and develops ways and means to improve it. This function does not include payload operations outside the vicinity of the STS. In particular, it evaluates and documents the effectiveness of the payload operations in the performance of:

- o Flight Feasibility Analysis
- o Payload Flight Support Requirements Development
- o Upper Stage Flight Design
- o Upper Stage ODDL Preparation
- o Payload FOSP Training
- o Payload Flight Operations Planning
- o Payload Prelaunch Operations
- o Payload Flight Operations Support

The purpose of this analysis is to maximize the effectiveness of the flight operations support by isolating and eliminating problem areas.

SAFSP-1 10 May 1979

Office of Management and Budget Study Report

SAMSO/LVO (Col Boyland)

1. Reference LVO letter, this subject, 25 April 1979. (Cy Atch.)

2. Forwarded herewith is the data requested in your letter. It represents a preliminary estimate of our requirements at this time.

JOHN E. KULPA, JR
Major General, USAF
Director

Atch
SAFSP Shuttle Requirements
Rpt (Preliminary) 10 May 79 (S)

SECURITY NOTICE

THIS ATTACHMENT IS DOD SECRET

This Attachment is a copy of SAFSP's DOD SECRET report which forwarded Shuttle workload and security requirements to SAMSO. SAMSO consolidated these with other DOD requirements and forwarded overall requirements package to:

a. HQ USAF for inclusion in Annex C of the Shuttle Mission Operations Task Force Evaluation, itself an Attachment to the Mission Element Needs Statement for a DOD Shuttle Operations Planning Center.

b. NASA/JSC for use by the SAMSO/NASA working group analyzing Shuttle control options.

Tables in this Attachment are referred to in the workload and security sections of the main report and are therefore provided here for reference.

If inclosures are withdrawn (or not attached the classification of this correspondence will be UNCLASSIFIED.

~~SECRET~~

ANNEX D
ATTACHMENT 2

SAFSP

SHUTTLE REQUIREMENTS REPORT
(PRELIMINARY)

10 MAY 1979

CLASSIFIED BY: Director, SAFSP
REVIEW ON: 10 May 1999
REASON: 2-301.c.6

~~SECRET~~

STS WORKLOAD REQUIREMENTS

1. Workload categories included are:

   o Payload delivery of free-flyers

   o Payload platform/pallets [redacted]

   o Retrieval

   o Repair and service

   o On-orbit construction

(b)(1)
(b)(3) 10 USC 424

2. Programs included in Rev 8 of the STS Mission Model are included in Table 1.

3. The scheduled STS Workload (Table 1) reflects the May 1979 program baselines through 1985 and its outyear implications through 1991. Projections through 1995 continue patterns established in prior years.

4. In Table 1 the total number of Delivery [redacted] cannot be directly equated to total number of Orbiter flights because of ride sharing, and because multiple missions may be accomplished on the same STS flight. The compatibility of multiple mission support on any STS flight can only be assessed on a case-by-case basis and cannot be determined at this time.

5. Table 2 presents the potential contingency workload forecast for those programs included in Rev 8 of the STS Mission Model (Table 1). The present Rev 8 does <u>not</u> include any contingency workload in response to crisis situations or unforeseen failures.

6. Table 3 presents workload <u>not</u> reflected in Rev 8 of the STS Mission Model. It represents potential R&D STS workload for advanced future systems, experimental system brassboard tests, subsystem tests, and component tests. While a few R&D efforts require dedicated missions, most R&D payloads are small ride share candidates. Component tests for example are typically 250 pounds, five cubic feet, sealed cans.

7. Table 4 is a summary of the scheduled, contingency, and R&D workloads, and reflects an estimated range of potential STS support missions.

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STS SECURITY REQUIREMENTS

1. STS mission operations will involve Flight Planning, Flight Readiness and Flight Control activities. While no program has yet gone through all the steps which will be involved, a comprehensive description of tasks and subtasks for each activity has recently been published in the MISSION OPERATIONS PLAN FOR THE DOD SPACE TRANSPORTATION SYSTEM PROGRAM, SAMSO-LV-0020, Jan 1979. These twenty-one element tasks are based on the successful pattern developed by NASA for the APOLLO and SKYLAB programs. The tasks described in the Mission Operations Plan are considered representative of workload to be accomplished independent of where the work is actually done.

2. Based on task descriptions in the Mission Operations Plan, assessments were made of the security level required to adequately conduct program-specific work on the tasks and subtasks of each of the twenty-one major activities encompassed in Flight Planning, Flight Readiness, and Flight Control. Table 5 summarizes the STS security requirements baseline for each of the twenty-one activities for each of five workload classes.

3. Because each program has its individual requirements, not all elements may be needed. For example, some programs have upper stages, others do not. Similarly, within any workload category, a range of security level required is shown which accommodates the needs of individual programs. Column six of Table 5 displays the overall security requirements for each activity.

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TABLE 5

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STS SECURITY REQUIREMENTS

STS MISSION OPERATIONS ELEMENT	WORKLOAD CLASS					
	DEPLOY	PALLET	RETRIEVAL	REPAIR & SERVICE	CONSTRUC-TION	OVERALL REQUIRE-MENT
***FLIGHT PLANNING**						
1. Flight Feasibility Analysis	TSC	TSC	TSC	TSC	TSC	TSC
2. Payload Flight Support Requirements Development	S→TSC	S→TSC	S→TSC	S→TSC	S→TSC	TSC
3. STS Utilization Planning (Payload Mix, Flight Assignment)	S→TSC	S→TSC	S→TSC	S→TSC	S	TSC
4. STS Flight Design	S→TSC	S→TSC	S→TSC	S→TSC	TSC	TSC
5. Upper Stage Flight Design	N/A→TSC	N/A	N/A	N/A	N/A→TSC	TSC
6. Flight Crew Activities Planning	S→TSC	S→TSC	S→TSC	S→TSC	TSC	TSC
***FLIGHT READINESS**						
1. Flight Data File Preparation	S→TSC	S→TSC	S→TSC	S→TSC	TSC	TSC
2. SSV On-Board Digital Data Load Preparation	S→TSC	S→TSC	S→TSC	S→TSC	TSC	TSC
3. Upper Stage On-Board Digital Data Load Preparation	N/A→TSC	N/A	N/A	N/A	N/A→TSC	TSC
4. Flight Crew Training	S & TSC	S & TSC	S & TSC	S & TSC	S & TSC	S & TSC
5. SSV Flight Operations Support Personnel Training	S	S→TSC	S→TSC	S→TSC	TSC	TSC
6. Payload Flight Operations Support Personnel Training	TSC	TSC	TSC	TSC	N/A→TSC	TSC
7. Integrated Rehearsals and Simulations	S→TSC	S→TSC	S→TSC	S→TSC	TSC	TSC
***FLIGHT CONTROL**						
1. SSV Flight Operations Planning	S	S→TSC	S→TSC	S→TSC	S→TSC	TSC
2. Payload Flight Operations Planning	TSC	TSC	TSC	TSC	TSC	TSC
3. SSV Prelaunch Operations	S	S	S	S	S	S
4. Payload Prelaunch Operations	S	S	S	S	S	S
5. SSV Flight Operations Support (launch, on-orbit, recovery)	S→TSC	S→TSC	S→TSC	S→TSC	S	TSC
6. Payload Flight Operations Support	TSC	TSC	TSC	TSC	TSC	TSC
7. SSV Operations Post-Flight Analysis	S	S→TSC	S→TSC	S→TSC	S→TSC	TSC
8. Payload Operations Post-Flight Analysis	TSC	TSC	TSC	TSC	TSC	TSC

* Ref: Mission Operations Plan for the DOD STS Program (SAMSO/LV-0020, Jan 79)

KEY: S = DOD SECRET
TSC = TOP SECRET Compartmented
N/A = Not Applicable

→ Indicates Range of Requirement
& Indicates both security levels are required

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