INTELLIGENCE COMMUNITY STAFF

25 March 1986

NOTE FOR: D/ICS

FROM: [redacted] STAT
DD/PPS (Policy)

SUBJECT: IG(Space) Meeting

- Cover memo (Tab A) contains recommendations on the Issues.

- Report (Tab B) has a more recent version of the Executive Summary.

- Tabs C and D contain two good papers prepared separately by [redacted]. If you have time, they would be worth reading. STAT

[redacted] STAT

INFORMATION

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IG(Space) Meeting (3/25/86)

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A

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IG(Space) Meeting (3/25/86)

- Draft report is almost fully coordinated and ready for SIG(Space) consideration:
  - -- Executive Summary not yet coordinated.
  - -- Appendices missing.
  - -- Minor editing needed.
  - -- Cost figures must be checked.
  - -- Draft NSDD needs to be written.
- Report calls out four issues that are likely to be discussed. Each of these is discussed on the following pages.

Recommendation:

-- Concur with conclusions and recommendations in report subject to Working Group clean-up.

-- Point out that Issues and Executive Summary need more work.

-- Point out the need for the IG(Space) to consult with the Rogers Commission on the following technical points.

- o Is basic orbiter design sound? (Can Commission recommendations on orbiter be accommodated within the 1990 production schedule?)
- o Can anomaly resolution be accomplished within 12 months and within NASA funding estimate?
- o Will Commission recommendations impact orbiter turn-around time? (This will affect realizability of "NASA-planned" vice "conservative" flight rates.)

-- Rogers Commission consultation is also important to ensure that there is no political disconnect between these two administration efforts.

Funding

Report:

- OMB advises offsets are required.
- No offsets identified.
- Administration decision on funding approach needed.

Discussion:

- Report does not give the information needed to resolve the issue such as:
    - o Alternatives
    - o Pros/cons
    - o Process
- We have previously stated that our space budget is already very tight and offsets are not available.
    - o We, therefore, favor treating this funding as a supplemental.

STS Competition for Commercial and Foreign Launches

Report:

- Agreement on policy reached.
- Issue over timing and definition.

  -- NASA: Must honor commitments.
  -- DoT : Earliest practical transition.

Discussion:

- We favor a healthy commercial ELV industry to off-load Shuttle so it can be devoted to its best and highest priority uses.

  Report does not contain sufficient information for choice between NASA and DoT alternatives:

  o Task Working Group to include this information in report.

  o If this can't be done, we should go ahead and reserve this decision for further study.

Timing of Decisions

Report:

- Consolidated strategy is advantageous.
- Rogers Commission recommendations could delay NASA recovery plan submission.
- ELV capability must be available in 1988-89 and must start in next few months.

Discussion:

- We need to start on ELVs and payload transition now to have them available by 1988-89.
- As a minimum, DoD part of supplemental and NASA anamoly resolution part cannot be delayed to wait for Rogers Commission recommendations.
- We doubt that Rogers Commission recommendations will significantly affect our recommendations.
    - Should have IG(Space) consult with Rogers Commission to confirm this.
    - We, therefore, favor supplemental ASAP.

Flight Rate Planning

Report:

- NASA--planned flight rates (consistent with Presidential policy).
- Conservative flight rates.
    - More realistic for overall planning purposes.
    - Provides reserve capacity for contingencies.

Discussion:

- We think conservative rates should be used in near-term.
- 24 flights/year planning goal should be eliminated.
- Believe this issue can be resolved with compromise language.

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DRAFT

March 24, 1986 3:07 AM

INTERAGENCY GROUP ON SPACE

RECOMMENDATIONS FOR THE U.S. SPACE LAUNCH PROGRAM

March 25, 1986

NOT FOR RELEASE WITHOUT APPROVAL OF THE NSC

Rev. L.3 03-24

FOREWORD

This draft report has been prepared in response to the directives received from the National Security Council Interagency Group (Space) per memorandum dated February 7th 1986, Rodney B. McDaniel to Donald P. Gregg and al., subject: IG (Space) Actions. The following members of the IG(Space) Working Group participated in the preparation:

Otho Eskin / Col. Malehy	Department of State	
Robert H. Brumley / C. Stadd	Department of Commerce	
M. Johnson / Karlyn Daube	Department of Transportation	
D. Taft / J. Struthers / A. Wu	Office of Management and Budget	
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T. J. Bishop / M.L. Hunter	Department of Defense (OJCS)	
L. Nosenzo/ V. Teplitz	Arms Control and Disarmament Agency	
M. Roesch / R. Johnson	Office of Science and Technology	
C. O. Forsythe	National Aeronautics and Space Administration (Co-Chairman)	
T.P. Rona / T.E. Maultsby	Department of Defense (Co-Chairman)	

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COORDINATION

	Concur	Non-Concur*
Department of State	________	________
Department of Commerce	________	________
Department of Transportation	________	________
Office of Management and Budget	________	________
Intelligence Community Staff	________	________
Department of Defense (OJCS)	________	________
Arms Control and Disarmament Agency	________	________
Office of Science and Technology	________	________
National Aeronautics and Space Administration	________	________
Department of Defense (OSD)	________	________

* Please See Page Number as Shown

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EXECUTIVE SUMMARY

Following the CHALLENGER accident on January 28, 1986, the National Security Council directed an Interagency Group to develop the recommendations for actions to be taken in regard to the U.S. space program. This draft report, developed under joint NASA - DoD chairmanship, is the current summary of the Group's findings and recommendations.

The loss of the CHALLENGER has serious bearing on the Nation's ability to implement the President's space policy as promulgated in NSDD-42. It disrupts the planned timetable for national security and for civil Government missions. The disruption threatens to delay during the 1989-1995 period the transportation support for the Space Station and for the Strategic Defense Initiative-related experiments. It forces reconsideration of the role of the space shuttle in flying commercial and foreign customers' satellites.

Beyond the schedule disruptions, the CHALLENGER accident highlights the vulnerability of all space launch systems regardless of their degree of sophistication and reliability. It demonstrates the risk of relying on a single system for all U.S. space programs. The accident thus raises broader questions in regard to the Nation's means for gaining access to space with the requisite degree of assurance, flexibility and surge capability. Actions need to be 'efined and implemented in order to improve these attributes at an affordable cost and to enhance the public perception of these improvements.

In the absence of recovery actions, the CHALLENGER accident will cause a backlog of space missions in all sectors of the space program (military, civil and commercial). Based on a possibly optimistic 12-month stand-down period before the current 3-orbiter STS resumes operations, and assuming the planned NASA flight rates thereafter, this backlog could reach approximately 70 shuttle-equivalent payloads by FY 1995. Should the stand-down period be extended, or should the planned flight rates not be achieved, the backlog could be significantly larger. While some of the planned missions can be cancelled or delayed, many of them are time-critical and a significant fraction is vital to the Nation's security posture.

The only recovery action for the immediate future, where new launch resources cannot be introduced, is to cancel or delay missions judged less critical to the U.S. space goals. Beyond 1989, some of the critical national security related payloads will be reassigned from the shuttle to expendable launch vehicles (ELVs), and more effective use will be made of the combined STS and ELV resources then available by replacing the orbiter equipment lost in the accident, by making the payloads compatible with both types of launchers whenever possible and by providing East and West Coast launch facilities for both. With all these actions ·ombined, the impact on the Nation's critical military and civil space missions can be held to ›lerably low levels.

Decisions taken now, or in the immediate future, could result in significant improvements in the U.S. space launch posture projected for the period beyond 1989-1990. First, the lost orbiter can be replaced, at a total cost of approximately $_____B, adding both inherent capacity and increased assurance of maintaining the scheduled flight rates. Second, additional ELVs can be made available by accelerating and/or augmenting the current Government procurement. Third, by explicitly encouraging the private sector, commercially produced ELVs could become available in roughly the same time frame. The combination and timing of these actions define the several options for longer-term recovery and reconstitution.

Two objectives are to be achieved by all these options: (a) to accelerate recovery from the interruption of space launch operations; and (b) to rebuild a more balanced and flexible national space launch posture that will support the U.S. space goals in all three sectors (national security, civil and commercial) while being largely independent of failures in a given system. Four options have been examined by using the criteria of capability / risk, ability to reduce the mission backlog or the lost mission opportunities, affordability, and impact on the private sector.

The assessment and comparison of the four options results in the following:

Option 1. Return to Pre-accident Baseline - Procure the fourth (replacement) orbiter with no change in STS goals or objectives and with no additional ELV procurement. This option will restore the lost assets but does not provide for improved diversity or flexibility of the U.S. launch posture. It will not meet the requirement for launch capability essentially independent of single launch system failure.

Option 2. Three Orbiters with Expanded ELVs - Do not replace the fourth orbiter; use the remaining three orbiters as efficiently as possible and augment launch capability with USG and commercial ELVs. This option provides adequate nominal capacity, with launch diversity beyond that planned prior to the CHALLENGER accident, and it satisfies the requirement for assured access to space. However, it provides inadequate flexibility in terms of responding to changes in payload schedules and delays. In the event an orbiter (of the three in service) was out of service for any extended time, the remaining two orbiters could not satisfy the manned space, the shuttle-unique and the national security mission requirements. With the appropriate declaratory policy, this option will support and encourage the development of U.S. private launcher and launch services industry.

Option 3A. Four Orbiters with Expanded ELVs - Replace the fourth orbiter by 1990 and augment launch capability with USG and commercial ELVs. This option provides adequate nominal capacity, with launch diversity beyond that planned prior to the CHALLENGER accident, and it would retain the U.S. commitment to the STS, while satisfying the requirement for assured ac-

›ss to space. It provides adequate flexibility in terms of responding to changes in payload schedules and delays. With the appropriate declaratory policy, this option will support and encourage the development of U.S. private launcher and launch services industry.

Option 3B. Fourth Orbiter by 1992 with Expanded ELVs - This option is identical to 3A, but the delivery of the fourth orbiter would be delayed until 1992. The merits of the option are the same as those of 3A, but the planned capacity becomes available two years later. The purpose of the delay is to reduce the procurement outlays in the early years of the program. Additionally, there might be more and better opportunity to incorporate in the replacement orbiter design all the recommendations derived from the Presidential Commission on the causes of the CHALLENGER accident.

Under the criterion of "affordability", these options compare as follows:

	BUDGET YEARS							
	1986 GRH	1987	1988	1989	1990	1991	BTC	TOTAL (All years)
OPTION 1								
Budget Authority	494	934	1114	590	72	277	0	3481
Outlays	177	906	1081	1147	364	185	102	
OPTION 2								
Budget Authority	798	947	1061	835	368	683	373	5064
Outlays	280	1115	1098	1085	440	595	464	
OPTION 3A								
Budget Authority	1055	1679	1970	1295	721	1039	373	8131
Outlays	370	1763	1951	1691	818	972	566	
OPTION 3B								
Budget Authority	988	1047	1826	1667	966	1016	373	7882
Outlays	310	1200	1810	1892	1089	999	582	

The quasi-unanimous position of the Working Group favors Option 3A. While the corresponding budget outlays are significantly larger than those for the other options , the latter do not satisfy the needs of the space program developed to support the U.S. space policy goals. If the replacement orbiter is not procured, this is tantamount on planning to operate with the 3-orbiter STS until the late 1990's. The Nation's manned space program and many shuttle-unique national security missions can ill afford the significantly higher level lof risk associated with a 3-orbiter fleet.

The Office of Management and Budget takes the position that, whether or not the Gramm-Rudman-Hollings budget constraints apply, the imperatives of budget reduction mandate a relatively slow procurement. The OMB's preference would be for Option 3B; which in addition would also afford the time required to incorporate in the program the recommendations of the "Rogers Commission". The Office of Science and Technology Policy tends to support a less hasty decision on the procurement of the replacement orbiter until broad agreement is reached that the design of the STS (not only that of the orbiter) is sound and that further investment in the STS is warranted. The Department of Transportation agrees with the recommendation in support of Option 3A, provided that NASA be directed to publicly and unambiguously commit to a policy of not competing with private industry for ELV-based launch services.

The Working Group is unanimous in accepting the view that advanced technology space launchers, such as the National Aerospace Plane and other concepts currently being studied by the Space Transportation System Architecture Study under NSSD 6-85, will not contribute to the U.S. space launch posture before the early years of the 21st century. The Working Group recognizes, however, that the furthering of these advanced space transportation technologies will call for substantial and sustained investments, in addition to those associated with the options discussed above.

A few unresolved issues pertinent to the subject have been identified. Among these, the following should be addressed by other groups or in a follow-on effort:

- o Mechanism for providing the funding for the recommended additional outlays
- o Specific timing of the formal decision in relation to the Rogers Commission report
- o Modalities and timing of NASA's new policy on commercial launch services
- o STS flight rates for planning purposes as contradistinguished from "target" rates.

A draft NSDD is forwarded under separate (classified) cover to embody the recommendations of Option 3A.

INTRODUCTION

This Interagency Group (Space) draft report responds to the National Security Council directive dated February 7, 1986 on the subject of recovery from the accidental loss of the STS orbiter CHALLENGER on January 28, 1986.

Three specific objectives have been set forth for the study reported here. First, consider, and report on, the expected impacts on the nation's capabilities to implement the national space policies. Second, summarize the recommendations made by the cognizant agencies on the ways to mitigate the immediate impact of the CHALLENGER accident on the on-going programs in the three sectors of the U.S. space activities: national security, civil, and commercial. Third, develop and assess the measures to be taken for reconstituting the U.S. means for providing assured access to space in order to accommodate the President's broad space policy objectives. The Group was encouraged to identify any longer-term policy issues that may require future consideration in the light of the CHALLENGER accident.

In broad terms, the several tasks have been completed. Two essential ques-tions have not been answered: how will the recommendations of the Presidential Commission on the causes of the CHALLENGER accident ("Rogers Commission") impinge upon the schedule and the cost of regaining operational status of the Space Transportation System; and are there sound approaches for providing the resources recommended for the reconstitution. The Interagency Working Group has made assumptions on the effects of the Rogers Commission's recommendations and has limited its work to the identification of the funding requirements associated with the recommendations.

The main body of the report contains the essential facts, suppported by background, approach and argument. Detailed qua ntitative background and supporting information is provided in Appendices.

Chapter I recapitulates the background of the situation addressed by the Working Group in the period immediately following the CHALLENGER accident.

Chapter II discusses the impacts on policy implementation and the means for mitigating the impact on our immediate space launch capability prior to resumption of operations and in the following period when the 3-orbiter STS fleet is operational. Chapter III defines and assesses the options available to recover and reconstitute the U.S. space launch posture to a level adequate to support the U.S. space policy goals for the mid-to late 1990's.

ChapterIV briefly identifies the issues pertinent to the recovery / reconstitution, but which have not been explicitly addressed or resolved by the Working Group.

Chapter V summarizes the conclusions and recommendations.

I. BACKGROUND

A. The CHALLENGER Accident. In January of this year, the twenty-fifth STS mission suffered a tragic accident that resulted in a fatal explosion that destroyed CHALLENGER and its crew. The CHALLENGER accident highlights the vulnerability of all space launch systems regardless of their degree of redundancy, sophistication, and reliability and demonstrates the vulnerability of relying on any single space launch system for all U.S. access to space.

While the Presidential Commission is investigating the cause of the CHALLENGER accident, the Interagency Group (Space) has been separately charged with assessing the impact on scheduled satellite deployments and identifying appropriate launch capability recovery options. This report was requested on an accelerated schedule to support the President's option of submitting an FY86 supplemental budget request for implementing recovery actions.

B. U.S. Space Program. The U.S. space program is composed of three independent, but highly interactive sectors -- national security, civil, and commercial. The national security and civil space programs are the direct responsibility of the U.S. Government. The commercial space activities are the responsibilities of the private sector; the government encourages and assists the commercial space sector by developing technology and providing a sound investment environment for commercial space activities. Administration policy specifically encourages the development of a U.S. commercial space launch industry.

The national security space program is principally oriented toward deploying and operating satellite systems that provide information and support to the National Command Authority (NCA) and operational military forces. These space systems provide critical functions such as attack warning, strategic communication, global navigation, and treaty monitoring.

Civil space systems provide opportunities for basic scientific research, planetary exploration, research and development, technology applications, including operational monitoring of the earth and its atmosphere, and manned spaceflight. These systems provide technology spinoffs that enable new commercial products and services, and advance our understanding of physics, astronomy, meteorology, environmental and life sciences. The U.S. manned spaceflight program is a part of the civil space program. These programs are a visible demonstration of U.S. technological leadership and offer opportunities to share space exploration with our international partners and allies.

Commercial space systems provide services to both the public and government. These ventures exploit private capital and augment government investments in space activities. Services are sold both domestically and internationally and contribute to the image of American leadership in space and technology.

Each sector of our space program relies on basic space services -- command and control, tracking, and launch services. To date, the government has been the sole provider of space launch services; until recently launch services were based on expendable launch vehicles (ELVs) developed by the government for primarily government use. Early this decade, the space shuttle entered operations and NASA began to phase out the use of ELVs; commercial satellite operators that had previously relied on NASA's ELVs for launch began to transition their payloads to the space shuttle.

The European Space Agency (ESA) developed an ELV and spun off its production and operation to the world's first quasi-commercial space launch system. This French company, Arianespace, began offering commercial launch services in competition with other launch systems, principally the shuttle.

The Department of Defense, while transitioning the majority of its payloads to the STS, established a policy of assured access to space and is procuring a limited number of ELVs as a complement to the shuttle. This effort was specifically designed to avoid total dependence on a single space launch system for all national security satellites.

C. National Space Goals and Objectives. The U.S. has established space policy goals or objectives which provide a focus for the activities in the individual space sectors. These goals are as follows:

1. Maintain U.S. space leadership.
2. Assure critical space system support to the NCA and operational commanders.
3. Provide a more assured access to space.
4. Provide routine, cost effective space transportation.
5. Establish a permanent manned presence in space.
6. Maintain a vigorous and balanced space research and development program.
7. Encourage U.S. private sector involvement and investment in space activities.
8. Encourage commercialization of U.S. ELVs.
9. Continue international cooperation in space.

D. The Space Transportation System. The STS was developed to be the workhorse of the U.S. space launch capability. The original concept called for a fleet of five reusable orbiters, providing 60 launches a year, and reducing space transportation costs well below the costs of ELVs. During the decade that the STS was being built, its costs increased, the number of orbiters was reduced, and the projected number of launches dropped to around 24 per year.

While the concept was based on high usage, rapid turnaround, and frequent satellite recovery and refurbishment, none of these have yet fully developed. Plans for intensive usage have not materialized; turnaround is more complex and time consuming than originally planned; and satellite recovery and refurbishment have gained slow acceptance by system designers. A reluctance to commit all U.S. space assets to sole dependence on a single launch system has led DoD to maintain an ELV capability in addition to the STS. Each of these factors combine to undermine the economic premise that encourages flying every spacecraft on the shuttle and flying the shuttle as frequently as possible to reduce the cost per flight.

The spacecraft deployment capability of the STS is only one of its features; the other major capability of the shuttle is its ability to carry man into space and support experimentation there for several days. This is the truly unique capability of the STS that cannot be matched by ELVs or any current foreign competition other than the Soviet Union. This capability has never been accounted for in the economic arguments of the STS concept. All costs were attributed to the cargo mission, and the importance of manned presence was not assigned a cost. Despite the emphasis on cargo carrying, the STS has been the centerpiece of the U.S. manned space program following Apollo/Skylab and is an essential element in satisfying the national space objectives.

E. Expendable Launch Vehicles. As the STS became operational in the early 1980s, national security and civil space systems were planned to transition from ELVs to the shuttle. Civil missions, and foreign and commercial missions launched by NASA have essentially completed this transition; the DoD and NOAA usage of ELVs was planned to continue into the 1988 timeframe.

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The current DoD inventory of ELVs consists of seven (7) T34D, one (1) T34B, sixteen (16) ATLAS vehicles, and nine (9) THOR vehicles in inactive storage. NASA has four (4) completed DELTA vehicles, three (3) partially built vehicles, as well as long-lead materials for eight (8) more.

The DoD has implemented an assured access to space strategy which calls for a limited number of ELVs to augment an otherwise complete dependence on the STS. This effort included ten (10) Complementary ELVs (CELVs), which are capable of launching Shuttle-size and weight payloads. The first of these will be available in the fall of 1988. In addition, thirteen (13) TITAN II ICBMs are being refurbished to launch selected small payloads; these will first be available in the spring of 1988.

II. IMPACTS

A. Introduction. The recent STS failure has two principal effects on the U.S. space launch capability. The first is the loss of the reusable flight hardware. The second is the disruption of all STS flight operations until the cause of the CHALLENGER accident is determined and corrected. This will create a backlog of missions that will have to be worked off in addition to the normally scheduled flights. The size of this backlog will be directly proportional to the length of time the STS is grounded. Once flight operations resume, both the normal schedule and the backlog will have to be accommodated with only 75% of the planned orbiters.

The types of actions that can be taken as well as the options available to decision-makers vary with time; five timeframes have been identified and considered by the study group.

The first timeframe is the grounding period defined by the length of the accident investigation and the time required to correct the cause of the STS failure. At this time, the most optimistic estimate of the grounding period is one year.

The second timeframe is the accommodation period. This period begins with the resumption of STS flight operations and continues until that time when additional launch assets (either additional ELVs or a replacement orbiter) can be brought into service. This period is characterized by reprioritizing missions and most effectively using the limited launch assets that are available. The earliest that a replacement orbiter could be available would be 1990 and the soonest that additional ELVs could be available would be 1988.

The third timeframe is the recovery period. This period could begin around 1988 when the first additional ELVs become available to assist in reducing the growing backlog of STS missions. The length of the recovery period will be determined by the operational capability of the orbiter fleet, the quantity of ELVs available, and any reduction in demand that may have resulted from payloads that have been canceled or lost to foreign competition during the disruption of STS launch operations.

The fourth timeframe is the nominal operations period. The period begins when the combination of U.S. space launch assets, both the STS and ELVs, are capable of handling each year's operational demand for launches.

The fifth timeframe is the next generation period. This period begins when new technology enables new launch systems and they enter operational service. This period is judged to be post 1995-2000.

B. Impact on Launch Capability. The CHALLENGER represented one fourth of the total STS fleet. It was one of two orbiters configured to carry the CENTAUR upper stage. This reduction in the number of available orbiters will significantly impact the nation's space launch capability. The remaining orbiters will be grounded pending the determination of the causes of the accident and the subsequent repairs. The current baseline assumption is that the STS fleet will be grounded for 12 months.

Based on a 12-month grounding, the same pre-accident demand for STS flights, a three-orbiter fleet, and the previously planned NASA STS flight rate, and no procurement of additional ELVs, the following backlog of missions would develop:

TABLE II - 1 STS BACKLOG PROJECTION (NASA Planned Flight Rates)

Shuttle-Equivalent Payloads	FISCAL YEARS									
	86	87	88	89	90	91	92	93	94	95
Pre-Accident Demand	9*	17	18	24	24	24	24	24	24	24
NASA Planned Flight Rates	0	6	14	15	18	18	18	18	18	18
Backlog	-9	-20	-24	-33	-39	-45	-51	-57	-63	-69

* Does not include the five missions previously flown in FY 1986, including 51L (CHALLENGER)

If more conservative flight rates are assumed, the resulting backlog is correspondingly increased:

TABLE II - 2 STS BACKLOG PROJECTION (Conservative Flight Rates)

Shuttle-Equivalent Payloads	FISCAL YEARS									
	86	87	88	89	90	91	92	93	94	95
Pre-Accident Demand	9	17	18	24	24	24	24	24	24	24
Conservative Flight Rates (three orbiters)	0	4	8	10	12	12	12	12	12	12
Backlog	-9	-22	-32	-46	-58	-70	-82	-94	-106	-118

The Complementary Expendable Launch Vehicle (CELV) being developed by the DoD could accommodate a shuttle-sized payload. Increases in production and launch rates could be achieved with additional capital investmentThe first CELV will be delivered in the fall of 1988. By that time the STS is already 24 to 32 shuttle equivalent missions (depending on the flight rate assumptions) behind pre-accident demand.

The FY 1986-89 backlog consists of existing payloads, whose launches will be delayed by reduced STS launch capacity. The FY 1990-95 backlog is better characterized as "lost flight opportunities" for missions not yet funded or completely defined that could not be launched as a result of the CHALLENGER loss.

Until additional ELVs can be made available in 1988, the nation will have to operate with essentially the launch capability that now exists. Therefore, the remaining orbiters, once they are released from grounding, will provide the only resources that can be reallocated to accommodate the highest priority launches over the next two years.

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C. Impacts During the Accommodation Period (FY 1986-88). If the current assumption that the STS fleet will be grounded for 12 months is valid, high priority national security missions will not be significantly impacted. DoD is in the midst of transitioning its payloads to the STS; the number of DoD payloads still on ELVs lessens the impacts of the STS grounding on defense, but some of the DoD payloads will have to be flown on the shuttle, as soon as practical. Civil and commercial missions will be impacted to a greater extent. Individual missions will be slipped on the order of 3 to 15 months. Initial manifest impact charts are provided in Appendix I and a preliminary manifest, based on a 12-month grounding is provided in Appendix II. If the STS is grounded for longer than 12 months, the impact on national security missions will become more serious and commercial and foreign customers might try to reschedule on Ariane or another ELV. Foreign partners cooperating in scientific missions may, when faced with lengthy or unknown delays, may elect to develop cooperative agreements with the U.S.S.R. or China, causing complex technology transfer and foreign policy problems. No efforts were made in this study to quantify the schedule impacts for downtimes longer than 12 months.

III. RECOVERY OPTIONS

A. Objectives. Before attempting to identify possible recovery options, a basic statement of the objectives of the recovery plan should be made. Simply stated the objective is twofold -- (1) to recover from the interruption in launch operations as efficiently and quickly as practical, and (2) to rebuild a more balanced and flexible national capability largely independent of failures in a given system.

B. Criteria. The following general criteria were selected for evaluating and comparing possible recovery options.

(1) Capability/Risk.

The U.S. space launch capability must offer a high degree of operational availability and be able to reliably satisfy the diverse requirements of all three sectors of the space program.

Time critical national security missions require assured access to space and need launch diversity to avoid total reliance on a single launch system. The majority of civil missions have become highly dependent on manned interaction and recovery of experimental equipment; they, therefore, require the unique STS capabilities. Commercial satellite operations are concerned with launch schedule availability and costs.

The unique manned capability of the shuttle must be explicitly considered in addition to its ability to support launching routine cargo. Routine cargo delivery not requiring manned capability may be more effectively allocated to expendable launch vehicles. STS-unique capabilities will be required to support programs such as space station, materials processing, and other space commercialization activities; revisit/resupply missions like the Hubble Space Telescope; as well as selected national security missions, including SDI.

Civil missions, including some with time-critical constraints (i.e., NOAA weather and remote sensing satellites) and many requiring the unique STS capabilities, are required to maintain U.S. leadership in space, in scientific research and exploration, in advanced space technology and applications and in manned space systems; to foster international cooperation in space and to facilitate and encourage private sector developments in space.

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Each option is assessed on its ability to provide a balanced space launch posture throughout the rest of this century.

The risk associated with each option's launch capability is a measure of the consequences if this capability is again perturbed or interrupted. The risks posed by this possibility of interruption are different for each sector of the space program.

Elements of this risk assessment include diversity of launch capability versus reliance on a single launch system; adequate reserve capability beyond anticipated demand to accommodate interruptions in launch operations without creating an unacceptable backlog of missions; the ability of a private sector expendable launch vehicle industry to augment government launch capacity on either a routine basis or in emergency situations; adequate capacity to accommodate growth in specific requirements. Risk is especially critical for those missions that must have manned interaction and must rely solely on the shuttle.

2. Backlog/Lost Flight Opportunities.

Backlog is a measure of reduced flight capacity -- the difference between the flight projections before the accident and current post-accident flight projections.

Backlog can be divided in two general categories:

-- Near-term (FY 1986-89) consisting of existing payloads whose launches will be delayed by reduced launch capability.

-- Mid-term (FY 1990-95) consisting of lost flight opportunities for planned missions not yet built.

The size of this cumulative backlog and the time required to eliminate it are indicators of the recovery capacity of each option.

A launch capability that is unable to eliminate the mid-term backlog would reduce the scope and extent of the U.S. space program in the 1990s.

3. Affordability.

The Balanced Budget Act (Gramm-Rudman-Hollings) and Presidential policy mandate that specific deficit reduction targets be met. The President's FY 1987 budget meets the targets from FY 1986-91. OMB advises that Administration policy requires any funding requests to Congress be accompanied by offsets.

This criterion addresses the ability to fund the required costs within each budget year.

The magnitude of the required budget authority and outlays projected for FY 1986-91, and the total costs will be shown for each option, and the ability to fund each each option in the currently constrained fiscal environment will be discussed.

4. Private Sector Launch Capability.

The availability of a privately funded U.S. ELV industry could represent an important element in developing a balanced U.S. space launch strategy. Even a limited commercial ELV launch capability could effectively augment government launch capacity for selected missions.

This criterion assesses the extent to which the individual option specifically encourages or discourages the private investment critical to developing a domestic, commercial ELV industry, consistent with existing Presidential policies.

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C. Common Assumptions and Considerations

(1) Flight Rate Assumptions.

Throughout this report, two flight rates are consistently used for all assessments. The NASA planned flight rates were used as a baseline; this planning builds to a rate of 6 flights per orbiter per year or a total of 24 flights a year with 4 orbiters.

A more conservative flight rate was assumed by the majority of the IG(Space) Working Group to be more realistic for planning purposes in this post-accident environment. This planning builds to a rate of 4 flights per orbiter per year, or a total of 16 flights a year with 4 orbiters.

These two flight rate assumptions represent a reasonable range of boundary conditions for the purpose of this study. In the current circumstance, conservative planning assumptions are crucial. Once new flight rate schedules are established, any significant shortfall in achieving these rates, will increase the already large backlog created by the accident. Costs to the government will also increase due to program delays -- costs that can be avoided now by conservative planning.

These planning assumptions are not a ceiling; higher rates may be achieved and would permit backlogs to be reduced more quickly. Rather, they represent prudent nominal capacity to be used for more conservative program and budget planning.

For the space shuttle program, the flight rate target of 24 per year by 1989 was based on detailed plans consistent with expected technical achievements in production, launch processing, and in-flight operations.

While the Working Group recognizes that such flight rate schedules may be technically feasible, they would not provide the conservative margins that are essential to reduce the risk of further serious disruption of the U.S. space program.

(2) NASA Salvage Operations and Corrective Action.

All options include all actions necessary to restore the remaining three orbiters to a safe operational status in as short a time as possible. This includes salvage operations, redesign, procurement, and requalification of flight hardware, and additional flight instrumentation. While it is assumed that orbiter performance will not be significantly reduced as a result of these post-accident modifications, a nominal decrease in payload lift capability is expected. The costs for these necessary actions are included in every option considered.

(3) Cost Estimates.

Because of the limited time available to assess the programatic implications resulting from the STS backlog created by the loss of CHALLENGER, the costs presented for each option focus on launch system assets, such as vehicles, facilities, and payload impacts.

Effects of the near-term backlog were addressed, where possible, in terms of changes in reimbursables, STS flight savings due to post-accident flight rates, and program adjustments through FY 1991. These effects tend to increase the total costs and are included with each option.

Additional effects due to delays in future programs or offsets from future reductions or cancellations, were beyond the scope of this effort. These unidentified costs are generally believed to lower the cost impacts identified in each option and were not addressed due to the limited time available.

OMB advises that Administration policy requires any funding requests to Congress be accompanied by offsets. No offsets were identified by the individual agencies and none were assumed by the IG (Space). Estimated costs are used to compare the options and are not meant to preempt the responsible agencies efforts to finalize their preliminary estimates.

(4) Next Generation Technology.

Consistent with the NSC tasking to the Working Group, advanced technology, such as the National Aerospace Plane, was reviewed. The operational availability of these next generation launch systems was judged to be no earlier than 1995. Since the recovery / reconstitution period covered by this report extended only through 1995, these new systems were not considered viable candidates.

A specific study of second generation space transportation systems, the National Space Transportation and Support (STAS) Study, is being conducted in response to NSSD-6-85. This study and the other ongoing NASA and DoD technology programs must reflect the strategy adopted to solve the near and mid-term launch problems. This can be done within the normal coordination/ budget process to ensure a coherent long-term plan.

(5) U.S Commercial Expendable Launch Vehicles.

In May 1983, a Presidential policy was established to encourage and facilitate development of a U.S. commercial ELV industry. This policy was based on the premise that the existence of a viable commercial ELV industry would add to the general economic vitality of the U.S. and provide it with a robust space launch capability. The policy was not fully implemented; low STS prices for commercial and foreign payloads, set in order to compete with Arianespace, precluded domestic ELV companies from gaining a share of this market.

Several of the options considered in this paper assume the availability of a U.S commercial ELV industry given proper government encouragement. The following is the status of this industry and vendor estimates of production and launch rates that could be achieved in the 1989-1990 timeframe without major capital investment in new facilities:

TITAN - 14 TITAN vehicles per year of various configurations.

ATLAS - 16 CENTAUR upper stages and 17 ATLAS vehicles per year of various configurations.

DELTA - 10 DELTA vehicles per year.

These quantities clearly exceed the available commercial and foreign market but provide strong assurance that a U.S. ELV industry could develop from existing resources. Both General Dynamics and Transpace Carriers, Inc. (TCI) have been negotiating with NASA for nearly two years, for commercial production, marketing, and launch responsibilities for the ATLAS and DELTA vehicles, respectively. Commercialization of the TITAN launch vehicles is also possible.

D. Options

The options described in this paper represent the spectrum of alternatives considered by the Working Group. Each option is described and assessed in relation to the preceding criteria.

The options addressed are:

1. Return to pre-accident baseline - replace the fourth orbiter with no change in STS goals or objectives and with no additional ELVs.

2. Three orbiters with expanded ELVs - do not replace the fourth orbiter; use the remaining three orbiters as efficiently as possible and augment launch capability with USG and commercial ELVs.

3A. Four orbiters with expanded ELVs - replace the fourth orbiter, and augment launch capability with USG and commercial ELVs.

3B. Four orbiters (delayed delivery) with expanded ELVs - the same as Option 3A except the delivery of the replacement orbiter is delayed to ease the near-term funding impact.

Option 1 -- Return to Pre-Accident Baseline (Four Orbiters - No Additional ELVs)

This strategy represents the baseline option in that it would attempt to return to pre-accident conditions. The lost orbiter would be replaced using existing structural spares and the spares would be replaced. The replacement orbiter would be operational in 1990. Under this option, the shuttle would be the nation's primary space launch system.

National security and critical civil missions would be given highest priority; commercial and foreign customers would be given the next highest priority; other civil missions would be the lowest priority.

The Vandenberg STS facility would be activated on schedule and, until the delivery of the fourth orbiter, used only for those missions that require orbit inclinations unattainable from Kennedy. The existing three orbiters are thus essentially dedicated to Kennedy usage to reduce the STS backlog.

No additional ELVs beyond those currently approved (i.e., ten CELVs and 13 TITAN IIs) would be procured. NASA's commitment to three STS equivalent commercial and foreign flights per year would be retained.

The following tables show the STS backlogs under two assumptions of flight rates (i.e., **NASA planned rates** of six flights per orbiter per year and **conservative rates,** i.e., four flights per orbiter per year):

TABLE III - 1 **OPTION 1** STS BACKLOG PROJECTION (NASA Planned Flight Rates)

Shuttle-Equivalent Payloads	FISCAL YEARS									
	86	87	88	89	90	91	92	93	94	95
Pre-Accident Demand	9	17	18	24	24	24	24	24	24	24
NASA Planned Flight Rates	0	6	14	15	22	24	24	24	24	24
Backlog	-9	-20	-24	-33	-35	-35	-35	-35	-35	-35

TABLE III - 2 **OPTION 1** STS BACKLOG PROJECTION (Conservative Flight Rates)

Shuttle-Equivalent Payloads	FISCAL YEARS									
	86	87	88	89	90	91	92	93	94	95
Pre-Accident Demand	9	17	18	24	24	24	24	24	24	24
Conservative Flight Rates	0	4	8	10	13	16	16	16	16	16
Backlog	-9	-22	-32	-46	-57	-65	-73	-81	-89	-97

For the NASA planned flight rates, the backlog/lost opportunities remains constant at 35 for the early 1990s.

For a conservative flight rate, the backlog continues to grow and almost doubles in the first half of the 1990s.

Assessment.

Capability/Risk. This option includes only the launch capacity from a restored four-orbiter fleet (16 to 24 STS flights a year). The option restores the assets lost in the accident, but does not improve the diversity and flexibility of our national launch posture from the posture planned prior to the accident. It further does not meet the national security requirement for a launch capability essentially independent of failures in a single launch system. However, two four-orbiter fleets provide increased flexibility in responding to changes to payload schedules and events. The replacement orbiter ensures that the STS fleet would not be reduced to two orbiters in the event that one of the three remaining orbiters was out of service for an extended period of time.

Backlog. As shown in Tables III - 1 and III - 2 this option does little to reduce or eliminate the STS backlog under either the optimistic or conservative flight rate assumptions.

Because this option returns to the launch posture that existed prior to the accident, it leaves the nation just as susceptible to future outages and does not provide the ability to recovery quickly.

The decision to replace CHALLENGER must consider that elements of the shuttle fleet will inevitably experience downtime for repairs. Furthermore, it would be prudent to recognize the possibility of another major shuttle accident and to protect the nation's capability to support critical programs requiring man, like SDI and space station, in the wake of such an accident. In addition, a four-orbiter fleet provides increased flexibility in response to launch schedule changes from payload and weather delays as well as maintenance and refurbishment.

Affordability. Table B.1 shows the fiscal impact of Option 1. Cost for selected replacement items (anomaly resolution/corrective actions, replacement orbiter, Integral Upper State Airborne Support Equipment (IUS ASE), and replacement structural spares) is estimated at $2.8 billion. Total NASA costs (including replacement items) considering flight savings, lost reimbursables, and program adjustments, are estimated at $3.8 billion. DoD impacts consist of program adjustments of about $0.3 billion and STS reimbursable credits of about $0.6 billion resulting in a net savings of about $0.4 billion. Total USG cost for Option 1 is about $3.5 billion.

NASA would require budget authority of $493 million in FY 1986 and $882 million in FY 1987. NASA outlays are projected at $177 million in FY 1986 and $867 million in FY 1987.

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DoD would require budget authority of $1 million in FY 1986 and $52 million in FY 1987. DoD outlays are projected at less than $1 million in FY 1986 and $39 million in FY 1987.

Option 1 is the least costly of all options in terms of total costs with a total outlay impact in FY 1987 of $0.9 billion with the least fiscal impact to the FY 1987 deficit reduction target required by Gramm-Rudman legislation. Option 1 is the least difficult to fund with accompanying offsets.

U.S. Commercial Space Industry. Since the STS continues to fly commercial and foreign payloads, a U.S. commercial ELV industry would fail to develop.

Option 2 - Three-Orbiter / Expanded ELVs

This option does not replace the fourth orbiter, but relies on expanded use of expendable launch vehicles. The STS would provide for all manned missions and other civil and national security missions which most effectively use the capabilities of the shuttle. The option also assumes the availability of a U.S. commercial ELV industry.

The DoD would increase its procurement of CELVs and expand existing ELV production to maintain the full spectrum of launch capability required in addition to that offered by the U.S. commercial ELV industry.

An ELV launch capability would be maintained on both eastern and western test ranges. The Vandenberg STS facility would be activated on schedule and, until the delivery of the fourth orbiter, used only for those missions that require inclinations unattainable from Kennedy. The existing three orbiters are thus essentially dedicated to Kennedy usage to reduce the STS backlog.

No commercial or foreign communications satellites beyond [those committed through FY 1988] [existing contractual/legal commitments] would be flown on the shuttle, although the shuttle would be used to fly commercial and foreign experiments requiring manned intervention to help explore new space applications. Approximately three STS equivalents would be offloaded from the STS and would be available for launch on commercial expendable launch vehicles. A U.S. commercial ELV industry, created through private investment, would compete with foreign ELVs. The government could buy U.S. commercial launch services for selected government missions.

This offload, when combined with the DoD offload, would result in the following revised demand:

TABLE III - 3 **OPTION 2** STS BACKLOG PROJECTION (NASA Planned Flight Rates)

Shuttle-Equivalent Payloads	FISCAL YEARS									
	86	87	88	89	90	91	92	93	94	95
Pre-Accident Demand	9	17	18	24	24	24	24	24	24	24
DoD Offloads	0	0	0	-2	-3	-2	-4	-5	-5	-5
C & F Offloads	0	0	0	-3	-3	-3	-3	-3	-3	-3
Adjusted Demand	9	17	18	19	18	19	17	16	16	16
NASA Planned Flight Rates	0	6	14	15	18	18	18	18	18	18
Backlog	-9	-20	-24	-28	-28	-29	-28	-26	-24	-22

TABLE III - 4 **OPTION 2** STS BACKLOG PROJECTION (Conservative Flight Rates)

Shuttle-Equivalent Payloads	FISCAL YEARS									
	86	87	88	89	90	91	92	93	94	95
Pre-Accident Demand	9	17	18	24	24	24	24	24	24	24
DoD Offloads	0	0	0	-2	-3	-2	-4	-5	-5	-5
C & F Offloads	0	0	0	-3	-3	-3	-3	-3	-3	-3
Adjusted Demand	9	17	18	19	18	19	17	16	16	16
Conservative Flight Rates	0	4	8	10	12	12	12	12	12	12
Backlog	-9	-22	-32	-41	-47	-54	-59	-63	-67	-71

Assessment.

Capability/Risk. This option includes launch capacity from a three-orbiter fleet (12 to 18 flights per year), additional DoD ELVs (three to five STS-equivalents per year), and commercial ELVs (three STS-equivalents per year) resulting in a total national capability of 18 to 26 STS-equivalents a year, starting in FY 1989. This provides additional launch diversity beyond that planned prior to the CHALLENGER accident and satisfies the national security requirements for assured access to space for critical national security payloads. The launch vehicle diversity in this option reduces the risk of dependency on a single launch system. A three-orbiter fleet provides less flexibility in responding to changes in payload schedules and delays. In the event an orbiter was out of service for an extended period of time, a two-orbiter fleet would be inadequate to satisfy manned spaceflight, shuttle-unique, and national security requirements.

Backlog. Offloading some DoD missions from the STS and not flying communication satellites beyond [those committed through FY 1988] [existing contractual/legal commitments] results in an adjusted demand which is depicted in Tables III - 3 and III - 4. Under these assumptions and NASA planned flight rates, the backlog would stabilize by 1989 at about 28 flights and would be reduced by approximately 2 shuttle equivalents per year beginning in 1992. If conservative flight rates are used, then the backlog continues to grow by approximately four STS-equivalents a year through 1995.

Affordability. Table B.2 shows the final impact of Option 2. Cost for selected replacement items (anomaly resolution/corrective actions and IUS ASE is estimates at $0.4 billion. Total NASA costs (including replacement items) considering flight savings, lost reimbursables, and program adjustments, are estimated at $1.9 billion. DoD costs include program adjustments, launch recovery plans estimated at $4.1 billion, and reimbursable credits of about $1.1 billion for a total DoD cost of about $3.2 billion. Total USG cost for Option 2 is estimated at about $5.1 billion.

NASA would require budget authority of $236 million in FY 1986 and $150 million in FY 1987. NASA outlays are projected at $87 million in FY 1986 and $219 million in FY 1987.

DoD would require budget authority of $562 million in FY 1986 and $797 million in FY 1987. DoD outlays are projected at $193 million in FY 1986 and $896 million in FY 1987.

Option 2 is the next higher cost option above Option 1 with a total outlay impact in FY 1987 of $1.1 billion. Option 2 is less difficult to fund with accompanying offsets than Option 3A and about the same as Option 3B.

U.S. Commercial ELV Industry. This option supports the development of a U.S. commercial ELV industry. Without direct competition from the government for routine commercial and foreign communications satellite launches and with proper government encouragement, this industry should be competitive in the world market. DoD could buy commercial launch services for those classes of defense missions that do not have high security requirements. Potentially, some civil satellites could also use commercial ELV launch services. This government business would enhance a sound economic base and contribute to competitive commercial prices. This option would implement the President's ELV commercialization policy by enabling the establishment of a U.S. commercial launch industry to augment government's launch systems. This industry could provide emergency relief in those cases when government launch systems were grounded for protracted periods of time; with no direct government funds required to maintain the option. A U.S. commercial launch industry could also maintain and enhance the U.S. competitive position in the international market, particularly if the dollar/French franc exchange rate remains favorable.

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Option 3A -- Four-Orbiter by FY 1990 / Expanded ELVs

This option replaces the fourth orbiter and delivers it by August of 1989, increases the DoD procurement of ELVs, and reserves the STS essentially for government use and those missions requiring unique STS capability. The option also assumes the availability of a U.S. commercial ELV industry.

Beginning in FY 1989, routine commercial and foreign satellite deployments not requiring manned presence would not be deployed by the shuttle. New commercial exploitation requiring manned interaction (i.e., materials processing and experimentation) would be encouraged on the STS. DoD would continue to use the STS for those high priority missions where the payloads cannot be effectively reconfigured for ELVs or where man's presence is required as well as in contingencies when ELVs are grounded. National security missions would rely equally on both the STS and ELVs.

Civil missions tend toward designs that take advantage of the unique manned capabilities of the orbiters and therefore rely heavily on the use of the STS. However, both government or commercial ELVs would be available for civil use.

An ELV launch capability is maintained on both the eastern and western test ranges. The Vandenberg STS facility would be activated on schedule and, until the delivery of the fourth orbiter, used only for those missions that require inclinations unattainable from Kennedy. The existing three orbiters are thus essentially dedicated to Kennedy usage to minimize the STS backlog.

Commencing in FY 1989, Defense would launch additional ELVs ranging from two to five STS-equivalents per year (see Tables III - 5 and III - 6). This offload, when combined with the elimination of three equivalent STS flights a year for commercial and foreign customers, beginning in FY 1989, would reduce the demand for shuttle flights to about 16 a year by FY 1993.

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TABLE III -5 **OPTION 3A** STS BACKLOG PROJECTION (NASA Planned Flight Rates)

Shuttle-Equivalent Payloads	FISCAL YEARS									
	86	87	88	89	90	91	92	93	94	95
Pre-Accident Demand	9	17	18	24	24	24	24	24	24	24
DoD Offloads	0	0	0	-2	-3	-2	-4	-5	-5	-5
C & F Offloads	0	0	0	-3	-3	-3	-3	-3	-3	-3
Adjusted Demand	9	17	18	19	18	19	17	16	16	16
NASA Planned Flight Rates	0	6	14	15	22	24	24	24	24	24
Backlog	-9	-20	-24	-28	-24	-19	-12	-4	+ 4	+ 12

TABLE III - 6 **OPTION 3A** STS BACKLOG PROJECTION (Conservative Flight Rates)

Shuttle-Equivalent Payloads	FISCAL YEARS									
	86	87	88	89	90	91	92	93	94	95
Pre-Accident Demand	9	17	18	24	24	24	24	24	24	24
DoD Offloads	0	0	0	-2	-3	-2	-4	-5	-5	-5
C & F Offloads	0	0	0	-3	-3	-3	-3	-3	-3	-3
Adjusted Demand	9	17	18	19	18	19	17	16	16	16
Conservative Flight Rates	0	4	8	10	14	16	16	16	16	16
Backlog	-9	-22	-32	-41	-45	-48	-49	-49	-49	-49

Assessment.

Capability/Risk. This option includes the launch capacity for a restored four-orbiter fleet (16 to 24 flights per year), additional DoD ELVs (three to five STS-equivalents per year), and commercial ELVs (three STS-equivalents per year) resulting in a total national capacity of 22 to 32 STS-equivalents per year starting in FY 1991. The combination of replacing the fourth orbiter and expanding government ELV usage achieves a more diversified launch capability. This option satisfies the requirement for assured access to space and the need to avoid dependencies on single launch systems. The emphasis on assuring mission capability for critical national security missions can best be satisfied by the diversified launch capability. This option allows the ability to select from various strategies (e.g., dual compatibility, mixed scheduling) to assure minimum interruption of critical national security functions, despite possible future launch vehicle outage. A four-orbiter fleet provides increased flexibility in responding to changes in payload schedules and events. The replacement orbiter ensures that the STS fleet would not be reduced to two orbiters in the event that one of the three remaining orbiters was out of service for an extended period of time.

Backlog. This option, assuming NASA planned flight rates, could support all manned missions, including space station and other civil and national security missions, while eliminating the STS backlog by 1993. Under more conservative flight rate assumptions, the backlog would be stabilized by 1992, rather than eliminated. Assuming that NASA-planned flight rate projections could be achieved, this reduction in combination with the availability of a replacement orbiter would allow the elimination of the backlog by 1994 (see Table III - 5). If more conservative flight rates are assumed, however, the backlogs would not be reduced (see Table III - 6).

Affordability. Table B.3 shows the fiscal impact of Option 3A. Cost for selected replacement items (anomaly resolution/corrective actions, replacement orbiter, IUS ASE, and replacement structural spares) is estimated at $2.8 billion. Total NASA costs (including replacement items) considering flights savings, lost reimbursables, and program adjustments, are estimated at $4.9 billion. Total DoD costs for program adjustments, launch recovery plans, and STS reimbursable credits are about $3.2 billion. Total USG cost for Option 3A is estimated at about $8.1 billion.

NASA would require budget authority of $493 million in FY 1986 and $882 million in FY 1987. NASA outlays are projected at $177 million in FY 1986 and $867 million in FY 1987.

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DoD would require budget authority of $562 million in FY 1986 and $797 million in FY 1987. DoD outlays are projected at $193 million in FY 1986 and $896 million in FY 1987.

Option 3A is the most costly of all options and has the highest total outlay impact in FY 1987 at $1.8 billion. Option 3A has the greatest impact to the FY 1987 deficit reduction target required by Gramm-Rudman legislation and would be the most difficult to fund with accompanying offsets.

U.S. Commercial ELV Industry. This option supports the development of a U.S. commercial ELV industry. Without direct competition from the government for routine commercial and foreign communications satellite launches, with proper government encouragement, this industry should be competitive in the world market. DoD could buy commercial launch services for those classes of defense missions that do not have high security requirements. Potentially, some civil satellites could also use commercial ELV launch services. This government business would enhance a sound economic base and contribute to competitive commercial prices. This option would implement the President's ELV commercialization policy by enabling the establishment of a U.S. commercial launch industry to augment government's launch systems. This industry could provide emergency relief in those cases when government launch systems were grounded for protracted periods of time; with no direct government funds required to maintain the option. A U.S. commercial launch industry could also maintain and enhance the U.S. competitive position in the international market, particularly if the dollar/French franc exchange rate remains favorable.

Option 3B -- Fourth Orbiter By FY 1992 / Expanded ELVs

This option is the same as 3A except that the fourth orbiter delivery is delayed until January of 1991. The additional orbiter procurement would proceed on a slower schedule to ease the impacts in meeting the deficit reduction targets imposed by the Gramm-Rudman legislation and Presidential policy.

With this option, the backlog under NASA planned flight rate assumptions, would be eliminated by 1995. More conservative flight rate assumptions would allow stabilization of the backlog by FY 1992.

TABLE III - 7 **OPTION 3B** STS BACKLOG PROJECTION (NASA Planned Flight Rates)

Shuttle-Equivalent Payloads	FISCAL YEARS									
	86	87	88	89	90	91	92	93	94	95
Pre-Accident Demand	9	17	18	24	24	24	24	24	24	24
DoD Offloads	0	0	0	-2	-3	-2	-4	-5	-5	-5
C & F Offloads	0	0	0	-3	-3	-3	-3	-3	-3	-3
Adjusted Demand	9	17	18	19	18	19	17	16	16	16
NASA Planned Flight Rates	0	6	14	15	18	18	22	24	24	24
Backlog	-9	-20	-24	-28	-28	-29	-24	-16	-8	0

TABLE III - 8 **OPTION 3B** STS BACKLOG PROJECTION (Conservative Flight Rates)

Shuttle-Equivalent Payloads	FISCAL YEARS									
	86	87	88	89	90	91	92	93	94	95
Pre-Accident Demand	9	17	18	24	24	24	24	24	24	24
DoD Offloads	0	0	0	-2	-3	-2	-4	-5	-5	-5
C & F Offloads	0	0	0	-3	-3	-3	-3	-3	-3	-3
Adjusted Demand	9	17	18	19	18	19	17	16	16	16
Conservative Flight Rates	0	4	8	10	12	12	14	16	16	16
Backlog	-9	-22	-32	-41	-47	-54	-57	-57	-57	-57

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essment.

Capability/Risk. Because of the capacity provided by an additional shuttle, manned flights, and unmanned payloads requiring the unique capabilities of the shuttle would have greater flight opportunities. The overall U.S. launch posture would be strengthened by the purchase of additional ELVs for DoD missions and the availability of a U.S. commercial ELV industry. Greater diversity and flexibility would be provided for the U.S. space launch program due to the replacement of the orbiter, increased DoD use of ELVs, and a strong market incentive for private investment in commercial ELVs. Increased risk would result from operating a three-orbiter fleet for two additional years.

Backlog. This option, assuming NASA planned flight rates, could provide for all manned missions, including space station, and other civil and national security missions while eliminating the backlog of planned missions by FY 1995.

As with Option 3A, at conservative flight rates, this option would stabilize the backlog of lost flight opportunities by the early 1990s. Under this option some civil government payloads may be further delayed as a result of delivering the fourth orbiter two years later.

Affordability. Table B.3 shows the fiscal impact of Option 3B. Cost for selected replacement items (anomaly resolution/corrective actions, replacement orbiter, IUS ASE, and replacement structural spares) is estimated at $3.1 billion. Total NASA costs (including replacement items) considering flight savings, lost reimbursables, and program adjustments, are estimated at $4.7 billion. Total DoD costs for program adjustments, launch recovery plans, and STS reimbursables are about $3.2 billion. Total USG cost for Option 3B is estimated at about $7.9 billion.

NASA would require budget authority of $426 million in FY 1986 and $250 million in FY 1987. NASA outlays are projected at $117 million in FY 1986 and $304 million in FY 1987.

DoD would require budget authority of $562 million in FY 1986 and $797 million in FY 1987. DoD outlays are projected at $193 million in FY 1986 and $896 million in FY 1987.

Option 3B has a total outlay impact in FY 1987 of $1.2 billion, reduces the NASA outlay impact in FY 1987 of Option 3A by $0.6 billion with a nine-month delay, reducing the fiscal impact to the FY 1987 deficit target required by Gramm-Rudman legislation. Option 3B, would be less difficult to fund with accompanying offsets, about equal in difficulty to fund Option 2.

U.S. Commercial ELV Industry. This option supports the development of a U.S. commercial ELV industry. Without direct competition from the government for routine commercial and foreign communications satellite launches, with proper government encouragement, this industry should be competitive in the world market. DoD could buy commercial launch services for those classes of defense missions that do not have high security requirements. Potentially, some civil satellites could also use commercial ELV launch services. This government business would enhance a sound economic base and contribute to competitive commercial prices. This option would implement the President's ELV commercialization policy by enabling the establishment of a U.S. commercial launch industry to augment government's launch systems. This industry could provide emergency relief in those cases when government launch systems were grounded for protracted periods of time; with no direct government funds required to maintain the option. A U.S. commercial launch industry could also maintain and enhance the U.S. competitive position in the international market, particularly if the dollar/French franc exchange rate remains favorable.

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OMB TABLES

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BUDGET SUMMARY FOR OPTIONS

	1986 Current Year GRH	1987 Budget Year	1988	1989	1990	1991	BTC	Total All Years
Option 1. Late 1986 Orbiter Buy (42 Month Delivery from Authority to Proceed)								
DOD Budget Authority	1	52	106	-363	-240	81	0	-364
Outlays	0	39	79					119
NASA Budget Authority	493	882	1008	953	312	196	0	3844
Outlays	177	867	1002	1147	364	185	102	3844
Total Budget Authority	494	934	1114	590	72	277	0	3481
Outlays	177	906	1081	1147	364	185	102	2962
Option 2. No New Orbiter with Offloads								
DOD Budget Authority	562	797	924	108	84	342	373	3189
Outlays	193	896	911	310	129	286	464	3189
NASA Budget Authority	236	150	137	727	284	341	0	1875
Outlays	87	219	187	775	311	309	0	[illegible]
Total Budget Authority	798	947	1061	835	368	683	373	5064
Outlays	280	1115	1098	1085	440	595	464	[illegible]
Option 3A. Late 1986 Orbiter Buy with Offloads (42 Month Delivery from Authority to Proceed)								
DOD Budget Authority	562	797	924	108	84	342	373	3189
Outlays	193	896	911	310	129	286	464	3189
NASA Budget Authority	493	882	1046	1187	637	697	0	4942
Outlays	177	867	1040	1381	689	686	102	4942
Total Budget Authority	1055	1679	1970	1295	721	1039	373	8131
Outlays	370	1763	1951	1691	818	972	566	8131
Option 3B. Early 1987 Orbiter Buy with Offloads (4/87 Start, 1/91 Delivery)								
DOD Budget Authority	562	797	924	108	84	342	373	3189
Outlays	193	896	911	310	129	286	464	3189
NASA Budget Authority	426	250	902	1559	882	674	0	4693
Outlays	117	304	899	1582	960	713	118	4693
Total Budget Authority	988	1047	1826	1667	966	1016	373	7882
Outlays	310	1200	1810	1892	1089	999	582	7882

Notes:

See fiscal data each option

TABLE B.1

2[illegible]-Mar-8[illegible]

Option 1. Late 1986 Orbiter Buy (42 Month Delivery from Authority to Proceed)

	1986 Current Year GRH	1987 Budget Year	1988	1989	1990	1991	BTC	Total All Years
DOD								
Program Adjustments/1	1	52	106	45	24	30	0	258
Launch Recovery Plan/2	0	0	0	0	0	0	0	0
STS Reimbursable Credits/3	0	0	0	-408	-264	51	0	-621
DOD Budget Authority/6	1	52	106	-363	-240	81	0	-364
Outlays/8	0	39	79					
NASA								
Program Adjustments/1	67	179	259	314	218	239	0	1276
Replacement Items/4	493	882	895	365	115	55	0	2805
Flight Savings/Reimb Loss/3,5	-67	-179	-146	274	-21	-98	0	-237
NASA Budget Authority/6	493	882	1008	953	312	196	0	3844
Outlays/7	177	867	1002	1147	364	185	102	3844
Total Budget Authority	494	934	1114	590	72	277	0	3481
Outlays/9	177	906	1081	1147	364	185	102	~~3962~~

Notes:

1) Adjustments to programs based upon 12 month STS Standdown,
NASA adjustments include TDRSS Follow-on, Spartan, STS changes including reliability & quality assurance, Tracking and Data, Science and Application, and R&PM
2) Dual compatibility/payload integration, ELV's, launch facility modifications and support
3) NASA/DOD reimbursables changes in negotiation
4) Anomaly Resolution/Corrective Actions, Replacement Orbiter, IUS ASE, and Replacement Structural Spares
5) Flight Savings due to reduced NASA Planned Flight Rates
6) Budget Authority amounts provided by agencies
7) Budget Outlay amounts provided by NASA
8) DOD Outlay amounts not estimated beyond 1988
9) Total Outlay amount does not include DOD outlays beyond 1988

TABLE 5.2

23-Mar-86

Option 2. No New Orbiter with Offloads

	1986 Current Year GRH	1987 Budget Year	1988	1989	1990	1991	BTC	Total All Years
DOD								
Program Adjustments/1	1	52	106	45	24	30	0	258
Launch Recovery Plan/2	561	745	819	694	421	465	373	4077
STS Reimbursable Credits/3	0	0	0	-631	-361	-153	0	-1145
DOD Budget Authority/6	562	797	924	108	84	342	373	3189
Outlays/8	193	896	911	310	129	286	464	3189
NASA								
Program Adjustments/1	67.0	179.0	259.0	314.0	218.0	239.0	0.0	1276
Replacement Items/4	236	150	0	0	0	0	0	386
Flight Savings/Reimb Loss/3,5	-67.0	-179.0	-122.0	413.0	66.0	102.0	0.0	213
NASA Budget Authority/6	236	150	137	727	284	341	0	1875
Outlays/7	87	219	187	775	311	309	0	
Total Budget Authority	798	947	1061	835	368	683	373	5064
Outlays	280	1115	1098	1085	440	595	464	

Notes:

1) Adjustments to programs based upon 12 month STS Standdown,
NASA adjustments include TDRSS Follow-on, Spartan, STS changes including reliability & quality assurance, Tracking and Data, Science and Application, and R&PM
2) Dual compatibility/payload integration, ELV's, launch facility modifications and support
3) NASA/DOD reimbursables changes in negotiation
4) Anomaly Resolution/Corrective Actions and IUS ASE
5) Flight Savings due to reduced NASA Planned Flight Rates
6) Budget Authority amounts provided by agencies
7) Budget Outlay amounts provided by NASA
8) DOD Outlay amounts estimated

TABLE B.3A

23-Mar-86

Option 3A. Late 1986 Orbiter Buy with Offloads (42 Month Delivery from Authority to Proceed)

	1986 Current Year GRH	1987 Budget Year	1988	1989	1990	1991	BTC	Total All Years
DOD								
Program Adjustments/1	1	52	106	45	24	30	0	258
Launch Recovery Plan/2	561	745	819	694	421	465	373	4077
STS Reimbursable Credits/3	0	0	0	-631	-361	-153	0	-1145
DOD Budget Authority/6	562	797	924	108	84	342	373	3189
Outlays/8	193	896	911	310	129	286	464	3189
NASA								
Program Adjustments/1	67	179	259	314	218	239	0	1276
Replacement Items/4	493	882	895	365	115	55	0	2805
Flight Savings/Reimb Loss/3,5	-67	-179	-108	508	304	403	0	861
NASA Budget Authority/6	493	882	1046	1187	637	697	0	4942
Outlays/7	177	867	1040	1381	629	686	102	4942
Total Budget Authority	1055	1679	1970	1295	721	1039	373	8131
Outlays	370	1763	1951	1691	818	972	566	8131

Notes:

1) Adjustments to programs based upon 12 month STS Standdown,
   NASA adjustments include TDRSS Follow-on, Spartan, STS changes including reliability & quality assurance, Tracking and Data, Science and Application, and R&PM
2) Dual compatibility/payload integration, ELV's, launch facility modifications and support
3) NASA/DOD reimbursables changes in negotiation
4) Anomaly Resolution/Corrective Actions, Replacement Orbiter, IUS ASE, and Replacement Structural Spares
5) Flight Savings due to reduced NASA Planned Flight Rates
6) Budget Authority amounts provided by agencies
7) Budget Outlay amounts provided by NASA
8) DOD Outlay amounts estimated

TABLE B.3B

23-Mar-8

Option 3B. Early 1987 Orbiter Buy with Offloads (4/87 Start, 1/91 Delivery)

	1986 Current Year GRH	1987 Budget Year	1988	1989	1990	1991	BTC	Total All Years
DOD								
Program Adjustments/1	1	52	106	45	24	30	0	258
Launch Recovery Plan/2	561	745	819	694	421	465	373	4077
STS Reimbursable Credits/3	0	0	0	-631	-361	-153	0	-1145
DOD Budget Authority/6	562	797	924	108	84	342	373	3189
Outlays/8	193	896	911	310	129	286	464	
NASA								
Program Adjustments/1	67	179	259	314	218	239	0	1276
Replacement Items/4	426	250	765	830	575	180	0	3026
Flight Savings/Reimb Loss/3,5	-67	-179	-122	415	89	255	0	391
	~~426~~	~~250~~	~~902~~	~~1559~~	~~882~~	~~674~~	~~0~~	~~4693~~
NASA Budget Authority/6	426	250	902	1559	882	674	0	4693
Outlays/7	117	304	899	1582	960	713	118	4693
Total Budget Authority	988	1047	1826	1667	966	1016	373	7882
Outlays	310	1200	1810	1892	1089	999	582	7882

Notes:

1) Adjustments to programs based upon 12 month STS Standdown,
NASA adjustments include TDRSS Follow-on, Spartan, STS changes including reliability & quality assurance, Tracking and Data, Science and Application, and R&PM
2) Dual compatibility/payload integration, ELV's, launch facility modifications and support
3) NASA/DOD reimbursables changes in negotiation
4) Anomaly Resolution/Corrective Actions, Replacement Orbiter, IUS ASE, and Replacement Structural Spares
5) Flight Savings due to reduced NASA Planned Flight Rates
6) Budget Authority amounts provided by agencies
7) Budget Outlay amounts provided by NASA
8) DOD Outlay amounts estimated

	OPT 1	OPT 2	OPT 3A	OPT 3B
1. Capability ~~[illegible]~~				
- launch Capacity/Diversity (STS equivilents)				
STS	16-24	12-18	16-24	16-24
DoD ELVs	0	3-5	3-5	3-5
Comm ELVs	0	3	3	3
TOTAL	16-24	18-26	22-32	22-32
Risk Factors				
- Dependent on Single System	YES	NO	NO	NO
- Total Number of Orbiters	4	3	4	4
- ~~Minimum Number Req'd~~	~~3~~	~~3~~	~~3~~	~~3~~
2. Back log/Lost Flights				
near-term: FY [illegible] 89 (cumulative)	-33/~~46~~	-28/-41	-28/-41	-28/-41
mid-term: FY [illegible]-95 (cumulative)	-35/-97	-22/-71	+12/-49	0/-57
(see accompaning graphs)				

3. Affordability ($M) Cost:	OPT 1 Budget Authority	OPT 1 Budget Outlays	OPT 2 Budget Authority	OPT 2 Budget Outlays	OPT 3A Budget Authority	OPT 3A Budget Outlays	OPT 3B Budget Authority	OPT 3B Budget Outlays
FY 86	494	177	798	280	1055	370	988	310
FY 87	934	906	947	1115	1679	1763	1047	1200
~~FY 88-91~~ Remainder	2053	2398	3319	3669	~~[illegible]~~ 5397	5998	5847	6372
TOTAL	3481		5064		8131		7900	

	OPT 1	OPT 2	OPT 3A	OPT 3B
4. Comm. ELV Industry Encouraged	NO	YES	YES	YES

FIGURE II.C.1.

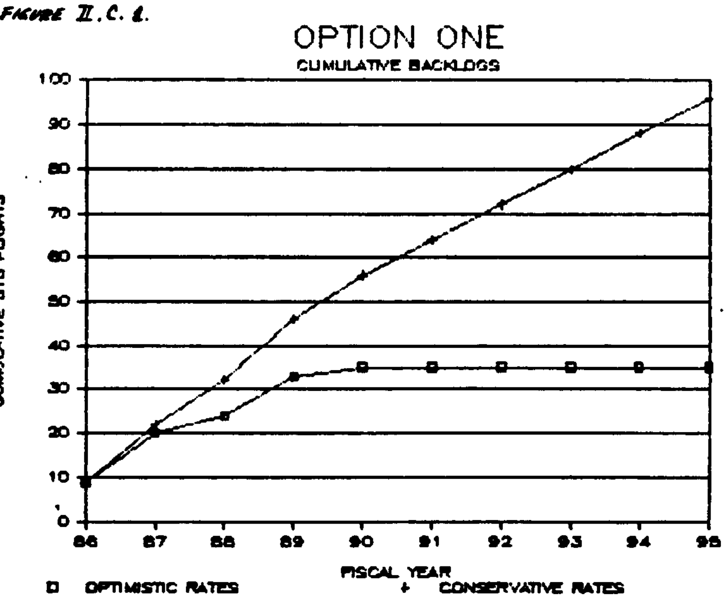


FIGURE II.C.2.

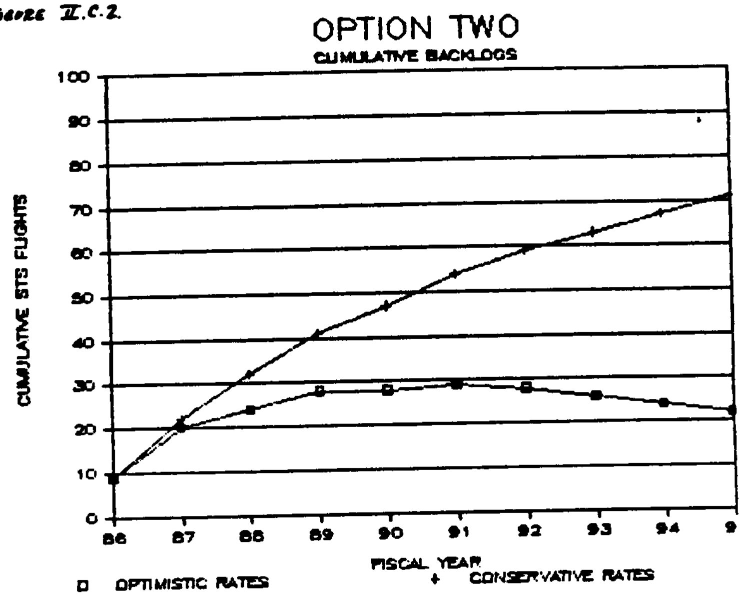


FIGURE II.C.3.

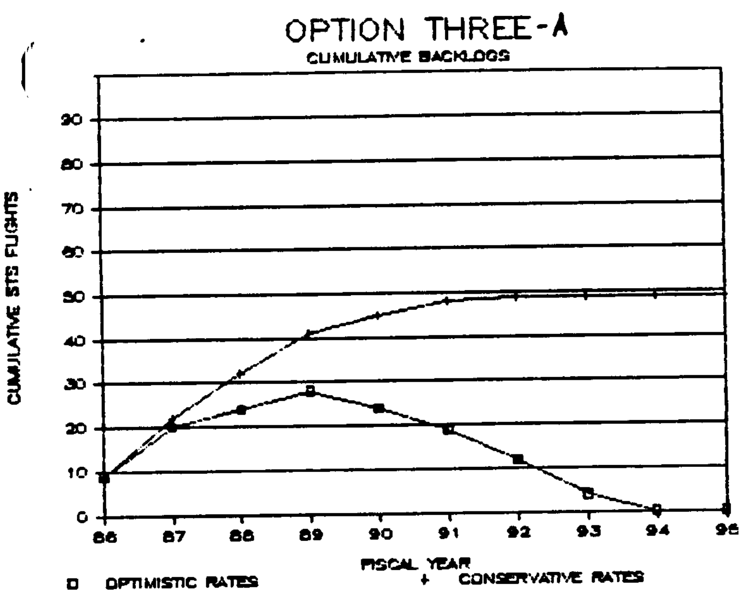
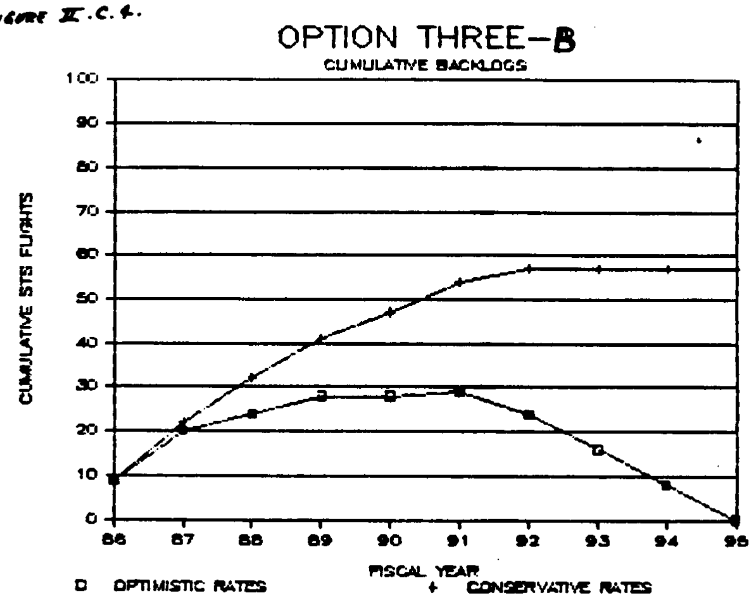
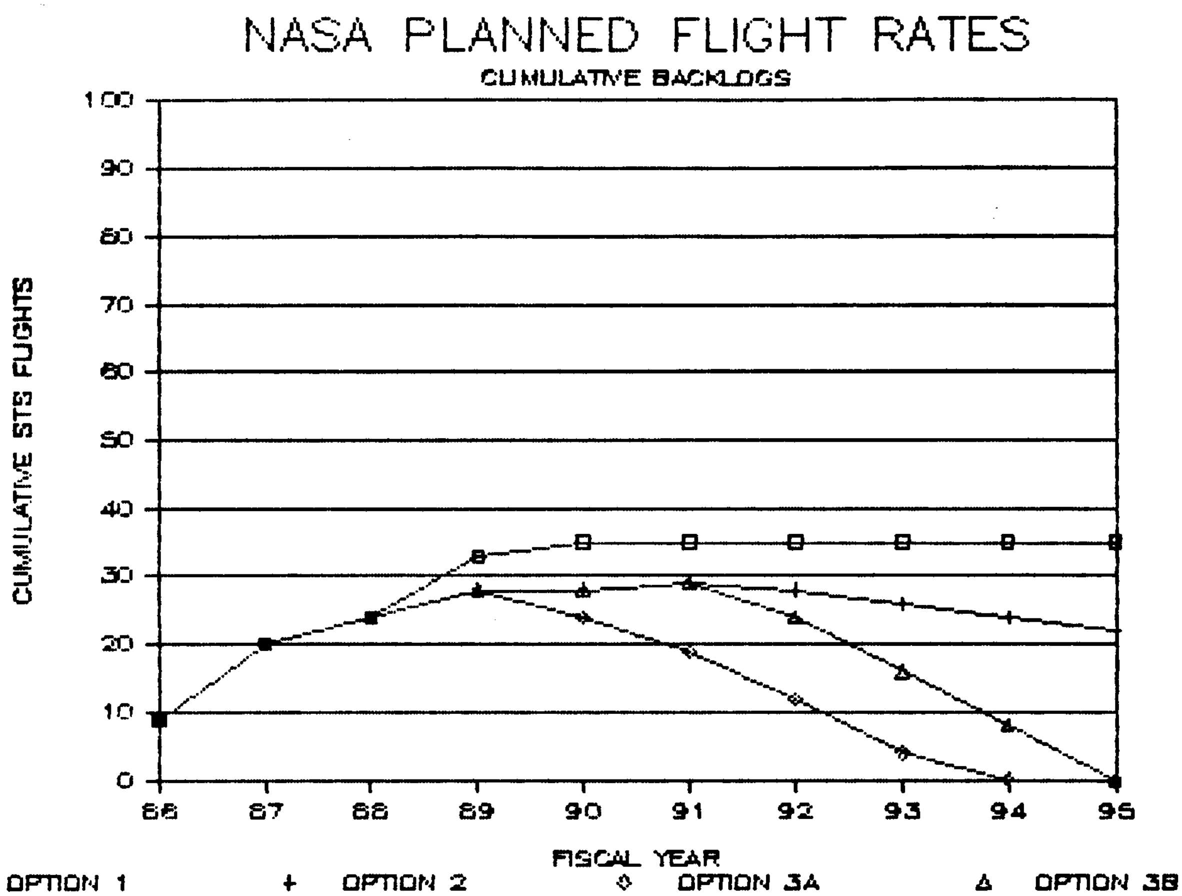
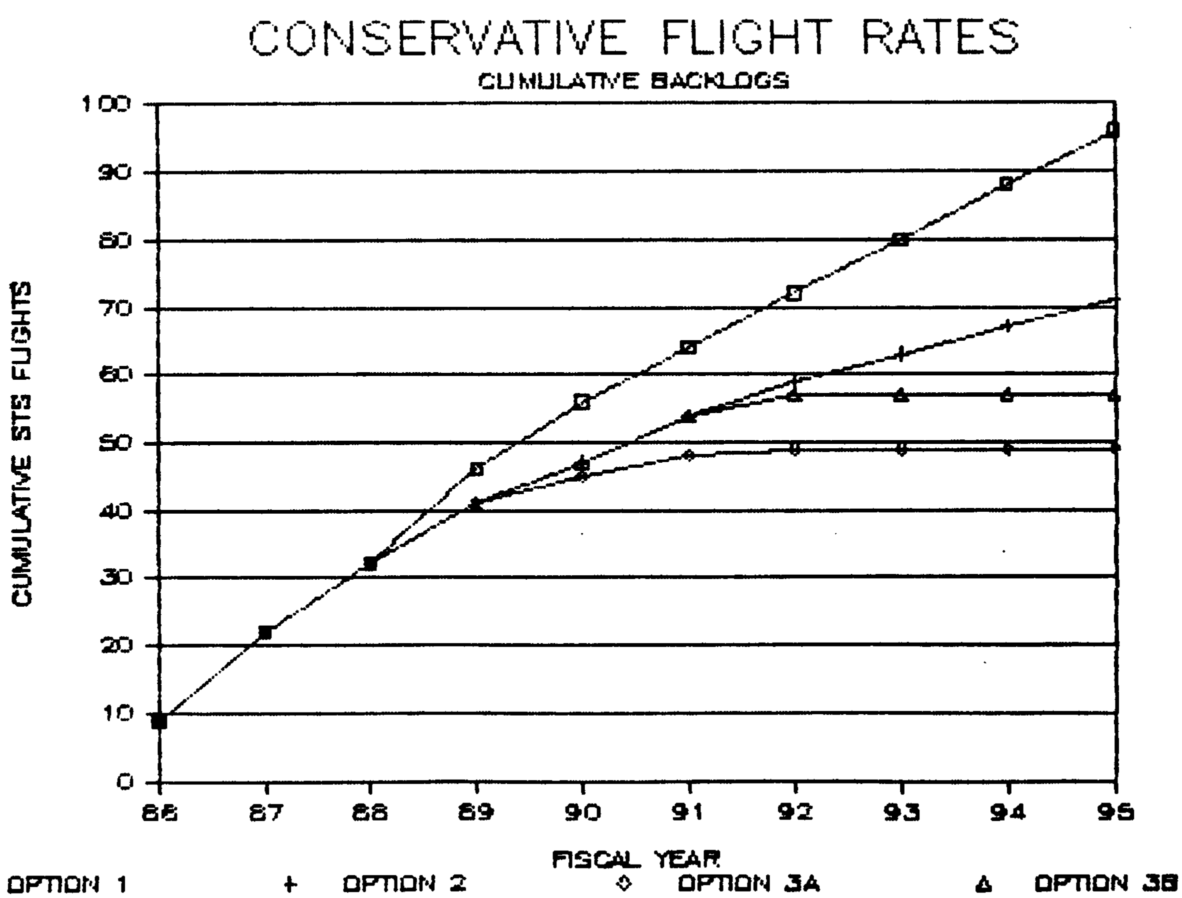


FIGURE II.C.4.




NASA PLANNED FLIGHT RATES
CUMULATIVE BACKLOGS
CUMULATIVE STS FLIGHTS
0
10
20
30
40
50
60
70
80
90
100
86
87
88
89
90
91
92
93
94
95
FISCAL YEAR
OPTION 1
+ OPTION 2
◇ OPTION 3A
Δ OPTION 3B


CONSERVATIVE FLIGHT RATES
CUMULATIVE BACKLOGS
CUMULATIVE STS FLIGHTS
0
10
20
30
40
50
60
70
80
90
100
86
87
88
89
90
91
92
93
94
95
FISCAL YEAR
OPTION 1
+ OPTION 2
◇ OPTION 3A
Δ OPTION 3B

IV. ISSUES

The following issues were identified as requiring resolutions:

1. Funding. While this report attempted to address the magnitude of the costs required for each option, no offsets were identified. These unanticipated costs are therefore increases above the FY 1986 appropriation and the FY 1987 President's budget request and exceed the Gramm-Rudman deficit reduction ceilings. OMB advises that the Administration policy is that any funding request to Congress must be accompanied by offset. This report made no attempt to resolve the funding issue. Once an Administration decision has been made as to the funding approach, the individual agencies will have to rework their funding requirements in conjunction with OMB before an Administration budget request is sent to Congress.

2. Timing of Decisions. Since the effects of the CHALLENGER loss impact several agencies, every effort was made to treat the proposed recovery options as coherent strategies. The advantage of presenting a consolidated package containing all the necessary actions to Congress is obvious. However, if the decision to recommend replacing the orbiter must await the final recommendations of the Rogers Commission, this approach needs to be reconsidered. If the additional ELV capability is to be available in the 1988-89 timeframe to meet critical DoD schedules, this activity must start within the next few months.

3. Restrictions of STS Competition for Commercial and Foreign Launch Services. The Working Group has agreed that the current practice of selling excess STS launch capacity within the commercial and foreign satellite market as a revenue generating practice should be discontinued. This proposed new policy would make an additional 3 STS flights a year available to reduce the backlog and provide extra capacity for future government needs.

While there is no disagreement over this proposed new policy, there is an issue over the timing and definition of the commitment. Without a clear, unambiguous transition point defined by the government, as well as the precise definition of the payload categories that would no longer be flown on the shuttle, it is unlikely that private investors will take the risk of potentially competing with the government. This is due to the limited size of the market, the uncertainty of the government's intentions, and the long term nature of the capital investments required to establish the industry.

Because of the backlog of STS missions resulting from the CHALLENGER accident, a commercial ELV industry would be useful as soon as practical; under the most favorable conditions, this could be 1988. This early date would only be achieved if a realistic market were available in this timeframe. The government can best influence the size of the available commercial market in this timeframe is by establishing a firm date to discontinue government competition for this market. NASA believes that it must continue to honor all its commitments to commercial and foreign customers, including those projected into the early 1990s. DoT believes that the earliest practical transition date must be established to convince the industry that they should invest now.

4. Flight Rate Planning. Presidential policy establishes an STS flight rate of 24 flights per year as a target. Throughout this report, two flight rates were used for all assessments. The NASA planned flight rates reflect their estimates of the technical capacity of the STS as a whole. The rest of the working group, while not challenging the technical capacity of the system, used a more conservative flight rate. These lower rates were believed to be more realistic for planning purposes during the recovery period in light of the many routine operational problems that are likely to continue to reduce the technically achievable capacity of 24 flights per year. The working group (with the exception of NASA) believes that a more conservative flight rate should use used for planning purposes. A lower flight rate should be planned than what is physically achievable; this reserve capacity could be required to recovery from brief interruptions of flight operations without developing a further backlog.

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V. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions.

The following major conclusions were unanimously agreed to by the Working Group.

1. CHALLENGER salvage operations and STS anomaly resolution costs must be funded regardless of the recovery/reconstitution strategy adopted.

2. The loss of CHALLENGER created significant reduction in U.S. space launch capacity that must be restored. This launch capacity could be restored by a replacement orbiter or expendable launch vehicles or a combination of both.

3. Second generation launch systems are currently under study but could not be operationally available until after the 1995 timeframe. In addition, schedules for advanced technology systems inherently include risk and could well be delayed until past 2000. These systems were not considered realistic alternatives for a near- to mid-term recovery/reconstitution strategy.

4. Since the production and use of ELVs were being phased out, no significant additional ELV capability could be operationally available before 1988. Until that time, all payloads will have to compete for the limited launch capacity of the remaining three orbiters.

5. A growing backlog of unlaunched missions is being created by the loss of one orbiter and the interruption of STS flights while the failure analysis and corrective actions are being completed. Selected missions should be offloaded from the STS to ELVs to free up additional capacity and assist in recovering from this backlog. Selected DoD missions and commercial communications satellites represent the most practical offload candidates. Civil missions tend to rely more on the unique manned capabilities of the orbiter and could not be easily offloaded. Offloading could not begin until additional ELVs become available in the 1988 timeframe.

6. The large backlog of STS flights represents delayed launches in the near term and lost flight opportunities in the longer term; these lost flight opportunities will reduce the scope of what could have been included in the U.S. space program in the early 1990s. Funding to restore the lost launch capacity will compete in part for the same funds that would have been required to develop the payloads that would have flown. Further study will be required to understand this competition and ensure that a proper balance between restoration of launch capacity and new and existing programs is maintained.

7. A more diversified national space launch capability must be developed and maintained to reduce the impacts of future accidents and system groundings. The nation cannot afford to rely totally on a single launch system; a launch posture must be developed that avoids dependency on single systems to the extent practical. A variety of ELV capabilities must be established and maintained to complement the STS to ensure that all weight classes of payloads could be launched by more than one launch system if necessary.

8. While the decision to replace the fourth orbiter may be dependent on the recommendations of the Roger's Commission, the decision to increase the use of ELVs. Immediate action must be taken to ensure that additional ELV capabilities are available by 1988; this cannot be accomplished unless efforts are initiated within the next few months.

9. The manned spaceflight program is totally dependent on the STS; adequate flight capacity for the manned spaceflight program cannot be assured throughout the rest of this century with only three orbiters. While three orbiters could service all projected manned spaceflight needs, the ability to routinely keep three orbiters in service is highly questionable. A future accident, significantly less severe than the loss of CHALLENGER, could reduce the fleet to only two orbiters for a protracted period of time. As shown by this grounding, such an interruption of flight operations results in significant delays and backlogs. The U.S. leadership in manned space activities cannot be assured without a minimum of four orbiters; four orbiters are required to assure that at least three orbiters can be maintained in operational service on a routine basis.

10. The emphasis of the STS program must be on the exploitation of the truly unique capabilities of the shuttle. Previous goals of increasing the flight rates to reduce the cost per flight should be reconsidered. Cost per flight is only a measure of the cost and ignores the effectiveness of the mission. Each STS flight should be focused on

applications that require the unique capabilities of the orbiter. Implicit in the options considered in this report are several changes in the recommended usage of the STS.The conscious offloading of selected national security, and commercial and foreign missions from the STS to increase the diversity of the national launch posture, encourage the development of a national launch posture, encourage the development of a domestic ELV industry, and increase the availability of the STS to reduce the backlog of unflown flights, runs counter to the previous objective of increasing the flight rates to reduce the cost per flight. This new approach recognizes the value of the STS assets and the unique capabilities that they offer and refocuses the emphasis of the STS usage on these highest value characteristics. This is also consistent with the preference for more conservative flight rates.

This approach is inconsistent with using cost per flight as a measure of the system's cost effectiveness. Cost per flight only measures the cost and does not address the effectiveness of the system's usage. If these concepts are accepted by the Administration, a consistent rationale must be adopted by all agencies that reflects this altered set of goals and priorities or the recommended strategies will be interpreted as inconsistent with what has been defined as the "most cost effective" use of the STS.

11. The U.S. should strive to regain its lost momentum in the provision of launch services for the international market; this has both the political and economic advantages. To help ensure that the U.S. can maintain a solid share of this market, consistent with the President's ELV commercialization policy, the government should work to have the U.S. private sector assume this role and maintain the U.S. competitiveness with private capital rather than government funds.

12. The single critical factor in encouraging the development of a domestic ELV industry is a clear and unequivocal statement of the government's intent to not compete with the private sector for this category of foreign and commercial payloads. Without this commitment from the government, the private sector will not risk investing the capital required to establish a competitive domestic launch services industry. Adequate ELV production and launch capacity, developed with government funds for previous government needs, exists and could be converted into a sound commercial venture. Additional ELV capcity being developed for DoD as well as future government purchases of commercial launch services to meet selected needs would further contribute to a sound economic base.

B. Recommendations

The following recommendations represent the consensus of the working group.

1. A more diversified national launch posture composed of the STS and expendable launch vehicles should be established and maintained to meet the full range of space launch needs and avoid dependencies on single launch systems to the extent practical.

2. The CHALLENGER orbiter should be replaced to ensure that a minimum of three orbiters are routinely maintained in operational service throughout the rest of this century to satisfy our manned spaceflight and national security related requirements. [OMB and DoT reserve their positions.]

3. Selected national security and commercial and foreign payloads should be transferred from the STS manifest to ELVs to reduce the dependency of national security missions on a single launch system, encourage the development of a domestic ELV industry, and provide additional STS capacity to eliminate the backlog of delayed missions.

4. The STS should be exclusively dedicated to those missions that best exploit the unique capabilities of the shuttle and manned spaceflight. The STS should not be used for routine commercial and foreign satellite deployments and the flight rates should not be increase simply to reduce the average cost per flight.

5. The government should establish clear guidelines (Issue #3) for discontinuing its providing launch services for commercial and foreign customers and encourage the establishment of a commercial ELV industry based on private capital.

6. The government should continue to encourage commercial exploitation of the shuttle for developing a new materials, products, and services.

APPENDIX III --- RECOMMENDED STRATEGY

A. Introduction.

Each segment of the space program has developed its respective launch recovery strategy -- DoD the national security strategy, NASA the civil strategy, and Transportation and Commerce the commercial strategy. Each of these is described in summary detail in this section. Finally, the NASA and DoD cost estimates associated with these strategies are presented as tables.

B. National Security Recovery/Reconstitution Strategy.

The need for assured access to space has been documented and recognized. DoD has currently programed for ten shuttle-class CELVs and 13 small TITAN II launch vehicles. This would provide for about two CELVs and two TITAN IIs a year beginning 1989. During this period, an average of about ten DoD missions would be dependent on the STS. The CHALLENGER accident, and subsequent grounding of the STS fleet, forces a review of this mixture of launch vehicles.

The basic objective of the national security strategy is to avoid dependencies on single launch systems that could lead to unacceptable interruptions capability or coverages of critical space systems. This requires a balance between missions dependent on the STS and missions dependent on ELVs. Such a balanced launch capability requires more ELVs than currently planned and dictates removing selected DoD missions from launch on the STS. An analysis of each mission area was performed and those payloads best suited for launch on ELVs were identified.

Some satellites are compatible with either the STS or ELVs; other have been specifically designed for launch on the STS and would require modifications to be compatible with ELVs. The objective would be to make satellites dual compatible where it is practical and cost effective. In those cases where dual compatibility is impractical alternate methods of ensuring that critical functions are not be compromised by the interruption of launch vehicle operations would be pursued. One alternative is to schedule separate satellite systems within a given mission area on separate launch systems. For example, within the communications mission area MILSTAR payloads could be scheduled on the STS while DSCS payloads could be scheduled on ELVs; while either system might be impacted by the grounding of its launch system, the communication mission area would not be totally affected.

Using this strategy of assured mission area capability, individual satellites would be assigned to either the STS or ELVs. This results in approximately an even number of STS and ELV missions and produces an estimate of the number and size of the ELVs required to support this plan. Generally, this averages about six to eight STS missions each year and four CELVs, two TITAN IIs, and four medium-class ELVs each year.

To effectively implement this plan, launch facilities must be available at both the eastern and western test ranges for at least the STS and the CELVs. The west coast STS launch complex will become operational this year. The Vandenberg TITAN launch complex will have to be modified to accommodate the CELVs. This will permit both the CELVs and TITAN IIs to be launched from Vandenberg into high inclination polar orbits. The CELVs are currently planned for launch from the east coast. In addition, the medium-class ELVs, to be used to launch GPS satellites, will require an east coast launch capability.

The DoD plans to competitively select the medium-class ELV for these GPS launches. However, if a commercial launch vehicle were available, this might satisfy this requirement without additional government development costs. Should this be the case, the only additional launch capability required over that currently planned by the government would be for a CELV at Vandenberg.

Once these ELVs, facilities, and satellites modifications have been completed, half of the balanced launch strategy will be complete. The other half of this balance depends on the STS. It is therefore critical that the STS fleet be maintained in a truly operational posture. An operational system must have adequate reserve capability to accommodate periodic inspections, new system modifications, routine overhaul, and normal operational problems, much less severe than a catastrophic failure, that could again ground the fleet.

Consequently, to ensure routine operation of a three-orbiter fleet requires at least four orbiters. Three orbiters are conservatively capable of about 15 flights a year if Vandenberg is operational. Four orbiters would comfortably allow keeping three orbiters in service to meet this demand. Under these circumstances, a fleet grounding of six to 12 months would create a backlog of around seven to 15 flights; four orbiters would provide adequate capacity to increase the normal flight rate and recover in a matter of two to three years rather than the seven to nine years that we are currently facing.

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This is only practical if the aggregate demand for STS missions does not significantly exceed 15 missions a year. This demand is consistent with the proposed DoD and commercial offloads. In the mid-1990s as space station and perhaps increased SDI demands materialize, demand could exceed 15 missions a year. A four-orbiter fleet would then be essential to satisfy these needs. Adequate operational experience would have been gained to increase the flight rates to the highest practical limits to meet the demand.

Without the replacement orbiter, no capability will be available to meet demands beyond about 15 flights a year. In addition, routine operational problems will likely reduce the effective number of STS flights below 15 a year. This strategy requires replacing the fourth orbiter and rescoping the STS objectives to ensure a high operational availability of at least a three-orbiter fleet.

Only with the STS fleet operating with sufficient reserve to handle routine operational delays and a complement of ELVs can the nation be assured of a balanced, effective, and responsive national launch capability.

C. Civil Strategy.

The civil space program includes manned spaceflight, science, applications, and research and development.

The shuttle is well suited to support these endeavors both as a launch vehicle and a manned spacecraft. NASA has invested heavily to develop programs which support the full range of these missions and which have been designed to take full advantage of shuttle capabilities. International scientific missions, such as Germany's Spacelabs and Japan's Materials Processing Test are shuttle dependent; many foreign science endeavors require a manned presence. The space station will require shuttles for both deployment and operational support.

A major NASA undertaking is the development and demonstration of unique shuttle capabilities. The space telescope has been designed for on-orbit refurbishment. The Solar Max and LEASAT on-orbit repairs were accomplished using shuttle unique capabilities. Derelict communications satellites have been retrieved. Demonstration of all these activities are necessary for acceptance and exploitation by operational payload designers.

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New concepts such as materials processing in space cannot be translated into commercial products without the man-tended opportunities provided by the shuttle.

For these reasons, the civil strategy relies on the shuttle as the primary launch system and exploits its capabilities to the fullest extent. A space transportation system, including four orbiters is the minimum capability required to satisfy currently projected needs in the early 1990s, and the CHALLENGER should be replaced as quickly as possible. To provide assurance that an operational four-orbiter fleet can be maintained, as well as provide the production option for additional procurements, if future requirements dictate, the structural spares used to expedite delivery of the replacement orbiter should be reconstituted. Without these actions, cost to procure a replacement orbiter at a future time could be prohibitive. In the event another orbiter is removed from service for an extended period for repairs or modification, insufficient capacity would result unless the fourth orbiter is replaced.

If there are instances where ELVs might be required for civil missions, NASA would obtain these from either the DoD or private sector. NASA will not maintain an ELV adjunct to the STS. This decision supports the development of a viable and internationally competitive domestic ELV industry.

Space shuttle resources will be used to support national space policy goals. Accordingly, manifesting priorities will be given to national security missions; civil science, applications, and space station support missions; commercial development and shuttle-unique operational missions; and international cooperative missions. The government will not compete for new commercial business with a viable domestic commercial launch services industry.

This strategy takes full advantage of the unique capabilities of the shuttle and makes most efficient use of large prior investments in the associated infrastructure.

D. Commercial Strategy.

A healthy U.S. commercial ELV industry can develop at no direct cost to the taxpayer. This industry will enhance a robust U.S. launch posture, ensure a long-term industrial base (for assured access to space) and ease fiscal demands on the government. However, in order for such an industry to develop, a definitive policy must be established and implemented which removes U.S. government competition with transportation services provided by the private sector. The policy must specify that:

> Beginning in FY 1989, NASA will launch only those commercial and foreign payloads that either require a manned presence or the unique capabilities of the STS for which there are no U.S. commercial ELV alternatives.

Such a policy will provide the needed incentive, heretofore lacking, for private industry to make necessary investment commitments. These commitments will only be forthcoming if the private section foresees a market.

In addition, future U.S. government procurement of ELVs, not currently in production (e.g., ATLAS, DELTA, etc.), should be strongly considered on the basis of commercial purchase rather than traditional government contract practices. Such commercial purchases should ease the need for upfront government outlays, as well as enable long-term cost/price reductions.

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RECOMMENDATIONS IN THE AFTERMATH OF THE CHALLENGER ACCIDENT

On February 7, 1986 the National Security Council tasked the Interagency Group for Space to assess of the impacts of the CHALLENGER accident on the nation's space launch capabilities and to develop recommendations that will reduce the adverse consequences of these impacts. The Working Group of the IG(Space) was also invited to consider policy implications that should be derived from the accident. This is a general summary of the IG-(Space) Working Group recommendations. Endorsement of these recommendations by the IG(Space) is anticipated.

The broad space policy goals of the U.S. should remain unaffected by the accident. As mandated by the currently prevailing NSDD-42, our goals are to explore the potential of space for the benefit of mankind; to use space-based or space-related systems to enhance the security of the United States and of its Allies; to use the U.S. Government space activities to maintain leadership among the world's nations in scientific and technological matters; and to further the U.S. economic interests by creating an environment favorable for private involvement and investment in commercial and industrial space activities. None of these policy goals are less valid today than the day they were promulgated; if anything, the growing space activities of the Soviet Union, of the major Western industrial powers, of the Peoples Republic of China and of a number of Third World nations should prompt us to pursue our space goals with unrelenting vigor. At the same time, both the military and the civil sectors of space are poised to make major advances in space-related concepts and experiments: the SDI, with its attendant consequences in terms of the evolution of our strategic posture, the Manned Space Station, with all its potential for scientific and industrial space developments, and as a symbolic focal point for Western space cooperation, are outstanding illustrations.

Specific space policy elements and implementation directives should be modified. The CHALLENGER accident brought sharply into focus the risks inherent in relying almost exclusively on the Space Transportation System ("shuttle") as mandated by currently prevailing directives. The Department of Defense was, until the accident, in the process of shifting most of its spacecraft launches to the shuttle, including some associated with missions that are vital from the national security standpoint. The Air Force, DoD Executive Agent for space launch , has been proceeding with the development of the Complementary Expendable Launch Vehicle (CELV), in order to serve its unique Defense needs, as well as to provide a limited complement to the shuttle. The modified policy directive should mandate increased emphasis on a balanced U.S. space launch capability, comprising the reconstituted shuttle orbiter fleet and an appropriate number of expendable launch vehicles.

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The CHALLENGER accident also calls our attention to the value of the STS as an irreplaceable, unique national asset. As such, given that risks of incapacitation can be reduced but never completely eliminated in systems of comparable complexity, the STS should be used for missions that are important in terms of the nation's space goals and where its unique capabilities are clearly required. It should not compete for routine space transportation tasks, if expendable launch vehicles can adequately serve the purpose. The modified space policy should aim at ensuring that the shuttle does not compete with a viable U.S. private launch industry. Under this policy, NASA should actively support fand acilitate the acceptance of U.S. commercially offered launch services by existing shuttle customers.

The STS is essentially sound and the investment in the orbiter replacement is warranted. The conclusions of the Presidential Commission on the causes of the CHALLENGER accident are likely to result in recommendations covering improved design, as well as more stringent manufacturing, inspection, test and launch procedures. NASA already has at this time a number of plans and actions under way to anticipate these recommendations and is confident that its related cost estimates are adequate. It is widely held that the Commissions's recommendations will not affect the basic design concept of the orbiter.

Procurement of the replacement orbiter is necessary. With the remaining three orbiters, it is not possible to reduce significantly the rapidly accumulating U.S. Government launch backlog, both military and civil, without virtually unobtainable high shuttle flight rate projections. Attempting to achieve such high flight rates would create increased attrition risks for the STS; completely unacceptable over more than a decade for a depleted (three-orbiter) system. One alternative, namely to eliminate a significant proportion of the U.S. Government space missions, would weaken our ability to support the Space Station, would create pressure to curtail the SDI-related experiments and, in a broad sense, would cause significant retrenchement in our planned space activities. The other alternative, namely to use expendables at a significantly increased rate, cannot address effectively the problem created by insufficient manned space launch capability. The STS, with perhaps minor evolutionary improvements, is the only manned space launcher / transportation system that will be at hand prior to the late 1990's, thus the integrity of the STS orbiter fleet is crucially important to the U.S. manned space program.

The decision to replace the orbiter is urgent. The Administration must convey to Congress, to the nation and to our Allies, as well as to potential adversaries, its firm resolve to continue the momentum of the U.S. space program, in keeping with our established policy goals and objectives. At a time when the Soviet Union seems to step up its well publicized manned space efforts, the U.S. cannot project an image of hesitancy or lack of resolve. The political risk in the appearance of undercutting the Presidential Commission on the causes of the CHALLENGER accident can be eliminated by consultations with the Committee and by including in the decision appropriate wording to the effect of making procurement of the replacement orbiter contingent upon implementing the Commission's recommendations.

The replacement orbiter should aim at the earliest possible operational capability. During the interim period (for the next three to four years) the 3-orbiter STS will have to carry the whole burden of U.S. manned space flight programs in addition to the shuttle-unique payloads for national security missions,. Delaying or protracting the replacement orbiter procurement (as advocated in the interest of avoiding undesirable additional deficit in the U.S. Federal budget) will, first, increase significantly the total cost of the replacement orbiter. Second, and perhaps most importantly, the virtual cost of the additional risk of flying the 3-orbiter STS fleet for two or more additional years at relatively high rates without practical means of recovery in the case of even the slightest incident, by far outweighs the value of the corresponding near-term budget reductions. (Note OMB , DoC and OSTP's non-concurring views on page 5)

The additional ELV procurement should be at the most efficient procurement rates. The program recommended by the IG(Space) corresponds to this rate. Launch rates will be adjusted to meet mission requirements and can be changed, based on shuttle availability projections. In the meantime, operational proficiency will be retained and certain payloads will be modified, so as to be compatible with both shuttle and ELV launch.

The commitment in principle of the DoD to the STS should remain strong. While DoD strongly advocates the increased emphasis on the balanced aspects of the future U.S. space launch posture, it does not intend to lessen its commitment to fly as many shuttle payloads as required by its missions and as many as can be accommodated without undue stress on the timing of critical civil missions planned by NASA. The two agencies will con-tinue to work together to define the composite STS flight schedule (the "manifest") that best serves the national interest.

The increased opportunities for private U.S. launch services industry should be aggressively pursued. With NASA planning on not competing against a viable launch services industry aimed at the commercial and foreign market, (where the unique shuttle capabilities are not required), and with the production base established by DoD, the competitive opportunities for the U.S. private industry could become attractive. The Department of Transportation, with the support of other agencies, will plan and implement the actions necessary to ensure that the U.S. industry takes full advantage of these unfolding opportunities.

The magnitude of the proposed funding and the modalities for providing the same should be in substance and form acceptable to Congress in the present budget environment.

The proposed funding requests will comprise the following * :

a. A single-item multi-year budget authority for NASA, submitted as a supplemental request for FY 1986 of $ 2. 805 B covering the replacement orbiter, the replacement of orbiter-associated equipment, and the estimated cost of implementing the design and procedural changes resulting from the Commission's recommendations. Other changes to upgrade safety and turnaround capability, as well as provision for long-lead structural spares are also to be included.

b. A single-item budget authority for DoD, submitted as a supplemental request for FY 1986 of $ 562 M, covering the changes necessary in the current ELV program to increase the production rate to the level required; it also covers the cost of payload and launch facility modifications in order to accommodate the best use of the STS / ELV mix during the interim period, before the availability of the replacement orbiter.

c. Additional budget authority for a total of $ 2.627 B to cover the procurement of additional expendable launch vehicles, during the FY87 through FY 1991 period.

The outlays against these budget authority items will be managed to reduce as much as possible the impact on the Federal budget deficit. (Note OMB's non-concurring views on Page 5)

RECOMMENDATION

The NSDD-XX**, submitted in draft form, will give effect to the policy implementation changes and decisions recommended by the Interagency Group for Space following the CHALLENGER accident. The Report of the Group is attached.

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* All budget fugures are provisional

** To be forwarded as a separate submittal

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Non-Concurring Views Received to Date

Timing and Pace of Orbiter Procurement: (Page 3, first paragraph)

OMB favors a somewhat delayed commitment and a slower rate of procurement on the replacement orbiter. The bases for this preference are (a) Awaiting the results of the Rogers Commission's investigation; (b) Ascertaining the technical soundnes of the STS in general and the orbiter inparticular; and (c) Possibly lower strain on the Federal budget, if supplemental funding is being considered at all.

DoC favors a somewhat delayed commitment for reasons (a) and (b) stated under the OMB heading above. OSTP shares the views of DoC.

Funding Mechanisms: (Page 4)

OMB is on record with the view that funding for any of the options must be offset by program reductions within the respective recipient Agencies