National Aeronautics and
Space Administration

AEROSPACE
SAFETY ADVISORY PANEL

ANNUAL REPORT

OVERING CALENDAR YEAR 1984

JANUARY 1985

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1. EXECUTIVE SUMMARY

Focus of the Aerospace Safety Advisory Panel's activities during 1984 was directed to three broad areas of NASA's responsibilities:

1. The Space Transportation System (STS) operations and evolving program elements,

2. Establishment of the Space Station program organization and issuance of Requests for Proposals to the Aerospace Industry, and

3. NASA's aircraft operations, including research and development flight programs for two advanced "X-type" aircraft.

The majority of the Panel's activities were dominated by the STS.

This report summarizes the Panel's 1984 review activities and resulting observations, and enumerates the Findings and Recommendations which the Panel deem to be appropriate to highlight for NASA management attention. NASA's response to the Panel's 1983 annual report is appended hereto; any matters remaining "open" are noted in this Executive Summary.

Government and industry support of the Aerospace Safety Advisory Panel and its work continues to be excellent, thus enabling the Panel to fulfill its statutory responsibilities.

Panel Meetings

The full Panel, or individuals and smaller groups of Panel members, conducted 36 fact-finding sessions during calendar 1984. These included meetings at six NASA centers and seven contractor sites, and Vandenberg Air Force Base. In addition, the Panel presented testimony before the cognizant committees of the U.S. House of Representatives and U.S. Senate and held other discussions with congressional staff.

Space Transportation System Program

The STS increasing mission frequency places new demands upon both management and the "hands-on" personnel, which will remain at a high level. The standards set during the first 15 safe and successful missions are admirable and commendable. To maintain or even improve upon those standards will require exceptionally perceptive management and disciplined execution of the program. Among the more crucial program precepts, as viewed by the Panel, are: recognition that the STS is a program still in transition from "single event demonstration" stage to "operational" stage, and will remain such until the full operational capabilities (and limitations) are known in quantitative terms based on scientific/engineering proofs; recognition that complacency bred of repetition is an inborn human hazard and conscious steps to avoid same are essential; changes to hardware and software must be controlled to the degree necessary to avoid overloading the processing team's ability to safely implement them; changing contractual and personnel arrangements must be carefully planned in advance; recognition that quality requires strict discipline and is everybody's business everyday; and the logistics system, at a minimum, must be supported by its current level of attention and funding.

The successful Orbital Refueling Demonstration Test conducted during the STS-41G mission, the successful repair and retrieval missions with previously launched satellites, and the successful static firing of the first Filament Wound Case solid rocket development motor (DM-6) are good examples of well constructed and executed adjuncts that support mainline program activities.

Basically the numerous elements comprising the STS ground and flight subsystems have shown good performance and dependability. There are, not unanticipated, some individual components and subsystems which have yet to meet design expectations and are cause for concern as flight rate increases. These include actuators and valves, fluid leaks, instruments, Orbiter brakes, Orbiter external thermal protection tile subsystem and its waterproofing, and Orbiter structural restrictions. Shortages of flight-critical spares continue to require extraordinary measures for each launch preparation.

Taking all of this into account, NASA's planning for the near term use of STS resources and for procedural adaptiveness continues to be thoughtful, thorough, and meets current mission needs during this STS transition period, albeit all the while drawing upon a slim logistics support base.

The Panel has recommended the use of Orbiter-102 as a combined payload carrier and a development vehicle. With its large array of instrumentation and recorders, OV-102 is an ideal vehicle to acquire the quantitative data necessary to fully define the Orbiter's performance capabilities and enhance the data base for future vehicle design. The STS program office concurs and a detailed plan dovetailing mission requirements and R&D needs is being constructed.

Specific Findings and Recommendations relating to the STS program are summarized in Section II of this report and are discussed in greater detail in Appendix D. Topically they concern:

1. STS Launch Processing and Logistics
2. Space Shuttle Main Engines
3. Space Shuttle Solid Rocket Boosters
4. STS Orbiter Structural Life Certification and Adequacy
5. Extra Vehicular Activities (EVA) and Life Sciences
6. Using Orbiter OV-102 in an R&D Role
7. KSC and VAFB Common STS Operations
8. Shuttle/Centaur
9. Radioisotope Thermoelectric Generator (RTG) as a Spacecraft Power Source

Space Station

The Panel was briefed by the program management principals at both JSC and NASA Headquarters on the Space Station concept and plans that are currently being implemented. Early exposure to the program was sought by the Panel to enable it to follow safety-related matters from the conceptual decisions onward through the design, development, and operational stages. The Panel's areas of interest in Space Station will include manned transportation, construction, residency, operations, maintenance, EVA, hazard exposure, escape and rescue, and the safety organization and safety requirements associated with foreign participation. The Panel believes Life Sciences and Space Medicine considerations must be among primary design criteria. It is similarly essential that the Space Station be designed for on-orbit maintenance, as basic design criteria.

NASA Aircraft Operations

The NASA Administrator has provided specific guidance regarding aircraft flight operations policies and procedures to achieve safe, efficient, and productive flight programs. The NASA Headquarters Aircraft Management Office has taken a number of steps to implement the Administrator's directions, including management instructions, revisions to the basic Safety Manual, and assurance of periodic review of each center's flight operations and safety programs.

For the first time in a number of years NASA is directly involved in flight testing "X-type" aircraft, the X-29 and the X-Wing aircraft. Both involve state-of-the-art-and-beyond technical status with attendant experimental flying risks. The Panel has initiated steps to stay abreast of the conduct of these flight testing programs.

NASA Response to ASAP 1983 Annual Report

The Panel's 1983 Annual Report was responded to by NASA with in-depth briefings at JSC and in writing by the Administrator (see Appendix E.). Most of the items are now considered "closed", based on either adequate explanation or implementation or plans to accomplish the activity. There are, however, some items regarding the STS that will continue to be of interest to the Panel.

The Panel continues to believe strongly that there are many benefits to be gained from reducing landing speed of the Orbiter (ref. 1983 Annual Report Conclusion and Recommendation No. 6). While the Panel accepts NASA's response regarding the impracticability of installing a specific solution such as canard control surfaces on the present Orbiter vehicles, the Panel urges NASA to continue to seek other, more readily adaptable solutions.

Other major areas of the STS such as Product Quality, the Orbiter External Thermal Protection System, Orbiter Structural Adequacy, Space Shuttle Main Engine improvement program, and maturing launch operations at Kennedy Space Center (KSC) and Vandenberg Air Force Base (VAFB) will continue to be followed during 1985. In addition, the Panel will "touch base" on specific hardware items such as Orbiter brakes, anti-skid system, nose-wheel steering, Auxiliary Power Unit, and General Purpose Computer improvement program.

NASA Aircraft Flight Operations are still undergoing change and will be further reviewed by the Panel.

II. Findings and Recommendations

1. Launch Processing and Logistics

FINDINGS

The transition to the Shuttle Processing Contractor (SPC) was achieved in early 1984. The SPC and NASA are both to be commended for commitment of effort and dedication to success of the concept.

Each subsequent launch processing sequence to date has generated an unexpected burden of modifications, change-outs, repairs, and maintenance tasks. Launch processing has thus been anything but routine and there is no reason to believe that "routine" operations are likely to be achieved in the near future. In effect, the STS is presently in a period of "developmental evolution" wherein a number of key systems will be changed and, one hopes, improved.

The Shuttle Processing Contractor (SPC) is struggling to handle the burden of work associated with each mission. The problems arise in part from difficult engineering tradeoffs and need for sufficient advance planning of modifications to the Orbiter; unexpected replacement of parts; some shortage of qualified spares at KSC; lack of necessary piece parts; some shortage of qualified technicians in certain disciplines, and heavy paperwork burden. The SPC must also assume launch processing responsibilities at Vandenberg Air Force Base using many of the same persons working at KSC.

Although serious, these transitional problems are neither unusual nor unexpected, given the complexity of the STS, its state of continuing development, and the large number of personnel and institutions that must collaborate in launching the Shuttle. The challenge to NASA is to move through this period of "developmental evolution" in a way that makes feasible a sustained period of "operations" into the next century. In other words, efforts and expenditures now to improve the reliability, maintainability, and safety of key STS systems should pay off handsomely in future years.

RECOMMENDATIONS

1. NASA management should continue to allocate the human and financial resources required to maintain acceptable levels of safety in what in many respects is still a developmental program from the point of view of the ultimate use of space as well as the maturity of the system.

2. Modifications to the Orbiter--such as the main engine, structure, avionics, and brakes--should be directed at improving reliability, maintainability, and safety as well as achieving additional increments in performance.

3. NASA management should make a concerted effort to identify and prepare for Orbiter modifications prior to commencement of the launch processing sequence. "Freeze point" discipline must be maintained. Unexpected changes and modifications must be held to a minimum if the Shuttle Processing Contractor (SPC) is to achieve the projected flight rate.

4. Vesting overall Shuttle management in an "operations entity" at NASA Headquarters would help achieve acceptable levels of efficiency, productivity, and schedule reliability during this period of "developmental evolution." The Panel has made this recommendation in past years and NASA management is presently examining this and related issues through the Shuttle Operations Strategic Planning Group, the Smylie Committee.

5. NASA management would be well advised to avoid advertising the Shuttle as being "operational" in the airline sense when it clearly isn't. More to the point, however, is the fact that Shuttle operations for the next 5 to 10 years are not likely to achieve the "routine" character associated with commercial airline operations. Given this reality, the continuing use of the term "operational" simply compounds the unique management challenge of guiding the STS through this period of "developmental evolution." NASA should continue to focus on making the STS as efficient, productive and reliable as possible while the research and development flights are defining the commercial use of space.

2. Space Shuttle Main Engines (SSME's)

FINDING

The three phase program to improve the SSME that was initiated last year has been restructured so as to provide a long term SSME technology program while staying within the FY 1985 congressional budget. The modified program will not achieve all of the original objectives. It will, however, result in a more reliable and durable engine for operation at 104% Rated Power Level (RPL) thrust with significant margin. Operation at 109% RPL thrust with improved but limited life, under hardware performance constraints will be possible. To achieve additional margin and/or additional life at 109% RPL thrust requires the incorporation of the large-throat main combustion chamber now relegated to the "Precursor" program, a technology-oriented program looking at long-range engineering advancements.

RECOMMENDATION

The modified improvement program should be pursued vigorously. All reasonable effort should be exerted to develop the new hot gas manifold and to incorporate it at the earliest date feasible. Activity to reduce start and shutdown temperature transients should be added to the"Phase 2+" program. Mission planning should continue to consider 104% RPL thrust as the normal operating level for the engines. 109% RPL thrust should be employed only for those missions dependent on the higher thrust and as an abort capability.

3. Space Shuttle Solid Rocket Boosters (SRM/SRB)

FINDING

The Solid Rocket Motor filament wound case may exceed flight to ground system clearance interface limits due to the filament wound case being more flexible than the steel case. Data indicate that the modal frequencies of the filament wound case are even lower than first estimated due to filament wound case joint free-play.

RECOMMENDATION

An analysis and tests be performed on the filament wound case with the total stack to establish lift-off loads and vehicle excursions considering the lower modal frequencies.

4. Orbiter Structural Life Certification and Structural Adequacy

(1) FINDINGS

The structural life certification program for the Orbiter is based on supplemental full-scale tests. However, two extremely important tests on the wing have not yet been conducted which leaves the certification plan incomplete. The full-scale test for these two articles are very expensive and show negligible fatigue damage based on a current simple analysis.

RECOMMENDATIONS

The Panel agrees with the decision to certify these two articles by analysis. A detailed analysis plan for the two test articles should be developed and implemented to fulfill the certification program for 100 missions.

(2) FINDINGS

The Space Shuttle has to fly in regimes requiring high performance missions with adequate launch probability. The new "ASKA 6.0" Loads/Thermal/Stress cycle program is an important part of certification because flight-measured data show that the wing normal forces were larger and more aft than the ASKA 5.1 and ASKA 5.4 design loads. The ASKA 6.0 Loads/Thermal/Stress cycle will not be completed until 1987. In the meantime, the Orbiter capability assessment (OCA) plan, employing current algorithms, derived from flight test, has been used to make launch decisions using a negative $q\alpha$ profile resulting in a loss of performance. Some wing/fuselage modifications have been made and others have to be completed in order to expand the Orbiter flight trajectory for future flight missions. The flight and wind tunnel aerodynamic data base used for the 6.0 Loads/Thermal Stress cycle (available in 1987) may not be verified by the data from OV-102 instrumented flights. The proposed structural modifications will probably not eliminate the restrictions now being required in flight.

RECOMMENDATIONS

Conduct a systematic review and document the structural differences, safety margins and major logistics impacts for each Orbiter vehicle. In recognition of these differences, baseline the performance envelope for each Orbiter and, as required, determine the trade-offs between any structural/aerodynamics modifications and performance.

5. Space Extra-Vehicular Activities (EVA's) and Life Sciences

FINDING

EVA will continue to be extensively used, both planned and impromptu. The Space Station will require considerable EVA initially for its construction and later for operational activity. While the current suit has performed well, within its limitations, there is need for a new EVA suit with improved flexibility and higher internal operating pressure. Such a concept is in the early development phase in NASA and needs to be funded for further development and possible production as a replacement for the current EVA suit.

RECOMMENDATION

NASA should encourage the development of an advanced higher pressure EVA suit to replace the existing unit.

6. Use of Orbiter-102 in R&D Role

FINDING

In responding to pressures for improved performance there will be a continuing need to expand the STS ascent and Orbiter descent flight envelopes (trajectories) creating the need to obtain flight data measurements relating to structural loads and aerodynamic behavior.

RECOMMENDATION

Orbiter OV-102 is the most suitably instrumented of the Shuttle fleet and should regularly be utilized as a research and development vehicle in addition to its normal mission activities.

7. Kennedy Space Center (KSC) and Vandenberg Air Force Base (VAFB) Common Operations

FINDING

In the near future, at least in part, common launch crews will be used at both KSC and VAFB and unless the schedules are coordinated conflicts may arise, particularly in the case of DOD's "on demand" launches. The conflicts may not be restricted to schedule but also as to vehicle.

RECOMMENDATION

Until such time as the KSC and VAFB sites have their own launch crews and dedicated Orbiters, the manifesting or scheduling activity should have a procedure to consider the schedule effects on crews who must travel back and forth. Also, attention must be given to the availability of specific Orbiters that may be required by specific missions. This is particularly critical in those cases where the DOD may be required to ask for an unscheduled launch.

8. Shuttle/Centaur

FINDING

The development of Centaur for Shuttle is on a very tight schedule. With but 30% of system weights being actuals, performance margins for the currently planned planetary missions are quite small and expected to decrease. Resolution of issues raised by some of the requests for safety waivers submitted by the Centaur project has not yet been achieved. This is a consequence of additional operational constraints introduced by the inclusion of abort modes for the Orbiter that do not provide the originally specified time for Centaur propellant dumping. There is also an issue concerning the interpretation of certain specifications for some Centaur fluid system components.

RECOMMENDATION

While acknowledging the fact that the issues are being addressed, the Panel urges that the matter of the safety waiver request and the interpretation of specifications be resolved with careful deliberation. The ability to make and incorporate significant design changes for Centaur G' within the time remaining to the planetary opportunity for Galileo is fast diminishing. With the major portion of the Centaur G' qualification test program remaining to be conducted, it would be highly desirable that the Centaur project staff be able to concentrate on insuring that the test requirements are met.

9. Radioisotope Thermoelectric Generators (RTG's) for Galileo and Ulysses Missions

FINDING

Both the planetary Galileo and solar Ulysses missions employ RTG's as the spacecraft power source. Obtaining clearance to fly such nuclear systems is a complex matter both technically and managerially. Relatively recently it was recognized that the capacity of the RTG fuel elements to survive overpressures that might be encountered under certain launch system failure modes might be less than had been anticipated. Concurrently, it was found that there were disagreements about the interpretation of experimental data used to estimate overpressures that would be generated for certain failure modes. Also, the probabilities of the several failure modes had not been agreed upon. During the last half of 1984 steps were taken by all organizations involved to resolve the issues in a fully coordinated manner.

RECOMMENDATION

The Panel endorses the proposal made by the ad hoc committee that addressed the issue to improve coordination among the organizations involved by appointing a "single point of contact" on this subject for each organization. Further, the Panel endorses the recommendation to assign prime responsibility for obtaining flight clearance to the science mission center, Jet Propulsion Laboratory (JPL).

10. NASA Aircraft Operations

FINDING

The record over the past year has been good. Progress is being made in providing up-to-date flight standards for both transport (administrative) aircraft and for experimental aircraft. Aircraft operations management resides in the Aircraft Management Office at Headquarters which reports to the Associate Administrator for Management. It is the Agency focal point for all NASA aircraft policy and related matters. The responsibility for development of flight standards is still somewhat fragmented as it is currently left to the various centers to establish and maintain them. The Aircraft Management Office has requested the Intercenter Aircraft Operations Panel to provide a "guidelines" document to serve as the basis for the management instruction to be issued by Headquarters giving central direction covering all NASA aircraft operations.

RECOMMENDATION

The Aircraft Management Office as the Agency focal point for all aircraft operations and related matters should include, if practical, an aviation safety function. The NASA centers would benefit by a single reporting location at Headquarters.

III. Panel Plans for Calendar Year 1985

Panel Membership

The Panel membership and consultant support has changed somewhat from the previous year. John C. Brizendine is the new Panel Chairman, Charles J. Donlan is a new member, Herbert E. Grier a former Panel Chairman and long-time member will become a Panel consultant in January 1985, and Lt. General Leighton I. Davis has elected to retire from the Panel in December 1984. A new consultant, John P. Reeder, has been brought on in support of Panel's "X" aircraft activities.

After completing 12 years as both a member and Panel Chairman, Herbert E. Grier, will become a consultant to the Panel on January 18, 1985 when his current term is completed. Mr. Grier's knowledge of NASA and its manned space program will continue to support Panel activities as the Space Transportation System transitions to full operations and the Space Station emerges as a full-blown program.

Candidates for membership are being screened at this time.

The following is a brief resume of Mr. Reeder:

Mr. Reeder started with NACA/Langley on June 2, 1938. Following 4-1/2 years of wind-tunnel research, he was trained by NACA/Langley as a research pilot and flew in that capacity with NACA/NASA for 25 years retiring after 42 years with NASA in 1980. He played an active role in the early development of handling qualities requirements for military and civil airplanes and the development of fixes and improvements to World War II aircraft. He performed early exploration of transonic phenomena pioneering in the exploration of the effects of sweepback and rotary wing and V/STOL aerodynamics, performance and handling characteristics. During this time, he flew transports for NASA/Langley and NASA Headquarters. He served as Head of Flight Operations, Assistant Chief of the Flight Mechanics and Technology Division, Chief of Research Aircraft Flight Division, and managed the Terminal Configured Vehicle Program. Research pilot experience include 235 different single and multi-engine, civil and military, land and sea aircraft types (40 jet airplanes, 40 fighter types, 61 rotary wing types including British, French and German, and 8 VTOL airplanes).

Mr. Reeder has been author or co-author of about 80 NACA/NASA technical reports and papers and is a Fellow of the Society of Experimental Test Pilots, a Fellow of the American Institute of Aeronautics and Astronautics (AIAA), an Honorary Fellow of the American Helicopter Society (AHS).

Panel Activities for 1985

Specific areas of interest will include the following. These, of course, may be modified as the fact-finding activities develop and as new concerns are brought to the Panel's attention from within NASA as well as external sources:

1. Space Transportation System - The Panel will continue to assess Orbiter structures and functional subsystems; External Tank (only if significant modifications are made to it); continued review of all aspects of the Space Shuttle Main Engine program; Shuttle Processing Contractor/NASA progress at KSC and VAFB as the flight rate increases, hardware ages and a new launch site becomes operational (design modifications to launch facilities to accommodate increased Filament Wound Case/SRB excursions, Centaur integration, bringing the second launch pad into operation at KSC); human factors associated with increased flight rates; Solid Rocket Booster steel case reuse, Filament Wound Case qualification for flight, range

the FWC, and the potential use of hybrid cases, i.e., mixed FWC and steel. From a logistics viewpoint the Panel expects to look at:

- o The problems associated with obsolescent parts.

- o Adequacy of the publications with regard to such things as the correct reflection of the configurations of each individual Orbiter and the incorporation of the data gained from trouble-shooting experience.

- o The plans to assure spare SSMEs and/or spare high pressure fuel and oxidizer turbopumps to cope with anomalies or use of higher thrust levels.

- o The development of an overall comprehensive maintenance plan for the entire STS system including Orbiter and SSME overhaul up through 1990. Major structural and other modification programs projected for the Orbiter at Palmdale and engine overhaul and update at Rocketdyne would be part of this.

- o Meeting or advancing the 1988 date for final "spares lay-in to support maximum flight rate" and what helps determine this, e.g., manufacturing lead times or limits of present funding?

- o The possibility of transferring "sustaining engineering" activities from JSC to the operating bases at KSC and VAFB earlier than the 1989 period so as to support centralized control over operations.

2. Payloads - The several upper stages in so far as

they affect the mission safety. The Inertial Upper Stage (IUS) under USAF cognizance and the Payload Assist Motors (PAM's) a commercial development will be covered at a low level of activity. The Shuttle/Centaur G' and G vehicles and their support activities will continue to be reviewed. An area of some special interest because of the new and untried aspects is the Tethered Satellite System, as will be any internal/external experiments which can have an effect on safety of the STS missions (e.g., EASE, ACCESS and so on).

3. Space Station - As a developing program it is the Panel's intention to maintain close touch with the NASA organizations involved and, where practical, provide support and achieve a thorough understanding of the underlying concepts and philosophy and how they are expected to be implemented from both a management standpoint and technical approaches. For example, the degree to which "lessons learned" from NASA and commercial operations of highly technical facilities are applied. The evolution of the NASA organization and the relationships with industry will be of interest.

4. NASA Administrative and R&D Aircraft Operations - The Panel will again participate in the Intercenter Aircraft Operations Panel and aircraft safety meetings. Additional time will be spent on the X-29A program as it is flown by NASA personnel in an "X-type" R&D program. The X-Wing program will also be examined with an eye toward assuring that the review system and the safety network are adequate to assure not only first flight safety but subsequent R&D flying safety.

5. As appropriate the Panel will support NASA as it is requested to fulfill its obligation to both NASA and the Congress regarding safety of NASA activities and the public

safety as well.

IV. Appendices

A. Panel Activities Conducted in Calendar year 1984

The Panel continues to operate with fact-finding sessions conducted on the average of three times a month. Individuals, small groups and the Panel focused on the transition period of the Space Shuttle as the flight rate is being increased to meet user's requirements, the emerging Space Station program and various aspects of NASA's administrative and R&D aircraft operations. As always the Panel usually uses scheduled, special and on-going activities at government and contractor installations to minimize the burden placed upon those we meet with and, more importantly, to obtain the most current information and maintain an open communications line with all whom we deal with. The responsiveness of all levels of NASA and others has been most gratifying and shows an excellent working relationship.

The technical and administrative support activities provided by the Panel Staff Director continue to prove invaluable to the Panel in meeting its objectives through continuing in-depth knowledge of the many facets of NASA activities.

The Panel's relationships with the congressional committees and subcommittees and their staffs remains at an excellent level. This provides a feed-back system to assure that the Congress is aware of the Panel's activities and their results and that the congressional requirements are factored into the Panel's fact-finding sessions throughout the year.

AEROSPACE SAFETY ADVISORY PANEL FACT-FINDING SESSIONS, 1984

SUBJECT	SITE	DATE	MEMBER
Shuttle Turnaround Analysis Group	KSC	1/17-18	Parmet
Intergrated Logistics Panel	KSC	1/25-26	Parmet/ McDonald
Flight Readiness Review for STS-41B	NASA HQ, Downey	1/25	Donlan, Grier, Himmel
Members of Computer Failure Review Team	NASA HQ	1/30-31	Battin
Orbiter Stability & Control	LaRC	1/31- 2/1	Davis, Donlan
Annual Meeting w/Administrator	NASA HQ	2/15	Panel
House Testimony	U.S. House of Representatives	2/23	Panel
Senate Testimony	U.S. Senate	2/28	Panel
Space Station Human Factors Meeting	ARC	2/27 - 3/1	McDonald
Space Processing Contract	KSC	3/5-7	Parmet, Stewart
Phase II Shuttle/Centaur Safety Review	JSC	3/13-15	Himmel

Flight Readiness Review for STS-41C	NASA HQ & RI/Downey	3/30	Brizendine, Grier, Donlan
Filament Wound Case Rocket Motor Technical Interchange Meeting	MSFC	4/4-6	Donlan
NASA Aviation Safety Officer's Meeting	Ft. Rucker AL	4/11-18	Davis
Abort, Orbiter Handling Characteristics, Autoland, Space Adaptation Syndrome, JSC Aircraft Operations	JSC	4/24-26	Panel
Integrated Logistics Discussions	NASA HQ	5/2-9	McDonald
NASA Aircraft Operations	ARC	5/3-5	Davis
Safety review on airborne & ground hazards/risk, Critical Design Reviews, Centaur	General Dynamics, San Diego	5/8	Elverum, Himmel
SSME Project	RD/Canoga Park	5/10	Elverum, Himmel
Shuttle Autoland Discussions	JSC	6/8	Battin
Filament Wound Case for Solid Rocket Motor Technical Review &	Hercules/ Thiokol	6/19, 20, 21	Panel

site inspection

Space Shuttle Main Engine Anomalies & future program direction	NASA HQ	7/11-12	Himmel
Orbiter Canards & Ditching	LaRC	7/31	Donlan
Panel Testimony	U.S. House of Representatives	8/2	Stewart, Donlan
USAF Space Transportation System Operations	VAFB, CA	8/21-22	Panel
Orbiter	RI/ Palmdale	8/23	Panel
Space Adaption Syndrome Seminar	JSC	8/31 9/1	Parmet
Space Station Orientation	JSC	9/25	Panel
STS Training & Simulations, Aircraft Operations	JSC	9/26	Davis, Battin
Shuttle Processing Contractor/NASA Operations	KSC	9/26	Brizendine, Donlan, McDonald
Centaur Project	LeRC	10/17	Himmel
X-29A Forward Swept Wing, Pre-Flight Readiness Review	DFRC	10/28 - 11/2	Donlan, Parmet

Panel Activities/ Discussions	Staff of the U.S. Senate & House of Representatives	10/30	Brizendine
Space Shuttle Main Engine Development Program Phase II, IIA	Rocketdyne Canoga Park	11/9	Elverum
Centaur Management Meeting	JSC	11/15	Himmel
Orbiter Life Cycle Certifiation Loads	RI/ Downey	11/16	Stone
Life Sciences	NASA HQ	11/29-30	Parmet
Update on STS, Space Station	NASA HQ	12/5-6	Panel
X-Wing Discussion	NASA HQ	12/17	Reeder, Krone

NOTE: Dr. Himmel was a member of a three-person Special SSME Review team visiting RD/Canoga Park, NASA HQ, and MSFC on a number of occasions.

B. Panel/Members/Consultants/Staff

Panel Chairman

Mr. John C. Brizendine, Chairman
Formerly President, Douglas Aircraft Company

Members

Dr. Richard H. Battin
Charles Stark Draper Lab.

Mr. Charles Donlan
Formerly, Dep. Assoc. Admin NASA HQ
Consultant, Institute Def. Analysis

Mr. Gerard W. Elverum, Jr.
VP & Gen. Mgr. TRW Space Group

Mr. Herbert E. Grier
Formerly, Senior VP EG&G Inc.

Mr. John F. McDonald
Formerly, VP TigerAir

Mr. Norman R. Parmet
Formerly, VP TWA

Mr. John G. Stewart
Ass't Gen. Mgr. TVA

Mr. Melvin Stone
Formerly, Dir. Structures
Douglas Aircraft Co.

Ex-Officio Member

Dr. Milton A. Silveira
NASA Chief Engineer

Consultants

Dr. Seymour C. Himmel
Formerly, Assoc. Dir. LeRC

Mr. John P. Reeder
Formerly, NASA Research Pilot

Lt. Gen. Leighton I. Davis
USAF (Ret.)

Staff

Mr. Gilbert L. Roth
Staff Director

Miss Susan Webster
Program Support Assistant

C. Panel Correspondence With Congress

There are items that come to the attention of the Panel which are considered valuable enough to warrant providing Panel comments and thoughtful considerations for congressional perusal. The letters which follow are typical of this type of correspondence. It is a part of the process noted in previous sections of this Annual Report noting the open forum, cooperative approach attached to Panel activities.

July 5, 1984

Honorable Slade Gorton, Chairman
Subcommittee on Science, Technology
and Space
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

As Chairman of the Aerospace Safety Advisory Panel I believe it is appropriate to comment to you and your Subcommittee regarding the auto shutdown of the Orbiter Discovery's main engines during launch sequence on June 26, 1984. The Panel believes it is particularly important to do so in view of the negative connotations in the media reporting of the event, which may have created misleading impressions in the minds of the public regarding the safety of the astronaut crew and the soundness of the Space Transportation System.

In fact, the system operated precisely as designed. The launch sequence was stopped automatically when the computer detected a mismatch between actual engine start function signals and the pre-programmed, required function signals. Thus this design safety feature performed as intended to ensure the safety of the crew and the vehicle system. This should bring positive connotations rather than negative ones.

We of the Panel view the Space Transportation System as a program still in transition from the development stage to the operational stage. Due to the nature of its missions and the necessary complexities of its hardware and software, the transition period will continue for some time into the future. It would be a misconception and an unrealistic comparison to expect airline-type operations from the Space Transportation System (although it can be noted that even sophisticated jetliners experience some departure delays and occasional cancellations for technical reasons). The important consideration is that each mission be carried-out safely and successfully. The Space Transportation System safety record is 100 percent thus far, and we are pleased to see the design performing to maintain this record.

Respectfully yours,

John C. Brizendine
Chairman
Aerospace Safety
Advisory Panel

September 14, 1984

Honorable Harold L. Volkmer
Chairman, Subcommittee on Space
Science and Applications
U.S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

I was pleased to substitute for Chairman John C. Brizendine in presenting the views of NASA's Aerospace Safety Advisory Panel at the Subcommittee's hearing on August 2, 1984, to review Space Shuttle requirements, operations, and future plans. In reviewing the transcript of the hearing, especially the discussion among William A. Anders, representing the NASA Advisory Council, myself, and subcommittee members, I was struck by what at times appeared to be the contradictory assertions that, on the one hand, the Space Shuttle should be viewed as a research and development vehicle for the duration of its operational life and that, on the other hand, NASA should move toward creation of an independent entity within NASA to manage Shuttle commercial operations since NASA's R&D centers were not well suited for this long-term operational responsibility. Given the importance of these roles and relationships for the future of the Space Transportation System, I thought it might be of help to the Subcommittee if I attempted to clarify this line of thinking. These are my personal views although I believe they reflect the general thinking of other Panel members.

In discussing continuing R&D as it relates to the Space Transportation System, several facts must be kept in mind:

1. Many of the original systems and equipment items--especially in the areas of general computers, avionics, and navigation--are obsolete and must be replaced or significantly upgraded.

2. Critical systems, such as the Space Shuttle Main Engines, the auxiliary power units, and the brakes, have performed below expectations and should be upgraded.

3. The complete flight envelope for the Orbiter has not been defined as yet and its definition may indicate the need for structural or other changes to the Orbiter.

4. The need for increased hardware reliability and reduced turnaround time is likely to dictate equipment and system improvements for many years to come.

5. A new generation of upper stages, principally the Centaur and the IUS, must be incorporated in Shuttle operations if the full capability of the STS is to be realized.

These facts indicate clearly why a continuing program of R&D is essential to the safe and efficient operation of the Space Transportation System. In other words, there is no way NASA could responsibly "freeze" all design elements at the present stage of STS maturity. As a consequence, Shuttle operations are not likely to resemble those of a commerical airline in the near future. To assume such highly predictable routine operations is to ignore the important R&D tasks still underway and the uncertainties that inevitably are part of any R&D effort. We can realistically expect elements of this R&D program to continue into the 1990s.

The Shuttle can also provide a useful "test bed" to evaluate various advances in space and astronautics in much the same manner as industrial R&D will be carried on in Spacelab and other missions. For this reason the Panel's statement at the recent hearing noted: "...the Orbiter itself is the only vehicle capable of negotiating the complete velocity and heating encountered during STS missions. This knowledge would help resolve current problems and point up future technical directions. The high technology information which would become available through its use would also be applicable to advanced commerical and military vehicle design."

In short, an adjunct R&D program focused principally on upgrading the operational characteristics and reliability of the Space Shuttle is essential. This program in my view, can be directed most effectively by an entity within NASA charged exclusively with commerical operation of the Space Transportation System. Such an entity, discussed by William Anders and myself during the question and answer period, has been recommended by the Panel in our last two annual reports. NASA has taken several initial steps in this direction.

This operational entity must necessarily draw heavily upon the scientific and engineering expertise of the NASA R&D centers in much the same way that NASA uses outside contractors. However, the R&D agenda maintained by the operational entity would reflect those task related to improved operations, rather than the much wider agenda of innovations that could be supported by the R&D centers relatively free of the discipline of commerical operations. The perspective is one of fundamentally accepting the Space Transportation System as it presenty exists, subject only to the improvements and changes discussed earlier in this letter.

As we noted in our testimony, even an R&D agenda focused on such operational priorities will be substantial and will require considerable funding support in the coming years. This R&D program will move the STS steadily in the direction of greater reliability, greater cost effectiveness and enhanced safety. It will help bring to full operational maturity the world's first reusable space vehicle and set the stage for the next generation. This essential work, in my view, can be directed most effectively by an entity within NASA that has achievement of this operational maturity as its principal mission.

I hope these additional views are of assistance to the Subcommittee in its important review of the STS. If I or other members of the Panel can be of further help, please do not hesitate to call on us.

Sincerely,

John G. Stewart
Member, Aerospace Safety
Advisory Panel

D. Fact-Finding Results in Calendar Year 1984

1. Space Transportation System Launch Processing and Logistics

While the Space Transportation System (STS) in 1984 demonstrated its unique versatility and usefulness in space through a number of highly successful missions, its problems (e.g., tiles, engine changeouts) on the ground continued to challenge NASA management, the R&D centers, and NASA contractors, especially those responsible for launch processing. Launch and landing operations encompass activities at KSC, VAFB and the many secondary and contingency landing sites as well as reaching into the development centers and their contractors. The Panel has focused on the developmental aspects of the program affecting the management needs of the current period, the hardware/software requirements, resource needs, and the integration of STS operations from the factory to the launch and landing sites. The ultimate management form and the means to achieve it are under study by NASA with no definite approaches as yet selected. Some points, however, have emerged:

- o There must be no disruption in the operational support adequacy and ability to safely launch and turnaround the Space Transportation System as currently operating.

- o Personnel are a key resource and provisions must be made to "feed in" new people to replace, as necessary, those leaving.

- o Hardware and software, as required, will require updating and replacement owing to obsolescence, aging or inability to obtain replacements.

o Traditional organization arrangements, review methodology, handling of payloads, and system certifications cannot remain static but will change with STS maturity and accompanying knowledge and objectives.

o Complacency at any point in the process must be guarded against.

o A specific aspect of the management process which bears further attention are the "Program Freeze Points" and their use. Program freeze points are established at specific intervals during flight processing. Freeze points are defined as those points in time when the design, definition, and content of the cargo, integration hardware/software and flight design, vehicle flight hardware/software, crew activities/stowage and launch site flow are complete. Subsequent to these points, only mandatory changes to the hardware, software or affected documentation are permitted (mandatory changes are those necessary to ensure crew/vehicle safety and/or accomplishment of primary mission objectives). Such freeze points are established for each mission.

o Preparations for contingency landing site (CLS) activities must be planned to meet mission goals and to minimize expenditure of resources which can best be used elsewhere.

o Operational efficiency as measured by such things as turnaround time reduction, hardware increased reliability (increased mean time between failures), increased crew effectiveness, weather predicting, are all a part of operations. Since Day-of-launch winds can affect vehicle aerodynamic loads, better trajectory shaping and load reduction can be accomplished with winds as near to T-0 as possible. The actual "doing" part of launch and landing