National Aeronautics and
Space Administration
Office of the Administrator
Washington, DC 20546-0001

Dr. Bradford Parkinson
Chair
NASA Advisory Council
Washington, DC 20546

Dear Dr. Parkinson:

Thank you for your reports on the NASA Advisory Council meetings on September 29 and 30, 1998, and December 3 and 4, 1998, which were held at NASA Headquarters and at the Jet Propulsion Laboratory. I apologize for the tardiness of this response, and as a result, we are combining both the September and December responses into one letter and enclosing our formal responses to the Council's September and December recommendations. We will provide more prompt responses to the Council's future reports and recommendations.

I was pleased to be able to address the Council in September and explain our renewed emphasis on safety at NASA. Safety is our top value. We must improve our safety awareness and planning in our current and future programs and projects. Improving safety must permeate throughout everything we do at NASA. I need the Council's assistance and guidance as we improve the institutionalization of safety into our everyday work and programs.

Your comments and recommendation on the need for a Probability Risk Analysis (PRA) on the International Space Station (ISS) program are well-taken and are vitally important to the future success of the program. The ISS program has instituted a variety of risk management activities, which are not strictly probabilistic risk assessment; however, more must be done in this area. I have instructed the Associate Administrator for Space Flight to provide the Council with our plans to incorporate a PRA into the ISS program at your May 1999 meeting.

I am also pleased with the Council's interest in examining the lessons learned from our efforts with Faster-Better-Cheaper (FBC) missions. At your December 1998 meeting, the Council heard a panel presentation concerning FBC lessons learned by select NASA project managers. Additionally, I have instructed the Chief Engineer to form a top-level team of Agency program managers to assess the impact of FBC on the Agency. After the Chief Engineer's FBC team reports, the Agency will consider an FBC

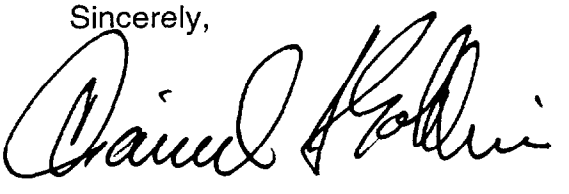
Agencywide workshop to help educate the Agency's employees about improving our FBC management processes. I have asked the Chief Engineer to report to the Council at your August 1999 meeting on our progress on this issue.

I am very interested in the Council's list of major "theme" areas. I urge the Council to continue its focus on each of these five major areas: maintaining a strong long-term technology program; future space transportation; ISS; FBC; and the aging NASA workforce. However, I ask that in your discussions on these and other issues that you assure that the importance of improving safety is comprehensively explored.

The Council's skeptical views and constructive comments on the Agency's commercialization plans for the ISS are appreciated. As our future commercialization plans evolve, we need the Council and the Advisory Committee on the ISS to provide feedback on our plans. Your comments have been forwarded to the Office of Space Flight for action. I have also asked my new Special Assistant for Commercialization, Daniel Tam, to attend your May meeting to explain his views on the broader NASA commercialization efforts.

As always, I appreciate the time and dedication you and the Council members give to our programs and policies.

Sincerely,



Daniel S. Goldin
Administrator

Enclosure

NAC Recommendations from September, 1998 meeting

Station Probability Risk Analysis (PRA)

Recommendation: In keeping with the Administrator's #1 priority, an independent outside PRA on the International Space Station (ISS) should be performed to cover both assembly and operations. Because it will be an extended effort, it should be funded and developed over an extended time period. It is hoped that an initial look would be available before the launch, and certainly by the date of the next NAC meeting, but it should be continued and refined over a period of several years. Outside, independent expertise can be found at a number of companies.

Response: The Office of Space Flight will provide the Council with NASA's plans to incorporate a PRA into the ISS program at its May 1999 meeting. The ISS program office agrees that probabilistic risk assessment methodology and analysis is an important factor in overall program contingency planning. The office is developing an integrated assembly and operation probabilistic risk model. This model integrates lower tier probabilistic analysis in the area of Shuttle availability, KSC payload and Shuttle integration flow process, onorbit assembly and operation, critical spare and logistic maintenance, and safety and reliability of onorbit segment. This risk model and analysis shall provide the ISS Program Management with the capability to prioritize the relative importance of major assembly sequence risk drivers, estimate the probability of assembly sequence success, and preplan for various risk and contingent scenarios. This model will also enable the program office to develop a composite risk posture, top risk drivers, their contribution to overall risk, and quantification of risk mitigation options.

Recommended Status: Open

Shuttle Solid Rocket Reliability

Recommendation: NASA should reassess the Shuttle solid rocket safety program to assure that everything practical is being done to maximize probability of successful Shuttle solid booster flight.

Response: The Space Shuttle Reusable Solid Rocket Motor (RSRM) was qualified for return to flight in an extensive series of full scale static firings and supporting margin and flaw demonstration tests. The redesign and its development and verification were completed with extensive independent review and the concurrence of national experts. In the subsequent 68 flights, through 1998, the RSRM has satisfied mission requirements and established high confidence for future flight success.

The Aerospace Safety Advisory Panel (ASAP), established by Congress as an independent oversight committee, conducts annual reviews of the Space Shuttle

program including operations, processing, and manufacturing of the RSRM. In the 1997 annual report, the Panel identified only one recommendation for improvement to the RSRM project. They suggested that Flight Support Motor test be performed every 12 months instead of every 18 months. These full-scale motor firings are used to test/verify new materials, processes or hardware prior to implementation. The Panel found no RSRM safety issues in the 1998 report to the NASA Administrator.

Additionally, since 1989, various Probabilistic Risk Assessments have been performed demonstrating the reduction in risk and improvement in overall safety with the Shuttle program as a result of continuous upgrades. The Space Shuttle program is currently using quantitative risk assessment (QRAS) to determine risk during ascent. Based on the QRAS method of modeling, the probability of RSRM failure during ascent is improbable to remote or 1 in 5682 (See attached). QRAS uses the top 50% of the critical failure modes plus "place holders" for the remaining failure modes. QRAS method of risk analysis has the full support of the NASA safety community as an excellent tool for determining risk.

A significant activity used by NASA and the RSRM contractor, Thiokol Propulsion, to ensure continued safe performance is rigorous postflight evaluation following each launch to confirm that all hardware features exhibited a typical in-family condition. This evaluation is structured to be thorough with systems to elevate all out-of-family observations for review and to collect data for statistical and trend assessments. This ability to recover and routinely evaluate the RSRM is a unique benefit for maintaining reliability. The process increases the likelihood of discovering adverse trends before they become a threat to flight safety.

Another important safeguard is the emphasis placed on control of materials and processes to maintain the consistency of the RSRM. Proactive steps that aid in this effort include upgraded manufacturing environments, increased use of automation and computer controlled equipment, and a vigorous process and configuration management system that extends to subtier vendors and suppliers. The in-family consistency of processes and hardware is maintained through the use of extensive data gathering, trending and statistical process control. It is confirmed by Quality Assurance checks such as witness panels, which are keyed to engineering, hazard and failure mode assessments; and is reviewed by independent technical and mission assurance boards in a structured flight readiness process at the contractor, project, and program levels. All of these systems are subjects of audits at the prime contractor and sub-tier vendors. An example is the Process and Product Integrity Audit which confirms that the detailed planning and shop practice are consistent and that they meet the intent of the baselined design and manufacturing process. The continuous application and fine-tuning of these tools has reduced both the number and significance of non-conformances and postflight observations and increased the confidence in RSRM safety.

An on-going Flight Support Motor (FSM) program provides opportunities to measure other aspects of RSRM performance in static firings. These full-scale tests and other test beds are used to verify that necessary changes, driven by material obsolescence,

perform satisfactorily. They also provide opportunities to introduce new features to enhance performance margins or to validate corrective action for any undesirable trend that is identified. The FSM program is an essential tool for proactive efforts to assure safety.

In 1997 an "Enhancement Team" completed an assessment of potential safety and reliability improvements for the RSRM and SRB Shuttle system elements. The team determined that the technical, design and philosophy changes institutionalized during the redesign had been successful in two areas. They had generated increased solid rocket/booster system reliability and had decreased the severity of the remaining reliability issues such that they are no longer safety issues. A substantially stable process and performance, enabled through the government / contractor teaming and challenge process, for each of the solid rocket motor / booster elements has been demonstrated for the 5 year period assessed.

The Enhancement Team provided recommendations for potential safety and reliability improvements. Both the non-hardware and near term hardware specific recommendations for the RSRM have been endorsed by the Shuttle program. The RSRM project has implemented an Enhanced Sustaining Engineering effort and other initiatives to act on these recommendations. This reassessment and the proactive actions which followed is a part of the ongoing effort to do everything practical to maximize the probability of successful RSRM flights.

In summary, confidence exists for the future safety of RSRM flights based on the excellence realized from the unique combination of several RSRM project initiatives. These initiatives include robust postflight evaluation activities, extensive pre- and postflight trending efforts, periodic audits of RSRM manufacturing process documentation both at Thiokol and sub-tier vendors, structured configuration/change management and qualification procedures, and a continuous government/contractor challenge process highlighted by the RSRM Project Flight Readiness Review process. However, the Office of Space Flight will work with the ACISS in developing an independent safety assessment of the RSRM and SRB system.

Recommended Status: Closed

ISS Crew Return Vehicle (CRV)

Recommendation: The Committee strongly recommends consideration of a more streamlined approach that utilizes a performance specification and selects a contractor-derived, fixed-price design. Given the interaction and exposure to the risk reduction and validation efforts on the X-38, we believe this strategy will provide the best long-term value to the Government and would offer some schedule relief to the development cycle.

perform satisfactorily. They also provide opportunities to introduce new features to enhance performance margins or to validate corrective action for any undesirable trend that is identified. The FSM program is an essential tool for proactive efforts to assure safety.

In 1997 an "Enhancement Team" completed an assessment of potential safety and reliability improvements for the RSRM and SRB Shuttle system elements. The team determined that the technical, design and philosophy changes institutionalized during the redesign had been successful in two areas. They had generated increased solid rocket/booster system reliability and had decreased the severity of the remaining reliability issues such that they are no longer safety issues. A substantially stable process and performance, enabled through the government / contractor teaming and challenge process, for each of the solid rocket motor / booster elements has been demonstrated for the 5 year period assessed.

The Enhancement Team provided recommendations for potential safety and reliability improvements. Both the non-hardware and near term hardware specific recommendations for the RSRM have been endorsed by the Shuttle program. The RSRM project has implemented an Enhanced Sustaining Engineering effort and other initiatives to act on these recommendations. This reassessment and the proactive actions which followed is a part of the ongoing effort to do everything practical to maximize the probability of successful RSRM flights.

In summary, confidence exists for the future safety of RSRM flights based on the excellence realized from the unique combination of several RSRM project initiatives. These initiatives include robust postflight evaluation activities, extensive pre- and postflight trending efforts, periodic audits of RSRM manufacturing process documentation both at Thiokol and sub-tier vendors, structured configuration/change management and qualification procedures, and a continuous government/contractor challenge process highlighted by the RSRM Project Flight Readiness Review process. However, the Office of Space Flight will work with the ACISS in developing an independent safety assessment of the RSRM and SRB system.

Recommended Status: Closed

ISS Crew Return Vehicle (CRV)

Recommendation: The Committee strongly recommends consideration of a more streamlined approach that utilizes a performance specification and selects a contractor-derived, fixed-price design. Given the interaction and exposure to the risk reduction and validation efforts on the X-38, we believe this strategy will provide the best long-term value to the Government and would offer some schedule relief to the development cycle.

Response: The CRV production contract is being broken into two parts. Part 1 will consist of the design, test, and analysis tasks to establish the baseline configuration for production, and Part 2 will consist of design finalization and actual manufacturing. Part 1 is expected to run from October 1999 to March 2001. Part 2 is expected to run from March 2001 through the end of 2004.

The X-38/CRV project briefed a "build-to-print" approach for the Part 2 to the ACISS. ACISS was concerned that a performance-specification approach might be superior for Part 2.

After discussions with ACISS, it was acknowledged that there is good programmatic and technical rationale for either approach. The same issue had been raised in the Code M-sponsored McDonald committee review on the CRV. The McDonald committee had also indicated that both approaches were feasible and had recommended the build-to-print approach. Build-to-print has been carried as the baseline, but questions have arisen on the feasibility of this approach, especially regarding the degree to which the contractors can be held accountable for total system performance.

Technical briefings at the highest management levels of Code M, JSC, and the ISSPO, and inputs from the contractor community, led to modifications of the baseline approach. The current baseline calls for Part 2 to be a build-to-design specification contract with the design space restricted only to the outer moldline of the X-38 and a parafoil landing. As long as the contractors agree the X-38 moldline and parafoil landing meet the basic system performance requirements. Also, the winning Part 1 contractors will be the integrators of their proprietary designs of the total CRV. These changes in the acquisition strategy allow for greater contractor accountability for the operational vehicle performance.

Recommended Status: Open

ISS Pre-Planned Program Improvement (P^3I)

Updated Recommendation: **The ISS P^3I program has made a valiant and successful effort in the past year and is taking shape as a viable and much needed element of the ISS program. ACISS has three areas of concern for the future.**

1. Be careful that the amount of funding expected does not drive the definition of the program and funding requested. Program and NASA management need to be informed on the total scope of both the fiscal requirements and the technical content of the P^3I program in order to guarantee that the ISS will remain a world-class scientific laboratory.

Response: We agree with the need to inform Program and NASA management on the total scope of the fiscal requirements and technical content of the P^3I program. In

addition to the annual review and ranking of P^3I candidates, which provides management with a funding priority list, we will update and use the P^3I Roadmap to brief management on the total scope of the technical content and to estimate the fiscal requirements required to implement this technical content. This activity is documented in the recently updated P^3I Process flow chart.

2. The list of recommended studies and new starts should be derived from a brief description of the process of identification of candidates to meet deficiencies. The list presented contained several items that address the needed upgrade of the onboard information system, such as upgraded Multiplexer/Demultiplexer and new compiler. To assist the reviewer (and the potential funder), the rationale for selection should be presented. For example, "The goal of this particular activity is to bring the system up to state-of-the-art capability and will require processors upgraded to Pentium II capability and changes to the Ada compiler to accommodate the new processor architecture. . . ."

Response: We will provide the rationale with each candidate recommended for near-term funding consideration. The recommended studies and new starts will be determined by the P^3I Process, which has as its focus the identification of improvements to meet system deficiencies and improve utilization capability.

3. Be vigilant that the P^3I effort does not become a convenient "catch-all" for odds and ends from other activities, such as using P^3I to pay for laptop computers or to support engineering research and technology demonstrations.

Response: We agree that the P^3I effort needs to be sure that any candidate considered falls within the scope of the P^3I objectives as established by program management. This initial assessment is documented in the P^3I Process. In addition, as we go through the management review process, the rationale for funding consideration of a P^3I candidate will provide additional opportunities for review of that initial assessment.

Recommended Status: Closed

Faster, Better, Cheaper (FBC)

Recommendation: The NAC recommends that NASA consider lessons learned from FBC programs it has reviewed, both successes and failures, in terms of the following:

1. **Processes and structure**
2. **NASA Infrastructure**
3. **External Infrastructure in industry and universities**
4. **The sustainability of all of the above**

A report to the NAC is requested at its December 1998 meeting. The NAC would like to include a roundtable of people who have had this experience.

Response: NASA provided the NAC with a panel discussion from project managers who have had broad experience in implementing FBC missions. We believe that the interaction by the panelists and the NAC provided additional anecdotal data for the Council as they examine this issue. Additionally, the Administrator has requested that the Chief Engineer form a top-level team of Agency program managers to assess the impact of FBC on the agency. This team will accomplish the following:

1. Exchange results and experiences of FBC and identify approaches and processes that worked well and why;

2. Evaluate how FBC is being evolved and institutionalized throughout the Agency;

3. Recommend FBC improvements.

After the Chief Engineer's FBC team reports to the Administrator, the Agency will consider an FBC Agencywide workshop to help educate the Agency's employees about improving our FBC management processes. The Administrator urges the Council to keep this issue open and to periodically revisit it as the Agency moves forward.

Recommended Status: Open

Recommendations from December, 1998 meeting

CONSOLIDATION OF THE PEER REVIEW PROCESS FOR RESEARCH PROPOSALS

Recommendation: NAC requests that, before consolidation is implemented, the Life and Microgravity Sciences and Applications Advisory Committee (LMSAAC) review the consolidation plans to insure that the peer review process will not be harmed by contractor consolidation.

Response: NASA concurs with the NAC recommendation that the LMSAAC will review the consolidation plans prior to implementation.

Recommended Status: Closed

CONSOLIDATION OF COMMERCIAL SPACE CENTERS (CSC)

Recommendation: As the Agency implements the Commercial Space Act of 1998 and consolidates the CCCDS/CSC, it should do so under a single office at Headquarters and include the corresponding run-out budgets. NAC suggests that this office be the Office of Life and Microgravity Sciences and Applications.

Response: Consolidation of the CSC/CCDS (hereafter referred to as the CSC program) is being accomplished in phases. The following has taken place or is in process:

1. NASA has instituted a series of quarterly meetings in which all CSC's are invited to participate. These meetings facilitate cooperation and discussions both of progress in and impediments to the commercial development and use of space.

2. The CSC management is being consolidated at NASA. OLMSA will maintain an overall policy coordination umbrella over all the CSC's. Technical management will be performed by the relevant Enterprise offices at NASA Headquarters. Representatives of these offices will develop a coordinated plan to further synergism and coordination. This plan should be completed by spring 1999.

3. The Associate Administrators of OLMSA and the Office of Space Flight have approved a plan to insure that the CSC's continue to play a key role in the commercialization of the ISS. Specifically, the plan calls for CSC participation in pilot commercial projects proposed for the ISS. This is an important first step because future research in space, both applied and basic, will be dependent on the ISS. This plan reiterates NASA's commitment to and support for commercial space activities and recognizes the significant role to be played by the CSC's in commercial Space Station activity.

Recommended Status: Closed