On the Extended Duration Orbiter Medical Research Program

On December 20, 1989, Space Studies Board Chair Louis J. Lanzerottie and Committee on Space Biology and Medicine Chair L. Dennis Smith sent the following letter to NASA Administrator Richard H. Truly.

As Chairman of the Space Studies Board (SSB) and Chairman of the SSB's Committee on Space Biology and Medicine (CSBM), it is our responsibility to keep you apprised of issues of particular concern to the CSBM and the Board.

At its last two meetings[1], the CSBM was briefed on the agency's Extended Duration Orbiter (EDO) Program. In response to a request for information, the committee also received a letter summarizing EDO activities at JSC and has evaluated summary data on landings of previous STS flights 1-24. **Based on this information, critical issues appear to exist concerning the ability of crews to perform the visual and manual. tasks involved :In piloting and landing the orbiter and the capacity of crews to achieve unaided regress after residence in the microgravity environment of space.** These issues relate to the safety of shuttle crews on short-term as well as extended duration flights. **Both the CSBM and the SSB are concerned with the adequacy of the proposed EDO Medical Research Program to support the development of appropriate countermeasures against physiological adaptations to microgravity and allow for the enhancement and prediction of crew performance during and after the critical phases associated with orbiter landings.**

We believe that the complex and lengthy process of developing countermeasures requires an understanding of the basic biological processes that underlie physiological adaptation to microgravity. With respect to the adequacy of the EDO Medical Research Program, the SSB and CSBM have identified two major issues: (1) Does the proposed research adequately link gravitational effects to the critical human behaviors? (2) Will the proposed research be subjected to rigorous, extramural peer review to ascertain whether it utilizes the most appropriate methodology and meets the highest standards? We believe that the development of countermeasures that will affect crew performance is an extremely important and difficult task that requires the use of new approaches in a strong collaborative effort involving the Astronaut Office, NASA flight surgeons and in-house scientists, and extramural basic and clinical scientists. The information made available to the CSBM indicates that the EDO

Medical Research Program is a continuation of long-standing protocols to measure changes in cardiovascular function/orthostatic tolerance, muscle function, aerobic and metabolic capacity and neurosensory function. The committee is of the opinion that such a program will be insufficient to answer the major questions. The EDO Medical Research Program must be firmly based on scientific concepts and methods, and the development of appropriate and statistically valid decision rules must precede any in-flight or ground- based evaluation of a proposed countermeasure. We are aware that the EDO Medical Program is in the final planning stages and hope that there is still some flexibility to affect the research that will be undertaken. Attachment A contains a set of recommendations from the Committee on Space Biology and Medicine that might better address both our near-term safety concerns and those associated with the goals of the EDO program.[2]

It is because of our serious reservations concerning the safety of our astronauts and continued success of the U.S. space program that we felt compelled to bring this issue to your attention. We would be happy to meet with you and discuss these issues further, or to help in any other way we can.

1. CSBM Meeting 6/1 - 6/2/89, Washington, D.C., and CSBM Meeting 9/27 - 9/29/89, Washington, D.C.

2. The recommendations in Attachment A derive in large part from the strategies previously prepared by the CSBM (*A Strategy for Space Biology and Medical Science for the 1980's and 1990's*) [NAP, 1987] and, *Life Beyond the Earth's Environment* (NAP, 1979]). We understand that some of these recommendations may have already been taken into account including the use of external disciplinary working groups to evaluate proposals.

ATTACHMENT A

The Committee on Space Biology and Medicine offers the following comments and recommendations as a possible approach to addressing the near-term safety issues associated with shuttle landings and the EDO Medical Research Program. A prerequisite for the success of the program is access to all pertinent individual data characterizing physiological functions, crew performance, and their interrelationship during the critical return to the 1-g environment. This effort will require a new level of collaboration between astronauts, flight surgeons, and scientists and also the development of a set of well-defined rules to maximize data access while protecting the individual crew member.

A purely empirical program that relies primarily on in-flight application of multiple countermeasures in a small number of subjects, and employs only simple traditional methods to determine outcome is unlikely to produce optimal

countermeasures. Countermeasures to be considered for in-flight must have a well-defined scientific rationale. A successful program will utilize data derived from work at all levels, including ground-based studies in different animal and human models.

(1) An evaluation of existing data on landing parameters characterizing crew performance and physiological functions from previous orbiter re-entries and landings and a determination of whether more sophisticated measures of these parameters should be developed and employed. The aviation research capabilities of Ames and Dryden could prove useful in this regard. Related to this, there should be review of the FAA database relative to crew performance under a variety of environmental conditions including fatigue and circadian dysrhythmia.

(2) Develop an empirically based program to compare systematically landing performance on re-entry with that shown in orbiter configured aircraft and simulators.

(3) Explore the feasibility of using changes in gravity and/or bedrest as an experimental factor influencing piloting performance. This could involve use of the reactivated centrifuge at Ames to induce gravity changes prior to or in concert with performance of perceptual/motor tests in the centrifuge and piloting tasks in a simulator.

(4) Fully utilize the existing database on deconditioning and the effects of countermeasures on physiological responses to microgravity to design all experiments on all forthcoming shuttle flights.

(5) Develop animal models to measure effects of microgravity on muscle function, neurosensory function, etc. The use of appropriate model systems should enhance the database quantitatively and allow more selected confirmatory experiments of the relatively small number of human subjects available for study.

(6) Utilize disciplinary working groups set up by the Aerospace Medical Advisory Committee to provide appropriate recommendations and peer review for proposed research projects.