On Clarification of Issues in the Opportunities Report: Letter Report

Committee on Microgravity Research, National Research Council

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On April 19, 1995, Committee on Microgravity Research Chair Martin E. Glicksman and Space Studies Board Chair Claude R. Canizares sent the following letter report to Mr. Robert Rhome, director of NASA's Microgravity Science and Applications Division.

In response to the questions you originally raised at its February 8, 1995, meeting, the Space Studies Board's Committee on Microgravity Research is pleased to offer clarification of the recommendations made in its report Microgravity Research Opportunities for the 1990s. The committee received your letter, dated February 27, 1995, in which you outlined several questions that were of greatest interest to you. The committee subsequently met on March 31, 1995, to finalize its response to questions posed in your letter. The questions and the accompanying committee responses are given below.

1. The Committee notes that although reproducibility of results is a critical element of laboratory science, nonetheless a balance should be established between reflight opportunities for reproducibility and the flight of experiments that address new scientific issues. Are there any decision rules or general criteria that NASA should apply to test whether we are meeting the intent of this likely recommendation?

Response: The requirement that experiments must incorporate new science in order to re-fly should not be a "decision rule." The committee acknowledges that hard and fast rules cannot be applied to reflight decisions and that the judgment and experience of Microgravity Science and Applications Division (MSAD) scientists and engineers must play key roles in striking a balance between reflight opportunities and new experiments. General criteria that the committee believes would be usefully applied in making these decisions include scientific importance, flight availability, competition from other experiments, and past experiment performance, all of which should be weighted heavily. The probability that the experiment will achieve its operational and scientific objectives is also an important consideration. This can be determined in part by evaluating the scientific maturity of the investigation, including the success of the ground-based investigation and the appropriateness of the theoretical modeling. However, this statement should

not be construed as advocating a higher priority for investigations based on the length of their tenure in the microgravity program. Reflight of experiments should be subject to the same peer review criteria as any other experiment.

2. As there may be specific reasons to augment the microgravity research with a variable-g capability of extended duration, shared utilization of a centrifuge on the Space Station for microgravity research would appear to be desirable. If shared use were not possible, what relative priority would the Committee give to development of a unique centrifuge for this purpose over other hardware development programs already underway within NASA's microgravity research activities?

Response: A general-purpose variable-g centrifuge has a lower priority than other hardware development programs already under way within NASA's microgravity research program. The committee recognizes, however, that gravity as a variable is an important issue and that the development of special-purpose centrifuges may be justified in the future for specific experiments.

3. The Committee is aware of the importance to NASA of categorizing experiments according to their minimum facility requirements to maximize scientific return and cost-effectiveness. NASA MSAD would be very interested to learn from the Committee how to test for 'cost effectiveness' as NASA struggles to become "better, faster, cheaper."

Response: The Opportunities report points out that minimum platform facilities should be utilized where possible in the interest of lowering experiment costs. Although the role of cost-effectiveness in creating a "better, faster, cheaper" program is a legitimate and important issue, it is beyond the scope of this report. The committee believes that question is not answerable without considerable further study.

4. Tradeoffs must be evaluated when suggesting to principal investigators that general-purpose laboratory equipment, versus experiment-specific equipment, be used to support their scientific protocols. MSAD is aware that in seeking cost effectiveness there may be some degradation of scientific results and it would be helpful to hear how the Committee would expect MSAD to evaluate and/or reconcile these tradeoffs?

Response: The committee believes that it would be a mistake to restrict investigators to generic facilities. MSAD should continue to provide opportunities for the development of experiment-specific hardware(as well as access to generic facilities. However, since experiment costs for the former are expected to be significantly greater than for the latter during the space station era, it is reasonable to judge proposals for research requiring new hardware more rigorously than those for research utilizing facilities already in place. Investigators requesting the development of complex new hardware would therefore have to compete for more limited flight opportunities than would other investigators. This policy would need to

be clearly stated in the NASA Research Announcements.

5. The Committee is aware that much of the extant NASA infrastructure and procedures were developed for missions in space with purposes other than laboratory science and that there has been an effort made in the past to simplify and unify the interactions among centers and between centers and NASA headquarters. MSAD has also worked very hard to ensure that principal investigators are continually involved with the development of experiments. MSAD believes that considerable progress has been made in these regards and would like to learn from the Committee if continuing concerns in this area are related to activities within the microgravity science research program (versus the way NASA does business, i.e., Spacelab from MSFC, mission from JSC and integration by KSC) and if these concerns are based on a community consensus or are more indicative of anecdotal exceptions to the improvement trend.

Response: The committee recognizes the considerable progress MSAD has made in the last few years in reducing the difficulties experienced by investigators interacting with NASA centers and their requirements. Room for further improvement still exists, however, and MSAD should remain vigilant on this issue. Opportunities remain for streamlining the diverse requirements imposed on investigators by the centers. Procedural requirements, particularly those pertaining to safety, are often applied across the board to experiments with very different needs and levels of risk. One possible improvement that MSAD might consider is to allow more flexibility in imposing NASA requirements on different experiments.

6. Since 1991, NASA's microgravity science research program has been pursuing the objective of expanding the ground-based portion of the program from 73 investigators in 1992 to over 300 ground-based investigators in 1998. As of February 8, 1995, there were 209 ground-based investigators supported by the program. Does the committee consider this target population to be adequate for the end of this decade in order to ensure the future supply of high-quality flight experiments?

Response: The committee is pleased with the direction of the ground-based program and the acknowledgment by MSAD leadership that the Research and Analysis program provides the intellectual underpinning of the microgravity program. The committee believes that the target of 300 ground-based investigators is adequate to ensure a reasonable supply of quality investigations for future flight opportunities. This judgment is based in part on the significant increase in the quality of research proposals made to the MSAD program in recent years.

7. Prompt documentation of experimental results should be required and enforced. There has been considerable discussion within NASA about access to experimental data. The observational sciences have traditionally shared their data with the community almost as soon as the picture is developed. On the other hand, laboratory research data is not usually archival in its raw state. Should NASA reconsider its policy relative to microgravity science research which provides the

principal investigator exclusive rights for up to one year after receipt of data in order to verify, analyze, and publish the data and the conclusion that can be drawn therefrom?

Response: The committee recognizes that the issue of archiving flight data from microgravity experiments is extremely important and timely. This subject is therefore being addressed in an upcoming committee study.

8. There have been several comments offered that suggest that the growth of large inorganic crystals need not be a priority of this program. It would be helpful if the Committee would help in defining the term 'large' as it has several different meanings to different research groups. For example, something over 2 centimeters in diameter could be considered large, whereas industry might interpret large as 4-10 centimeters in diameter.

Response: Size, per se, is not the issue in the report's recommendations concerning the growth of large inorganic single crystals. Large in this context refers not so much to the quantitative crystal size as to the type of crystal that is the objective of the experiment. The large inorganic single crystals studied by NASA are usually grown for use in semiconductors, detectors, oscillators, and lasers. The committee in its report stated that carrying out the growth of these large inorganic single crystals in space contributes little to the fundamental understanding of crystal growth or to improving terrestrial commercial practice.

We hope that these clarifications of the report's recommendations prove useful to you and your staff.