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MATERIALS AND FLUIDS SCIENCES SPLINTER GROUP SUMMARY

Gravity Level Characterization and Management

1. Findings:

The recent analyses of rigid and elastic models of the Space Station performed by Level II show that: the quasi-steady state g-level requirement put forth by OSSA can be met in portions of the module; the dynamic requirements (both oscillating and impulse), however, cannot be met in their present form. There appear to be various technologically feasible alternatives, such as reorientation of the treadmill, that will significantly reduce the discrepancy between the OSSA user requirement and the predicted environment. (10^{-6} DG-G AVAILABLE IN SOME LOCATIONS)

SSSAAS, in recommendation #13 of the 1988 Summer Workshop has requested that MSAD and OSS plan for the necessary technology to characterize the Space Station g-level environment, and vibration management. Activities, in response to this recommendation, have not been communicated. Furthermore, OSSA has been unable to identify responsibility for vibroacoustic planning within the Space Station Program Office (SSPO, Level II).

2. Conclusions:

Vibration isolation and accelerometry are still critical issues. They appear to be currently inadequately addressed.

3. Recommendations:

a) OSSA's Microgravity Sciences and Applications Division (MSAD) should immediately examine the changes in the dynamic g-level requirements suggested by the Chief Scientist of Space Station. This examination should be carried out through the DWG's and, desirably, in coordination with the International partners and the Users Requirements Panel of NASA's Office of Commercial Programs.

b) The accelerometer subsystem, providing for determination of magnitude and direction of the g-level distribution, should be considered a non-negotiable prerequisite for meaningful microgravity missions.

c) Station has to assume responsibility for the development and management of a vibroacoustic budget.

Model Experiment Scenarios

1. Findings:

Only an insufficient number of realistic scenarios exist for the Microgravity Sciences.

2. Conclusions:

Model experiment scenarios are a primary means of establishing criteria for the following issues:

- g-levels, power, heat rejection, data acquisition and management, etc.
- laboratory support equipment
- crew time and skill requirements
- on-board characterization and/or rapid sample return
- safety hazards.

Model experiment scenarios are, therefore, essential for the development of a high-fidelity envelope of scientific, engineering and operational requirements. It is urgent that this high-fidelity data base be established and become the basis for future program development, including specifically the issues detailed above.

3. Recommendations:

a) OSSA's Microgravity Sciences and Application Division (MSAD) should immediately request model experiment scenarios from DWG members, SS Facility Project Scientists and all currently MSAD-funded PIs. The attached format, currently used by NASA's Office of Commercial Programs (OCP) may serve as a guideline for this request.

Review of the responses and establishment of the working envelope should be conducted by MSAD and reviewed by the next combined meeting of the DWGs in the Fall of 1989. The results should be reported to SSSAAS within 6 months.

b) NASA should suggest that OCP and NASA's Office of Aeronautical and Space Technology, and the International partners establish envelopes to a similar schedule. The resulting high-fidelity envelopes should be used as the source of requirements to be presented to OSS at the earliest possible date.

Laboratory Support Equipment (LSE)

1. Findings:

SSSAAS, in recommendation #12 of the 1988 Summer Workshop had requested that"user groups should be encouraged to participate in the selection and specification of support equipment at all levels, including Level III".

The latest proposed LSE list (as defined by OSSA CR #53) with its Contract End Item Specifications (CEI) represent considerations before the current constraints on Space Station funding were known, i.e. it is a wish list. However, a similar list has already become the CEI Specification for LSE in the US Lab. This equipment is presently being designed and worked by contractors.

2. Conclusions:

The above recommendation has not been adequately addressed and the situation has become acute.

The currently proposed LSE list does not reflect the realistic on-orbit needs of the potential SS experimenters (DWG members, SS Facility Project Scientists, currently MSAD funded PIs), and lacks prioritization, realistic phasing and specifications. In addition, crew skills required for efficient operation of some LSE appear not to have been considered.

3. Recommendations:

a) The latest proposed LSE list, as defined by OSSA CR #53, must be audited based upon the revised model experiment scenarios, as prescribed in the recommendations for model scenarios.

b) In conjunction with this audit, SSSAAS recommends that the appropriate OSSA Program Offices conduct a study considering the impact on the quantity and quality of science and cost-effectiveness, resulting from rapid sample return and/or on-board characterization. The results of this study should be reported within in a year to SSSAAS for their recommendation prior to implementation.

c) SSSAAS requests that SSAC advise SSFP to organize an audit among all user codes and make appropriate changes to the LSE items, specifications, prioritization and phasing.

d) SSSAAS supports the establishment of Requirements Integration Groups (RIG) to facilitate communication between designers and the user community, and in particular the establishment of an LSE RIG as soon as possible.

Rack and Interface Commonality

1. Findings:

The recent Memoranda of Understanding (MOUs) with our International partners call for commonality (full interchangeability of rack-sized elements) within the pressurized volume of SS. Such commonality does not exist at present; there appears to be no effective mechanism at present to achieve commonality. This situation is considered intolerable by both SSSAAS and IFSUSS.

2. Conclusion:

Without commonality, the US community will not be able to effectively utilize the internationally agreed upon share of the pressurized SS elements. In addition, the international partners will be restricted to their respective pressurized elements.

3. Recommendation:

The Associate Administrator of OSSA should declare establishment of commonality as of highest priority and address it to the Administrator. In the interest of international partnership, commonality in rack sizes and interfaces should be accomplished in a spirit of compromise.

- George Ludwig

Materials and Fluids Sciences Splinter Group

Science Operations Concepts

Issue: International Commonality and Interoperability

1. Finding:

The Memoranda of Understanding (MOUs) with our International partners call for commonality in the interest of the fullest possible cross-utilization of SSF capabilities. In the operations arena we have not seen evidence that arrangements are being made to achieve this goal.

2. Conclusion:

Without a greater level of commonality in the operations area the goal of cross-utilization (interoperability) is unlikely to be achieved. This would include provisions ranging from the ability to locate and operate racks in either the US or International partner modules to the availability of uniform data formats and standards, display formats, and command protocols and user interface languages.

3. Recommendation:

We recommend that the subject of operations commonality, in all of its aspects, be included for discussion at the December SSSAAS Meeting. Specifically, we ask for presentations by OSS and OSSA of arrangements being made to assure international interoperability. This should include agreements on user interfaces, command and data formats, operations protocols, scheduling procedures, and other areas necessary to produce a fully international flavor for operating within the SSF environment.

Materials and Fluids Sciences Splinter Group

Science Operations Concepts

Issue: Operations Functionality

1. Finding:

The SSSAAS, in recommendation # 35 of the 1988 Summer Workshop, requested that NASA describe the planned functionality of the SSF operational system so that the users could assess its ability to meet their needs. We note that good progress has been made in this area, with strong participation by OSSA on behalf of the science and applications user community.

Discussions at this meeting centered on several new aspects of this issue:

- NASA should make sure that we take full advantage of SpaceLab experience to avoid problems or deficiencies encountered there by the Materials and Fluids Sciences experimenters. This represents the most applicable base of experience for SSF operations system design.

- The Subcommittee was not clear on the distinction between, and the need for, the separate POIC and ISOC. It appears, at least at the surface, to be primarily a management and funding distinction.

2. Conclusions:

The Subcommittee would like to be updated at each meeting on progress in planning the operations system.

The current evolutionary path for moving from an initial relatively centralized approach to a more distributed approach is strongly endorsed.

3. Recommendations:

a) We recommend that OSS and OSSA, in an explicit sense, examine SpaceLab lessons learned in Materials and Fluids Sciences and use them as a guide and "sanity check" on the SSF operations concept and design. We request that NASA report the results of this examination at the next SSSAAS meeting.

b) We recommend that NASA critically examine the possibility of physically combining the POIC and ISOC (even though the functions may still be separate) in the interest of reducing cost.

Materials and Fluids Sciences Splinter Group

Science Operations Concepts

Issue: Telescience

1. Finding:

Studies have shown that crew time is one of the most critically short resources for this discipline. The ability to perform substantial research will depend on our ability to maximize the use of this resource.

The Materials and Fluids Sciences investigators have repeatedly stated their need for very direct personal involvement in the conduct of the experiments on board, even though they may have to remain on the ground. They have also stated the desirability of being able to participate from their home laboratories as much as possible, rather than having to spend extended periods at a center far removed from their home sites.

2. Conclusion:

Crew effectiveness is a factor to me maximized, even if substantial resources must be expenced early in the program to achieve it.

Telescience offers an excellent possibility for both increasing crew effectiveness and for permitting direct investigator involvement from the ground and from their home sites.

3. Recommendation:

a) NASA should aggressively pursue the use of telescience to improve crew effectiveness and to permit direct participation of investigators in the conduct of their experiments.

b) We request that this subject be made a major agenda item at our December 1989 meeting. We would like to have:

- A tutorial session on the technical (but user-related) aspects of telescience.

- An outline of NASA plans for incorporating telescience capabilities into the OSSA and OSS portions of the SSF operations system. Special attention should be given to the role of telescience in international partner operations. This presentation should also include any plans to test telescience concepts in advance and to provide a basis of experience for its use for SSF investigators and operators.