OFFICE OF SPACE SCIENCE AND APPLICATIONS

Requirements of the Space Science and Applications Program for the Use of Space Station

Robert C. Rhome, P.E.
Assistant Associate Administrator for
Space Science and Applications (Space Station)

September 22, 1989

E 211730SEP89

1. Access to Space Station:

The principal concern of OSSA is that the current assembly sequence does not deliver a sufficient number of OSSA payloads to Space Station nor provide for adequate resupply. During all years, from FEL through AC, OSSA will have more payloads developed than can be delivered. Under the assumption that there is no additional upmass available on these assembly flights, and that the ASRM, while helpful, will not solve the problem, it will be necessary to insert utilization flights during the 6 year assembly sequence, and perhaps after AC.

OSSA expects to operate approximately three Spacelab flights per year, and in the mid to late 1990's anticipates that these flights will be EDO. It may be appropriate after the EMTC to terminate all or part of this Spacelab program, and use the flight opportunities for utilization flights, which are defined to be flights which both take payloads to Space Station and which utilize the Station for an extended duration, i.e. 28 days, to conduct science. Such flights should be scheduled between assembly flights, and utilize a crew which includes trained scientists.

Action:

- The Space Station and Shuttle programs should commit to providing utilization flights during the assembly sequence, at a rate of several times per year, and sufficient to fully outfit Station.

- Adequate ground processing facilities should be provided to support these flights, and the Station/Shuttle made usable to conduct science on the Station for an extended duration during these flights.

2. Power:

A 75 kW Space Station is marginal for effective science utilization, but, with care (and deletion of most attached payloads, see item 3) is manageable. However, anticipated photovoltaic degradation exacerbates the problem. It appears that power in addition to the planned 75 kW will be required.

Action:

- The Space Station program should commit to installing the second 37.5 kW of power before PMC and the assembly of the JEM and Columbus modules.

- The Space Station program should commit to providing a controlled and "fenced" absolute minimum of 30 kW to all users (computed after the system requirements to maintain all laboratories active), following the installation of the 75 kW of the power units, i.e. if the Station housekeeping power requirements grow beyond 40 kW, appropriate design changes should be made to preserve the user power.

- The Station program should make no design decisions which will limit the addition of power, beyond 75 kW, in the future, and plans should be made to add such additional power as soon as possible.

3. Attached Payloads:

The redesigned Space Station drastically limits the ability to fly attached payloads, e.g. there is limited payload attachment hardware, no payload pointing system, etc. The power limitation on the redesigned Station, however, is such that it will not be possible to conduct an aggressive attached payload program and a pressurized element program simultaneously. OSSA has consistently stated that its priority for the use of Station is the laboratory sciences, and its priority for the assignment of power is microgravity research. To preserve the option for attached payloads, however, the Station should be appropriately scarred with adequate resource ports on the Truss. Moreover, attached payload capability is an attractive and exclusive U.S. resource which the users could barter to obtain access to other partner space assets, such as the Columbus Free-Flyer. Every effort should be made to increase the user share of the Station power in order to take advantage of this opportunity.

Action:

- The Space Station program should preserve the option of using the Station for attached payloads by providing 8 resource ports for major experiments on the Truss with 10 kW capacity, and should also provide a significant number of small attached points, e.g. 20, with 1 kW capacity.

- OSSA will use the available ports as early as 1996 to fly a small number of power-limited attached payloads.

- In the absence of an appropriate power augmentation, OSSA will have to restructure its recent selection of attached payloads.

4. Life Science Research:

To conduct life science research on the Space Station it is essential to have a functioning centrifuge and to have late and early access of animals, and animal specimen transportation systems; capabilities currently available on Spacelab.

Action:

- The Space Station program should commit to assembling and testing the centrifuge on the ground and launching it in the node designated for it, and to providing for both the transportation of and early-and-late access to animals, as specified in OSSA CR#33 (March 1988).

- OSSA is prepared to consider providing for the development of the animal specimen transportation system, to be used within the logistic modules, beginning with the FY 1992 budget. Necessary study costs prior to FY 1992 need to be borne by the Station program.

5. Crew Time:

The early phases of the Station which supports only a four person crew is a severe limitation on the conduct of the OSSA laboratory science, particularly if the modules are fully outfitted.

Action:

- The Space Station program should commit to developing operational sequences which maximize the crew time available to science, and to the aggressive use of utilization flights, as defined in item 1 above, which bring additional crew to Station for limited periods, until such time as an 8 person permanent crew is available.

6. Data System:

OSSA will have payloads in all laboratories, a node, on the Japanese exposed facility and on the Station truss. At PMC each experiment rack and attached payload resource port must have direct access to a data handling system which supports continuous data collection from several experiments operating simultaneously at data rates ranging from 1-100 mbps. Especially important is the capability to buffer data to accommodate the available TDRSS bandwidth and to cover periods of data transmission outages. Use of a stopgap non-Station data handling system (i.e., Spacelab CDMS) is the least desirable alternative system in that it requires the duplication of both Spacelab and Station systems in the ground handling and operations systems.

Action:

- Space Station should implement in a single data handling system for both users and systems data which accommodates access to a low rate (<10mbps) local area network, high data rate (10 -100 mbps) connections to the Communications and Tracking (C&T) system, and also connections to the Space Station video subsystem.

- With the exception of a video connection these requirements also apply to the major attached payload resource ports.

- Space Station must provide by PMC a minimum of 4 high rate ports to the C&T Base-band Signal Processor in order to support more than one experiment at a time in more than one element.

- Station should provide a user dedicated Network Interface Unit (NIU) on the core DMS LAN in order to ensure that the users have assured 10 mbps access to the C&T system and to preclude unnecessary encryption of experiment data.

- The data system must be transparent to the user independent of location, i.e., U.S. Lab, node, JEM or Columbus Attached Laboratory, truss, etc.

- Space Station must also provide on orbit data buffering adequate to compensate for interruption of experiment data transmission from a variety of sources, i.e., TDRSS outage, shadowing of antennas, etc.

7. Laboratory Support Facilities:

There are certain laboratory support functions that will have to be provided in order to utilize the pressurized volume for science. Some of these only the Station program can effectively provide; others can be provided by the users but currently there are no budgets to do so. Basic laboratory resource supplies such as water and gases to individual racks, and the collection, storage, and controlled venting of gases and liquids must be integral elements of the Station design. Other support elements, such as the Laboratory Support Equipment can be developed by OSSA with appropriate resources.

Action:

- The Space Station program should commit to providing a Process Materials Management System (excluding toxic materials) and a Fluid Management System, and a ECLSS system adequate to support reasonable user requirements.

- OSSA is prepared to consider providing the generic and the specific Laboratory Support Equipment necessary to support its facilities, beginning with the FY 1992 budget. Definition activities prior to FY 1992 need to be supported by the Station program.

8. Acceleration Mapping System:

Extended periods of time on orbit at low gravity levels provides the principal supporting rationale for the manned science program underpinning the Space Station program. The gravity level must be sufficient to support a broad range of microgravity science programs in both life and materials sciences, that is 10 -6g, for periods of time adequate to complete discrete research projects, that is 30 days. The gravity environment must be specified and controlled through an active vibro-acoustic control plan and then verified by measurement.

Action:

- The Space Station Program should institute a vibro-acoustic control plan to sub-allocate and control this vital environmental parameter.

- Station should also measure and verify both the steady state and dynamic microgravity environment through the pressurized volume.