LARRY
Cdr. John Young

SSSAAS LIFE SCIENCE SPLINTER GROUP

TUESDAY SESSION
JUNE 27, 1989

SESSION CHAIRMAN: Dr. S. Pool

EXTENDED DURATION CREW OPERATIONS (EDCO)

The EDCO initiative originated in a National Research Council study that showed a six-month rotation for the space station crew would save shuttle flights. Soviet observations concerning extended duration effects on humans are available, but many questions remain. Three years of data collection will be needed to address bone loss regeneration, countermeasures, psychological effects, and crew effectiveness. The resources required, the sharing of equipment with Life Sciences, and the location of the equipment is under discussion.

STATEMENT: The SSSAAS Life Sciences Splinter Group heard a briefing on Extended Crew Duration Operations (EDCO) and supports this initiative. EDCO is a space station operational initiative, and the allocation of resources for it appropriately come from space station common systems.

TIGHT BUILDING SYNDROME/MICROBIAL BUILD-UP

Tight Building Syndrome refers to a build-up of contamination, especially airborne, which is similar to that which may exist on the space station. A toxicology database and policy and procedures are in place for the shuttle and recommended for the station. Air quality affects plants and animals, as well as man.

Major space station concerns include: the extended mission length and 24-hour exposure, closed-loop aspect of the ECLSS, air distribution and flow, air scrubbing capabilities, microbial contamination, toxic contamination, particulate contamination, representative sampling, slowly accumulating toxins, depression of the immune system, setting of Spacecraft Maximum Allowable Concentrations (SMAC) values, batteries (lithium) as source of contamination, limited rescue options, system fouling, colonization of vital components of the spacecraft (including man), and biodegradation. The exchange of air between modules and interactions between cabin air and avionics air are significant unknowns. A clean atmosphere may lack desired microbial species and enhance negative effects. Users of the space station may be negatively impacted if requirements are too stringent. Nominal, contingency, emergency, and EVA operations should be addressed. Standard triple containment will be used for toxic materials.

STATEMENT: The SSSAAS Life Sciences Splinter Group received a briefing entitled, "Tight Building Syndrome and Space Station." The group acknowledges the concerns and potentially severe problems addressed, and encourages application of the lessons learned in shuttle operations. The Life Sciences community will rely on the air and water quality control and, to date, has established no further demands on station toxicology. The effects on plants and animals (in addition to man) of both a contaminated and a sterile atmosphere should be studied. The group remains concerned about the possibility that a toxic spill or other mishap in one module could not be isolated and might spread to all pressurized modules.

CENTRIFUGE STATUS

The centrifuge is currently being considered for location in Node 3 adjacent to the U.S. Laboratory and will be of the largest diameter possible for that location. The animal holding facilities will be in the laboratory.

STATEMENT: The SSSAAS Life Sciences Splinter Group is gratified by the action for relocation of the centrifuge and continues to encourage development of a centrifuge of the largest possible diameter in the Node.

BIOTECHNOLOGY/POLICY

Responsibility for biotechnology presently resides with Microgravity Science and Applications Division of OSSA NASA Headquarters. NASA OSSA should consider a review of its policy toward management of biotechnology efforts in NASA and this should include the location and affiliation of the applicable expertise.

STATEMENT: The SSSAAS Life Sciences Splinter Group believes the biotechnology efforts should be reviewed by OSSA NASA Headquarters to determine appropriate management policy.

SSSAAS LIFE SCIENCE SPLINTER GROUP

WEDNESDAY SESSION
JUNE 28, 1989

SESSION CHAIRMAN: Dr. A. Krikorian

ON-BOARD ANALYSIS/SAMPLE CHARACTERIZATION AUTOMATION, EXPERT SYSTEMS, AND ARTIFICIAL INTELLIGENCE RAPID SAMPLE RETURN

Sample analysis necessitates an evaluation of the requirement for on-board characterization and this in turn implicates crew availability. On-board characterization allows the most rapid data reduction and enables reconfiguration of experiments in real-time. While the crew should be experienced, well educated, and trained, for the optimization of science return, the evaluation and interpretation of unexpected results is ideally done by the principle investigator using the most sophisticated analytical equipment in ground-based laboratories. Beyond the question of skills is the question of crew availability. Crew time may not be available for on-orbit analysis. For example, the ESA biotechnology facility requires five hours per day when operational and up to nine additional hours to maintain analytical equipment. Analytical equipment takes up volume and resources on the station, is often labor-intensive, and generally requires extensive, experienced maintenance. The costs for rapid sample return should be weighed against costs of flight qualified analytic equipment, crew time, training, and other resources. Sample preservation and storage techniques, late and early access to specimens, automation and telescience are all closely related issues. An ESA study of rapid sample return reviewed is now two years old and written to requirements which have since changed. The Joint Science Utilization Study recommends that an in-depth study be done on rapid sample return as a complement to on-board analysis, especially to determine the optimum combination of the options. LifeSat technology may be applicable.

STATEMENT: Current conditions are less than satisfactory because of crew time limits. Analytical equipment and phasing are not certain. Delays associated with the planned 90-day return interval, in the absence of suitable on-board analysis, are not consistent with efficient interactive science. The SSSAAS Life Sciences Splinter Group recommends a thorough, multi-case cost-benefit analysis be done including reliable on-board analytical equipment and rapid sample return.

LAB SUPPORT EQUIPMENT/PHASING

Lab Support Equipment (LSE) requirements, both general and detailed, require refinement. Requested new items have not been accepted. No firm rules or priorities have been established to make decisions. The complete complement of diagnostic equipment for Life Sciences is contained in several lists; Space Biology Initiative, Extended Duration Crew Operations, Health Maintenance Facility, the Life Sciences user facilities, the centrifuge suite, and the list of station-provided LSE. (Life Sciences plans to review and refine this complete complement whether provided by the station program or by Life Sciences.) Questions remain about availability of crew time or skills to operate to full range of available equipment.

The science disciplines have the responsibility to review their requirements, and provide guidance for phasing information. The "phases" of space station, though, do not significantly spread over time the requirements for Lab Support Equipment. Other groups of researchers aboard the station may be able to use the same equipment, e.g., that for toxic materials identification. Multiple copies of equipment will be needed for training. Off-the-shelf equipment might be used to reduce costs and facilitate updating to avoid obsolescence. No recent user scientist review of the facilities or equipment, or of the detailed specifications has been conducted.

No well-defined process or means of communicating detailed needs from the scientist to the contractors exists. A Requirements Integration Group (RIG) is being established by OSSA and the Marshall Space Flight Center Work Package office to facilitate the user-to-contractor flow of information. Significant changes will go through OSSA change control process. Contractors need to have more in-house scientists to aid the design process. Equipment already developed and flight qualified by other parts of NASA should be considered.

STATEMENT: Once a complete list of all analytical and characterization equipment is available, the appropriate user panels should examine it and advise on a process for phasing. Limitations of resources such as crew time and training opportunities should be realistically considered. The group recommends a clear-cut vehicle be devised to enhance the capability for investigator interaction with contractors in a timely fashion. Contractors should be encouraged to look into off-the-shelf options, at least as a point of departure for further development.

MODEL EXPERIMENT SCENARIOS

The sample model scenarios were selected to disclose stresses on the systems and to identify potential weak points in facilities, power, volume, communication, crew resources, operations planning, etc. Further, the scenarios show what model experiments are like and test the facilities. Not all issues emerge, such as crew patterns, and experiment interactions. While not selected for review, experiments involving cell cultures were seen as offering additional examples of experiments that could stress the systems. Accommodations and operations analyses are being done under the Multilateral Utilization Study sponsored by the Space Station Program Office.

STATEMENT: Model scenarios selected for Life Sciences by Ames Research Center and Johnson Space Center should continue to be refined and evaluated from the perspective of disclosing needs. (Add one to include cell cultures with real-time examination, to stress the communication requirements with video microscopy.)

LOGISTICS SUPPLY

The latest change request concerning late and early access to the shuttle for space station flights includes international requirements and provides scientific and humane justifications. It does not consider rapid sample return. A pressurized logistics module is required and has been formally requested. Resupply statistics should be carefully considered. Unmanned resupply is not presently contemplated.

STATEMENT: The SSSAAS Life Sciences Splinter Group supports the change requests submitted and recommends that unmanned resupply of the station be considered as a later eventuality.

SSSAAS LIFE SCIENCE SPLINTER GROUP

THURSDAY SESSION
JUNE 29, 1989

SESSION CHAIRMAN: Dr. M. Cleave

CREW TIME/SKILLS, TELESCIENCE TRADES

For science to be optimized, the users should have more input to the crew selection and assignment processes. Increment operational emphasis (with little equipment change from increment to increment) will probably be implemented. In some cases, the best experimenter is one who can follow specific directions (recipe) and not introduce irregularities through the applications of imagination. Further, unbiased observations are often more objective than those by an experimenter with more experience. It does not require special skills to be the subject of an experiment, but crew needs to know they will be subjects and what is being done with bodily fluid samples they provide.

Telescience will fill gaps in training or skills. Different levels and types are possible from voice coaching to joy-stick control from the ground. Video uplink will exist; full video is preferred. Rather than a choice of one method over another, telescience, automation, robotics, and so on can be used as drivers for development on several fronts. May start with precursor missions on Spacelab and shuttle.

Crew with different skill levels and types may be needed at different times; i.e., technicians for early assembly phase, and specialists later to run experiments. The need for two types of people is foreseen: those with manual and observational skills, and those with scientific interpretation and judgment skills. Technical solutions to do training or refresher training on-orbit include electronic textbooks, "PI in a Box," video discs, and more.

The means for astronauts to increase and maintain specialized proficiency needs to be devised.

STATEMENT: The SSSAAS Life Sciences Splinter Group recommends more involvement in the crew selection and assignment processes for Space Station Freedom. The crew should be informed when they are expected to be the subjects of experiments and they should know the disposition of samples they provide. Telescience is essential and should be implemented as soon as possible on precursor flights.

PRECURSOR SCIENCE AND OPERATIONS ACTIVITIES

Life Sciences expects to be able to run few experiments over a long period of time. Spacelab is being used as a precursor to the space station, and synergy with other disciplines or countries has created mixed missions to accomplish more. The space station will provide longer duration for experiments, but the high intensity of Spacelab-type missions may be lost. The engineering differences between Spacelab and the space station can be handled. Systems should not be flown for the first time on the space station. The life support system planned for space station, for example, includes phase-change processes which have not been flight tested. The space station information system architecture is another prime candidate that should be tested on Spacelab. Those endeavors on the ground that may lead to flight must be better funded before they are selected and their results incorporated into the flight knowledge base.

STATEMENT: The Life Sciences Splinter Group continues to endorse viable Spacelab testing programs that lead to Space Station Freedom, and expect such missions to continue into the space station era. The group recommends better connections be established between ground-based activities and flight-selected activities.

DISTRIBUTION OF FUNCTIONAL USER CAPABILITIES
DISCIPLINE OPERATIONS CENTERS

The ideal situation for science users of the space station would be completely decentralized operations centers with electronic linkage direct to the space station. Precursor missions could be used to test the concepts starting with non-hazardous operations and just data communications.

The ESA expresses the fear that bureaucratic practices and requirements may interfere with the conduct of optimum science on the space station and the publishing of results.

STATEMENT: The Life Sciences Group expressed concern about excessive administration hampering the accomplishment of science. The recommend completely decentralized operations.* They recommend the use of Spacelab precursor missions to test the concepts. They prefer discipline-oriented operations centers rather than national.

* consistent with resource management, safety, and non-interference.

SMALL AND RAPID RESPONSE PAYLOADS IN THE PRESSURIZED VOLUME

Small and Rapid Response (SARR) payloads can be incorporated into the pressurized volume on the space station (by definition). The station Program Requirements Document enables SARR for the

pressurized laboratory. The concept has not been investigated to any depth as yet. The present anticipated users of the volume and other resources do not want to give up portions of their allocations for SARR. The Consolidated Operations and Utilization Planning (COUP) process should take SARR into account.

STATEMENT: The SSSAAS Life Sciences Splinter Group believes the space station program office and user organizations should promote Small and Rapid Response payloads.

ASSUMPTIONS AND MODEL FOR INITIAL CAPABILITY
OPTIONS/CRITERIA FOR CAPABILITY EVOLUTION

STATEMENT: The Group points out that a significant amount of science can be carried out prior to space station Permanently Manned Capability (PMC).