

Space Station Advisory Committee
September 20, 1988
Holiday Inn Capital, Washington, D. C.

Members Present:

Laurence Adams	Jack Kerrebrock
Donald A. Beattie	Franklin Lemkey
William Brinkman	John McElroy
Radford Byerly	John McLucas
Edward Crawley	Robert Moser
L.R. Greenwood	Stanley Weiss
Donald Hearth	Peter Wilkniss
Benjamin Huberman	

Members Absent:

A. Thomas Young

At 8:40 a.m. Chairman Adams opened the meeting with a discussion of schedule and administrative items. Agenda items are intended to be timely, but Committee members should consider offering ideas for space policy to the next administration. Executive Secretary Raney reminded members to complete conflict of interest disclosure forms so as to ensure the legal position of the committee. December, March and June are possible months for future meetings.

Associate Administrator James B. Odom, Office of Space Station, complimented committee members as a valuable resource to the program and for their service as a sounding board. Mr. Odom began by reviewing the national goals governing the Space Station Freedom program. Alluding to the President's 1984 State of the Union address, he underscored "peaceful" and "economic" and "scientific gain" as dominant characteristics of the permanently manned space station. Any one activity alone, such as scientific experimentation, is insufficient to justify the program. We are seeing the beginning of world-wide interest in the space station; Italy, for example, wants NASA to consider a long-duration logistics facility and sees high-tech R&D as an investment in the future. Dr. Byerly and Mr. Huberman suggested "exploration" and "flexibility" as more evocative than "evolutionary" as program configuration requirements.

Dr. Robert Moser inquired about the role of manned presence in Dr. Sally Ride's report; Mr. Odom replied that manned spaceflight adds lustre and engenders enthusiasm for the space program, quoting recent supportive statements by Carl Sagan. Mr. Hearth questioned the present configuration because it does not provide variable gravity for human research. Mr. Odom pointed to the plans for the Extended Duration Crew Operations (EDCO) program and added that EDCO can be pursued later as funding becomes available. He noted, however, that a compelling requirement for variable gravity would necessitate an additional station.

Mr. Odom then gave an update on budget: \$967 million requested for FY89 and \$900 million granted, a firm endorsement. Efforts are under way to seek a three-year funding commitment. Of the \$900 million, \$385M is available before May 15, 1989, and the balance, during the rest of the fiscal year. The FTS program was strengthened by \$26 million transferred from the development account. Phase C/D

awards are to be let in April for FTS, but changing requirements may bring cost problems. Dr. McElroy observed that the FTS has a launch date and a budget but no objectives.

Mr. Odom gave an update on the Associate Contractor Agreements (ACA) to simplify program integration and reduce engineering risk. Directives were sent to contractors in July and negotiations for the contract modifications are set for November and December. The expected changes in time and cost are in the 1 to 2 percent range; the concept has been well received. Mr. Hearth voiced his concern that the ACA is a different mode of management for NASA, and may have an adverse affect on Centers. Mr. Odom suggested that such problems are manageable and that the ACA is necessary because of the complexity of integration.

The state of the Civil Service workforce was deemed critical by Mr. Odom. We are "dreadfully short" at Level II in Reston in the systems engineering and integration area. We must have adequate staffing for the management structure that is needed to deal successfully with the interfaces and complexity. Only 167 employees are on board at Level II out of a total authorized 378. A combination of shortages in authorized billets for hiring, funding in the salary accounts, and available skills led to understaffing at Reston. The staff is currently overworked and in danger of burning out. There has been public criticism of the amount the program has been devoting to management, but management/integration costs drop from 24.2% in FY88 to 11.3% in FY89, while hardware/software development costs rise from 59.4% in FY88 to 74.8% in FY89. Two more substantial contracts are outstanding: the Test Control and Monitor System (TCMS) at KSC and the Flight Telerobotic Servicer (FTS). His presentation ended at 10:50 a.m. with discussion of commercial initiatives. Dr. Wilkniss asked about international competition/cooperation; Mr. Odom said if we don't do a space station, other nations will.

Mr. Robert C. Rhome reported on space science and applications aboard Space Station Freedom, alluding to the March 1988 publication, Science and Applications on the Space Station. He pointed to impacts of the FY89 budget decisions on development of a 1.8m centrifuge and on starting the Extended Duration Crew Operations (EDCO) program, as well as the Space Biology Initiatives (SBI), all due to a \$25 million cut in life sciences. Dr. Robert Moser suggested that the cut indicates a mindset that, if unchanged, would render a voyage of 14-month duration in space a critical risk. This is "not a good way to do science." Dr. Weiss asked that the Office of Exploration and the life sciences people report at a subsequent meeting or to his panel. Budget reductions have cut back definition and contamination studies on payloads, plus on-orbit servicing, payload categorization and standards for pressurized volume studies, operation planning and scheduling, and science utilization management at field centers. Activities and studies deferred from the FY89 plan include polar platform servicing, payload support, expert system/strategic planning for science utilization and ground processing support for simulations. However, Mr. Rhome indicated that sufficient flexibility exists to permit shifting priorities. He outlined the August 1988 baseline Spacelab manifest and flight projection to September 1995.

Fred Povinelli, Director for Space in the Office of Aeronautics and Space Technology (OAST), reported a slight upturn in FY89 funding for OAST after a two-decade decline. The Civil Space Technology Initiative (CSTI) focuses on operations, science, propulsion, robotics, and technology for use in low Earth orbit. The new Pathfinder project for solar system exploration combines life sciences and mission studies for transportation, operations, exploration, transfer vehicles, and humans-in-space

studies. Dr. Greenwood suggested that OAST is "missing the boat" on beneficial interactions with private corporations and the DoD that the IR&D program could provide. Under the University Space Engineering Research Program, now involving nine colleges, NASA is expected to engender more academic support for civil space programs and recruit more college graduates in engineering. This will stimulate greater industrial and academic involvement with in-space experimentation. Of 231 proposals submitted, 41 were selected in the Out-Reach Program, and 7 of 58 proposals from the In-Reach Program at NASA Centers, including a thermal energy storage technology project for solar dynamics.

Dan Herman, Senior Engineer for the Office of Space Station, reported on special studies, including Extravehicular Mobility Unit (EMU) commonality, on-orbit servicing, ELVs in space station logistics operations and frequency allocations for communications among the elements of the cluster. Recommendations on EMU commonality will be submitted to the Associate Administrator in late October. Expendable launch vehicles for the space station will require assistance from the Orbital Maneuvering Vehicle. A report is planned for December. Cluster frequency allocation depends upon Ka/Ku studies in interference and risk. A recent workshop at GSFC has examined Ku baseline and Ka strawman scenarios. The determining factor in on-orbit servicing is geometry: aboard the station, aboard the Shuttle, in low Earth orbit in situ aboard the OMV, and in geosynchronous orbit in situ aboard an STV for polar platforms. A draft RFP is ready for the Flight Telerobotic Servicer (FTS), with selection of a proposal set for April. Dr. Martin added that perhaps platforms should be made easily serviceable whether or not they will ever be serviced on orbit. Solar Max stands as a lesson learned. Mr. Herman concluded by describing a new On-Orbit Servicing Steering Committee created to formulate NASA-wide policy and strategy in this area.

The morning session ended at 1:00 P. M.

At 2:00 p.m. Margaret Finarelli, Director of the Policy Division, Office of Space Station, began the afternoon session with a report on international participation: agreements, obligations, management and implementation. Space Station Freedom includes participation by Canada, Japan, and nine of the nations contributing to the European Space Agency (ESA). All together, these nations will contribute about \$7 billion to the development phase. Specifically the ESA will contribute a pressurized laboratory, a polar platform and a Man-Tended Free Flyer, tended about twice a year, all totaling \$4.2 billion. The Japanese Experiment Module (JEM) with exposed facility, manipulator, and logistics capability, is valued at \$2 billion, and Canada's mobile servicing system at \$1 billion. Mr. Hearth indicated that the U.S. is dependent upon Canada for assembly and maintenance, but dependent upon Japan and ESA only for increments in total capability. Signatures for Phase C/D/E (detailed design, development, operation, and utilization) agreements are scheduled for September 29, 1988, for IGAs and MOUs. Management structure is multilateral in the operations era, but each partner is technically, financially and managerially responsible for its own development program. NASA retains authority to make the decisions on safety issues. Dr. Weiss asked for comparison with Spacelab; Dr. Martin replied that agreement on utilization and operations is new; Gene Rice added that NASA does not intrude on partner responsibilities unless there is an impasse in station operations or utilization. A joint PDRD is to be signed by the end of the year. Current utilization allocations for station resources are: U. S. 71.4%, Canada 3%, ESA 12.8% and Japan 12.8%, reflecting their contributions. These allocations can be adjusted for specified periods by barter or trade among the partners. Partners will pay the going rate for

Shuttle and TDRSS support, over the 30-year life of the station. Common system operations cost is predicted at \$350 million per year, to be shared proportionally by all partners.

Dr. Franklin Lemkey reported on the Space Station Science and Applications Advisory Subcommittee (SSSAAS) Workshop in Hyannis, MA, June 20-24, 1988. Expected output from the workshop will include statements on the station environment, a large centrifuge on orbit, TDRSS limitations, a QIB assessment, OSSA accommodation studies and implications of station stretch-out. A pressurized-volume group concluded that there is no fundamental incompatibility between work on materials and work on life sciences. An attached-payloads group urged OSSA to study trade-offs between reliability and servicing. A life sciences panel developed several specific suggestions for OSS and OSSA, including measurement of disturbances and their impact on the microgravity environment. Dr. Crawley suggested that existing requirements are confusing and need revision. An astronomy, astrophysics and solar-terrestrial physics panel was relatively favorable towards the space station. Dr. Martin added that this is the best and only near-term opportunity for astronomers. The Earth sciences panel identified several uses of the station for earth observation, especially involving tropical regions and reforestation. An information systems panel urged testbedding and simple user interfaces, as well as data security and protection against loss of TDRSS. The SSSAAS issued their statement on life and material sciences compatibility. There will also be panel reports on the need for commonality and standards. The next meeting on October 13-14 at Clearlake, TX, will focus on crew issues.

Dr. Crawley recommended that the June 1988 SSAC meeting be tied to the SSSAAS meeting in Woods Hole. Chairman Adams will take it under advisement.

Dr. Crawley reported on activity of the Panel 3 (Brinkman, Lemkey, and Moser) on Requirements. Objectives are to examine treatment of requirements at all three levels of program management and include seeking a clear rationale and objectives for the space station; to examine whether the station will be equipped physically to meet those objectives; and to see if the manifesting and integration process assures easy access by users. Necessary participants include OSS, SSPO, OSSA, OAST, OCP, OSF, and OSE, plus "real users," in industry and universities. The suggested approach is to address rationales and facilities this autumn, and the operations process next spring. Chairman Adams and Dr. Martin both expressed some skepticism about changing the opinions of manned spaceflight critics. Specific questions to report back on in the spring include maximum user benefits from the station, conflicting requirements, and user accommodation. Chairman Adams suggested that SSAC need not try to justify the station but rather should advise NASA on procedures. Dr. Kerrebrock suggested that the space station is not a "thing" but an institution, with fluid requirements, and evolutionary. Dr. Crawley offered to omit "rationale" inquiry and focus on user requirements with a report in six months. Chairman Adams added emphasis on whether requirements are excessive and/or flexible.

Dr. McElroy reported on his review of communications. He said the most precious commodities are crew time and experiment run time, so communications and a rich computation environment are essential. Not patently clear, however, is any need to make measurement results available to all crew members, whose intervention remains uncertain. Space station communications needs leadership from the Administrator, with input from Office of Space Operations (Code T) and Office of Space Station (Code S) for clear, strong policy. Communication contingencies should

include emergency scenarios, sensitive to international partner concerns. And an end-to-end perspective is needed for communications, covering, for example, telescience, perishable data and downlinks. Dr. Martin indicated that many of these concerns have been addressed and policies set. Dr. McElroy expressed concern over single-access data flow for station and platform forms; TDRSS, for example, can communicate only with White Sands; he also expressed concern about 300 megabit capacity, or requirements for high resolution TV. Dr. Martin volunteered to forward those concerns to Operations and Utilization for answers.

Dr. Martin thanked the members for their attention and enthusiasm. Chairman Adams adjourned the first day of discussion at 5:40 p.m.

Dr. Stanley Weiss started the agenda on September 21 with a report on preparations for the activities of Panel 1 (Byerly, Crawley, Greenwood, Kerrebrock, and Moser), charged with examining the balance between long-term and short-term program activities. He has circulated a memorandum to the members suggesting issues that should be examined, while noting that some of them will require completion of the PRR process and an authoritative statement of what is the mission of the Station. Proper analysis will identify the design drivers created by the baseline mission and by envisioned future missions; and it will rate the current design on how it has accommodated those drivers. The program should have plans to change the configuration to correct current deficiencies and to move toward supporting future missions. There should be plans to insert newly developed technologies for the correction of current deficiencies and for station evolution.

Donald Hearsh pointed out that terrestrial laboratories often evolve beyond the vision of their founders in both mission and the employment of new technology. Flexibility is necessary to avoid precluding desired changes. Current design drivers appear to be the need for power for the laboratory activities and the need to fit within the Shuttle launch parameters. In response to a question about the range of possible future missions being considered by NASA, it was explained that a group at Langley Research Center is looking at both future technology and future missions, while the focus of studies of possible planetary expeditions is in the new Office of Exploration, (Code Z), headed by John Aaron. Dr. Weiss plans to review what hooks and scars preserving various lines of evolution have been accommodated in the design and at what cost. It was noted that there will be an advisory group for the Code Z under the aegis of the NAC and close coordination should be arranged.

Mr. Hearsh next reported on the work of Panel 7 (Hearsh, Beattie, Greenwood, Weiss, and Young), charged with reviewing the program Systems Engineering and Integration, Test, and Verification plans and activities. After some preliminary activity and study of documents supplied, the group held fact-finding sessions in Reston on August 22-23, 1988. Some observations are ready for reporting at this meeting. Others will take more study. The following points were offered:

The plans put together for SE&I and T&V work are consistent with NASA experience in major developments.

The Panel was impressed by the necessary complexity of the program, which still shows a large amount of work on distributed systems and calls for intercenter deliveries of equipment at specific times.

Given this complexity, it is now apparent that the Level II SE&I organization has far more responsibility and more numerous line management functions than the Panel had appreciated.

It is critical that there be and continue to be a clear understanding among all the participating organizations of what functions have been assigned to which Centers.

The Panel believes that the size of the Level II Civil Service staff and the size of the Program Support Contractor's staff have been too tightly constrained, with consequent overwork and fatigue among the dedicated people trying to do the job. The staffs must handle a large amount of program rescoping work and what-if studies required with a very short time horizon.

Discussion of these observations brought forth the fact that senior managers of the program agree that meager staffing at Level II is a problem, although the necessary work has been done with no major slips. The complexity of the program is unavoidable, but detailed delineation of delegation and responsibilities is reasonably in hand. In principle, the work could be regrouped among the Centers to make the interactions simpler, but at the cost of substantial increase in required funding. It is clear that arranging for proper coordination of the schedules of the several work packages will require constant attention. It was agreed that at the next meeting of the SSAC in December 1988 there will be extensive discussion of the Associate Contractor Arrangement that has been set up among the prime work package contractors and further discussion of the relationship of the NASA work package Centers with those contractors. Other future activities of Panel 7 involve a return visit to Level II before the spring meeting of the SSAC. In the summer of 1989, the Panel plans to spend as much as 10 days reviewing the state of design work. The Panel will desire careful review of the SE&I situation at the time of Preliminary Design Review in June of 1990.

Dr. Crawley and his Panel 3 members will start a review of the accommodation and performance requirements obtained from potential users and how those inputs are reflected in the hierarchy of Program documentation. In particular, Panel 3 will concentrate on the requirements which will be satisfied by the first phase of the station.

Dr. Weiss and the Panel 1 members will finish laying out their plan of action, and Dr. McElroy asked for a detailed description of how end-to-end data traffic will be handled, including contingency plans.

The SSAC agreed that the agenda for the next meeting would include a discussion of the Associate Contractor Arrangement, a report on the studies of an Assured Crew Return Capability, and a thorough report on plans for the use of the Polar Orbiting Platform, including methods of servicing. Other topics considered at the May meeting of the Committee were deferred until later meetings. The group agreed to meet next in the Washington area on December 13-14, 1988.

The meeting was adjourned at 12:30 p.m.

William P. Raney
Executive Secretary

Laurence J. Adams
Chairman