

## MEMORANDUM

Lyndon B. Johnson Space Center



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SUBJ: Urine Measuring System

The JSC Life Sciences UMS is scheduled for its first inflight test on SL-3 which includes: use and volume measurement on all subjects throughout the mission, samples from four crewmen, and samples and calibrations by MS-3. There are several significant, assured and potential impacts on any crew using this device and especially SL-3. These include: time, a significant probability of malfunction, noise and other interference with mid-deck operation and impact on the WCS operations. The last item will not be addressed here.

Previous Experience: The WCS and UMS have a common origin, project engineer, manufacturer, etc., and both were operationally tested on SMD III, a simulation of a L.S. Spacelab mission. Both failed completely and our criticisms were ignored. The UMS was intermittent in operation and leaked incessantly around the sample tubes and then failed entirely.

Current Status: Since that time, dozens of modifications have been made, but in spite of years of work, neither of two "flight" units is complete. Both are being demonstrated but supported by a variety of mechanical and operational workarounds which include multiple switch throws and other procedures that will "be fixed" by a yet to be written software program. Some features such as the continuing spurts and leaks of water from the sample mechanism obviously will not be fixed that way. The redesigned device has never been tested with urine. The only test that approximates operational use is a planned "durability test" in which the total operational time is less than 1/2 of our nominal mission time using twice the subjects.

Nominal Flight Operations: The device required the stop watch times shown in table 1 for me to operate it in 1-g. With increased experience, which will require several days to attain, this may be reduced, but by seconds. This obviously imposes a significant time impact. If several people need to use the device in a short period, as often happens, other problems will arise. The one to two minutes of screaming noise by the WCS for current urinations will now be extended several fold.

Planned Fixes: (1) A new software program is to be completed in 2 weeks. (2) The engineers' answer to the SLS-1 crew complaints about time impacts was to show by calculation the times quoted by the crew were wrong. Unfortunately, the engineers allowed no time in their calculations for switch



operations, obtaining sample containers and other maneuvers essential to operation. (3) There is a proposal to add an automatic timer to the WCS such that the crew does not have to stand and wait 2-4 minutes. (4) A "Y" valve to allow bypass of the UMS during contingencies is proposed.

Concerns - Nominal Operations: The time impact will in fact be significant, even with the WCS timer in place. The timer will not help in the event of several people wanting to use the WCS nor will it reduce the noise time for the WCS, a real concern for a sleeping crew. A recommendation of the SL-1 crew was that every attempt be made to reduce mid-deck noise for two-shift operations. Addition of the "Y" valve to allow direct use of the WCS is desirable.

An inadequately considered issue is absence of a bacterial filter from the UMS to water connection. This results in potential contamination of the galley auxillary water port.

Concerns - Realistic: The device has had a long and unsuccessful history, and the missed dates and continuing problems of the past 6 months do nothing to add confidence; e.g., rewriting and debugging a software program in 2 weeks must be seen to be believed. The unit has never been successfully demonstrated with urine, and some of us remember an identical situation in the Skylab UMS. Water is not urine.

The proposed durability test gives little reason for confidence for the following reasons. A single test of 80 hours meets no criteria and certainly no statistical criteria for life tests that I know. Realistic testing requires usage longer than planned operations. The conditions for the test are not realistic. Fourteen subjects will use the device, but this is not equivalent to 7 people, 24 hours a day for there will be 8 hours of increased flow and 16 of drying without power or pressures on. Precipitation and incrustation will not be the same. The unit will not be mated to the WCS but have its own constant air flow and other stand-alone supports.

I am very concerned about the leaking sample apparatus on orbit but even more concerned about the attitude often expressed--"So what if it doesn't work." Devices that have repeatedly failed in 1-g seldom do better in flight. Large amounts of money and effort are being spent on this device, and why shouldn't it be realistically demonstrated in 1-g first? Everything else is. Further, based on extensive experience, it will not be "so what" but "they must be doing something wrong" and after long pages of how to do it right and air/ground hassles, there will be longer pages of how to fix it, and when it won't work even then, the crewmen will collect some considerable blame, e.g., as with the WCS.

Another problem is that procedures are not ready nor can they realistically be until it is used in its real configuration. It should also be set up in the 1-g trainer to see if all the planned operations are mechanically possible, by the crew.

In summary, we are a few months before shipping a unit which is an integral part of operations which is known to have heavy operational impact at best

but which has never been demonstrated to work and which is still being rebuilt with one abbreviated test prior to flight planned.

Recommendations: A more realistic urine measuring/collecting system should be sought. If this test must be continued with the present device, (1) set some realistic dates, (2) design some realistic tests and use them, (3) develop procedures when we know what must be done, (4) work with the people who must use it, and (5) if it is obvious that these cannot be accomplished prior to SL-3, delay it.

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