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MEMORANDUM

Lyndon B. Johnson Space Center — NASA

REFER TO:	DATE	INITIATOR	ENCL
CB	November 15, 1976	CB/WEThornton:ss:11/15/76:2421	

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SUBJ: Progress Note on SMD III

This is not intended to be a serialized crew report. However, some of you are making inputs to both procedures and preliminary design reviews and other inputs on various systems including the Spacelab. Since this is a very typical mixed-life sciences payload, many of the problems that we are encountering are directly relevant to these functions and in some cases the problems are also applicable to the physical science loads as well.

Crew Selection and Training. Formal scheduled training has been underway now for two weeks, and we had a most productive session at NASA Ames which was also revealing of many potential problems. Unfortunately, the JSC investigators were unable to meet their training requirements this week. This re-emphasizes the need for fixed realistic dates with a firm cutoff for training and hardware for it will not be possible to slip everything until just prior to launch time on a simulation or a mission of this complexity. Again, someone must institute cutoff dates and be willing to enforce these dates unless a major slip is planned. There are still several loose ends having to do with the backup crew and its training, but this problem is being worked out. Our concept of training has convinced us it is still correct for each crew must train as a team.

Inflight Experiment Monitoring. Data management effectively removed all onboard monitoring except for an oscilloscope. It is quite simply impossible to perform several of the experiments without some form or equivalent of a medium-speed DC to 10-20 Hz recorder with three to four channels and paper speeds up to 25 millimeters per second. For life sciences purposes there are three classes of recorders which are needed in many of the experiments. The first is a multi-channel DC scope with variable, including infinite, persistence. The previously mentioned direct writing recorder is also required and some form of long term trend presentation, i.e., some method of displaying several parameters for time periods of hours to days. A data terminal and dedicated microprocessor or minicomputer could do the latter job adequately. It would be desirable to have hard copy of the trends. A good deal of work still remains to be done on how much data is transmitted to ground, but it was gratifying to note that not one of the principal investigators that we have encountered to date expects or wants us to work as remotely controlled robots.

State of Equipment Development. While some method must be found to overcome the previous expense and difficulty and delay of "space qualified' instrumentation and all that that entailed, the other extreme must not be resorted to. Several investigators have typical electronic setups gathered and put in operation by life scientists which is the electronic equivalent of a kitten and ball of yarn. This is not the fault of the investigator but usually the total lack of adequate engineering support. Two of the experiments that we encountered were nightmares in this regard in that they used off-the-shelf elaborate multi-function equipment to perform a single function, e.g., a single 1-kilohertz 1-volt calibrate signal was being supplied by a 19-inch rack full of audio oscillator with 10 knobs all to be set or checked and there were 12 or 15 similar pieces of equipment in the setup which were attached by a maze of pluggable wires and other apparatus. With the proper approach the entire apparatus could have been put in a large shoe box for twenty thousand dollars by a competent, honest engineering concern. It seems to me that NASA should make sure that the apparatus is not just any general-purpose off-the-shelf apparatus, but is specifically intended for the purpose. In addition, checklists should not be prepared which cover every knob on a piece of general-purpose apparatus to be performed everytime the apparatus is calibrated. The knobs should be fixed.

Fidelity of Apparatus for Weightless Operation. Some experiments were properly removed because the investigator had made no preparation for weightless operation and in some cases did not even appreciate the impact of weightless operations. However, once we were into training, it became obvious that many other investigators were in exactly the same position. Further, time and cost are being cited as elements which preclude weightless simulation, e.g., the animal cages by and large are some sort of misbegotten mix of aerospace engineer's first approach at weightless operation and conventional lab cages with the result that our zoo-keeping tasks are going to be more onerous than would have been required by ordinary cages. Whether they will ever reach weightless operation, as the aerospace companies assure the buyers will happen at some future time, remains to be seen. Several typical classes of weightless operations recur again and again, one of the more common being liquid handling including the transfer and separation and storage of blood. Mass measurement is another frequent item. Another frequently encountered example is decapitation and exsanguination of rats. The guillotine very effectively and energetically lops off the bleeding head while the remaining corpus spurts blood in varying directions and amounts and for surprising distances until it is stuffed into a funnel which then drains the blood into a test tube by gravity. It is my strong recommendation, to insure that this essential aspect of operations be adequately identified and to insure that corrections are made, that we institute a series of single-page deviations which are incompatible with weightless operation which in order to be part of the simulation must then be recorded and waivered. This should not turn into an elaborate documentation but should be a simple sheet in which the discrepancy was listed, the proposed fix is listed, and with the waiver then being granted. In all fairness, if experiments have essential

operations which can never meet weightless criteria they should be dropped. The same should be done for power and other constraints.

Procedures. It is the crew's recommendation after the week's experience that many of the procedures be simplified to a cue card, e.g., draw blood on the monkey with directions for processing and storing the blood only. There can be no justification for the expense and complication of generating several pages which could be done on this procedure. Conversely, a number of the poorly integrated experiments need rather detailed procedures. This is supposed to be in work by a man skilled in the art at Ames.

Waste Management. This is going to present the usual problems both from personal hygiene system and particularly with dozens of animal bodies and parts of bodies. No thought at all has apparently been given to the entire problem of animal waste management. This, of course, is intolerable either for SMD III and especially a flight. The word from the waste management people is that the systems would not be available for working with until one month prior to flight. I retain my concern, previously expressed, that this test may be used as a substitute for proper engineering tests by waste management people.

I see no major problems unless support personnel begin to slip, as they did this week's training. This is turning out to be an excellent test bed of many policies, procedures, and apparatus for future missions.