CE5b

REVISED SKYLAB MEDICAL EXPERIMENTS FOR POWERED DOWN MISSION

Several meetings have been held with the Principal Investigator team and other elements of the Johnson Space Center to evaluate the Skylab medical experiments and to establish the minimum protocols required to obtain data required for a commit to a 56-day mission. Initially, 4 mission options were considered. Subsequent management meetings established a baseline for a 5-day CSM only mission, this allows the medical team to consider then only two options. These options may be summarized as follows:

Option I would cover a degraded mission where thermal or other constraints would preclude full time habititation of the OWS. In this mode of operation, the crew would be permitted to enter the workshop and perform medical and other experiments for periods of roughly 6-8 hours on a daily basis. In this mode of operation the crew would sleep in the CM and would use the OWS waste management system.

Option II has been defined as a modified normal flight plan with reductions in equipment operating time, frequency of experiment protocols or other changes which would result in the reduction of electrical power requirements to complete the medical experiments. This reduced experiment plan, if conducted for a sufficient length of time will provide data which could be used as a basis for the extension of the flight duration of the next mission. The definition of this minimum time is not possible at this time since at best it would only be a guess. ~~The basis for the quality of the data and~~ the capability to make projections for long duration flights must be based on real time evaluation of the data and the crew health status post flight. The medical team feels that if the planned data acquisition (in Option II) and evaluation procedures proceed in an orderly fashion that these limited protocols will be adequate to support the program.

Richard S. Johnston
May 17, 1973

SKYLAB CARDIOVASCULAR EVALUATIONS 5/16/73
FOR
CONTINGENCY MISSIONS

BACKGROUND AND JUSTIFICATION

Sufficient inflight data to establish the magnitude and time course of cardiovascular alterations effecting orthostatic tolerance decrements observed in postflight tests, have been considered essential for committing man to longer duration (i.e., 56 days) missions. Only Option IV provides these data.

All other options calling for compromise procedures, altered protocols and tests frequencies, curtailed mission duration, and inadequate baseline crew data cannot be used as confident substitutes. If the issue be forced, postflight full protocol evaluations by M092/M093 Experiments will offer more reliable data than other limited procedures for commitment to longer missions.

OPTION I

M092 (LBNP) tests will be performed as governed by thermal constraints. The test protocol will not be altered but the Scientist Pilot (Physician) should monitor both other crewmen tests before he himself is tested, if the first tests are as late as 10 days into the mission.

THERMAL CONSTRAINTS

A. Within the specified comfort range (67-78° F. at 1/3 atmosphere) - - no physiologic data problems are anticipated.

B. Between 78° and 90° F., M092 tests will be conducted based on realtime decisions by P.I. (or representative) with knowledge of the subject's previous test data.

C. At temperatures sustained above 90° F., M092 Experiment will not be performed without modifications.

OPTION II

M092 Experiment protocol to be performed according to the following schedule (M171 always follows):

A. As soon as possible after OWS entry with Option I rule governing.

B. As late as possible before return.

C. Remaining tests equally spaced every 3 days.

SKYLAB M171 EVALUATIONS FOR CONTINGENCY MISSIONS

BACKGROUND/JUSTIFICATION

The complexities and the magnitude of the physiological responses to exercise make this type of stress a primary indicator of the status of homeostatic mechanisms. For this reason Skylab Medical Experiment M171 has always been considered a major experiment and one which must provide information before committing man to longer durations in space.

The Apollo program, through pre- and postflight measurements, provided us with some preliminary data which indicated significant alterations in these mechanisms after space flight. It is now essential that we follow the time course of these changes during flight.

EXPERIMENT PROTOCOL

OPTION I

The M171 protocol will be conducted on each crewman at the following intervals:

a. ASAP

b. As close to end of mission as possible

c. Remaining tests will be equally spaced 5 days apart

MA (including ion pump) should be powered down between test periods and powered up 1 hour before use. Ion pump should be left on for 30 minutes after each run to remove H_2O.*

Thermal Constraints

a. Within the specified comfort range (67 - 78° F. at 1/3 atmosphere) -- no physiologic data problems are anticipated.

b. Between 78° and 100° F., M171 tests will be conducted based on real-time decisions by P.I. (or representative) with knowledge of the subject's previous test data.

c. At temperatures sustained above 100° F., the M171 experiment will not be performed without modifications.

OPTION II

The same schedule will be followed as Option I without the thermal constraints. MA will be powered down between tests as stated in Option I.*

* If MA operation is adversely affected by this mode of operation, normal procedures will be requested. Reduced power for M171 could then be obtained by not utilizing the MA for two series of experiments.

M070 OPTIONS

BACKGROUND AND JUSTIFICATION

Metabolic changes have been observed following US and USSR spaceflights. In particular, metabolic balance studies conducted on Gemini VII and Apollo XVII have revealed negative balances of a variety of mineral elements. Disturbances in fluid and electrolyte metabolism accompanied by changes in endocrine homeostasis have been a consistent finding throughout the Apollo program. Inflight data on these changes is extremely limited and cannot yet be used to predict with confidence man's ability to withstand even the shortest periods of orbital exposure. Predictive analysis cannot be made without obtaining kinetic data from a number of crewmen after various periods of time in flight. Such data is greatly enhanced by the establishment of stable baselines prior to flight, and by the conduct of sufficiently long postflight recovery studies.

PLANNED PROTOCOLS

OPTION I

During CSM operations urine samples will be collected in the UCTA and OWS contingency urine collection bags. Boric acid tablets will be added to the urine bags as a preservative for these urine samples. Fecal samples will be collected in CSM fecal bags and will be stowed in the CSM for later drying when the OWS is activated. If the OWS cannot be occupied on a full-time basis, the crew will use the OWS waste management system and perform sample collection procedures.

OPTION II

CSM operations will be performed as defined in Option I above until normal M070 procedures can be established when the crew occupies the OWS.

LAUNCH STOWAGE - Six (6) additional OWS urine collection bags and roll-on cuffs are required. Boric acid tablets, mineral supplements.

RETURN STOWAGE - The sample stowage provisions in the CSM must be retained to accomplish this experiment. (Urine and fecal samples)

ELECTRICAL POWER REDUCTIONS - Fecal sample drying will be accomplished per normal procedures with vacuum only and no electrical heaters.

M070 PREFLIGHT CONTROL

JSC/KSC — 0700 May 17 (or F-3 days) through 0700 May 22

Food and Beverages:

Prime and backup crewmembers will consume their nominal preflight menus. Changes in these menus may be made at crew option by deleting or adding Skylab food items. Wine (Skylab analyzed type) may be consumed in moderation during this period.

Collections:

No metabolic collections will be performed.

Away from JSC/KSC (MSFC, MDAC, etc)

Food and Beverages:

Crew should attempt to maintain as much nutrient control as possible. Preferably, kits consisting of Skylab foods, beverages and wine will be supplied. Alternatively a record of intake should be maintained by each crewmember. Eating in public restaurants is discouraged.

Collections:

No metabolic collections will be performed.

0700 (or F-3 days) May 17 until Launch

Food and Beverages:

Crewmembers should adhere to nominal preflight menus and should not consume alcoholic beverages.

Collections:

Complete metabolic collections will be performed.

Activity:

The crew surgeon should be apprised of the occurrence of any kind of strenuous physical activity, e.g. null gravity simulations.

Change in bowel stabilization

Need rest, hormone volumes.

Special Protocol for Conducting Modified M131 Motion Sensitivity Test in CM/MDA/AM (Options I)

BACKGROUND AND JUSTIFICATION

Past experience has indicated that exposure to weightless space flight does frequently result in motion sickness symptomatology which can affect the crewmen's performance. We have no data to determine whether or not slow, progressive changes may occur in the vestibular system during long duration exposure to 0-g which may render the crewmen susceptible to motion sickness or other vestibular difficulties, either inflight or postflight. The M131 experiment is designed to obtain such information. Even though M131 cannot be conducted if the OWS is inaccessible, every attempt should be made to collect limited data re motion sickness susceptibility by using the following protocol in the CM or AM/MDA.

PROTOCOL

It is highly recommended that the SPT and PLT perform the motion sensitivity portion of the M131 experiment in essentially a zero RMP mode. The procedure would require that the subject crewmen sit in an area of the CM or AM/MDA where he would have sufficient room to execute front, right, back and left head movements as per the M131 procedure. Available hand-holds or a velcro restraining strap across the lap would be required to hold the crewmen in place while executing head movements. The head movement sequence should be as trained for M131, i. e., perform five head movements, pause 20 sec, perform five movements, pause 20 sec, etc. A stop watch should be used to time the sequence. Instruct crewmen to keep eyes closed throughout procedure. During 20 sec. pauses the subject should report symptoms as trained per M131. The observer should watch for symptoms as per M131. The observer should carefully voice record or hand log all symptoms as they occur as well as keep accurate count of the number of head movements. The test should be terminated when the subject reaches the MIIa level of malaise or after 150 head movements.

NOTE: It is very important for this procedure that a list of the motion sickness symptoms and associated point values be provided to the crew for reference.
(A copy of this list is attached)

These procedures should be performed every third or fourth day on the SPT and PLT. Following each run the symptoms and number of head movements performed should be transmitted to ground.

CSM LAUNCE AND RETURN STOWAGE

1. Launch check list which contains MS symptoms and point values.

2. Return data only if it has not been voice recorded/telemetered.

CATEGORY	SYMPTOM	SCORE
Nausea	Epigastric Awareness	1
	Epigastric Discomfort	2
	Nausea I	4
Temperature	Temperature II	1
Cold Sweat	Sweat I	2
	Sweat II	4
Salivation	Salivation I	2
	Salivation II	4
Drowsiness	Drowsiness I	2
	Drowsiness II	4
Headache	Headache II	1
Dizziness	Dizziness II	1

M131 Requirements for 16 - 28 Day Mission with OWS at Half Power (Option #II)

BACKGROUND AND JUSTIFICATION

Each of the three different parts of the M131 experiment are addressed separately below. Although highly significant from a scientific point of view, the data to be gained from the spatial localization (SL) portion of the experiment are not critical to a decision to commit to a 56-day mission. However, because these tests require absolutely no power and relatively little time, they should be conducted as planned.

Information to be derived from the oculogyral illusion (OGI) and motion sensitivity (MS) are essential to a decision on whether or not man can tolerate 56-days exposure to 0-g. Past experience has indicated that inflight motion sickness symptomatology does frequently occur and can affect the crewmen's performance. We have no data to determine whether or not slow, but progressive changes may occur in the vestibular receptors as a result of prolonged exposure to 0-g which may render the crewman susceptible to motion sickness or other vestibular difficulties, either in flight or postflight. Therefore, it is imperative that we attempt to collect as much data on the vestibular system as conditions will permit.

REQUIRED PROTOCOL

1. Perform Option I in CSM.

2. Spatial Localization (SL) portion of experiment does not require electrical power, and would therefore be unaffected. Perform nominal SL tests three times each on each crewman as planned. If time would not permit testing all three crewmen, then delete CDR entirely and as minimum conduct three nominal tests on SPT and PLT as per check list procedures. If data cannot be voice recorded, than logs must be returned. These data would not be affected by OWS air temperature as long as crew is reasonably comfortable.

3. OGI portion of experiment does require power and will be affected. It is recommended that the number of runs on the SPT and PLT be reduced from the currently scheduled five (5) to an absolute minimum of three (3) on each crewman. These runs should be early, middle and late in the OWS phase of the mission. It is also acceptable to eliminate accel· step 18 from the protocol, thereby shortening the tests by 6 minutes. Aside from these changes the OGI test should be

run as per check list procedures. These changes would reduce OGI power requirements by approximately 45%. These data would not be affected by OWS air temperature as long as crew is reasonably comfortable.

* 4. MS portion of experiment does require power and is affected. It would be acceptable to reduce the number of runs from the currently scheduled five (5) to an absolute minimum of three (3). It should be noted that the first of these runs is suppose to be at zero chair RPM; therefore, only two of the three runs would require full power. These runs should be scheduled early, middle and late in the OWS phase of the mission. Aside from these changes the MS tests should be run according to check list procedures. These changes would reduce MS power requirements by approximately 50%. If voice recording is not possible then data logs must be returned. OWS lighting in vicinity of chair must be adequate to detect pallor changes. Also, these data will be affected by excessive OWS air temperature. An assessment of these potential thermal effects cannot be given at the tim e of this writing.

All M131 photography requirements can be eliminated with no degradation in the experiment.

CSM LAUNCH AND RETURN STOWAGE

1) Return any logs containing data which was not received via telementry.

2) Delete requirement for return of one (1) otolith test goggle (OTG).

AM/OWS TRANSFER REQUIREMENTS

None.

* NOTE: If the crewmen do perform Option I (i.e. head movements) in the CSM and can perform 150 head movements without reaching MIIa, then all three of the MS tests in the OWS should be with chair rotation. This would be a normal sequence of events as per check list procedures. Running all three MS tests in the OWS in a powered mode instead of two will, of course, require slightly more power.

M-074/172 Options

BACKGROUND--JUSTIFICATION

Body mass measurement is one of the most critical pieces of information for medical evaluation, for evaluation of longer missions and for general knowledge of the effects of weightlessness. A workable mass measurement system will also be required for any future investigation. For these reasons all possible attempts should be made to obtain body mass.

OPTION I - M172 - Calibrate BMMD using C/L (see note on power in Option II) and then measure mass of each crewman as often as possible (one per day maximum). Note and log time of each measurement.

M074 - Calibrate one SMMD (crew option which one but both if schedule permits) using C/L procedure

OPTION II - Perform 172 and M074 per C/L procedure. NOTE: If power is critical, consumption can be reduced to approximately 1/3 of normal by switching unit to off except just prior to actual measurement when it is turned on and reset and then off if next measurement is not to be made immediately.

M110 SERIES: HEMATOLOGY AND IMMUNOLOGY

Reduced Protocol for Inflight Blood Collection on SL-2 Mission

The protocol for the inflight collection of blood samples as defined in the MRD would be changed for the SL-2 Mission as follows:

OPTION 1

Inflight blood samples would be collected from each crewman twice during the flight as described in the appropriate Biomed Experiments Checklist (M110). The procedures to be followed would be for the first and last sample day and thus would include preparation of a fixed cell sample using the BSV.

If the environment of the OWS is not suitable for blood collection, the IBCS kit could be removed to either the MDA or the CSM and the sample collected there. In this case the ASP would be evacuated using a spare syringe as described in the Checklist (note: at least 80 cc of air should be removed from the ASP, or four syringes full).

Should the urine freezer not be operational, the blood sample (after separation in the centrifuge) would be stowed and returned at ambient temperature. There would be significant loss of data from an unfrozen blood sample.

OPTION 2

The minimum requirements would be three blood samples; early, middle and late in the mission.

It is recommended that the IMSS slide stainer and microscope be used in conjunction with scheduled blood samples, and that the stained slides be returned for postflight examination.

MEDICAL EXPERIMENT M133 - SLEEP MONITORING

SKYLAB 2 PROTOCOL

BACKGROUND AND JUSTIFICATION

Skylab Medical Experiment M133 - Sleep Monitoring is an approved Skylab medical experiment with the objective of evaluating sleep quality and quality during prolonged space flight. No such data presently exists, and it is essential both from the standpoint of crew health and performance that such information be collected and analyzed prior to a 56-day mission.

EXPERIMENT PROTOCOL

OPTION I - The M-133 protocol could be accomplished as scheduled if the crewman can sleep in the airlocks. This would required the M-133 equipment to be moved into the airlock and restrained. The electrical power compatability, mechanical mating and restraint must be evaluated further before this option can be implemented.

OWS Transfer Equipment:
The following items will be removed from the OWS and taken to the MDA:

S 190	High power cable
E 624	#1 Phillips screwdriver (1B)
E 623	Adhesive tape (2A)
F 578	M133 Panel assembly
S 913	M133 Power cable and SIA cable M133 Rucksack Tape return canister
F 521	M133 Tape canister bag

No Temperature constraint on M133.

OPION II - OWS LIMITED POWER

M133 will be conducted as originally scheduled with the experiment runs picked up and continued as of the day the OWS is activated and inhabited.

CSM LAUNCH AND RETURN STOWAGE

CSM launch and return stowage is the same as for a nominal 28-day mission.

M151 TIME AND MOTION STUDY
"LIMITED OWS DAILY USE" PROTOCOL

OPTION I

If the OWS becomes useable for limited daily use, M151 would still have to curtail much of its planned activity particularly those which require the portable photo light. However, a major part of M151's original requirements can still be accomplished.

Briefly, the following change would be made to the original M151 protocol in order to reduce power required by using the photo light. First, coverage of crew activity involved in the S190B experiment (OWS) would be switched to coverage of S190A (MDA) if S190B is not scheduled. Coverage of the SO73 photometer activity (OWS) would be reduced from 8 performances to 2 performances. Coverage of the MO92/M171 would be attempted as planned but would be subject to any changes made in those experiments as they are scheduled. Coverage of food prep would be deleted and coverage of suit donning would be as planned.

There is a high probability that the film on board (OWS) has been damaged by the high temperature and humidity. If no evidence is presented that the film has not been damaged, five (400-foot) cassettes should be resupplied via SL-2 CSM.

OPTION II

Identical with OPTION I, above.

RADIATION REQUIREMENTS FOR OPTIONAL SL-2 CONTINGENCY MANNING MODES

INTRODUCTION

The requirements previously established for operational radiation measurements (Section 20.11 of the Mission Requirements Document) should be modified to reflect the present problems which include reduced power and temperature limitations. This report identifies radiation measurement requirements for two possible manning options:
A) normal habitation of OWS with limited electrical power, and
B) habitation of the CM/MDA, with only limited excursions into the OWS.

REQUIREMENTS

A) Normal Habitation, Limited Electrical Power

1. Van Allen Belt Dosimeter (VABD) - continue operation until OWS Activation. Obtain data for all South Atlantic Anomaly (SAA) and electron horn encounters. Power down at activation.

2. Electron-Proton Spectrometer (CSM) - Operate continuously for first two days of SL-2. Obtain data for all SAA and electron horn encounters. Power down at end of 48 hours if data is satisfactory for dose equivalent (rem) evaluation and radiation is nominal. Power up later only if radiation enhancement occurs or is projected.

3. Personal Radiation Dosimeters (PRD's) - Each crewman will wear his assigned PRD continuously for the first four days of the mission. After four days, PRD's will be positioned as follows: one (1) PRD in the sleep area, one (1) PRD in the OWS experiment compartment, and one (1) PRD in one of the two scientific airlock locations. PRD data will be voice logged for each crewman twice during each day of the mission (i.e., once immediately before sleep, and once immediately after sleep). PRD's will be worn for all EVA's. Data will be obtained from each crewman's PRD just prior to, and just after EVA.

4. Radiation Survey Meter (RSM) - One survey will be performed, and will consist of three data readings taken at one-minute intervals at a central location in the forward dome area. The RSM will be pointed toward the solar scientific airlock, and will be read during a maximum radiation SAA traverse as soon as possible after OWS activation.

5. Passive Dosimeters (PD's) - Each crewman will wear his assigned PD continuously throughout the mission.

Subject: Radiation Requirements For Optional SL-2 Contingency Manning Modes.

B) Habitation of CM/MDA Only

1. Van Allen Belt Dosimeter (VABD) - Continue operation through second day of SL-2. Obtain data for all South Atlantic Anomaly (SAA) and electron horn encounters. Power down after second day of SL-2.

2. Electron-Proton Spectrometer (CSM) - Operate continuously for first two days of SL-2. Obtain data for all SAA and electron horn encounters. Power down at end of 48 hours if data is satisfactory for dose equivalent (rem) evaluation and radiation is nominal. Power up later only if radiation enhancement occurs or is projected.

3. Personal Radiation Dosimeters (PRD's) - Each crewman will wear his assigned PRD continuously for the first four days of the mission. After four days, PRD's will be positioned as follows: one (1) PRD in the MDA, two (2) in CM. Use any available velcro patch or stowage location (crew option). Voice log locations. PRD data will be voice logged for each crewman twice during each day of the mission (i.e., once immediately before sleep, and once immediately after sleep). PRD's will be worn for all EVA's. Data will be obtained from each crewman's PRD just prior to, and just after EVA.

4. Radiation Survey Meter (RSM) - One survey will be performed, and will consist of three data readings taken at one-minute intervals at a central location in the MDA. The RSM will be pointed toward an unencumbered MDA exterior wall, and will be read during a maximum radiation SAA traverse as soon as possible after MDA habitation.

5. Passive Dosimeters (PD's) - Each crewman will wear his assigned PD continuously throughout the mission.

SUBMITTED:

J. Vernon Bailey
Chief, Radiological Health Section

CONCUR:

R. G. Rose
Chairman, Radiation Constraint Panel

M151 TIME AND MOTION STUDY
"LIMITED OWS DAILY USE" PROTOCOL

OPTION I

If the OWS becomes useable for limited daily use, M151 would still have to curtail much of its planned activity particularly those which require the portable photo light. However, a major part of M151's original requirements can still be accomplished.

Briefly, the following change would be made to the original M151 protocol in order to reduce power required by using the photo light. First, coverage of crew activity involved in the S190B experiment (OWS) would be switched to coverage of S190A (MDA) if S190B is not scheduled. Coverage of the SO73 photometer activity (OWS) would be reduced from 8 performances to 2 performances. Coverage of the MO92/M171 would be attempted as planned but would be subject to any changes made in those experiments as they are scheduled. Coverage of food prep would be deleted and coverage of suit donning would be as planned.

OPTION II

Identical with OPTION I, above.