U.S. Government

# MEMORANDUM

Lyndon B. Johnson Space Center NASA

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TO: BX/KX/J. B. Costello
MF/W. W. Lofland, Jr.

FROM: CB/W. E. Thornton, M.D.

CC
EC/W. W. Guy
MA/R. A. Colonna
MF/J. R. Goodman
Whitmore Enterprises, Inc./H. Whitmore

SIGNATURE W. E. Thornton
W. E. Thornton, M.D.

SUBJ: Improved WCS Development

Enclosed is a proposed development for flight of the piston compactor WCS. After discussions this morning, the last page "schematic" was added. Please comment on any aspects of this.

## Plan for Prototype Development and Evaluation of IWCS

The goal is the quickest possible development of a prototype WCS using piston-compaction for demonstration in flight. A simplified version of the planned operational prototype will be attempted by flight 61-A. This is an impossibly short time frame, and for any hope of success unconventional procedures must be used. Further, parallel efforts will also have to be resorted to. Above all, the device must work and working includes making it sufficiently foolproof to insure that (1) it cannot be inadvertently jammed or otherwise misused and (2) that the methodology is fairly demonstrated.

At this point only the most elemental demonstration hardware has been built and briefly tested, and a much larger number of systems remain to be demonstrated before the unit is minimally acceptable as a contingency system and still more systems must be demonstrated for an operational system.

The following plan promises the shortest development time: There will be two major but inseparable efforts, (1) design and test of a working WCS and (2) interface and support of this unit into the vehicle with the hardware and management and documentary support. Two coordinated groups are needed for this--the first centered around the contractor and the second at JSC and other NASA facilities including other contractors if necessary.

Addressing the WCS design fabrication and test effort, two parallel efforts should be made here. The first is already underway and is a continuation of the design and test of the basic features of the WCS which include: An automated piston face sheet loader; i.e., a device which positions the interface material and cuts it from the supply roll. An air circulation system which pulls air from a portion of the fecal collection chamber and directs it through the collection orifice beneath the seat and through positive pressure jets, possibly with pulse or vortex action. An essential part of this system are the air collection inlets which must be protected from fouling by wastes during the fecal collection cycle. The present plan is to use mechanical inlet orifice occluders which will automatically be shifted in place during the sweep and compression cycle. A secondary downstream filter system will remove any small particles or drops. An odor filter must be used in the air returned to the cabin.

Another primary function is drive power for the various mechanical operations and the control and coordination of this power. The first is the piston itself which must not only be actuated bi-directionally but must also be controlled as to actuation stroke and compressive force. In addition, the seat slide valve and air inlet occluder must be operated in coordination with and probably by this drive.

The evolved gases and odors must be trapped and removed from the unit ,and it is assumed that a flow restricted vent, rather than hard vacuum, will be used here. There are a number of unknowns such as flow rates that can only be determined by testing, for the studies in this area to date have been inadequate. This will require both a vent system and adequate sealing of all portions of the collection chamber such as the inlet seal, piston mechanism, air circulation system, etc., as well as pressure reliefs.

A seat and properly sized and oriented inlet system is an obvious essential, and it must be integrated with the air circulation and air jet system for optimum fecal separation and transport functions.

As important as any other function will be means of manual override of any and all mechanical functions.

Still to be determined are the physical size and capacities of the unit as well as power limitations, etc. Capacity of this prototype should not be less than 40 defecations.

All of the above systems will be integrated into a 1-g prototype for extensive testing; however, each system will be tested as necessary to demonstrate its suitability and reliability before becoming a part of the 1-g prototype. To expedite matters, it will be necessary to use non-flight motors using standard power, e.g., 60 Hz vs. 400, etc., but which meet the power limitation and other flight requirements and which can be replaced with flight items as they become available. Non-flight materials may be used in this 1-g prototype.

Second Effort - The only hope of an early flight for a prototype is to build a flight prototype with only minimal features. It will have to be done in parallel with the 1-

g prototype but can only be completed as the items are successfully tested. Such a stripped version would still require most of the features; i.e., it would need as a minimum:

1. Automatic piston facing
2. Seat & restraint
3. Piston drive
4. Air circulation system
5. Vent system

Savings could be made primarily in the automation area by resorting to some manual systems. This unit should not be started until key features such as piston facing and piston drive are demonstrated; and, if these fall into place simply, then there is a chance to make 61-A, but if not, it could be flown as soon as possible thereafter. N.B. It must be recognized that such a prototype for 61-A would not be complete and would then need upgrading and inflight testing to be repeated prior to final flight hardware.

The effort cannot be specified at this time in more than general terms. It can probably be expedited by support from NASA JSC in both interfaces, etc., but also by aid in finding suitable flight materials such as motors, filter material, etc. Also essential to this effort will be extensive testing, primarily at the contractor's site but also here, on the completed prototype and possibly in such areas as the vent system.

# Improved WCS Development

Bill Lofland

Specifications, Integration & Test of WCS

JSC

Support Contractor

Dimensions, Capabilities, Etc.

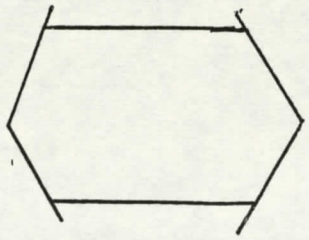
Power Limits

Material and Q. & A. Specs, Etc.

Documentation

Component and Material Support

Etc., Etc.



Improved WCS Prototypes & Testing

Contract Monitor

Contractor
H. Whitmore

Tech. Monitor
W. Thornton

1-g Prototype

Paper Transport; Test

Piston Drive; Test

Air Circulation; Test

Vent; Test

Seat & Restraint ;Test

System Integration &
Manual Override

Test, Test, Test . . .

Flt. Proto.

Paper Transport

Piston Drive

Air Circ.

Seat & Restraint

Test