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UNITED STATES GOVERNMENT

Memorandum

DATE: MAR 1 1 1968

TO : See list below

In reply refer to:
PD5/M532-16.1

FROM : PD/Assistant Chief (C&SM)
Systems Engineering Division

SUBJECT: Minutes of meeting on procedures for 60% oxygen/40% nitrogen cabin atmosphere

A meeting to develop procedures for incorporation of a 60% oxygen/40% nitrogen CM cabin atmosphere was held at KSC on February 27, 1968, with KSC, MSC, and NR participation. A list of attendees is attached as Enclosure 1.

Ground crew and flight crew procedures pertinent to 2TV-1, CSM 101, and subsequent were developed for MSC Chamber A, the MSOB altitude chamber, and for pad operations.

Ground Rules

The following ground rules and guidelines were used in deriving procedures:

1. Minimum crew participation.
2. No cabin dump in flight to deplete mixed gas.
3. The cabin atmosphere will be purged in flight through the WMS (Waste Management System) overboard dump nozzle.
4. The oxygen content of the cabin atmosphere for manned operation after crew insertion and hatch closeout shall be not less than 60% or greater than 65%.
5. With a 60/40 cabin atmosphere, the maximum total pressure is 16.2 psia.
6. The oxygen partial pressure (PO_2) shall be not less than 3.0 psia at 5.0 psia total pressure.

Discussion

Action items resulting from this meeting are attached as Enclosure 2.

a. A value for the cabin volume behind stowage panels which would not be purged with the cabin was not available at

the meeting. It is estimated that 10% of the cabin volume is involved and it was assumed a separate purge will be required. An analysis to define the volumes, purge method, timeline, and GSE requirements is in work at NR. Verification of procedures, GSE, and the timelines is required, and it was indicated that the earliest opportunity may be on 2TV-1 at MSC prior to altitude runs.

It was recommended that oxygen content sampling of the atmosphere behind panel areas be accomplished during pre-altitude chamber development testing to establish purge capability. Due to the estimated 20-30 areas involved and the limited timeline on the pad, it was recommended that the prelaunch procedures not require verification of oxygen content behind each panel.

b. A requirement was defined to vent the ECU relief valve oxygen into the main cabin volume instead of behind a panel to prevent localized excessive oxygen buildup.

c. Procedural considerations of whether to prelaunch purge to 60/40, then leak test to 16.2 psia, or to leak check to 17.7 psia by adding a 60/40 mix, and then purge the cabin to 60/40 at ambient pressure were discussed. It was generally concluded that a purge to 60/40 followed by a leak test to 16.2 psia was slightly more advantageous.

d. Procedures to minimize the possibility of suit loop contamination with cabin GN_2 during the prelaunch cabin leak test were discussed. It was concluded that the suit circuit return air shutoff valve (1.3) is normally closed during this operation and leakage into the suit loop from other sources, considering the slight negative pressure possible, would be minimal for the leak test period.

e. KSC requested MSC define CM cabin oxygen content redline limits on pad for mission rules. MSC accepted this action item.

f. The accuracy of the present GFE non-flight Beckman D-2 oxygen analyzers used to verify cabin atmosphere was stated as $\pm 2\%$ of full scale. This was considered marginal or unacceptable, depending upon final resolution of redline limits. MSC can accurately measure cabin O_2 content in Chamber A by use of remote sampling analysis equipment. KSC, MSC, and NR are to review requirements and procure more accurate non-flight oxygen analyzers, as required. The accuracy of the flight suit and cabin PO_2 sensor was described as $\pm 5\%$ of full scale. The inability of this sensor to determine cabin PO_2 values to the tolerance anticipated for redline values was discussed. More information on this sensor and its use was requested by the attendees.

g. A discussion was held on the effect of oxygen flow through the direct oxygen valve (4.17) on the cabin PO_2 and total pressure after cabin closeout and for a launch hold condition. An acceptable condition is anticipated, but NR was requested to provide the required data.

h. Dr. C. Jernigan of MSC stated that a minimum PO_2 value had not yet been arrived at for crew protection from hypoxia in case of cabin decompression. He accepted an action item to provide this limit value.

i. The draft ground and flight procedures from the previous meeting at Downey were reviewed and modified. Two methods were discussed which would arrive at a sea level PO_2 equivalent atmosphere in orbit. One method would require a crew procedure to further open the direct oxygen valve in orbit and maintain approximately 5.5 psia total pressure assuring a PO_2 level equivalent to sea level at all times. A second and preferred method is to allow cabin pressure to decrease to 5.0 ± 2.0 psia through the WMS dump nozzle and by cabin leakage. This can result in a cabin PO_2 equivalent to approximately 5,000 feet altitude. Oxygen enrichment of the cabin will be through the demand pressure regulator to makeup outflow through the WMS dump nozzle and cabin leakage. The recommended procedures are attached as Enclosure 3.

j. It was recommended that the cabin fans be turned off and that the hatch be closed during booster cryogenic loading. During cabin purge the cabin fans should be on to assure mixing of cabin gases.

Aaron Cohen

Enclosures 3

Addressees:
PA/G. M. Low
PA/K. S. Kleinknecht
PA/S. H. Simpkinson
PT2/J. E. Mechelay
EC3/F. H. Samonski
PF/R. W. Lanzkron
ES7/A. L. Branscomb
PD9/A. W. Joslyn
Attendees

PD5:WWJaderlund:bn 3/4/68

A T T E N D E E S

60/40 ATMOSPHERE PROCEDURES MEETING

Name	Organization	Mail Code	Phone
W. W. Jaderlund	MSC-ASPO	PD5	483-4921
C. G. Jenkins	RASPO-KSC	PSK	867-7870
T. A. Bottomley	NASA Hqs-Bellcomm	MAS	269-8357
L. G. Miller	NASA Hqs-Bellcomm	MAS	269-8369
R. D. Raymond	NASA Hqs-Bellcomm	MAS	269-8309
G. T. Carter	KSC	SF-TEC	867-4493
J. P. Kerwin	MSC	CB	483-2421
R. M. Hunnings	KSC-ECS	LS-ENG-32	867-8770
E. E. Griffith, Jr.	NR-ECS-KSC	AK-86	867-5182
J. V. Laclave	KSC	AP-SCO-2	867-5618
H. Kuznicki	NR-KSC	ZK-20	867-2680
C. A. Chauvin	KSC	LS-OPN-1	867-7282
C. A. Jernigan	MSC	DC-4	483-4021
A. C. Harter, M.D.	KSC	DDK-11	867-3541
J. M. Ross	NR	FB-13	923-6886

ACTION ITEMS

60/40 ATMOSPHERE PROCEDURES MEETING

1. Define CSM 101 redline limits to KSC for CM cabin oxygen content on pad.
   Action: MSC-W. W. Jaderlund, PD5; Date: March 15, 1968

2. Define requirements for more accurate oxygen analyzers.
   Action: NR, MSC, KSC; Date: March 15, 1968

3. Flight hardware ECP to vent ECU discharge from behind panel into cabin.
   Action: NR; Date: March 21, 1968

4. Define compartments behind panels requiring purge, their volumes, purge method, and GSE requirements.
   Action: NR; Date: March 6, 1968

5. Review capability to verify CM compartment purge procedures and GSE on 2TV-1 at MSC prior to altitude chamber tests.
   Action: MSC-W. W. Jaderlund, PD5; Date: March 21, 1968

6. Define procedures for use of PO_2 on-board sensor in suit and cabin.
   Action: MSC-J. Kerwin; Date: March 15, 1968

7. Define amount of GN_2 from cabin atmosphere that could possibly enter suit loop during final cabin leak check pressure increase.
   Action: NR-J. Ross; Date: March 1, 1968

8. Determine feasibility of procedures to monitor CM cabin total pressure after orbital insertion from ground stations.
   Action: MSC-J. Kerwin; Date: March 15, 1968

9. Establish minimum PO_2 in breathing mixture for protection from hypoxia in case of cabin decompression.
   Action: MSC-Dr. C. Jernigan; Date: March 1, 1968

10. What cabin PO_2 pressure rise and total pressure rise can be expected after prelaunch cabin closeout as a result of the direct O_2 valve (4.17) flow?
    Action: NR-J. Ross; Date: March 21, 1968