# REPORT OF APOLLO 204 REVIEW BOARD

TO

THE ADMINISTRATOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

## APPENDIX D

PANELS 12 thru 17

# REPORT OF PANEL 12
# WITNESS STATEMENTS
# APPENDIX D-12
# TO
# FINAL REPORT OF
# APOLLO 204 REVIEW BOARD

WITNESS STATEMENTS

## A. TASK ASSIGNMENT

The Apollo 204 Review Board established the Witness Statements Panel, 12. The task assigned for accomplishment of Panel 12 was prescribed as follows:

An orderly process to collect all data from witnesses (includes eye witnesses as well as console monitors). This includes a determination of who to interview, arranging for competent people to conduct the interviews, recording data, and collecting it into a form suitable for publication as an appendix to the formal report. Included also in this taks is an analysis of the pertinent sequence of events as reported by the bulk of the witnesses together with a summary of that testimony which is contradictory to the main data.

## B. PANEL ORGANIZATION

1. MEMBERSHIP

The assigned task was accomplished by the following members of the Witness Statements Panel:

Mr. Norbert B. Vaughn, Manned Spacecraft Center, (MSC), NASA, Chairman

Mr. J. J. O'Donnell, Kennedy Space Center, (KSC), NASA

Mr. C. B. Netherton, Kennedy Space Center, (KSC), NASA

Mr. H. F. Blackwood, Headquarters, NASA

Lt. Col. J. W. Rawers, U. S. Air Force

Mr. C. J. McNanara, North American Aviation, (NAA), Kennedy Space Center (KSC)

2. COGNIZANT BOARD MEMBER

Colonel Charles F. Strang, U. S. Air Force, Board Member, was assigned to monitor the Witness Statements Panel.

## C. PROCEEDINGS

1. OBJECTIVES

a. To collect all data through written statements and taped interviews from:

(1) Eye Witnesses

(2) All other personnel who had access to Launch Complex (LC) 34 during the test

(3) All monitoring personnel at:

(a) The Launch Complex 34 Blockhouse

(b) The Acceptance Checkout Equipment (ACE) Control Rooms in the Manned Spacecraft Operations Building (MSOB)

(c) All the other observation or recording stations where audio or television (TV) monitoring was available.

(4) Other personnel as required by the Board

(5) Volunteers of pertinent information that were not contacted in (1), (2), (3), or (4) above.

b. To construct a sequence of events from the bulk of witness reports and to update this information on a timely basis for use by the Review Board and other Panels.

c. To identify the pertinent inconsistent or contradictory statements to the main data as presented in 5. Ojbective (b).

d. To summarize the pertinent information for use by the Review Board and other Panels.

e. To prepare the statements in proper form for publication as Appendix B to the Final Report.

2. INTRODUCTION

For use as general information and orientation are Enclosures 12-1 through 12-5, which are drawn approximately to scale. Enclosure 12-1 is a simulated aerial view of Launch Complex (LC) 34. Enclosure 12-2 shows the Service Structure elevators and the Umbilical Tower elevator on LC 34. At the time of the incident, the Umbilical Tower elevator (450 feet per minute capability) was held at the top of the tower in anticipation of the schedule "egress" exercise. The Service Structure elevators were programmed as follows for this test:

No. 1 (Northeast) - 200 feet per minute, capable of being stopped at every level
No. 2 (Northwest) - 100 feet per minute, capable of being stopped at every level
No. 3 (Southwest) - 200 feet per minute, capable of being stopped at every level
No. 4 (Southeast) - 450 feet per minute, capable of being stopped at every level

The Pedestal elevator (65 fpm capability) is a hydraulic lift type platform that rises to the 27 foot level. Enclosure 12-3 is a plan view of adjustable level 8 (A-8) at LC 34. Enclosure 12-4 is a plan view of adjustable level 7 (A-7) at LC 34. The overlays in Enclosures 12-3 and 12-4 show the position of the eye witnesses at the time of the incident. On the Enclosures 12-2, 12-3, and 12-4 are arrows indicating the direction North and an assumed North. The assumed North is a Kennedy Space Center common practice used for ease of locating items relative to the Service Structure axes. Witness statements make use of this in describing their existing the Structure on elevators after the incident. Enclosure 12-5 is a sketch of the Command Module, White Room, Egress Access Arm, and Umbilical Tower elevator, showing the egress route of astronauts on LC 34.

3. INVESTIGATION

Investigation by the Witness Statement Panel was initiated January 31, 1967 when the Panel received nine (9) miscellaneous written statements and twenty-six (26) "eye-witness" statements from the NASA-KSC Security Office. These were written or taped statements obtained the evening of the Apollo 204 incident. At the same time, twenty-one (21) Pan American World Airwasy (PAA) employee witness statements were received from the Air Force Eastern Test Range (AFETR) Representative to the Board.

4. OBJECTIVE A

Panel objective a (Collection of Data) was accomplished by contacting the contractors and agencies involved in the test operations. Those contacted were either "eye-witnesses", or television (TV) or audio monitors of the incident. A total of eighteen (18) agencies or contractors were contacted (See General File for list). There were responses for 590 people with 572 written statements and forth (40) recorded statements. Since some witnesses submitted more than one written statement or were interviewed twice, a total of 612 statements was obtained.

5. OBJECTIVE B

Panel 12 objective b (Sequence of Events) was accomplished as shown below, and by the Review Board Counsel as shown in Enclosure 12-6. Enclosure 12-6 is a detailed narrative description of the events. The sequence of events briefly listed herein was established from the bulk of the witness statements.

## SEQUENCE OF EVENTS FROM WITNESS STATEMENTS

| Between time 6:31:00 p.m. EST to 6:31.15 p.m. EST | Events: |
|---|---|
| The: Witnesses in Launch Vehicle Aft Interstage, Level A-2: | Felt two definite rocking or shaking movements of vehicle seconds prior to "Fire" report. Unlike vibrations experienced in past fron wind, engine gimballing or equipment input. |
| Witnesses on Levels A 7 & A 8. | Heard "Fire" and/or "Fire in Cockpit" transmissions Heard muffled explosion, then two loud whooshes of escaping gas (or explosive releases).<br>Observed flames jet from around edge of Command Module and under White Room. |

| | |
|---|---|
| TV Monitors: | Heard "Fire" and/or "Fire in Cockpit" transmissions. Observed astronaut helmet, arm, and back movements; increase of light in Spacecraft window, and tongue-like flame pattern within Spacecraft. Observed flame progressing from lower left corner of window to upper right, then spreading flame filled window, burning around hatch openings, lower portion of Command Module, and cables. |
| Between time 6:31:15 p.m. EST to 6:33 p.m. EST. | |
| Witnesses on Levels A-7 & A-8: | Repeated attempts to penetrate White Room for egress action. Fought fires on Command Module, Service Module, and in White Room area. |
| TV Monitors: | Observed smoke and fire on Level A-8. Progressive reduction of visibility of Spacecraft hatch on TV monitor due to increase of smoke. |
| Between time 6:33 p.m. EST to 6:37 p.m. EST | Repeated attempts to remove hatch and reach crew. Continued fire-fighting on Levels A-7 and A-8 in White Room. Spacecraft Boost Protective Cover (BPC) removed by NAA personnel J. D. Gleaves and D. O. Babbitt. Spacecraft outer (Ablative) hatch removed by NAA personnel J. W. Hawkins, L. D. Reece, and S. B. Clemmons. Spacecraft Inner hatch opened and pushed down inside by NAA personnel J. W. Hawkins, L. D. Reece, and S. B. Clemmons at approximately 6:36:30 p.m. EST. No visual inspection of Spacecraft interior possible due to heat and smoke. No signs of life. |
| Between time 6:37 p.m. EST to 6:45 p.m. EST | Extinguish remains of fires. Fire and Medical support arrive. Fireman J. A. Burch, Jr. and NAA Technician W. M. Medcalf removed the Spacecraft Inner hatch from the Spacecraft. Examination of crew and verification of condition. |
| Between time 6:45 p.m. EST, January 27, 1967 to 2:00 a.m. EST, January 28, 1967 | Service Structure cleared. Photographs taken. Crew removed. Complex and area under secure conditions. Personnel from Washington and Houston arrive and assume control of situation. |

6. OBJECTIVE C

Panel objective c (Contradictory Statements) was accomplished. The only significant deviation, which had no other substantiation, was the statement of Mr. Gary W. Propst, RCA Technician. The Witness was monitoring Operational Intercommunication System (OIS) channel Black 3 and observing the TV view of the S/C 012 hatch. The call of "Fire" over the OIS and observation of a bright glow in the spacecraft occurred simultaneously. He stated there was a two to two and one-half minute time elapse from the call until flames increased and covered the hatch opening. At about three (3) minutes, Mr.

Propst stated, the flames from the outside bottom of the spacecraft began to eat through the area where the bottom lip of the White Room meets the Spacecraft, and the White Room began to fill with smoke. He also stated there was movement inside the Spacecraft lasting about two (2) minutes before the flames began to block the view, and no one entered the White Room until it had become smoke-filled some minutes later. Mr. Propst stated that he changed the electronic control knobs on the hatch TV monitor while the incident was happening. This caused all the other TV monitor screens as mentioned by some witnesses, to have a monetary (1 to 2 seconds) loss of picture, with either gray, black, or white-out, but most probably white appearance. As the camera built-in electronics and internal mechanisms were adjusting themselves, the hatch area could have appeared washed-out due to the Spacecraft interior brightness for approximately 2 seconds.

7. OBJECTIVE D

Panel objective d (Summary of Pertinent Information) was accomplished as shown herein. Section (a.) is a summary prepared from the statements of witnesses located primarily on adjustable levels 7 and 8 of the Launch Complex 34 Service Structure. Section (b.) is a summary prepared from statements of witnesses who had access to TV monitors located at either the Launch Complex 34 Blockhouse or at the ACE Control Rooms. These summaries indicate only the initial observations of the witnesses. Subsequent observations and actions taken are contained in the witnesses entire statements found in Appendix B.

## SUMMARY OF WITNESS OBSERVATIONS REGARDING FIRE

a. Levels A-7, A-8 and other Areas of Service Structure

| Name, Duty, Location | Time Reference | Initial Observation |
|---|---|---|
| Donald O. Babbitt<br>NAA, Project Engineer<br>Pad Leader; A-8 Pad<br>Leader Desk | Immediately after OIS report | Flame from under BPC near steam duct - followed by concussion. |
| James D. Gleaves<br>NAA, Mechanical Lead<br>Technician; A-8 Flyaway<br>Umbilical | Shortly after hearing OIS report - believed to be Astronaut Chaffee. | Heard loud shoooooc - entered White Room, saw flash - followed by fire and debris covered right side of Spacecraft. . |
| L. D. Reece<br>NAA, Systems Technician;<br>A-8, Flyaway Umbilical | Immediately after OIS report. | Sheet of flame from Command Module 12 access. |
| Richard A. Hagar<br>NAA, Electrical Systems<br>Technician; A-8, -Y<br>Area | Immediately after OIS report. | Two loud pops - fire blew out of -Y and +Y access panels. |
| Richard L. Bachand<br>NAA, Systems Technician;<br>A-8, +Z +Y area | Immediately after OIS report. | Low burp, large whoosh, wall of flame - floor to ceiling. |
| Stephen B. Clemmons<br>NAA, Systems Technician;<br>A-8, Pad Leader Desk | Immediately after OIS report. | White glow around BPC, access paned between umbilical and White Room. Loud venting of gases, then ignition like gas jet being ignited. No loud explosion. |
| James E. Cromer<br>PAA, Elevator Technician;<br>Umbilical tower elevator<br>looking at White Room | Did not hear report - - saw flash first. | Flash of fire from White Room doorside doors blew open. |
| Joseph H. Pleasant<br>NAA, Systems Technician;<br>A-8, near stairs to White<br>Room | Someone called "There's a fire in spacecraft". | Heard someone call fire in Spacecraft - heard muffled explosion - fire around bottom of Command Module - several places - smoke. |
| Bruce, W. David<br>NAA, Systems Technician;<br>A-8, Flyaway umbilical | Immediately after OIS report. | Flames within open access panels near umbilical - followed by whoosh and flames shooting out of the panels. |
| Friend D. Hickenbottom<br>NAA, Systems Technician;<br>A-8, South of Tower | Immediately after OIS report. | Spurt of flame under White Room - explosion - flames at all Command Module openings. |

| | | |
|---|---|---|
| Jerry W. Hawkins<br>NAA, Systems Technician;<br>A-8, Swing Arm | After hearing someone yell "Fire". | Flame from Spacecraft to Pad Leader desk. |
| W. Donald Brown<br>NAA, Mechanical Inspector; A-8, -Y Quality Control Desk | No time reference | Command Module 012 access seemed to ignite - minor explosion - 2 loud whooshes - escaping gas |
| Jessie L. Owens<br>NAA, Systems Engineer;<br>A-8, Pad Leader Desk,<br>+Y area | Immediately after OIS report. | Heard relief valve open - hi-velocity gas escaping, burst into flame. |
| Robert C. Hedlund<br>NAA, Systems Technician;<br>A-8, +Z +Y Area | Immediately after OIS report. | Hears whoosh - saw small flames from access hatches. |
| John E. Markovich<br>NASA/KSC, Q. C. Inspector; A-8, +Z (NW) | Heard explosion - first notice | Heard muffled explosion - saw huge flash fire - service port +Z axis. |
| Joseph L. Stoeckl<br>NASA/KSC, Q. C. Inspector; A-8,<br>SW corner | Hears explosion - first notice | Muffled explosion - Command Mod- engulfed in flame. |
| Henry H. Rogers, Jr.<br>NASA/KSC, Q. C. Inspector; A-8, on S.W. Elevator | Very shortly after hearing report on PA | Entered White Room - fire appeared burning from inside Spacecraft out. |
| Creed A. Journey<br>NAA, Electrical Leadman; A-8, +Z -Y axis Area | Heard shout as entering level A-8 from A-7. Threw self to floor as fire burst out. | Fire broke out of Command Module in high velocity streams, 6 to 7 feet long out of servicing ports in southeast corner (-Y area). |
| William J. Schneider<br>NAA, GSE Technician;<br>A-7, with back to Service Module at +Y Area | Heard "Fire" either over squawk box or down from level A-8. | Felt heat on back at call "Fire". Went out to get on NE passenger elevator. Didn't get on. Saw fire inside Service Module. Got fire extinguisher and extinguished fire in Service Module. |
| Dave E. Howard<br>NAA, Systems Technician;<br>A-7, near access to Service Module | After initial fire - no reference to OIS report. Heard Astronaut say, "Fire in cockpit". | Saw fire dimish from first flame - loud swoosh ball of flame from bottom of Command Module. |
| J. C. Scott<br>NAA, Q. C. Inspector;<br>A-7, under umbilical | Heard someone say, "Fire in cockpit" | Heard noise - then second noise - ball of fire fell from Command Mod- to Service Module. |

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| Robert I. Bass NAA, Systems Technician; ACE Room | Hears explosion - saw smoke - heard shouts of "Fire". | Muffled explosion - smoke pouring out and around swing arm into White Room. |
| John C. McConnell NAA, GSE Technician; Umbilical Tower level 190 Ft. | Heard someone on A-8 or else over OIS say "Fire in the Spacecraft". | At indication of "Fire" sound - level A-8 all lit up when it exploded. Got fire extinguisher - and crossed over to A-6, grabbed 2 gas masks and went up to level A-8. |
| Burt B. Belt NAA, GSE Leadman; On Service Structure express elevator, level 2 | Heard people yelling "Fire in the Spacecraft" as elevator was going to level A-6. | Wanted elevator to go to A-8 but stopped at A-6. Grabbed gas masks and took up to A-8. Started fighting fires coming from parts of Command Module with extinguishers. |
| George W. Rackleff NAA-Tulsa, Systems Technician; A-7, under White Room | Heard report from spacecraft crew member | Large puff of smoke and explosion - swing arm entry hatch. |
| Samuel Williams NAA, GSE Technician; A-7, A14-019 Fly-Away umbilical connection | Astronaut: "Fire in cockpit" over headset. | Heard explosion immediately follow-by another, then fire down through A-7 at Swing Arm. |
| Forrest R. Rooker NAA, GSE Technician; A-7, A14-019 Fly-Away umbilical connection | Astronaut: "We have fire in cockpit" over headset. | Heard small explosion then larger one - Flash of flame through opening A-8 and A-7 at umbilical swing arm. |
| William H. Wingfield NAA, GSE Electrical Technician; Level A-5 | Heard Chaffee say "Fire" over OIS. | Smoke came down to area, saw paper on fire flying from A-8 level. Went up to A-8 for few moments only and went down to 188 ft. level to open power supply breakers. |
| Marvin L. Nelson NASA/KSC QC Inspector; A-7, N.E. side of Service Module | Immediately after report from P/A | Smoke began to fill the area. |
| Patrick E. Mitchell NASA/KSC QC Inspector; A-7, A14-019 umbilical disconnect | Immediately after report | Level filled with smoke |
| William C. Deaver NAA, Electronic Technician; A-7, A14-019 Fly-Away umbilical connection | Heard someone say, "Fire in Cockpit" | Heard 2 explosions - then fire between Command Module and Service Module. |
| Willis M. Medcai NAA, Mechanical echnician; Service Structure elevator between levels 3 and 4 | Heard cry of "Fire" as elevator passed levels 3 and 4 | Elevator stopped at level A-8 Ran down a level or two and took gas masks to A-8. |

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|---|---|---|
| Robert C. Foster<br>NAA, QC Inspector;<br>Complex 34 Fuel Area | Saw smoke | Looked upward and saw smoke. Carried gas masks and fire extinguishers to SE elevator and took to level A-8. |

b. TV and Audio Monitors

| Name, Duty, Location | Initial Notice | Observation |
|---|---|---|
| Clarence A. Chauvin<br>NASA/KSC Test Conductor;<br>Test Conductors Console<br>ACE Control Room 1,<br>MSO Building | "Fire" over Operational Intercommunications System (OIS). | Noticed flames in vicinity of apex cover at top of Command Module. Not aware fire was in Spacecraft until heard over headset shortly after. |
| William H. Schick<br>NASA/KSC Assistant Test Supervisor; Test Supervisor's Console - Blockhouse Launch Complex 34 | "Fire in Cockpit" over OIS | Saw flames climbing about halfway up the side of the Spacecraft coming from the interface between the Command Module and the Service Module. |
| Gary W. Propst<br>RCA Technician;<br>Operational TV Control Racks - Blockhouse Launch Complex 34 | "Fire in the cockpit" over OIS | Observed hatch in TV monitor. Saw bright glow in Spacecraft. Observed Astronaut arm and leg movements lasting about 2 minutes until flames obscured vision. A split second later flames go past window. Fire increased steadily. Flames from outside bottom of Spacecraft where it meets lip of White Room and from under hatch. |
| Alan R. Caswell<br>RCA-Communications Controller; Communication Control Racks - Blockhouse Launch Complex 34 | Technician Propst called attention to monitor - stating Fire in Spacecraft. | Observed hatch on TV monitor. Flames flickered inside Spacecraft on left side of window and in 15-20 seconds almost covered window. Saw center astronaut's helmet move during first few seconds. |
| Donald K. Slayton<br>NASA-MSC, Director of Flight Crew Operations; Astronaut Console Blockhouse Launch Complex 34 | Call of "Fire" on OIS | Observed Spacecraft hatch on TV monitor. Flame around hatch. Smoke increased. Detected people trying to get to hatch door. Smoke obscured view from TV Camera. |
| Daryl O. Cain<br>NAA, Spacecraft 017 Test Conductor; ACE Control Room No. 2, MSO Building | Hatch Camera seemed to blank out like someone had shined a very bright light into lens of camera. | Picture was regained. Saw "Guttery" type flames about 6 inches high mostly on right hand side at base hatch. Impression one of the quads had fired and fire was outside Spacecraft underneath the Command Module. Observed the fire fighting attempts and |

| | | |
|---|---|---|
| | | assumed Astronauts were safe and staying inside craft until fire exinguished and smoke cleared from area. Camera eventually turned off. Not aware of tragedy for couple of hours because principally engaged in monitoring own test on spacecraft 017. |
| Donald R. Jones NASA/KSC - Chief, Electrical Systems, Saturn IV-B; VIP Room - Blockhouse Launch Complex 34 | Illumination within Spacecraft and call of "Fire" over OIS | Noted tongue of flame between center Astronaut's helmet and hatch window on hatch camera. Saw Astronaut's arms move toward hatch. At this time interior of Spacecraft was illuminated to such brilliance picture blacked out. |
| Albert E. Jorolan NASA/KSC - Launch Vehicle Measuring Instrumentation Engineer; Measuring Station-Blockhouse Launch Complex 34 | "Hey, there's a fire in here", over Spacecraft communication channel. Identifies voice as Chaffee's. | Observed 2 distinct tongues of fire positioned at 11 and 7 o'clock on TV monitor. Screen was dark, location of fire not identifiable. Camera and/or target was not identified in statement. |

8. APPENDIX B - WITNESS STATEMENTS

The witness statements and releases for the statements contained in Appendix B are from:

(1) Personnel on adjustable levels 7, 8, and other areas of Launch Complex 34 Service Structure (34 total)

(2) Representative TV monitors (7)

(3) Representative audio monitors (2)

(4) Other Witnesses (3)

The index of Appendix B contains witnesses names, organization, position or duty, location at the time of the incident, and date(s) of statement(s). A page of common abbreviations and definitions is included in Appendix B. Only the witness statements containing testimony relevant to the investigation are included in this Appendix.

9. OTHER STATEMENTS

The statements of witnesses (names listed in Appendix B), which do not provide relevant testimony, are retained in the Apollo 204 Review Board General File as a matter of record. These statements, not part of Appendix B, are arranged by order of primary importance within the categories:

(1) TV monitors

(2) Audio monitors

(3) Related areas

(4) Miscellaneous

The relevancy of testimony has been reviewed by Counsel to the Board. The Board Administrative Procedure No. 16, titled "Coordination Policy for Interviewing Witnesses", was used when obtaining recorded witness statements. The General File also includes all original statements and/or tape recordings of all witnesses.

10. OTHER RESPONSIBILITIES

A total of thirty (30) requirements for information were placed on the Panel. These requests varied from lists of witnesses to information in definite disciplines (Enclosure 12-7). The requirements came from the Board, the Board Panel Coordination Committee, other Panels, and NASA Headquarters.

11. WITNESS CATEGORIES

Several categories of witnesses were established on the basis of information contained in their statements. These were: gas or vapor odors during pre-ingress, astronaut ingress, eye-witnesses of the incident, TV monitors, audio monitors, and rescue, security and medical personnel. A tape recorded conference among members of Panel 7 (Test Procedures), Panel 8 (Materials Review), and witnesses who had mentioned an unusual odor during ingress or cabin purge, was conducted February 9, 1967. The purpose of this conference was to ascertain the exact articles passed in and out of the Spacecraft hatch, the placement of articles in the Spacecraft, and a more detailed description of any odors noticed. The findings obtained in this conference were forwarded to Panels 7 and 8. The minutes of the conference are contained in the Review Board General File.

## D. FINDING AND DETERMINATION

FINDING

A total of 612 witness statements were obtained by Panel 12.

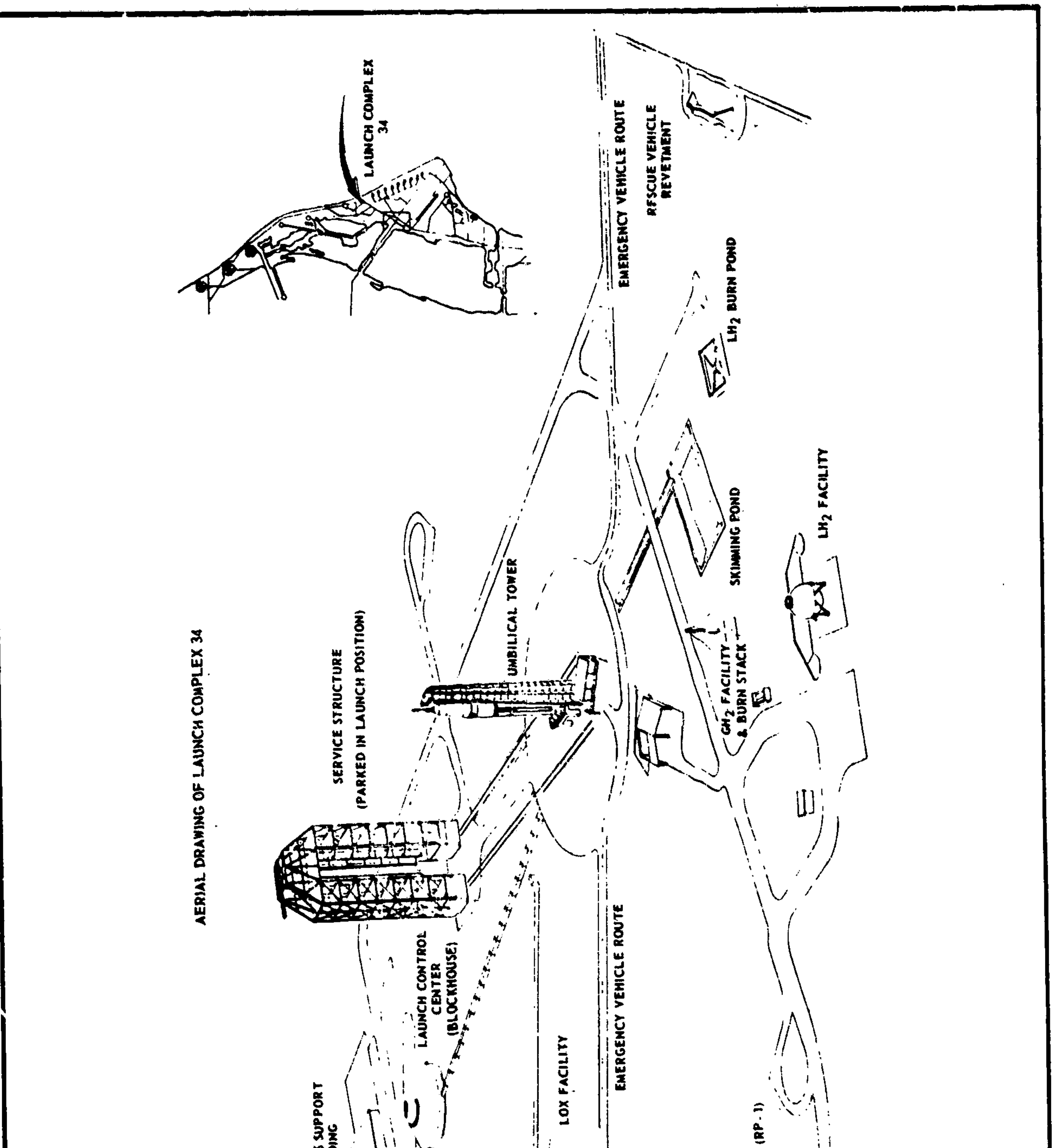
DETERMINATION

The Witness Statements Panel 12 believes that all people with pertinent information regarding the Apollo 204 incident of January 27, 1967 have been contacted.

## E. SUPPORTING DATA

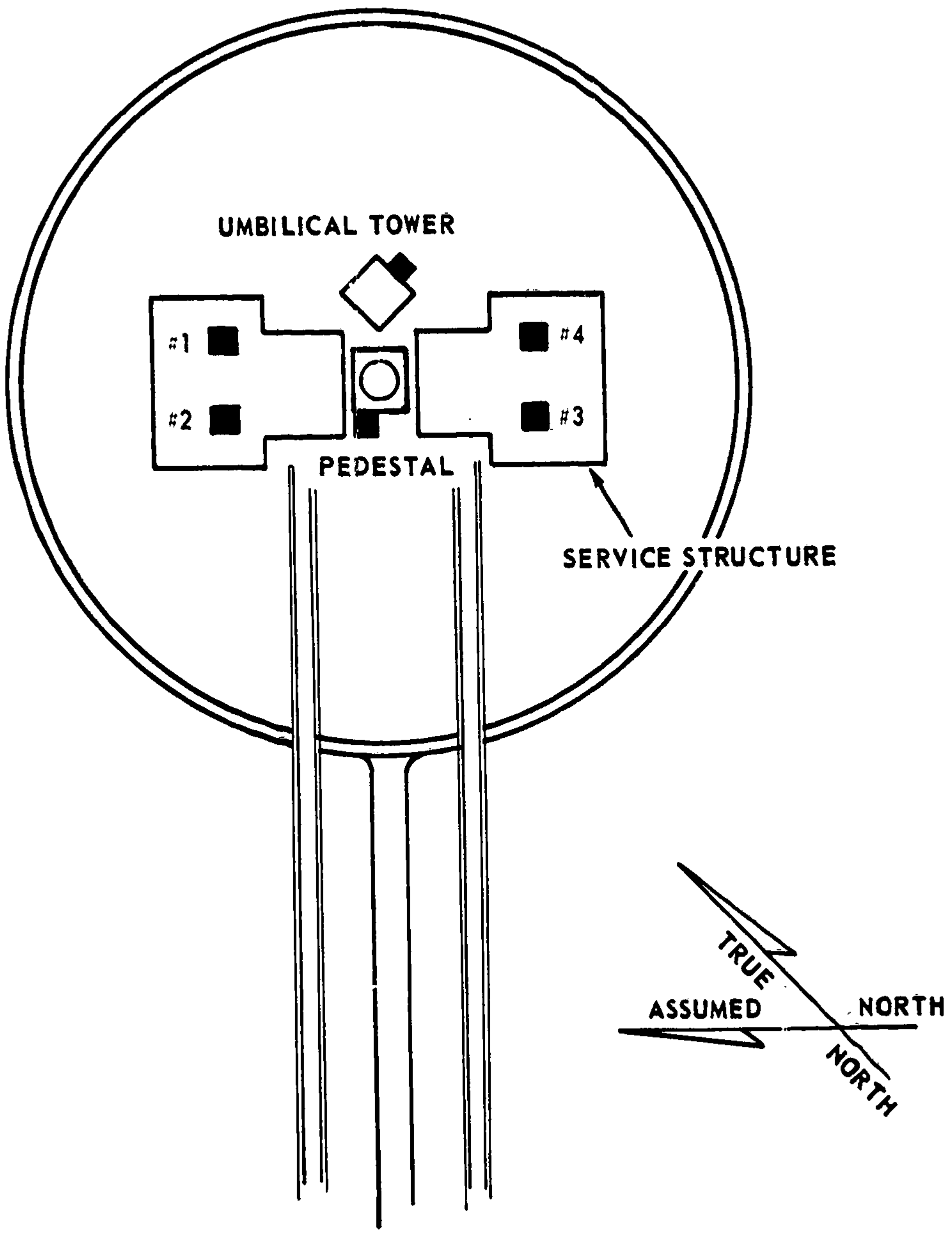
Enclosure

| | |
|---|---|
| 12-1 | Aerial Drawing of Launch Complex 34 |
| 12-2 | Launch Complex 34 Elevators |
| 12-3 | LC 34 Service Structure Adjustable Level 8 Platform |
| 12-4 | LC 34 Service Structure Adjustable Level 7 Platform |
| 12-5 | LC 34 Egress Route for Astronauts |
| 12-6 | Detailed Narrative Description of the Sequence of Events |
| 12-7 | Requirements placed on Panel 12. |



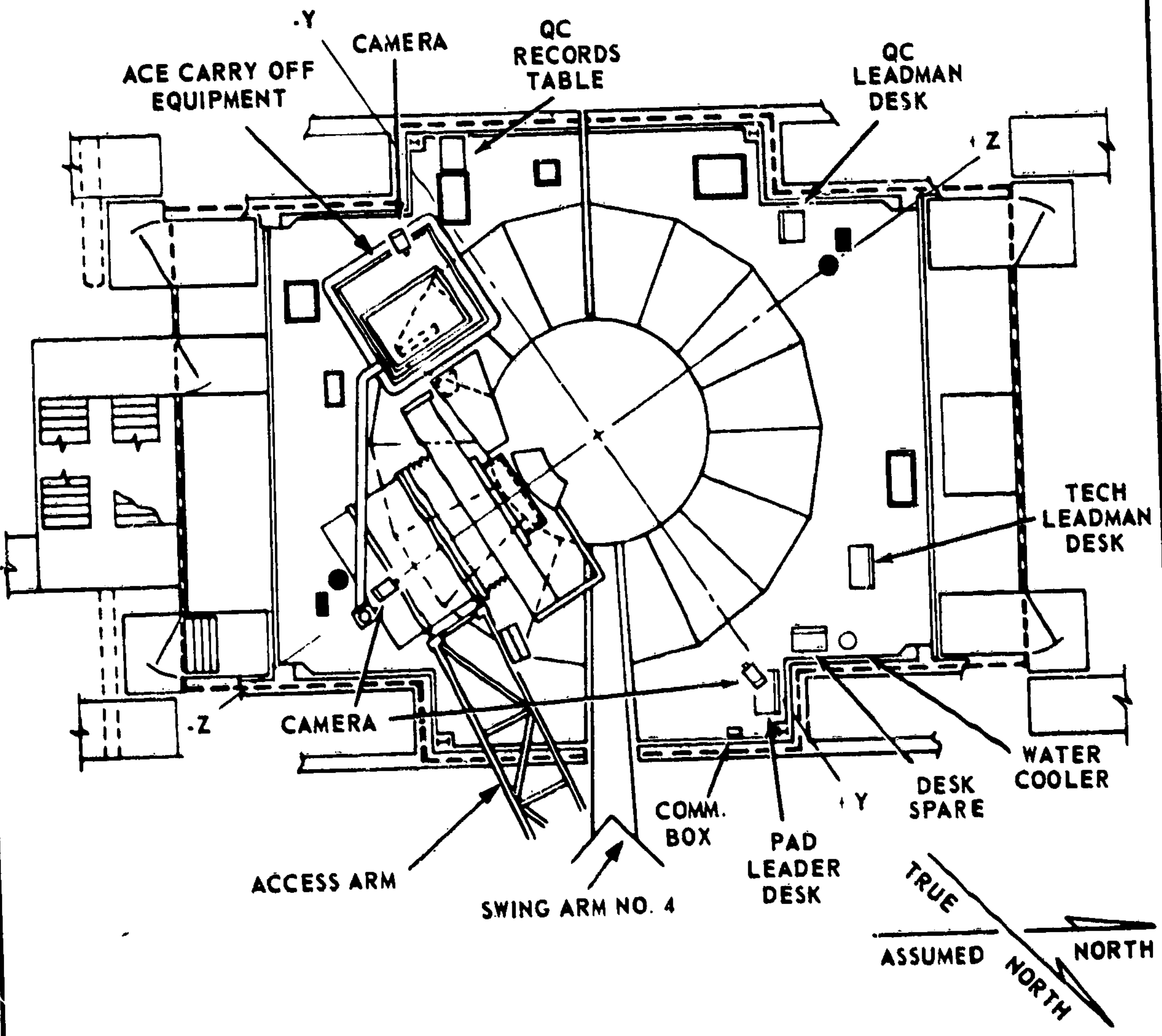

**ENCLOSURE 12-1**

LAUNCH COMPLEX 34 ELEVATORS



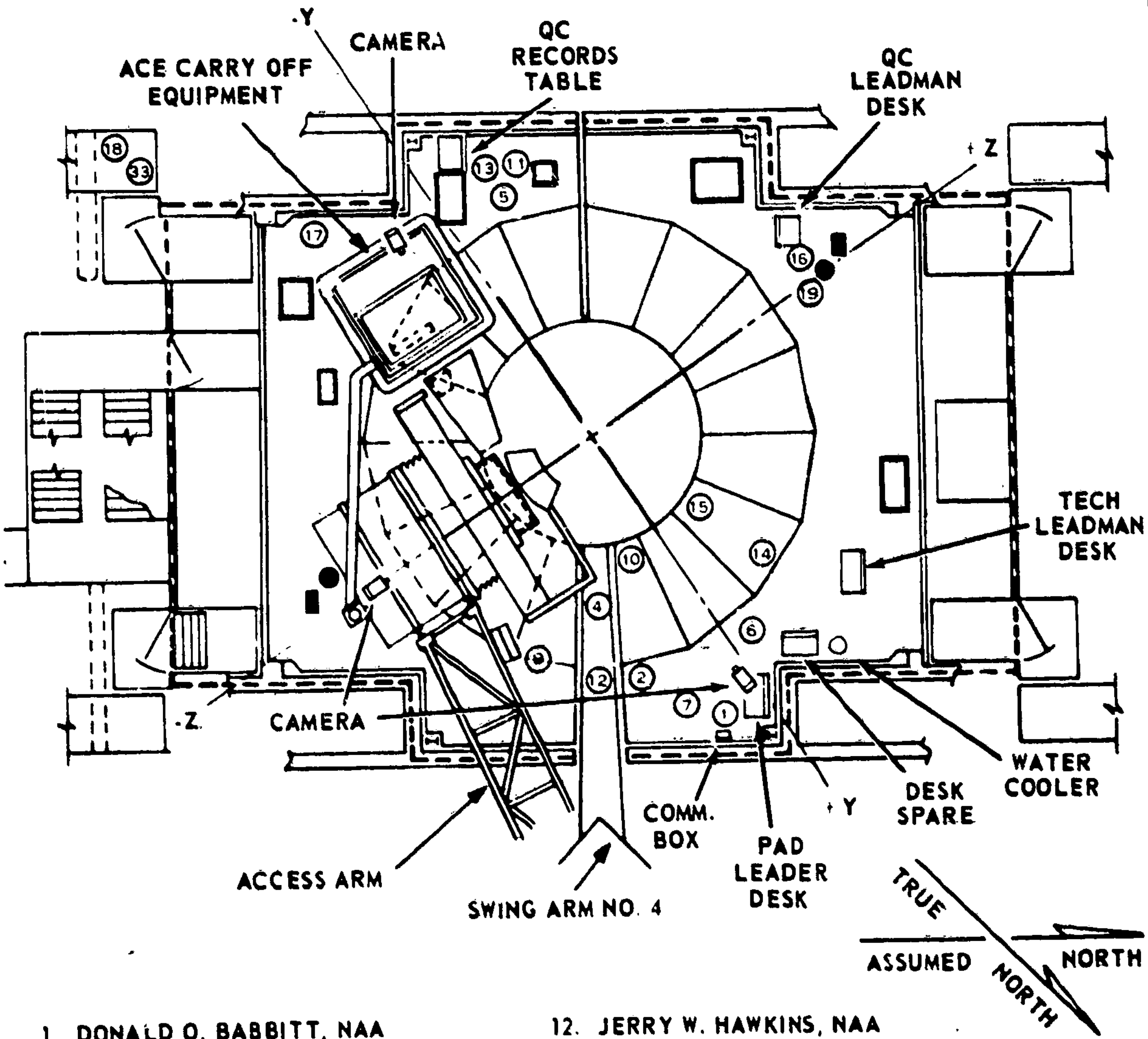

ENCLOSURE 12-2

## LC-34 SERVICE STRUCTURE ADJUSTABLE LEVEL 8 PLATFORM




ENCLOSURE 12-3A

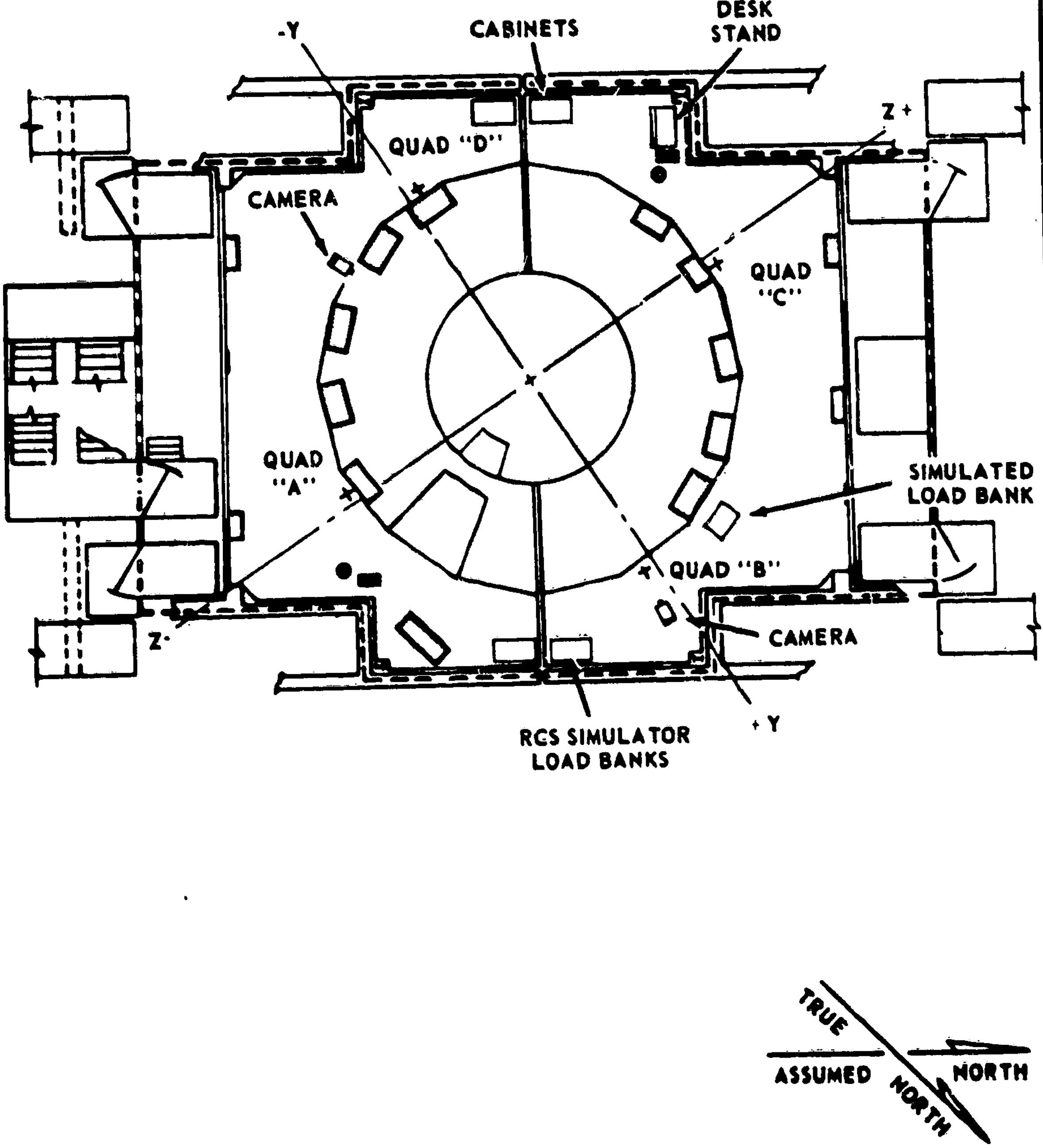
## LC-34 SERVICE STRUCTURE ADJUSTABLE LEVEL 8 PLATFORM




1. DONALD O. BABBITT, NAA
2. JAMES D. GLEAVES, NAA
4. L. D. REECE, NAA
5. RICHARD A. HAGAR, NAA
6. RICHARD L. BACHAND, NAA
7. STEPHEN B. CLEMMONS, NAA
9. JOSEPH H. PLEASANT, NAA
10. BRUCE W. DAVIS, NAA
11. FRIEND DALE HICKENBOTTOM, NAA
12. JERRY W. HAWKINS, NAA
13. W. DONALD BROWN, NAA
14. JESSIE L. OWENS, NAA
15. ROBERT C. HEDLUND, NAA
16. JOHN E. MARKOVICH, NASA
17. JOSEPH L. STOECKL, NASA
18. HENRY H. ROGERS, JR., NASA
19. CREED A. JOURNEY, NAA
33. WILLIS M. MEDCALF, NAA

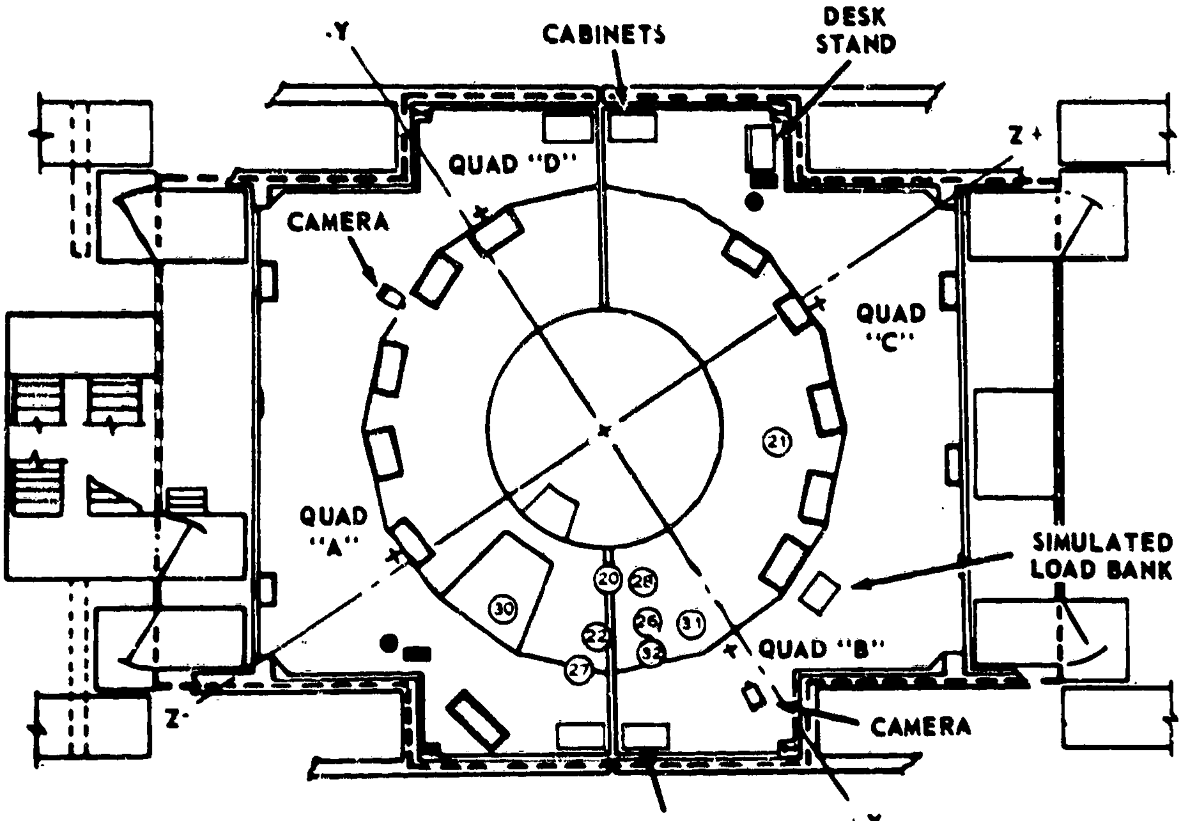
ENCLOSURE 12-3B

# LC-34 SERVICE STRUCTURE ADJUSTABLE LEVEL 7 PLATFORM

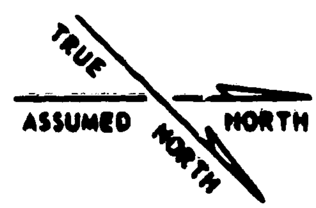



ENCLOSURE 12-4A

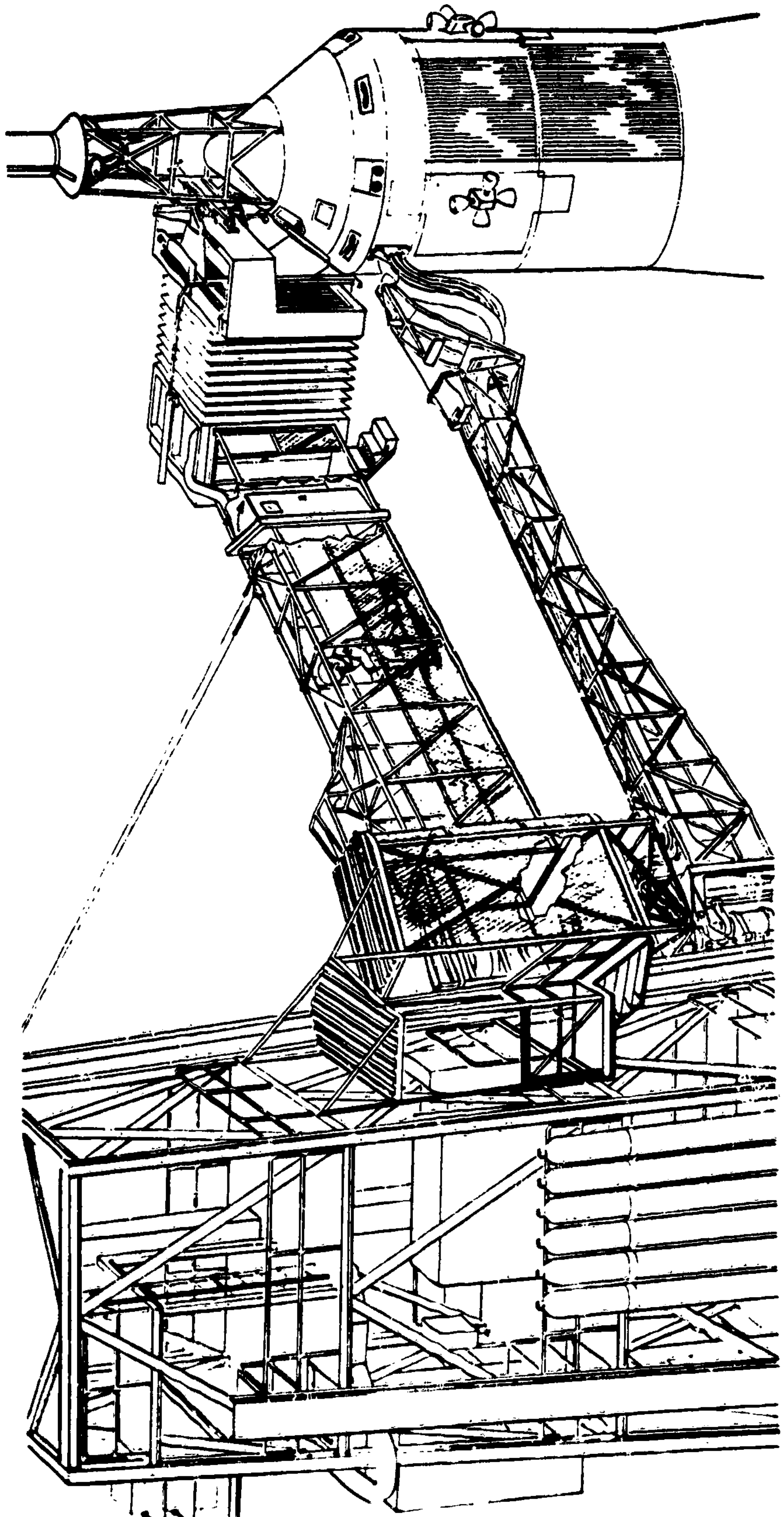
## LC-34 SERVICE STRUCTURE ADJUSTABLE LEVEL 7 PLATFORM




20. WILLIAM J. SCHNEIDER, NAA
21. DAVE E. HOWARD, NAA
22. J. C. SCOTT, NAA
26. GEORGE W. RACKLEFF, NAA-TULSA
27. SAMUEL WILLIAMS, NAA
28. FORREST R. ROOKER, NAA
30. MARVIN L. NELSON, NASA
31. PATRICK E. MITCHELL, NASA
32. WILLIAM C. DEAVER, NAA




ENCLOSURE 12-4B



LC-34 EGRESS ROUTE FOR ASTRONAUTS

ENCLOSURE 12-5

## DETAILED NARRATIVE DESCRIPTION OF THE SEQUENCE OF EVENTS

The following is a description of the events surrounding the Apollo 204 incident, as determined by the Apollo 204 Review Board Counsel. This narrative is based upon witness statements (Appendix B), a recording of the communications on the OIS channel Black 3, and re-interviews (non-recorded) of the principal participating witnesses. The re-interviews (March 28, 29, and 30, 1967) were done by the Review Board Counsel with the Witness Statements Panel 12 chairman and one Panel 12 member present. The following was reviewed by the chairman of Panel 12 and in his opinion is a true representation of the facts.

ENCLOSURE 12-6

# DETAILED NARRATIVE DESCRIPTION OF THE SEQUENCE OF EVENTS

The following is a description of the events surrounding the Apollo 204 accident, as determined by the Apollo 204 Board Counsel. This narrative is based upon witness statements (Appendix B), a recording of the communications on the OIS channel Black 3, and re-interviews (non-recorded) of the principal participating witnesses. The re-interviews (March 28,29 and 30, 1967) were done by the Board Counsel with the Witness Statements Panel 12 Chairman and one Panel 12 member present. The following was reviewed by the Chairman of Panel 12 and in his opinion is a true representation of the facts.

It should be recognized that during the attempt to remove the various hatches, visibility within the working areas was virtually non-existent. At the same time, some individuals were wearing gas masks making identification extremely difficult. It is possible that individuals have been improperly placed during the description of a particular sequence. Care has been taken to reconstruct the scene as accurately as human memory will allow. In an effort to identify the individuals involved during the various hatch removals, participants ran through an experiment on a mock-up spacecraft. The experiment tended to clarify the sequence of events and is relied upon in this narrative as being a reliable indication of the actions involved in the crew rescue attempt.

Complex 34 consists of the Service Structure containing adjustable levels which completely surround the vehicle and the Command Module and an umbilical tower. Work on the vehicle during erection and preparation for launch, is carried out on the various enclosed adjustable levels. Prior to launch, the entire service tower is moved away from the erected vehicle.

The umbilical tower is a fixed installation containing an elevator, umbilicals to the Launch Vehicle, and an environmental control assembly (called a "white room"), at the end of a swinging access arm. The "white room", which is relatively small, swings against, and surrounds the hatchway of the Command Module. It is separate from adjustable Level 8 which completely surrounds the Command Module, until the service tower is pulled away. When the service tower moves away, the "white room" stays in position, pressed against the Command Module hatch, until 30 minutes prior to launch. It is through the white room, the access arm and the elevator, that crewmen can escape from the Command Module in the event hazardous conditions are discovered. After the access arm and the white room swing away from the vehicle, escape from hazardous conditions on the pad would be via the Launch Escape System (LES). It contains a solid fueld rocket motor, capable of pulling the Command Module clear of the complex. Prior to the Plugs Out Test, the Launch Escape System, with its rocket motor, was erected on top of the Command Module. While the wires activating the LES were shorted, there nevertheless remained the possibility that if sufficient heat were generated, the solid fuel could explode or the motor ignite. This would cause wide spread destruction to the adjustable levels of the service tower and to the Launch Complex itself.

The "white room" is completely separate from the service structure since it is an integral part of the umbilical tower. However, the "white room" and the access arm, swing into Level A-8 where the Command Module is situated. In this configuration, the "white room", the access arm and the umbilical tower appear to be part of the service structure.

The "white room" is attached to the Command Module by an hydraulically operated adapter boot. The boot fits against the Command Module, it's flexible material forming a seal around the Command Module hatch. From inside the rectangularly shaped "white room", the adapter boot presents a ramp-like appearance to the Command Module hatch; the floor of the white room being elevated above the hatchway. A door opens from the access arm into the "white room". Another white room door directly opposite the access arm doorway leads into Level A-8. This second door was sealed shut at time of the accident. The door is sealed as a safety precaution to prevent use once the service structure is pulled away from the Command Module. Until that time, access into Level A-8 is possible from the access arm itself.

**ENCLOSURE 12-6**

Four corner elevators on the service structure serve the various levels.

The count on OCP-FO-K-0021, the Plugs Out Test, was at T-10 minutes and holding. Efforts were being made to correct communications difficulties which had existed throughout the test. However, the communications difficulties, while still existing, were not deemed important enough to halt the test. The count was due to resume within minutes when the first report of fire was heard.

The report from inside the Command Module is believed by the witnesses on Level A-8 to have been made by the Pilot. Some heard the report over their headsets, others heard it over speakers installed on Level A-8.

After the initial shock of the report of fire, followed within seconds by the rupturing of the Command Module with flames pouring out of the failed area of the Command Module, efforts were begun to remove thr three hatches of the Command Module.

At the instant of the report of fire, J. D. Gleaves, standing on the access arm, immediately began moving toward the "white room". He heard pressure escaping from the cabin relief valve and recalls thinking at the time, that the Command Pilot had dumped the pressure of the Command Module in accordance with the fire emergency procedures. It was his feeling that since the cabin was being depressurized he would have no difficulty in removing the inner hatch. As Gleaves started to step into the white room, he saw a very bright flash of light emanating through the porthole of the Command Module. He turned around. With him at this time was J. W. Hawkins. As they neared the door on the access arm, Gleaves recalls feeling a pressure and seeing tongues of flame escaping from the failed portion of the Command Module. The force of the pressure pushed him against Hawkins. With some difficulty they opened the door, which opened toward them. Their first thoughts after seeing the Command Module rupture and the flames spread across Level A-8, was that Pad Leader D. O. Babbitt and the others must have been killed. It was only after Babbitt and others joined them on the swing arm, that they realized that no one on Level A-8 had been seriously injured as a result of the rupture of the Command Module. Hawkins secured a fire extinguisher, entered the "white room" and put out two localized fires. Babbitt and Gleaves immediately returned to the white room area and began the job of removing the boost protective cover (BPC) hatch, which is the Command Module's outermost hatch. Though the BPC hatch had not been fully installed, that is, dogs which attach it to other portions of the boost protective cover surrounding the Command Module had not been engaged, it was necessary to insert a tool into te hatch in order to secure a hand hold. Babbitt and Gleaves report that the BPC hatch itself had been distorted, probably by the fire and rupturing of the Command Module. The hatch, which normally would have been easily removed, had to be forced. During this period of time, the "white room" continued to fill with smoke.

While some individuals had working gas masks, others did not. Even when the gas masks, primarily designed for use in toxic atmospheres, became operative, they were unable to work efficiently except for very short periods of time in the dense smoke-filled atmosphere of the white room.

Visibility was virtually zero. The various crews working in relays had to proceed primarily by the sense of touch.

After removal of the boost protective cover by Babbitt and Gleaves, they left the "white room". Gleaves had no gas mask and was obviously feeling the effects of the dense smoke. He was beginning to gag and choke, and yet, in spite of his physical condition, was able to complete, with Babbitt's assistance, the complete removal of the boost protective cover hatch. The tool used to remove this hatch is the same tool used to remove the ablative hatch and the inner hatch of the Command Module. As Babbitt and Gleaves left the "white room", Gleaves recalls handing the tool to Hawkins. Hawkins does not recall who handed him the tool. He knows someone did.

With Hawkins were S. B. Clemmons and L. D. Reece. During the ablative hatch removal, Babbitt was also in the "white room". Within one minute and 30 seconds of the first report of fire, Babbitt had entered the "white room" at least once and perhaps twice. He had recovered his headset and was able to contact the blockhouse and describe the conditions as they were developing.

The removal of the ablative hatch was relatively simple. After the tool was inserted, the hatch was lifted off and carried out of the white room by Reece who threw it on the floor of adjustable Level 8 once he was clear of the "white room".

Hawkins remained in the "white room" after the ablative hatch was removed. Continuing to use the removal tool, he began work on the inner hatch. With him were Clemmons and Reece, though the witnesses at this point, because of the dense smoke, do not recall seeing all others in the "white room" at the time. Hawkins and Clemmons were apparently nearest the hatch, Hawkins using the tool to unlock the hatch while Clemmons was attempting to secure a hand hold on it.

There are two handles on the exterior of the inner hatch which, when installed, are wired down with safety wire. Whether or not Clemmons broke the safety wires holding the handles flush to the hatch, he does not recall. Once the hatch was unlocked, both men pushed it upward to relieve it from the dogs. Once the inner hatch was free, they attempted to drop it down onto the Command Module door. The hatch went only part way down.

The pad crew realized that it was not necessary to completely remove the inner hatch in order to provide access to the interior of the Command Module. During the scheduled egress exercise the inner hatch would have been unlocked by the crew and placed on the floor of the Command Module. While a small portion of the hatch cover extends above the lower rim of the hatch, access to and from the Command Module is possible.

When the inner hatch was unlocked, intense heat ans smoke came out of the open hatchway. No flames were visible on the inside. Two floodlights installed on the couches were barely visible through the smoke.

Hawkins attempted to examine the interior of the Command Module. He called out to the crewmen. He remembers there was an unusual silence from the Command Module interior.

Babbitt too had examined the Command Module's interior. Concerned about reporting over the wide communications net that he was then using that the astronauts were dead, he simply advised the ground that he would not describe what he had seen..

Babbitt and H. H. Rogers, Jr., returned to the "white room" after the inner hatch had been unlocked and partially lowered into the Command Module. During the efforts to lower the hatch, it dropped further down into the Command Module. Babbitt and Rogers then returned for fresh air to the swing arm.

Shortly, thereafter, Babbitt, suffering from smoke inhalation in the efforts of the attempted rescue, was relieved as Pad Leader by L. Curatolo.

Gleaves who had at various times been forced to the swing arm by the smoke, returned, saw that the hatch was part way down and gave it a kick. As a result of the kick, the hatch fell even further into the Command Module. Gleaves had secured a flashlight from his tool box during one of his entries into the white room and peered into the dark smoke and soot-covered interior of the Command Module. He could see nothing except the faint glow of the floodlights mounted near the couches. The lights were within inches of his position, but they appeared to be small candles very far away.

W. M. Medcalf entered the "white room" and began his attempt to remove the inner hatch completely from the Command Module.

Members of the regular fire department began arriving at Level A-8. The pad egress team, which had been standing by at the fire station, also responded to the call, but in much slower M113 Armored Personnel Carriers. The team was scheduled to participate in the egress exercise, scheduled at the end of the plugs out test.

Fireman B. Dawes arrived at Level A-8 through a service elevator and went to the "white room". He recalls seeing the hatch laying inside the Command Module. Fireman J. A. Burch, Jr., upon his arrival at the "white room" saw people working around the hatch. He joined them and began to pull at the inner hatch in an effort to remove it completely from the Command Module. He began to feel the effects of the smoke and had to run out of the "white room" to the access arm. On the access arm he found a gas maks, donned it, and returned to the "white room" to continue in his attempt to remove the hatch from the Command Module. Once again he was not successful. He was forced out of the "white room" by the smoke. He replaced his gas maks, and returned for a third attempt at the inner hatch removal. This time with the aid of Medcalf, he was successful. With the exception of Assistant Chief J. C. Mooney, who was a member of the pad egress team, none of the firemen were familiar with the configuration of the Command Module. They had received no training in the removal of the various hatches, since it was felt that the pad egress team would be available to perform this function during hazardous tests or launches. The pad egress team did have knowledge of the Command Module configuration and had appropriate tools to remove the three hatches. Chief Mooney arrived at "white room" after the inner hatch cover had been completely removed from the Command Module.

After the hatch was removed, Burch leaned into the Command Module. Everything was black. He could not see any bodies. He secured a flashlight but even with its assistance he was unable to see anything. As he was crawling out of the open hatchway, he did notice one body. He attempted to pick it up, but he was unable to move it. He then left the Command Module. In the meantime, Fireman B. H. Batts with others was removing the panel that sealed the second door of the "white room", which led directly onto Level A-8. This was necessary in order to vent the "white room" and the Command Module. The use of fans to blow the smoke out of the Command Module was considered unwise, since the fans could possibly re-ignite substances within the Command Module. Chief Mooney, a member of the pad egress team which had planned to participate in the egress exercise scheduled for the end of the Plugs Out Test, also made an effort to remove crewmen from the Command Module. This activity was stopped, confirmed by physicians who had arrived at the Command Module, that all three astronauts were dead, and that an investigation of the Command Module as it was found after the hatches were open would be important in attempting to determine the cause of the fire.

Photographs were then taken of the Command Module, of Level A-8, and other portions of the service structure.

Witnesses reported seeing firemen on the complex without firefighting equipment. Since each level contains fire extinguishers as well as hose lines, it was not necessary for them to being equipment from the ground in order to fight fires. The hose lines were working and lines were charged, though not used. Fire extinguishers from Level A-8 and other levels of the service structure were used to control blazes outside the Command Module and at other locations on the service structure.

Because of the proximity of fires, workers removed their nylon work smocks. Examination of the smocks after the incident showed that some of them had been burned, apparently from fire brands erupting onto Level A-8 when the Command Module ruptured.

The access arm was the closest position to the "white room" in the Command Module where fresh air was available for the workers. While a few witnesses reported that their gas masks were operative, a majority indicated they were of little assistance during the rescue attempt, because of the density of the smoke.

J. E. Cromer, on duty at the Umbilical Tower elevator, reported that the elevator was at Level 200, which corresponds with Level A-8, at the time the fire began. While the elevator could be remotely controlled from the blockhouse, Cromer could also control it from his position on the umbilical tower. The elevator remained at Level 200 until Gleaves, choking and gagging from the smoke inhaled in his repeated entries into the "white room", had to be sent to the ground. Cromer reports that the first indication that he received of the fire was the sensation that there was an explosion on Level A-8. He also reports seeing a tongue of flame emanating from the "white room". Immediately after the explosion, personnel from the inside of Level A-8 came out on the access arm. After reporting there was a fire to his control point within the blockhouse, Cromer broke out a box containing gas masks. Cromer reports that personnel on the access arm immediately began re-entering the "white room" in their efforts to remove the hatches and effect crew rescue.

Gary Propst, an RCA technician, stationed in the blockhouse and responsible for controlling remote television cameras installed on Level A-8 and in the "white room", first became aware of the fire through the report heard on his headset. He immediately looked at the "white room" monitor. He saw light in the Command Module emanating from a point on it's left side. At the same time he saw hands reach above the hatch, and movement of the crew inside of the Command Module. With the light increasing in intensity inside of the Command Module, Propst immediately adjusted the camera to the light levels within the Command Module. This action may have caused television monitors to show what appeared to be an explosion of white light, but was in reality an adjustment of the camera's sensitivity to the light.

Propst is convinced that the time of the accident, from the moment he first learned of the fire, until the "white room" filled with smoke, was much longer than data indicates. He recalled engaging in a conversation with others in the blockhouse as to when the crew would blow the hatches. Propst was not aware that the hatches on the Command Module could not be exploded off. He recalls, by viewing other monitors at Level A-8, that the "white room" did not fill with smoke until visibility was almost impossible on Level A-8 itself. As the fire progressed, smoke did fill the "white room" making detailed viewing through the TV camera impossible. However, Propst could tell that there was activity going on in the "white room" as individuals would stand in front of lights installed for the TV cameras, thus varying the light intensity. While he could discern that something was going on, he could not see in detail, what was happening.

While arrangements can be made to video tape the television monitors, facilities for doing this are not located within the blockhouse, and a video tape does not exist of what the monitors showed during the fire period.

Propst viewed a motion picture of a test fire in a boilerplate Command Module taken in Houston, Texas, after the incident. He states that the film showing fire through the boilerplate hatches, at 16.4 pounds per square inch pure oxygen, were very close to what he viewed through the monitor. At one point in the film, bright white flames sweep across the hatch. Propst does not believe that this happened the night of the fire, though the quality of flickering light was similar to what he observed. It should be noted that in the boilerplate fire test, the vessel was vented at a different point than where rupture occurred on Spacecraft 012 during the night of the fire.

The report of fire was radioed to the fire station by G. C. Meyer, Pad Safety Officer. As the fire trucks approached the complex in response to Meyer's call, firemen looked at the top of the launch complex and saw very little smoke. Thinking that the area would be relatively clear, they did not take air packs with them, which were available on the truck. Later, after the smoke conditions were discovered by the firemen, the air packs were taken to the fire scene.

The total elapsed time from the report of fire to the opening of the inner hatch into the Command Module could not have exceeded five minutes, 27 seconds. This is based upon a timing of the tapes made of voice transmissions during the incident. The timing is verified by a log matintained by W. H. Schick from within the Blockhouse. Schick's log is based upon reports he heard over the communications network. While the GMT timer he was using did not show "seconds" he was able to discern minutes and record them in his log. He shows the first report of fire as having been received at 6:31 p.m. and the first report that the hatches were off at 6:36 p.m. Since he did not have a "seconds" display he was unable to record the exact second the fire report was heard, nor the exact time of the report that the hatches were off.

None of the men working on the hatch removal believed the crew could have survived the fire. The heat was described as intense, the destruction considerable. Despite their belief that the crew was lost, and their knowledge of the hazard which existed because of the rocket motor above them on the Launch Escape System, they proceeded under almost impossible conditions to open the Command Module in a desperate effort the save the crew. That the hazard was real in their minds, is shown by the statement of one witness, that he considered jumping from the tower immediately after the Command Module erupted. He felt that death was imminent in any event. He, nevertheless, stayed at Level A-8 and worked in the "white room" to remove the hatches.

Curatolo, who had relieved Babbitt, was relieved by J. Murphy at 8:00 p.m. By then, all of the fires had been exinguished for some time.

Removal of the crew was to begin only after complete photographic coverage of the Command Module had been completed. The exact configuration of the Command Module, the position of its switches, and the evidence of what lights were burning, were considered to be important for further investigation.

By 2:00 a.m. Saturday morning, the crew had been removed from the Command Module.

## REQUIREMENTS PLACED ON PANEL 12

| From | Subject |
|---|---|
| 1. Dr. Floyd Thompson, Board Chairman | Required memorandum regarding Baron and Parker reports. |
| 2. Col. Charles F. Strang, Board Member | Requested information from witnesses on Levels A-7 and A-8 on whether they touched or caused movement of the Command Module or Service Module in the five-minute interval immediately preceeding the incident. |
| 3. Mr. George C. White, Jr., Board Member | Requested a statement from LeRoy G. West (NASA) regarding placement of gas chromatograph plug. |
| 4. Board Panel Coordination Committee | Requested copies of extracts of witness statement information be sent to the Committee members. |
| 5. Board Panel Coordination Committee | Required Panel 12 to submit a status report to the Committee at the daily 5:00 p.m. meeting. |
| 6. Board Panel Coordination Committee | Requested Interim Report on Panel activities. |
| 7. Board and Panels 6, 8, 11, 14, 17, 18, and 19 | Required copies of all published witness statements and extracts. |
| 8. Dr. George E. Mueller, NASA Headquarters | Requested number of people located on Levels A-7 and A-8 of the Service Structure and on the Umbilical Tower at LC 34 at the time of the incident. |
| 9. Panel 1 | Requested statements from personnel involved in pre-crew ingress, crew ingress, cabin close-out, and cabin purge. |
| 10. Panel 2 | Requested a set of witness statements for temporary perusal. |
| 11. Panel 3 | Requested copies of Bendix Gas Analyses. |
| 12. Panel 5 | Required further statement from James F. Terry (NASA-KSC) regarding times in relation to indications of fire versus TV monitor image. |
| 13. Panel 7 | Requested information on documents that went into and out of Spacecraft 012 prior to hatch closure. |
| 14. Panel 8 | Required:<br>(a) Information concerning astronaut placement of loose articles.<br>(b) Interview of ingress and hatch close-out crew.<br>(c) Interview of witnesses regarding knowledge of solvents used and or strange odors detected. |

**ENCLOSURE 12-7**

(d) A list of personnel who visited Levels A-7 or A-8 on LC 34 for the 24-hour period prior to the incident.
(e) Certain witnesses to participate in sniff test.

15. Panel 10 — Requested statements regarding cabin relief valve operation, or times of explosive or popping noises during the first 15 to 20 seconds of the fire.

16. Panel 11 — Requested:
(a) A PAA Dispensary list including medication given to personnel involved in the incident.
(b) All information regarding astronaut body positions.

17. Panel 13 — Requested witness comments regarding emergency equipment.

18. Panel 14 — Required:
(a) List of all personnel who were on LC 34 from 5:30 p.m. EST to 7:30 p.m. EST on January 27, 1967.
(b) Copies of statements made by Thomas R. Baron (self-employed), Donald O. Babbitt (NAA), James D. Gleaves (NAA), and Rocco A. Petrone (NASA-KSC).
(c) Copies of any statement that comments on security or lack of security.
(d) Copy of Arthur E. Vreeland (Federal Electric Corporation) statement.

19. Panel 16 — Requested certain witnesses observe the TV simulation film to obtain witnesses reaction regarding clarity and detail of the simulation.

20. Panel 17 — Requested Panels 3, 11, and 12 prepare a final "Time Line" from onset of T-10 minutes hold through medical determination of deaths.

21. Panel 18 — Requested:
(a) Certain primary witnesses view the Panel 16 TV simulation film and note any changes in, or verify, the witness observations and time correlations.
(b) Interviews of Richard A. Hagar (NAA) and Richard L. Bachand (NAA) regarding movement of any article in the Spacecraft during crew removal.

# REPORT OF PANEL 13
# GROUND EMERGENCY PROVISIONS
# APPENDIX D-13
# TO
# FINAL REPORT OF
# APOLLO 204 REVIEW BOARD

# GROUND EMERGENCY PROVISIONS

## A. TASK ASSIGNMENT

The Apollo 204 Review Board established the Ground Emergency Provisions Panel, 13. The task assigned for accomplishment by Panel 13 was prescribed as follows:

This task involves an orderly review of planned ground emergency procedures relative to their adequacy, as well as a review to determine that emergency procedures, in fact, exist for all appropriate activities. This review should concentrate on activity at the launch site, and should include recommendations to the Board for changes in existing procedures and for the creation of new emergency procedures if deemed necessary.

## B. PANEL ORGANIZATION

1. MEMBERSHIP

The assigned task was accomplished by the following members of the Ground Emergency Provisio Panel:

Mr. G. F. Page, Chairman, Kennedy Space Center (KSC), NASA
Mr. L. A. Barnett, Kennedy Space Center (KSC), NASA
Mr. N. M. Carlson, Kennedy Space Center (KSC), NASA
Mr. J. H. Chappee, Manned Spacecraft Center (MSC), NASA
Mr. R. W. Cunningham, Manned Spacecraft Center (MSC), NASA
Mr. R. S. Sayers, Manned Spacecraft Center (MSC), NASA
Col. H. G. Russell, U. S. Air Force, Office of Manned Space Flight (OMSF), NASA
Mr. R. Rochester, North American Aviation (NAA), Downey, California
Mr. G. F. Smith, North American Aviation (NAA), Downey, California
Mr. K. C. Wishon, North American Aviation (NAA), Downey, California
Mr. H. H. Luetjen, Consultant, McDonnell Company, Kennedy Space Center (KSC)

2. COGNIZANT BOARD MEMBER

Colonel Frank Borman, U. S. Air Force, Board Member, Manned Spacecraft Center (MSC), NASA, was assigned to monitor the Ground Emergency Provisions Panel.

## C. PROCEEDINGS

1. The Panel approached the assigned task in two phases. First, a review and evaluation of the emergency provisions at the time of the accident. This review included investigations of:

a. The emergency procedures in the published documents;
b. The emergency equipment internal and external to the spacecraft;
c. The emergency training of the flight crew and checkout test team personnel.

The second phase was a review of the existing methods used to identify hazards and insure adequate documentation of appropriate safety procedures and applicable emergency instructions in the operational test procedures.

2. PUBLISHED EMERGENCY PROCEDURES

a. The Apollo Crew Abbreviated Checklist (Reference 13-1) was prepared by the contractor under the direction of the Manned Spacecraft Center (MSC) Flight Crew Support Division. The document includes flight crew emergency procedures for:

(1) Fire or smoke in the cockpit in flight; and.
(2) Pad egress from T-30 minutes to lift-off.

The in-flight fire or smoke procedures considered in (1) above are not appropriate for the situation involving internal fire during ground operations. (Reference report by Panel 20.) The unaided Command Module (C M) egress instructions provided in (2) above were applicable for actions required by the crew to effect egress from the C/M for any reason. A minor change to the unaided crew procedure was documented during the course of a briefing given to the AS-204 Flight Crew by members of the Apollo Emergency Egress Working Group (Enclosure 13-1) on January 23, 1967. This change reflected an agreement to maintain suit oxygen flow and crew communications until the hatches were removed.

b. The Apollo Operations Handbook (AOH) (Reference 13-2) is prepared by the contractor under the direction of MSC and contains flight crew emergency procedures similar to those described above in paragraph a. In practice, the emergency procedures developed and documented in the abbreviated crew checklist are subsequently included in the AOH so that ground control personnel are made aware of the crew actions to be followed in the event of an emergency.

c. The Apollo Flight Crew Hazardous Egress Procedures Manual (Reference 13-3) is prepared by the Emergency Egress Working Group of the Apollo Launch Operations Committee (Enclosure 13-2). This manual is the definitive document concerning spacecraft and pad egress procedures and represents the combined efforts of Kennedy Space Center (KSC), MSC, and the Air Force Eastern Test Range (AFETR). The scope of this document is limited to cover only the terminal 30 minutes of a launch countdown or countdown demonstration. The procedures defined concern only the actions involved in unaided, aided, or incapacitated crew egress during that time period. Actions required to cope with the contingencies which could require crew egress are specifically excluded.

The procedures in this manual which define flight crew actions involved in unaided egress agree with those documented in the Crew Checklist and the AOH. The time line on Page 25 (Enclosure 13-3) of the egress manual indicates 60 seconds are required for the flight crew to open the spacecraft hatches and egress once the cabin pressure is vented. Practice runs under ideal conditions involving non-flight spacecraft configurations indicate that estimate to be correct. (A practice run involving a fully suited flight crew, venting cabin pressure, removing the three flight configuration hatches and egressing the spacecraft has never been performed.) Although there are no documented data available, the portion of the unaided egress time (60 seconds) involved in hatch removal by the flight crew is considered to be 40 to 50 seconds.

Incapacitated flight crew egress procedures defined in the egress manual are intended for use by the trained members of the Pad Egress Team. The time lines on Pages 26 and 27 of the manual (Enclosure 13-4) indicate 10 minutes is required from initiation of the operation to completion of crew removal. However, the portion of that time required to remove all three hatches from the outside is 70 seconds, assuming cabin pressure is already vented. Numerous practice runs by Pad egress personnel have verified that time to be correct under ideal conditions.

At the time of the AS-204 accident, the trained Pad Egress Team was not on station at Launch Complex 34. Their presence during the Space Vehicle Plugs Out Integrated Test had not been required since the operation was not previously identified as hazardous. However, the entire egress team was due on station following completion of the test in support of an unaided egress practice operation.

d. The spacecraft checkout procedure for the AS-204 Space Vehicle Plugs Out Integrated Test was OCP FO-K-0021-1 (Reference 13-4). This document, like all spacecraft test documents at KSC, was prepared by the contractor and approved by NASA-KSC-Spacecraft Operations (SCO). The document did not contain emergency procedures other than two pages of instructions for emergency shutdown of spacecraft direct current (DC) and alternating current (AC) power. The safety requirements included in the Operational Checkout Procedure (OCP) do not designate any portion of the test procedure as hazardous. (Enclosure 13-5).

The test objectives listed for the procedure include:

(1) To verify overall Spacecraft Launch Vehicle (SC/LV) compatibility and demonstrate proper function of Spacecraft (S/C) systems with all umbilicals and Ground Support Equipment (GSE) disconnected.

(2) To verify no electrical interference at time of umbilical disconnect.

(3) To verify astronaut emergency egress procedures (unaided egress).

Objective (3) required suited crew operations in a closed cabin with a pressurized 100 percent oxygen atmosphere. This was the first time this third objective was combined with a Space Vehicle Plugs Out Integrated Test.

e. The Launch Vehicle Checkout Procedure being used for the AS-204 Space Vehicle Plugs Out Integrated Test was I-20015-SA204 (Reference 13-5) prepared by Chrysler (CCSD) and approved by NASA-KSC-Launch Vehicle Operations (LVO). This document contains emergency procedures (Section AW) which provide instructions for recycling the Launch Vehicle following a cutoff or a hold at any point in the final 30 minutes of the count. No reference is made to any hazardous operations being involved in the LV portion of the test other than standard safety procedures for handling LV ordnance items.

f. The only other published procedure involved in the AS-204 Space Vehicle Plugs Out Integrated Test was the Integrated Space Vehicle Procedure I-41001-204 (Reference 13-6) prepared and approved by NASA-KSC-Launch Operations Directorate (DLO). This document was used by the NASA-KSC Test Supervisor to coordinate LV-to-S/C interface activities and all off-site real-time support functions. The procedure does not contain any emergency procedures.

g. Published emergency procedures are of limited value to a flight crew in the presence of an extremely time critical emergency. In such instances, they must resort to those procedures committed to memory or instinctive action. Such procedures are developed by the crews as a result of intimate knowledge of the written procedures coupled with a real-time awareness of spacecraft configuration.

For time critical egress from the C/M, the flight crew would have eliminated all unnecessary steps from the documented procedures. Reaction would have been by reflex to the following minimum escape procedures:

(1) Initiate cabin pressure dump
(2) Unfasten restraint harnesses
(3) Release inner hatch dogs
(4) Wait for pressure decay
(5) Remove inner hatch
(6) Release and push out ablative hatch and boost protective cover
(7) Disconnect umbilicals and cobra cables
(8) Exit spacecraft

Post-accident investigation (Reference Panel 11 report) indicates that the AS-204 flight crew accomplished very little, if any, of the above minimum procedures before being incapacitated by the fire.

3. EMERGENCY EQUIPMENT INSIDE THE COMMAND MODULE

a. Spacecraft Cabin Depressurization Equipment:

As established in paragraph 2.g., the initial requirement for S/C egress is cabin depressurization. The Apollo Block I spacecraft incorporates no provisions for emergency cabin depressurization. Three depressurization methods are possible from within the cabin:

(1) The normal and documented method of cabin depressurization requires activation of one of the cabin relief valves. It has an effective venting area of 1.5 square inches and would accomplish venting from 16.4 pounds per square inch absolute (psia) to 14.8 psia in approximately 18 seconds (Enclosure 13-6, Figure 4).

(2) Activation of the post-landing cabin vent fans would also initiate cabin depressurization. This method, designed for use after water impact, opens two sliding valves in the tunnel area, each of which has an effective opening of 19.5 square inches. The specification limit for operation of these valves is 0.75 pounds per square inch differential (psid), although they have been demonstrated to 5 psid. There are no available data to indicate time of venting through these valves into the closed forward deck area (prelaunch configuration). Venting by this method was not included in the documented emergency egress procedures

(3) As a last resort, emergency depressurization could be accomplished by breaking one of the cabin windows. This method has never been demonstrated and there are no data indicating the

venting time involved.

There is no indication that the AS-204 flight crew was able to initiate cabin depressurization following the outbreak of the fire. In the presence of the rapidly increasing cabin pressure which resulted from the fire, activation of the normal vent would have had no noticable effect.

b. Quick Release Crew Restraint Harness:

Each crewman is provided with an individual restraint harness. The harness assembly consists of two shoulder straps and one lap belt. The shoulder straps and lap belt are connected together by means of a three-point locking/release mechanism attached to one side of the lap belt. Release of both the shoulder straps and the lap belt is accomplished by pulling a release lever located on the top of the lap belt buckle.

c. Internal Spacecraft Hatch Release Equipment:

The main hatch assembly provides the only means of crew egress on the pad. The hatch assembly consists of three separate covers or hatches (Enclosure 13-7). The inner hatch serves as a spacecraft structural load carrying member and crew compartment pressure seal. It has an effective area of 1200 square inches. The ablative (middle) hatch provides thermal protection for entry. Over this fits the boost protective cover (outer) hatch. Removal of all three hatches was essential for crew egress. Removal of the inner hatch requires rotation of a wrench counter-clockwise through approximately 220 degrees to release six latch assemblies located on the bottom edge (outer side) of the hatch (Enclosure 13-8). A prerequisite to inner hatch removal is the lowering of cabin pressure to approximately ambient. A crewman may then lift the inner hatch (approximately 55 pounds) up and in for stowage in the spacecraft.

The Boost Protective Cover (BPC) is released by the crewman striking a push-type plunger which extends through the middle hatch and is attached to the BPC. The middle hatch is then released by pulling on a cable arrangement. Both middle and outer hatches may then be pushed out of the egress path permitting crew egress.

d. Flight Crew Protective C. aing:

The protective clothing worn by the AS-204 crew at the time of the fire were Pressure Garment Assemblies (PGA) (P/N A 1936). They were essentially the same as the non-Extravehicular Activity (EVA) suits used on Gemini missions. The suit is fabricated of an outer layer of HT-1 nylon, a nylon webbing layer, a neoprene inner-pressure vessel, and a nylon comfort liner. Each crewman also wore a cotton constant wear garment (P/N A 1912-003) under the spacesuit.

Tests conducted at MSC in late 1965 (Enclosure 13-9) using six-inch-square swatches of similar suit material indicate its fire protective qualities. The swatches were tested in a 100% oxygen, 14 psia environment for high temperature flame impingement effect.

Samples were exposed to the pure oxygen environment following two evacuation periods at a pressure of 5 millimeters of mercury (mmHg) to allow out-gassing. A 30-minute soak at 14 psia, 100% oxygen was then made. At the end of this soak, a propane flame was then brought into contact with the swatches. The results were:

(1) No scorching occurred in three seconds.

(2) Burning occurred after five seconds flame exposure.

e. On-Board Communications:

Reliable and clear communications are a significant requirement in support of any emergency operation. The status of the communications system therefore requires consideration. In addition to an on-board intercom system there are two Radio Frequency (RF) systems for voice transmission from crew-to-ground personnel during pad testing. These two systems are the Very High Frequency (VHF) and S-band. A single hardline communication line using the on-board intercom system is also available. Voice transmission by the crew-to-ground support and test personnel is controlled by the switch configuration on the three individual crew communications center panels, panel 20 on the main display console, and the individual cobra cable switches. Voice distribution between the ground personnel and crew is controlled through the capsule communicator's console located in the Launch Complex 34 Blockhouse.

On the afternoon of the accident, the test had been plagued with communication difficulties. Communications had been sometimes good, generally poor, and occasionally intermittent. At the time of the accident, the spacecraft test personnel thought that the communications problems had been "worked around". Voice quality was still poor, however, and it was subsequently discovered that the Command Pilot's communications were continuously keyed. Post-accident inspection disclosed discrepancies between all three communications panels with respect to positions of the VHF and intercom switches.

f. On-Board Fire Fighting Equipment:

There were no provisions for extinguishing a fire within the spacecraft at the time of the accident. This statement is based on the on-board crew stowage list in effect for the AS-204 Space Vehicle Plugs Out Integrated Test. No procedures existed at the time of the fire for on-board fire fighting by the crew.

g. On-Board Fire Detection Equipment:

The primary means of fire detection available to the crew were the physiological cues of smell, sight and touch. With helmet visors closed (as was the case) they were limited to sight and touch only. No instrumentation other than normal spacecraft systems instruments were available for fire warning. Depending upon the source of ignition, the normal spacecraft systems instrumentation could indicate a hazardous condition such as excessive electrical current flow. However, the normal instruments apparently did not provide any warning to the crew in the case of this accident.

4. EMERGENCY EQUIPMENT EXTERNAL TO THE SPACECRAFT:

a. Fixed Facility Fire Extinguishing Equipment:

Launch Complex 34 is supplied by two separate water systems, Potable Water and Industrial Water. The potable water supplies the safety showers, eye baths, and two 1¼ inch diameter 50-foot reel hose lines on each of the spacecraft work levels. This system was operable during the emergency.

The Firex Water System (deluge) supplies industrial water to four spray nozzles on each spacecraft level. Local push-button controls are at all exits to the elevators. However, these controls were not operable during the time of the accident because the system was being modified and had not been functionally tested as a complete system. Had water deluge been necessary on the Command Module level, two valves on the Service Module level (A-7) would have had to be manually operated. There is no remote (from the blockhouse) activation capability for this system.

On the Service Module (S/M), a Gaseous Nitrogen ($GN_2$) Deluge System is used to inert the S/M in the event of Hydrogen leakage during or after Liquid Hydrogen ($LH_2$) servicing. The $GN_2$ system was not active for the Space Vehicle Plugs Out Integrated Test since $LH_2$ servicing activities were not involved.

b. Portable Fire Fighting Equipment at the S/C Work Levels:

The Pan American Aviation (PAA) Fire Department inventory calls for two 50-pound wheel Carbon Dioxide ($CO_2$) units and two 15-pound hand-held $CO_2$ units on each S/C work level. The latest Fire Department inspection of these units was not within the 30-day inspection schedule. (Enclosure 13-10). Under full flow conditions (outlet valve wide open), all of the above units have a specification flow time of 10 to 35 seconds.

An inventory following the accident shows that two 50-pound wheeled $CO_2$ units, sixteen 15-pound $CO_2$ units and one 30-pound dry powder unit were expended on the C/M fire. Two 15-pound $CO_2$ units were used on the Service Module. The additional units were carried to the S/C levels to aid in extinguishing the fire.

c. Auxiliary Breathing Apparatus:

There were 80 masks available at the S/C work levels at the time of the accident. The masks were packed in sealed boxes (20 masks to a box) located as follows: One box on the lower S/M work level (A-6); two boxes on the C/M work level (A-8); and one box on the S/M work level (A-7). Of the available masks, 76 were Mine Safety Appliance (MSA) Rocket Propellant Fuel

Handler's Gas Masks incorporating M-15A1 type canisters. These canisters are designed for use in the presence of toxic vapors and are not suitable for use in high smoke density situations. The remaining four masks were Wilson masks containing LG-6-RTGD canisters which include smoke filters as well as toxic vapor protection.

Witness statements (Reference report by Panel 12) indicate that the dense smoke concentration in the White Room was a major deterrent to the rescue effort. Investigation indicates that 15 of the MSA masks and 3 of the Wilson masks had been used in the rescue attempt.

d. Protective Clothing:

The test in progress was not classified as hazardous; therefore, no special protective clothing was required to be available. S/C technicians on station were clothed in the normal white coveralls or smocks over street clothes.

e. External Hatch Removal Equipment:

No special emergency provisions were available for rapid cabin depressurization and hatch removal from the outside. Tools normally used for installing and removing the hatches were in the hatch close-out kit along with 34 other associated items. This kit was located in the White Room to the left of the access arm entry door A special heavy duty hatch removal tool had been developed by the Emergency Egress Working Group for use by the Pad Egress Team. It is more rugged and easier to use than the standard tool and is normally available in the White Room only during launch countdown or countdown demonstration when the Pad Egress Team is on station; therefore, it was not there at the time of the AS-204 accident.

Cabin depressurization, if required from outside the S/C, can be accomplished by removing the plug from the inner hatch purge fitting. Venting is then accomplished through an effective opening of 0.378 square inches. Figure 3 of Enclosure 13-6 indicates that 80 seconds would be required to vent by this method from 16.4 psia to a pressure that would allow inner-hatch removal. An alternate venting method of breaking the inner-hatch window had been approved for use in Pad Egress Team operations, if required.

f. Ventilation Equipment for Smoke Removal:

There is no ventilation equipment in the White Room that would remove smoke. Filtered conditioned air is supplied to the White Room from the facility conditioning air plant. There are two exhaust ventilating fans on the C/M work level. These were operating during the time of the accident. Two exhaust fans were being installed on the lower S/M level, (A-6) but at the time of the accident, they were not operable. There are no exhaust fans on the upper S/M level (A-7) for the removal of smoke.

g. Test Team Personnel Evacuation Equipment:

There are two means of access or escape; elevators and stairs. There are five elevators and two stairways from ground level to Level 9 (one level above S/C level). The stairways are located on the outer structure, one on the North side and one on the South side. There is also one inner-structure stairway from Level 9 to Level A-6 where it is possible to reach the South outer-structure stairway. On other S/C levels, there is not direct access to the outer-structure stairways.

There are five doorways to the inner-structure on the C/M and S/M levels. All doors are equipped with inside panic bars and open out. For security reasons, all doors except one were locked from outside (could be opened from the inside but not from outside). However, the only means of escape from any of the elevator bridges, if the elevator is not available, is to re-enter the inner-structures. A personnel hazard resulted during the subject accident when one member of the test team was locked out and reached a stairway by climbing out across structural members. The access arm door which must be used for ingress or egress to the umbilical tower is an inward (toward the White Room) swing door. It has a pull latch on the inside and a push button latch on the outside.

h. Communication Equipment:

Communications to the S/C levels are provided by four standard black phones, operational intercom (OIS), hard lines and the public address (PA) system. The OIS hard lines provide for communications to the blockhouse, support building, necessary NAA and NASA trailers, control center, and crew members on board the spacecraft.

The PA system is controlled from the blockhouse and any OIS station can be patched in for transmitting PA announcements. For this test, the Test Supervisor's console was the only transmitting station patched in.

i. Emergency Lighting:

There are no fixed or portable emergency battery lights on the S/C work levels or in the White Room. The only auxiliary lighting available during the emergency was a limited number of personal flashlights.

j. Stand-by Emergency Equipment at Launch Complex 34:

Due to the non-hazardous classification of the S/C test operation, there were no medical or fire equipment or personnel on standby at the Launch Complex in support of the operation. AFETR disaster team and fire fighting equipment arrived at the Launch Complex within five minutes of the first indication of the emergency. The first firemen to arrive at the spacecraft were not equipped with self-contained breathing apparatus. One fireman had to return to the bottom of the gantry to obtain suitable equipment.

k. Complex 34 Egress Facilities:

The facilities for flight crew egress at Complex 34 include the Apollo Access Arm and Enviromental Enclosure (White Room) as depicted on Enclosure 13-11. During post-accident investigation, the following undesirable features of these facilities were noted:

(1) The fiberglass ledge at opening between the White Room (W/R) and S/C makes egress difficult.

(2) A low step in the W/R leading to the S/C entry hatch is a tripping hazard.

(3) The combination hinged and sliding door normal exit from the W/R is very difficult to operate.

(4) Two steps along the access arm (one at the pivot point and one at the W/R entrance door) could cause a fully suited crewman to trip.

(5) The access arm entry door at the juncture of the work level is hinged inward and incorporates no means for emergency escape.

5. FLIGHT CREW EMERGENCY TRAINING:

a. AS-204 primary crew spacecraft egress training was conducted in the mockup building at NAA-Downey, utilizing Block 2 mockup on July 13, 1966. The mockup was equipped with flight type couches, restraint system, and pressure and ablative hatches. A White Room adapter mockup similar to the one on Launch Complex 34 was used. The training included a 30-minute lecture on procedures and equipment and an examination of the hatches and latching mechanisms. Following crew ingress, the hatches were installed and a total of four practice egress runs were performed in street clothes. Several improvements to the egress procedures were made as a result of this session.

b. Further crew training specifically for purposes of effecting spacecraft egress was conducted at the Manned Spacecraft Center and in the Gulf of Mexico as a part of water egress training. A total of four egress exercises were conducted as a part of this training. Pressure Garment Assemblies were worn by the crew in all of the egress runs. The boilerplate vehicle used was in a near-flight configuration with all significant geometry, couches, and pressure and ablative hatches installed. The boost protective cover was not used. Its use would be inappropriate for water egress.

c. On January 24, 1967, the Emergency Egress Working Group of the Apollo Launch Operations Committee briefed the AS-204 flight crew for approximately two hours. As a result of this briefing, several minor changes were made to the procedures in order to make them more compatible with pad egress requirements (Reference Paragraph C.2.a.).

The egress exercise to be conducted at the end of the Space Vehicle Plugs Out Integrated Test on January 27, 1967, was to be the most valid run-through of the procedure up to that time. It was to be the first egress demonstration with the actual spacecraft in prelaunch configuration and with full flight equipment utilized by the crew.

6. CHECKOUT TEST TEAM EMERGENCY TRAINING:

a. The spacecraft test team personnel most closely associated with emergency operations involved in the AS-204 accident were the technicians at the spacecraft. They were responsible for external removal of the spacecraft hatches under normal circumstances. The NAA personnel primarily as• gned this function were the Pad Leader (who has the responsibility for all technicians working on or around the spacecraft), the mechanical engineer, and his two assigned mechanical technicians. None of the NAA personnel on duty at the time of the accident had ever been given training in hatch removal operations under emergency conditions. Hatch technicians on station at the time of the accident had all performed hatch installation and removal operations under normal conditions on numerous occasions and were familiar with the procedures involved.

b. The NASA-KSC Test Supervisor stationed in the firing room of the blockhouse has overall test team responsibility during test operations on Launch Complex 34. Detailed spacecraft test functions are delegated by the Test Supervisor to the S/C Test Conductor also stationed in the firing room. The Test supervisor and S/C Test Conductor on duty at the time of the AS-204 accident were both experienced in hazardous egress practice operations. They had both participated in similar egress operations on numerous manned Gemini and Mercury operations. The Test Supervisor had conducted the only previous Launch Complex 34 hazardous egress exercise on Apollo which was performed during the AS-202 Countdown Demonstration Test in August 1966.

c. There is no record of any type of emergency training exercises pertinent to general launch pad hazardous operations having been conducted on Launch Complex 34. Personnel assigned to pyrotechnic, hypergolic, and cryogenic handling operations do receive specific training in the hazards involved in those activities. However, there are no regular emergency drills to insure that all pad personnel are familiar with the location and use of the available emergency equipment.

7. INVESTIGATION OF THE METHODS PRESENTLY USED TO IDENTIFY HAZARDS AND DOCUMENT EMERGENCY PROCEDURES:

a. Spacecraft ground test operations at KSC are primarily documented in Operational Checkout Procedures (OCP) prepared by the contractor and approved by NASA-KSC-SCO personnel. Special non-repetitive type test operations are documented on Test Preparation Sheets (TPS) which are originated by contractor system engineers and also approved by KSC-SCO. The process by which test requirements from MSC are transferred into specific OCP's is defined in detail in the Panel 7 report. The following discussions are confined to the hazard identification and emergency procedure provisions of that process.

b. Primarily, the documented instructions for determining hazardous and emergency procedures for S/C test documents are contained in the Apollo Pre-Flight Operations Procedure (APOP). As defined in APOP G-100 (Enclosure 13-12), this document is the instrument by which joint contractor / NASA management directives are documented, approved and levied upon the S/C operations conducted at KSC. APOP 0-202 (Enclosure 13-13) is the pertinent directive concerning the generation of test procedures and the associated safety considerations. The KSC document defining the overall safety program at KSC is Kennedy Management Instruction (KMI) 1710.1 (Reference 13-7) which includes general guidelines concerning the generation and approval of hazardous test documents. A third documented source of instructions concerning this subject is a NAA internal directive (Enclosure 13-14).

c. Review of these three sources reveals a certain amount of specific instructions, but very little in the form of an overall plan for insuring adequate safety considerations and emergency procedures in the test documents. In actual practice, those features of the S/C OCP's are developed as defined in the following paragraphs.

d. The Test Outline (Reference Panel 7 Report) for each spacecraft defines, in outline form, all of the tests planned for that vehicle at KSC. The Contractor Safety Office reviews the outline and establishes a list of the operations considered hazardous. The criteria for determination of the hazardous tests is based upon guidelines established in Reference 13-7. The list of hazardous OCP's and all of the test outlines are reviewed by the KSC and AFETR Safety Offices. They, in turn, release a letter establishing the official KSC and AFETR Safety Review Requirements List designating the OCP's for that S/C which must be reviewed and approved by those offices.

e. OCP's are prepared by contractor operations support personnel in conjunction with contractor system engineers. The OCP writer, or originator, is responsible for including all references to safety, hazardous situations and emergency instructions. The instructions defining the scope of this responsibility are completely general and in many instances vague. As a result, the specific test procedures reflect a lack of definitive instructions in these areas.

f. Copies of the draft release of procedures identified as hazardous are reviewed by the Contractor Safety Office and the systems engineers. Significant comments or inputs from the Contractor Safety Office are incorporated in the master-draft copy which is then approved by KSC-SCO, and published as the released document.

g. Copies of released test procedures are forwarded to the KSC Safety Office. Those procedures specified on the list created in paragraph 7.d require review and approval by KSC Safety. Procedures involving hazardous operations at AFETR are forwarded by KSC Safety to AFETR Safety for comments and approval. Approval by KSC Safety is made in writing to the contractor after AFETR Safety has signified their formal approval. Receipt of formal KSC Safety Office approval (after the procedure is released) is a constraint upon initiating the test operation involved.

h. Revisions to procedures originally reviewed by the KSC Safety Office require the same review and approval as the basic document. The AFETR Safety Office must also approve revisions to procedures which will be conducted under their jurisdiction. Real-time deviations required during the performance of a test procedure are orally approved by the responsible on-site Safety Supervisor to the NASA Test Conductor.

i. There is no formal review requirement in the area of S/C safety or emergency procedures between KSC and MSC. As described in Panel 7's report, the existing procedure review system between the two Centers is loosely defined. There is no approval requirement from the MSC Flight Crew Operations Directorate on those procedures involving flight crew participation.

j. TPS's as defined in paragraph 7.a do not presently require review or approval by either Contractor or KSC Safety Offices. The TPS originator is responsible for determining safety or emergency considerations and for soliciting Safety Office review.

## D. FINDINGS AND DETERMINATIONS

1. FINDING

The applicable test documents and flight crew procedures for the AS-204 Space Vehicle Plugs Out Integrated Test did not include safety considerations, emergency procedures or emergency equipment requirements relative to the possibility of an internal spacecraft fire during the operation.

DETERMINATION

The absence of any significant emergency preplanning indicates that the test configuration (pressurized 100 percent oxygen cabin atmosphere) was not classified as a potentially hazardous operation.

2. FINDING

There are no documented safety instructions or emergency procedures in existence which are applicable to the possibility of a serious internal spacecraft fire.

DETERMINATION

The occurrence of an internal spacecraft fire of the magnitude and intensity experienced in this accident was not considered to be a significant possibility under any operational circumstances.

3. FINDING

The propagation rate of the fire involved in the AS-204 accident was extremely rapid (Reference report by Panel 5). Removal of the three spacecraft hatches to effect emergency egress from either the inside or outside involved a minimum of 40 and 70 seconds respectively under ideal conditions.

DETERMINATION

Considering the rapidity of propagation of the fire and the time constraints imposed by the existing spacecraft hatch configuration, it is doubtful that any amount of emergency preparation would have precluded injury to the crew prior to crew egress.

4. FINDING

Procedures for unaided egress from the spacecraft were documented and available. The AS-204 flight crew had participated in a total of eight egress exercises employing those procedures.

DETERMINATION

The AS-204 flight crew was familiar with and well trained in the documented emergency crew procedures for effecting unaided egress from the spacecraft.

5. FINDING

The Apollo Flight Crew Hazardous Egress Procedures Manual contains procedures relative to unaided, aided and incapacitated flight crew egress. By scope and definition, this document is concerned only with evacuation of the flight crew from the spacecraft and the pad under hazardous conditions occurring primarily external to the spacecraft during a launch operation.

DETERMINATION

The Apollo Flight Crew Hazardous Egress Procedures Manual does not contain adequate emergency provisions for significant emergency conditions internal to the spacecraft any time the crew is on board.

6. FINDING

The spacecraft pad work team on duty at the time of the accident had not been given emergency training drills for combating fires in or around the spacecraft or for emergency crew egress. They were trained and equipped only for a normal hatch removal operation.

DETERMINATION

The spacecraft pad work team was not properly trained or equipped to effect an efficient rescue operation under the conditions resulting from the fire.

7. FINDING

There was no equipment on board the spacecraft designed to detect or extinguish a cabin fire.

DETERMINATION

The flight crew had to rely upon physiological cues to detect the presence of a fire. When all face masks were closed, the cues were limited to sight and touch. Once detected, there were no means by which the fire could have been contained or extinguished.

8. FINDING

Frequent interruptions and failures had been experienced in the overall communications system during the operations preceding the accident. At the time the accident occurred, the status of the system was still under assessment.

DETERMINATION

The status of the overall communication system was marginal for the support of a normal operation. It cannot be assessed as adequate in the presence of an emergency condition.

9. FINDING

Emergency equipment provided at the spacecraft work levels consisted of portable $CO_2$ fire extinguishers, Rocket Propellant Fuel Handler's Gas Masks and 1-1/4-inch diameter fire hoses.

DETERMINATION

The existing emergency equipment was not adequate to cope with the conditions of the fire. Suitable breathing apparatus, additional portable $CO_2$ fire extinguishers, direct personnel evacuation routes and smoke removal ventilation are significant items which would have improved the reaction capability of the personnel involved.

10. FINDING

There are steps and doorways on the Launch Complex 34 Apollo Access Arm and in the environmental enclosure (White Room) which consitute safety hazards, particularly under emergency conditions.

DETERMINATION

The present configuration of the access arm and White Room is not compatible with emergency personnel evacuation requirements or with fast, safe flight crew egress.

11. FINDING

During the preparation of S/C test procedures at KSC, safety considerations for hazardous operations and documentation of applicable emergency procedures are limited in most cases to routine safety reference notations and emergency power-down instructions.

DETERMINATION

Insufficient emphasis is applied by the test procedure originator upon documenting emergency procedures and identifying specific hazards and applicable safety requirements.

12. FINDING

Under the existing method of test procedure processing at KSC, the cognizant Safety Offices review only those procedures which are noted in the OCP outline as involving hazards. Official approval by KSC and AFETR Safety is accomplished after the procedure is published and released.

DETERMINATION

The scope of contractor and KSC Safety Office participation in test procedure development is loosely defined and poorly documented. Post-procedure-release approval by the KSC Safety Office does not insure positive and timely coordination of all safety considerations.

13. FINDING

Criteria for defining hazardous test operations are not complete.

DETERMINATION

A positive method does not exist for insuring identification and documentation of all possible hazards involved in test operations.

14. FINDING

Requirements for the review and concurrence of KSC S/C test procedures by MSC are not well defined.

DETERMINATION

The present review system does not insure that MSC concurs with released KSC test procedures.

## E. SUPPORTING DATA

Enclosure

13-1 Memo dated Nov. 19, 1965, containing minutes of the First Apollo Emergency Egress Working Group Meeting and a copy of the Charter of that group.

13-2 KSC KMI 1150.8 dated Oct. 11, 1966, defining the Charter of the Apollo Launch Operations Committee.

13-3 Time line for unaided flight crew egress. Page 25 of the Apollo Flight Crew Hazardous Egress Procedures Manual.

13-4 Time line for aided and incapacitated flight crew egress. Pages 26 and 27 of the Apollo Flight Crew Hazardous Egress Procedures Manual.

13-5 Page 0-8 of OCP FO-K-0021-1 showing documented safety instructions for the AS-204 Space Vehicle Plugs Out Integrated Test.

13-6 BELLCOM, INC. report concerning C/M depressurization during terminal countdown. Case 330, dated Jan. 20, 1967.

13-7 Figure 1-4 of Apollo Operations Handbook (AOH) showing spacecraft hatch arrangement viewed from the outside.

13-8 Drawing of spacecraft inner hatch showing emergency handle, viewed from inside.

13-9 MSC memo dated Jan. 26, 1965, concerning the results of Gemini suit flammability test.

13-10 Memo dated Mar. 8, 1967, concerning inspection of the fire extinguishers used at the time of the AS-204 incident.

13-11 Drawing of Apollo Access Arm and environmental chamber. Page B-10 of the Apollo Flight Crew Hazardous Egress Procedures Manual.

13-12 Definition of the Apollo Preflight Operations Procedures APOP G-100, dated Nov. 4,1966.

13-13 Instructions for processing test procedures APOP 0-202, dated May 13, 1966.

13-14 NAA Florida Facility Implementing Instruction, II 12-5, dated Jan. 27, 1966, titled, Safety Criteria for Apollo C/M and S/M and S II Operations.

13-15 List of reference documents

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA GEN. REG. NO. 27
5010-107

UNITED STATES GOVERNMENT

# *Memorandum*

TO : Distribution

DATE: November 19, 1965
Memo No. SC033-65-214

FROM : Chairman, Apollo Emergency Egress Working Group

SUBJECT: Minutes of the First Apollo Emergency Egress Working Group Meeting

1. The first meeting of the Apollo Emergency Egress Working Group was held at Kennedy Space Center (KSC) on 18 November 1965. The charter was read and approved and a copy has been enclosed. Per Section 3 of the charter, each member organization is requested to furnish the chairman the names of a primary member and an alternate.

2. The following action items were given to the Working Group and were discussed:

a. A discussion was centered on the access arm and environment room mock-up procurement, and the design of a mock-up with flight weight equipment. It was decided that a suited-astronaut-run with flight type equipment would be mandatory to obtain adequate time motion studies to develop the operational procedures. An action item was placed on the Apollo Launch Operations Panel (ALOP) Emergency Egress Sub-panel through Frank W. Horn to have a suitable mock-up review as soon as possible for both the Block I and Block II versions.

b. It was also decided that air packs are needed in the environment controlled room on the access arm for each crew member and should be in place for launch. Safety showers are needed at level A on the LUT (Complex 39); a survey will be made by Norris Gray of SOP-22 to determine the need for additional showers.

c. ALOP asked this Working Group to decide on placement of the pyro bus arm switch, elevator control, and access arm controls. To properly place the switches and controls it will be necessary to define the relationship between the Launch Director, Test Supervisor, and Test Conductor. The KSC Test Conductor Office has been assigned this as an action item to report on by December 15, 1965.

d. The manning of the emergency armored vehicles was discussed with the three (3) M113's each being manned by a Pan American Airways Pad Safety Supervisor, two (2) PAA firemen, and two (2) DOD medical technicians. The M59 armored fire fighting vehicle manning will be determined by Norris Gray and the rescue personnel.

3. Cleanliness requirement was discussed by L. Miller of Bellcom and an air lock or other cleanliness requirement changes to the access arm may be made. Any changes to the access arm will be reviewed by this group to determine the emergency egress impact.

4. There is a need to define what criteria is to be used for determining hazardous and emergency conditions. This will be discussed at the next meeting.

5. The next meeting will be held after the mock-up review discussed above.

S. T. Beddingfield
Chairman

Distribution:

MSC

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NAA

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KSC

SOP-22/N. C. Gray
PPR-7/F. W. Horn
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SCO-5/G. F. Page
LVO/E. Fannin
EDV-15/R. T. Moore, Jr.
EDV-2/J. H. Deese
SCO-8/G. T. Sasseen
SCO/J. J. Williams
LDO/G. M. Preston
LDO/P. C. Donnelly

PAA

Pad Safety, Mail Unit 5260, Elmer Brooks

AFETR

ETORS-1/Capt. C. D. Parker

OMSF

MSS/MAS (Bellcom)/L. G. Miller
MO-1/C. H. Bolender

List of Attendees:

Lewis G. Miller, MAS (Bellcom)
Ryborn R. Kirby, FL/MSC Houston
Capt. C. D. Parker, ETORS-1, PAFB
F. J. Powell, NAA/Cape
Ralph Wilson, SOP-21
F. W. Horn, PPR-71
N. C. Gray, SOP-22
W. F. Williams, PAA Pad Safety
C. C. Williams, MSC/CB
S. T. Beddingfield, SCO-33

CHARTER

APOLLO EMERGENCY EGRESS WORKING GROUP

1. Purpose.

The Apollo Emergency Egress working group is established by the Apollo Launch Operations Committee to develop and integrate spacecraft crewman egress procedures for the pad areas of the Saturn Apollo Operations.

2. Function.

The Working Group will be the direct link between the Apollo Launch Operations Panel and the various organizations performing special activities in the egress-rescue area.

The Working Group will recognize existing organizations, provide guidelines, make recommendations, and formulate procedures as necessary to coordinate and integrate all elements of the egress operation.

3. The formal membership of the Working Group consists of the following:

NASA KSC-SCO Chairman
NASA MSC - APO
NASA - MSC - FCSD
NASA - MSC Landing Recovery Division
NAA - NAA-21
NASA - KSC LVO
AFETR - ETORS-1 - PAFB
PAA - Pad Safety
NASA - MSF/MAS (BELLCOMM)
NASA - LSEED
NASA - LVO

One permanent member and one alternate member will be designated by each member organization and will represent their organization in all Working Group functions.

4. Meetings will be held as necessary to accomplish the function of the Working Group. Authority for calling meetings rest with the chairman.

Reports: Minutes of all Working Group Meetings will be provided by chairman for distribution to members and the chairman of the Apollo Launch Operations Committee.

P. C. Donnelly

S. T. Beddingfield

**TRANSMITTAL SHEET**

| TO | DATE |
| --- | --- |
| "H" | October 11, 19[illegible] |

**MATERIAL TRANSMITTED**

KMI 1150.8, "Apollo Launch Operations Committee"

This is a new Instruction.

**FILING INSTRUCTIONS**

File in a standard 3-ring binder in numerical sequence, in accordance with the alphabetic prefix which identifies the type of issuance.

**ENCLOSURE 13-2**

KMI 1150.8

October 11, 1965

*Effective Date*

# JOHN F. KENNEDY SPACE CENTER, NASA
# MANAGEMENT INSTRUCTION

SUBJECT : APOLLO LAUNCH OPERATIONS COMMITTEE

1. PURPOSE

This Instruction incorporates into the KSC Issuance System as Attachment A the charter establishing the Apollo Launch Operations Committee.

Simon J. Burttschell
Chief, Administrative Services Office

Attachment:
A. Charter--Apollo Launch Operations Committee

Distribution "H"

ATTACHMENT A to
KMI 1150.8

# CHARTER

# APOLLO LAUNCH OPERATIONS COMMITTEE

## 1. PURPOSE

This charter establishes an Apollo Launch Operations Committee at KSC and assigns certain responsibilities and authorities to it. The ALOC is a NASA-Contractor Management Team responsible to the Director, Launch Operations.

## 2. OBJECTIVES & RESPONSIBILITIES

The objective of the Apollo Launch Operations Committee (ALOC) is to provide the KSC, Launch Operations Directorate, a management tool for assuring coordination of Apollo prelaunch/launch interorganizational operational activities at the Kennedy Space Center. The primary responsibilities of the ALOC are to:

a. Serve as a point of input into the Launch Operations Directorate for Apollo prelaunch/launch operational problems which affect the working interfaces between the various elements in the total launch team.

b. Develop problem definitions, propose solutions, and forward to the cognizant KSC organizations for decision and/or action,

c. Receive reports, status information, and recommended solutions on problem areas from supporting working groups and operational organizations,

d. Serve as a policy reviewing group; providing guidance and policy advice for assuring coordination and effective solution to problem areas.

e. Serve as a mechanism for the Director of Launch Operations to implement management policy that has been established by the Center Director of a prelaunch/launch operational nature, and

f. Provide input to the Space Vehicle Planning & Supervision Office such that Launch Operation Plans, Space Vehicle Test Sequences, and Space Vehicle Test Catalogues may be developed in compliance with the test requirements.

ATTACHMENT A to
KMI 1150.8

3. CHAIRMAN

The Chairman of the Apollo Launch Operations Committee will be the Director, Launch Operations or his designated representative.

4. ORGANIZATION

The Apollo Launch Operations Committee will be supported by two management subcommittees, Saturn IB and Saturn V.

5. MEMBERSHIP

Membership on the Apollo Launch Operations Committee will consist of representatives from appropriate management elements of KSC, other NASA elements and interfacing organizations. A list of members of the Apollo Launch Operations Committee and the industry representatives of the Saturn IB and Saturn V subcommittee is as follows:

APOLLO LAUNCH OPERATIONS COMMITTEE MEMBERSHIP

Chairman Director, Launch Operations
Space Vehicle Test Supervisor
Saturn IB Operations Manager
Saturn V Operations Manager
Technical Planning & Scheduling Office
Apollo Spacecraft Operations Manager
LEM Spacecraft Operations Manager
Chief Spacecraft Test Conductor
Representative, Assistant Director for Information Systems, KSC
Representative, Assistant Director for Support Operations, KSC
Representative, Director, Plans, Programs, & Resources, KSC
Representative, Apollo Spacecraft Program Office, MSC
Representative, Saturn Industrial Operations, MSFC
Representative, Assistant Director for Flight Operations, MSC
Representative, Assistant Director for Flight Crew Operations, MSC
Representative, NASA Hdqts. Apollo Flight Operations
Representative, Apollo Support Planning Office, DOD
Representative, Assistant Director for Administration
Recorder

SATURN IB SUBCOMMITTEE INDUSTRY REPRESENTATIVES

Representative - Chrysler
Representative - Douglas

Representative - North American (Spacecraft)
Representative - Grumman
Representative - IBM (IU)

SATURN V SUBCOMMITTEE INDUSTRY REPRESENTATIVES

Representative - Douglas
Representative - North American (Spacecraft)
Representative - Grumman
Representative - Boeing
Representative - North American (Launch Vehicle)
Representative - IBM (IU)
Representative - Bendix

Attendance at the subcommittee meetings will be based on the agenda of each meeting and could possibly include, in addition to the attendance of appropriate members of the ALOC, and the above assigned industry representatives, additional representatives from industry and the government at the discretion and invitation of the subcommittee chairman.

6. MEETINGS

The Apollo Launch Operations Committee will have periodic meetings which will be called by the Chairman as necessary. Normally, meetings will be held on a bi-weekly basis.

a. Agenda

Agendas will be provided to all members of Apollo Launch Operations Committee by the Chairman prior to each meeting.

b. Minutes

Minutes of Apollo Launch Operations Committee meetings will be taken by an Apollo Launch Operations Committee recorder provided by the Chairman. Minutes of Apollo Launch Operations Committee meetings will be made available to all members.

7. RELATIONSHIP TO KSC ORGANIZATIONAL ELEMENTS

The creation of the Apollo Launch Operations Committee does not change in any respect the responsibilities of KSC organizational

ATTACHMENT A to
KMI 1150.8

elements as currently assigned. The Committee Chairman, therefore, shall assure that the Committee conducts its activities with full regard for the assigned functions of other elements of the Kennedy Space Center.

The Apollo Launch Operations Committee will consider items assigned by the Director of Launch Operations and report its findings to him.

APPROVED: [signature]
Kurt H. Debus
Director, Launch Operations

# UNAIDED EGRESS

Time scale: 0 · 1 · 2 · 3 · 4 · 5 · 6 · 7 · 8 · 9 · 10 (subdivisions 0 20 40)

| SEQ | COMM CHAN | COMM STA | RESP STA | |
|---|---|---|---|---|
| | | | CVTS | HAZARD IDENTIFIED - SITUATION EVALUATED - EGRESS MODE SELECTED |
| 1 | P4 | CVTS | | ANNOUNCE HAZARD & EGRESS MODE |
| 2 | BK2 | CVTS | ALL | ANNOUNCE HAZARD & EGRESS MODE - DIRECT OPERATIONS START |
| 3 | BK2 | CVTS | RWCP | ACTIVATE FIRE SUPPRESSION SYSTEMS AS REQUIRED |
| 4 | BK3 | CSTC | SCMD | ADVISE HAZARD CONDITION & EGRESS MODE - SAFE PYRO ARM & LOGIC BUSSES - VENT CABIN PRESS. - SAFE QUAD. PROP. ISOLATION VALVES |
| 5 | | | HARD TOP | M-113's TRAVEL TO PAD |
| 6 | BK2 | CVTS | RAAA | EXTEND ACCESS ARM TO COMMAND MODULE |
| 7 | BK2 | CVTS | CPSS | REQUEST PERMISSION TO SECURE COMM. RCVR'S. SAFE S & A's & SAFE IGNITION PERMISSION SW s. |
| 8 | BK2 | CVTS | CLTC | SAFE GRD.. PROPELLANT DISPERSION SYS. & TURN-OFF DRSCR's |
| 9.1 | BK1 | CLTC | CINP RIDP | FUNCTION SELECTOR TO PRELAUNCH |
| 9.2 | BK1 | CLTC | R4DP RIDP | S & A's TO SAFE |
| 9.3 | BK1 | CLTC | R4DP RIDP | SYSTEM SAFE TO ON |
| 9.4 | BK1 | CLTC | R4DP RIDP | VERIFY SIB & SIVB S & A's SAFE |
| 9.5 | BK1 | CLTC | R4DP | VERIFY SIB & SIVB EBW #1 & #2 FIRING UNIT VOLTAGE READS ZERO |
| 10 | BK2 | CVTS | CSTC | VERIFY SPACECRAFT ORD. SAFED |
| 11 | BK2 | CVTS | RAAA | VERIFY ACCESS ARM LATCHED TO COMMAND MODULE |
| 12 | BK2 | CSTC | SCMD | ADVISE ACCESS ARM CONNECTED TO CM - DIRECT FLT. CREW EGRESS |
| 13 | | | SCMD | FLIGHT CREW EGRESS COMMAND MODULE |
| 14 | BK2 | CVTS | CLTC HARD | VERIFY LAUNCH VEHICLE ORD. SAFED |
| 15 | LSR NET | CVTS | TOP HARD | ADVISE LAUNCH VEHICLE & SPACECRAFT ORD. SAFED |
| 16 | | HARD | TOP | PAD EGRESS TEAM ARRIVE AT PAD |
| 17 | BK2 | TOP | CVTS HARD | CONFIRM PAD EGRESS TEAM AT PAD STAND-BY |
| 18 | | | TOP | MONITOR TEST SUPERVISOR'S NET |
| 19 | | | SCMD | FLIGHT CREW TRAVERSE ACCESS ARM TO ELEVATOR |
| 20 | | HARD | SCMD | FLIGHT CREW DESCEND TO GROUND LEVEL |
| 21 | BK2 | TOP | CVTS | CONFIRM FLIGHT CREW AT GROUND LEVEL |
| 22 | | | SCMD HARD | FLIGHT CREW INGRESS M-113's |
| 23 | | | TOP | M-113's TRAVELING FROM LAUNCH COMPLEX |

# AIDED EGRESS

Time scale: 0 20 40 | 1 0 20 40 | 2 0 20 40 | 3 0 20 40 | 4 0 20 40 | 5 0 20 40 | 6 0 20 40 | 7 0 20 40 | 8 0 20 40 | 9 0 20 40 | 10 0

| SEQ. | COMM CHAN | COMM STA | RESP STA | EVENT |
|---|---|---|---|---|
| | | | CVTS | HAZARD IDENTIFIED - SITUATION EVALUATED-EGRESS MODE SELECTED |
| 1 | PA | CVTS | | ANNOUNCE HAZARD & EGRESS MODE |
| 2 | BK 2 | CVTS | ALL | ANNOUNCE HAZARD & EGRESS MODE -DIRECT OPER'S START |
| 3 | BK 2 | CVTS | BHCP | ACTIVATE FIRE SUPPRESSION SYSTEMS AS REQUIRED |
| 4 | BK 3 | CSTC | SCMD | ADVISE HAZARD & EGRESS MODE - SAFE PYRO ARM & LOGIC BUSSES - VENT CABIN PRESS.-SAFE QUAD. PROP. ISOLATION VALVES. |
| 5 | | | HARD TOP | M-113'S TRAVEL TO PAD |
| 6 | BK 2 | CVTS | RAAA | EXTEND ACCESS ARM TO COMMAND MODULE |
| 7 | BK 2 | CVTS | CPSS | REQUEST PERMISSION TO SE[illegible]E COMM. RCVR'S, SAFE S & A & SAFE IGNITION PERMISSION SW'S |
| 8 | BK 2 | CVTS | CLTC | SAFE ORD., PROPELLANT DISPERSION SYS. & TURN-OFF DRSCR'S |
| 9.1 | BK 1 | CLTC | C1NP | FUNCTION SELECTOR TO PRELAUNCH |
| 9.2 | BK 1 | CLTC | R1DP R4DP | S & A'S TO SAFE |
| 9.3 | BK 1 | CLTC | R1DP R4DP | SYSTEM SAFE TO ON |
| 9.4 | BK 1 | CLTC | R1DP R4DP | VERIFY SIB & SIVB S & A'S SAFE |
| 9.5 | BK 1 | CLTC | R1DP R4DP | VERIFY SIB & SIVB EBW #1 & #2 FIRING UNIT VOLTAGES READ ZERO |
| 10 | BK 2 | CVTS | CSTC | VERIFY SPACECRAFT ORD. SAFED |
| 11 | BK 2 | CVTS | RAAA | VERIFY ACCESS ARM LATCHED TO COMMAND MODULE |
| 12 | BK 3 | CSTC | SCMD | ADVISE ACCESS ARM LATCHED TO COMMAND MODULE - DO NOT OPEN CM HATCHES |
| 13 | BK 2 | CVTS | CLTC | VERIFY LAUNCH VEHICLE ORD. SAFED |
| 14 | LSB NET | CVTS | HARD TOP | ADVISE LAUNCH VEHICLE & SPACECRAFT ORD. SAFED |
| 15 | BK 2 | CVTS | CAST | LOWER ELEVATOR TO GROUND LEVEL |
| 16 | | | HARD TOP | PAD EGRESS TEAM ARRIVE AT PAD |
| 17 | BK 2 | HARD TOP | CVTS | CONFIRM PAD EGRESS TEAM AT PAD - EGRESS OP'S IN PROCESS |
| 18 | | | HARD TOP | MONITOR TEST SUPVR'S - NET UNTIL M-113'S LEAVE PAD |
| 19 | | | HARD TOP | PAD EGRESS TEAM ASCEND TO LEVEL 22 |
| 20 | | | HARD TOP | PAD EGRESS TEAM CROSS ACCESS ARM TO CM |
| 21 | BK 2 | CVTS | CSTC | VERIFY EGRESS TEAM AT LEVEL 22 - OPEN CM INNER HATCH |
| 22 | BK 2 | CSTC | SCMD | UNFASTEN COUCH RESTRAINTS - OPEN CM INNER HATCH |
| 23 | BK 2 | HARD TOP | CVTS | CONFIRM START OF CM HATCH REMOVAL |
| | | | | BOOST PROTECTIVE HATCH REMOVED |
| 24 | BK 2 | HARD TOP | CVTS | CONFIRM BPC HATCH REMOVED |
| | | | | ABLATIVE HATCH REMOVED |
| 25 | BK 2 | HARD TOP | CVTS | CONFIRM ABLATIVE HATCH REMOVED - CONFIRM FLIGHT CREW CONDITION & EGRESS FROM CM - CONFIRM EGRESS FROM ENVIRON. CHAMBER |
| 26 | | | HARD TOP | FLT. CREW & EGRESS TEAM CROSS ACCESS ARM TO ELEV. |
| 27 | | | HARD TOP | FLT. CREW & EGRESS TEAM DESCEND TO GROUND LEVEL |
| 28 | BK 2 | HARD TOP | CVTS | CONFIRM FLT. CREW INGRESSING M-113'S |
| 29 | | | HARD TOP | M-113 TRAVELING FROM COMPLEX |

# INCAPACITATED FLT. CREW EGRESS

1 THRU 24 SAME AS AIDED FLIGHT CREW EGRESS

| SEQ | COMM CHAN | COMM STA | RESP STA | EVENT |
|---|---|---|---|---|
| 25 | BK2 | CVTS | CSTC | VERIFY CABIN PRESS. OK TO REMOVE INNER HATCH |
| 26 | BK2 | HARD TOP | CVTS | CONFIRM ABLATIVE HATCH REMOVED - VERIFY CABIN PRESSURE OK |
| | | | | INNER PRESSURE HATCH REMOVED |
| 27 | BK2 | HARD TOP | CVTS | CONFIRM INNER HATCH REMOVED/CONFIRM PYRO ARM & LOGIC BUSS & QUAD. PROP. ISOL. VALVES SAFED. CONFIRM FLIGHT CREW CONDITION & REMOVAL STARTED |
| | | | | CENTER ASTRO. REMOVED FROM CM |
| 28 | BK2 | HARD TOP | CVTS | CONFIRM 1ST ASTRO REMOVED FROM CM |
| | | | | 1ST ASTRO CARRIED TO ELEV. |
| 29 | BK2 | HARD TOP | CVTS | CONFIRM 1ST ASTRO DESCENDING TO GND. LEVEL |
| | | | | 1ST ASTRO DESCENDING TO GND. LEVEL |
| 30 | BK2 | HARD TOP | | CONFIRM 1ST ASTRO AT GND. LEVEL |
| 31 | | | HARDTOP | SEND ELEVATOR TO LEVEL 22 |
| 32 | BK2 | HARD TOP | CVTS | CONFIRM 1ST M-113 LEAVING PAD AREA WITH 1ST ASTRO |
| | | | | 2ND ASTRO REMOVED FROM CM |
| 33 | BK2 | HARD TOP | CVTS | CONFIRM 2ND ASTRO REMOVED FROM CM |
| | | | | 2ND ASTRO CARRIED TO ELEVATOR |
| 34 | BK2 | HARD TOP | CVTS | CONFIRM 2ND ASTRO CARRIED TO ELEVATOR |
| | | | | 2ND ASTRO DESCENDING TO GND |
| 35 | BK2 | HARD TOP | CVTS | CONFIRM 2ND ASTRO AT GND |
| 36 | | | HARD TOP | SEND ELEVATOR TO LEVEL 22 |
| 37 | BK2 | HARD TOP | CVTS | CONFIRM 2ND M-113 LEAVING PAD AREA WITH 2ND ASTRO |
| | | | | 3RD ASTRO REMOVED FROM CM |
| 38 | BK2 | HARD TOP | CVTS | CONFIRM 3RD ASTRO REMOVED FROM CM |
| | | | | PAD EGRESS TEAM & 3RD ASTRO CROSS ACCESS ARM |
| 39 | | | HARD TOP | PAD EGRESS TEAM & 3RD ASTRO DESCEND |
| 40 | BK2 | HARD TOP | CVTS | CONFIRM PAD EGRESS TEAM AND 3RD ASTRO LEAVING PAD |
| 41 | | | HARD TOP | LAST M-113's LEAVES PAD AREA |

5.0 SAFETY REQUIREMENTS

5.1 SUPERVISION IS RESPONSIBLE FOR PROVIDING COMPLIANCE WITH ALL NASA/NAA APPLICABLE SAFETY RULES AND REGULATIONS.

5.2 THE TEST CONDUCTOR SHALL COORDINATE DEVIATIONS FROM ACCEPTED SAFETY STANDARDS, WITH NAA AND NASA SAFETY REPRESENTATIVES.

5.3 ALL PERSONNEL WILL BECOME FAMILIAR WITH THE FOLLOWING DOCUMENTS:

A. AFETRM 127-1 RANGE SAFETY MANUAL

B. APPLICABLE SAFETY STANDARD AND SAFETY SUPPORT PLAN.

C. AFETR PAD SAFETY PLAN FOR LC34

D. SOP FOR LC34

E. KSC GENERAL SAFETY PLAN KMI-1710.1 ATTACHMENT-A

5.4 ALL PERSONNEL WILL BECOME FAMILIAR WITH THE EMERGENCY SHUTDOWN PROCEDURE.

5.5 THE EMERGENCY PROCEDURE SHALL BE UNFOLDED AND REMAIN VISIBLE THROUGHOUT THE TEST.

5.6 PERSONNEL INVOLVED IN TESTING WILL BE INFORMED OF THE SPECIFIC HAZARDS OF EACH TEST.

5.7 INSTALLED PYROS SHORTED PER OCP'S K-2016 AND 4617.

BELLCOMM, INC.

SUBJECT: Final Report: Command Module Depressurization During Terminal Countdown – Case 330

DATE: January 20, 1967

FROM: L. G. Miller

## ABSTRACT

For some time, there has been concern about the time required to effect on-pad depressurization of the CM sufficient to permit hatch opening. Because of their specific interest in astronaut pad egress under hazardous conditions, the Emergency Egress Working Group of ALOC had instituted an action item to define the scope of the problem. In connection with this effort, a previous memorandum recommended that the times associated with cabin venting under various conditions be determined experimentally. Such a test was recently performed and is reported herein.

To verify experimental findings, an analytical solution was attempted. A computer program was developed which simulates CM depressurization both in flight and on the ground. The program is described and compared with one being prepared by NAA. Results are presented in a form which should aid preplanning for on-pad contingencies, and future application of the program is briefly described.

The combination of experimental and analytical findings was sufficient to close the action item.

## MEMORANDUM FOR FILE

### INTRODUCTION

In a previous memorandum[1] it was concluded that the times associated with cabin venting under various conditions should be verified experimentally in order to facilitate planning for on-pad contingencies during final countdown. If the experiments had shown that excessive time was required to vent the cabin using the cabin pressure relief valve, it was proposed that specific methods of improving performance be explored. These consisted of (1) using the post landing ventilation system, (2) using the purge fitting on the side pressure hatch, and (3) determining the time required to open the side pressure hatch under a number of overpressure conditions.

A cabin venting test was subsequently performed at MSC and is described herein. Although little data was obtained, it was sufficient to establish the order of magnitude of the time required to vent the CM cabin. To extend this knowledge, attention was focused on the mathematical basis for predicting depressurization times. In order to make use of this theory, it was necessary to employ a digital computer. Therefore, a FORTRAN IV computer program which theoretically calculates CM depressurization times under various conditions was developed by the writer and Miss P. A. Cavedo of Department 2013. The program, named DEPRES, is described and compared with a similar program prepared at North American Aviation.

---

[1] "Command Module Pressurization During Terminal Countdown - Current Status," Case 330, by L. G. Miller, Bellcomm Memorandum for File, dated October 14, 1966.

## DEPRESSURIZATION TEST ON S/C 008

A test, in which the CM cabin was partially depressurized via the cabin pressure relief valve, was performed in conjunction with the S/C 008 Thermal Vacuum (T/V) Test #3 at MSC. At an initial cabin pressure of 5 psig (vacuum chamber pressure = 0psig), a valve which simulates a ½ inch diameter micrometeoroid puncture was opened. Cabin pressure decreased to 3 psig in 80 seconds at which time the micrometeoroid valve was closed. The cabin pressure relief valve was then placed in its "manual dump" position, and the cabin pressure fell from 3 psig to 0 psig in 20 seconds. Pressure was reported to have been measured with a large diameter (approximately 25-30 inches) pressure gage having a scale of from zero to 15 psig.

## SIGNIFICANCE OF TEST RESULTS

Flight crew hazardous egress procedures require that the CM cabin be vented as soon as the egress decision has been announced. Since (1) NAA has indicated that it is quite unlikely that the CM cabin pressure will be in excess of 2 psig after CM closeout and (2) it takes approximately 40 seconds for the CM Access Arm to extend and attach to the LES tower, the time reported in the T/V test is considered to be compatible with egress requirements for aided and unaided egress during the period following spacecraft closeout. This leaves two cases unresolved.

The first case is for "Incapacitated Flight Crew." In order for difficulties to arise, all three crewmen would have to be incapacitated[2]. In this unlikely case, any cabin overpressure would have to be vented through a purge fitting on the inner side crew hatch (i.e. the side pressure hatch).

The second case, which could occur prior to spacecraft closeout, is the possibility of a hazardous condition during the CM cabin leak check. Cabin pressure could be as high as 6.2 psig, and depressurization times using either the cabin pressure relief valve or the purge fitting would be of interest.

The lack of data for the two cases cited above prompted an investigation of the theoretical basis for predicting depressurization times. If the available data could be duplicated, the formula would then be used to predict depressurization times for the remaining cases. The iterative nature of the calculation called for the use of a digital computer in performing the work. Hence, DEPRES came into being. The mathematical theory behind this FORTRAN IV program and the program itself are described in Appendix A.

## USE OF THE DEPRES PROGRAM

An early version of DEPRES[3] was used to simulate CM depressurization on the launch pad from overpressures of 3.00 and 6.20 psig. The results, plotted in terms of absolute pressure, are shown in Figures 1 and 2 for three different values of orifice coefficient. Since

[2] Ordinarily, the crewman in the left hand couch would open the cabin pressure relief valve. It is possible, though, that the other crewmen could reach over or crawl over and perform the task.

[3] See Appendix B.

the area is a constant in the iteration formula, varying K corresponds with varying the effective are of the orifice used for depressurization (cf. Appendix A where effective area is defined as the product KA). Figure 1 shows the data point obtained during the #3 T/V test. Both figures show the value predicted by a conservative method of calculation contained in a Bellcomm Memorandum for File[4] by T. A. Bottomley.

Information obtained from NAA specifies an effective area for the cabin pressure relief valve of 1.5 sq. in. in the manual dump mode. Hence, for the cases shown in Figure 1, the data point should fall between the curves for K = .7 and K = .8. Considering the asymptotic nature of the curves, agreement is quite good. If we extend this level of confidence to the curves of Figure 2, it can be seen that depressurization from an overpressure of 6.2 psia should take about 28 seconds, a time which is quite reasonable with respect to egress requirements.

A round of discussions followed which probed the need for a computer program with broader capabilities. Interest was expressed in acquiring the in-house (i.e. Bellcomm) capability for calculating depressurization times in flight; this called for a program which could duplicate the response of the Environmental Control System (ECS) to both intentional and unintentional cabin depressurizations. A number of other refinements were also considered. The subsequent changes are described in Appendix A, and the program itself will be found in Appendix C.

This refined version of DEPRES, without the ECS option, was used to compute on-pad depressurization times with an area corresponding to that of the purge fitting on the inner side crew hatch. Overpressures ranging from 6.2 to 0.3 psi were used, the results being shown in Figure 3. The curve represents time required to depressurize to 0.1 psig from various values of cabin overpressure. The data is most useful for planning purposes when presented in this form. A companion curve, representing depressurization through the cabin pressure relief valve, is shown in Figure 4.

COMPARISON WITH NAA PROGRAM

Having developed what appeared to be a useful tool for studying depressurization problems, a number of telephone contacts were made at both MSC and NAA in order to determine if the DEPRES program could be profitably applied by those organizations. Some encouragement was offered by ECS personnel from both groups, and a conference was arranged. Thus, the writer had the opportunity to examine and discuss an NAA computer program which, it was learned, has been developed during the past year or so. It differs from DEPRES in two major respects. First, it simulates repressurization of the CM and pressurization of the LM as well as CM depressurization. Secondly, the effects of upstream pressures and temperatures are considered in determining ECS flow rates. This latter difference gives a slightly conservative flavor to DEPRES results when the ECS is used to maintain cabin pressures.

Although a direct comparison of results was not possible, one set of data was examined which seemed to be quite close to the conditions used for a DEPRES run. For a final pres-

[4] "CSM Depressurization Considerations for Astronaut Pad Abort," Case 330, by T. A. Bottomley, Jr., Bellcomm Memorandum for File, dated March 29, 1966.

sure of 0.1 psia, DEPRES predicted a depressurization time of 1864 seconds with the ECS on whereas the NAA program predicted 1780 seconds. Results for an intentional cabin depressurization, with no attempt to maintain cabin pressure through the use of the ECS, showed very close agreement. The times required to reach 0.1 psia differed by no more than a few seconds.

The two advantages that DEPRES possesses are its clarity and the ease with which changes can be accomplished. The NAA program has been developed and modified by several different engineers and is not yet officially documented. This, when added to the multiple-purpose nature of the NAA program, makes it somewhat more difficult to see what is going on. The fault could be remedied, just as DEPRES could be changed to give it a repressurization capability.

It seems unlikely, though, that NAA will make use of the DEPRES format since it lacks the degree of sophistication which their program contains. Given a continuing need for the calculations, it seems more probable that they will devote some effort toward improving their own program.

It is of interest to note that NAA also has a boost and reentry program for CM pressure. A brief look indicated that it has the same advantages and disadvantages as the pressurization-depressurization program. That is, it is available, fairly sophisticated, but hard to follow.

CONCLUSIONS

Study of on-pad depressurization times for the CM came about as an adjunct to the writer's activities with the Emergency Egress Working Group of the Apollo Launch Operations Committee. As a result of the MSC data and subsequent work with the DEPRES program, it was recommended that an EEWG action item on the subject be closed. This memorandum will serve, in part, as a final report to the Chairman of the EEWG in support of the closure. In addition, Figures 3 and 4 should serve as an adequate planning tool for determining depressurization times under various, non-standard conditions. For a given cabin pressure, they will yield a good estimate of the time required to open the side pressure hatch using either the cabin pressure relief valve or the purge fitting on the hatch.

Further work with DEPRES is planned in support of an investigation of ECS capabilities. Depressurization times will be developed as a function of micrometeoroid puncture size, and impacts on emergency in-flight procedures will be sought.

2032-LGM-gmp

S L. G. Miller

Attachments
Appendixes A-D

Copy to Messrs. F. B. Benjamin - NASA MM
C. H. Bolender - NASA MO-1
L. E. Day - NASA MAT
J. K. Holcomb - NASA MAO
C. Bidgood
D. R. Hagner
J. J. Hibbert
W. C. Hittinger

T. A. Keegan – NASA/MA-2

S. T. Beddingfield – KSC/KB-4
F. W. Horn – KSC/DK
C. A. Turner – KSC/HC/GE
J. C. Wootton – KSC/DB

R. J. Gillen – MSC/EC9
C. M. Jones – MSC/FL
R. D. Langley – MSC/ES
J. P. Loftus – MSC/PM5
F. H. Samonski, Jr. – MSC/EC9
R. S. Sayers – MSC/CF-24
C. C. Williams – MSC/CB-7

B. T. Howard
P. R. Knaff
J. Z. Menard
I. D. Nehama
T. L. Powers
I. M. Ross
T. H. Thompson
G. B. Troussoff
R. L. Wagner
Department 1023
Department 2032
Central Files
Library

## APPENDIX A

### THEORY OF DEPRESSURIZATION CALCULATIONS

The mass flow of a compressible fluid through an outlet from a reservoir is given by

$$Q = KA \sqrt{2g \left[\frac{\gamma}{\gamma - 1}\right] P_1 \rho_1 \left[\left[\frac{P_2}{P_1}\right]^{\left[\frac{2}{\gamma}\right]} - \left[\frac{P_2}{P_1}\right]^{\left[\frac{\gamma + 1}{\gamma}\right]}\right]}$$

where

| | | |
|---|---|---|
| $K$ | = | orifice coefficient |
| $A$ | = | area of the outlet |
| $g$ | = | acceleration of gravity |
| $P_1$ | = | pressure of the fluid in the reservoir |
| $\rho_1$ | = | density of the fluid in the reservoir |
| $P_2$ | = | pressure of fluid outside the reservoir |
| $\gamma$ | | ratio of specific heats of fluid |

Putting

$$C = \sqrt{2g \left[\frac{\gamma}{\gamma - 1}\right]}$$

$$r = \frac{P_2}{P_1}$$

and

$$\dot{m} = \epsilon \exp\left[\frac{2}{\gamma}\right] - \epsilon \exp\left[\frac{\gamma+1}{\gamma}\right]$$

we have

$$Q = KAC \sqrt{P_1 \rho_1 m}$$

and the ratio, $\epsilon$ determines the character of the flow. If

$$\epsilon \leq \epsilon^* = \left[\frac{2}{\gamma+1}\right] \exp\left[\frac{\gamma}{\gamma - 1}\right]$$

the velocity of the fluid through the orifice is equal to the velocity of sound, and m is constant and equal to

$$m^* = \epsilon^* \exp\left[\frac{2}{\gamma}\right] - \epsilon^* \exp\left[\frac{\gamma+1}{\gamma}\right]$$

Then, the mass flow depends only upon the parameters of the fluid and of the reservoir. (Dimensional units for this Appendix will be found in Appendix D.)

THE DEPRES PROGRAM

An early version of the DEPRES program is contained in Appendix B. Basically, the program assumes that an outlet of area A is opened at time equal to zero. The CM cabin has a volume of V and is initially at pressure P and temperature T. A 100% oxygen atmosphere is assumed, whence the values for R and GAM (i.e. $\gamma$). PO is the pressure of the fluid outside the cabin, and G is the acceleration of gravity. A final value for density of the fluid in the cabin (RHOF), corresponding to a cabin pressure of 14.8 psia for the present case, is used to determine when the calculation should end.

When the computer is instructed to execute the program, an initial value of fluid density in the cabin (RHO) is calculated. If RHO is less than or equal to RHOF, the value of N (i.e. elapsed time in tenths of a second), RHO and P are printed. If not, a mass flow rate (QN) through the outlet is computed, and a new value of RHO is obtained, assuming that the flow rate holds constant for a time interval (DLT) of .1 second[5]. RHO is then tested again and iterations continue until the termination criteria is met. N, RHO and P are printed every second.

[5] Use of a .01 second time interval did not affect results significantly.

Appendix C contains a more recent version of DEPRES. While the basic iterative process is the same, a number of refinements have been added. These are listed as follows:

1. The constant orifice coefficient was replaced by K = .85 – .22 EPSLON (i.e. .22$\epsilon$), this being a linear approximation of Shapiro's curve* for the variation of orifice coefficient with pressure ratio.

2. A program path was created which approximates the behavior of the Environmental Control System. It includes a cabin pressure regulator with a flow rate (CPREG) which increases, linearly, from zero to full flow between pressures $P_1$ and $P_2$ and is turned off at $P_5$. An emergency inflow regulator, with flow rate EIREG, opens in a similar fashion between $P_3$ and $P_4$ and stays on until pressure $P_6$ is reached. The Environmental Control System can be shut off at any pressure by setting a variable named PSTOP. TOTAL is the maximum flow rate from the Service Module Regulator. It is used to replenish the amount of oxygen (OTANK) in the surge tank when EIREG is on. If the quantity OTANK falls below a certain amount (EMPTY), then the total flow from the Environmental Control System (QP) equals TOTAL, assuming that the system has not previously been shut off. Losses due to normal cabin leakage (QLEAK) and metabolic usage (QMETA) are also considered.

3. A test was included to see if the value of EPSLON is such that sonic flow exists in the orifice. If sonic flow exists, m (i.e. M in the program) assumes a constant value, corresponding to m[6], in the calculation of QN.

4. A variable (IECS) was included to specify whether the Environmental Control System is turned on (=1) or off (=0). When IECS = 1, values for QP, OTANK and QN are printed at time intervals of one second.

The net result of these refinements is to give DEPRES the capability of simulating conditions not only on the launch pad but in outer space as well. There is a large amount of flexibility built into the program. The values of both constants and variables can be changed quickly and easily.

---

[6] Ascher H. Shapiro, "The Dynamics and Thermodynamics of Compressible Fluid Flow," Volume I. The Ronald Press Company, New York, 1953, page 100.

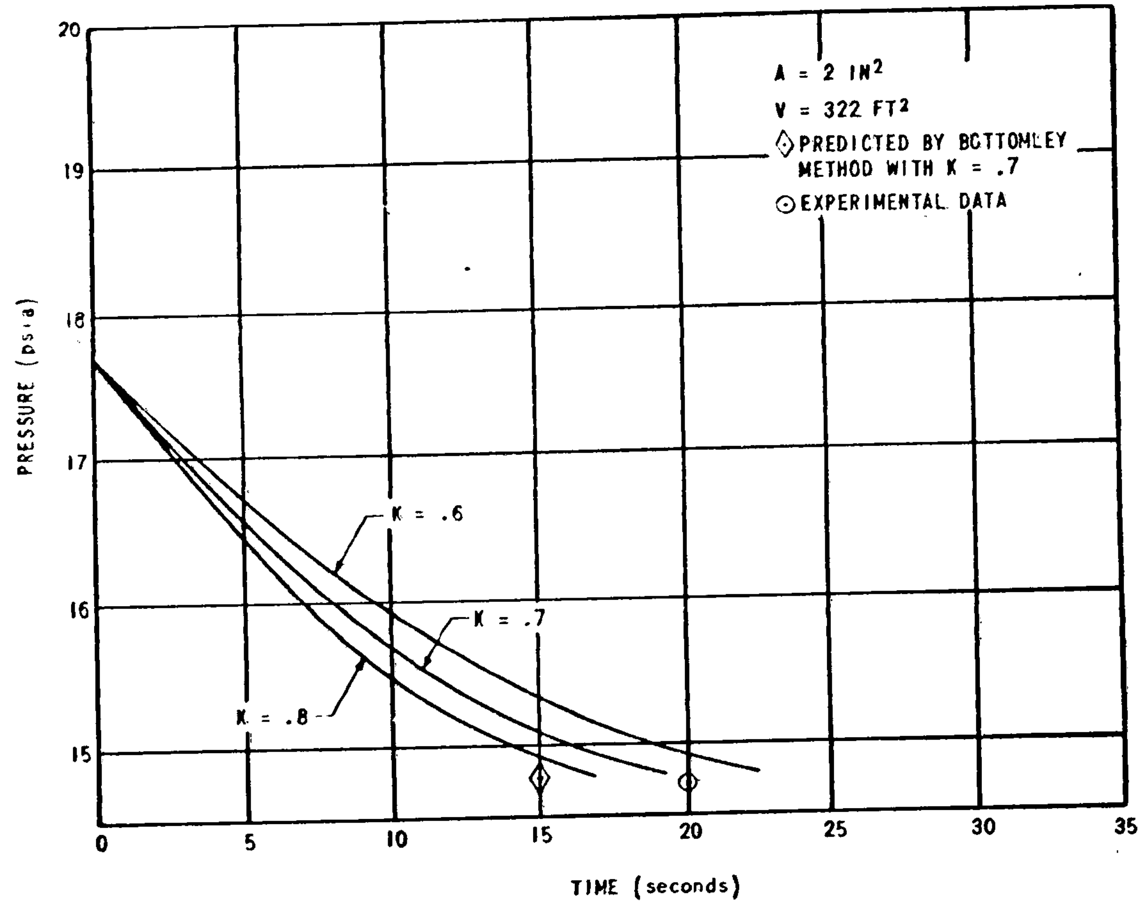



FIGURE 1: DEPRESSURIZATION CURVE WITH 3.0 PSI OVERPRESSURE

(DEPRESSURIZATION ASSUMED TO BE COMPLETE AT AN OVERPRESSURE OF 0.1 psi.)

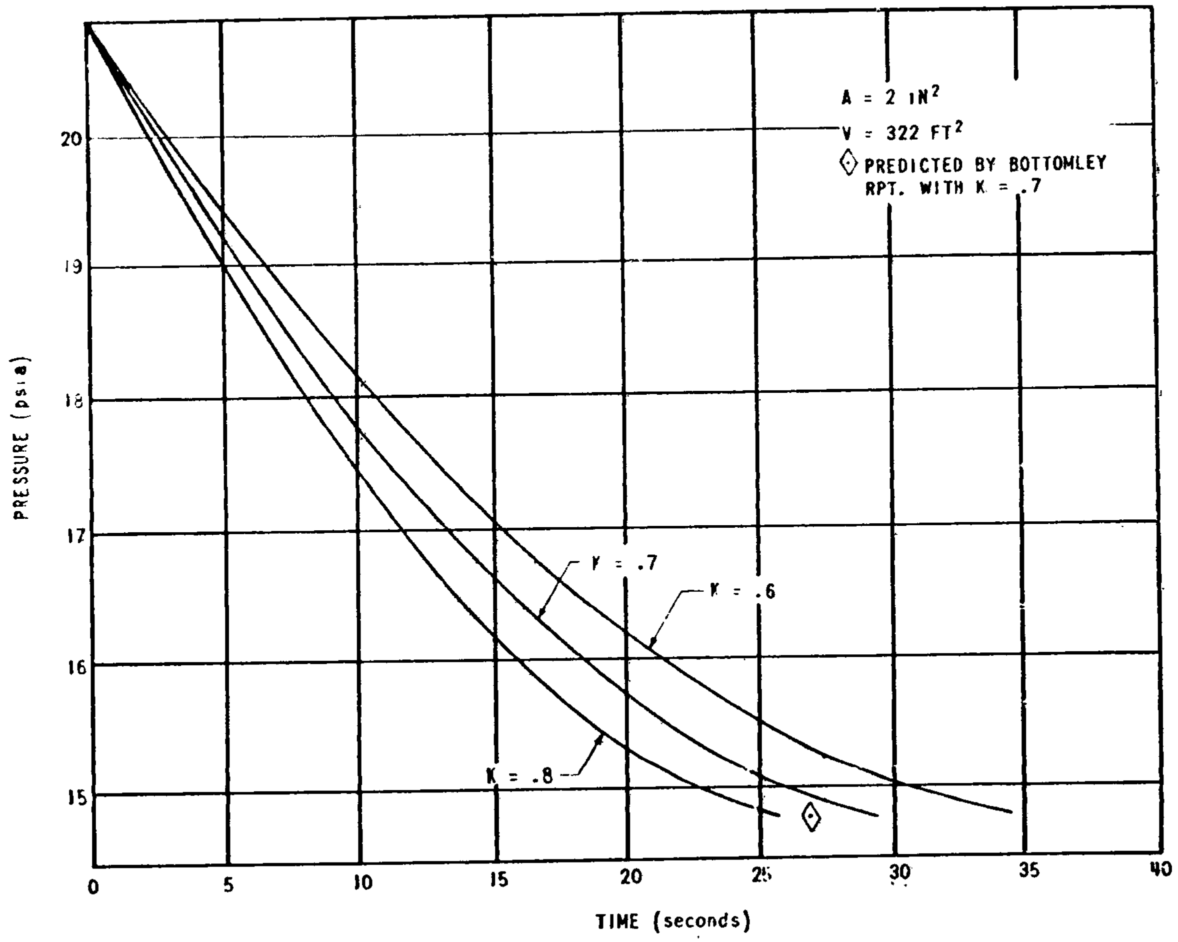



FIGURE 2: DEPRESSURIZATION CURVE WITH 6.2 PSI OVERPRESSURE

(DEPRESSURIZATION ASSUMED TO BE COMPLETE AT AN OVERPRESSURE OF 0.1 psi.)

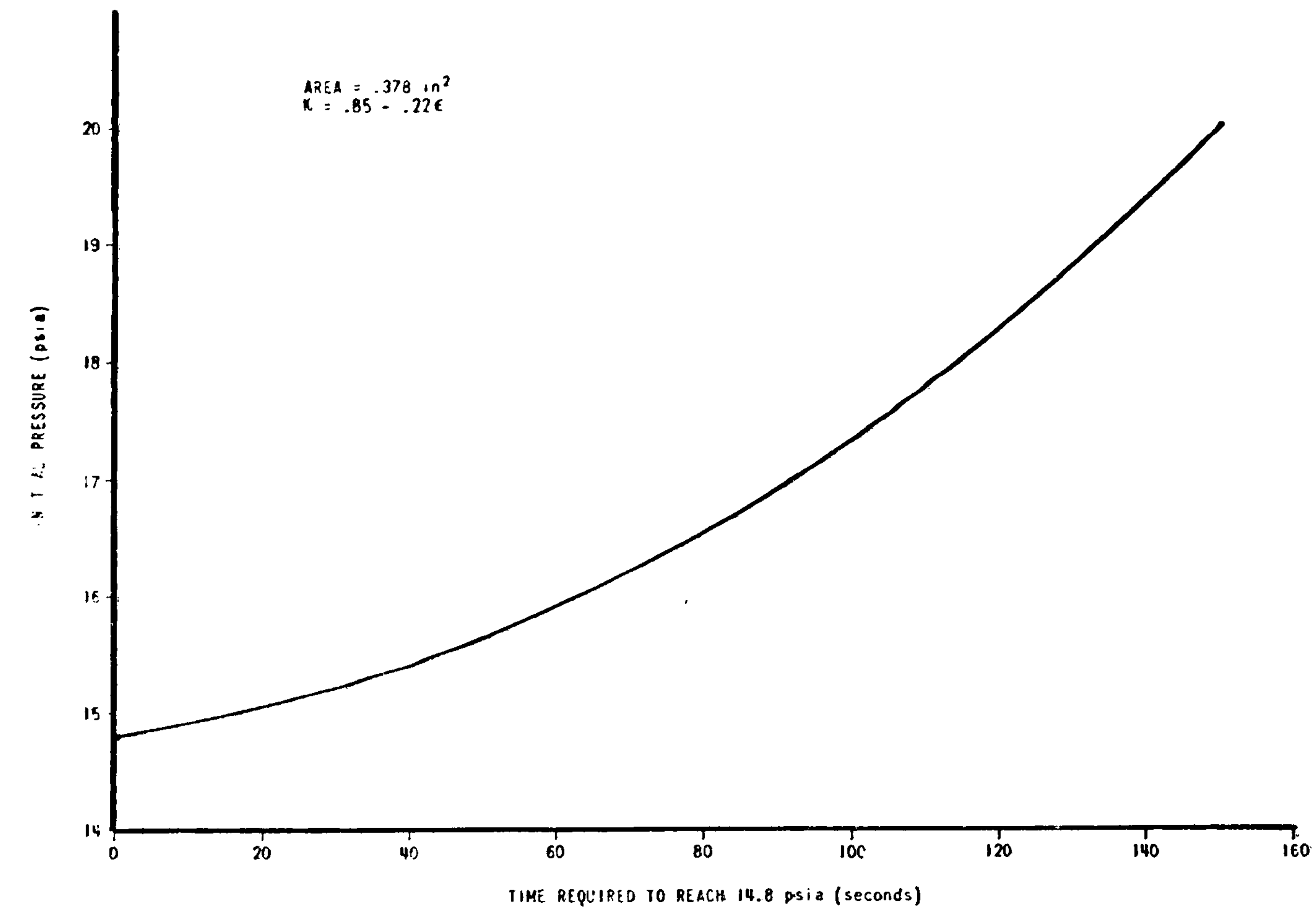



FIGURE 3: TIME REQUIRED TO DEPRESSURIZE TO 14.8 psia THROUGH PURGE FITTING AS A FUNCTION OF INITIAL CM CABIN PRESSURE

(DEPRESSURIZATION ASSUMED TO BE COMPLETE AT AN OVERPRESSURE OF 0.1 psi.)

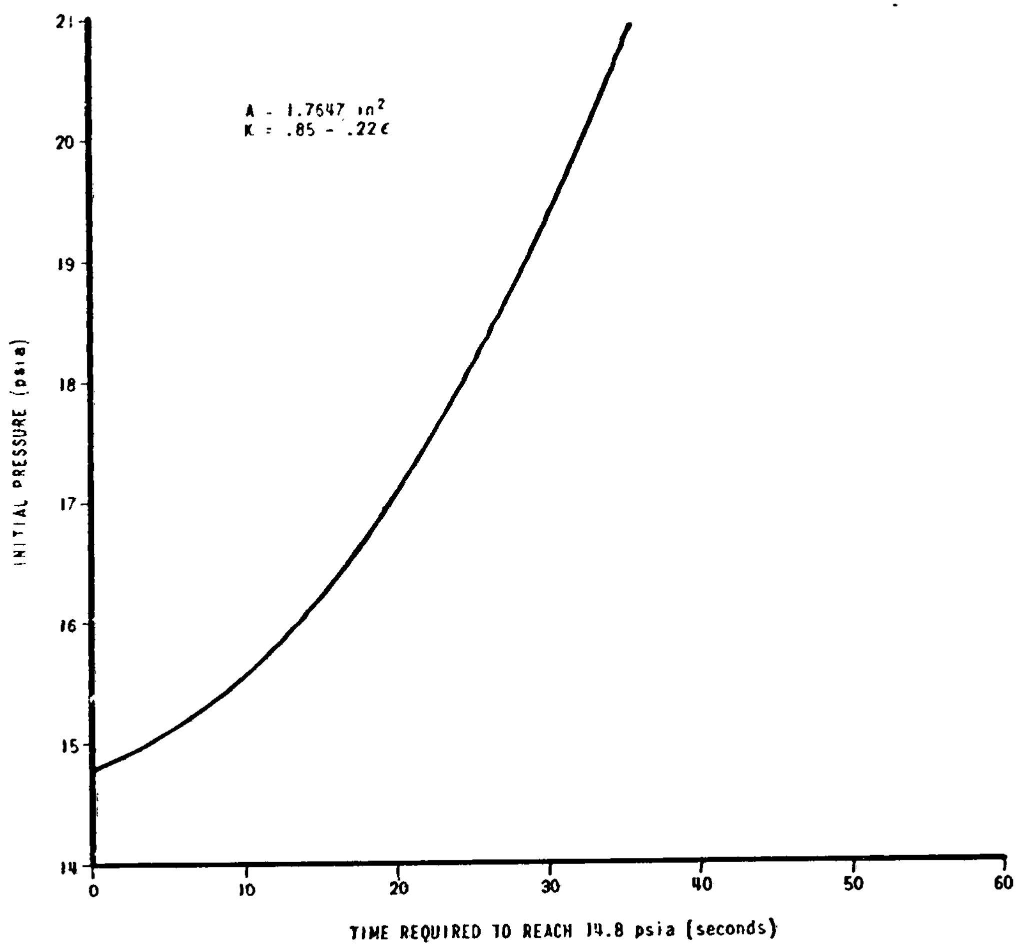
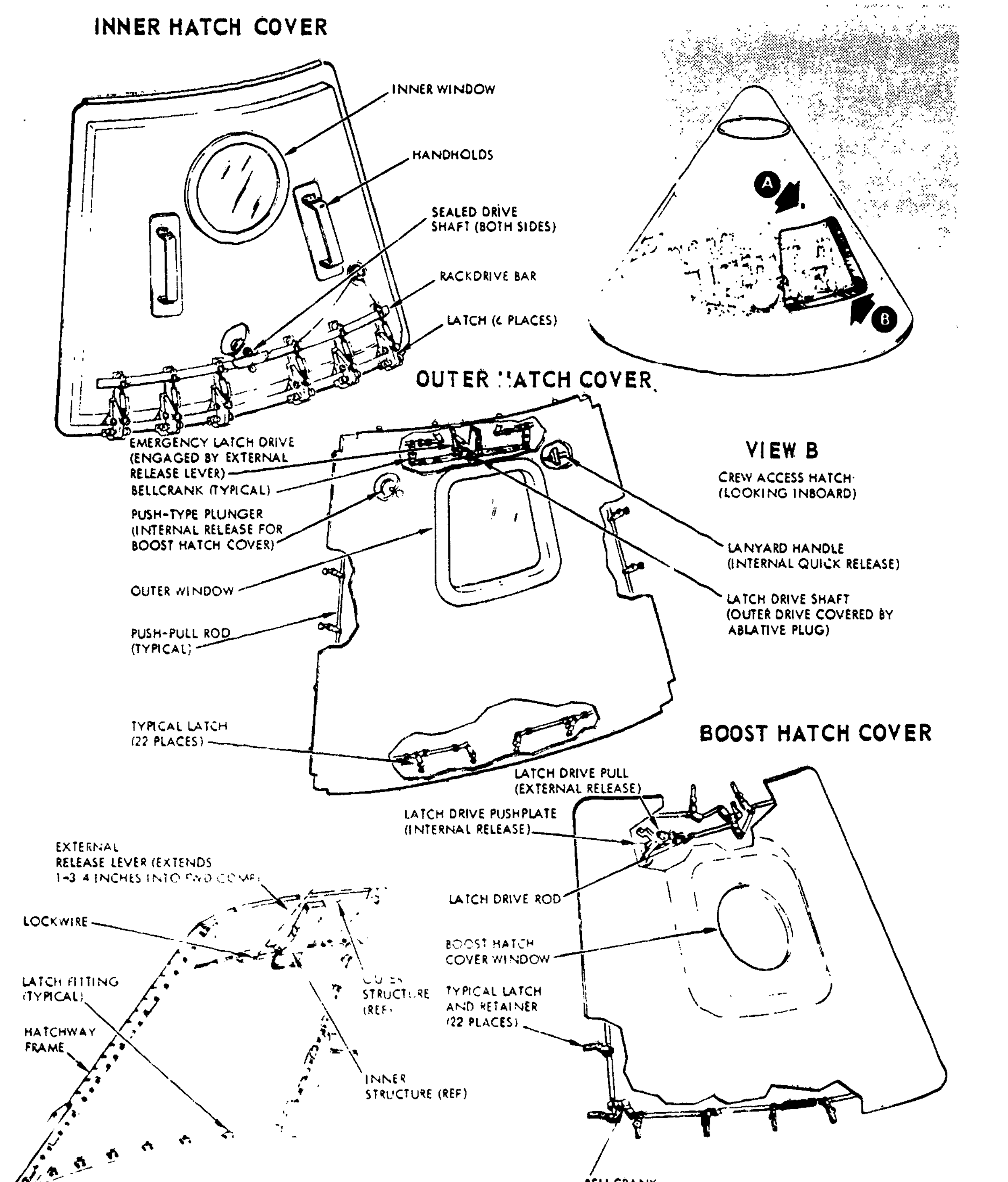


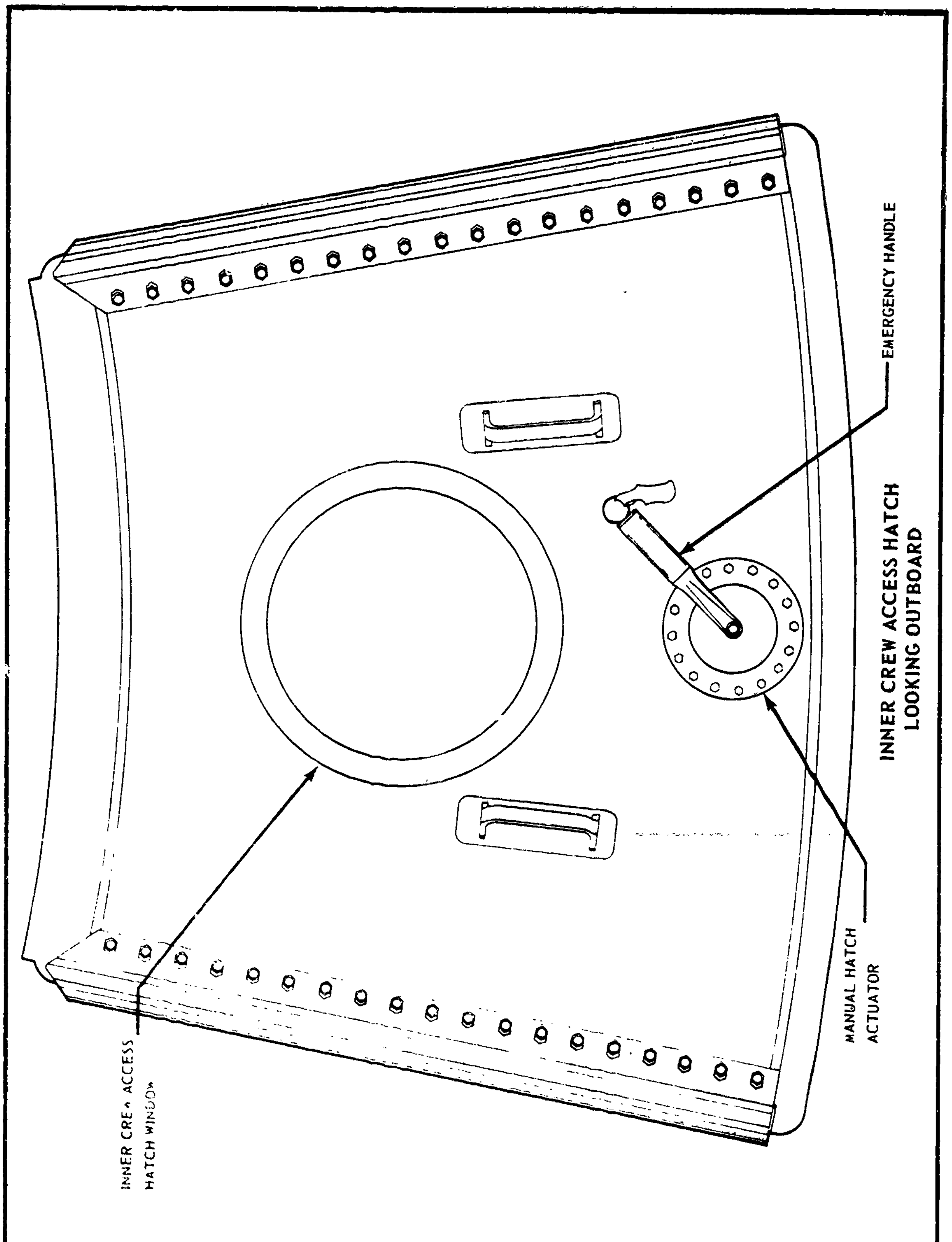

FIGURE 4: TIME REQUIRED TO DEPRESSURIZE TO 14.8 psia THROUGH CABIN PRESSURE RELIEF VALVE AS A FUNCTION OF INITIAL CM CABIN PRESSURE

(DEPRESSURIZATION ASSUMED TO BE COMPLETE AT AN OVERPRESSURE OF 0.1 psi.)




COMMAND MODULE MECHANICAL CONTROLS

ENCLOSURE 13-7


INNER CREW ACCESS HATCH
LOOKING OUTBOARD
EMERGENCY HANDLE
MANUAL HATCH
ACTUATOR
INNER CREW ACCESS
HATCH WINDOW

CF23/C. D. Wheelwright

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

# *Memorandum*

**TO** : GA/Gemini Program Office

**DATE:** Jan. 26, 1965

**FROM** : CA/Assistant Director for Flight Crew

In reply refer to: CF23-5M-5

**SUBJECT:** Ejection seat catapult rocket fire flash effects on Gemini suit material

Before a full scale 100 percent $O_2$, 14 psi "off-pad" abort test is conducted on the tower at China Lake, it was decided to conduct a series of pilot tests in one of the small chambers at MSC. Five 6-inch by 6-inch swatches were made using the materials in the Gemini thermo integrated space suit (outer layer HT-1 nylon, 7 layers of mylar and interpressure vessel). One 6-inch by 6-inch swatch of the outer parachute pack and a miniature parachute pack were tested in the same manner.

The 7 swatches of materials, 5 similar to the Gemini space suit, 1 similar to the parachute pack, and 1 the outer parachute pack covering, were tested in a 100 percent $O_2$, 14 psi environment for high temperature flame effect. Each swatch was tested separately in a small chamber. The swatches were placed in the chamber and the chamber was evacuated to 5 mm Hg and left for 5 minutes to insure complete out-gassing of the swatches. The chamber was brought to ambient with 100 percent $O_2$ and the swatches were soaked for 5 minutes. At the end of the 5-minute soak, the chamber was again evacuated to 5 mm Hg for 5 minutes. The chamber was brought to 14 psi with 100 percent $O_2$ and the swatches soaked for 30 minutes. At the end of 30 minutes, a propane flame with a flame temperature above 1,800°F was brought into contact with the swatches. Each of the 5 suit swatches were brought into contact with the flame for 0.5 second, 1 second, 2 seconds, 3 seconds, and 5 seconds respectively. The parachute pack outer material was in the flame for 7 seconds and the simulated parachute package for 2 seconds.

The results were:

a. No scorching occurred before 3 seconds in the flame.

b. Burning occurred after 5 seconds for the suit material.

c. Smoldering occurred after 7 seconds for the parachute outer pack material.

d. No effect was noted to either the parachute canopy or the pack during a 2-second flame contact duration.

The attached photographs show the results of the above test. All the materials were in contact with the flame considerably longer than the suit or parachute would be during an "off-pad" ejection. The maximum duration that the man is partially engulfed in the flame in an "off-pad" abort will be 0.01 second (10 milliseconds).

The results of these tests indicate that during an ejection, the fire flash of the ejection seat catapult is not of sufficient duration to cause the space suit to burn. Therefore, the test recommended in paragraph 1 is no longer considered mandatory and a decision to run the test must be based on program considerations.

/s/ D. K. Slayton

Donald K. Slayton

Enclosures 2

cc:
AM/D. O. Coons
AM2/G. F. Kelly
CB/A. B. Shepard
A. L. Bean
CF23/J. C. Joerns
EC/R. S. Johnston
EC4/F. S. Dawn
EC8/E. M. Tucker

CF23:CDWheelwright:bsf 1/22/65

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA GEN. REG. NO. 27

5010-107

UNITED STATES GOVERNMENT

# *Memorandum*

TO : Mr. S. Beddingfield, KB-4

DATE: March 8, 1967

FROM : KSC Fire Protection Officer, RF-1

SUBJECT: Fire Extinguishers used on 204 incident.

1. Attached is a copy listing the conditions found on each extinguisher used on the 204 incident.

2. All extinguishers were out of date in accordance with the last date of inspection according to AFM 92-1 dated 15 January 1964, Section D, Paragraph 6-16 (1), Page 6-6, which states all extinguishers should be inspected monthly.

3. We are holding these extinguishers under bond until notified in writing by proper authority to release them.

4. Some of the discrepancies noted might have occurred during or after their use, (i.e., pins bent or missing, defective plunger, etc.).

N. C. Gray



**ENCLOSURE 13-10**

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| | | | |
|---|---|---|---|
| Pirr 202 | Tag. No. 93 | 15 lb. $CO_2$ | Used |

1. Factory stamp number — 15-2060378
2. Hydrostatic — 10/65
3. Stencil Inspection date — 9/13/66
4. Last Inspection date — 12/1/66
5. Empty weight — 27-1/4 lbs.
6. Full weight — 44-5/8 lbs.
7. Weighed at KSC — 31 lbs.
8. Discrepancies — Out of date.
9. Useable remaining $CO_2$ — Empty (18 seconds gas only)

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| Pirr 203 | Tag. No. 93 | 15 lb. $CO_2$ | Used |
|---|---|---|---|

| | | |
|---|---|---|
| 1. | Factory Stamp number | 15-224028 |
| 2. | Hydrostatic | 1/65 |
| 3. | Stencil Inspection date | 8/1/66 |
| 4. | Last Inspection date | No tag |
| 5. | Empty weight | 27-1/2 lbs. |
| 6. | Full weight | 44-7/8 lbs. |
| 7. | Weighed at KSC | 30 lbs. |
| 8. | Discrepancies | Out of date |
| 9. | Useable remaining $CO_2$ | Totally empty |
| 10. | Recharged discharge time | 28 seconds, good $CO_2$ |

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| Pirr 204 | Tag No. 93 | 15 lb. $CO_2$ | Used |
|---|---|---|---|

1. Factory stamp number — 15-252929
2. Hydrostatic — 8/65
3. Stencil Inspection date — 12/3/66
4. Last Inspection date — 12/1/66
5. Empty weight — 26-1/2 lbs.
6. Full weight — 43-5/8 lbs.
7. Weighed at KSC — 32-1/2 lbs.
8. Discrepancies — Out of date
9. Useable remaining $CO_2$ — Empty ( 14 seconds, gas only)

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| Pirr 205 | Tag No. 93 | 15 lb. $CO_2$ | Used |
|---|---|---|---|

1. Factory stamp number — 15-220110
2. Hydrostatic — 12/64
3. Stencil Inspection date — 12/22/66
4. Last Inspection date — 12/1/66
5. Empty weight — 27-1/4 lbs.
6. Full weight — 44-5/8 lbs.
7. Weighed at KSC — 31 lbs.
8. Discrepancies — Out of date, horn split badly
9. Useable remaining $CO_2$ — Empty (12 seconds, gas only)

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| Pirr 206 | Tag No. | 15 lb. $CO_2$ | Used |
|---|---|---|---|

| | |
|---|---|
| 1. Factory stamp number | HH 26940 |
| 2. Hydrostatic | 11/62 |
| 3. Stencil Inspection date | 8/22/66 |
| 4. Last Inspection date | 12/1/66 |
| 5. Empty weight | Not legible |
| 6. Full weight | Not legible |
| 7. Weighed at KSC | 32 lbs. |
| 8. Discrepancies | Out of date, defective trigger plunger |
| 9. Useable remaining $CO_2$ | Empty (20 seconds, gas only) |

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

Pirr 207 Tag No. 93 15 lb. $CO_2$ Used

| | | |
|---|---|---|
| 1. | Factory stamp number | USA-16535BN |
| 2. | Hydrostatic | 1/64 |
| 3. | Stencil Inspection date | 9/66 |
| 4. | Last Inspection date | 12/1/66 |
| 5. | Empty weight | 25 lbs. |
| 6. | Full weight | 40 lbs. |
| 7. | Weighed at KSC | 39-1/2 lbs. |
| 8. | Discrepancies | Out of date, defective trigger plunger |
| 9. | Useable remaining $CO_2$ | 21 seconds, good $CO_2$ |

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| | | | |
|---|---|---|---|
| Pirr 208 | Tag No. 94 | 15 lb. $CO_2$ | Used |

| | | |
|---|---|---|
| 1. | Factory stamp number | 15-224214 |
| 2. | Hydrostatic | 1/66 |
| 3. | Stencil Inspection date | 8/1/66 |
| 4. | Last Inspection date | 12/1/66 |
| 5. | Empty weight | 27 lbs. |
| 6. | Full weight | 44-3/4 lbs. |
| 7. | Weighed at KSC | 29-1/2 lbs. |
| 8. | Discrepancies | Out of date, band broken |
| 9. | Useable remaining $CO_2$ | Empty |

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| Pirr 209 | Log No. 94 | 15 lb. $CO_2$ | Used |
|---|---|---|---|

1. Factory stamp number — 15-39-926
2. Hydrostatic — 8/63
3. Stencil Inspection date — 8/9/66
4. Last Inspection date — 9/30/66 - on tag
5. Empty weight — 23-3/4 lbs.
6. Full weight — 38-3/4 lbs.
7. Weighed at KSC — 35-1/2 lbs.
8. Discrepancies — Out of date
9. Useable remaining $CO_2$ — 19 seconds, good $CO_2$

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| Pirr 210 | Log No. 94 | 50 lb. $CO_2$ | Used |
|---|---|---|---|

| | | |
|---|---|---|
| 1. | Factory stamp number | TC-2807 |
| 2. | Hydrostatic | 10/59 |
| 3. | Stencil Inspection date | 12/1/66 |
| 4. | Last Inspection date | 12/1/66 - Wood |
| 5. | Empty weight | 137 lbs. (cyl.) - with cart 160 lbs. |
| 6. | Full weight | 187 lbs. (cyl.) |
| 7. | Weighed at KSC | 205 lbs (cyl. and cart) |
| 8. | Discrepancies | Out of date, discharge lock pin missing |
| 9. | Useable remaining $CO_2$ | Empty (1 min. 42 sec. gas only) |
| 1. | Actual empty weight at KSC | 104-1/2 lbs. (cyl.) |
| 2. | Actual empty weight at KSC | 45.5 lbs. (cart) |
| 3. | Actual empty weight at KSC | 150 lbs. (cyl., cart and hose) |
| 10. | Recharged discharge time | 1 min. 46 sec., good $CO_2$ |

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| | | |
|---|---|---|
| Pirr 211 | Log No. 94 | 30 lb. Dry Chem. Used Ansul, Met-X |
| | 1. Factory stamp number | None |
| | 2. Hydrostatic | 5/64 |
| | 3. Stencil Inspection date | 8/10/66 |
| | 4. Last Inspection date | 12/1/66 |
| | 5. Empty weight | Not marked |
| | 6. Full weight | Not marked |
| | 7. Weighed at KSC | 42 lbs. |
| | 8. Discrepancies | Cartridge punctured, Cylinder marked by stencil "ABC Dry Chemical" |
| | 9. Useable remaining Dry Chem. | Visual inspection - approximately 2/3rds full of agent |

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| Pirr. 212 | | 15 lb. $CO_2$ | Used |
|---|---|---|---|
| 1. | Factory stamp number | 15-223723 | |
| 2. | Hydrostatic | 10/60 | |
| 3. | Stencil Inspection date | 8/1/66 | |
| 4. | Last Inspection date | 12/1/66 | |
| 5. | Empty weight | 27-3/4 lbs. | |
| 6. | Full weight | 45-1/8 lbs. | |
| 7. | Weighed at KSC | 31 lbs. | |
| 8. | Discrepancies | Out of date, no band or horn clamp | |
| 9. | Useable remaining $CO_2$ | Empty (6 seconds gas only) | |
| 10. | Recharged discharge time | 29 seconds, good $CO_2$ | |

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| | | | |
|---|---|---|---|
| Pirr 213. | Log No. 94 | 15 lb. $CO_2$ | Used |

| | | |
|---|---|---|
| 1. | Factory stamp number | 15-223653 |
| 2. | Hydrostatic | 1/65 |
| 3. | Stencil Inspection date | 8/1/66 |
| 4. | Last Inspection date | No tag |
| 5. | Empty weight | 27-5/8 lbs. |
| 6. | Full weight | 45 lbs. |
| 7. | Weighted at KSC | 31-1/2 lbs. |
| 8. | Discrepancies | Out of date |
| 9. | Useable remaining $CO_2$ | Empty (21 seconds gas only) |

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

Pirr 214 Log No. 95 15 lb. $CO_2$ Used

| | | |
|---|---|---|
| 1. | Factory stamp number | HSC-27898F |
| 2. | Hydrostatic | 6/63 |
| 3. | Stencil Inspection date | 11/3/66 |
| 4. | Last Inspection date | No tag |
| 5. | Empty weight | Not legible |
| 6. | Full weight | 46 lbs. |
| 7. | Weighed at KSC | 31-1/2 lbs. |
| 8. | Discrepancies | Out of date |
| 9. | Useable remaining $CO_2$ | Empty |

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| | | | |
|---|---|---|---|
| Pirr 215 | Log No. 95 | 50 lb. $CO_2$ | Used |

| | | |
|---|---|---|
| 1. | Factory stamp number | TT 7128. |
| 2. | Hydrostatic | 1/57 |
| 3. | Stencil Inspection date | 8/1/66 |
| 4. | Last Inspection date | 12/1/66 |
| 5. | Empty weight | Cyl. - not legible, with cart 148-1/2 lb. |
| 6. | Full weight | 183 lbs. (Cyl.) |
| 7. | Weighed at KSC | 194-1/2 lbs. (Cyl. and cart) |
| 8. | Discrepancies | Out of date, Hose pitted near connection to bottle, defective trigger pin |
| 9. | Useable remaining $CO_2$ | Empty (1 min. 56 seconds, gas only) |
| 1. | Actual empty weight at KSC | 98 lbs. (Cyl.) |
| 2. | Actual empty weight at KSC | 143-1/2 lbs (Cyl., cart and hose) |

LC-34 .- - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found .

| Pirr | Tag No. 95 | 15 lb. . $CO_2$ | Used |
|---|---|---|---|

1. Factory stamp number — USA-61538BL .
2. Hydrostatic — 11/64
3. Stencil Inspection date — 12/1/66
4. Last Inspection date — 12/1/66
5. Empty weight — 26 lbs.
6. Full weight — 41 lbs.
7. Weighed at KSC — 27-1/2 lbs.
8. Discrepancies — Out of date
9. Useable remaining $CO_2$ — Empty.( 10 seconds gas only)

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| Pirr 218 | Tag No. 96 | 15 lb. $CO_2$ | Used |
|---|---|---|---|

1. Factory stamp number — 223584
2. Hydrostatic — 1/65
3. Stencil Inspection date — 12/1/66
4. Last Inspection date — 12/1/66
5. Empty weight — 28 lbs.
6. Full weight — 45-3/4 lbs.
7. Weighed at KSC — 32-1/2 lbs.
8. Discrepancies — Out of date
9. Useable remaining $CO_2$ — Empty (16 seconds gas only)
10. Recharged discharge time — 35 seconds, good $CO_2$

LC-34 - - 204

Bonded Extinguishers

Examined by KSC Fire Service

2/28/67 by Inspectors Weber and Olsson

Conditions Found

| | | | |
|---|---|---|---|
| Pirr 219 | Tag No. 96 | 15 lb. $CO_2$ | Used |

| | | |
|---|---|---|
| 1. | Factory stamp number | F-458277 |
| 2.. | Hydrostatic | 8/60 |
| 3. | Stencil Inspection date | 7/26/66 |
| 4. | Last Inspection date | 12/1/66 |
| 5. | Empty weight | Not legible |
| 6. | Full weight | 52 lbs. |
| 7. | Weighed at KSC | 38 lbs. |
| 8. | Discrepancies | Out of date |
| 9. | Useable remaining $CO_2$ | Empty |

(Sheet 18 of 20)

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

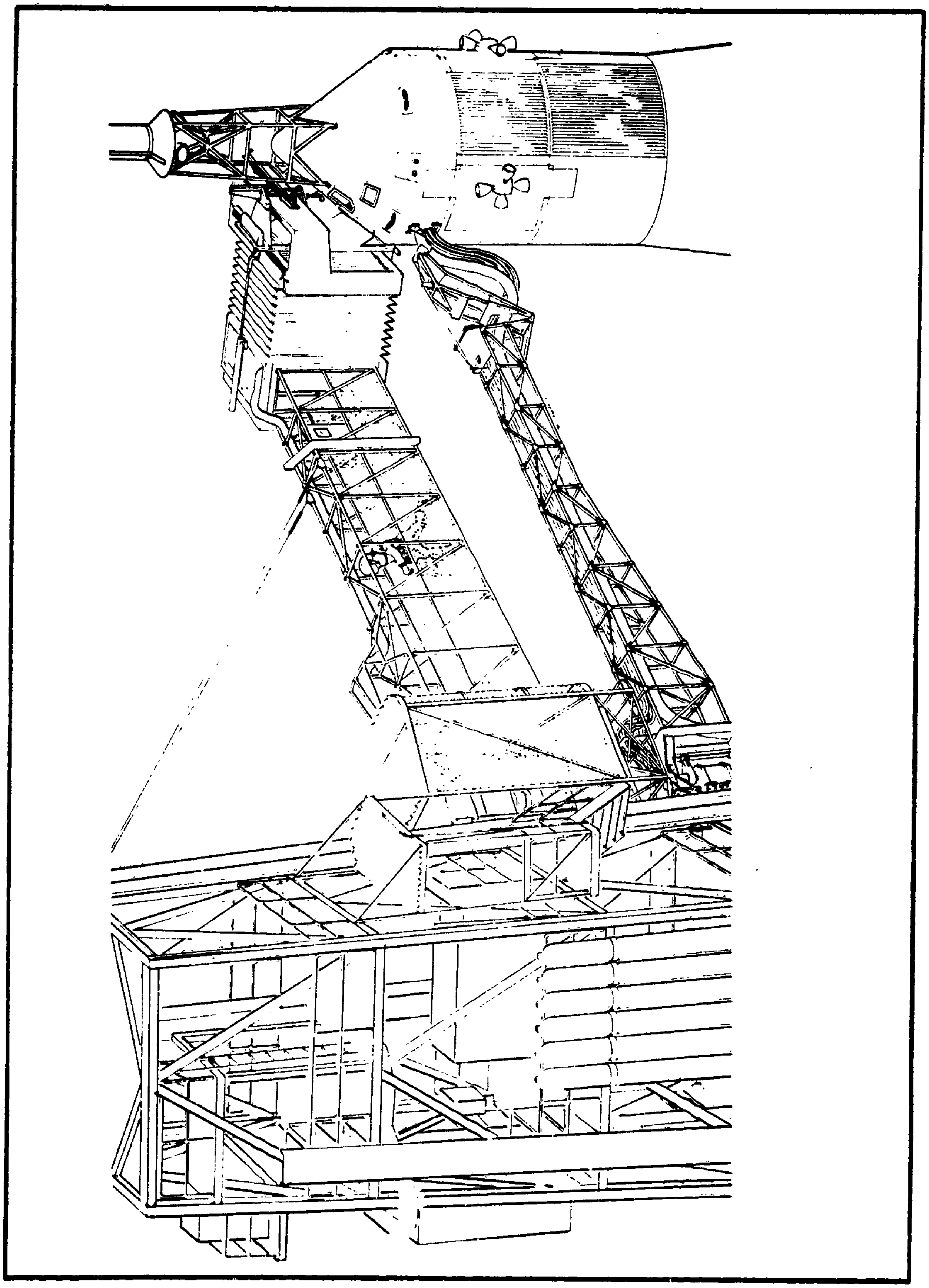
| Pirr | Tag No. 227 | 15 lb. $CO_2$ | Used |
|---|---|---|---|
| | 1. Factory stamp number | 15-176031 | |
| | 2. Hydrostatic | 2/65 | |
| | 3. Stencil Inspection date | 7/1/66 | |
| | 4. Last Inspection date | 2/1/66 | |
| | 5. Empty weight | 30-3/4 lbs. | |
| | 6. Full weight | 45-5/8 lbs. | |
| | 7. Weighed at KSC | 33-1/2 lbs. | |
| | 8. Discrepancies | Out of date, pin bent in head | |
| | 9. Useable remaining $CO_2$ | Empty | |

LC-34 - - 204
Bonded Extinguishers
Examined by KSC Fire Service
2/28/67 by Inspectors Weber and Olsson

Conditions Found

| Pirr | Tag No. 228 | 15 lb. $CO_2$ | Used |
|---|---|---|---|

| | | |
|---|---|---|
| 1. | Factory stamp number | 15-210863. |
| 2. | Hydrostatic | 12/64 |
| 3. | Stencil Inspection date | 8/1/66 |
| 4. | Last Inspection date | 12/1/66 |
| 5. | Empty weight | 27-5/8 lbs. |
| 6. | Full weight | 45 lbs. |
| 7. | Weighed at KSC | 44-1/2 lbs. |
| 8. | Discrepancies | Out of date |
| 9. | Useable remaining $CO_2$ | 25 seconds good $CO_2$ |
| 10. | Recharged discharge time | 31 seconds good $CO_2$ |



**ENCLOSURE 13-11**

KSC SO

# APOLLO

S&ID FLORIDA

## PRE-FLIGHT OPERATIONS PROCEDURE

**NO.** G-100

**DATE:** November 4, 1966

**TITLE:** Originating and Changing Apollo Pre-Flight Operations Procedures

1. PURPOSE

This procedure establishes the method of initiating, coordinating, publishing, and distributing new and revised Apollo Pre-Flight Operations Procedures (APOP's).

2. FORMS

Apollo Manual Change Request (AMCR, KSC Form 4-33NS - 7/66)

3. DEFINITIONS

Apollo Pre-Flight Operations Procedure: A basic procedure necessary to manage the technical operations performed at the Kennedy Space Center which requires joint and/or concurrent action by NASA and NAA/S&ID. "Joint and concurrent action" as delineated herein refers to: direct participation by NASA and NAA in signature approval or acceptance stamping of a disposition, operation, or document. Examples that do not constitute joint and concurrent action are: (a) independent review and evaluation of prior actions, (b) receipt of documents, and (c) need-to-know without direct participation.

4. RESPONSIBILITY AND HANDLING

Ø 4.1 Cognizant NASA/NAA employees may propose a new procedure or a revision to an existing one. Proposals will be transmitted by preparing an AMCR in triplicate. NASA initiated AMCR's will be signed by the originator and approved by his supervisor. NAA initiated AMCR's will be signed by the originator and approved by his manager. One copy will be retained on file and two copies will accompany the procedure and be forwarded to NASA Spacecraft Operations Procedures Control Office or the NAA Procedures Representative as applicable. A clearly stated reason for the proposal will be included on the AMCR.

Ø 4.1.1 Proposed new procedures or revisions will be reviewed by NASA Spacecraft Operations Procedures Control, or the NAA Procedures Representative, to determine if they (1) contain joint or concurrent action as outlined in paragraph 3 above, (2) duplicate or conflict with existing procedures, (3) conform to established format. Proposals that are not valid will be returned to the originator with reasons for the rejection stated on the AMCR.

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Revision: Remove and destroy APOP G-100, dated December 13, 1965, and replace with this issue. Ø indicates revisions. Retain Appendix "A" dated December 13, 1965. Revised to update signature requirements, organizational titles and provide for the use of Addendums.

Ø 4.1.2 NASA Spacecraft Operations Procedures Control will forward coordination copies of NASA originated procedures to the NAA Procedures Unit and applicable NASA coordination points requesting comments be returned on the due date specified. NAA Procedures Unit will forward copies to applicable NAA coordination points.

Ø 4.1.3 The NAA Procedures Unit will forward coordination copies of NAA originated procedures to the NASA Operations Procedures Control Office, and applicable NAA coordination points requesting comments be returned on the due date specified.

4.1.4 Comments submitted will be clearly stated, referencing specific paragraphs, giving reasons, and offering alternate instructions where possible.

4.1.5 Comments to the draft must be returned by the due date. If comments are not returned, concurrence with proposals will be assumed.

4.1.6 When the coordination period has expired, the comments received will be reviewed and coordinated with the affected groups. Those deemed applicable will be incorporated into the procedure. An attempt will be made to resolve conflicting comments by means of telephone calls, meetings, etc. If conflicting comments cannot be resolved, they will be brought to the attention of NASA/NAA management for decision.

Ø 4.1.7 When coordination is complete and conflicts resolved or management decision made, the procedure will be typed by NAA for publication, signed by the NASA Spacecraft Operations Procedure Control and the NAA Procedures Representative, and forwarded to the NASA Manager, Test and Operations Management Office and the NAA Director of Apollo CSM Operations for approval signatures.

4.2 <u>Minor Revisions</u>

Ø Minor revisions (i.e., grammatical corrections, format corrections, and word changes that have only a minor effect on the intent of the procedure), may be issued as pen and ink changes upon approval of the NASA Spacecraft Procedures Control and the NAA Procedures Representative.

4.3 Interim Procedures

Ø 4.3.1 APOP's may be published on an interim basis upon approval by NASA/NAA Management. Requests will be forwarded on an AMCR to the NASA Spacecraft Procedures Control or NAA Procedures Representative as applicable; however, action may be initiated by a verbal request and confirmed in writing on an AMCR prior to publication. NAA originated AMCR's for interim publication must be signed by a NAA/FF manager or above.

Ø 4.3.2 NASA Spacecraft Procedures Control and NAA Procedures Representative will obtain preliminary approvals of interim procedures by the most rapid means available.

4.3.3 When preliminary approvals are obtained, the procedure will be distributed as an interim procedure with a life span of 30 to 60 days. The expiration date will be noted on the first page under the publication date. Approval signatures will be the same as for a regular procedure or revision.

4.3.4 The life span will serve as the coordination period. At the end of this interim period, the procedure will be issued as a regular procedure incorporating changes or published as is, if no comments are received. If an interim procedure is unresolved, conflicting points will be referred to NASA/NAA management for decision.

Ø 4.4 Addendums

4.4.1 Certain key procedures require frequent revisions to accurately reflect the latest change in the NASA/NAA operations. These revisions include both minor and major changes in procedure, and, depending upon the circumstances, may need to be issued on an emergency basis. To expedite this kind of procedural updating and to avoid the frequent and time consuming retype and reissue of lengthy procedures, such revisions may be published as addendums. However, addendums will be used only as a last resort and under emergency conditions when time will not permit a normal revision or interim publication.

4.4.2 The addendum will normally be a one or two page statement of the changes being adopted. The paragraphs affected will be clearly referenced and the new or revised information will be clearly stated.

4.4.3 Requests for publication of revisions as addendums will be processed in the same manner as other proposed revisions (see paragraph 4.1). However, action may be initiated by a verbal request and confirmed later in writing on an AMCR.

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4.4.4 NASA Spacecraft Procedures Control and the NAA Procedures Representative will coordinate the proposed addendum and obtain necessary approvals. Normally addendum changes will receive regular coordination. However, when operational requirements dictate immediate publication, coordination similar to that for interim procedures will be used. (Reference paragraph 4._.2).

4.4.5 When approvals are obtained, the addendum will be typed on multilith mats and signed by NASA Manager, Test and Operations Management Office and the NAA Director of Apollo CSM Operations.

4.4.6 Following the publication of an addendum, the procedure affected will be revised as soon as practical, incorporating the revisions outlined in the addendum.

4.5 Distribution and Control

4.5.1 Request to be placed on distribution for the APOP's will be made by memorandum and submitted to the NASA Spacecraft Procedures Control or the NAA Procedures Representative, as applicable.

4.5.2 The NAA Procedures Unit will maintain complete history files of all APOP's and will be responsible for the publication and distribution.

4.6 Format

4.6.1 When preparing a draft for a proposed procedure, the originator should organize the material into a format as shown in Appendix "A". Paragraphs should be numbered using the decimal system, and when possible, four decimal places should not be exceeded. Information such as lengthy Forms Guide Instructions, Flow Charts, List of Names, Categories, etc., should be omitted from the basic instructions and included as an Appendix.

Coordinated by: Sam Bridges Jr
Procedures Unit
NAA/S&ID Florida Facility

Coordinated by: [signature]
NASA Spacecraft Operations
Procedures Control

Approved by: J L Pearce
J. L. Pearce, Director
Apollo CSM Operations
NAA/S&ID Florida Facility

Approved by: for [signature]
NASA Manager, Test and
Operations Management
Office

KSC SO

# APOLLO

## PRE-FLIGHT OPERATIONS PROCEDURE

S&ID FLORIDA

**NO.** 0-202

**DATE:** May 13, 1966

**TITLE:** Operational Checkout Procedure

1. PURPOSE

This procedure establishes the methods for the preparation, processing, release, and use of Operational Checkout Procedures.

2. REFERENCE DOCUMENTS

2.1 Apollo Pre-Flight Operations Procedure T-501, "Work Authorization - TPS"
2.2 Apollo Documentation Procedure No. 2
2.3 Apollo GSE Plan S&ID 62-14[illegible]C
2.4 APOP 0-201, "Access Control of Test and Work Areas"

3. FORMS

3.1 Operational Checkout Procedure (OCP, Form KSC 11-16A)
3.2 Parts Installation and Removal Record (NAA Form FLA-62)
Ø 3.3 Apollo Launch Operations Test Summary Sheet (KSC Form OT-109)

4. DEFINITIONS

4.1 OPERATIONAL CHECKOUT PROCEDURE (OCP) - An engineering document which provides detailed instructions to personnel for operational checkout and verification of equipment during site activation, pre-launch, launch, or post-launch operations.

4.2 OPERATIONAL CHECKOUT PROCEDURE CHECKLISTS - A checklist especially designed to supply the necessary information to accomplish routine tasks in a particular order, prepared on an 11 x 17 sheet and providing for inspection buy-off.

4.3 INTEGRATED OPERATIONAL CHECKOUT PROCEDURES - An OCP which unites two or more Apollo Command and Service Module (CSM) systems or unites CSM systems with the booster.

4.4 DEVIATIONS - A change to a published OCP, such as changes in equipment lists, test parameters, sequences added or deleted or modified by order of occurrence or content to permit accomplishment of the test. Obvious errors, such as typographical errors, wrong page numbers, etc., are not considered deviations.

Revision: Remove and destroy APOP 0-202, dated February 4, 1966, and replace with this issue. Ø denotes revisions. Retain Appendix A and B, dated February 4, 1966.

4.5 REVISION - Technical changes including permanent deviations published in page form for insertion into a published OCP.

4.6 RE-ISSUE - A complete re-write of an OCP published to supersede a previously released OCP.

4.7 APOLLO OCP CONTROL GROUP - A joint NASA/NAA Management Committee responsible to assure timely and technically adequate OCP's and to establish policy concerning NAA Florida Facility (FF)/Kennedy Space Center (KSC) OCP's.

5. GENERAL REQUIREMENTS

5.1 OCP's are based on NAA Process Specifications. Those applicable should be referenced in the OCP by document number.

5.2 A series of OCP's for each vehicle will be prepared and released at the Florida Facility in accordance with OCP requirements as specified in this and referenced documents.

5.3 OCP's will (1) provide detailed step-by-step delineation of required personnel activity for the operation, assembly, handling, or test of the equipment and for system(s) involved, (2) provide for insertion of program requirement record data, (3) provide NASA/NAA Engineering and Inspection acceptance, (4) provide for safety of personnel and equipment.

5.4 Ground Support Equipment (GSE) nomenclature will be standardized in accordance with Reference 2.3. The GSE model number and title will be listed in the special equipment section. In the procedure section, the model number and abbreviated title will be used.

5.5 All OCP's will include the following statement: "NAA supervision and the responsible NAA test engineer are directly responsible for the safety of all NAA personnel, safe working conditions, and implementing all safety requirements".

5.6 All safety requirements will be considered in the preparation of OCP's, and the OCP originator will coordinate the procedure with the NAA/KSC Safety Offices and affix his signature to the FF "Safety Office Sign-off Statement" (file card) prior to publication.

5.7 Any OCP which involves any of the critical operations described in Reference 2.4 will be designated on the front page as follows: "This Test Procedure Is a Critical Operation"

5.8 Emergency shutdown procedures (sequentially if necessary) will be included for all equipment.

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5.9 Applicable KSC/NAA Safety Directives will be referenced and complied with or waivers will be obtained, prior to commencing the test to ensure safe operations.

5.10 Notes, Cautions and Warnings will not be numbered within the OCP, but will be set apart from the text by placing them in the center of the page above the procedural step as shown below:

NOTE

An operation or special requirements, etc., in which no danger exists but which, if not accomplished, may cause inconvenience, delay, or invalidation of test.

CAUTION

Operational step practice, etc., which, if not strictly adhered to or observed, could result in damage of equipment.

WARNING

Operational step practice, etc., which, if not strictly adhered to or observed, could result in personal injury.

5.11 Illustrations will be used only to aid in the overall clarity of the text when necessary and will be referenced in the text, but in no case will they be used as directives for accomplishing work.

6. RESPONSIBILITIES AND HANDLI[illegible]

6.1 Preparation, Processi[illegible] and Release

6.1.1 OCP's to accomplish work tasks are developed to support a specific Florida Operations Flow Plan. Titles and numbers are provided for the OCP Control Group for review and approval.

6.1.2 OCP outlines are prepared by the NAA Systems Engineer, reviewed by the NASA Engineers, and submitted to the OCP Control Group for review and approval.

6.1.3 Rough drafts for each individual OCP are prepared with text and illustrations as outlined in Reference 2.2.

6.1.4 Rough drafts are forwarded through the NASA to Electronic Data Processing (EDP) for processing in flimsy print-out form.

6.1.5 Flimsies are forwarded to the NAA Documentation Support Group, who send copies to Systems Engineering, NAA Quality Engineering, NAA Safety, Downey, Engineering, and NASA Technical Library for distribution to KSC Engineering, NASA QC, Safety, and Manned Spacecraft Center (MSC) Houston.

6.1.6 Review comments from those agencies listed in 6.1.5 are returned to the responsible NAA Systems Engineer. The responsible Systems Engineer then develops a master review copy which is reviewed and signed by the input agencies. On integrated procedures, a formal review is held for final comments and sign-off.

6.1.7 NAA Documentation Support Group attaches a cover sheet and releasing Field Engineering Order (FEO) - see Appendix A - to the signed master flimsy, and obtains appropriate NAA signatures. Following NAA sign-off, the signed FEO is released by NAA Configuration Control, and a copy of the released FEO is provided for Documentation Support at the time of release. The master flimsy and cover sheet are then given to the NASA for procurement of appropriate signatures as directed by the NASA/NAA OCP Control Group. The released FEO is maintained by Documentation Support until the OCP is submitted to Technical Services (TS) for publication.

6.1.8 When all signatures are affixed to the cover sheet, and the package is returned to NAA Documentation Support, the master flimsy is forwarded through the NASA to EDP for processing of final offset masters for printing.

6.1.9 The finalized offset masters, the signed-off cover sheet, and the released FEO are provided to TS for publication and distribution 30 days prior to test.

6.1.10 TS is responsible for OCP distribution directed by the NASA/NAA OCP Control Group; in addition, three (3) published copies will be forwarded to each Test Site OCP Coordinator.

## 6.2 Deviations to OCP's

6.2.1 All deviations will be recorded on pre-printed deviation sheets and will become an official part of the record copy OCP. Pretest deviations will be written by the Systems Engineers; the deviation [illegible] number ([illegible] per item); and a copy will be given to Inspection prior to starting the test.

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6.2.2 Deviations that occur during the test will be recorded by the Systems Engineers or NAA OCP writer if one is assigned to the test (integrated tests only). When the requirements for a deviation become known, the Systems Engineer will be notified. The Systems Engineer or writer will assign a deviation number and inspection will record the number in the record copy OCP. If no writer is assigned, the Systems Engineer will red line the OCP, issue deviation numbers, and notify Inspection who will record the number as stated above. At no time will a test be held up to record deviations on an official deviation sheet. This can be done upon completion of the test.

6.2.3 Upon completion of the test all deviation sheets will be completed and signed as [illegible] in Paragraph 6.2.5 and turned over to Inspection to [illegible] in the record copy OCP. Deviation sheets are self-releasing [illegible] not require an FEO.

6.2.4 It is the responsibility of the Systems Engineer to assure that properly approved deviation sheets are supplied to Inspection and to NAA Documentation Support following completion of the test. No OCP will be bought by Inspection until official deviations are provided by engineering for ALL deviations noted during performance of the OCP.

6.2.5 Approval signatures for deviation sheets will be as follows: for Systems tests of specific systems sections of integrated OCP's - NAA and NASA System Engineers; for control sections of integrated OCP - NAA Test Project Engineer (TPE) and NASA Spacecraft Test Conductor (STC); for electrical and mechanical check lists - NAA and NASA system engineers.

Ø 6.2.6 Deviations that should be incorporated in like OCP's for future CSM should be marked PERMANENT and later incorporated by NAA Documentation Support into the applicable OCP and released in accordance with Paragraphs 6.1.6 through 6.1.9. Deviations that are "one time only" items are recorded on the deviation sheet as Temporary Deviations. No further action is required on Temporary Deviations.

6.3 Open Item Review

Ø 6.3.1 NAA service engineering will maintain current TAIR Book status and will publish a daily status report ("fink sheet"). Only TPS's, DR's and DRCS's will be statused.

Ø 6.3.2 Completed OCP's that are still open will be reviewed for constraints. Special attention will be given to the open, non-transferred [illegible].

Ø 6.3.3 Review of open PIRR's and TIR's and shortage sheets will be accomplished by the NAA Systems Engineer prior to the Open Item Review. Any constraining shortages, PIRR's, or TIR's will be listed by the Systems Engineer and submitted to the Test Project Engineer (TPE)/Spacecraft Test Conductor (STC) at the Open Item Review.

Ø 6.3.4 The open items review will be conducted from the status report, and constraining items will be listed on a separate sheet, or the status report may be marked up accordingly. The determined constraints will be listed, signed by the TPE and STC, and published to insure that concentrated effort is applied to those items.

Ø 6.3.5 NAA and NASA engineering will sign the cover of the reviewed status report along with the TPE and STC. The signed copy of the status report will be filed with the record copy of the OCP upon completion of the test.

Ø 6.3.6 NAA Project Engineering and NASA Engineering must approve the Open Item Review Sheet by signature, prior to beginning the test. The original signed copy of the review sheet will be filed with the record copy of the OCP upon completion of the test.

Ø 6.3.7 NAA Technicians will work required constraints for NASA/NAA Inspection Acceptance.

6.4 All tests will be conducted by the NAA TPE and NASA STC. The TPE and STC may delegate their duties as necessary.

6.5 Quality Control Responsibilities during Test

6.5.1 Quality Control responsibilities after satisfactory completion of an OCP step or operation are as follows:

6.5.1.1 NAA Inspection will enter acceptance stamp impression and date after each operation requiring verification on each horizontal line designated for NAA inspector and at the bottom of each completed page of the OCP.

6.5.1.2 NASA Inspection will conformance stamp each line item requiring NASA inspection verification during all CSM testing and on GSE testing designated as NASA Mandatory Inspection Points (MIP).

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6.5.1.3 When NASA MIP's have not been entered in the NASA block for a GSE OCP, NAA Quality Control will double stamp, date and enter N/R in each NASA Quality Control Block after stamping the NAA Inspector block.

Ø 6.5.1.4 When an inspection stamp entry is required for verification or witnessing of an operation occurring at a remote area, which is removed from the location of the Quality Control buy-off copy of the OCP, the inspector will verify over the Operation Intercom System (OIS) the satisfactory completion of an operation, and will affix a functional test inspection stamp impression to the verified step in the OCP. The NAA final acceptance stamp will not be used for verification over the OIS.

6.5.1.5 Recycles, shutdowns at the end of shift or subsequent restarting of test at the beginning of the next test shift do not require deviations since these situations do not exceed nor change the scope of the test as specified by OCP, e.g., CSM power may be removed at the end of a shift to secure from the test until the next shift starts. At that time CSM power may be reapplied and the test resumed where it was terminated. No deviation is required for either the power down or power up. However, the point and time of events will be recorded in the record copy and will be noted in the OCP Test Summary Sheets.

Ø 6.5.1.6 The following time entries will be required on certain OCP s as specified. During the test, the NAA Inspector will record the time, using the 24-hour clock system, in the OCP as follows: (a) in the time column adjacent to the first sub-sequence entry on each page, (b) at stop and restarts due to test "holds." (In addition, a reference to the problem causing the hold will be noted: IDR Number, Deviation Number, etc.), (c) at the start and completion of sequences, (d) at intervals of 5 minutes as an objective, but not more than 15 minutes between sub-sequences. (If the duration of a sub-sequence does not exceed 5 minutes, the time need only be recorded once for that particular sub-sequence. The date is not required for this item).

NOTE: (1) Additional time recording may be necessary for critical points in the OCP. The above time requirements are to be considered as minimum.

Revision: Remove and destroy pages 7 and 8 ONLY of APOP 0-202, dated May 13, 19[illegible] and replace with this page. Revised to incorporate the Functional Inspection Stamp. Ø denotes changes.

(2) The date will be included with the first and last time entry during each 24-hour period and at the end of the OCP.

6.5.2 All deviation entries on the Quality Control buy-off copy of the OCP will be verified by the responsible NAA inspector affixing the double stamp and date adjacent to the entry.

6.5.3 If an OCP is to be rerun, a new copy of the OCP will be used. "Inspection Copy" will be entered on the front cover of the OCP along with the notation "Run Number 2" and authority.

6.5.3.1 Sequence reruns will be indicated by the notation Run #2 or Run #3, etc. as applicable, entered on the upper right portion of the page.

6.5.3.2 As deemed practicable, use one of the following methods for documentation of sequence reruns and for the run time involved: (a) File duplicate OCP pages in the OCP, indicate rerun as in paragraph 6.5.3.1, and proceed in the normal manner: (b) File a rerun time record adjacent to the OCP page being rerun, indicate rerun as in Paragraph 6.5.3.1, and log time as indicated on the rerun time record. (Indicate acceptance of each rerun sequence on the OCP page).

6.5.4 When an OCP is discontinued before completion the NAA Inspector will

6.5.4.1 Enter "Discontinued" and reason for discontinuance after the last entry, and double stamp and date beneath the entry.

6.5.4.2 When a discontinued test is resumed, the NAA TPE and NASA STE will be responsible for determining the step at which testing should resume; however, all Interim Discrepancy Records and/or Discrepancy Records which will remain open against the previous run are valid until dispositioned and satisfied.

6.6 OCP Test Summary Sheet

After each OCP Test, the NAA TPE or his designated alternate will prepare a Test Summary Sheet (signed by the NASA counterpart engineer) providing the information listed below.

**NOTE:** Test Summaries for [illegible] systems [illegible] prepared for individual systems by Systems Engineering [illegible] approved by the TPE and STC.

6.6.1 Summary of major problem indicating:

6.6.1.1 Corrective action
6.6.1.2 Time of occurrence
6.6.1.3 Sequence
6.6.1.4 Applicable TPS's and IDR's

6.6.2 Summary of re-runs necessary to accomplish a given sequence of test successfully.

6.6.3 A listing of all IDR's that are transferred but not closed.

6.6.4 Bar Chart to indicate the actual order in which testing was accomplished, including actual test time.

6.7 OCP Acceptance Criteria

Following the completion of each OCP, NASA/NAA Inspection will close out the record copy OCP after all of the following steps have been completed by stamping each Summary Sheet and by signature on the last Summary Sheet.

6.7.1 The checklist PIRR forms have been recapped for subsequent tests or operations.

6.7.2 Sequences in the OCP have been verified as complete.

6.7.3 Deviations have been recorded and approved per Paragraph 6.2.

6.7.4 OCP Test Date Summary Sheets have been completed and signed by NASA/NAA.

6.7.5 Test Summary Sheets have been completed and approved.

6.7.6 The Bar Chart has been completed in accordance with Paragraph 6.6.4 above.

6.7.7 IDR's that have been assigned to CSM or GSE categories are either closed out or specifically dispositioned to:

6.7.7.1 Eliminate restraint on the next scheduled test.

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6.7.7.2 Reflect the subsequent test which will be restrained.

6.7.7.3 Retest requirements following any planned rework to insure system readiness.

6.7.8 "Other" category IDR's have been closed out (sold).

6.7.9 A copy of the IDR log, each IDR, all deviations and open item recap have been filed with the closed out OCP.

Coordinated by: K. Alford ...
Procedure Unit
NAA/S&ID Florida Facility

Coordinated by: Karl A. Heimann
NASA APOP Coordinator

Approved by: J. G. Hazard
J. G. Hazard, General Manager
NAA/S&ID Florida Facility

Approved by: George T. Sasseen
NASA Manager of Apollo
Spacecraft Operations

NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

S&ID

# IMPLEMENTING INSTRUCTION

FOR

THE FLORIDA FACILITY

NO. 12-5

DATE 27 Jan 1966

REFERENCE: (a) Florida Facilit Implementing Instruction 12-1, "Florida Facility Safety Program"
(b) Operations Systems Safety Notice 1-65, dated 21 July 1965
(c) Apollo Document tion #2 (NASA/MSC)
(d) Operations System Safety Handbook
(e) S&ID Policy E-4.1, "Crew Qualification and Environmental Readiness for C tical Tests"
(f) S&ID Policy E-4 , "Employee Qualification/Certification for Critical Jo Assignments"

SUBJECT: Safety Criteria for Apollo Command & Service Module and Saturn S-II Operations.

1. PURPOSE

This procedure identifies certain operational areas that shall be considered hazardous or critical. It establishes requirements to insure that all such administrative procedures, test procedures, work processes, methods, work authorizations and corrective action documents are reviewed to insure the inclusion of the necessary safety criteria.

2. SCOPE

The requirements established in this procedure are applicable to all programs at the S&ID Florida Facility and will be implemented as appropriate by all operational activities.

3. GENERAL

3.1 The following categories f Apollo Command & Service Module and Saturn S-II operations are designated critical. These operations will require specific safety reviews and must include certain specific requirements in preparation of proce ures and related documents.

3.1.1 Ordnance System - any operation involving the handling, transport, installation an checkout of live ordnance devices. Also any operation or checkout of an ordnance system after live ordnance items have been installed.

3.1.2 Propellants - y operation involving the loading, downloading, or system activ tion with operating propellants.

3.1.3 Cyrogenics - an operation involving the loading and/or downloading of the t vehicle and system activation with cyrogenics.

3.1.4 Environmental T ts - a environmental tests conducted in an environmental mber w combustible gases or fluids are utilized in the , or when an altitude chamber is at altitude with p the chamber or vehicle.

New Procedure

Form 955-B-1 New 7-63

3.1.5 Hi-Energy Potential Systems - operations designated by the **Systems Safety Engineer** involving the operations of pressure systems or operation of gaseous systems utilizing tanks or reservoirs.

3.1.6 Handling Operations - any operation involving the lifting, hoisting, loading or transporting of an end item flight vehicle and such other itmes as may be specificially designated by the Systems Safety Engineer.

3.2 All safety requirements will be considered in the preparation of all test procedures and work authorization documents: Operational Checkout Procedures (OCP), Detailed Operating Procedures (DOP), Detailed Installation Procedures (DIP), General Operating Procedures (GOP), General Work Orders (GWO), Test Preparation Sheets (TPS), and Discrepancy Records (DR). Safety requirements will also be considered in revisions to OCP's, DOP's, DIP's, and GOP's. The originator will coordinate test procedures (OCP's, DIP's, DOP's and GOP's) with the Florida Facility Safety Office and affix his signature to the Florida Facility "Safety Office Sign-off Statement" (file card) prior to publication.

3.3 The responsible systems engineer will coordinate with the Florida Facility Safety Office for all test procedures (OCP's, DOP's, DIP's, and GOP's) for operations that have been designated as critical.

3.4 Safety checklists will be used in the preparation of test procedures (OCP's, DIP's, DOP's, GOP's) and work authorization documents (TPS's, DR's and GWO's). Safety checklists will also be used in conducting the pre-operation review described in paragraph 4.7. These checklists will be developed by the Florida Facility Safety Office in coordination with representatives from Operations, Quality Assurance, Project Engineering and KSC Safety.

3.5 The Florida Facility Safety Office will submit safety reports in accordance with Reference (a).

3.6 It is the responsibility of supervision to ensure that all personnel are certified or qualified to perform assigned tasks in accordance with References (e) and (f).

4. INSTRUCTIONS

4.1 Any test procedure which involves any of the critical conditions described in paragraphs 3.1.1 through 3.1.6 will be designated on the front page as follows: "This test procedure is a critical operation".

4.2 When a test procedure has been designated as "critical", cautions and warnings shall be used as necessary and precede critical steps. This will ensure that the instruction is received prior to actual need. The words CAUTION and WARNING shall be centered on the page.

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4.2.1 CAUTION: Used prior to any operation that could result in damage to equipment if not followed.

Example: CAUTION

If C14-075 gage PG12 exceeds 170 PSIG report condition to test conductor.

4.2.2 WARNING: Used prior to any operation that could result in injury or death to personnel if not followed.

Example: WARNING

High pressure gas will now be in lines G14017793 and G14-17798.

4.3 The Operations Department will be responsible for informing the Safety Office of any simultaneous operation to be performed in the same area as a critical operation.

4.4 Emergency shutdown procedures for all equipment will be included in all test procedures.

4.5 Applicable KSC and NAA safety directives will be referenced and complied with or waivers obtained prior to commencing the test to ensure safe operations.

4.6 It is the responsibility of the Test Project Engineer to brief all personnel involved in the test, prior to participation, on all cautions and warnings contained within the procedure.

4.7 Before each test designated as critical, the responsible systems or test engineer will conduct a safety review of the operation with all test team members. Those present to include not only personnel actually engaged in the operation but also any others that may be required, depending upon the nature of the operation (Project Engineer, Safety, Quality Assurance, NASA Representatives, etc.). The review shall consist of a "talk through" of the operation, a "walk through" inspection of the area, and a dry run of the operation by the personnel involved.

For the General Manager

W. S. Ford
Assistant General Manager
Florida Facility

# LIST OF REFERENCES

The following documents, referenced in the Ground Emergency Provisions Panel Report, are contained in the AS – 204 Review Board permanent file:

REFERENCE

13-1 The Apollo Crew Abbreviated Checklist SM 2A-03-SC012/CL, dated 23 January 1967.

13-2 The Apollo Operations Handbook, SM 2A-03-SC012, dated 12 November 1966, revised 30 November 1966.

13-3 The Apollo Flight Crew Hazardous Egress Procedures Manual, dated 1 November 1966, revised 7 November 1966.

13-4 Operational Checkout Procedure, OCP FO-K-021-S/C012/14, dated 13 December 1966, revised 24 January 1967.

13-5 Launch Vehicle Test Procedure I-20015-SA 204, dated 18 January 1967, revised 23 January 1967.

13-6 Space Vehicle Test Procedure I-41001-204, dated 12 January 1967, revised 23 January 1967.

13-7 KSC Management Instruction, KMI 1710.1, dated October 4, 1966, defining KSC Safety Program.

ENCLOSURE 13–15

**REPORT OF PANEL 14**
**SECURITY OF OPERATIONS**
**APPENDIX D-14**
**TO FINAL REPORT OF**
**APOLLO 204 REVIEW BOARD**

# SECURITY OF OPERATIONS

## A. TASK ASSIGNMENT

The Apollo 204 Review Board established the Security of Operations Panel, 14. The task assignment by Panel 14 was prescribed as follows:

This group shall review existing security practices for adequacy. This includes such things as access control, personnel sign-in requirements, buddy systems, background investigation requirements, etc. They shall also make responsible recommendations to the Board on changes to existing practices.

## B. PANEL ORGANIZATION

1. MEMBERSHIP

The assigned task was accomplished by the following members of the Security of Operations Panel:

Mr. Charles L. Buckley, Jr., Chairman, Kennedy Space Center (KSC), NASA
Mr. William J. Horner, Jr., Kennedy Space Center (KSC), NASA
Mr. Charles A. Buckel, Manned Spacecraft Center (MSC), NASA
Mr. Howard G. Maines, Headquarters, NASA
Mr. S. Drake Ellis, Marshall Space Flight Center (MSFC), NASA
Mr. Robert W. Gaines, Lewis Research Center (LeRC), NASA
Lt. Col. William Dugan, U. S. Air Force

2. COGNIZANT BOARD MEMBER:

Colonel Charles F. Strang, U. S. Air Force, Board Member, was assigned to monitor the Security of Operations Panel.

## C. PROCEEDINGS

1. In response to the Board directive of February 1, 1967, the Panels' task was outlined in detail, as follows:

a. Conduct review of physical security practices at Kennedy Space Center and other appropriate locations supporting the mission. This review would include, but would not be limited to, the following:

(1) Launch Complex, including blockhouse, pad, and white room, access control system before and during the accident.

(2) Sign-in procedures which were in effect for persons having access to various critical locations during the pre-accident time period.

(3) Escort requirements that were in effect at the Launch Complex.

b. Examine the efforts of participating NASA management and security organizations aimed toward assuring the integrity and reliability of persons having critical access to key locations prior to and during the mission period.

2. The Panel prepared a tentative detailed schedule agenda and established milestones for the Security Panel's deliberations and activities.

3. The Panel accumulated pertinent background data, such as guard orders, access lists, samples of

badges, back-ground documentation, etc., for use by the Panel upon its initial convening.

4. Attended to necessary security administrative duties in support of the Board and other Panels. These reviews were conducted during the course of the Panel deliberations, reviews, analyses and interviews aimed toward determining whether a security-related factor caused or contributed to the accident.

5. A concurrent and detailed analysis of the general security posture prior to and at the time of the accident was accomplished. The plans for subsequent operations and tests were also reviewed.

6. The entire Panel visited Launch Complex 34 (LC 34) area for direct observation of security posts, including observation of the eighth adjustable level of the service structure, white room, and spacecraft.

7. Interviews and discussions were conducted with representatives of supervisory and operational elements of the KSC Security Office and uniformed security (guard) forces to establish:

a. The responsibility for (1) establishing security principles and guidelines and (2) monitoring implementation.

b. The responsibility for implementation of principles and guidelines.

c. The effectiveness of the management, structural, and communications relationships between the KSC Security Office and the implementing organizations.

8. An analysis was conducted of the various principles and guidelines designed to provide physical security and personnel access control involved in Apollo missions and their implementation by the uniformed security forces.

9. Reviewed and discussed the KSC and Air Force Eastern Test Range (AFETR) regulations concerning the "controlled area" personnel access concept at Cape Kennedy Air Force Station. Analyzed and discussed the North American Aviation, Inc. (NAA) instruction concerning the "controlled area" concept.

10. Interviewed the KSC Security Office representative concerning the concept and function of the access controls provided through use of the Apollo Saturn Operations Area Permit and the mechanics of implementing the "controlled area" concept at LC 34.

11. Reviewed security post requirements, post orders, badge and access control systems for the arrival and movement of flight hardware at Cape Kennedy and KSC; the KSC Industrial Area locations, the Astronaut Quarters and Suiting Room at KSC, the Astronaut Van; and LC locations such as the main gate, the blockhouse, and various work levels of the Space Vehicle at the pad .

12. The NASA representative in charge of the Astronaut Support Office at KSC (Astronaut Quarters, Suiting Room, etc.) was interviewed concerning access controls, control of the Astronaut Van; purchase, handling and preparation of astronauts' food (non flight); occupational health examinations of Support Office personnel (e.g maids, cooks, stewards, etc.) kitchen and dining facilities; and the investigative program concerning the Support Office personnel and the information resulting therefrom.

13. The Panel:

a. Analyzed the NASA NAA Apollo Prelaunch Operations Procedures concerning access control of test and work areas

b. Interviewed the NASA Apollo 204 Test Supervisor concerning physical security and personnel access controls at LC 34.

c. Interviewed the NAA pad leaders concerning the NAA system of administrative access control of personnel to the service structure spacecraft work areas, including the white room and Command Module.

d. Reviewed the Command Module Ingress Egress Log maintained by NAA personnel.

e. Interviews, analyses, and reviews conducted by the Panel (it should be noted that Panel 6 is also conducting an inquiry in this area) reflected that

(1) In some cases, individuals over whom the contractor had not exercised access control gained.

entry to the spacecraft areas on the fifth, sixth, and seventh adjustable levels;

(2) No "off shift" log exists;

(3) The Command Module Ingress/Egress Log in some cases failed to reflect:

(a) the names of all individuals who entered the Command Module;

(b) whether or not equipment or tools were taken into the Command Module;

(c) that all equipment or tools were taken out or otherwise disposed of;

(d) the time individuals ingressed and/or egressed the Command Module;

(e) the authorization basis for individuals entering the Command Module;

(f) sufficiently legible writing to determine the identity of individuals entering the spacecraft.

14. An analysis was conducted of the investigative program which formed the basis for access to LC 34. A similar analysis was conducted of the system in effect at the Mission Control Center/Houston. An inquiry was conducted to verify the clearance and investigative status of a representative sampling of all persons who were at selected locations on the Launch Complex, in the Command Module, on the eighth adjustable work level of the service structure, etc., prior to the accident. The Panel analyzed the benefits which can reasonably be expected to result from measures suggested in a letter of December 30, 1966, from NASA Office of Manned Space Flight (OMSF) to selected Apollo contractors, emphasizing the need to be exceedingly selective in the placement of reliable and trustworthy persons at the launch facility during the critical period immediately prior to launch. The analyses reflected the degree to which a prior standard National Agency Check (NAC) investigation was a reasonable precaution in controlling unescorted access to the Launch Complex. In most cases, the standard NAC relied upon was the one which had been conducted in the processing of the individual's industrial security clearance for access to classified information. In these cases, the results of the NAC were not furnished to NASA. The last Government-conducted NAC Investigation relied upon for access varied from being current to in excess of ten years old. A sampling of such NAC's on individuals at LC 34 on the day of the accident established that a standard NAC is apparently not designed to include a check of pertinent files of all appropriate Federal agencies. These agency files contain information, some of which would be relevant in evaluating individual trustworthiness and reliability.

15. Reviewed and analyzed the uniformed security force's General guard orders.

16. Interviewed PAA Security policemen who performed security post duties at LC 34 to establish the individual officer's comprehension and understanding of his responsibilities, and the extent to which actual performance matched assigned duties. Interviewed supervisory and patrolmen personnel concerning their actions on the day of the accident.

17. Reviewed disciplinary action cases concerning uniformed security personnel resulting from minor instances of noncompliance with their security post responsibilities at LC 34 in order to establish the degree of discipline at the Launch Complex.

18. Representatives of the Federal Bureau of Investigation were interviewed concerning their prior investigations of various types of incidents (thefts, fraud, malicious damage to Government property) at Cape Kennedy and KSC with emphasis on LC 34. They were also interviewed regarding their participation in the activities at LC 34 immediately following the accident.

19. The Panel reviewed all statements taken by the Witness Panel for any items having a security implication.

20. An analysis was conducted of pertinent incident reports and daily log sheets (prior to and at the time of the accident) maintained by the KSC Patrol and the PAA Security Police.

21. Reviewed and discussed the NASA Headquarters Apollo Mission Failure Contingency Plan, and the KSC Apollo/Saturn IB Failure Investigation Plan.

22. Discussed approaches to personnel security investigative program to be used in future Apollo missions.

## D. FINDING AND DETERMINATIONS

1. FINDING

a. The KSC Security Office:

(1) Developed security principles and guidelines, concept for badge, access control systems, and security post requirements, and furnished them to the uniformed security forces.

(2) Provided technical direction to the uniformed security forces and published physical and personnel security regulations, instructions, and notices.

(3) Developed security procedures for each Apollo mission and issued a security plan setting forth prelaunch, test, and launch security requirements.

(4) Periodically inspected the uniformed security forces.

(5) Frequently surveyed the field and security post operations of the uniformed security forces.

b. By contract, the uniformed security forces (PAA Security Police at Cape Kennedy, and the KSC Patrol at Kennedy Space Center) were responsible for the implementation of established security principles and guidelines.

DETERMINATION

The KSC Security Office adequately established security principles and guidelines and effectively monitored implementation of same. Uniformed security forces properly implemented these principles and guidelines. The KSC Security Office, in a timely fashion, effectively emphasized with the uniformed security forces, the importance of the forthcoming Apollo manned missions.

2. FINDING

Current written orders were in existence for all established security posts related to the AS-204 mission. The orders were furnished to uniformed security forces in a timely manner. The interviews and analysis of pertinent records revealed no significant instances reflecting a failure by uniformed security personnel to comply with their post orders.

DETERMINATION

Uniformed supervisory security personnel were knowledgeable concerning their responsibilities. Uniformed security policemen understood their duties and performed satisfactorily. Operational security requirements placed on PAA were timely and adequate. Security post orders were realistic and adequate.

3. FINDING

KSC Security personnel and or uniformed security personnel were assigned to all locations requiring safeguarding measures, including Launch Vehicle stages and spacecraft from the time of arrival at KSC to time of the accident.

DETERMINATION

The number of KSC Security personnel and uniformed security personnel utilized was adequate.

4. FINDING

Apollo Preflight Operations Procedures (APOP) 0-201, dated October 17, 1966, and January 24, 1967, concerning access control of test and work areas, required that: (1) access controls to spacecraft work areas be exercised by the contractor; (2) the contractor maintain a log of all personnel permitted access during "off-shift" non-work periods, (3) the contractor control Command Module ingress-egress, and maintain a log concerning same.

DETERMINATION

The procedures established in the APOP were not followed in that: (1) the contractor failed to exercise adequate access controls on the fifth, sixth, and seventh spacecraft levels, (2) the contractor failed to maintain an "off-shift" log; (3) the Command Module ingress egress log was inadequately