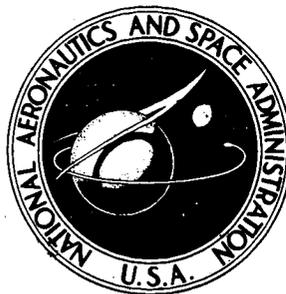


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APOLLO EXPERIENCE REPORT  
THE COMMAND AND SERVICE MODULE  
MILESTONE REVIEW PROCESS

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## ACRONYMS

ACE	acceptance checkout equipment
ASHUR	Apollo spacecraft hardware utilization request
ASPO	Apollo Spacecraft Program Office
CAR	corrective action request
CARID	customer acceptance review item disposition
CARR	Customer Acceptance Readiness Review
CCB	Configuration Control Board
CCFF	crew compartment fit and function
CCP	Configuration Control Panel
CMO	Configuration Management Office
CSM	command and service module
CVR	configuration verification record
DCOE	Downey checkout evaluation
DCS	Downey checkout specification
DR	disposition record
DR-CAR	corrective action request disposition record
DR-MR	material review disposition record
DRSS	disposition record squawk sheet
DRUC	disposition record unsatisfactory condition
ECS	environmental control system
EEE	electrical, electronic, and electromagnetic
ELS	Earth landing system
EO	engineering order
EOAS	Engineering Order Accountability System

<b>FCA</b>	<b>Field Change Authorization</b>
<b>FRR</b>	<b>Flight Readiness Review</b>
<b>FRRID</b>	<b>flight readiness review item disposition</b>
<b>G&amp;N</b>	<b>guidance and navigation</b>
<b>GFE</b>	<b>Government-furnished equipment</b>
<b>GSE</b>	<b>ground-support equipment</b>
<b>HRE</b>	<b>hardware reuse evaluation</b>
<b>IDR</b>	<b>interim disposition record</b>
<b>IPL</b>	<b>irregular parts list</b>
<b>KSC</b>	<b>John F. Kennedy Space Center</b>
<b>LES</b>	<b>launch escape system</b>
<b>LM</b>	<b>lunar module</b>
<b>LO</b>	<b>Launch Operations</b>
<b>MR</b>	<b>material review</b>
<b>MRD</b>	<b>material review disposition</b>
<b>MSAD</b>	<b>material summary acceptance document</b>
<b>MSC</b>	<b>Manned Spacecraft Center</b>
<b>NR</b>	<b>North American Rockwell Corporation</b>
<b>OISR</b>	<b>open item status report</b>
<b>OPLS</b>	<b>operation page and line schedule</b>
<b>ORDEAL</b>	<b>orbital rate drive, Earth and lunar</b>
<b>PMWO</b>	<b>preventive maintenance work order</b>
<b>P/N</b>	<b>part number</b>
<b>RAMA</b>	<b>recap and movement authorization</b>
<b>R&amp;QA</b>	<b>reliability and quality assurance</b>
<b>RASPO</b>	<b>Resident Apollo Spacecraft Program Office</b>

<b>SAR</b>	<b>Spacecraft Assessment Review</b>
<b>SCN</b>	<b>specification change notice</b>
<b>SLA</b>	<b>spacecraft/LM adapter</b>
<b>S/N</b>	<b>serial number</b>
<b>SSAD</b>	<b>System Summary Acceptance Document</b>
<b>SSM</b>	<b>subsystem manager</b>
<b>STE</b>	<b>subsystem test engineer</b>
<b>TAIR</b>	<b>test and inspection record</b>
<b>TCOP</b>	<b>Test Checkout Operational Plan</b>
<b>TCP</b>	<b>test checkout procedure</b>
<b>TCRD</b>	<b>Test and Checkout Requirements Document</b>
<b>TIR</b>	<b>temporary installation record</b>
<b>TPF</b>	<b>test project engineer</b>
<b>TPS</b>	<b>test preparation sheet</b>
<b>TSCD</b>	<b>Test Specification and Criteria Document</b>
<b>UCR</b>	<b>unsatisfactory condition record</b>
<b>UR</b>	<b>unsatisfactory report</b>

APOLLO EXPERIENCE REPORT  
THE COMMAND AND SERVICE MODULE  
MILESTONE REVIEW PROCESS

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SUMMARY

The Apollo spacecraft milestone review process was used by NASA to provide formally documented assurance that the spacecraft was satisfactorily completing scheduled milestones from manufacturing to launch. The milestone review process was begun with the completion of manufacturing and was continued through test and checkout at the launch site. The application of this process at specific intervals provided early definition of problem areas and timely resolution of problems and thus avoided major program impacts. The milestone review process also imposed disciplines upon both NASA and contractor personnel that aided in making the Apollo Program successful.

INTRODUCTION

From the beginning of the Apollo Program, a contractual requirement to conduct certain milestone reviews during the life cycle of each command and service module (CSM) before launch was levied on the CSM prime contractor. The reviews were identified as Spacecraft Assessment Reviews (SAR's), Customer Acceptance Readiness Reviews (CARR's), and Flight Readiness Reviews (FRR's). The agenda items for the reviews were the responsibility of the contractor, who presented the status of the spacecraft subsystems and submitted a written report for NASA review. Significant items from the contractor presentation and report were brought to the attention of NASA management by memorandums or by review item dispositions, in which the nature of the problem was described and a solution was recommended. Disposition of these problems was conducted by a review board convened by the Manager, Apollo Spacecraft Program, and consisting of NASA senior staff members.

Before acceptance of the first Apollo man-rated spacecraft (CSM 101), NASA management determined that a more disciplined and more detailed milestone review process was required. As a result, the SAR's were discontinued and a formal plan was prepared for conducting a three-phase CARR and an FRR for each CSM. The data from each CARR and FRR were reviewed comprehensively by NASA personnel, who

determined the agenda items that were presented to the review board. This procedure shifted the determination of significant issues for the board's review from the contractor to NASA.

The Phase I CARR was primarily a configuration assessment that was conducted after completion of manufacturing and served as a checkpoint for power-on testing.

The Phase II CARR was conducted after completion of subsystem-level testing and served as an assessment before the start of integrated systems testing.

The Phase III CARR was a complete assessment of the spacecraft. The Phase III CARR was conducted after completion of integrated systems testing and served to verify the degree of completion, the customer acceptance, and the degree of readiness for shipment of the spacecraft to the NASA John F. Kennedy Space Center (KSC).

The FRR was a mission readiness assessment. The FRR was conducted after the test and checkout activities at KSC but before the start of launch countdown.

## MILESTONE REVIEW PROCESS

### General Sequence

The sequence of the CSM milestone review process is shown in figure 1. The CARR plan and the FRR plan provided specific definition of responsibilities and requirements for both NASA and contractor personnel. The CARR and FRR plans determined the review team and board membership; which included contractor personnel, the review team tasks and objectives, the requirements to support review team tasks, and the action item resolution responsibilities.

The contractors provided the data required for review (appendixes A to E) in System Summary Acceptance Documents (SSAD's), in which the data were sorted and cataloged by subsystem and type to facilitate the work of the review teams. Data not suitable for sorting by subsystem also were provided for the review teams. In addition, other data were made available to the review team on request.

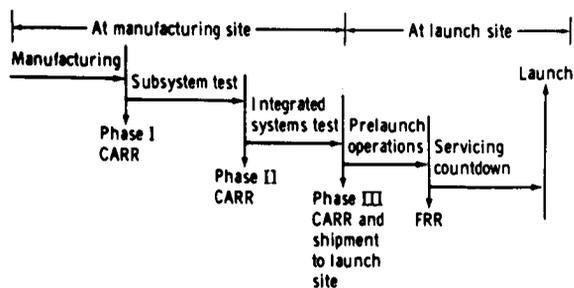


Figure 1. - Command and service module milestone review sequence.

The responsibility for coordination and implementation of the CSM reviews was assigned to the Review Planning Office of the NASA Manned Spacecraft Center (MSC) (now the Lyndon B. Johnson Space Center) CSM Project Engineering Division. Because frequent coordination was necessary to determine the most practical time for formal reviews in support of the CSM milestones, focal points were established at the NASA office in Downey, California (NASA-Downey), and at the CSM prime contractor, North American Rockwell Corporation (NR), facility.

Implementing correspondence establishing review schedules and locations, identifying team and board members, and defining data to be reviewed as well as board presentation requirements was prepared and distributed at least 2 weeks before each review. (Appendix F is a typical implementing letter.) Various MSC divisions supporting these reviews were requested to provide a listing of individuals who would participate in the review. The MSC Review Planning Office screened these lists and included approved team members on an official visitation list for access to the contractor facility. This screening process was necessary to ensure appropriate support during the team reviews.

The review process flow consisted of a 3-day subsystem data review followed by a 3-day period in which the contractor or other design agency prepared responses to the problems identified by the review team or special briefings requested by the NASA program management (or both). The board normally convened the following day to act on the contractor responses.

Each review team consisted of the subsystem manager (SSM), the reliability and quality assurance (R&QA) specialist, and the subsystem test engineer (STE). Each team included a contractor representative to answer on-the-spot questions by the team members. Individuals from the MSC Flight Safety Office, the MSC Flight Crew Support Division, and the KSC CSM Engineering Division also supported the team.

The teams reviewed the data presented by the contractor, which included subsystem SSAD books for all applicable subsystems and data in support of these subsystems that were too bulky to include in the SSAD. Other data required by the review teams in completing their tasks were also provided on request.

To aid the review team in performing a comprehensive review, brief handouts that contained descriptions of team tasks and objectives and a detailed description of the SSAD book sections and supporting data were provided at the review. This information was extracted from the CARR and FRR plans as required. The review teams prepared daily team minutes (figs. 2 and 3) to record their review activities and documented all significant problems to which the contractor was not able to readily respond on customer acceptance review item dispositions (CARID's) (fig. 4) or flight readiness review item dispositions (FRRID's) (fig. 5).

The CARID's and FRRID's contained the problem description, recommendations for corrective action, and constraints. Before submittal to the contractor, the CARID's and FRRID's were serialized and reviewed by the NASA review coordinator for completeness and accuracy. The CARID's and FRRID's then were given to the contractor for preparation of a written response or position regarding corrective action or other disposition of the problem.

At the conclusion of each subsystem review, the applicable NASA and contractor SSM, R&QA representative, and STE signed readiness statements (figs. 6 to 9), which attested that the vehicle was ready to proceed to the next phase of test acceptance or flight and that all exceptions were identified and documented on CARID's and FRRID's.

TEAM MINUTES

PHASE \_\_\_ CARR

S/C \_\_\_\_\_ REVIEW TEAM MINUTES DATA \_\_\_\_\_

TEAM TITLE \_\_\_\_\_

SUBSYSTEM \_\_\_\_\_

NASA TEAM LEADER \_\_\_\_\_

NR TEAM LEADER \_\_\_\_\_

TEAM MEMBERS

<u>NAME</u>	<u>ORGANIZATION NAME</u>	<u>ORGANIZATION</u>
-------------	--------------------------	---------------------

_____	_____	_____
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_____	_____	_____
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_____	_____	_____
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MINUTES OF MEETING \_\_\_\_\_

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\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

NR TEAM LEADER

NASA TEAM LEADER

Figure 2. - The subsystem review team minutes for CARR's.

TEAM MINUTES

S/C \_\_\_\_\_ FRR REVIEW TEAM MINUTES      DATE \_\_\_\_\_

TEAM TITLE \_\_\_\_\_

SUBSYSTEM \_\_\_\_\_

NASA TEAM LEADER \_\_\_\_\_

NR TEAM LEADER \_\_\_\_\_

TEAM MEMBERS

<u>NAME</u>	<u>ORGANIZATION NAME</u>	<u>ORGANIZATION</u>
-------------	--------------------------	---------------------

_____	_____	_____
_____	_____	_____
_____	_____	_____

MINUTES OF MEETING \_\_\_\_\_

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\_\_\_\_\_

\_\_\_\_\_  
NR TEAM LEADER

\_\_\_\_\_  
NASA TEAM LEADER

Figure 3. - The review team minutes for FRR's.

SPACE DIVISION OF NORTH AMERICAN ROCKWELL CORPORATION  
**CUSTOMER ACCEPTANCE REVIEW ITEM DISPOSITION (CARID) FORM**  
 Customer's Review Item Definition Sheet

CSM	Phase	System YOUR SYSTEM NAME	System No. PER CARR PLAN	CARID No. LEAVE BLANK
Initiator YOUR NAME		Organization YOURS	Phone No. YOURS	Date TODAY
Reference Documentation DR's, OCP, MR, ICD, etc.				Part No.
PROBLEM (Title) <u>                    SHORT PHRASE DESCRIBING PROBLEM                    </u>  COMPLETE DESCRIPTION				
RECOMMENDED ACTION JUSTIFICATION  BE SPECIFIC WITH LOGIC				
RECOMMENDED CONSTRAINT      BE SPECIFIC				
CONTRACTOR RESOLUTION (SUMMARY)  LEAVE BLANK				
Board Comments/Remarks/Direction  LEAVE BLANK				
Action Required to Close CARID				
Board Decision Summary (To be filled in by the Board or Pre-Board)				
Approved: Mandatory this SC      CAT. I <input type="checkbox"/> Mandatory SC Subs      CAT. II <input type="checkbox"/> Study & Submit ECP      CAT. III <input type="checkbox"/> Closed-No Action Req'd   CAT. IV <input type="checkbox"/> Disapproved Withdrawn   CAT. V <input type="checkbox"/> Other (Specify)    BLANK   CAT. VI <input type="checkbox"/>		Action: Contractor <input type="checkbox"/> NASA <input type="checkbox"/>  HARDWARE <input type="checkbox"/> SOFTWARE <input type="checkbox"/>		Constraint: Subsystems Test <input type="checkbox"/> Combined Sys. Test <input type="checkbox"/> Integrated Test <input type="checkbox"/> Acceptance <input type="checkbox"/> Other <input type="checkbox"/> BLANK None <input type="checkbox"/>
NASA Board Chairman Signature _____				Date _____

FORM 3900-Q REV 2-68

Figure 4. - The CARID.



FLIGHT READINESS REVIEW ITEM DISPOSITION (FRRID)			
Contractor's Review Item Resolution Sheet			
S/C	SYSTEM	SYSTEM NUMBER	FRRID NUMBER
ORIGINATOR		DEPT.	DATE
REFERENCE DOCUMENTATION			
PROBLEM TITLE			
RESOLUTION/ACTION TO BE TAKEN (USE CONTINUATION SHEETS AS REQUIRED)			
<u>USE AS REQUIRED</u>			
AUTHORIZED NAA REPRESENTATIVE			DATE

MSC FORM 2089B (AUG 67)

NASA - MSC

(b) The problem resolution sheet.

Figure 5. - Continued.

FLIGHT READINESS REVIEW ITEM DISPOSITION (FRRID) Continuation Sheet			
S/C	SYSTEM	SYSTEM NUMBER	FRRID NUMBER
<input type="checkbox"/> NASA <input type="checkbox"/> NAA		CONTINUATION	DATE
PROBLEM TITLE			
<u>USE AS REQUIRED</u>			

MSC FORM 2089C (AUG 67)

(c) The continuation sheet.

Figure 5.- Concluded.

NASA READINESS STATEMENT

CSM \_\_\_\_\_ READINESS STATEMENT

\_\_\_\_\_  
Subsystem Number (SSAD Book)

The NASA-MSC Subsystem Manager, and the MSC Reliability and Quality Assurance Office and the NASA-Downey Subsystem Test Engineer have assessed the readiness of the

\_\_\_\_\_  
Subsystem as of (Date)

based upon applicable NASA/NR specifications and NASA requirements and upon reviews conducted in accordance with the current, applicable NASA CARR Plan, and have determined this subsystem to be in a condition of readiness for

( ) Initiation of subsystem test

( ) Acceptance

with the exceptions of (a) open items known to be documented against this subsystem, and (b) those open CARID's identified below.

Open CARID's

\_\_\_\_\_  
NASA-Downey Subsystem Test Engineer Date

\_\_\_\_\_  
NASA-MSC Subsystem Manager Date MSC Reliability and Quality Assurance Date

Figure 6. - The NASA readiness statement for CARR's.

NR READINESS STATEMENT

CSM \_\_\_\_\_ READINESS STATEMENT

TEAM NUMBER \_\_\_\_\_

North American Rockwell Corporation Representatives have assessed

the readiness of the \_\_\_\_\_ as of \_\_\_\_\_  
(System or Other) (Date)

based upon applicable NASA/NR specifications and NASA requirements and upon reviews conducted in accordance with the current, applicable NASA CARR Plan, and have determined this subsystem to be in a condition of readiness for

( ) Initiation of subsystem test

( ) Acceptance

with the exception of the open items included in the SSAD.

•

\_\_\_\_\_  
NR Engineering Date NR Quality Assurance Date

\_\_\_\_\_  
NR Reliability Date NR Test and Operations (Ø III) Date  
NR Manufacturing (ØI)

\_\_\_\_\_  
NR Assistant Program Date  
Manager

Figure 7. - The contractor readiness statement for CARR's.

NASA READINESS STATEMENT

CSM \_\_\_\_\_ READINESS STATEMENT

\_\_\_\_\_  
Team Number

The NASA-MSC Subsystem Manager and the MSC Reliability and Quality Assurance Office have assessed the readiness of the

\_\_\_\_\_  
Subsystem as of (Date)

based upon applicable NASA/NR specifications and NASA requirements and upon reviews conducted in accordance with the current, applicable NASA FRR Plan, and have determined this subsystem to be in a condition of readiness for launch with the exceptions of (a) open items known to be documented against the CSM, and (b) those open FRRID's identified below.

Open FRRID's

\_\_\_\_\_  
NASA-MSC Subsystem Manager      Date      MSC R&QA Representative      Date

Figure 8. - The NASA readiness statement for FRR's.

NR READINESS STATEMENT

CSM \_\_\_\_\_ READINESS STATEMENT

TEAM NUMBER \_\_\_\_\_

North American Rockwell Corporation Representatives have assessed the  
readiness of the \_\_\_\_\_ as of \_\_\_\_\_  
(System or Other) (Date)

based upon applicable NASA/NR specifications and NASA requirements and  
upon reviews conducted in accordance with the current, applicable NASA  
FRR Plan, and have determined that, except for known items documented  
against this system, it is in a condition of readiness for launch.

\_\_\_\_\_  
NR Engineering                      Date      NR Quality Assurance                      Date

\_\_\_\_\_  
NR Reliability                      Date      NR Test and Operations                      Date

Figure 9. - The contractor readiness statement for FRR's.

The CARID's and FRRID's and any other items of special interest were presented to the CARR and FRR Boards for review and disposition. (A typical CARID is in appendix G.) The CARR and FRR Boards were chaired by the Manager, Apollo Spacecraft Program, with senior NASA management members representing the various NASA Center directorates or offices. The contractor provided individuals from the comparable levels of management for discussion of the problem and for acceptance of actions. Minutes of the board meeting were written to document significant discussions, agreements, and action. (For minutes of a typical CARR Board meeting, see appendix H.)

A tracking system was established for closeout of these action items, and reports were prepared at various intervals to document the closure status of these actions. This system was implemented by the NASA and contractor review coordinators. (Typical closeout documentation is contained in appendix G.)

## Customer Acceptance Readiness Review Plan

The purpose of the CSM CARR was to evaluate the CSM, the spacecraft/lunar module adapter (SLA), and other related items for assessing the readiness to start integrated testing of individual subsystems and to ship to KSC. The review objective was to define any action required to bring the CSM and the SLA to a condition of readiness for testing or acceptance for delivery (or both).

The Phase I CARR was conducted immediately before the start of installed subsystem checkout of the stacked CSM to identify constraints to subsystem tests. The Phase II CARR was conducted immediately before the start of CSM integrated checkout at the CSM prime contractor facility in Downey, California (NR-Downey), to identify constraints to integrated checkout. The Phase III CARR was conducted immediately before shipment to identify constraints to acceptance and shipment. If the Earth landing system (ELS) was not complete at the time of the Phase III CARR, it became the subject of a separate (delta) Phase III CARR.

Procedures and implementation. - Information on data requirements, scheduling, activities, reviews, composition of teams, and team tasks and other considerations necessary for implementing the CARR plan are presented in the following paragraphs.

Data and documentation: The primary data and documentation required for the CARR's were the SSAD's listed in table I. (For SSAD contents, see appendix A.) Supporting data are described in appendix B.

The NASA associate contractors were responsible for the preparation of data in support of the guidance and navigation (G&N) equipment and the acceptance checkout equipment (ACE). Data requirements were specified by a separate directive. The G&N and ACE data were forwarded to NR at least 1 day before the start of the subsystem team review.

TABLE I. - SYSTEM SUMMARY ACCEPTANCE DOCUMENTS FOR CARR

Book no.	Subsystem or category
Launch escape system	
1.1	Structures (includes boost protective cover)
1.2	Ordnance
1.3	Mechanical (includes canard)
1.8	Electrical power (includes wiring)
Command module	
2.1	Structures (excludes thermal protection)
2.2	Ordnance
2.3	Mechanical (includes docking)
2.4	Experiments <sup>a</sup>
2.5	Environmental control
2.6	Reaction control
2.7	Instrumentation
2.8	Electrical power (includes wiring)
2.9	Entry monitor
2.10	Stabilization and control (includes orbital rate drive, Earth and lunar (ORDEAL))
2.11	Communications
2.12	Sequential
2.13	Crew equipment, couches, and stowage
2.14	Displays and controls
2.15	Guidance and navigation (G&N) (NR interface data only) <sup>b</sup>
2.16	Earth recovery
2.17	Heat shields

<sup>a</sup>Data and documentation related to the scientific instrument module, excluding Government-furnished equipment (GFE), were contained in the applicable SSAD (e. g., Structures, Instrumentation, etc.).

<sup>b</sup>Associate contractors prepared separate documentation.

TABLE I. - SYSTEM SUMMARY ACCEPTANCE DOCUMENTS FOR CARR - Continued

Book no.	Subsystem or category
Service module	
3.1	Structures (includes thermal protection)
3.2	Ordnance
3.3	Mechanical
3.4	Experiments <sup>a</sup>
3.5	Environmental control
3.6	Reaction control
3.7	Instrumentation
3.8	Electrical power (includes wiring)
3.11	Communications
3.12	Sequential
3.18	Service propulsion (includes launch escape system (LES) motors)
3.19	Cryogenics
3.20	Fuel cells
3.21	Radar
SLA <sup>c</sup>	
6.1	Structures
6.3	Mechanical and ordnance (separation)
6.4	Experiments <sup>a</sup> (if applicable)
6.7	Instrumentation (if applicable)
6.8	Electrical power
6.12	Sequential

<sup>a</sup>Data and documentation related to the scientific instrument module, excluding GFE, were contained in the applicable SSAD (e. g., Structures, Instrumentation, etc.).

<sup>c</sup>The SLA CARR was conducted in one phase only.

TABLE I. - SYSTEM SUMMARY ACCEPTANCE DOCUMENTS FOR CARR - Concluded

Book no.	Subsystem or category
Total CSM	
4. 34	General (includes combined and integrated tests)
Miscellaneous <sup>d</sup>	
5. 24	Acceptance checkout equipment (ACE)
5. 27	Pressure vessels
5. 28	Nonmetallic materials <sup>e</sup>
5. 29	Safety
5. 31	Configuration
5. 32	Thermal control
5. 33	Quality assurance

<sup>d</sup>Sections were set up for CARID numbering but did not require separate SSAD books.

<sup>e</sup>A data book was prepared but did not conform to the standard SSAD format.

The CSM contractor furnished data packages for hardware built by the lunar module (LM) prime contractor but installed in the CSM. These data covered the history of the hardware after its receipt from the LM prime contractor. These data were provided at the Phase III CARR only and were related to the following hardware.

<u>Component</u>	<u>Part no.</u>
Antenna kit	LDW 370-21007 (or equivalent)
Transponder	LSC 370-500-3 (or equivalent)
Waveguide	LSC 370-203-101 (or equivalent)
Adapter	LSC 370-203-110 (or equivalent)
Seven-digit timer	LSC 350-31200-01 (or equivalent)

Data schedules for the Phase I, II, and III CARR's were established jointly by NASA-Downey, the NR CARR coordinator, and the MSC Review Planning Office.

The CARID workbook was used as the working document to report and expedite the CARR Board action items. The CARID workbook was published by NR and contained the CARID actions and responses at the time of the CARR Board meeting. Distribution was limited to the NR and NASA CARR coordinators for use as required in the closeout of CARID's. The minutes of the CARR Board meetings, including summaries of the CARID's, were distributed by MSC to all offices and organizations having a working interest in the CSM.

**Pre-CARR activities:** The SSAD data were prepared by the contractor on a progressive basis concurrently with the manufacturing and checkout of the subsystem. The NASA-Downey office participated with NR in the review of the SSAD's to ensure that they were adequate to support the formal review.

In accordance with current procedures, NASA R&QA reviewed, in real time, all closed disposition record (DR) squawk sheets, material review disposition records (DR-MR's), DR failures, and DR unsatisfactory conditions. Issues from this review were resolved in real time or presented to the board as an open, unsatisfactory condition.

In accordance with current procedures, MSC reviewed (at NR-Tulsa, Oklahoma) all SLA repairs resulting from material-review dispositions approximately 2 weeks before acceptance. A report of the review was prepared by NR and submitted to MSC. This report was made available at the formal CARR for reference only. Issues covered by this report were reopened at the formal CARR only if new information was available or if the MSC SLA project engineer approved (or both).

**Formal reviews:** Approximately 1 week before the CARR Board meeting, a formal review of SSAD's and supplemental data was conducted at NR-Downey by the subsystem review teams listed in table II. The review teams were structured as defined in the following paragraph. The formal reviews lasted approximately 3 days and were audits of the data provided in accordance with the team tasks enumerated on the following pages. Approximately 2 weeks following acceptance of the SLA, a formal review of SLA-SSAD and supplemental data was conducted at an MSC-designated location by the SLA subsystem review team described in the following paragraph. The review lasted approximately 2 days, and all issues resulting from this review were presented to the chief of the MSC CSM Project Engineering Division for disposition.

**Subsystem review teams:** The subsystem review teams were composed of the following members.

1. MSC SSM (team leader)
2. NASA R&QA representative (MSC or NASA-Downey)
3. NASA-Downey STE
4. NR systems engineer
5. KSC systems test engineer (as available)

TABLE II. - SUBSYSTEM REVIEW TEAM TASKS FOR CARR

Tasks	SSAD sections	Supplemental data	Responsibility (a)	
			SSM/STE	R&QA
1. Compare the parts serialization list with the latest parts list (Phase I, delta for Phase III).	3, 6	Irregular parts list (IPL) configuration index	(1)	(2)
2. Review and compare supplier data with part and serial number (S/N) list. Audit data packages for acceptability (Phase I, delta for Phase III).	6	Acceptance data package Supplier data listing	(1)	(2)
3. Audit applicable parts of the operating time/cycle and shelf-life record as specified in specifications MA0201-0077 and MA0201-5695 for adequate remaining time (Phases I and III).	24	Specification MA0201-0077 Specification MA0201-5695	(1)	(2)
4. Ensure that open engineering orders (EO's) are identified to the proper constraint in the open item status report (OISR) (Phases I and III).	15	OISR	(1)	--
5. Review unreleased engineering data for constraints or retest requirements (Phases I and III).	8	None	(1)	--
6. Compare S/N's taken from actual hardware in the CSM with the S/N's in the serialized parts record (Phase I).	6	S/N's supplied by NASA-Downey CMO	(1)	(1)
7. Audit EO's resulting from failures for actual spacecraft implementation (Phases I and III).	7, 8, 15	Program failure tape OISR Configuration verification record (CVR)	(1)	(2)
8. Review waivers and deviations for acceptability (Phase I, delta for Phase III).	5	None	(1)	(2)
9. Verify that all effective EO's have been planned or incorporated (Phase I, delta for Phase III).	7, 8, 15	Engineering Order Accountability System (EOAS) OISR Historical product plan	<sup>b</sup> (2)	(2)
10. Ensure that proper corrective action has been taken as the result of unsatisfactory reports (UR's) specifically related to the vehicle under review (Phase I, delta for Phase III).	20	None	--	(1)
11. Ensure that all items requiring fit check at Downey have been fit checked or are scheduled to be fit checked (Phase III).	12	OISR Closed fabrication and inspection record Closed test and inspection record (TAIR)	(1)	(2)

<sup>a</sup>(1) indicates prime responsibility; (2) indicates support responsibility.

<sup>b</sup>Configuration Management Board prime responsibility.

TABLE II. - SUBSYSTEM REVIEW TEAM TASKS FOR CARR - Concluded

Tasks	SSAD sections	Supplemental data	Responsibility (a)	
			SSM/STE	R&QA
12. Review material summary acceptance document (MSAD) for acceptance of material (Phase III).	None	Nonmetallic materials summary acceptance document	<sup>c</sup> (1)	(2)
13. Ensure that retest requirements have been defined for modifications performed after integrated test (Phase III).	36	Recap and movement authorization (RAMA) report	(1)	(2)
14. Ensure that hardware reuse evaluations (HRE's) have been approved for previously flown equipment (Phases I and III).	40	Supplier data packages	(2)	(1)
15. Review open DR's and open DR-MR's for proper constraint in OISR (Phases I and III).	13, 14	OISR	(1)	(2)
16. Audit OISR, temporary installation record (TIR), and removal sheets to verify that constraints are properly identified (Phases I and III).	9, 11	OISR TIR RAMA report	(1)	--
17. Review completed Downey checkout specifications, test preparation sheets (TPS's), test variances, and DR's for compliance with Part II specification (Phase III).	4, 26, 29	Part II specification Process specification	(1)	--
18. Identify unexplained anomalies on a CARID for CARR Board information.	All	Unexplained anomaly TAIR book	--	--
19. Review open CARID's and attempt to close out (Phase III).	37	None	(2)	(2)
20. Audit instrumentation listing.	None	Instrumentation equipment list (SID 67-570)	(1)	--
21. Review closed DR's and closed material reviews (MR's) for compliance with applicable specifications.	18, 19	None	(1)	(2)
22. Identify (on a CARID for the CARR Board) any mishap or accident related to a closed or open DR. <sup>d</sup>	18, 19	None	(2)	(1)
23. Review IPL (electrical, electronic, and electromagnetic (EEE) parts) for acceptability.	None	None	(2)	(1)

<sup>a</sup>(1) indicates prime responsibility; (2) indicates support responsibility.

<sup>c</sup>ASPO systems engineer prime responsibility.

<sup>d</sup>NR systems engineers actively supported the SSM, the STE, and the R&QA representative in accomplishing this task.

Special teams: Special working teams were established to review items of special consideration such as tanks, nonmetallic materials, wiring, and ACE.

Members-at-large: The following individuals were designated as subsystem review team members-at-large.

1. Members-at-large from NASA
  - a. NASA-Downey vehicle manager
  - b. Apollo Spacecraft Program Office (ASPO) project engineer
  - c. NASA R&QA representative (MSC or NASA-Downey)
  - d. NASA-Downey configuration management representative
  - e. MSC safety representative
2. Members-at-large from NR
  - a. Reliability representative
  - b. Quality representative
  - c. Manufacturing representative
  - d. Quality information representative
  - e. Apollo Test Operations representative
  - f. Configuration Management Office (CMO) representative
  - g. Safety representative

The members-at-large or their designated representatives attended all sessions and were available for consultation to all subsystem review teams. The members-at-large ensured that all program anomalies and hardware problems applicable to the spacecraft under consideration that were known to them were considered for CARID's.

Review team tasks: The CARR team review objectives were met by performing the team tasks outlined in table II.

Team minutes: Team minutes were submitted to the CARR secretariat daily. The minutes included the team accomplishments, the CARID's submitted, and other significant information as a permanent record of the team activities. The team leader was responsible for the preparation of the team minutes (fig. 2).

**Use of CARID's:** The CARID's were used to identify specific problems by citing part number, reference documentation, and a brief summary of how the problem was identified. In the CARID, a specific action was recommended to solve the problem and a specific constraint that included the logic for arriving at the constraint was given. Immediately following data review cut-off time, the NASA-Downey engineer and the ASPO project engineer for the designated vehicle convened a meeting to ensure that the specified criteria had been met. The CARID's were also prepared for each unexplained anomaly by the MSC SSM for presentation to the CARR Board.

Design review or product improvement items or items that affected mission rules were handled through program (Configuration Control Panel (CCP) or Configuration Control Board (CCB)) channels rather than through CARID's. No CARID's were to be written for planned work (including open DR's) unless the schedule for completion of the planned work would not support the overall schedule of events. No CARID's were to be written on open certifications and open failures because the contractor normally presented data on these subjects to the CARR Board. The CARID's were submitted as soon as they were written to give the contractor the maximum allowable time to respond, and CARID's submitted after the deadline announced at the CARR were not to be processed. The contractor was allowed 3 working days before the CARR Board meeting to prepare responses to the CARID.

**The NASA-NR CARR coordinator team:** The NASA-NR CARR coordinator team consisted of the Chief, MSC Review Planning Office, the MSC CSM Project Engineering Division representative, the NASA-Downey representative, and the NR Project Engineering Division representative. This team was responsible for the following.

1. Establishing a CARR control station
2. Reviewing CARID's and advising team members in the preparation of CARID's
3. Reviewing and coordinating CARID resolutions
4. Serving as the CARR Board secretariat
5. Preparing and publishing the CARID workbook and the minutes

**The NASA preboard (Phase III CARR only):** The NASA preboard reviewed the items presented on CARID's and established the agenda items for the Phase III CARR Board. The CARR Board members designated representatives from their respective offices to serve as preboard members. The contractor provided personnel of sufficient authority to accept CARID action items.

**Postreview closeout activities:** The applicable SSM and the R&QA systems engineer review teams evaluated contractor resolutions and recommended approval or disapproval of closeout actions in a timely manner. Final approval or disapproval was by the CARR Board chairman. This activity was coordinated by the MSC Review Planning Office.

**Delta CARR for ELS.** - A special data review of the ELS was conducted by designated representatives of the MSC Engineering and Development Directorate and representatives of the MSC R&QA Office. The ELS CARR Board was chaired by the Manager

for the Command and Service Modules, Apollo Spacecraft Program. Members of the board and of the review team were designated by implementation letter for each CSM. The applicable portions of the CARR plan were followed in the conduct of this review.

The CARR Board. - The CARR Board reviewed the items presented in CARID's and briefings and determined the action required to bring the spacecraft to a condition of readiness for testing or acceptance (or both). Support from NR complemented the NASA membership.

Organization of the Phase I and Phase II CARR Boards consisted of the following.

1. Chairman — Manager for the Command and Service Modules, Apollo Spacecraft Program, MSC
2. Members
  - a. Chief, CSM Project Engineering Division, MSC
  - b. R&QA representative, MSC or NASA-Downey
  - c. Engineering and Development Directorate representative, MSC
  - d. Project Engineering representative, NASA-Downey
  - e. Test Engineering Office representative, NASA-Downey
  - f. Manager, NASA-Downey
  - g. Safety Office representative, NASA-Downey
3. Secretariat — CSM Project Engineering Division representative, MSC

Organization of the Phase III CARR Board consisted of the following.

1. Chairman — Manager, Apollo Spacecraft Program, MSC
2. Members
  - a. Assistant Program Manager for Flight Safety, ASPO, MSC
  - b. Director of Engineering and Development, MSC
  - c. Director of Flight Crew Operations, MSC
  - d. Director of Flight Operations, MSC
  - e. Director of Medical Research and Operations, MSC
  - f. Manager of Safety Office and R&QA Office, MSC

- g. Manager, NASA-Downey
  - h. Director of Science and Applications, MSC
  - i. Manager, Command and Service Modules
3. Secretariat — CSM Project Engineering Division representative, MSC

The following were invited to attend the CARR Board meetings.

- 1. Director of Launch Operations, KSC
- 2. Manager, Resident Apollo Spacecraft Program Office (RASPO), KSC
- 3. Director, Apollo Program Office, KSC
- 4. Director of Spacecraft Operations, KSC
- 5. Director, Apollo Program, NASA Headquarters
- 6. Mission Director, Apollo Program, NASA Headquarters

**Meetings:** Meetings of the CARR Boards consisted primarily of presentations by NR and NASA. The presentations included the NASA and NR readiness status and a summary of results of the subsystem team reviews (CARID's). The SSM, his designee, or the originator presented the CARID's at the CARR Board meetings. At Phase III CARR Board meetings, the contractor presented the information shown in appendix I.

**Minutes:** The NASA-NR CARR Board secretariat prepared the minutes of the CARR Board meetings (appendix H). The minutes were based on briefings, CARID's, CARID responses, and board direction and were submitted to the CARR Board chairman for approval.

**Action items:** The NASA-NR CARR Board secretariat recorded the board action items and made them available to the CARR Board chairman for approval. Each action item was annotated on the CARID under consideration. The CARID's written on anomalies and closed by the CARR Board authorized the NASA R&QA Office to close the applicable open DR's from this anomaly. Those action items that were considered to be constraints to further testing or to shipment of a later vehicle were closed by generating a "program action" CARID against that later vehicle for submittal and disposition at, or before, the CARR or FRR for that vehicle. The preparation of the program action CARID authorized closure of the action against the specific vehicle under review but ensured that the action was pursued for subsequent vehicles. The CARR Board proceedings were tape recorded and impounded by NR as a permanent record to permit review at a later time by the secretariat.

**Action item resolution:** The Manager, Apollo Spacecraft Program, MSC (or his designee), was responsible for determining when action had been taken to resolve the action items resulting from the CARR Board meetings. Constraints to further testing or shipment defined by the CARR Boards were considered removed only by this definition of action item resolution.

Status report of action items: The contractor provided a monthly status report of all open CARID's to MSC. The monthly status report included the following information.

1. The CARID number
2. The action abstract
3. The reference closeout documentation

The first monthly report by NR was made within 10 days following the CARR Board meeting and offered closeout actions on all items constraining the next test phase or acceptance. This report was submitted to the Manager, Apollo Spacecraft Program, MSC. Subsequent reports were grouped with reports from CARR's for other vehicles. Also, NR submitted closeout proposals for all open CARID's and action items to MSC in real time.

Contractor logistic support: In addition to the logistic support defined in the preceding sections of the CARR plan, the contractor provided secretarial, reproduction, and data retrieval services required to support the various CARR activities. The workbooks for the Phase I and Phase II CARR's included the CARID's and the CARID responses. Twenty copies were provided by NR for the CARR Board meeting. The workbooks for the Phase III CARR included the CARID's, the CARID responses, and special briefings. Forty copies were provided by NR for the CARR Board meeting.

Environmental control system and crew compartment fit and function KSC data review. - Special environmental control system (ECS) and crew compartment fit and function (CCFF) data reviews were held at KSC after the Altitude Chamber Test to ensure that the ECS was acceptable for flight. The data review did not constrain CSM acceptability for delivery. The applicable sections of the SSAD were updated, and the necessary supporting data were provided for this review. The requirements for these reviews are contained in the CSM FRR plan.

## Flight Readiness Review Plan

The FRR was conducted at KSC and MSC. The FRR data reviews were held at KSC, and the NASA preboards and FRR Boards met at MSC. The purpose of the FRR was to evaluate the CSM, the SLA, the ground-support equipment (GSE), and other related items for assessing their readiness to support the launch and designated mission. The review objectives were to define any action required to bring the CSM and the SLA to a condition of flight readiness and to bring the GSE to a condition of CSM launch support readiness. The scope of the FRR was limited to the information developed on the CSM, the SLA, and related items subsequent to (i. e., delta data from) the Phase III CARR of the specific vehicle under review.

Procedures and implementation. - Information on data requirements, scheduling, activities, reviews, composition of teams, and team tasks and other considerations necessary for implementing the FRR plan are presented in the following paragraphs.

Data and documentation: Spacecraft data were assembled and sorted by subsystem as described in table III. The detailed content of each SSAD was as described

in appendix C. The SSAD contained data accumulated subsequent to data cut-off for the Phase III CARR unless specifically noted otherwise. The SSAD was prepared on a progressive basis concurrently with the spacecraft checkout.

TABLE III. - SYSTEM SUMMARY ACCEPTANCE  
DOCUMENTS FOR FRR

Book no.	Subsystem or category
Launch escape system	
1.1	Structures (includes boost protective cover)
1.2	Ordnance
1.3	Mechanical (includes canard)
1.8	Electrical power (includes wiring)
Command module	
2.1	Structures (excludes thermal protection)
2.2	Ordnance
2.3	Mechanical (includes docking)
2.4	Experiments
2.5	Environmental control
2.6	Reaction control
2.7	Instrumentation
2.8	Electrical power (includes wiring)
2.9	Entry monitor
2.10	Stabilization and control (includes ORDEAL)
2.11	Communications
2.12	Sequential
2.13	Crew equipment, couches, and stowage
2.14	Displays and controls
2.15	G&N (NR interface data only) <sup>a</sup>
2.16	Earth recovery
2.17	Heat shields

<sup>a</sup>Associate contractors prepared separate documentation.

**TABLE III. - SYSTEM SUMMARY ACCEPTANCE**

**DOCUMENTS FOR FRR - Continued**

Book no.	Subsystem or category
<b>Service module</b>	
3.1	Structures (includes thermal protection)
3.2	Ordnance
3.3	Mechanical
3.4	Experiments
3.5	Environmental control
3.6	Reaction control
3.7	Instrumentation
3.8	Electrical power (includes wiring)
3.11	Communications
3.12	Sequential
3.18	Service propulsion (includes LES motors)
3.19	Cryogenics
3.20	Fuel cells
3.21	Radar
<b>SLA</b>	
6.1	Structures
6.2	Ordnance
6.3	Mechanical
6.8	Electrical power
6.12	Sequential
<b>Total CSM</b>	
4.34	General (includes combined and integrated tests)

TABLE III. - SYSTEM SUMMARY ACCEPTANCE

DOCUMENTS FOR FRR - Concluded

Book no.	Subsystem or category
Miscellaneous <sup>b</sup>	
5. 23	Ground-support equipment (GSE)
5. 24	ACE
5. 25	GFE
5. 26	Plumbing
5. 27	Pressure vessels
5. 28	Nonmetallic materials <sup>c</sup>
5. 29	Safety
5. 30	Crew stations
5. 31	Configuration
5. 33	Quality assurance

<sup>b</sup>Sections were set up for FRRID numbering but did not require SSAD books.

<sup>c</sup>A data book was prepared but did not conform to the standard SSAD format.

In addition to SSAD data, supplemental data were provided. The supplemental data were existing data that were unsuitable for sorting by subsystem. Supplemental data requirements are defined in appendixes D and E. The NASA associate contractors prepared that portion of the data for which they were responsible and submitted their inputs through NASA-Downey to KSC for inclusion in the data package.

The MSC was responsible for the preparation of the SSAD and of supplemental data involving all Government-furnished equipment (GFE). The equipment managers were responsible for the preparation of these inputs and for submission through the GFE Office, MSC, for inclusion into the GFE data package in accordance with applicable procedures. The GFE data were forwarded to RASPO-KSC 1 week before the start of the team reviews.

All problems identified by the data review teams were documented on FRRID's. An FRRID (fig. 5) was a two-part form that allowed NASA to document problems in a uniform format and the contractor to provide an answer in the corresponding uniform manner. The FRRID's were assigned control numbers to facilitate communications on specific problems.

An FRRID workbook was prepared by the contractor for presentation to the MSC preboard. The workbook contained copies of the NASA problem definition sheets, the contractor resolution sheets, and any supporting data relative to the FRRID. Thirty-five copies of the FRRID workbook were required to support the MSC preboard meeting.

An FRRID workbook also was prepared for presentation to the MSC FRR Board. The workbook contained FRRID's that were presented to the FRR Board for disposition or information and was published by NASA. Fifty copies were required. The contractor was permitted to publish a preliminary issue of the FRRID workbook for use at his in-house review.

Presentations of FRRID's and special briefings for the MSC preboard and the FRR Board were by means of film transparencies (view graphs). The contractor provided two copies of each view graph. Two hard copies of each view graph were prepared by the contractor in support of the preboard meeting. After mutual determination of the FRRID's and special briefings to be presented to the FRR Board, a final briefing was prepared. Support for preparation of the view graphs was provided to the contractor by NASA, who published 50 copies of the contractor's briefing material to be handed out at the FRR Board meeting. This handout constituted the FRR report. Schedules for data and documentation were established jointly by KSC, MSC, and the contractor.

**Pre-FRR activities:** Following the Altitude Chamber Test, a special review was convened by the Manager, RASPO-KSC, to assess the acceptance of the ECS and the results of the CCFE Test conducted during the Ambient Chamber Test. The review was scheduled to start within 5 days following the completion of the Altitude Chamber Test. Exact dates were coordinated with the contractor by RASPO-KSC, and implementing correspondence was originated by the MSC Review Planning Office. The contractor provided data in accordance with SSAD content requirements for the ECS and the crew equipment subsystem, with applicable backup data available on request.

The ECS review team was composed of the following individuals. (Subsystem review team tasks are shown in table IV.)

1. MSC SSM
2. MSC reliability systems engineer
3. MSC Flight Crew Support Division representative
4. NR-Launch Operations (LO) systems engineer
5. KSC systems engineer (as available)
6. MSC Safety Office representative

TABLE IV. - SUBSYSTEM REVIEW TEAM TASKS FOR FRR

Tasks	SSAD sections	Supplemental data	Responsibility (a)	
			SSM	R&QA
1. Compare the parts serialization list with the latest parts list.	3, 6	IPL configuration index	(1)	(2)
2. Audit, review, and compare supplier data with part and S/N list; also audit data packages for acceptability (delta from Phase III CARR).	6	Acceptance data package Supplier data listing	(1)	(2)
3. Audit applicable parts of the operating time/cycle and shelf-life record as specified in specifications MA0201-0077 and MA0201-5695, for adequate remaining time (including one scrub and recycle).	24	Specification MA0201-0077 Specification MA0201-5695 Limited life tabulation run, by spacecraft	(1)	(2)
4. Ensure that open EO's are identified to the proper constraint in the operation page and line schedule (OPLS).	15	CVR OPLS	(1)	--
5. Review unreleased engineering data for constraints or retest requirements.	8	None	(1)	--
6. Audit EO's, including those resulting from program failures, for actual spacecraft implementation.	7, 8, 15	CVR OPLS EOAS	(1)	(2)
7. Review waivers and deviations for acceptability (delta from Phase III CARR).	5, 12	Test and Checkout Requirements Document (TCRD) Test Specification and Criteria Document (TSCD) Part II specification Specification change notices	(1)	(2)
8. Ensure that proper corrective action has been taken as the result of UR's specifically related to the vehicle under review and limited to those UR's not yet reviewed at MSC (delta from Phase III CARR).	20	None	(2)	(1)
9. Identify flight readiness spares for shortages and limited life.	34	Flight-critical spares shortage list tabulation run, by spacecraft number	(1)	--
10. Ensure that retest requirements have been defined for modifications performed or planned after integrated test (test checkout procedure (TCP) 0005).	36	OPLS	(1)	(2)
11. Ensure that HRE's have been approved for previously flown equipment (delta from Phase III CARR).	40	Supplier data packages	(2)	(1)

<sup>a</sup>(1) denotes prime responsibility; (2) denotes support responsibility.

TABLE IV. - SUBSYSTEM REVIEW TEAM TASKS FOR FRR - Concluded

Tasks	SSAD sections	Supplemental data	Responsibility (a)	
			SSM	R&QA
12. Review OPLS, TIR, and removal sheets to verify that constraints are properly identified (delta from Phase III CARR).	9, 10, 11	TIR OPLS	(1)	(2)
13. Review TCP's, TPS's, interim disposition records (IDR's), DR's, and deviations for compliance with TSCD and TCRD.	26, 27 28, 29	TSCD TCRD Test Checkout Operational Plan (TCOP) Part II specification	(1)	--
14. Review open CARID's and take action to close out.	37	None	(2)	(2)
15. Audit instrumentation listing to ensure compliance with instrumentation specifications (delta from Phase III CARR).	None	Master measurement list	(1)	(2)
16. Review MSAD for acceptance of material changes made at KSC (delta from Phase III CARR).	None	MSAD	(1)	(2)
17. Review open DR's for proper constraint in OPLS (delta from Phase III CARR).	13, 14, 18, 19	OPLS	(1)	(2)
18. Ensure that closed DR-MR's are supported by proper engineering analysis.	14, 19	None	(2)	(1)
19. Review IDR's and DR's for unexplained anomalies at KSC, and identify by subsystem on FRRID's (mandatory).	13, 18 26, 27	List of unexplained anomalies IDR's by request	(1)	(2)
20. Review first flight components for excessive open and closed DR's.	13, 14, 18, 19 34	None	(2)	(1)
21. Review pressure vessel data for contract compliance.	None	Fracture mechanics summary and pressure vessel data	(1)	(2)
22. Review closed DR's and MR's for acceptability.	18, 19	None	(1)	(1)
23. Record (on FRRID for the FRR Board) any significant mishap or accident that resulted in a DR (whether closed or open).	13, 14, 18, 19	None	(2)	(1)
24. Review IPL (EEE parts) for acceptability.	None	None	(2)	(1)

<sup>a</sup>(1) denotes prime responsibility; (2) denotes support responsibility.

The CCFF review team was composed of the following individuals.

1. MSC SSM (crew equipment)
2. MSC Systems Engineering Division representative (crew station)
3. MSC GFE Office representative
4. MSC Crew Systems Division representative
5. MSC Flight Crew Support Division Representative
6. MSC R&QA representative
7. NR-LO systems engineer
8. KSC systems engineer (as available)
9. MSC Safety Office representative

The organization of the ECS-CCFF review board was as follows.

1. Chairman — Manager, RASPO-KSC
2. Members
  - a. CSM Project Engineering Division representative, MSC
  - b. Systems Engineering Division representative, MSC
  - c. Safety and R&QA representative, MSC
  - d. Flight Crew Operations Directorate representative, MSC
  - e. Engineering and Development Directorate representative, MSC
  - f. Test Division representative, MSC
  - g. Project Engineer, RASPO-KSC
  - h. Spacecraft Operations Directorate representative, KSC
3. Secretariat — CSM Project Engineering Division representative, MSC

Approximately 1 week after the spacecraft was transferred to the KSC Vehicle Assembly Building, a special pre-FRR meeting was conducted to review the readiness of the GSE to support prelaunch activity. This meeting was scheduled jointly by MSC, KSC, and RASPO-KSC. The GSE review team tasks are shown in table V. The contractor provided data as outlined in appendix E and personnel support in all applicable areas. The pre-FRR meeting was the only formal GSE review. The GSE was not reviewed again as part of the CSM subsystem team reviews, although a GSE representative was available to resolve any interface problems between the vehicle subsystems and the GSE. Open items were presented to meetings of the MSC preboard and the FRR Board.

TABLE V. - GROUND-SUPPORT-EQUIPMENT REVIEW TEAM TASKS FOR FRR

Tasks	Data requirements	Responsibility (a)	
		SSM	R&QA
1. Review GSE being used for the first time for proper configuration and validation.	Contractor-prepared list of GSE to be used for the first time (new part number or dash number) GSE Periodic Maintenance and Site Checkout Plan (KO215) TCOP	(1)	(2)
2. Ensure that installed GSE is of the proper configuration and has been validated.	KO215 Status of TCP's applicable to GSE Modification summary drawings CVR's (open and closed) OPLS	(1)	(2)
3. Review all special test equipment and workarounds that are used in vehicle test and checkout to ensure that test and checkout requirements are not compromised.	GSE problem summaries KO215	(1)	(2)
4. Ensure that redundancy requirements are met for redundant units and spares.	List of GSE versus TCP's (TCOP matrix)	(1)	(2)
5. Review pertinent actions from prior GSE reviews.	Copy of all open program action GSE FRRID's Copy of all GSE FRRID's from previous two vehicles (closed and open)	(1)	(2)
6. Review open work applicable to site activation and validation to determine that constraints are properly identified.	OPLS for mobile launcher, mobile service structure, and pad area	(1)	(2)
7. Review open modifications for constraints to further testing.	Open modification kit status -- NR Contractual direction -- NASA-furnished open Field Change Authorization report	(1)	(2)
8. Ensure that applicable failures and previous anomalies related to the GSE under review have been reported and assessed.	DR log Closed DR's (as requested) Open DR's (onstation TAIR book) OPLS GSE operational readiness report problem summaries	(2)	(1)
9. Audit configuration accounting documents to ensure that EO's resulting from failures and unsatisfactory conditions have been implemented in the GSE, including launch-critical spares. (Safety failures should be considered on a program basis.)	List of EO's to be audited (NASA supplied) CVR's (open and closed) (in configuration control areas) OPLS Launch-critical spares list Status of undelivered launch-critical spares	<sup>b</sup> (1)	<sup>c</sup> (1)
10. Ensure that GSE spares are available to support items open in the OPLS.	OPLS Warehouse time-critical tabulation run Launch-critical spares list	<sup>b</sup> (1)	--
11. Evaluate shelf-life, recycle, and recalibration data for potential constraints.	Warehouse time-critical tabulation run Preventive maintenance work order (PMWO) (onsite TAIR book) Apollo GSE time/age component replacement list (SD 68-925)	<sup>b</sup> (1)	(2)
12. Ensure that GSE launch-critical spares are available in the correct configuration	Launch-critical spares list Status of undelivered launch-critical spares	<sup>d</sup> (1)	(2)
13. Ensure that the specified preventive maintenance has been accomplished or planned.	PMWO (onsite TAIR book) TPS's on request KO215	<sup>b</sup> (1)	(2)
14. Ensure that corrective action has been taken or is planned on problems found by the Ground Safety Hazard Review.	Ground safety hazard analysis document	(2)	(1)
15. Ensure that corrective action has been taken or planned as the result of UR's and unsatisfactory condition records (UCR's).	UR's UCR's	(1)	(2)

<sup>a</sup>(1) denotes prime responsibility; (2) denotes support responsibility.

<sup>b</sup>Prime responsibility for spares.

<sup>c</sup>Prime responsibility for failures and unsatisfactory conditions.

<sup>d</sup>Prime responsibility for logistics.

Representatives of the following MSC offices reviewed the data and reported their findings on FRRID forms.

1. R&QA Office
2. Test Division
3. Engineering and Development Directorate (ACE only)
4. Program Control Office (logistics)
5. Safety Office (as appropriate)

At the conclusion of the data review, the MSC representatives also executed readiness statements indicating any constraints. The contractor supported the review teams with representatives from Downey electrical GSE, mechanical GSE, and reliability. At a meeting after the data review, the FRRID's resulting from the GSE pre-FRR meeting were presented for final disposition to the Chief, Test Division, MSC, and to the Chief, CSM Engineering Division, KSC.

Spacecraft formal data review: As soon as possible after the completion of integrated tests, a 3-day formal review of the SSAD and supplemental data was conducted at KSC. This review was an evaluation of the data provided in support of the specific team tasks enumerated in tables IV and V. The review teams, by subsystem (table III), had the following members.

1. MSC SSM (team leader)
2. MSC R&QA representative
3. NR systems engineer (or his designee)
4. NR-LO systems specialists (on call)
5. KSC systems engineers (as their time allowed)

Members-at-large: The subsystem review team members-at-large or their designated representatives attended all sessions and were available for consultation to all subsystem review teams. Members-at-large maintained awareness of all activities, reviewed all FRRID's submitted, and offered constructive criticism. The following individuals were members-at-large from NASA.

1. ASPO project engineer
2. RASPO-KSC project engineer
3. KSC project engineer (on call)
4. KSC R&QA representative (on call)
5. MSC R&QA representative

6. NASA-Downey CMO representative
7. MSC Safety Office representative

Contractor members-at-large were representatives from the following NR organizations.

1. Program Reliability
2. Program CMO
3. Program Quality
4. Project Engineering

**Team minutes:** Team minutes were compiled daily for the purpose of recording the activity of the team and of indicating the team tasks completed, the FRRID's submitted, and other significant information. Minutes were to be submitted to the FRR control station no later than 8:30 a. m. on the following day. The team leader was responsible for the preparation of the team minutes.

**Use of FRRID's:** The FRRID's were used to identify specific problems by citing part number, reference documentation, and a brief summary of how the problem was identified. In the FRRID, a specific action for solving the problem was recommended and a specific constraint including the logic for arriving at the constraint was given. Design review or product improvement items or items affecting mission rules were to be handled through program (CCP or CCB) channels rather than through FRRID's. No FRRID's were to be written for planned work (including open DR's) unless the schedule for completion of the planned work would not support the overall schedule of events. No FRRID's were to be written on open certifications and open CSM failures because the contractor presented data on these subjects to the FRR Board. The FRRID's could be generated on GSE problems if NASA took exception to the operational readiness report problem summary and if the problem might impact launch. The FRRID's were to be submitted as soon as they were written to allow the contractor time to respond. The FRRID's submitted after the deadline, which was announced at the FRR kickoff meeting, were not to be processed.

**The NASA-NR coordinator team:** The NASA-NR coordinator team consisted of the Chief, Review Planning Office, MSC; the RASPO-KSC project engineer; the NR-Downey Project Engineering representative; the NR-LO representative; the KSC Spacecraft Operations representative; and the ASPO-MSO project engineer. The team was responsible for the following.

1. Establishing an FRR control station
2. Reviewing FRRID's and advising team members in preparation of FRRID's
3. Reviewing and coordinating FRRID resolutions
4. Serving as FRR Board and preboard secretariat

5. Assisting any or all team members with problem areas at any time
6. Preparing and publishing minutes

**Contractor in-house review:** The contractor could elect to conduct a review of FRRID's and briefings before the MSC preboard meeting. If such a review was held, the NASA FRR coordinator was invited to attend.

**The NASA preboard:** The NASA preboard conducted a review of all FRRID problems and FRRID resolutions and established the agenda items for the FRR Board meeting. The NASA preboard informally reviewed the contractor presentations for the FRR Board. The preboard members were designated by the FRR Board members. The contractor provided personnel of sufficient authority to accept the action items of the preboard. The preboard meeting was scheduled to allow the contractor a minimum of 5 working days in which to prepare responses to the review team FRRID's.

**The FRR Board.** - The FRR Board reviewed the special briefings and the FRRID's presented and determined the action required to bring the spacecraft to a condition of readiness for flight. The FRR Board meeting was scheduled at a time that did not conflict with the Flight Readiness Test. The organization of the FRR Board was as follows.

1. Chairman — Director or Deputy Director, MSC
2. Vice-chairman — Manager, Apollo Spacecraft Program, MSC
3. Members
  - a. Manager for the Command and Service Modules, MSC
  - b. Manager for the Lunar Module, MSC
  - c. Manager for Experiments and GFE, MSC
  - d. Director of Flight Crew Operations, MSC
  - e. Assistant Program Manager for Flight Safety, ASPO, MSC
  - f. Director of Medical Research and Operations, MSC
  - g. Director of Engineering and Development, MSC
  - h. Director of Flight Operations, MSC
  - i. Director of Science and Applications, MSC
  - j. Manager for Safety Office and R&QA Office, MSC
  - k. Manager, NASA-Downey
  - l. Manager, RASPO-KSC

- m. Mission Director, Apollo Program, NASA Headquarters
  - n. Director, Apollo Test, NASA Headquarters
  - o. Director, KSC
  - p. Director of Launch Operations, KSC
  - q. Director of Spacecraft Operations, KSC
  - r. Manager, Apollo Program, KSC
4. Secretariat — CSM and LM Project Engineering Division representatives, MSC

Meetings: Meetings of the FRR Board consisted of an NR summary presentation of the subjects identified in the following paragraph and a detailed presentation of the FRRID's. The FRR Board defined the actions required to proceed with the countdown and launch of the CSM and the SLA. The FRR Board meeting was scheduled after the Flight Readiness Test.

Presentations: The contractor made the following presentations to the FRR Board.

- 1. Closed or information FRRID's
- 2. Significant configuration differences
- 3. Status of flight anomalies from previous mission
- 4. Certification test status
- 5. Reused hardware summary
- 6. Significant CSM open failures and unsatisfactory conditions
- 7. Critical single-point failure summary
- 8. Limited life summary
- 9. Contract specification waivers and deviations
- 10. Spacecraft issues (defined for each CSM)
- 11. Status of flight-critical CSM and GSE spares
- 12. Open launch-impact GSE problems
- 13. Test Specification and Criteria Document waivers
- 14. KSC history and open work

15. Contractor safety assessment
16. Open FRRID's (requiring board disposition)
17. Sneak-circuit analysis results and status

**Action items:** The FRR Board secretariat recorded the board action items and made them available for approval by the board chairman or his designee immediately following meeting adjournment. Those action items that were considered to be constraints to further testing or launch of the vehicle under review were so identified. Each action item was annotated on the FRRID under consideration. Contractor personnel with sufficient authority to accept or negotiate these actions attended the FRR Board meetings. Action items affecting other vehicles were closed by generating a program action FRRID.

**Minutes:** Minutes of the FRR preboard and FRR Board meetings were prepared jointly by NASA and NR. Single points of contact to assist the secretariat in this task were designated by NASA and the contractor. The minutes were prepared and made available for approval by the chairman within 24 hours after meeting adjournment. Program action FRRID's assigned by the chairman were included in the minutes and summarized by an attachment to the minutes.

**Action item resolution:** The FRRID closeout submittals and action item resolutions were coordinated by the MSC Review Planning Office. The Manager for the Command and Service Modules, MSC (or his designee), determined when proper action had been implemented to resolve the action items resulting from the FRR Board meeting. Constraints to further testing or to launch, as defined by the FRR Board, were considered removed only by this determination of action item resolutions. The Manager for the CSM confirmed or rejected all NR submittals for closeout of action items or FRRID's in a timely manner that supported the launch schedule.

**Status report of action items:** The contractor provided a formal status report of all open FRRID's and other action items to the Manager for the Command and Service Modules, Apollo Spacecraft Program, MSC. The status report included the following.

1. The FRRID number
2. The action abstract
3. The reference to closeout documentation

A status report was submitted to NASA following the ECS and CCFF reviews. A second status report was provided following the GSE review. Interim reports were submitted if the status changed significantly or if the contractor could not complete the action item closeouts before the assigned constraint. In the period between the MSC FRR Board meeting and the NASA Headquarters FRR, status reports were provided weekly.

Daily closeout actions were coordinated by telephone, and facsimiles were transmitted to the MSC Review Planning Office so that a real-time status could be maintained. The MSC Review Planning Office kept the appropriate KSC office posted on closeout status.

The NASA Headquarters FRR. - The NASA Headquarters FRR was held at KSC. The contractor supported this review with management personnel of sufficient authority to accept or negotiate action items assigned by the FRR Board. The contractor was requested to prepare and present briefings on the CSM. In addition, the contractor was requested to support MSC in the preparation of briefings on contractor-furnished equipment for portions of the CSM.

## CONCLUDING REMARKS

The milestone review process provided NASA with positive assurance that each subsystem was assessed by both contractor and NASA personnel and, except for the problems noted on the customer acceptance review item dispositions and the flight readiness review item dispositions, that the command and service module was ready to proceed to the next milestone or flight. The milestone review process identified numerous hardware and software problems and allowed the contractor a specific amount of time to resolve these problems before the command and service module completion schedule was impacted.

The frequent working sessions resulted in the development of a rapport between the contractor and NASA subsystem engineers that improved the NASA-contractor working relationship by the establishment of mutual confidence and communications at the working level. The milestone review process imposed a discipline on both the contractor and NASA that encouraged better work and greater attention to detail and thereby contributed to a successful command and service module program.

Lyndon B. Johnson Space Center  
National Aeronautics and Space Administration  
Houston, Texas, November 12, 1973  
961-11-00-00-72

**APPENDIX A**  
**CONTENTS OF SYSTEM SUMMARY ACCEPTANCE DOCUMENTS**  
**FOR CUSTOMER ACCEPTANCE READINESS REVIEWS**

## SUMMARY OF CONTENTS

Each System Summary Acceptance Document (SSAD) for a Customer Acceptance Readiness Review (CARR) will be divided into the following sections. When a section is not applicable, it will be so stated.

1. Readiness statements
2. Intentional blank
3. Latest parts list
4. Contract specifications list (SSAD 4. 34 only)
5. Contract specification waivers
6. Parts serialization list
7. Engineering Order Accountability System (EOAS) printout
8. Unreleased engineering data list
9. Parts removal summary
10. Hardware shortage list
11. Temporary installation record (TIR) (Phase III CARR only)
12. Fit-check summary (Phase III CARR only)
13. Open disposition records (DR's) and disposition record squawk sheets (DRSS's) (except test DR's)
14. Open material review disposition records (DR-MR's)
15. Open engineering orders (EO's) and drawings
16. Intentional blank
17. Intentional blank
18. Closed DR's and DRSS's (except DR-MR's, corrective action request disposition records (DR-CAR's), disposition record unsatisfactory conditions (DRUC's), and test DR's)
19. Closed DR-MR's
20. Unsatisfactory reports (UR's)

21. Open failures
22. Intentional blank
23. Intentional blank
24. Operating time/cycle records
25. Intentional blank
26. Downey checkout specifications (DCS's)
27. Test project engineer (TPE) reports or test cell supervisor's report
28. Downey checkout evaluation (DCOE) report (Phase III CARR only)
29. Test preparation sheets (TPS's)
30. Intentional blank
31. Associate contractor guidance and navigation (G&N) report (SSAD 2.15 only)
32. Intentional blank
33. First flight components (SSAD 4.34 only)
34. Intentional blank
35. Irregular parts list (IPL)
36. Modification after integrated test (SSAD 4.34, Phase III CARR only)
37. Customer acceptance review item disposition (CARID) status (Phase III CARR only)
38. Intentional blank
39. Intentional blank
40. Apollo spacecraft hardware utilization requests (ASHUR's) and hardware reuse evaluation (HRE) requests
41. Intentional blank
42. Intentional blank

## DETAIL OF CONTENTS

The SSAD book data shall be limited to the specific command and service module (CSM) under consideration unless otherwise noted and to copies of existing documentation or an extraction from an existing data system.

1. Readiness statements — The readiness statements shall be filled out and signed at the conclusion of each system review. Readiness statements are signed by the NASA and contractor representatives. The contractor will sign the readiness statements during the contractor SSAD review before the NASA review.
2. Section 2 will be left blank.
3. Latest parts list — An alphanumeric, "as designed" parts list for the particular system will be provided. This list will include part number (P/N), nomenclature, next assembly, quantity, and traceability for contractor parts, specification control drawing parts, and field installed parts.
4. Contract specifications list (SSAD 4.34 only) — The contract specifications that are applicable to the CSM being reviewed will be listed in SSAD 4.34 ("CSM General") only.
5. Contract specification waivers — A copy of each contract specification waiver or deviation accumulated since the preceding phase will be included.
6. Parts serialization list — A list is required of serial and lot numbers based on the manufacturing completion records for all parts that require traceability in accordance with the engineering drawing and that have been installed on the vehicle.
7. EOAS printout — The EOAS printout will be included in this section. The Phase III CARR input will be limited to delta data from the previous phase.
8. Unreleased engineering data list — A list of unreleased contractor engineering data will be provided. The list shall be coded to reflect those items that affect hardware and to identify the constraint points.
9. Parts removal summary — The parts removal summary is a tabulation by P/N based on the parts serialization list (section 6) summarizing open removals and all parts that have been replaced on the vehicle.
10. Hardware shortage list — The hardware shortage list should include all items that do not support the normal departmental installation requirement. The list will be based on the fabrication and inspection record and the test and inspection record shortage sheets.
11. TIR (Phase III CARR only) — A TIR that contains temporary installations of category B (nonflight functional) and category C (flight items being fit checked) items will be provided for Phase III CARR's.

12. Fit-check summary (Phase III CARR only) — A summary of the field site installation that requires a Downey (or Tulsa for spacecraft/lunar module adapter) fit check will be provided for Phase III CARR's. The fit-check completion status will be included.
13. Open DR's and DRSS's (except test DR's) — Copies of open DR's, open DRSS's, and open DRUC's (except test DR's) will be included.
14. Open DR-MR's — Copies of open material review dispositions (MRD's) and open DR-MR's will be included.
15. Open EO's and drawings — A list of open EO's according to the open item status report and the drawing that each EO is effective against will be included. A copy of each open EO will be included, and the list will indicate the constraint coding of the EO.
16. Section 16 will be left blank.
17. Section 17 will be left blank.
18. Closed DR's and DRSS's (except DR-MR's, DR-CAR's, DRUC's, and test DR's) — Copies of closed DR's and DRSS's that do not define failures will be included. In addition, any corrective action records will be included (delta from preceding CARR).
19. Closed DR-MR's — Copies of closed MRD's and closed DR-MR's will be included (delta from preceding CARR).
20. UR's — Copies of all open and closed NASA UR's that have accrued since the last phase and that are specifically related to the vehicle under review will be included.
21. Open failures — Copies of open failure program action requests, DR-CAR's, or failure reports written on the vehicle under review shall be included. Any open failure shall be defined as a failure for which corrective action to preclude recurrence has not been approved by NASA.
22. Section 22 will be left blank.
23. Section 23 will be left blank.
24. Operating time/cycle records — Copies of the code A (as defined by specification MA0201-0077) hardware cumulative time records will be included along with the milestone data so that the remaining useful life can be assessed easily. Pressure vessel cycle data will be included for each pressure cycle.
25. Section 25 will be left blank.
26. DCS's — A list of the checkout requirements showing status and copies of the annotated, "as run" DCS's including the associated test readiness lists, TPS's, test variances, and test DR's will be included. (Phase III CARR data shall be delta from the Phase I CARR.) Manufacturing test procedures will be included for the Phase I CARR.

27. TPE reports or test cell supervisor's report — A list of the checkout requirements showing status and a copy of each applicable report are to be included.
28. DCOE report (Phase III CARR only) — A list of the checkout requirements showing status and a copy of each applicable DCOE report are to be included for the Phase III CARR only.
29. TPS's — A copy of each applicable TPS (excluding TPS's included in section 26, "DCS's") will be included.
30. Section 30 will be left blank.
31. Associate contractor G&N report (SSAD 2. 15 only) — Information contained in this section shall be provided in lieu of prime contractor inputs for all SSAD 2. 15 sections that require G&N information not under prime contractor cognizance.
32. Section 32 will be left blank.
33. First flight components (SSAD 4. 34 only) — A list by P/N and name of each certification-test-network-level part that has not been flown on a previous mission is to be included.
34. Section 34 will be left blank.
35. IPL — An IPL documenting the use of irregular parts and the rationale for their acceptance in flight hardware applications will be provided.
36. Modification after integrated test (SSAD 4. 34, Phase III CARR only) — A list with a short narrative description of all modifications or rework planned after integrated test and before shipment will be included. The impact on retest requirements is to be included for the Phase III CARR only.
37. CARID status (Phase III CARR only) — A list of CARID's from the previous increment along with a short narrative summary describing the status of each will be provided. A copy of each CARID and the contractor's response will be included for the Phase III CARR only. The SSAD 4. 34 book will include the CARID's numbered 5. 24 to 5. 33.
38. Section 38 will be left blank.
39. Section 39 will be left blank.
40. ASHUR's and HRE requests — Copies of all ASHUR's and HRE requests applicable to previously flown hardware items currently installed in the CSM under review will be included.
41. Section 41 will be left blank.
42. Section 42 will be left blank.

**APPENDIX B**  
**SUPPORTING DATA FOR CUSTOMER ACCEPTANCE**  
**READINESS REVIEWS**

## SUPPORTING DATA

The following data are required as reference documentation to support the Customer Acceptance Readiness Review (CARR) team reviews and include program related data.

## CATEGORY A DATA

The following category A data will be provided at the review. All material will be of the latest revision and will be dated.

1. Specification change notices (SCN's) pending NASA approval
2. Process specification index
3. Indentured parts list
4. Configuration index (alphanumeric parts list)
5. Integrated system schematics
6. Critical life item specification (MA0201-0077)
7. Program failure tape
8. Historical product plan
9. Pressure vessel data in accordance with supplemental agreement SA300
10. Supplier data package list (SID 67-570B)
11. Unexplained test anomalies test and inspection record (TAIR) book
12. Engineering Order Accountability System history report (alphanumeric)
13. Nonmetallic materials summary acceptance document
14. Instrumentation equipment list (specification MA0505-0040)
15. Open item status report
16. Shakedown inspection (Inspection Test and Instructions)
17. Recap and movement authorization report (Phase III CARR only)
18. Shelf-life specification (MA0201-5695)

## CATEGORY B DATA

The following category B data will be provided on special request by drawing number, engineering order (EO) number, and so forth.

1. Drawings and EO's
2. Process specifications
3. Interface control drawings
4. Unaccomplished Downey checkout specifications that have been released for review or formally released
5. Material usage agreements and Characteristics of Materials summary tabulation run on nonmetallic materials
6. Contract specifications with all approved SCN's
7. Test and Checkout Requirements Document with all change notices
8. Test Specification and Criteria Document with all change notices
9. Copy of all master change records
10. Spacecraft/lunar module adapter review narrative report in accordance with applicable procedure
11. Data packages for hardware built by Grumman Aerospace Corporation (Phase III CARR only)
12. Configuration verification record (CVR) (records research only)

## CATEGORY C DATA

The following category C data will be available for review at the Quality Data Center, North American Rockwell Corporation, Downey, California.

1. Acceptance data package
2. Closed fabrication and inspection record (including out-of-station rework)
3. Closed TAIR
4. Closed CVR
5. Supplier data package

6. Instrumentation data
7. X-rays and N-rays
8. Contamination reports (environmental control system, reaction control system, and service propulsion system)
9. Shelf-life records

APPENDIX C  
CONTENTS OF SYSTEM SUMMARY ACCEPTANCE DOCUMENTS FOR  
FLIGHT READINESS REVIEWS

## SYSTEM SUMMARY ACCEPTANCE DOCUMENT

Each command and service module (CSM) system (including the spacecraft/lunar module adapter) designated in table III shall have a separate System Summary Acceptance Document (SSAD) prepared to document the history of that system area. The SSAD data shall be limited to the specific vehicle under consideration unless otherwise noted and to copies of existing documentation or to an extraction from existing documentation.

### SUMMARY OF CONTENTS

Each SSAD will be divided into the following sections. When a section is designated as "not used" or has limited applicability, no divider or data are required.

1. Readiness statements
2. Not used
3. Parts list
4. Contract specifications list (SSAD 4. 34 only)
5. Contract specification waivers
6. Parts serialization list
7. Engineering Order Accountability System (EOAS) printout
8. Unreleased engineering data list
9. Parts removal summary
10. Hardware shortage list (SSAD 4. 34 only)
11. Temporary installation record (TIR)
12. Test Specification and Criteria Document (TSCD) and Test and Checkout Requirements Document (TCRD) waivers (SSAD 4. 34 only)
13. Open disposition records (DR's) and corrective action requests (CAR's)
14. Open material reviews (MR's) and CAR's
15. Open engineering orders (EO's)
16. Not used
17. Engineering analyses

18. Closed DR's and CAR's
19. Closed MR's and CAR's
20. Unsatisfactory reports (UR's) (SSAD 4. 34 only)
21. Not used
22. Not used
23. Not used
24. Operating time/cycle record
25. Not used
26. Annotated test checkout procedures (TCP's)
27. Test summary reports
28. Downey checkout evaluation (DCOE) reports
29. Test preparation sheets (TPS's)
30. Not used
31. Not used
32. Not used
33. First flight components (SSAD 4. 34 only)
34. Launch-critical spares list
35. Irregular parts list (IPL) (SSAD 4. 34 only)
36. Modification after integrated test (SSAD 4. 34 only)
37. Customer acceptance review item dispositions (CARID's) and responses
38. Not used
39. Not used
40. Apollo spacecraft hardware utilization requests (ASHUR's) and hardware reuse evaluations (HRE's)
41. Not used
42. Not used

## DETAIL OF CONTENTS

The following list contains details of SSAD section contents.

1. Readiness statements — The readiness statements shall be signed by the contractor at the conclusion of each subsystem review.
2. Section 2 will not be used.
3. Parts list — An alphanumeric parts list shall be provided. This list will include contractor parts, specification control drawing parts, Government-furnished equipment (GFE), and field installed parts. Information presented in this parts list will include part number, nomenclature, next assembly, quantity, and traceability coding.
4. Contract specifications list (SSAD 4. 34 only) — A list of all contract specifications that are applicable to the vehicle being reviewed shall be provided for SSAD 4. 34 only.
5. Contract specification waivers — A copy of each NASA-contractor contract specification waiver or deviation shall be provided. Data shall be delta from the Phase III Customer Acceptance Readiness Review (CARR).
6. Parts serialization list — A list of those parts identified in the alphanumeric parts list (section 3) that are required to have traceability in accordance with the engineering drawing and that have been installed on the vehicle shall be provided. This list will show serial and lot numbers based on the manufacturing completion records.
7. EOAS printout — A copy of the EOAS history report shall be provided. The data will be delta from the Phase III CARR data cut-off. (This section is intended to show change traffic since the Phase III CARR but does not necessarily correlate with section 15, "Open EO's.")
8. Unreleased engineering data list — A list of unreleased contractor engineering data shall be provided. The list shall be coded to reflect those items that affect hardware and to identify the constraint points. This list also will be coded to items on the latest product plan.
9. Parts removal summary — A tabulation by part number based on the parts serialization list (section 6) summarizing open removals and parts that have been replaced on the vehicle shall be provided. Data shall be delta from the Phase III CARR.
10. Hardware shortage list (SSAD 4. 34 only) — A list of all parts (including GFE) that do not support the normal department installation requirements shall be provided. This list will be based on the fabrication and inspection record and the test and inspection record shortage sheets. The parts shall be coded with the appropriate SSAD number and listed in SSAD system numerical order in SSAD 4. 34 only.
11. TIR — A TIR that contains temporary installation of category B (nonflight functional) and category C (flight items being fit checked) items shall be provided.

12. TSCD and TCRD waivers (SSAD 4. 34 only) — A copy of each John F. Kennedy Space Center Launch Operations waiver or deviation will be included. The waivers will be marked with the SSAD system numbers and filed in numerical order in SSAD 4. 34 only.

13. Open DR's and CAR's — A copy of each open DR and any associated CAR except for MR items will be included.

14. Open MR's and CAR's — A copy of each open material review disposition record (DR-MR) (a DR that has been elevated to an MR) and any associated CAR will be included.

15. Open EO's — A copy of each EO that is open according to the configuration verification record will be provided.

16. Section 16 will not be used.

17. Engineering analyses — A copy of any engineering analysis to support material review dispositions (MRD's) in areas where possible system degradation can occur will be provided. Each analysis must include the composite effect of prior MRD's so that total system integrity can be demonstrated. If no analysis is required, a statement listing the MR's reviewed and affirming that no analysis is required will be provided.

18. Closed DR's and CAR's — A copy of each closed DR and any associated CAR except for MR items will be included.

19. Closed MR's and CAR's — A copy of each closed DR-MR and any associated CAR will be included.

20. UR's (SSAD 4. 34 only) — A copy of all open and closed NASA UR's specifically related to the vehicle under review shall be provided. A copy of the contractor response shall be provided for each closed item. The UR's will be coded with the appropriate SSAD system number and filed in numerical order in SSAD 4. 34 only. Data shall be delta from the Phase III CARR.

21. Section 21 will not be used.

22. Section 22 will not be used.

23. Section 23 will not be used.

24. Operating time/cycle record — Copies of the code A (as defined by specification MA0201-0077) hardware cumulative time records shall be provided. The milestone data shall be provided so that the remaining useful life can be assessed easily. Pressure vessel cycle data will be included for each pressure cycle.

25. Section 25 will not be used.

26. Annotated TCP's — Each annotated, "as run" TCP shall be provided along with applicable test deviations. (Tests relating to multiple systems, to modules, or to the CSM stack are in SSAD 4. 34.)

27. Test summary reports — A list of tests requiring test summary reports and a copy of each report will be provided.

28. DCOE reports — A copy of each applicable DCOE shall be provided. The data will be delta from the Phase III CARR.

29. TPS's — A copy of each applicable TPS shall be provided. Data shall be delta from the Phase III CARR.

30. Section 30 will not be used.

31. Section 31 will not be used.

32. Section 32 will not be used.

33. First flight components (SSAD 4. 34 only) — A list by part number and name (based on the alphanumeric parts list, section 3) of each certification-test-network-level part that has not been flown on a previous mission will be provided. Parts shall be coded with the applicable SSAD system number and listed in SSAD numerical order in SSAD 4. 34 only.

34. Launch-critical spares list — An alphanumeric listing of the spare parts that will be held in a condition of flight readiness for the vehicle being reviewed shall be provided.

35. IPL (SSAD 4. 34 only) — The IPL will contain the parts installed since the Phase III CARR. The IPL will be coded with the SSAD system number and listed in SSAD sequence in SSAD 4. 34 only.

36. Modification after integrated test (SSAD 4. 34 only) — A list of all modifications and rework planned or completed after integrated test shall be provided. The list will include a short narrative description of the modification and the retest requirements, if any. The list will be included in SSAD 4. 34 ("CSM General") only. The items will be coded with the applicable SSAD system code and listed in numerical order.

37. CARID's and responses — A copy of each CARID with the contractor's response from the Phase III CARR, delta environmental control system data, and delta crew compartment fit and function data will be provided. (The CARID's numbered 5. 23 to 5. 33 will be included in SSAD 4. 34.)

38. Section 38 will not be used.

39. Section 39 will not be used.

40. ASHUR's and HRE's — A copy of each ASHUR and each HRE applicable to previously flown hardware items currently installed in the vehicle under review shall be provided.

41. Section 41 will not be used.

42. Section 42 will not be used.

**APPENDIX D**  
**SUPPLEMENTAL DATA FOR FLIGHT READINESS REVIEWS**

## SUPPLEMENTAL DATA

The following data are required as reference documentation to support the Flight Readiness Review team reviews.

### CATEGORY A DATA

The following category A data will be provided at the review. All material will be of the latest revision and will be dated.

1. Parts I and II contract specification with all approved specification change notices (SCN's)
2. Part II specification SCN's pending NASA approval
3. Test and Checkout Requirements Document for John F. Kennedy Space Center (KSC)
4. Test Specification and Criteria Document
5. Indentured parts list
6. Configuration index (System Summary Acceptance Document coded)
7. Integrated system schematics (as applicable)
8. Critical life item specification (MA0201-0077)
9. KSC Test Checkout Operational Plan
10. Shelf-life specification (MA0201-5695)
11. Pressure vessel data (in accordance with supplemental agreement SA300)
12. Fracture mechanics analysis summary form
13. Supplier data package list (SID 67-570C)
14. List of Launch Operations unexplained test anomalies
15. Engineering Order Accountability System history report (subsystem report)
16. Nonmetallic materials summary acceptance document
17. Operation page and line schedules
18. Copy of all customer acceptance review item dispositions (CARID's) and responses

19. Open modification status report
20. Flight-critical spares shortage list
21. Master measurement configuration list
22. Apollo warehouse time-critical tabulation run
23. CARID status list (includes number, title, and status)
24. KSC constraints document
25. Title listing of all structural subsystem squawks, interim disposition records, disposition records, and material review disposition records in numerical sequence (structures subsystem only)
26. Limited life tabulation run, by spacecraft
27. Process specification index
28. Historical product plan

### CATEGORY B DATA

The following category B data will be provided upon special request by drawing number, engineering order (EO) number, and so forth.

1. Drawings and EO's
2. Process specifications
3. Interface control drawings
4. Unaccomplished test checkout procedures that have been released for review or formally released
5. Material usage agreements and Characteristics of Materials summary tabulation run on nonmetallic materials
6. Master change records
7. Closeout photographs

## CATEGORY C DATA

The following category C data will be available for review at the Quality Data Center, North American Rockwell Launch Operations, Kennedy Space Center, Florida.

1. Acceptance data package
2. Test and inspection record (closed)
3. Closed configuration status records
4. Supplier data packages (restricted to items installed since Phase III Customer Acceptance Readiness Review including Grumman Aerospace Corporation items, except pyrotechnic devices)
5. X-rays taken at KSC in support of specific problems
6. Shelf-life records

APPENDIX E

DATA REQUIRED FOR GROUND-SUPPORT-EQUIPMENT REVIEW

## DATA REQUIREMENTS

The following data are required to support the ground-support-equipment (GSE) review before the Flight Readiness Review.

1. Ground safety hazards analysis document
2. Modification summary drawings
3. Open modification status report
4. List of GSE used first time, including part number and dash number for each item
5. Operation page and line schedules
6. GSE operational readiness problem summaries (and handwritten update), including launch-impact problem summaries
7. NASA corrective action request (as applicable to GSE)
8. Copy and status of customer acceptance review item dispositions (CARID's) and flight readiness review item dispositions from previous two reviews
9. Copy of open GSE program action CARID's
10. Status of test checkout procedures applicable to GSE (completed, scheduled, and annotated)
11. Test Checkout Operational Plan (K0203)
12. GSE Periodic Maintenance and Site Checkout Plan (K0215)
13. Launch-critical GSE spares list (SD 67-929)
14. Status of undelivered launch-critical spares
15. Apollo GSE time/age component replacement list (SD 68-925)
16. Apollo warehouse time-critical tabulation run
17. Open Field Change Authorization (FCA) report
18. Test and inspection record (onstation, including disposition records (DR's))
19. Closed GSE configuration status records (in configuration control area)

20. Integrated system schematics; installation drawings; individual drawings; and closed DR's, test preparation sheets, FCA's, and preventive maintenance work orders (available on specific request by specific number)

21. NASA unsatisfactory condition records (as applicable to GSE)

**APPENDIX F**

**IMPLEMENTING CORRESPONDENCE FOR A**

**CUSTOMER ACCEPTANCE READINESS REVIEW**



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
MANNED SPACECRAFT CENTER  
HOUSTON, TEXAS 77058

REPLY TO  
ATTN OF: PF6-0/49-72

April 24, 1972

TO: Skylab Distribution 19

FROM: PA/Manager for the Command and Service Modules  
Apollo Spacecraft Program

SUBJECT: Customer Acceptance Readiness Review for Spacecraft 118,  
Phase I

The Customer Acceptance Readiness Review (CARR) Board for Spacecraft 118, Phase I will be held in Building 2, Room 602, MSC, Houston, Texas, and at North American Rockwell Corporation, Downey, California, via telecommunications on May 16, 1972, at 1:00 p.m., c.d.t.

Board Members

Chairman: Manager for the Command and Service Modules  
Apollo Spacecraft Program

Members: Skylab Program Office, Representative, MSC  
Chief, CSM Project Engineering Division, MSC  
Safety Office, Representative, MSC  
Engineering and Development Directorate,  
Representative, MSC  
Reliability and Quality Assurance, Representative,  
MSC or Downey  
Manager, NASA-Downey  
Project Engineering, Representative, NASA-Downey  
Test Engineering Office, Representative, NASA-  
Downey

Secretariat: CSM Project Engineering Division, Representative,  
MSC

It is requested that any substitutions of board members be cleared with the Manager for the Command and Service Modules, Apollo Spacecraft Program, MSC.

Review Location/Schedule

The Team Reviews will be held in the Assembly Room, Building 1, NR-Downey.

Accumulated Data Cutoff		Apr. 28
Data Inventory	8:30 a.m.	May 8
Opening Briefing	8:45	May 8
Reliability and Subsystem	9:00-	May 8-
Team Reviews	3:00 p.m.	May 10
Team Report Preparation		May 15
CARR Board	1:00 p.m.	May 16
	c.d.t. via telephone	

Notification of any change in scheduled CARR dates or location will be provided prior to the start of the CARR.

Data and Documentation

The data and documentation for this review will be in accordance with contractual requirements and will be sorted by subsystem and by module included in SSAD's (System Summary Acceptance Documents). Data too bulky and data that do not lend themselves to sorting will be available at NR-Downey, California. The required information may be obtained by telephone. ACE data will be included in the supplemental data.

Customer Acceptance Review Item Disposition (CARID's)

CARID's are to be prepared in accordance with the CARR plan. They will be submitted to the CARR secretary for number assignment and typing. Contractor responses to CARID's will be cleared through the CARR secretary. CARID's should be submitted as soon as they are prepared.

Readiness Statements

Readiness statements will be prepared in accordance with the CARR plan. They will be submitted to the CARR secretary, identifying all items which may affect test readiness or acceptance.

Review Teams

Reliability and Quality, subsystem, and special teams for NASA/contractor organizations, as established by the CARR plan, will review the data and documentation provided by the contractor.

The following systems will be reviewed:

SSAD Book Numbers

<u>LES</u>	<u>CM</u>	<u>SM</u>	<u>SUBSYSTEM</u>
1.1	2.1	3.1	Structures
1.2	2.2	3.2	Ordnance
1.3	2.3	3.3	Mechanical
	2.5	3.5	Environmental Control System

<u>LES</u>	<u>CM</u>	<u>SM</u>	<u>SUBSYSTEM</u>
	2.6	3.6	Reaction Control System
	2.7	3.7	Instrumentation
1.8	2.8	3.8	Electrical Power System and Wiring
	2.9		Entry Monitor System
	2.10		Stabilization and Control System and ORDEAL
	2.11	3.11	Communications
	2.12	3.12	Sequential Events
	2.13		Crew Equipment and Couches
	2.14		Displays and Controls
	2.15		Guidance and Navigation
	2.16		Earth Recovery System
	2.17		Heat Shield
		3.18	Service Propulsion System (LES Motors)
		3.19	Cryogenics
		3.20	Fuel Cells

Total CSM.

4.34 CSM General

The following additional sections will be set up for the CARR report and CARID numbering, but will not require separate SSAD books:

5.24 ACE  
5.26 Plumbing  
5.27 Pressure Vessels  
5.29 Safety  
5.31 Configuration  
5.32 Thermal Control  
5.33 Quality Assurance

It is requested that all division representatives having a working interest in this review provide a list of individuals by name and review area (subsystem, special teams, etc.), including contractor personnel, who will participate in the CARR, and dates of participation. This information may be furnished on the enclosed sheet and submitted at least five working days prior to the start of the review to H. L. Brendle, PF6, MSC. Members of the special team will be notified of their required attendance. For subsystems requiring more than two team members, or more than one R&QA member, it is requested a brief rationale for the requirements be submitted on the enclosed form.

The Manager, NASA-Downey; Manager, RASPO-KSC; Director, Spacecraft Operations, KSC, should provide a list of individuals, from their respective offices, who will participate in the CARR and the dates of participation. This information may be furnished on the enclosed sheet and submitted at least five working days prior to the start of the review to H. L. Brendle, PF6, MSC.

### Team Report Preparation

The leaders of the Reliability and Quality, subsystem, and special teams, will be responsible for consolidation of their findings and preparation of the team report to the CARR Board.

### NASA Pre-Board

There will not be a NASA Pre-Board for Phase I CARR on Spacecraft 118.

### General

The coordinator for the team reviews is the ASPO CSM 118 Project Engineer, H. F. Rees. The CARR Secretary, H. L. Brendle, will be in attendance during the team reviews and should be advised of team progress through submittal of daily team minutes. Questions concerning the planning and implementation of this review should be directed to H. L. Brendle, PF6, extension 5311, MSC, Houston.

Aaron Cohen

Enclosure



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
MANNED SPACECRAFT CENTER  
HOUSTON, TEXAS 77058

REPLY TO  
ATTN OF:

MEMORANDUM

TO: PF6/Chief, Review Planning Office

FROM:

SUBJECT: Customer Acceptance Readiness Review for Spacecraft 118,  
Phase I

The following persons will attend and be responsible for the CARR activities per letter PF6-0/49-72.

<u>NAME</u>	<u>CODE</u>	<u>DATE</u>	<u>FUNCTION</u>
-------------	-------------	-------------	-----------------

\_\_\_\_\_  
Signed

**APPENDIX G**  
**CUSTOMER ACCEPTANCE REVIEW ITEM DISPOSITION**  
**WITH CLOSEOUT DOCUMENTATION**

SPACE DIVISION OF NORTH AMERICAN ROCKWELL CORPORATION  
**CUSTOMER ACCEPTANCE REVIEW ITEM DISPOSITION (CARID) FORM**  
 Customer's Review Item Definition Sheet

CSM 116	Phase III	System ECS	System No. 2.5	CARID No. 116.2.5.5
Initiator R. Young/D. Hughes		Organization Boeing/MSC/ECS	Phone No. 483-5536	Date 3/17/72
Reference Documentation CAR PF 112010-1; DR A189587				Part No.

**PROBLEM** (Title) Inspection of Toggle Actuators

CAR PF 112010-1 requires inspection by recording position of retaining nut and number of shims for each item. DR records only number of shims. Position (flushness) of nuts is unknown.

**RECOMMENDED ACTION JUSTIFICATION**

Reinspect per CAR requirements

**RECOMMENDED CONSTRAINT** Shipment

Pre-Board Comments Remarks Direction Refer to Board  Dispositioned  (See Decision Summary)

NR stated that the flushness was verified per DRSS but did not have the paper available, but would verify and document.

The chairman requested the flushness of the nuts be reverified during PCO-2.  
 Action Required to Close CARID NR verify flushness of nuts.

Board Comments Remarks Direction

Action Required to Close CARID

**Board Decision Summary** (To be filled in by the Board or Pre-Board)

<b>Disposition:</b>	<b>CATEGORY</b>	Action:	Constraint:
Action this SC	I <input checked="" type="checkbox"/>	Contractor <input checked="" type="checkbox"/>	Subsystems Test <input type="checkbox"/>
Closed-Action/SC Subs	II <input type="checkbox"/>	NASA <input type="checkbox"/>	Combined Sys. Test <input type="checkbox"/>
Closed-Unexplained Anomaly	III <input type="checkbox"/>		Integrated Test <input type="checkbox"/>
Closed-No Action Required	IV <input type="checkbox"/>		Acceptance <input checked="" type="checkbox"/> (PCO-2)
Other	V <input type="checkbox"/>	HARDWARE <input checked="" type="checkbox"/>	Other <input type="checkbox"/>
Withdrawn	VI <input type="checkbox"/>	SOFTWARE <input type="checkbox"/>	None <input type="checkbox"/>

NASA Board Chairman Signature \_\_\_\_\_

Date \_\_\_\_\_

FORM 1900-Q REV 2-68

CUSTOMER ACCEPTANCE REVIEW ITEM DISPOSITION (CARID)  
FORM

## Contractor's Review Item Resolution Sheet

CSM 116	Phase III	System ECS	System No. 2.5	CARID No. 116.2.5.5
Originator R. Young/D. Hughes		Dept. Boeing/MSC/ECS	Phone No. 483-5536	Date 3/17/72
Reference Documentation CAR PF 112010-1; DR A189587				

(Problem Title) Inspection of toggle actuators

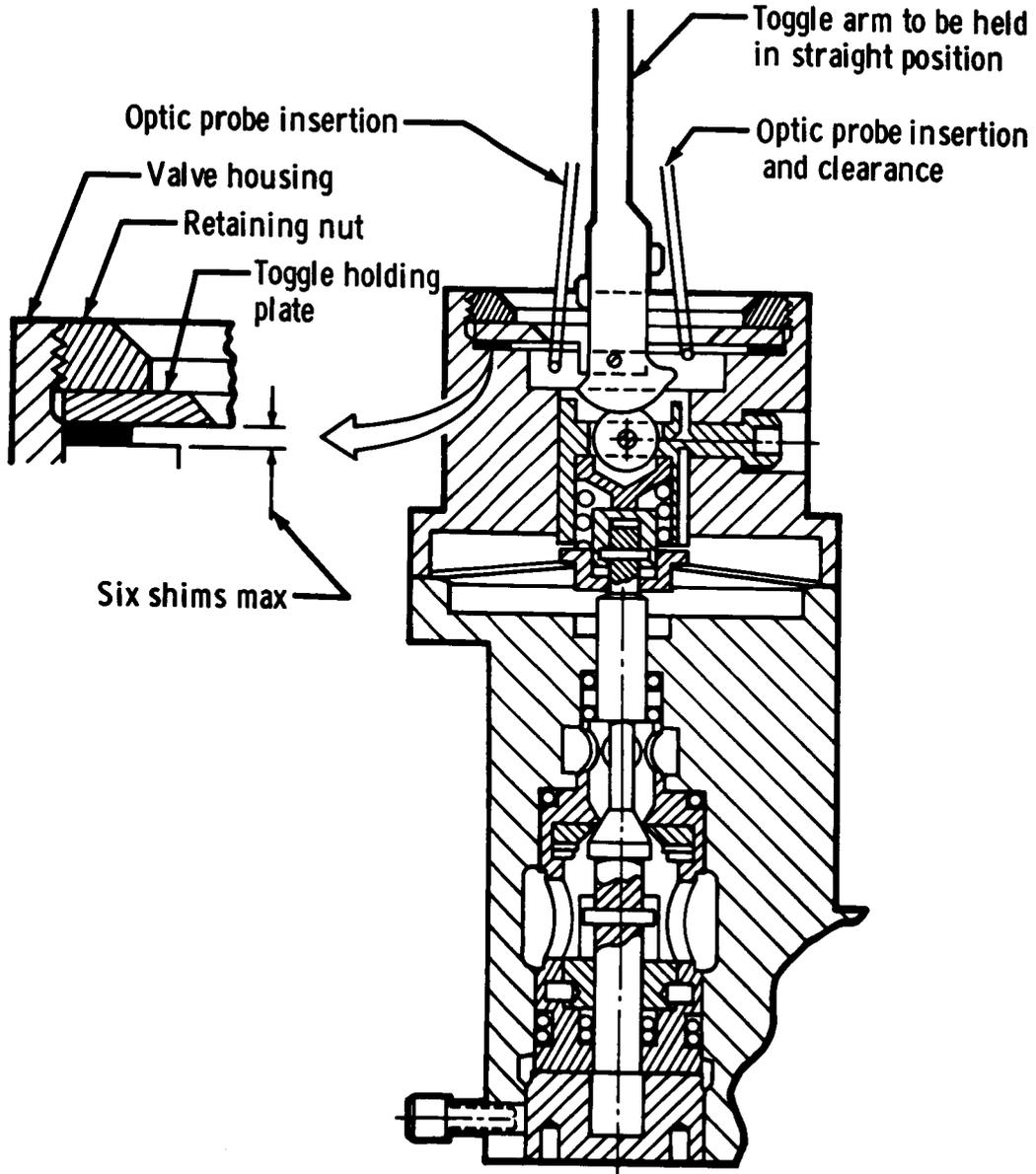
## Resolution/Action to be taken:

Five valves were checked for proper number of shims on 11-4-71. All valves had 6 shims except the valve on panel 600 which had 7 shims. The replacement valve SN 0044 was inspected for shims on 11-8-71 and it had 6. Position of retaining nut will be accomplished per instructions of CAR PF 112010-1. DR A166584 with CAR instructions is open against CSM 116 and will be accomplished during PCO-2 scheduled for June 23, 1972, through August 1, 1972.

Signature/C. E. Kindelberger  
Authorized NR Representative

3/21/72

Date



O<sub>2</sub> regulator in-place inspection

**CUSTOMER ACCEPTANCE REVIEW ITEM DISPOSITION (CARID)  
FORM**

**Contractor's Review Item Resolution Sheet**

CSM 116	Phase III	System ECS	System No. 2.5	CARID No. 116.2.5.5 R-1
Originator R. Young/D. Hughes		Dept. Boeing/MSC/ECS	Phone No. 483-5536	Date 3/17/72
Reference Documentation CAR PF 112010-1; DR A189587				

(Problem Title) Inspection of toggle actuators

Resolution/Action to be taken:

The position of the toggle actuator retaining nut will be verified during PCO-2, CSM 116. To ensure that this action occurs, a DR A166584 has been initiated against CSM 116 and is currently open in the CSM 116 V36-GEN FAIR book. The DR reads as follows: "When ready to reinspect the 116 toggle actuators, contact R. A. Kotler, ext. 4178. The retaining nut must be flush or the toggle parts S/B flush or recessed in the valve. If the nut projects above the valve, notify engineering for disposition. Record the nut position of 5 toggle actuators, panel 351 sys. A\_\_\_\_, panel 351 sys. B\_\_\_\_, panel 600\_\_\_\_, panel 601\_\_\_\_, panel 603\_\_\_\_. Report inspection results to PAA."

Signature/C. E. Kindleberger  
Authorized NR Representative

4/12/72

Date



UNITED STATES GOVERNMENT

2-Way Memo

Subject: CSM 116 Ø III CARID  
2.5.5 Inspection of Toggle Actuators

by: 5-10-72

DATE OF MESSAGE
5-3-72
DATE OF REPLY
5-4-72
<b>INSTRUCTIONS</b>
Use routing symbols whenever possible.
<b>SENDER:</b> Forward original and one copy. Conserve space.
<b>RECEIVER:</b> Reply below the message, keep one copy, return one copy.

To: EC3/Don Hughes

— FOLD — USE BRIEF, INFORMAL LANGUAGE — FOLD —

Please review the attached NR reply dated 4-12-72 with regard to the action assigned the subject CARID and indicate in writing if it is adequate to close this CARID.

Action: NR verify flushness of nuts during PCO-2.

CARID 2.5.5 \_\_\_\_\_open X closed

Comments: if req'd

It should be noted that if the nut is not flush or recessed, the valve shall be rejected.

Signature/Don Hughes

From: Frank Saknar/PF6  
X-5221  
CSM Review Planning Office

5027 - 102

1. TO BE RETAINED BY ADDRESSEE

OPTIONAL FORM 27  
OCTOBER 1962  
GSA FPMR (41 CFR) 101 - 11.6

**APPENDIX H**  
**MINUTES OF A CUSTOMER ACCEPTANCE**  
**READINESS REVIEW BOARD MEETING**

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

MINUTES OF MEETING

CUSTOMER ACCEPTANCE READINESS REVIEW BOARD

CSM 117 PHASE I

JANUARY 14, 1972

The Customer Acceptance Readiness Review (CARR) Board for CSM 117 Phase I convened at 10:30 a.m., c.s.t., via telecommunications in Room 602, Building 2, MSC, Houston, Texas, and in the Program Manager's Conference Room, Building 290, North American Rockwell Corporation, Downey, Calif.

Board Members

Chairman	:	A. Cohen, MSC @ MSC
Member	:	L. Chauvin, MSC @ MSC M. Fields, MSC @ MSC W. Graves, Downey @ Downey J. Hoffman, MSC @ MSC D. Mayhew, MSC @ Downey F. Miller, Downey @ Downey C. Perner, MSC @ MSC H. Rees, MSC @ MSC
Secretariat	:	H. L. Brendle F. Sakmar (Representative)
NR Representatives	:	G. Jeffs G. Merrick D. Thomas E. Smith
Astronaut Representatives:	:	A. Bean V. Brand

Proceedings

In accordance with the letter of implementation, PF6-0/233-71, dated Dec. 20, 1971, the Reliability, quality, subsystem, and special review teams were in session at NR-Downey, Jan. 10-12, 1972. During this time, the teams reviewed the data provided by the contractor. The contractor provided the data in accordance with the CARR plan. The team members recorded their findings on daily team minutes with discussion issues presented on Customer Acceptance Review Item Disposition (CARID) forms.

Readiness statements for CSM 117 initiation of subsystem tests were executed by applicable NASA-MSC subsystem manager, NASA-Downey subsystem test engineer, and NASA-MSC R&QA representatives.

CARID 2.1.1 Spillage of Unknown Fluid on CM Aft Bulkhead

PROBLEM

Upon removal of protective covers from the command module floor interior at the start of the third shift, May 7, 1970, an oily substance, red in color like machine coolant oil, was discovered on the floor of the CM aft bulkhead. Also metal chips from drilling were scattered throughout the CM floor.

DISCUSSION

NR reported that the only fluid which could have been in use at the time and which fits the description is machining oil. A suspect material would be Alumintap, an organic fluid customarily used for aluminum machining. The fluid was removed by wiping with MEK and ultraviolet light was used to verify removal. Ultraviolet light will show the smallest trace of the subject fluid. The metal chips were removed by vacuuming.

NR considers this condition acceptable with no further action required.

The chairman asked if corrective action has been taken to preclude this incident from occurring in the future. NR indicated they have taken precautionary measures for preventing recurrence. The NR answer was acceptable to the board.

ACTION - Closed

CARID 2.1.2 Over Torque of Fitting Attach Screws

PROBLEM

During installation of the V36-311048-3 fitting (3 places), the LD112-0011-0304 screws (8 per fitting) were torqued to 200 in. lbs. The maximum allowable torque is 120 in. lbs. plus 10 percent per MA0101-005, table VIII. The screws are considered not to be overstressed and accepted for unrestricted usage.

DISCUSSION

NR stated that the minimum qualifying torque requirement for the LD112-0011-0304 screws is 250 in. lbs. as indicated in corporate standards LD112-0010 through LD112-0015.

Mr. Brand, CB, asked what would happen if the subject screws failed. Mr. Sandars, ES, stated that from a structural standpoint the failures would be insignificant and that there was no technical concern.

This was acceptable to the board.

ACTION - Closed

CARID 3.5.1 SM Radiator Panel Water Glycol Spillage

PROBLEM

During water glycol flow verification tests on the sector II and III radiator panel, tygon tubing came loose causing spillage of water glycol on the panel and through bolt holes on the inside of the panel. The panel was not installed in the SM. MRB analysis indicated the panel is acceptable for unrestricted usage.

DISCUSSION

NR reported that after the water glycol was spilled on sector II and III panel, the structure was cleaned and chemically tested per Standard Repair ST 4.2. No evidence of glycol contamination remained. A close visual inspection revealed no contamination of the external cork and finish. The position of the panel allowed the water glycol to immediately drain to the center of the panel and through the attach holes.

NR recommended that no further action be taken.

The chairman asked what NR has done to preclude the tygon tubing from coming loose again. NR indicated precautionary measures will be taken to eliminate this type of incident.

This was acceptable to the board.

ACTION - Closed

CARID 3.6.1      DCS 4192 Closed Without Contractual Compliance

PROBLEM

DCS 4192 has been closed without contractual compliance and without any indication of open requirements in the vehicle records. DCS 4192 was closed with TVAR 39049, dated Nov. 9, 1971, identified as "not acceptable" to NASA engineering as it does not meet the requirements of the end item part II specification.

DISCUSSION

NR stated that the recommended action of CARID 3.6.1 has been completed. NR letter 72MA299 transmitted SCN 5316 to end item specification SID64-1345D, Part II. SCN 5316 revises the SM RCS quad proof pressure from  $315 \pm 5$  psig to  $305 \pm 5$  psig from CSM's 117-119.

The NR answer was acceptable for CSM 117; however, the chairman asked what was done for CSM 116. Mr. Jeffs, NR, indicated he would like to discuss the CSM 116 issue outside of this meeting. This was agreeable to the chairman. The CSM 116 issue remains open.

ACTION - Closed (CSM 117 only)

CARID 3.6.2      Overpower at Transducer Signal Conditioner

PROBLEM

Instrumentation power on digital voltmeter (DVM I) oxidizer manifold transducer reads 2.5 volts and should be not more than 0.5 volts. Investigation of this problem indicates output of the signal conditioner was overloaded with 28 volts DC during reconfiguration. A corrective action TVAR has been written to insure the problem does not happen again.

DISCUSSION

NR reported that the valve latching verification testing and final instrumentation checks in preparation for delivery utilize the same test cell recording equipment, but with significant differences in patching configuration. Normally, power is removed and the test cell configuration is repatched between test sequences; however, during a rewrite of MA0710-4192 these requirements were inadvertently omitted thus permitting latching voltage (28V) application to the subject signal conditioner. TVAR 39043 was prepared to remove power from test equipment between test phases. TVAR 40147 was prepared to ensure test equipment is properly configured, thus correcting the test procedure.

In addition, the pressure measurement system for measurement SR5821P, oxygen manifold pressure, system D (part no. ME431-0069-0132) was removed and replaced with a new part. The system retest was acceptable and the failed part returned to the supplier for rework.

The chairman noted that there is no spacecraft issue and that the procedures have been changed.

The NR answer was acceptable to the board.

ACTION - Closed

### CARID 3.6.3      Dropped Diffuser Assembly

#### PROBLEM

Diffuser assembly, ME282-0C06-0007, was dropped from a desk top at Bell damaging the propellant outlet tube and bleed tube. Subsequently, the assembly was installed in secondary oxidizer tank, S/N 139, with diffuser leakage occurring. The diffuser assembly was repaired and satisfactorily tested per Bell MDR #60253.

#### DISCUSSION

NR reported that Bell Aerosystems initiated final rework of diffuser assembly, 8271-471200-11, S/N 268 per MDR 60253, with proof pressure leakage test and X-ray inspections, completed successfully. After installation into the tank assembly, helium pressure and leakage tests were performed per Bell ATP 8271-928061. Following receipt at NR/SD, the tank assembly was installed in CSM 117 and leakage and proof pressure tests performed successfully per MA0710-4192. NR considers the tank, including subject diffuser assembly, acceptable for unrestricted usage.

The chairman asked if there were any concerns by E&D and R&QA regarding this incident. No concerns were expressed.

The NR answer was acceptable to the board.

ACTION - Closed

CARID 2.11.1 Coax Cable Dropped During Fabrication

PROBLEM

Coax cable, P/N V36-444330, was dropped approximately 3 feet from the workbench. The contact insulator bushing, braid clamp, "V" groove gasket, and large washer were installed. This mishap occurred during fabrication, and the connector was not installed.

DISCUSSION

NR reported that the V36-444330 coaxial cable is a RG1421U coax connector assembly used to interconnect the VHF/AM and the digital ranging generator. At the time of the occurrence of the reported droppage, the assembly was in fabrication process. No parts of the connector that are susceptible to damage from such a drop were installed. Subsequent to completion of the assembly fabrication, the completed item was subjected to and passed acceptance test per MA0205-0161, range II, verifying acceptance for unrestricted use.

The chairman noted that there is no spacecraft issue and that the procedures have been changed.

The NR answer was acceptable to the board.

ACTION - Closed

CARID 2.13.1 Control of Schedules for CM Crew Items Required by MSFC

PROBLEM

SSAD documentation 2.13, section 8, indicates that crew equipment manufacturing delivery schedules are established for CM usage only. However, many crew items are required in support of MSFC reviews; i.e., CCF and altitude chamber test. These items and delivery dates were identified to NR by NASA letter EC73NR71-0729-BT2-422, dated Oct. 27, 1971. Examples of crew items listed in the referenced SSAD are:

<u>NOMENCLATURE</u>	<u>P/N</u>	<u>CSM ENGR RELEASE DATE</u>	<u>MSFC NEED DATE</u>
A2 Locker	V56-787502	4-28-72	3-1-72
A5 Locker	V56-787505	4-28-72	3-1-72
A7 Locker	V56-787507	4-28-72	3-1-72

## DISCUSSION

NR stated that a plan is being prepared to support both requirements (reference UCN 31114) and is expected to be released on Jan. 21, 1972.

The chairman asked if NASA-MSO has provided sufficient information to NR for completion of its plan in support of the subject requirements. Mr. McAllister, EC, indicated that the dates provided by him to NR were complete and to the best of his knowledge accurate. Mr. McAllister coordinated with the Skylab Program Office on the dates provided NR.

The chairman stressed that NR must have realistic dates to support the subject requirements. Since this issue was related to the program and not CSM 117 only, the CARID is closed; however, the issue remains open for the program.

ACTION - Closed

## PROGRAM ACTION

(1) NASA, L. Chauvin, EN, assure that realistic schedules are provided to NR.

(2) NR review with Mr. Cohen the program plan for this issue by Jan. 21, 1972.

## CARID 5.24.1 Experiment S071/72 Real Time Data Display for ACE

### PROBLEM

The ACE subprogram computer specification (MA0201-0499) and the CSM 117 programming requirements process specification (MA0201-5875) have not been revised to reflect subprogram U0051, "Process Circadian Periodicity Experiments Data", for use at Downey during DC8 8100 and DCS 0131 with one ACE computer room. The revision 1 into MCR 31238 has not yet been released to manufacturing.

### DISCUSSION

NR reported that upon successful completion of Phase I verification of the new test file tape incorporating the new subProgram U0051 (to be released by 2-1-72), NR will submit a revised ECP (ref. MCR 31238) to NASA. The ECP will reflect the use of one test file tape and the use of one computer room.

In addition, NASA will be asked to supply a copy of the test file tape, a second computer room, and G.E. and experiment contractor support as a contingency, if operational conditions so dictate.

The NR answer was acceptable to the board.

ACTION - Closed

CARID 4.34.1 Fuel Overboard Dump Connection Improperly Protected

PROBLEM

The fuel overboard dump connection is protected by a makeshift method (unknown) per DRSS S035150, item 091, with no corrective action.

DISCUSSION

NR reported that the incident occurred in B290 clean room and involves a non-critical ventline through the CM heat shield beyond an inline squib. The unsatisfactory condition was loose tape which was replaced and appeared to be makeshift. The tape, overwrap, and bag were removed and replaced per MA0616-035.

NR and NASA approved the corrective action on July 30, 1971. NR recommends no additional corrective action.

The chairman noted there was no technical concern; only a paperwork problem.

The NR reply was acceptable to the board.

ACTION - Closed

CARID 4.34.2 CSM 117 Overage Parts

PROBLEM

Several CSM 117 parts will exceed their established expiration date as shown in MA0201-15695 on or before 80 days after the currently scheduled launch date, Oct. 19, 1973. These parts include seven valves, P/N ME284-0357-0001; four tanks, P/N's ME282-0006-0007, ME282-0008-0006, ME192-0008-0101, and ME192-0036-0004; two couplings, P/N ME273-0074-1004; and a reservoir, ME282-0049-0001.

DISCUSSION

NR stated that all age life DR's are being processed by ALAS or MRB per the instructions of NR internal letter no. 695-100-000-71-248, dated Dec. 20, 1971.

The chairman indicated that there appears to be no technical concern regarding these items. Mr. Raciti, NB, speaking for R&QA, agreed with the chairman. It is just a matter of the paperwork being processed.

The NR reply was acceptable.

ACTION - Closed

This concluded the agenda items.

The chairman polled the board for comments and concerns.

It was generally agreed there were no additional concerns and that CSM 117 was a cleaner spacecraft, problem-wise than CSM 116 at its Phase I CARR milestone review.

The meeting was adjourned at 11:25 a.m., c.s.t.

Submitted:

*F. J. Sakmar*  
F. J. Sakmar

Approved:

*R. K. Zwick*  
for A. Cohen 1/14/72

**APPENDIX I**  
**BRIEFING REQUIREMENTS FOR CUSTOMER**  
**ACCEPTANCE READINESS REVIEWS**

## SUMMARY OF REQUIREMENTS

The following briefings shall be prepared for presentation at the Phase III Customer Acceptance Readiness Review Board only. Each briefing will show status and impact assessment. Items that will not support shipment or altitude chamber testing or that may result in a hardware change will be emphasized.

1. Command and service module (CSM) status/schedule position
2. Open work to be transferred to John F. Kennedy Space Center (KSC)
3. Open specification change notices (SCN's)
4. Waivers
5. Open certification tests
6. Open program failures and unsatisfactory conditions
7. Open customer acceptance review item dispositions (CARID's)
8. Safety assessment

## DETAIL OF REQUIREMENTS

The following list contains details of briefing requirements.

1. CSM status/schedule position — Summarize, by use of a schedule chart, the significant work remaining to be accomplished before shipment.
2. Open work to be transferred to KSC
  - a. Summarize, by task, the changes to the baseline (new effort) transferred to KSC.
  - b. Summarize, by task, (1) the hardware shortages and (2) the test or retest effort normally accomplished at Downey transferred to KSC.
3. Open SCN's — Summarize the SCN's that affect the spacecraft under review and that are pending NASA approval or contractor submittal to NASA.
4. Waivers — Summarize each waiver or deviation that affects the spacecraft under review, and show the rationale for acceptability.

**5. Open certification tests**

a. Summarize, by quantity and type, the open certification tests affecting the spacecraft under review.

b. Identify each test having a scheduled completion after shipment of the spacecraft, showing the type of test and the scheduled completion date.

**6. Open program failures and unsatisfactory conditions**

a. Summarize, by quantity and type, the open program failures affecting the spacecraft under review.

b. Identify each significant failure having potential hardware impact to the spacecraft under review, giving a problem description, a plan for resolution, and a closeout schedule.

**7. Open CARID's**

a. Summarize the open CARID's as related to hardware or software.

b. Summarize the resolution to the CARID's, using a special briefing if necessary.

8. Safety assessment — Summarize the activities of the contractor safety organizations, including the accidents and incidents related to the spacecraft under review with specific dates of occurrence and rationale for acceptance.

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