ALSEP ENGINEERING

MODEL TESTS

Bendix

Aerospace Systems Division
CATEGORY #1 - CENTRAL STATION INTEGRATION

RTG SIMULATOR

DATA SUBSYSTEM
TEST SET

POWER SUBSYSTEM
DATA SUBSYSTEM

EXPERIMENT SIMULATORS

4422-2302
CATEGORY #2 - INDIVIDUAL EXPERIMENTS
INTEGRATION WITH CENTRAL STATION

RTG SIM

CENTRAL STATION

EXPERIMENT #1

SIGNAL BREAKOUT BOX

EXPERIMENT TEST SET

DSSTS
CATEGORY #3
INTERACTIONS OF ALL EXPERIMENTS

RTG SIM

CENTRAL STATION

DSSTS

EXPERIMENTS

#1

#2

ETs #1

#2

#3

#4

SBOB'S

#4

#3

#2

#1
CATEGORY #4 - EXPERIMENTS
DATA VERIFICATION TESTS

RTG SIM

CENTRAL STATION

EXPERIMENTS

SBOB'S

SYSTEM TEST SET

ETS #1

#1

#2

#3

#4

4422-2305
## EM SCHEDULE AND STATUS

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4422-2306
TEST RESULTS
SOLAR WIND SPECTROMETER

- A-OK
- OUTSTANDING OPERATION
- NO SIGNIFICANT FAULTS

DISCREPANCY NOTED

1. POWER CONVERTER
   NOISE, 200 MV ON
   +29V LINE

2. CHANGE IN TURN-OFF VOLTAGE TRANSIENT

CORRECTIVE ACTION

1. PROBABLE ACCEPTABLE
2. PI INFORMED

4422–2308
SIDE - BREADBOARD

- A-OK
- EXCELLENT OPERATION
- ONE SIGNIFICANT FAULT

<table>
<thead>
<tr>
<th>DISCREPANCY</th>
<th>CORRECTIVE ACTION</th>
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<tbody>
<tr>
<td>1. POWER CONVERTER NOISE, 2-4 VOLTS, RADIATED EMI</td>
<td>1. MODS INCORPORATED IN SUBSEQUENT MODELS</td>
</tr>
<tr>
<td>2. TURN-ON POWER TRANSIENT</td>
<td>2. CORRECTED IN BB</td>
</tr>
<tr>
<td>3. FALSE EXP. STANDBY INDICATION</td>
<td>3. CORRECTED IN BB</td>
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4422-2309
PASSIVE SEISMIC EXPERIMENT

- B- OK
- FUNCTIONS WELL BUT EXCESSIVE NOISE ON SCIENCE DATA LINES

<table>
<thead>
<tr>
<th>DISCREPANCY</th>
<th>CORRECTIVE ACTION</th>
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<tbody>
<tr>
<td>1. POWER CONVERTER NOISE</td>
<td>1. CORRECTED ON QUAL MODEL</td>
</tr>
<tr>
<td>a. RESULTS IN SCIENCE DATA NOISE</td>
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<tr>
<td>b. 3V ON 29V LINE</td>
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<tr>
<td>2. CURRENT LIMITING ON</td>
<td>2. MOD IN PROTOTYPE</td>
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<tr>
<td>HEATER AND LEVELING MOTOR LINES</td>
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</table>
3. TURN-OFF VOLTAGE TRANSIENT

4. ETS INOPERATIVE IN SYSTEM CONFIGURATION

3. REFERED TO TELEDYNE

4. EXTENSIVE MODS INCORPORATED AT BxA
LUNAR SURFACE MAGNETOMETER

- INTERFACE CIRCUITS CORRECT
- LOWEST EXPERIMENT POWER CONVERTER NOISE
- FUNCTIONAL OPERATION ERRATIC-24 DISCREPANCIES

<table>
<thead>
<tr>
<th>DISCREPANCY</th>
<th>CORRECTIVE ACTION</th>
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<tbody>
<tr>
<td>1. EXCESSIVE TURN-ON</td>
<td>1. MOD. IN PROTO</td>
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<tr>
<td>POWER TRANSIENT</td>
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<tr>
<td>2. EXCESSIVE FLIP-MOTOR</td>
<td>2. MOTOR DRIVE MALFUNCTION</td>
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<td>POWER</td>
<td>TO BE CORRECTED IN QUAL</td>
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<td>3. HIGH OPERATIONAL</td>
<td>3. MOD IN QUAL</td>
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<tr>
<td>POWER</td>
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LSM
(CONTINUED)

4. RANDOM SEQUENCE FAULTS
   a. FLIP MOTOR POWER
   b. ENG. DATA COMMUTATOR
   c. POWER GLITCH

5. Z-OFFSET SEQUENCE INCORRECT

6. QUESTIONABLE SCIENCE
   DATA OUTPUTS

7. ETS JITTER

8. ONLY ONE AXIS COMPLETELY
   FUNCTIONAL AND NO SITE
   SURVEY MODE

4. PARTIALLY CORRECTED IN PROTO
   SOME FAULTS STILL UNEXPLAINED
   BY ARC-PHILCO

5. CYCLE TO BE CORRECTED

6. CIRCUIT MOD IN PROTO

7. TO BE CORRECTED

8. PROTO TO BE COMPLETELY
   FUNCTIONAL
CHARGED PARTICLE LUNAR ENVIRONMENT EXPERIMENT

- A^- OK
- FUNCTIONS PROPERLY
- CATEGORY #2 TESTS COMPLETE

<table>
<thead>
<tr>
<th>DISCREPANCY</th>
<th>CORRECTIVE ACTION</th>
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<tbody>
<tr>
<td>1. EARLY COMPONENT FAILURE</td>
<td>1. EXP. REPAIRED BY BRLD</td>
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<tr>
<td>2. POWER CONVERTER NOISE</td>
<td>2. BRLD INFORMED</td>
</tr>
<tr>
<td>3. POSSIBLE LOW NOISE IMMUNITY OF LOGIC</td>
<td>3. EXP. FUNCTIONED AFTER SHIELD GROUNDING CHANGES CONTINUED INVESTIGATION</td>
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ACTIVE SEISMIC EXPERIMENT

- PRELIMINARY CATEGORY 2 TESTS COMPLETE
- GOOD FUNCTIONAL OPERATION

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<th>DISCREPANCY</th>
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<tr>
<td>1. TURN-ON AND TURN-OFF CIRCUITS</td>
<td>1. CIRCUITS MODIFIED AND EM NOW FUNCTIONS PROPERLY</td>
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<tr>
<td>2. NOISE ON REAL TIME EVENT CHANNEL</td>
<td>2. UNDER INVESTIGATION</td>
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HEAT FLOW EXPERIMENT

- SUBSYSTEM TESTS COMPLETE
- GOOD FUNCTIONAL OPERATION

4422-2316
CENTRAL STATION- STS INTERFACE

- A - OK
- HARDWARE
  DATA UNIT
  PROGRAMMER PROCESSOR } FULLY CHECKED OUT
  PSE READ OUT - UNDER INVESTIGATION

- SOFTWARE
  6 OUT OF 9 FULLY CHECKED OUT

4422–2317
STS SOFTWARE

BASIC EXECUTIVE CENTRAL STATION

{ LSM
SWS
SIDE
CPLEE

} A - OK

PSE - NOT FULLY DEBUGGED

ASE
HF

} FINAL STAGES OF PREPARATION
CENTRAL STATION SUMMARY

DATA SUBSYSTEM

DIGITAL-COM. DECODER, DATA PROCESSOR
A+ PERFORMANCE
6 MONTHS FAULTLESS OPERATION

ANALOG MULTIPLEXER
FAULTLESS OPERATION FOR 3.5 MONTHS
RECENT FET GATE FAILURES

POWER DISTRIBUTION UNIT
A - OK
NO SIGNIFICANT PROBLEMS
RF UNITS

DISCREPANCY

1. REC. LO SEARCH MODE
2. TEMPERATURE AND PERFORMANCE LIMITATIONS POWER SUBSYSTEM
   1. POWER CONVERTER NOISE
2. VOLTAGE TRANSIENTS ON PCU CHANGEOVER
3. RIPPLE-OFF INCOMPATIBILITY
4. INTERMITTENT OUT OF REG. CONDITION

CORRECTIVE ACTION

1. INCORPORATED IN PROTO
2. CORRECTED IN PROTO
   "B - OK"
1. CORRECTED BY FILTERING AND SHIELDING
2. CORRECTED BY MOD. OF EM
3. MOD. IN EM
4. UNDER INVESTIGATION

4422-2321
GENERAL COMMENTS ON EXPERIMENTS

FUNCTIONAL OPERATION CORRECT
SIGNAL CHARACTERISTICS
TIMING
COMMAND RESPONSE
NOISE IMMUNITY
OPERATIONAL SEQUENCING
POWER INTERFACE
COMMON PROBLEM
POWER CONVERTER NOISE

4422-2323
• PLANS
  TEST SEQUENCE
  TEST DESCRIPTIONS
• SCHEDULE
• STATUS
  TESTS COMPLETED
  PROBLEM AREAS
  SOLUTIONS
COMPONENT TESTS

FUNCTIONAL VIBRATION
LOW TEMPERATURE T/V.
FUNCTIONAL AT LOW TEMP.
HIGH TEMPERATURE T/V.
FUNCTIONAL AT HIGH TEMP.
AMBIENT FUNCTIONAL
C.S. INTEGRATION

1. HARNESS - T.P. - PDU.
2. COMM RECEIVER
3. COMM DECODER
4. TRANSMITTER & RECEIVER
5. DATA PROCESSOR
6. PCU.
7. MISC.
   PDM - SWITCHES
CENTRAL STATION TEST

C/S - STS - INTEGRATION

UP-DOWN LINK R.F.

SOFTWARE CHECKOUT

EXPERIMENT'S SIM. C/O

COMMAND C/O

PROCEDURE C/O

C/S E.M.I. TEST
EXPERIMENT INTEGRATION

EXPERIMENT PIA

INDIVIDUAL EXP. INTEGRATION

ALL EXP. TEST

4422–2405
SYSTEM PERFORMANCE TESTS

INTEGRATED SYSTEM TEST

MAGNETIC PROPERTIES

MASS PROPERTIES
SYSTEM ENVIRONMENTAL TESTS

VIBRATION (EACH AXIS)
SINE
RANDOM
I.S.T.
THERMAL VACUUM/SOLAR SIMULATION

4422–2407
SCHEDULE AND STATUS

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<td>PROBLEM</td>
<td>SOLUTION</td>
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<td>VARIATION IN CURRENT RELAY TRIP POINT</td>
<td>SHUNT MAT' L CHANGED QUAL MODEL (SAME R-&lt;T_c)</td>
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COMMAND DECODER

STATUS

PROBLEM

OK

SOLUTION

1. INTERMITTENT DURING $\Delta T$

2. DEFECTIVE FLAT-PAK REPLACED BY ENGR.
**DATA PROCESSOR**

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<td>1. PLATED HOLE FAILURE FAILURE IN VIB.</td>
<td>1. REPLACE PC BOARD</td>
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<td>2. INTERMITTENT FLAT-PAK DURING SOAK TEST</td>
<td>2. REPLACE COMPONENT</td>
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<td>3. EVEN FRAME MARK TIMING INCORRECT</td>
<td>3. CORRECT WIRING ERROR</td>
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4422-2411
**PCU**

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<td>1. LOW TEMP PERFORMANCE UNSATISFACTORY</td>
<td>1. CORRECTED TRANSISTOR DRIVE CIRCUIT.</td>
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<td>2. LOW EFFICIENCY</td>
<td>2. CORRECT SHORTED TURN ON TRANSFORMER</td>
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<td>3. WILL NOT SWITCH #2 to #1</td>
<td>3. INCREASED RELAY DRIVE CURRENT</td>
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### CENTRAL STATION E.M.I.

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<td>RADIATED INTERFERENCE OUT OF SPECIFICATION 30 D. B</td>
<td>REDESIGN TRANSMITTER COVER PLUS THERMAL BAG.</td>
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4422-2410
We are running an informal competition among our various Bendix artists to produce a reasonably realistic and yet exciting painting of ALSEP deployed on the moon. This is an extremely difficult task especially if one wishes to be accurate with colors and lighting. Here is this month's submittal. It is a correct perspective of the view of ALSEP 300 feet away as seen from the window of the lunar module. Many of you have also seen the black and white picture which shows the SIDE in the foreground. We have another one coming up which for some strange reason shows the central station in the foreground. When we are all happy with one of these we will make copies available to you. I hope before the end of the program.

At the last meeting on 26 January I was pleased to report to this conference that the central station was on schedule and supporting an "on time" delivery of the first flight unit on 14 July of this year. I am again happy to repeat the same message at this meeting. We continue to be on schedule and our flight configuration hardware is performing well.

Needless to say when I made my report in the last meeting I made the usual qualifications about unforeseen problems. We did have an annoying problem for a few weeks in our PCU. Although it performed well in the specified environments it was marginal at temperatures below -22°F. This problem has now been resolved and did not hold up any of our system level operations.

Before reviewing the schedule of the prototype, qual and flight models and relationship to experiments, I would like quickly to describe the final central station hardware. Although these pictures are of the prototype model, there are few if any changes in these pieces between prototype and the qual-flight models.
Slide 2 - This is the primary structure for Compartment 1, machined from a single 7075 aluminum forging. The original forging was 7" high and has been machined to the final 4.5" height. The forging was 4" thick; side panels are now .037 and top and bottom flanges are .050. Overall dimensions are held to .010. A thin aluminum skin is riveted in tension to the bottom of the structure. One can see the square holes where the sunshield extenders mount. We are looking at this structure from the back of Compartment 1.

Slide 3 - The next slide shows the Array A sunshield/experiment pallet which is a high temperature bonded aluminum honeycomb 0.88" thick, covered top and bottom with .016 aluminum skins. The solid channels on the side are machined aluminum. Inserts have been placed in this sunshield for the Array A experiments. These inserts on which the experiment mounting brackets are located are bonded into the honeycomb core. The large holes around the periphery mount the Calfax fasteners. The technique for mounting this experiment is to attach our brackets to a tool plate identical to the one provided to the PIs. The entire bracket-tool plate assembly is then bonded to this sunshield.

Slide 4 - Is an exploded view of the central station mechanical assembly showing the primary structure, the thermal plate on which central station electronics are mounted, and the sunshield. The bracket holding the connectors in this view is a test fixture. In the final assembly the connectors are mounted directly to the primary structure panels below.

Slide 5 - If we turn over the thermal plate we see the data subsystem mounted beneath. I will describe these components in more detail in a few minutes. The space at the top left is for the PCU which was undergoing component tests when this picture was made. At the top right is the location of the passive seismic
electronics in appropriate arrays. The only changes between arrays in this assembly are of course the presence or absence of the active seismic electronics, changes to the format and address code patch panels, and harness changes affected by format.

Slide 6 - Shows the prototype data subsystem about 1 month ago before it was assembled into the central station. Of primary interest in this slide is the final configuration of the antenna.

Slide 7 - Is the PDU which contains 5 PC boards one of which is exclusively devoted to the dust detector electronics. All of the boards involve discrete components such as relays and circuit breakers and are therefore foamed in place. This view shows the heat dissipation technique used throughout the electronics which involve the tightly pressed wedges running between the edge of the board and the mounting structure.

Slide 8 - Is the back of the PDU showing the 6 layer motherboard and the connector. The only wiring in this unit are the wires running from connector to the motherboard. All other wiring in this and all units of the data subsystem is printed into the PC boards.

Slide 9 - The Command Decoder contains 9 integrated circuit PC boards and a 10th discrete component board located at the bottom. Each side of the integrated circuit board contains approximately 30 flat packs.

Slide 10 - The back view of the Command Decoder shows the patch panel for address codes. This panel, which is the light area on the motherboard, can be easily changed without disturbing the total command decoder.
Slide 11 - The Data Processor has a double sided PC board at the top. One can see the standard conformal coating in this view. On the lefthand side of the top board is the patch panel for the data format. If format changes are required between arrays only changes to this easily removed patch panel are required. In the practical case, however, we would always build a new board rather than digging out coatings to change format. The small light area on the motherboard is a patch panel for the unique identification code associated with each data processor.

Slide 12 - Is the Dynatronic's A/D converter. This was the qualification unit which successfully passed all qual tests at Dynatronics except, as you can see, for a small corrosion problem on the gold plating. This process has subsequently been changed.

Slide 13 - Is the interior of the unit. Dynatronics uses double sided boards with each board hard wired to the connector. A cover provides structural strength.

Slide 14 - Shows one of the redundant transmitters.

Slide 15 - Is the receiver which requires no cover. One can see the individually manufactured and tested receiver modules.

Slide 16 - Is the Rantec diplexer switch which provides switching between the redundant transmitters.

Slide 17 - Is the diplexer filter by Rantec. Both the switch and filters have been completely qualified at the component level.
Our current schedule for the prototype system is shown on Slide 18. As Al Schorken has mentioned our major internal milestone was completion of the central station electrical integration and the readiness of the system test set. This was accomplished with successful checkout on schedule in March. On 15 March we ran a successful electrical integration on the solar wind experiment. Although this experiment was not absolutely complete nor thoroughly tested before it arrived it was adequate for a check of functional integration into the prototype system. This integration check was accomplished with no particular difficulties and the experiment was returned to JPL with a delivery on an on-call basis until required to support tests when we receive a second experiment. When this slide was made up last Friday, we expected the MSC CCIG and the prototype Magnetometer on last Monday, 3 April. The gauge experiment is expected momentarily but the prototype Magnetometer has been further delayed. We expect to have the prototype PSE next week as Dick Schmidt will undoubtedly tell you later. Recent news on the seismometer is very encouraging. The model to be delivered to Lamont successfully passed vibration tests and we have every reason to believe that the prototype will also be successful. The forecast for the prototype SIDE is optimistically shown here for 15 April. As you can see this delay causes us to slip completion of experiment integration by an estimated 2 weeks or 28 April.

The current schedule of the qual model for Array A is shown on the Slide 19. The key milestone for Bendix is completion of assembly and integration of the central station electronic components on 21 April. All parts are in work in manufacturing. We have no part shortages or manufacturing difficulties so far. We are approximately 50% complete and we should make 21 April. The period
allotted for experiment integration in the qual model extends from 21 April to 19 May. We are showing, however, a one week slip due to the late delivery of SIDE. Our forecast for the SIDE is 15 May which again may be somewhat optimistic. The MSC CCIG is expected on 5 May. We are still showing the commitment of 1 May for the LSM and we expect both PSE and SWE to be back on original schedule for the qualification model.

The flight model schedule for the first Array A is shown on the next slide (Slide 20). The major milestone for this model, equivalent to the 21 April date for qual, is 19 May completion of central station electrical assembly. Again we have no part shortages, the piece parts are now being manufactured. Since this model is in all respects identical to the qual model, in many cases it is a case of building 2 each of each part. In order to meet the required date of 14 July our schedule requires that we must start acceptance test on 16 June. We are currently forecasting a 2 week slip in this date due to the late delivery of the SIDE which does not arrive until 16 June. Unless there are unforeseen problems we expect the PSE back on schedule for 1 May. We understand that the SWE should have no difficulty meeting 1 June and that the Magnetometer should be able to meet 1 June if the May qual model has been successful.

Although there have been many informal discussions and preliminary planning for realignment of the schedule, I would like to emphasize that we in Bendix, and I assume all organizations that have contracts inALSEP, are proceeding full tilt to meet our obligations on the current schedule until we are officially asked to do something different.
DSS PROTOTYPE HARDWARE WITH ANTENNA
DSS POWER DISTRIBUTION UNIT PROTOTYPE (VIEW 1)
DSS COMMAND DECODER PROTOTYPE (VIEW 1)

4422-2264
DSS DIGITAL DATA PROCESSOR
PROTOTYPE - DIGITAL UNIT (VIEW 1)
DSS DIGITAL DATA PROCESSOR PROTOTYPE - ANALOG MULTIPLEXER CONVERTER (VIEW 1)
DSS DIGITAL DATA PROCESSOR PROTOTYPE - ANALOG MULTIPLEXER CONVERTER (VIEW 2)

4422-2269
DSS DIPLEXER SWITCH PROTOTYPE
DSS DIPLEXER FILTER PROTOTYPE (VIEW 1)
DSS TRANSMITTER PROTOTYPE (VIEW 1)
DSS RECEIVER PROTOTYPE (VIEW 2)
PROTOTYPE SCHEDULE - ARRAY A

CENTRAL STA INTEG

EXPERIMENT INTEGRATION

SYSTEM TEST
SET READY

COMPLETED ON SCHEDULE

CCIG
LSM
SWS
PSE
SIDE

MAY

12 19

DES. VERIF. TESTS

SYSTEM LEVEL

4422-228
FLIGHT MODEL SCHEDULE - ARRAY A

MARCH

24 31 7 14 21 28 5

APRIL

MAY

26 2 9

JUNE

16 23 30

COMPONENT MFG

CENTRAL STA ASSBY

EXPERIMENT INTEG

PSE

SWS

LSM

SIDE

4422-2284
**STATUS OF P.I. DATA**

<table>
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<tr>
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<th>CONVERSION &amp; CALIB DATA</th>
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*DEVELOPED BY BxA AND APPROVED BY P.I.*
Attachment A to
KN 1142.5, Ch. 1
ALSEP Ground Operation Flow - D-2 Model at KSC. BxS 4940
ALSEP Ground Operations Flow at KSC. BxS 5341
Proposed KSC ALSEP Launch Preparation Site - Approximate Equipment Arrangement
PROPOSED TRENCH CONCEPT TO ALLOW VEHICLE TRAFFIC WHILE CABLE IS IN PLACE. WEATHER COVER FOR CABLE IS PRIME CONSIDERATION.

NOTES:

PROPOSED TRENCH CONCEPT TO ALLOW VEHICLE TRAFFIC WHILE CABLE IS IN PLACE. WEATHER COVER FOR CABLE IS PRIME CONSIDERATION.

Diagram:

- Proposed Trench Concept
- Cable Crossing Trench
- Weather Cover

Proposed Bunker Facility - ALSEP Active Seismic Experiment
Grenade Launch Assembly. BxS 5345
ALSEP LAUNCH PREPARATION SITE - FIGURE 1

*Augmented staff during 90 day period prior to T-40 days in launch cycle.
| ALSEP Ground Operations Time Flow (D 2 Mass Sim.) |
KENNEDY SPACE CENTER
SPACECRAFT OPERATIONS DIRECTORATE

PREFLIGHT OPERATIONS AT KSC

Coordinated By: [Signature]
NASA/KSC Spacecraft Operations Procedure Control

Approved By: [Signature]
Manager, Test & Operations Management Office
NASA/KSC/SCO

January 18, 1967
SUBJECT: PREFLIGHT OPERATIONS AT KSC

1. PURPOSE

This document establishes the basis upon which NASA and the flight equipment contractors maintain records of receiving, handling, operating, testing, and modifying flight equipment and associated ground equipment.

2. DEFINITION

Flight Equipment Contractor is defined as one composed of technicians, engineering, and quality control personnel resident at KSC.

3. GENERAL

3.1 KSC Documents

Because of the number of personnel and organizations engaged in preflight operations at KSC, a standardized system for regulating operations must be adhered to. The documents which control the preflight operations are described briefly in the following paragraphs.

3.1.1 Work Authorization - Test Preparation Sheet (TPS)

The TPS (see Appendix A) establishes a method of work control, furnishes historical records and facilities inspection under the two categories defined below:

3.1.1.1 Type "A" TPS

Required to authorize work involving a change in configuration (equipment modification) to the flight equipment or related ground support equipment.

3.1.1.2 Type "B" TPS

Required to authorize all other planned work and tests on the flight hardware and related ground support equipment.

3.1.2 Operational Checkout Procedures - OCP

This is an engineering document which provides detailed instructions to personnel for operational checkout of the flight hardware and ground support equipment. (See Appendix B).
3.1.3 **Discrepancy Record - DR**

Any discrepancy encountered during testing or work activity will be recorded by contractor/NASA Inspection on a KSC Form 4-21 entitled DR Form. Investigation or troubleshooting will be documented on this form or its continuation sheets, KSC Form 4-22. Step-by-step troubleshooting will be monitored by contractor and NASA Quality Control. The conclusions to the troubleshooting and the resulting disposition will be approved by contractor and NASA engineering. A detailed description of the DR is in Appendix C.

3.2 **Other Documents**

The contractor will also have other requirements generally fulfilled on company documents. In the event the contractor does not have a system, the contractor and NASA will mutually agree locally upon a system. The requirements are listed below.

3.2.1 **Data Package**

All end items will be accompanied by a data package. The intent of this package is to provide identification, historical information, status, and configuration of the hardware. The data package should consist of:

3.2.1.1 System and Component Historical Record.

3.2.1.2 Set of system and component drawings with drawing changes.

3.2.1.3 Acceptance test procedures and data.

3.2.1.4 Approved functional test procedures.

3.2.1.5 Material review, waiver, and non-conformance information.

3.2.1.6 Certification of cleanliness.

3.2.1.7 DD 250, DD 1149, and required shipping documents.

3.2.1.8 History of failures and their resolution. The data package and contents must be verified by contractor QC, and accepted and certified by a government inspection agency. Insufficient data package information to establish the status of hardware, or a lack of contractor/government certification and acceptance stamps, will require that a letter of waiver be prepared.
by the contractor for the applicable program office approval prior to the use of the equipment at KSC. A copy of this waiver will be inserted in the data package. This requirement also applies to end items and components which are shipped separate to KSC.

3.2.2 Request for Use of Non-Conforming Material

A departure from End Item Specification requires an approval from NASA in the form of a waiver.

3.2.3 Failure Reporting

The contractor is required to report significant failures to the developing government agency. This form can either be specified in the contract or again can become a contractor/NASA agreement.

3.2.4 Temporary Installations and Removals

The contractor must establish a system for maintaining a record of all temporary installations and removals of all flight equipment into the spacecraft, and also a record of all permanent installations and removals of flight equipment.

3.2.5 Material Review

The contractor must establish a system to review material with NASA in order to determine scrap, repair/rework or "use as is" action.

3.2.6 Equipment Parts Tag

A parts tag is to establish inspection verification of the flight and ground support equipment and is attached to the equipment at completion of receiving inspection. This tag remains attached until installation into the spacecraft. NASA/KSC can supply this tag if necessary.

3.2.7 Work Schedule

The contractor will prepare and submit work and test schedules which will permit adequate planning between contractor and NASA.

3.2.8 Flight Readiness Review Report (FRR)

The contractor is required to present a written report at some designated point in time prior to launch. This written report is to be presented to the mission director.
and is to give an account of the history of the
operations on the flight equipment, the equipment
problems encountered and how they were resolved.
The FRR is attended by all involved NASA and
contractor groups and is the last formal meeting
to determine if all systems are acceptable for
flight.

3.2.9 Contractor Procedures

The contractor shall provide NASA with a copy of the
applicable Quality Assurance procedure and instructions,
and process specifications to be used at KSC. Areas of
operations which require further clarification will be
defined by local procedures/agreements generated at KSC
and approved by NASA/KSC.

3.2.10 KSC Safety Requirements

The contractor will provide to KSC-Safety information
as delineated in Kennedy Management Instruction No.
KMI 1710.1, Appendix A.
APPENDIX A

TITLE: Work Authorization - TPS

1. PURPOSE

To establish one document for authorizing planned testing and related work on spacecraft equipment and its associated ground support equipment at KSC.

2. FORMS

2.1 Test Preparation Sheet (TPS, KSC Form 4-46) (Sample attached)

3. DEFINITIONS

3.1 Test Preparation Sheet - TPS

A document which authorizes work, provides engineering instruction, establishes a method of control, establishes a historical record, and facilitates inspection under the two categories defined below:

3.1.1 Type "A" TPS

Required to authorize work involving a change of configuration to flight equipment or its related ground support equipment (GSE) and as called out in paragraph 4.1.

3.1.2 Type "B" TPS

Required to authorize all other planned work and tests of flight equipment and related GSE, except operations authorized by specific agreements between contractor and NASA.

3.2 Configuration Change Panel (CCP)

A joint NASA/Contractor panel established to evaluate configuration changes (Type "A" TPS's) for approval or disapproval.

4. GENERAL REQUIREMENTS

4.1 Type "A" Application is required for the following:

4.1.1 To perform work (fabrication/installation) on a newly released drawing or drawing changes, not reflected in the Acceptance Data Package.
4.1.2 To accomplish a configuration change prior to release of a Contractor Engineering Directive or Order (EO). The TPS must remain open until EO/TPS compatibility is verified and the EO number is entered on the TPS.

4.1.3 Voiding an existing "A" Type TPS, or released EO requires a new "A" Type TPS. The TPS will reflect EO(s) or superseding EO(s) which "correct the effectivity of the initial document."

4.1.4 To authorize all S/C electrical disconnects after Flight Readiness Test (FRT).

4.2 **Type "B" Application** - is required for the following:

4.2.1 To initiate tests per established OCP's. Supplemental steps (e.g., special pre-test requirements) may be entered on the TPS as necessary.

4.2.2 To perform special test not covered by OCP's. A special test TPS may refer to specific OCP paragraphs, contractor specifications or supplier documents which will be used as test procedures, including any supplemental steps required to perform the test. Approval of the TPS will constitute approval of the entire test package. Special tests will be completed step-by-step with approval, acceptance and closeout per this procedure. Test modification and changes will be continued on additional TPS sheets (numbered). A copy of all discrepancy reporting documentation and all numbered TPS Sheets will be filed with a copy of the TPS and associated test documents in the appropriate data package. A TPS Sheet will be used to summarize the results of the test and Systems Engineering acceptance.

4.2.3 To authorize temporary installations. The subsequent removals must be specified and accomplished by the installing TPS.

4.2.4 To assemble, install, clean, validate, and service ground support equipment. Sketches of the parts will be on the TPS or on a separate sheet. Release of the TPS will constitute release of the sketch.

4.2.5 To remove/reinstall flight equipment for access, repair, bench testing, replacement, etc. In addition to removal/installation instructions, the TPS will detail such requirements as handling, transportation, location, method, processing agency, etc., or reference an OCP or other specification which covers these items.
4.2.6 To move or transport the flight equipment and critical items of GSE. The TPS will reflect securing, towing speed, equipment required for transport/hoisting, safety precaution, etc., or reference an OCP or other specification which covers these items.

4.3 S/C Weight Data

Any work altering the flight weight by 0.1 pound or more requires the weighing and recording of weights of the items involved.

4.3.1 The responsible Inspector assures that parts are weighed as specified on the TPS, enters weight data and related information in the appropriate control book.

5. RESPONSIBILITIES AND HANDLING

5.1 Initiation may be by anyone (normally a Contractor Engineer) who will:

5.1.1 Prepare a separate TPS for each unrelated task.

5.1.2 Assure that the TPS is designated Type "A" or Type "B" in accordance with definitions.

5.1.3 Assure that the TPS, in conjunction with referenced (and accompanying) EO's, etc., provides information including associate Contractor's TPS's if required. Provide sufficient details to:

5.1.3.1 Accomplish work in proper sequence.

5.1.3.2 Provide for inspection verification of each operation.

5.1.3.3 Define special tools and equipment as required.

5.1.3.4 Define required hardware by part number and serial number, if applicable.

5.1.3.5 Define traceability and qualification requirements, if applicable.

5.1.3.6 Define the requirement for retest when a functional component or system has been violated, i.e., replacement of part(s), disconnecting fittings or connectors, altering circuits, etc. Retest may be immediate or be verified during a future OCP. In any case,
the retest entry must delineate the specific data required to verify the functional integrity of the item(s).

5.1.3.7 Define test constraint/accomplishment date, if applicable.

5.1.3.8 Define S/C weight recording requirements, if applicable.

5.1.3.9 Define safety precautions and procedures to be followed while working the TPS including such "Caution" and "Warning" notes that are required or necessary to ensure safety to personnel and hardware.

5.1.3.10 When the TPS authorizes the accomplishment of one or more EO's enter each EO number on a separate line of the first page of the TPS so that individual EO acceptance can be affected as accomplished.

5.1.3.11 Reinstall all hardware removed during performance of the work outlined.

5.1.3.12 Specify packaging and routing of items removed for further action.

5.1.3.13 Define only those steps to be performed when testing to a given specification.

5.1.3.14 When potting or bonding is required, list the NASA approved specification applicable, class and application.

5.1.4 Insure that the Safety Office is advised of and given the opportunity to review all TPS's that contain or include critical operations such as handling of ordnance, cryogenics, toxic propellants, high pressure gases, large components of the S/C, etc.

5.2 TPS Approval Signatures

This is specified by letters of agreement between NASA and various contractors.

5.3 Indexing and Work Accomplishment

The means of control and accounting TPS's will be specified in letters of agreement between NASA and the various contractors.
5.4 **TPS Modification**

5.4.1 A TPS Modification may be initiated to revise, add or delete unworked portions of a TPS providing it does not change the intent, or bought-off portions, or the original document. If the intent is changed, a new TPS is required.

5.4.2 A TPS Modification is initiated by writing "Modification" across the top of a TPS form.

5.4.3 Approval of TPS Modifications will be in accordance with letter of agreement between NASA and contractor. All Mods will be listed on the original TPS before it is closed out.

5.5 **TPS Voiding and Supersedure**

5.5.1 An entire unworked TPS may be voided only by initiation of a new (voiding) TPS of the same type (A or B) as the original.

5.5.2 The unworked steps of a partially completed TPS may be voided via a Modification TPS described in 5.4.2.

5.5.3 Supersedure must be accomplished by a new TPS in all cases.

5.5.4 A new TPS superseding a partially worked TPS must return the worked items to their original configuration unless specified by the superseding TPS.
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**PANT** WEIGHED & MARKED IF REQUIRED

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APPENDIX B

TITLE: Operational Checkout Procedure

1. PURPOSE

To establish the procedure for the preparation, processing, release and use of Operational Checkout Procedures (OCP).

2. SCOPE

This procedure applies to tests involving flight and associated ground equipment.

3. REFERENCE DOCUMENTS

3.1 Work Authorization - TPS (KSC Form 4-46)

4. DEFINITIONS

4.1 Operational Checkout Procedure
An engineering document that provides detailed instructions to personnel for operational checkout and verification of equipment at KSC.

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

5. GENERAL REQUIREMENTS

5.1 OCP's are to: (1) provide detailed step-by-step delineation of required personnel activity for the sequential operation, assembly, handling, servicing and testing of system(s) involved; (2) provide system(s) specification data alongside the recorded data; (3) provide for NASA/Contractor Engineering and Inspection acceptance; (4) provide information for safety of personnel and equipment.

5.2 Operational Checkout Procedure cover sheet will provide for: title of the test or operation; places for contractor and NASA signatures; date of effectivity of the document and OCP No.
5.3 Contractor will provide a form for listing OCP deviations as they occur during testing.

5.4 Contractor will provide a form for listing all test discrepancies in sequence as they occur during testing.

6. RESPONSIBILITY AND HANDLING

6.1 Preparation, Approval and Release

6.1.1 The preparation of an OCP for tests where the equipment does not interface other contractor equipment functionally is the responsibility of the flight equipment contractor.

6.1.2 Preparation of an OCP for flight equipment that will functionally interface another contractor's equipment will be the responsibility of a designated prime S/C contractor. Procedural information to the prime contractor must be in the KSC standard document format.

6.1.3 Usage of established OCP's will be authorized by a Type "B" TPS.

6.2 Deviations and Changes to OCP

6.2.1 Deviations to the published OCP will be denoted on a OCP deviation sheet at time of occurrence by contractor engineering. NASA approval of a deviation is required prior to test continuation.

6.2.1.1 All deviations will be recorded and will become an official part of the record copy OCP.

6.2.1.2 Deviations that should be incorporated in like OCP's for future OCP's should be marked permanent and later incorporated into the applicable OCP. Deviations that are "one time only" items are recorded on the deviation sheet as temporary deviations. No further action is required on temporary deviations.

6.3 The contractor will review all OCP's for technical accuracy and submit same to NASA in sufficient time for review and approval.

6.4 Open Item Review

6.4.1 An open item review, prior to performance of an OCP, will be held by the contractor and NASA Engineering.

6.4.2 Contractor and NASA Engineering must approve the Open Items, if any, prior to conducting the test.
6.5 **OCP Test Summary**

Contractor Engineering will prepare a test summary after OCP completion. This summary sheet will accompany the record copy of the OCP. If no test summary deviation sheet is provided in the OCP, the OCP test summary and its deviations will be written on the TPS authorizing the test.

6.5.1 Test Summary should include all major problems with the following description:

- **6.5.1.1 Corrective Action**
- **6.5.1.2 When occurred**
- **6.5.1.3 Sequence**
- **6.5.1.4 Applicable TPS's and Test Discrepancies**

6.5.2 Summary should include reruns necessary to accomplish a given sequence of tests successfully.

6.6 **OCP Acceptance Criteria**

Following the completion of each OCP, NASA/Contractor Inspection will close out the record copy OCP after all the steps have been completed as defined:

- **6.6.1 Deviations have been recorded and approved.**
- **6.6.2 OCP Test Summary sheet has been completed and signed by NASA/Contractor.**
- **6.6.3 Test discrepancies are either closed out or transferred to a DR classification.**
APPENDIX C

TITLE: NASA Discrepancy Recording System

1. PURPOSE
   This procedure provides instructions for recording, dispositioning and maintaining records of all discrepant conditions.

2. FORMS
   2.1 Discrepancy Record, (DR, KSC 4-21) (Sample attached).
   2.2 Discrepancy Record Continuation Sheet (KSC 4-22) (Sample attached).

3. SCOPE
   This procedure covers all discrepant conditions related to flight equipment and its associated GSE at KSC.

4. DEFINITIONS
   4.1 Discrepancy
      A defect or departure from drawing, specification requirement or quality standard.
      4.1.1 Minor Discrepancy
      Any deficiency which can be returned to drawing configuration without engineering disposition, e.g., workmanship items, string ties, oversize clamps, unclean areas, past due calibrations, etc. This discrepancy is sometimes referred to as a squawk. What constitutes a squawk will be locally agreed upon between contractor and NASA QC.
      4.1.2 Significant Discrepancy
      A discrepancy that requires engineering evaluation.

5. GENERAL REQUIREMENTS
   5.1 Significant discrepancies are recorded on the DR Form, dispositioned and signed by flight equipment contractor with signature concurrence by NASA Systems Engineers. The Contractor shall provide a means of keeping a log on all DR's.
5.2 Discrepancies that arise during the course of systems testing are recorded on the DR Form and are identified as Interim DR’s (IDR) if the classification of the discrepancy is not known. After investigation or troubleshooting the IDR is transferred to some appropriate classification, i.e., flight equipment problem, GSE problem, personnel error problem, etc. Disposition and classification is made by the contractor with signature concurrence by NASA Engineering.

5.3 All DR (KSC 4-21) discrepancy reporting documentation shall be distributed by Contractor Quality Control to NASA Quality Control.

6. RESPONSIBILITY

6.1 Minor Discrepancies (sometimes referred to as squawks)

6.1.1 Initiation is by Contractor/NASA Quality Control who will:

6.1.1.1 Record the squawk in the discrepancy section of the contractor's squawk record.

6.1.1.2 Verify rework is to applicable drawing.

6.2 Significant Discrepancies (DR)

6.2.1 Initiation is by flight equipment Contractor/NASA QC personnel who will:

6.2.1.1 Complete the discrepancy portion of the DR Form (Block 1 through 23).

6.2.1.2 Assure that a separate DR is initiated for each discrepancy involving more than one end item. Multiple mechanical discrepancies on a single end item may be listed on one DR; however, only list one functional discrepancy on a DR.

6.2.1.3 Assure that all applicable documents (drawings, datafax, etc.) are referenced on the DR.

6.2.1.4 Obtain the next sequential DR number from the applicable control book or source.

6.2.1.5 Notify the flight equipment Contractor/NASA Engineering of DR initiation.

6.2.1.6 Place acceptance stamp and date adjacent to all changes or corrections in the discrepancy section.
6.2.2 Disposition is by flight equipment contractor engineers who will:

6.2.2.1 Complete the engineering disposition sections (Blocks 24-31).

6.2.2.2 When the problem requires troubleshooting, accomplish same in accordance with 6.2.5.

6.2.2.3 When a malfunctioned part is removed per a DR disposition, a subsequent step will be added to the DR that shall specify the disposition of the removed part.

6.2.2.4 Assure that those dispositions which allow minor deviations from specification, including "USE AS IS" is accompanied with suitable background information.

6.2.2.5 Assure that configuration changes are not affected by DR disposition. If configuration change is necessary, Type "A" TPS action is also required.

6.2.2.6 Stipulate the requirement for retest when a functional component or system has been violated, i.e., replacement of part(s), altering circuits, etc. Retest may be immediate or later but should be specified on the DR.

6.2.2.7 Enter his signature and date directly below the disposition and obtain the concurrence signature of NASA systems engineer.

6.2.3 Acceptance is by flight equipment contractor Quality Control who will:

6.2.3.1 Assure that the discrepant condition has been corrected per the DR disposition.

6.2.3.2 Assure that a TPS, or other documents generated to correct the discrepant condition(s) is closed and that a brief description of the action taken is referenced on the DR.

6.2.3.3 Assure that the proper engineering signature appears in the disposition block.

6.2.3.4 Affix acceptance stamp opposite each line item and present to NASA Inspection for acceptance.
6.2.3.5 Signify final acceptance of the DR by affixing acceptance stamps in the lower right hand corner of the DR and present to NASA Inspection for acceptance.

6.2.3.6 Affix acceptance stamps and date the closeout entry in the DR log of the flight equipment contractor.

6.2.4 Voiding DR is accomplished as follows:

6.2.4.1 Contractor QC will enter "VOID" and state the reason in the disposition section above the final acceptance block of the DR. He will sign the statement and obtain his NASA QC counterpart's signature (if applicable).

6.2.4.2 DR's which have been dispositioned may not be voided without the concurrence and signatures of the personnel signing the original disposition.

6.2.5 Troubleshooting is accomplished as follows:

6.2.5.1 Troubleshooting operations shall be documented and accepted on IDR or DR Continuation Sheet(s). Each page will carry the related DR and/or IDR number as applicable and the pages numbered sequentially, normally starting as the second page of a DR/IDR.

6.2.5.2 The Contractor Engineer will enter "Troubleshoot per continuation sheet(s) instructions" in the Disposition Section of DR or IDR, sign the statement and obtain the concurrence signature of the NASA Engineer. If troubleshooting is to be performed later, Contractor Engineering shall denote this in the disposition column and state "No test constraint" and obtain NASA Engineering approval prior to continuing on with test operations.

6.2.5.3 The Contractor Engineer or his designee will enter on the continuation sheet(s) each step taken during the troubleshooting operation. If specific sequence of an OCP or TPS are used as part of the procedure each sequence shall be called out as a separate step.
6.2.5.4 The Contractor Engineer will co-sign following the final step of troubleshooting, enter a statement of conclusion in the disposition section of the DR/IDR and obtain NASA Engineering signature concurrence.

6.3 Discrepancies during Testing (IDR)

6.3.1 Instructions to initiator of IDR.

6.3.1.1 Restrict usage of the IDR to those problems previously defined as "test discrepancies." Do not write more than one functional problem on an IDR.

6.3.1.2 Have IDR entered in the IDR log record.

6.3.1.3 Describe the problem in the discrepancy section of a DR Form and enter "IDR NO ___" above the CATEGORY block and record on the IDR the ref. document (TPS number) in Block 9. The remaining blocks are to be filled out when the IDR is categorized flight equipment, GSE, etc. The disposition space on the first page of an IDR or DR is to be used for the disposition only. Write troubleshooting steps on the continuation sheets. A statement on the first page shall denote "troubleshoot per continuation sheet."

6.3.1.4 Advise the responsible Systems Engineer of IDR initiation.

6.3.2 Disposition is by Contractor Systems Engineers who will:

6.3.2.1 When cause of a discrepancy is not known, accomplish troubleshooting to isolate the problem.

6.3.2.2 With the source of the problem established classify the IDR as flight equipment, GSE, etc. Enter the final conclusion under the disposition section of the first page and obtain the NASA Engineer's concurrence.

6.3.2.3 When classified as "Flight Equipment" or "GSE," disposition in accordance with paragraph 6.2.2. When disposition is transferred to either of the aforementioned - state on the first page in the disposition block "Transferred to Category______ DR Number_______."
6.3.2.4 When classified to a category other than "Flight Equipment" or "GSE", the reason for the classification will be clearly stated in the Systems Engineer's disposition.

6.3.2.5 Sign the disposition and obtain the NASA Systems Engineer's concurrence signature.

6.3.2.6 Processing of discrepancies across an associate contractors interface will be defined by individual letters of agreements.

6.3.3 Acceptance is by Contractor QC who will:

6.3.3.1 Assure that each IDR has been properly classified.

6.3.3.2 Acceptance stamp the transfer and/or complete block when the IDR is accepted or has been converted to a DR and present to NASA Inspection for acceptance.

6.3.3.3 File the closed (accepted) hard copy of the DR recorded during the OCP test, in the applicable log book.

6.3.3.4 Contractor Inspection is responsible to notify NASA Inspection of impending operations requiring NASA acceptance, and NASA will either witness or waive the requirement.

6.4 NASA Approval and Acceptance Functions (Engineering)

6.4.1 NASA Engineers shall approve, by signature, the following dispositions: (Note: approval signature may be obtained via telecon if necessary. The approvers name, date and the Contractor Engineer who obtained the approval shall be entered on the DR).

6.4.1.1 All flight equipment DR's and IDR's (including troubleshooting conclusions).

6.4.1.2 All GSE DR's and IDR's (including troubleshooting conclusions).

6.4.2 NASA Inspection shall verify, by acceptance stamp, the following dispositions:

6.4.2.1 All flight equipment DR's and IDR's (including troubleshooting conclusions).

6.4.2.2 All GSE DR's and IDR's (including troubleshooting conclusions).
NASA - KSC
DISCREPANCY RECORD

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20. INITIATOR'S SIGNATURE

21. STAMP NUMBER

22. ORGANIZATION AND LOCATION

23. DATE

ENGINEERING DISPOSITION

24. MR ACTION REQUIRED

25. CONTINUATION SHEET REQUIRED
   (KSC FORM 4-02)

26. SCRAP TAG NO.

27. REPLACEMENT PART NO.

28. SERIAL NO.

29. SYSTEM RETEST REQUIRED

30. FAILURE ANALYSIS REQUIRED

31. OTHER SYSTEMS AFFECTED

32. RETEST ACCEPTED

DATE

ITEM NO.

DISPOSITION

ITEM REWORK

ITEM ACCEPTANCE

SHOP STAMP

CONTR. NASSA

FOR FURTHER DISPOSITION OR CHANGE IN DISPOSITION, USE ADDITIONAL COPIES OF THIS FORM.

FINAL ACCEPTANCE

DATE

SHOP

CONTR.

NASSA

DISCREPANCY COPY
<table>
<thead>
<tr>
<th>1.</th>
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<tbody>
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<td>IDR NO.</td>
<td>D.R. NUMBER</td>
<td>CONTINUATION SHEET</td>
<td>PART NAME</td>
<td>CONTRACTOR PART NO.</td>
<td>SERIAL NO.</td>
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</table>

For further disposition, or change in disposition, use additional copies of this form.

Discrepancy Copy
Discrepancy Record Forms Guide (KSC 4-21)

All blocks on this report must have a specific entry or "N/A" (not applicable), except as noted to leave blank. No part of the discrepancy or disposition shall be written on the back of the record.

Block 1  Enter category (ref. Appendix A). Include general category and in the case of GSE, the model and serial number (ref. Appendix B).

Block 2  Enter the number of the DR.

Block 3,4  Enter contractor, part name, and number. Use lowest assembly name and number to which a discrepancy could be attributed at the time of the occurrence.

Block 5  Enter serial number as listed on nameplate or component body.

Block 6  Enter assembly or installation drawing number or next higher assembly number.

Block 7,8  Enter the supplier or manufacturer and the supplier or manufacturer's part number.

Block 9  Enter document which authorized the operation during which the discrepancy was found (i.e., OCP, TPS number). Include paragraph number reference.

Block 10  Enter total operating time (hours, minutes, seconds) or total cycles when available. If required, but not available, enter unknown or "U/K".

Block 11,12  Contractor Inspection will enter required fault, function, disposition, cause, origin, and system codes.

Block 13,14,15

Block 16  Enter the number of the Inspection Withholding Tag (red) when required.

Block 17  N/A

Block 18  N/A

Block 19  Enter Failure Report number when applicable.

Discrepancy: Enter a description of the discrepancy in a clear, concise manner. Multiple discrepancies concerning one part may be listed on one record. Discrepancies shall be recorded by steps; i.e., (1), (2), (3), etc.
Block 20  Initiator's name.

Block 21  Initiator's stamp impression or number.

Block 22  Organization of initiator. e.g., Department Number, Room Number and Facility Building as applicable.

Block 23  Date.

Block 24  Engineering will determine the requirement for material review action and will check "Yes" or "No" as applicable.

Block 25, 26, 27, 28  Leave blank.

Block 29  Engineering will determine requirement for retest and check appropriate block.

Block 30, 31, 32  Leave blank.

Final Acceptance  Contractor Inspection will date and stamp the final acceptance block after all blocks are completed.
PROBLEM AREAS

1. S.O.S. TESTING
2. COMMUNICATIONS WITH BENDIX
3. GEOPHONE CONFIGURATION AND TEST INADEQUACIES
4. GEOTECH'S LOG COMPRESSION AND QUANTIZATION LEVELS
5. PARTICLE BLOW-OUT FROM THUMPER
6. SUBSYSTEM AND SYSTEM TEST INADEQUACIES
MAJOR ASE ACCOMPLISHMENTS

- GLA TESTED SUCCESSFULLY IN SHOCK AND VIBRATION.
- CENTRAL ELECTRONICS INTEGRATED WITH SYSTEM.
- THUMPER TEST FIRED SUCCESSFULLY AT MSC.

- TEST PLAN COMPLETED
- WSTF FIELD SITE SELECTED
- OCP'S FOR WSTF IN PREPARATION
- WSTF FIELD TEST HARDWARE IN PROCESS
- KSC RANGE SAFETY DOCUMENT FOR ASE PREPARED
ASE MORTAR PACKAGE (WSTF NO. 1)
## ASE Schedule

<table>
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<th>Event</th>
<th>March</th>
<th>April</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>August</th>
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<tr>
<td>Ready for System Integration</td>
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<tr>
<td>Ready for System Integration</td>
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4422-2381
PSE LONG PERIOD VERTICAL SEISMMOMETER
PSE LONG PERIOD VERTICAL SEISMMOMETER ASSEMBLY
<table>
<thead>
<tr>
<th>PSE SCHEDULE</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
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<tbody>
<tr>
<td><strong>EM-2 (LGO UNIT)</strong></td>
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<td><strong>Prototype</strong></td>
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<td><strong>Design Verification</strong></td>
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<td><strong>Qualification</strong></td>
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<td>17</td>
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<td><strong>Flight</strong></td>
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</table>

4422-2361
MAJOR PSE ACCOMPLISHMENTS

- EM-2 VIBRATION TESTED.
- EM-2 FUNCTIONALLY TESTED: ACCEPTANCE TESTS IN PROCESS
- PROTOTYPE CSE COMPLETED
- PROTOTYPE SENSOR 85 PERCENT COMPLETE
- IN FABRICATION: DESIGN VERIFICATION MODEL QUALIFICATION MODEL #1
- BENDIX ASSISTANCE TO TELEDYNE
  - PROGRAM MANAGEMENT
  - PARTS PROCUREMENT

4422–2362
## PSE PHYSICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>WEIGHT (POUNDS)</th>
<th>TARGET</th>
<th>LATEST REPORTED</th>
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<tbody>
<tr>
<td>SENSOR</td>
<td>17.15</td>
<td>15.43</td>
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<td>CENTRAL STATION</td>
<td>4.10</td>
<td>4.14</td>
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<td>ELECTRONICS</td>
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<td>THERMAL CONTROL</td>
<td>0.25</td>
<td>0.12</td>
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<tr>
<td>LEVELLING STOOL</td>
<td>24.00</td>
<td>22.19</td>
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<table>
<thead>
<tr>
<th>VOLUME</th>
<th>9 in DIAMETER BY 12 in HIGH 130 cu. in.</th>
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4422–2363
### PSE PHYSICAL SPECIFICATIONS (CONTINUED)

**POWER (WATTS)**

<table>
<thead>
<tr>
<th>Component</th>
<th>Power (Watts)</th>
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<tbody>
<tr>
<td>ANALOG ELECTRONICS</td>
<td>1.02</td>
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<td>DIGITAL ELECTRONICS</td>
<td>1.21</td>
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<td>HEATER</td>
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<td>LEVELLING</td>
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**FUNCTIONAL POWER (INCL. CONVERTER LOSS)**

<table>
<thead>
<tr>
<th>Component</th>
<th>Power (Watts)</th>
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<tbody>
<tr>
<td>PLUS THERMAL HEATER</td>
<td>5.35</td>
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<td>PLUS LEVELLING</td>
<td>7.20</td>
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4422-2364
HFE ENGINEERING MODEL PROBE
HFE ENGINEERING MODEL PROBE (FOLDED POSITION)
# H. F. E. Deliverable Hardware Schedule

<table>
<thead>
<tr>
<th>Event</th>
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<tbody>
<tr>
<td>Prototype Electr. Del.</td>
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<tr>
<td>Assy-Test (ADL)</td>
<td>6/22</td>
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<tr>
<td>ALSEP Verif. Tests (BxA)</td>
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<tr>
<td>Integration</td>
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<td>DES Verif. Test</td>
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<tr>
<td>Qual. Electr. Del.</td>
<td>6/12</td>
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<tr>
<td>Assy-Test (ADL)</td>
<td>7/3</td>
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<tr>
<td>ALSEP Verif. Tests (BxA)</td>
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<td>Integration</td>
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<tr>
<td>Accept. Test</td>
<td>8/14</td>
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<td>Qual. Test</td>
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<tr>
<td>Flight Del to BxA.</td>
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</tbody>
</table>

1967

- May: 5/18
- June: 6/22
- July: 7/28 (B), 7/24 (2nd Qual.)
- August: 8/14
- September: 9/1 (B)
- October: 10/13
- November: 11/3
- December: 12/2 (B), 11/10 (B), 1/14/68 (B)

1968

- January: 4/29, 8/1, 10/13, 11/3, Flt. #4

**FLIGHT DEL TO BxA.**

**4422-2333**
# H.F.E. Development Schedule

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<tr>
<th>Activity</th>
<th>Date</th>
<th>Month</th>
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<tr>
<td>H. F. Thermal Model</td>
<td>3/28</td>
<td>March</td>
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<tr>
<td>PROCUR./FAB/ASSY/SHIP</td>
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<tr>
<td>Thermal Test at Boulder, Colo.</td>
<td>4/24</td>
<td>April</td>
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<tr>
<td>H. F. Structural Model</td>
<td>4/14</td>
<td>April</td>
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<td>PROCUR./FAB/ASSY.</td>
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<td>Structural Tests</td>
<td>4/18</td>
<td>April</td>
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<td>H. F. Eng. Model #1</td>
<td>3/23</td>
<td>March</td>
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<td>ADL Del. to BxA</td>
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<tr>
<td>ALSEP Array (B) Eng. Model</td>
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<td>Integration</td>
<td>4/28</td>
<td>April</td>
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<td>CAT 2 THRU 4</td>
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<tr>
<td>H. F. Eng. Model #2</td>
<td>5/8</td>
<td>May</td>
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<td>Elect. Del</td>
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<td>Eng. Calib.</td>
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<tr>
<td>Test at ADL.</td>
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<tr>
<td>(Unit not req'd at BxA)</td>
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<td>12/15</td>
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4422–2332
### Master Schedule for CPLEE Calibration

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<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUNE</th>
<th>JULY</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
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<tr>
<td>Vacuum System Delivered</td>
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<td>Vacuum System Checked Out</td>
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<td>UV Source Delivered</td>
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<td>UV Source Calibration</td>
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<td>Command &amp; Control Unit Comp.</td>
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**CPLEE PROGRAM SCHEDULE**

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- READY FOR ARRAY B INTEGRATION
- DELIVERY TO BxA

4422-2341
CPLEE ENGINEERING MODEL

TEST RESULTS (CONTINUED)

• ALL TESTS PERFORMED WITH CPLEE OPERATING IN ETS VACUUM CHAMBER
• ALL ELECTRONIC CIRCUITS AND DETECTORS WERE OPERATED
• OPERATION OF HIGH VOLTAGE POWER SUPPLIES DID NOT AFFECT INTERFACE CIRCUIT PERFORMANCE
• ONE DISCREPANCY THAT DID NOT OCCUR WITH ETS
MAJOR CPLEE ACHIEVEMENTS

1. COMPLETED ENGINEERING MODEL SUBSYSTEM TESTS

2. COMPLETED CATEGORY 1 & 2 SYSTEM INTEGRATION TESTS

3. COMPLETED CATEGORY 4 TESTS IN ARRAY A-3 CONFIGURATION

4. COMPLETED DESIGN AND FABRICATION OF PROTOTYPE
CPL EE ENGINEERING MODEL TEST RESULTS

SUBSYSTEM TESTS WITH EXPERIMENT TEST SET

- Tests were performed under ambient pressure and vacuum conditions
- All electronic circuits and detectors were operated
- No degradation of interface circuit performance under vacuum conditions
- Four test discrepancies
KEY MILESTONES

DEVELOPED M-4 MOCKUP SYSTEM
DEVELOPED MOD 14 FUNCTIONAL SYSTEM
DEVELOPED M-5 MOCKUP SYSTEM
DEVELOPED CAPSULE COMPONENTS FOR FIRST FUELING
DEVELOPED CAPSULE COMPONENTS FOR FUELING OF SECOND CAPSULE
(FIRST FLIGHT UNIT)
INITIATED MOD 5 ENGINEERING GENERATOR LIFE TEST
COMPLETED FABRICATION AND PROCESSING OF MOD 15 QUAL
COMPLETED FABRICATION AND TESTING OF PRIME IPU CABLE AND
GENERATOR ATTACHMENT HARDWARE
DEMONSTRATED REPRODUCIBLE ELECTRICAL AND THERMAL PERFORMANCE
OF ENGINEERING GENERATORS
COMPLETED QUAL AND PRIME GROUND SHIPPING CASES
COMPLETED QUAL TESTING OF IPU TEST PANELS
INITIATED ASSEMBLY OF MOD 19 THERMOPILE (FIRST FLIGHT GENERATOR)
COMPLETED ENGINEERING STAGE DESIGN ON GRAPHITE CASK AND INITIATED
PROCUREMENT OF PROTOTYPES
COMPLETED DESIGN OF KSC HANDLING TOOLS AND FABRICATED MOCKUPS
ISSUED DRAFT OF SAFETY ANALYSIS REPORT
COMPLETED FABRICATION AND PLACED ON TEST THE FINAL SERIES OF
10 COUPLE MODULES (STABLE PERFORMANCE NOW DEMONSTRATED UP TO
6500 HOURS)
COMPLETED DESIGN OF M-6 AND M-7 MOCKUP SYSTEM
SIGNED GRAPHITE CASK INTERFACE SPEC
<table>
<thead>
<tr>
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<th>INITIAL POWER</th>
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**GENERATOR POWER OUTPUTS**

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FLIGHT HANDLING TOOL
FUEL CAPSULE LOADING SEQUENCE
PRIMARY METHOD
FUEL CAPSULE LOADING SEQUENCE
ALTERNATE METHOD
FUEL CAPSULE LOADING EQUIPMENT

- Capsule
- Transfer Cask
- Port Entry Trough
- Inspection Tool
- Torque Tool
- SLA Handling Tool