



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
WASHINGTON, D.C. 20546

REPLY TO  
ATTN OF: MAL

October 14, 1970

TO : Distribution  
FROM : MA/Apollo Program Director  
SUBJECT: Minutes of the Apollo Site Selection Board Meeting  
Held on September 24, 1970

Attached are the minutes of the subject meeting. It is not planned that there will be any further Apollo Site Selection Board meetings prior to the Apollo 14 mission.

*R. A. Petrone*  
Rocco A. Petrone

Enclosure

Distribution:

- MSC/PA/McDivitt
- CA/Slayton
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- ~~TJ/Gasser~~
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- PM-SAT-MGR/Smith
- MLT/Simmons
- Bellcomm/Wagner
- Hinners
- Boysen
- Hqs/MA/Stoney
- MA/Lee
- MO/Stevenson
- MAO/Holcomb
- MAL/Scherer
- MAL/O'Bryant

INDEXING DATA

DATE	OPR	#	T	PGM	SUBJECT	SIGNATOR	LOC
10-14-70	HQS		M	LEX	(Above)	PETRONE	075-44

# MINUTES OF THE APOLLO SITE SELECTION BOARD MEETING

Held at

Apollo Action Center  
955 L'Enfant Plaza North, S.W.  
Washington, D. C. 20024

September 24, 1970

The Apollo Site Selection Board met at NASA Headquarters on September 24, 1970. The meeting agenda is attached as Attachment A and attendees are listed in Attachment B.

## INTRODUCTION

Capt. Scherer noted that the objectives of this meeting are to select one firm site for Apollo 15, to select a tentative site for Apollo 16 (subject to reconsideration after the Apollo 14 flight), and to come up with a list of leading candidates for Apollo 17. Capt. Scherer spoke briefly of the concern of some scientists that more Apollo flights might be lost (in addition to the "old" 15 and 19) and the resulting tendency to select the 15 site as if it were the last mission. This, he (and others) felt, is an over-reaction - we must look at the total Program in considering the Apollo 15 site.

Capt. Scherer itemized points which all should bear in mind in the ensuing discussions:

1. The Bellcomm summary on factors affecting site selection provides a good kick-off point;
2. we must plan on an all-out Lunar Roving Vehicle (LRV) mission but keep in mind the possibility of a late LRV delivery or LRV failure - i.e., have a walking mission back-up capability at the selected site;
3. plans must be based upon the current schedule:  
    Apollo 15 - July '71  
    16 - Jan. '72  
    17 - June '72;

4. there is a requirement for at least three months accessibility; and
5. we do not believe that the surface experiments are decisive influences on specific site selection but they, and the orbital experiments, should be considered.

#### OPERATIONAL CONSIDERATIONS IN LANDING SITE SELECTION

J. R. Sevier presented the operational considerations affecting the site selection (Attachment C). His discussions focused on accessibility, landability, and photographic coverage for all leading candidate sites which include the five previously approved by the Board (Copernicus, Davy, Descartes, Hadley-Apennine, and Marius Hills) plus Tycho.

#### Accessibility

The constraints assumed by MSC are shown in Attachment C. Discussion on the relaxed free return indicated that the S-IVB will inject the spacecraft on a non-free-return trajectory such that the SM RCS can put it back on free-return within five hours. After transposition and docking, further departure from free-return is permissible up to the DPS capability for abort. In response to Dr. Petrone's question, it was noted that if separation does not occur, in about half the cases looked at one would have to use RCS + APS to achieve a free-return trajectory. Concerning maximum mission duration, it was pointed out that a T-24 launch adds a day to the 14.5 day mission on account of waiting a day in lunar orbit for the sun elevation to be right at the site. The T + 24 opportunity does not affect total duration because landing would occur at a higher sun ( $18^\circ - 25^\circ$ ) than nominal ( $7^\circ - 13^\circ$ ). On that point, MSC feels that there is no safety problem in landing at the higher sun since at ~500 feet altitude the crew can obtain a good look at the site, away from the 0 phase point, and can detect hazardous areas. However, if the trajectory is not on the center of the nominal ellipse, there might be a problem in getting to the desired science point. Col. McDivitt noted that there are tests by the CMP on Apollo 14 designed to shed light on this problem - that may not provide all the answers, however, and McDivitt expressed an opinion that the lighting problem will be with us until the end of the program.

The last constraint discussed was the one on maintaining a constant flight plan (lunar orbit ground track) for the three-month period. When Dr. Petrone noted that Apollo 14 is not so constrained, Jack Sevier pointed out that it is only the urgency in acquiring Descartes photography that resulted in the multiple flight plan. MSC is not in favor of doing such again. Dr. Petrone sympathized but noted that we would do it again given sufficient reason.

The accessibility summary indicated that Davy and Descartes are available for 15, 16 and 17 even with all constraints; Copernicus presents no great problem (reduced weather avoidance  $\Delta V$  in October '71 and a reduction in post-rendezvous science in November '71) and that Tycho is possible only in January - April '72 (Apollo 16). The fact that Tycho requires DPS + APS for abort and three days in lunar orbit before landing did not result in eager enthusiasm for the site. For reasons clarified later, discussion focused on Hadley and Marius in the Apollo 15 time slot (the 16 time frame is not good for either and the 17 period is no problem for either). Marius is accessible without restriction in July, August and September. October would require reduced weather avoidance  $\Delta V$  and allow only two days of post-rendezvous orbital science. A November launch would not allow any post-rendezvous orbital science. Concerning Hadley, July and August look good while September requires the reduced weather avoidance  $\Delta V$  and October requires, additionally, a new flight plan and reduced (to two days) post-rendezvous orbital science. It is not available in November. [Note: in the summary accessibility chart, the "circle" for Hadley in July is based on the patched conic trajectory. MSC believes the integrated trajectory will bring Hadley into the totally acceptable region.]

#### Landability

Jack Sevier reported that in general, of the six sites considered, Hadley, Marius, and Copernicus (northern touchdown point 4-5km from peaks) appear to have no bothersome approach and touchdown problems. The Descartes approach and touchdown were not evaluated on account of lack of photography. There appears to be no problem with the Davy approach but there is no data available to evaluate a touchdown point. A Tycho approach was not evaluated and MSC considers the touchdown area "poor" on account of the rolling terrain. Col. McDivitt took this opportunity to say that he would not agree to a Tycho mission. The crux of his thinking is why take a high risk when there are so many other, easier, interesting areas.

Discussion on landability specifics centered on Hadley and Marius. It was noted that at Hadley one has to avoid shadowed regions which results in desirable landing sites being significantly west of the mountains. Dr. Petrone inquired as to how one can do the Hadley planning since the landing site shown is off the high resolution photography. Sevier responded that at Hadley one can extrapolate from the nearby high resolution photography. At this point, Col. McDivitt noted that we would not extrapolate in a complex area (e.g., Descartes) and that the rille and mountains at Hadley make it quite easy to locate specific areas. Sevier went on to note that the final Hadley site is not fixed but that the one being looked at has good walking mission capability and a good medium resolution "n-number" of 0.73 (versus 0.69 in an equivalent area in the high resolution region). Regarding walking missions, D. K. Slayton asked if anybody proposes flying without the LRV. Dr. Petrone stated that we always want a fallback. A launch might be delayed one month to wait for the LRV but probably no longer (remember that the Skylab is constraining the other end of the Apollo schedule). Right now, however, it's Rover all the way.

Brief consideration of the Marius site indicated that it is acceptable but that the "n-numbers" are lower (0.54 middle site, 0.40 south site) than at Hadley.

Next, Sevier pointed out that the best "science site" at Copernicus has an "n-number" of 0.15 and requires a  $-70^\circ$  approach azimuth while the best MSC can do is  $-80^\circ$ . The only currently acceptable site is the northern one 4-5km from the peaks ( $n \approx 0.55$ ). That site requires an LRV since walking traverses must be kept to within  $\approx 2 \frac{1}{2}$  km of the LM.

### Photography

Photography was judged acceptable for Hadley, Marius, Copernicus and Tycho, and judged unacceptable for Descartes and Davy. Once more it was pointed out that the Apollo 14 mission is being torqued to get the Descartes photography.

A summary of the overall operational considerations is shown in Figure 1.

SITE	ACCESSIBILITY			LANDABILITY	AVAILABLE PHOTOGRAPHY
	15	16	17		
HADLEY	*	x	*	*	*
MARIUS HILLS	*	x	*	*	*
COPERNICUS	*	*	*	*	*
DESCARTES	*	*	*	?	x
DAVY	*	*	*	?	x
TYCHO	x	*, if constraints <u>relaxed</u>	x	?	*

\* ACCEPTABLE

x NOT ACCEPTABLE

? NOT EVALUATED

SUMMARY OF MAJOR OPERATIONAL CONSIDERATIONS

FIGURE 1

## SCIENTIFIC CONSIDERATIONS AND RECOMMENDATIONS

Mr. A. J. Calio briefly traced the recent history of the science input to site selection noting in particular the problem in getting a consensus at the last (augmented) GLEP meeting. He thus tried a new approach in which geologists, geochemists and geophysicists met as separate disciplinary groups. The geology group consisted primarily of the Swann (Apollo 14, 15) and Muehlberger (Apollo 16, 17) Lunar Geology Investigations Experiment Teams and was not overly constrained by operational considerations (their priorities are science priorities, not mission priorities). The geochemistry and geophysics groups, chaired by MSC, had operations personnel available for consultation. The group memberships and details on rationale are included in Mr. Calio's presentation material in Attachment D.

Two representatives from each disciplinary group plus appropriate MSC, NASA Headquarters and Bellcomm personnel met at MSC on September 21, 1970 to arrive at a consensus. The recommendations arrived at are shown in Figure 2 along with the summarized group priorities. [Note: Figure 2 does not agree in certain detail with Attachment D but includes minor amplification and corrections of Attachment D].

It is difficult to summarize all the rationale behind the MSC consensus position. Note, however, that there was a general desire of the geology and geochemistry groups to get two highland sites. Unfortunately, the second highland site (Davy) usually considered depends upon the Descartes mission to acquire the photography and, in turn, the Descartes mission cannot fly before Apollo 16 since it depends on Apollo 14 photography (it is not possible to "turn-around" in one mission). A combination of the strong affirmative geophysical support for Hadley (for reasons connected with geophysical networks, orbital coverage, and mascons), a low geochemical priority for Marius, and no walking mission at Copernicus resulted in the recommendation of Hadley for Apollo 15. The Descartes recommendation on Apollo 16 was non-controversial. Concerning Apollo 17, there was a fair amount of support for the possibility of getting a new highland site from the Apollo 14 and/or 15 photography.

Dr. Petrone, noting that Descartes appears to be a top priority in everybody's mind wondered how we best get the Descartes photography. He noted that we have only

SCIENCE SITE PRIORITIES

	<u>GEOLOGY</u> <sup>1</sup>	<u>GEOCHEMISTRY</u>	<u>GEOFYSICS</u>	<u>MSC</u>
15.	TYCHO (DESCARTES)	DESCARTES (COPERNICUS) (HADLEY)	HADLEY	HADLEY (COPERNICUS)
16.	DAVY	COPERNICUS (DESCARTES)	DESCARTES	DESCARTES
17.	MARIUS	DAVY (HADLEY) (MARIUS)	DAVY (MARIUS) <sup>2</sup>	MARIUS/COPERNICUS <sup>3</sup>

1. SCIENTIFIC PRIORITY WITHOUT CONSIDERATION OF OPERATIONAL CONSTRAINTS
2. PREFERRED - CHOSE DAVY FOR SUPPORT BY OTHERS
3. MIGHT PREFER NEW HIGHLANDS SITE FOR 17.

FIGURE 2

two opportunities on Apollo 14 - the T-0 launch in January '71 and on the T-24 opportunity for the March launch (second launch month). [See later discussion for more on this topic.]

#### APOLLO 14 PHOTOGRAPHIC COVERAGE

F. El-Baz briefly reviewed the photo plan for Apollo 14 with specific regard to bootstrap photography. Descartes will be photographed on a low orbit pass with the Hycon at  $\sim 1$  meter resolution at a sun angle of  $32^\circ$  ( $27^\circ$  the second month). That photography will cover a strip starting at the western rim of Nectaris and ending east ( $\sim 8 1/2^\circ$ ) of Fra Mauro. Later in the mission, another strip will be taken from the 60 nm orbit of the same general area (Descartes sun angle  $\sim 56^\circ$ ) but at  $\sim 5$  meter resolution.

El-Baz stated that Davy cannot be photographed on the Apollo 14 mission without a plane change and addition of two days to the mission (one more day in orbit and one more day in TEC). El-Baz went on to say that the 500 mm lens will be carried as a back-up only on the January launch opportunity. This results from the fact that on the March opportunity bootstrap photography is done before LM separation in which case the LM obscures the view from the CM window used for 500 mm photography.

#### DETAILED MISSION PARAMETERS FOR LEADING APOLLO 15 CANDIDATE SITES

R. Berry discussed SPS  $\Delta V$  reserves ( $3\sigma$  low) required for weather avoidance and LM rescue for both Hadley and Marius (viewgraph material is in Attachment E). He noted that of the 500 fps weather avoidance reserve, about 250 fps is for longitude control at EI-24 hr and which is a firm, mission independent requirement. The other 250 fps is for latitude and inclination control via TEI targeting. This latter amount is "negotiable" on a mission-to-mission basis since experience shows that "latitudinal weather" is sensibly predictable and can be accounted for at little cost at TEI. For Hadley, in July, August and September certain cases arise where one eats into negotiable weather avoidance reserves while for Marius in those same months there is no problem (at this point Berry mentioned that Marius presented a unique opportunity to get two nominal launch opportunities in one month - July 30 and July 31).

Both Hadley and Marius have sufficient reserves to meet the 600 fps  $\Delta V$  required for worst case LM rescue in the July-August-September period. In response to a question Berry pointed out that MSC does not carry reserves for both weather avoidance and worst case LM rescue.

For the month of October, of interest in case of schedule and/or launch delays, Hadley has weather avoidance  $\Delta V$  for the no post-rendezvous science case. The same is true for Marius which, in addition, could be flown with two days post-rendezvous science if return inclination is relaxed ( $>40^\circ$ ). Both Hadley and Marius look good on LM rescue reserves for October.

Berry finished his presentation with a discussion of Descartes bootstrap photography opportunities on a Marius Hills mission. The conclusions were that you can get Descartes at  $27^\circ$  sun angle (setting) on a three-day post-rendezvous science mission in July, August and September or at  $39^\circ$  on a two-day post-rendezvous science mission in July and August. Although the calculations were not done, Berry stated, in response to a question, that he thought one might get Descartes on a one-day post-rendezvous science mission (but at  $\sim 52^\circ$  sun which is getting marginal) in July and August. F. Bennett continued with a landability discussion (his material, except for site photographs, is included in Attachment F). The landing points being considered at Hadley do not appear to present problems since they allow clearance of the 8000 foot peaks to the east and are out of shadow for proposed launch dates (presumably July - September). Regarding the Marius Hills, Bennett noted that for the central landing point the nominal trajectory looks good. There is a potential problem with the northeast hill for cases of flight paths 2500 or 5000 feet north of nominal.

#### CONSIDERATION OF EFFECT OF 15 SITE ON 16 AND 17

A. P. Boysen, Jr. summarized site selection issues as follows:

1. Apollo 15 October launch availability (highly desirable);
2. Apollo 15 degree of dependence on LRV (want a walking mission capability);

3. Copernicus on Apollo 15, 16 or 17 (will MSC commit to Copernicus?);
4. Backup photography of Descartes for Apollo 14 photo failure (Descartes is top priority site); and
5. Desirability of second highland site (most scientists in favor of two).

Considering that Copernicus is not a walking mission under present circumstances and that Davy, Descartes and Tycho are not viable Apollo 15 candidates, Boysen suggested that the only real alternatives are as shown schematically in Figure 3. The right hand sequence, with Marius on Apollo 15, has the advantage that it is possible to recover from an Apollo 14 photography failure by photographing Descartes on the Marius mission and flying to Descartes on Apollo 17. Even with successful Apollo 14 photography that scheme would allow one to pick a second, possibly new, highland site from Apollo 15 photography of the central highlands. The left hand scheme, with Hadley on Apollo 15, does not offer a recovery position in case of an Apollo 14 photographic failure since the Hadley ground tracks do not fly over either Descartes or other accessible highlands (at proper sun angle). In both cases, however, if the Apollo 14 photography is not acquired one is left with Copernicus as the only reasonable site (of those considered) for Apollo 16.

#### MSC SUMMARY

Jack Sevier briefly summarized the MSC outlook for Apollo 15. Descartes and Davy are out of contention because of inadequate photography. Tycho is inaccessible and Copernicus is out since it requires the LRV and is the only Descartes backup site. Hadley and Marius are both acceptable. Sevier went on to compare Hadley with Marius as shown in Figure 4.

#### DISCUSSION

The discussion evolved around the relative merits of Hadley and Marius since there seemed to be general agreement with Boysen's and Sevier's summaries which eliminated Descartes, Davy, Copernicus and Tycho from consideration as viable Apollo 15 candidates. The points which follow below have been culled from over one hour of rather intensive deliberations - intensive because it was obvious that there was no single overwhelming discriminator among the factors considered.



	<u>HADLEY</u>	<u>MARIUS HILLS</u>
ACCESSIBILITY	ENDS AFTER OCT.	ENDS AFTER NOVEMBER
LANDABILITY	BETTER APPROACH & TOUCH-DOWN AREA	
PHOTO COVERAGE		CONTINUOUS HIGH RESOLUTION FOR TRAVERSE PLANNING
WALKING MISSION	ABOUT EQUAL	
ADDITIONAL BOOT-STRAP PHOTOGRAPHY		<ul style="list-style-type: none"> <li>•DESCARTES POSSIBLE AT 27° SUN - 3 DAYS AFTER RENDEZVOUS</li> <li>•MAY BE POSSIBLE 2 DAYS AFTER RENDEZVOUS, IF SPS PERFORMANCE PERMITS.</li> </ul>
SCIENCE	<ul style="list-style-type: none"> <li>•HIGH INCLINATION ORBIT FOR SATELLITE, SIM</li> <li>•ALLOWS S-IVB IMPACT FOR SEISMOMETER</li> </ul>	PREFER HOLDING FOR TRAVERSE SCIENCE

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COMPARISON OF HADLEY & MARIUS HILLS

FIGURE 4

1. On science merit, there appears to be no strong reason for selecting one site over the other. Hadley has an advantage in having a high latitude (for orbital science coverage and geophysical networks), in being on the edge of a mascon basin, and in possibly having pre-Imbrian rocks. Marius contains some of the youngest looking lunar material and lies athwart a great volcanic ridge system. Further, one is confident that at Marius, rocks can be found in situ on outcrops. Alternatively, both sites have some disadvantages. Hadley samples may partly duplicate some Apollo 14 samples and the Apennine front may be an indecipherable complex jumble of material. On the other hand, one can question the value of Marius volcanics in yielding information critical to the interpretation of the lunar interior composition. [The above is by no means an inclusive listing of science factors but is a representative sample of the more significant items.]
2. Both sites seem to have acceptable walking mission possibilities.
3. There seemed to be a consensus that whichever site is flown on Apollo 15, the other would not be flown on Apollo 17 (Copernicus or a new highland site would probably have priority).
4. Operationally, November is out for both sites but Marius has an edge with two launch opportunities in July and can be used with one flight plan through October. Hadley would need a new flight plan for October.
5. Copernicus is available as an Apollo 16 backup and/or an Apollo 17 prime mission. From an orbital science point-of-view one would not want to fly both a Marius and Copernicus mission because of ground-track overlap.
6. Davy bootstrap photography is not practical on a Marius mission since it would require remaining in orbit three days after rendezvous to get the photos at  $\sim 50^\circ$  sun angle.

7. The Program is leaning strongly towards concurrent orbital science with the objective of minimizing post-rendezvous staytime in orbit. Thus staying three days to get low sun (29°) Descartes photography on a Marius mission is not considered in a favorable light (one can, however, trade post-rendezvous staytime for sun angle. Topocom can handle sun angles up to ~55°).
8. On the general topic of photography, it appeared that there would be no problem in using pan camera photography from an Apollo 15 mission for use in selecting an Apollo 17 site.
9. MSC is concerned that if Marius is selected and Apollo 14 photography is successful there will be pressure put on them to change the flight plan - which they would not want to do at a late date (~March).

Dr. Petrone wrapped up the meeting by making the decision in favor of Hadley-Apennine for Apollo 15. The swaying factors were: the desire to keep post-rendezvous staytime to a minimum; a feeling that we've done our utmost already to get Descartes photography; that we have a scientifically acceptable backup site for Descartes (Copernicus); and that the high inclination of a Hadley mission on J-1 is a solid plus.

Dr. Petrone stated that we should go ahead with Descartes planning for Apollo 16. The only foreseeable thing which would change that is Apollo 14 photography failure. Apollo 17 is still open. Candidates include Marius, Copernicus and some new highland site.

ATTACHMENT A

APOLLO SITE SELECTION BOARD  
NASA HQ/APOLLO ACTION CENTER  
SEPTEMBER 24, 1970  
9 A.M.

AGENDA

- |    |  |                        |        |
|----|--|------------------------|--------|
| 1. | INTRODUCTION -   | CAPT. L. R. SCHERER/HQ | 10 MIN |
| 2. | SUMMARY OF OPERATIONAL CONSTRAINTS FOR<br>CANDIDATE SITES -          | J. R. SEVIER/MSC       | 30 MIN |
|    | ACCESSIBILITY<br>LANDABILITY<br>PHOTOGRAPHIC COVERAGE                |                        |        |
| 3. | SCIENTIFIC CONSIDERATIONS AND<br>RECOMMENDATIONS -                   | A. J. CALIO/MSC        | 45 MIN |
| 4. | APOLLO 14 PHOTOGRAPHIC COVERAGE -                                    | F. EL-BAZ/BELLCOMM     | 10 MIN |
| 5. | DETAILED MISSION PARAMETERS FOR LEADING<br>APOLLO 15 CANDIDATE SITES |                        |        |
|    | ACCESSIBILITY -  | R. L. BERRY/MSC        | 30 MIN |
|    | LANDABILITY -  | F. V. BENNETT/MSC      | 30 MIN |
| 6. | CONSIDERATION OF EFFECT OF 15 SITE<br>ON 16 AND 17 -                 | A. P. BOYSEN/BELLCOMM  | 15 MIN |

ATTACHMENT B

ATTENDANCE ASSB MEETING, SEPTEMBER 24, 1970

BOARD MEMBERS PRESENT

R. A. Petrone - NASA/MA  
L. R. Scherer - NASA/MAL  
C. M. Lee - NASA/MA  
W. D. Stoney - NASA/MAE  
J. D. Stevenson - NASA/MO  
  
A. L. Calio - MSC/TA  
J. A. McDivitt - MSC/PA  
D. K. Slayton - MSC/CA  
  
R. G. Smith - MSFC/PM-SAT-MGR  
F. A. Speer - MSFC/I-MO-MGR

BOARD MEMBERS ABSENT

M. G. Simmons - MSC/TA  
S. A. Sjoberg - MSC/FA  
T. W. Morgan - KSC/AP

OTHER PARTICIPANTS

B. Milwitzky - NASA/MAE  
W. J. Newman - NASA/MAB  
W. R. Preysnar - NASA/MAB  
T. H. Smith - NASA/MAB  
G. F. Esenwein - NASA/MAL  
J. B. Hanley - NASA/MAL  
L. J. Kosofsky - NASA/MAL  
W. T. O'Bryant - NASA/MAL  
F. I. Roberson - NASA/MAL  
W. H. Shirey - NASA/MAL  
P. J. Bayer - NASA/MAO  
D. E. Beck - NASA/MAO  
J. K. Holcomb - NASA/MAO  
C. H. King - NASA/MAT  
  
R. C. Hock - KSC/AA  
  
D. R. Scott - MSC/CB  
G. S. Lunney - MSC/FC  
F. V. Bennett - MSC/FM2  
R. L. Berry - MSC/FM5  
P. W. Gast - MSC/TN  
  
W. R. Perry - MSFC/PM-SAT-LRV

OTHER PARTICIPANTS (CONT'D)

D. R. Anselmo - Bellcomm  
M. K. Baker - Bellcomm  
R. A. Bass - Bellcomm  
P. Benjamin - Bellcomm  
A. P. Boysen, Jr. - Bellcomm  
F. El-Baz - Bellcomm  
D. G. Estberg - Bellcomm  
V. Hamza - Bellcomm  
J. W. Head - Bellcomm  
W. G. Heffron - Bellcomm  
N. W. Hinnens - Bellcomm  
T. B. Hoekstra - Bellcomm  
K. P. Klaasen - Bellcomm  
M. Liwshitz - Bellcomm  
J. A. Llewellyn - Bellcomm  
K. E. Martersteck - Bellcomm  
P. E. Reynolds - Bellcomm  
P. F. Sennewald - Bellcomm  
J. A. Sorensen - Bellcomm  
R. A. Troester - Bellcomm  
R. L. Wagner - Bellcomm  
  
G. Neary - Boeing