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DEPARTMENT OF THE AIR FORCE
OFFICE OF THE ASSISTANT SECRETARY

MEMORANDUM ~~HEXAGON~~

27 September 1966

MEMORANDUM FOR DR. FLAX

SUBJECT: HEXAGON SBA Source Selection Board

In addition to the bound report of the source selection board, Colonel Buzard left the attached memorandum to you from him summarizing certain critical aspects of each contractors proposal.

David L. Carter

DAVID L. CARTER
Colonel, USAF

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DEPARTMENT OF THE AIR FORCE
DIRECTORATE OF SPECIAL PROJECTS (OSAF)
AF UNIT POST OFFICE, LOS ANGELES, CALIFORNIA 90045

REPLY TO
ATTN OF:

26 September 1966

SUBJECT: HEXAGON Satellite Basic Assembly Source Selection

TO: Director, National Reconnaissance Office

1. The Satellite Basic Assembly Source Selection Board recommends that the Lockheed Missile and Space Company be selected as the Development Contractor for the SBA and the Integration Contractor for the Satellite Vehicle. All four proposals were in general responsive to the RFP with no glaring technical, operational, or management deficiencies. From a technical viewpoint, GE and IMSC chose proven equipments as far as possible (IMSC considers solar cells proven) and minimum risk components where new items are required. MAC generally took the minimum weight approach moderated some by simplicity. NAA also traded off in favor of minimum weight but permitted a considerable amount of complexity. A more detailed summary of each technical proposal follows.

A. GENERAL ELECTRIC

In principle, GE has made a most conservative set of design choices except for their 2 by 2 (side by side) RV arrangement. A 4 in-line configuration would almost surely exceed the weight allotment, and since certain other GE subsystems have insufficient weight margin, it is clear that GE has paid a price for mature, on-the-shelf equipment.

GE does not consider the Stellar Index mounting problem or the electrical power for it.

Growth is obtained by making major hardware changes such as fuel cells for power and possibly bipropellant for attitude control gas. These changes are so major that GE's concept should not be considered for growth (unless a larger booster is available), even though they have a nice modular design.

B. LOCKHEED MISSILE AND SPACE COMPANY

Lockheed's approach is an interesting mixture of conservative design, selecting proven concepts and equipment for the most part. In some areas, notably OA propulsion and structure, IMSC proposes new equipment based upon simplicity. The OA is a single engine monopro-pellant with good reliability potential but still to be developed

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and tested. The LMSC outside-corrugated structure is still controversial as to its actual loading carrying strength. LMSC proposed new but state-of-the-art TT&C equipment. LMSC's RV and payload layout is very good.

Growth to longer missions is possible by conservation of expendables, or use of a larger booster. The modular approach will allow easy modification for up to 40 to 50 days.

C. McDONNELL AIRCRAFT CORPORATION

McDonnell made a straightforward design based upon minimum weight selections from proven state-of-the-art subsystems. In some subsystems this means a development program is required to adapt proven concepts to this program's size requirements: Attitude Control, Orbit Adjust, Solar Arrays, and TT&C. McDonnell shows excellent design and tradeoff ability for a newcomer amongst the unmanned spacecraft development companies.

The MAC design has two quite different RV layouts, which complicates their proposal, but MAC does a good job of keeping these separated and clearly presented. Their 4 RV layout locates the Stellar Index Camera away from the main payload, resulting in more difficult alignment. MAC shows good knowledge of camera designs and should be an excellent integrating contractor; and, if anything, they may have too much emphasis on such work. For example, they propose considerable payload alignment at MAC and on the pad, using collimation equipment on the pad in ways which are probably not feasible.

Growth with MAC's design is obtained by conservation of expendables or some redesign of the orbit adjust tankage to yield a greater capacity. Up to 35 or 40 days life should be possible on the 3-Segment booster.

Some of MAC's SBA equipment is integrated with the RV section. This yields the most compact SBA layout and provides good access to subsystems, at the expense of more wiring through the payload section.

D. NORTH AMERICAN AVIATION

While North American made design studies and tradeoffs similar to the other contractors, they made some choices which led them to quite different conclusions. They chose an attitude control mechanization (and components) which consumed 10 to 50 watts higher power than the other contractors; and a duty cycle for TT&C components which added 100 watts more of average power. As a result, NAA was led (by weight considerations) to a two-axis controlled sun-oriented solar array which is less reliable and certainly causes much higher

drag. Secondly, probably to save weight, NAA chose a clustered 4 RV arrangement which requires a very complex film handling arrangement (not discussed); and which results in large cg shifts as RV's leave, necessitating either a higher thrust level attitude control or a gimballed orbit adjust engine. NAA took the more complex choice here and proposed the gimballed OA engines. In TT&C, they also propose a very complex interconnection of both out-of-date and new units. In general, it appears that NAA made some unfortunate design choices.

Growth in NAA is achieved easily as a consequence of choosing very large OA-Attitude Control fuel tanks, suitable for 70 days life. Present booster limits will allow about 35 days life.

NAA integrates the solar array with the RV section yielding a split-SBA, and they further complicate the interfaces by separating all the major power loads from the solar energy collection.

2. In view of the orbital experience of most of the proposing contractors, and the conservative nature of the proposals, there is little risk associated with the 612 SBA development.

3. The greatest weight risk exists in GE, where no contingencies were allowed and where several growths may occur: Orbit Adjust is low by 200 lbs, attitude control gas is marginal, BRAC gas is low, and (most important) the electrical power load may grow by 30 to 50 watts requiring 200 to 400 lbs of additional batteries, or a mission reduction of 3 to 5 days. Also a design change to the more desirable 4 in-line RV layout would require up to 500 lbs additional structure.

4. In the LMSC proposal, contingencies are included in all weights ranging from 3 percent on existing hardware to 20 percent on new items. The only soft spot in LMSC's weights is in the solar cell array sizing where the array is not sized for 20 percent out, as the proposal implies. About 50 lbs more array would be needed. Otherwise LMSC has low risk in their weight estimates.

5. MAC also presents a low risk design with contingencies in all weight allowances. An additional 150 to 180 lbs will be needed for OA fuel but this weight is available since MAC did not use the full SBA allowance.

6. NAA proposes a design also low in weight risk. Their solar array is oversized for the correct power levels likely to be used and their orbit adjust hardware is also oversized and conservatively estimated. Small growth allowances are included in subsystem weights and NAA also did not use the full SBA weight allowance.

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7. In the area of electrical power, GE may be low due to their standby redundancy plan for gyros and horizon sensors. Practical considerations will probably dictate that the standby gyros and horizon sensors be kept under thermal control heating even when inactive. This could add 20 watts to the contractor's power load. GE is also deficient in power for the SI and Recovery section. IMSC's power in TT&C is likely to increase by 15 watts because their second (redundant) programmer is needed to provide primary command storage; IMSC has a 14 watt contingency item (secondary payloads) which can absorb this power load.

8. In the Operations Area the General Electric software capability is clearly superior to that of the other proposals. However, this capability exists and can be used independent of the selection of SBA Contractor.

9. In the Management Area the MAC proposal was most complete and thorough. This was especially true in the Configuration Control and Accounting Category where MAC proposed an extremely high degree of conformance to 375-1, whereas GE and IMSC proposed essentially the less formal procedures used successfully in current SAFSP programs.

10. In considering the proposed costs of the programs the Source Selection Board was able to identify manpower loading and subcontracting as the prime differences between MAC, the high proposer, and the SAFSP experienced contractors, GE and IMSC. The Board was unable to identify any significant reductions in the MAC proposal which could be made without affecting the quality of the proposal.

11. In summary, IMSC and MAC are superior in technical approach, risk, and growth capability, GE is superior in operational computer support, and all show reasonable management capability.

12. When the vast cost differential between MAC and IMSC is considered, the selection of IMSC becomes apparent.

F. S. Buzard

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Colonel, USAF

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