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JUL 12 1968

MEMORANDUM FOR DR. FLAX

SUBJECT: MOL Fuel Cell

As you know, Pratt and Whitney has been encountering some development difficulties in their PC-3 (Bacon) Fuel Cell. Recent development powerplant test data indicates that the present P&W configuration probably would not meet primary MOL electrical power specification requirements for:

1. 720 hours operation in the high temperature mode.
2. Full electrical load transient.
3. Powerplant temperature reset time.

(I also gather that the PC-3 will be rather marginal as a 50-60 day power source for Flight Vehicles 6 and 7.)

Over the past several months, P&W and DAC have been discussing design modifications to the PC-3 which would correct its shortcomings. These include an increase in the basic cell sinter area, elimination of one cell, further optimization of the cell ceria coating, and further adjustments to cell operating temperatures. The DAC evaluation, supported by Aerospace, is that the so-called "Big Sinter" version of the PC-3 probably would meet the flight requirements -- with, perhaps, minor specification deviations -- of FV-3, 4, and 5, and also FV-6 and 7 (if the proposed power allocations for those vehicles can be met by the Associates). There is some increase in program cost associated with the "Big Sinter" PC-3.

In May, P&W proposed to DAC that in lieu of the "Big Sinter" PC-3, they be permitted to change to a matrix fuel cell approach (the PC-8) -- same external configuration, same

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interfaces, etc. (P&W has been doing in-house matrix fuel cell research in an attempt to keep up with Allis-Chalmers). The industrial "espionage" system being what it is, Allis-Chalmers heard of the P&W proposal within a very short while and immediately descended on the MOL Program Office, MOL Systems Office, and DAC with an A-C MOL fuel cell proposal. Allis-Chalmers obviously is now very eager to get into the MOL Program and has been for some time (witness the periodic correspondence from Congressman Laird -- see Atchs -- on behalf of A-C), even though they did not choose to participate in the original MOL fuel cell competition.

DAC was rather "cool" at first to the Allis-Chalmers proposal, apparently concerned that there might be significant interface problems and also -- I suspect -- that A-C's project management capability was considerably less reliable than P&W's. However, A-C had numerous sessions with DAC, with the results being that the latter's concerns were allayed, and A-C submitted an unsolicited fixed-price proposal of \$10.3 million to develop and produce flight-qualified fuel cells for the baseline MOL Program.

Allis-Chalmers representatives talked with me in June, and I assured them that if the matrix fuel cell approach were taken for MOL, it would be done competitively and they would be invited to bid; however, of necessity, because of schedule considerations, there would have to be a short competition (perhaps, only 45 days). Dr. Stanford assured me, in turn, that A-C now was thoroughly familiar with the MOL requirements and specifications, had submitted an unsolicited proposal to DAC, and would feel that they were being fairly treated even in a 30-day competition.

Meanwhile, in mid-June, I heard rumors that P&W had visited Mr. John Disher, NASA, expressing an intent to "get out of the space fuel cell business" after fulfilling their basic Apollo contract. P&W representatives visited me shortly thereafter to assure me that they were not thinking of backing out of the MOL commitment, that P&W had a continuing future interest in fuel cells (commercial market, etc.). We discussed the P&W matrix cell proposal for MOL briefly, and I flatly

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stated that the AF could not sole-source the PC-8 matrix cell development to P&W, that if such a change were made, it had to be done competitively. In response to my question and expression of hope that P&W would compete "if", they assured me they would do so.

The P&W people also grumbled that A-C had been funded for several years for fuel cell advanced technology work; meanwhile, P&W was restricted to 1961 technology, etc. They inquired as to the maintenance of a competitive base should the MOL fuel cell be competed and A-C won (through advanced technology at P&W). I only assured them that this would be a consideration since the Government generally didn't prefer single sources for important subsystems, etc.

On July 3, DAC, the MOL Systems Office and Aerospace reviewed in depth a comparison of matrix and Bacon fuel cell power plants; the background and development status of the P&W and A-C matrix fuel cell proposals; current development problems and the proposed solutions for the PC-3; MOL power requirements, etc. The general conclusions were that the matrix fuel cell offered substantial program advantages in terms of performance, weight, operations, flexibility for future growth, cost and FY fund requirements; that either P&W or A-C should be able to meet the program schedule with a matrix cell without jeopardy to intermediate milestones or flight dates; and that DAC and the AF would be ill-advised to pursue further the Bacon fuel cell development because of its inherent limitations as well as current technical problems.

DAC has prepared a fuel cell RFP (which has been reviewed by the Systems Office and Aerospace) which asks bidders to submit a primary proposal without deviation from the specs or Statement of Work (alternates may also be submitted); requesting either a firm fixed price or fixed price-incentive contract be signed and submitted with the response. I will have a copy of the RFP early next week should you care to see it. P&W, A-C, GE, and perhaps Union Carbide will be requested to propose. DAC proposes the following schedule:

1. July 17 - issue RFP.

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2. August 19 - Responses due.
3. 19 August-27 September - Evaluation and fact finding (DAC with AF participation).
4. September 30 - DAC source selection.
5. October 1-14 - AF review.
6. October 15 - Authority to proceed.

During the competition process, DAC proposes to continue P&W at a reduced level, working only in areas which are common to both the PC-3 (Bacon) and PC-8 (matrix). This preserves the option to still continue the PC-3, if desired, and/or P&W's capability to start the PC-8 should they win the matrix cell competition. The cost for this continuing effort at P&W would be \$900K. Should P&W lose the competition, another \$150-200K termination costs would be incurred.

If a matrix cell were started October 15, it is a consensus of opinion that an EDCTU date of June 69 and a 1st flight equipment delivery date of September 1970 could be met by either P&W or A-C. These dates could be compatible, if necessary, even with our former August 1971 first manned launch date.

The cost situation briefly is as follows. The present P&W PC-3 contract value is \$31.4 million, to be increased by upgrading development costs to at least a total contract value of \$33.5 million. \$14.9 million will have been spent by P&W through July 15. P&W therefore would still spend an additional \$18.6 million on the PC-3 (Bacon), or as an alternative, proposed \$20.5 million more for the PC-8 (matrix) program (\$35.4 million total). Meanwhile, A-C submitted a \$10.3 million proposal (FP or FPI) to DAC for the same program. Thus, on the surface, it appears that P&W could be carried through October 15, terminated, and A-C given the contract for perhaps a \$27 million total investment (including all prior costs).

A question is whether any credence be placed at this time in A-C's unsolicited proposal (both cost and technical

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assurance). The answer probably is generally affirmative since A-C is "hungry", they have done a great deal of work on the matrix fuel cell approach, and are developing essentially the same cell as a back-up for Apollo and the AAP Orbital Workshop. With regard to the latter, NASA on July 1 started negotiating a 15 month program with A-C to develop and produce four flight-quality 2KW matrix fuel cells (one to be qualified at 1500 hours; a second to undergo 2500 hours extended life testing; plus two spares). I assume, if development goes well, that NASA will utilize the A-C fuel cell in the Orbital Workshop rather than the P&W Bacon cell.

In summary, DAC, General Bleymaier, Aerospace, and I all believe that we should recompute the MOL fuel cell and take the matrix approach for cost, performance, reliability, simplification (e.g., abandon the present automatic switching kluge), growth potential, etc., reasons. Mr. Palley has no qualms about this. Neither does Dr. Yarymovych. I recommend we do the following:

1. Authorize DAC to issue RFP's to qualified bidders on July 17.
2. Direct the continuation of the P&W effort at a reduced level, as described previously, through the competition process to at least preserve the option of continuing the Bacon cell should none of the matrix proposals be attractive.
3. Advise Congressman Laird promptly of the course of action we are taking (also NASA -- I have informally advised both Mr. Mathews and Mr. Luskin that we are considering such a change).
4. Review the DAC/Systems Office evaluation plan prior to the receipt of proposals from the bidders.

SIGNED

JAMES T. STEWART
Major General, USAF
Vice Director, MOL Program

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