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MEETINGS AT AFHQ RE ELECTRONIC SYSTEMS FOR CF-105  
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During the past few days George Oscar, Irv Liss and myself have been privileged to attend presentations made by would-be suppliers of CF-105 electronic systems to the R.C.A.F. Although our role has been that of advisor to the R.C.A.F., we have been permitted to join freely in all discussions and we have been loaned copies of the proposals prepared by the companies. This note is to summarize briefly the systems proposed and to present some views on the qualifications of the companies concerned, and on the possible repercussions on the program for the CF-105.

The R.C.A.F., through U.S.A.F. channels, requested proposals from R.C.A. (with M-H support), Hughes, Bendix and Sperry. Of these, only Sperry did not formally propose a system. The R.C.A.F. requirement was as described in AIR 7-6 and Inst. 92-5. For scheduling purposes, the companies were told that CF-105 development aircraft would be available in November and December of 1957, with a possible third aircraft in August of 1958. Pre-production deliveries were required to start in April 1959.

In brief, the systems proposed are as follows:-

1) R.C.A. - M-H

R.C.A. has combined forces with M-H to produce an interesting proposal. R.C.A. definitely gained the leadership of this alliance and M-H is described as principal sub-contractor. The division of effort is for R.C.A. to concentrate on fire control and navigation with M-H doing AFCS. There was some talk of CDC being brought into the navigation phase. R.C.A. would handle communications and would provide overall project direction. The primary system proposed, known as ASTRA ONE, is based on the Hughes MQ-10 fire control which is an E-9 variant, the M-H E-10 autopilot and W/C Wright's Navigation Interception Computing System. This latter feature is an afterthought in terms of the proposal itself. R.C.A. proposes to concentrate its efforts on improving the radar, particularly in terms of its range performance by introducing a 32" dia. dish, and increasing the transmitted power from the present Hughes 250 Kw to 1 megawatt. This involves the development of a new, tuneable magnetron which R.C.A.F. intends to undertake itself, although it refers to a Raytheon 750 Kw airborne magnetron, now under development for the U.S. Army Signal Corps.



as an insurance policy. R.C.A.'s remarks about the chances of success of this Raytheon magnetron were not too complimentary, and R.C.A. felt that it could handle the larger unit within the time with greater probability of success. The computer sub-system for ASTRA ONE is our old friend the Hughes universal computer, with mode plugs and minimum changes to accept the weapons specified by the R.C.A.F. The system is the logical development of the one I tried to sell in 1954 and early 1955, with MG-3, N.I.C. data link, etc. At that time this system was turned down by A/V/M Plant as insufficiently advanced for the project. However, I still believe it could perform an adequate job, particularly in view of the fact that W/C Wright has ideas for the N.I.C. to optimize the offset point and possibly to compute the attack course using A.I. inputs.

ASTRA ONE is the system R.C.A. offers for 1959 pre-production delivery. In view of the big changes in the radar R.C.A.'s ability to meet this date with an operational system is open to suspicion, particularly as I believe that the R.C.A. mechanization of the attack mode of AFCS cannot be developed until the radar itself is successfully developed.

R.C.A. is offering an advanced version of the system, known as ASTRA TWO for 1961 pre-production deliveries. It is proposed to refine many of the sub-systems and to make use of an airborne digital computer. In this form the system would be similar to the Hughes proposed system, based on MA-1 or MX-1179, but may well have improved radar range performance, performance in the presence of ECM, etc., when compared with the Hughes system, although in defence of Hughes, it should be noted that it is two years later than the Hughes equivalent system.

The price quoted for the development of the ASTRA ONE system is \$11,252,124, on a CPFF basis. Over and above this R.C.A. requests a long list of items as GSM so that the cost to the R.C.A.F. will probably be well in excess of this figure. They do not quote costs for ASTRA TWO.

R.C.A. succeeded in giving the impression at their presentation that they are an energetic and competent team. M-H were not much in evidence but are well known to us. I believe that R.C.A. are extremely keen to break into the fire control development field and that they would spare no effort to ensure the success of this project. I seemed to detect that their strength lay in sub-system and hardware development rather than in the overall concept of a system of this type, and they did not seem to have a logical grasp of the overall problem.



However, this failing, if present, may be something of an attraction to the R.C.A.F., in that they have always tried to give this overall direction, and much of the apparent problem with Hughes may stem from the self-sufficiency of Hughes in this respect, and their apparent indifference to R.C.A.F. ideas.

2)

#### HUGHES

The Hughes proposal is based on the MA-1 system. It differs from previous submissions in that the increased radar dish is part of the basic system rather than a parallel development, and the basic system will have Sparrow 2 capabilities and also will probably fire the long range unguided rockets. These new features are important and represent a real gain, although one is left wondering whether the passage of the time involved would not have produced these in any case. Hughes has not increased transmitter power over the standard 250 Kw and does not seem to feel that an increase is either desirable or practical. It is interesting to note that the LRI proposal, for which HAC now has a letter contract, uses twin 250 Kw magnetrons rather than the larger units now under development. Whether this is over-conservatism or a realistic outlook is not clear and we are trying to get a reading from the U.S. Army Signal Corps on the feasibility of the big magnetrons within the time scale.

The Hughes proposal is the only one offering digital computing by 1959, with its inherent flexibility of operation, self checking features, etc. The advantages of this may not be too significant in terms of a system to tackle the problem stated, but it is noteworthy that R.C.A. says it will offer digital computing by 1961, and Bendix talks of investigating it thoroughly in the phase 2 program.

Quite a number of features required by the R.C.A.F. are relegated to studies, e.g. I.R. tracking, Auto-throttle, etc. The Hughes presentation was not comparable to those put on by R.C.A. and Bendix, and I did not feel that Hughes made a real selling effort, although the HAC people were obviously of the opinion that the many previous presentations had covered the necessary territory.

Hughes quotes a price of \$13,300,000. on a CPFF basis for the system development. When it is considered that a very considerable portion of the ground work for the system is either complete or being carried out on parallel U.S.A.F. contracts, this price is either inordinately high in comparison with the other proposals, or the other submissions are extremely optimistic.



The Hughes proposals are in extremely tidy form, as may well be expected by this time, with all deviations neatly listed, statement of work properly detailed, etc. In view of the short time available and the lack of knowledge re the project neither R.C.A. nor Bendix have the contractual aspects of their submissions in this concise form.

3) BENDIX

Bendix proposes an electronic system based on an improved version of the Westinghouse APQ-50 radar, the Douglas computer we tried to use with the MG-2 for Sparrow 2, an Eclipse Pioneer AFCS and the CDC - W/C Wright navigation system. Weapon capability is limited to Sparrow 2 and/or Sparrow 3. This Bendix calls its phase 1 system and proposes a phase 2 system with extra weapon capability, possible digital computer, etc., as a logical development of phase 1. By some magic it is proposed to have phase 2 systems available on a pre-production basis by 1959, but I suspect this timing is tight even for phase 1. The phase 1 system may be likened in capability to the proposed system for Sparrow 2 to be installed in the CF-100. Compared with this it will have improved radar range performance, improved navigation facilities and data link, etc., but will be short of the rocket firing capabilities of the CF-100 installation. Bendix proposes to improve the APQ-50 range capability by use of a 31" dish and the Raytheon 750 Kv magnetron in place of the present 250 Kv magnetron. Bendix is the company with the least knowledge of the airplane, as R.C.A. obtained data from M-II, forwarded as part of the damping system negotiation. This lack of knowledge is apparent in the detail of the proposal, some of which is not directly applicable.

Bendix is known to be a competent and talented outfit. Its approach does not follow the traditional Hughes line, as does the R.C.A. approach, and Bendix proposes to use many novel features to solve the various problems. For example, A.W.T.I. proposed to give good low altitude performance, but instead the use of short pulses transmission, which appears to give good results on Sparrow 2, is proposed. Many ideas are based on missile experience. The timing, particularly on flight test programs, seems to be most unrealistic and optimistic, and this may show lack of experience in this field.

Bendix quotes a price of \$6,245,954. for phase 1 development, plus \$672,537. for field testing in phase 1. The cost of phase 2 development is estimated as \$3,900,000. for budget purpose. Prices are on a CPTF basis. Over and above these figures Bendix would require certain equipments as GSN but does not give a clear statement of this requirement.



Certain other factors are worthy of consideration. For example, the U.S.A.F. seem to be in a position where it will encourage competition with Hughes, and be unwilling to further load the Hughes engineering effort. I get the impression that the U.S.A.F. would certainly favor the entry of R.C.A. into this development field, particularly if this were financed by somebody else's funds. Much of the Bendix equipment and know-how is tied up with U.S. Navy, and this is to some extent a strike against them as our efforts to deal with U.S. Navy have been tied in the maximum of red tape.

Both Bendix and R.C.A., particularly the latter, are anxious to get the contract. To some extent the Bendix interest is to further the cause of Sparrow 2, in which it has a considerable interest, and the Bendix phase 1 system is aimed specifically at the use of this weapon. R.C.A. just wants "in" and gave the impression that anything necessary would be done to satisfy the customer. This attitude could certainly lead to a favorable situation regarding prices, etc., and R.C.A. has a considerable reputation to guard.

If the position of the R.A.F. in this matter is any consideration, I expect that it would come down heavily in favor of Hughes. Neither the R.C.A. nor the Bendix proposals are much different from what could probably be accomplished in U.K. using Al-18 as the basic radar. Although some sections in MGS are in favor of this approach, the R.A.F. authorities are distinctly cynical and want something backed by more experience and more development.

From the foregoing and from the technical comparison it will be seen that in many ways the decision rests on certain intangibles.

For example:

- 1) How soon must the full system capability be realized?
- 2) How capable are the different companies of meeting their dates?
- 3) To what extent will U.S.A.F. or U.S.N. support or oppose a given decision, and what effect will this have on 1) or 2)?
- 4) Is the Hughes failure to accept certain R.C.A.F. requirements based on wisdom, indifference, or lack of capacity?



- 5) Is the R.A.F.'s position in this matter to be considered? If so, what are the chances of funds being made available to purchase systems from an American source?

It is hoped to resolve these many considerations at an R.C.A.F. meeting at Director's level, to be held on Friday, March 15th, 1956. George Oscar and I have been invited to attend this meeting and to offer comment on behalf of the Company.

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