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Mr. G. H. Morel,
Societe Commerciale et Industrielle Franco-Britannique,
43, Avenue Raymond Poincare,
Paris 16e,
France.

Dear Gerry:-

It was very nice indeed to meet you in Paris and I would like to thank you and Jose for looking after John McCulloch and myself so well. I am sorry that I was feeling so sick while I was over there, which rather cramped things a little, however, I am certainly optimistic about the possibilities of concluding something with Zborowski, and was reasonably impressed with the work that he has done to date.

I am attaching a brief outline of what I feel is our position on the coleopter project at this time, and the details, will of course, have to be worked out later in conjunction with Joe Morley. The first step, however, is, I believe, for us to indicate, on the lines of the attached draft, what we require from Zborowski; he will then submit a statement of what he is prepared to do, and after our receipt and perusal of this in Canada, Joe Morley can then send instructions over with regard to the contractual and financial authorization. In the meantime I hope this draft will be of some assistance to you.

Hoping to see you and Jose again in the not too distant future.

Au revoir,

J. C. Floyd.

cc Mr. J. Waschter
Mr. J.A. Morley
Mr. J. McCulloch

D R A F T

SUGGESTIONS ON METHOD OF NEGOTIATION
WITH M. ZBOROWSKI FOR A DESIGN STUDY
ON THE COLEOPTER

The statement from M. Zborowski should contain the following :-

- (a) A statement of the work to be done within the terms of the design study contract.
- (b) An agreement on the method of liaison and checking of progress of the job.
- (c) The time and cost of carrying out this work.
- (d) Method of payment, etc.

The various items would be dealt with in detail as follows :-

- (a) A Statement of the work to be done within the terms of the design study contract

Avro would require, as part of the design study, a complete statement of performance of the proposal, based on the target drone specification left with BTZ, including estimates of drag, installed thrust, nozzle efficiency, ram jet performance, etc., stability derivatives, complete weight breakdown, CG and aerodynamic center plots against time and Mach number. Fully dimensioned drawings will be required including drawings of the interior layout and cross sections through the project; also installation drawings of the engine and aircraft control systems. An engine performance brochure should be included, based on the engine used. Mission patterns should also be included, showing time, distance and altitude for the mission considered, also a statement of weight change against this mission.

Note In Item 2 of the target drone specification we call for a subsonic design which is capable later of being developed to a supersonic design. It would be preferable, in the proposal received from BTZ, if the design was based

on a supersonic capability up to Mach 1.5 to 2 depending on the penalties on range and performance of achieving this, but at the same time ensuring that the project can be operated at high subsonic Mach numbers in the event that extended operation at these speeds was required.

(b) An agreement on the method of liaison and checking of progress of the job

Avro are to have full access to study, in conjunction with BTZ engineers, all work being carried out by BTZ in relation to this project. We should be free to send any of our engineering specialists, or other specialists that Avro delegates, to discuss and monitor, where necessary, the design of the project.

Avro understand that BTZ will not be able to build special wind tunnel models or carry out wind tunnel work on this project, within the terms of this preliminary design study, but BTZ will use their best efforts to correlate the performance and wind tunnel work already achieved, to ensure that as much of the performance as possible is correlated and checked by reasonable testing.

(c) The time and cost of carrying out this work

BTZ have agreed to provide this design study within a period of 90 days from receipt of a design study contract and have further agreed to extend an option for Avro to participate in the coleopter program in a manner still to be discussed between BTZ and Avro. Avro would like to extend this option to a period of at least 60 days, and preferably 90 days, after receipt of the completed preliminary design study from BTZ. In the meantime BTZ have agreed that no discussions will take place with anyone on the North American Continent without the prior knowledge of Avro.

(d) Method of payment, etc.

For the three months preliminary design study, M. Zborewski agreed to discussion of a total figure of \$25,000.00. It is suggested that this be made in three pro-

gress payments, at one per month at the end of each month, the first payment being \$10,000.00; the second payment \$10,000.00 and the third payment \$5,000.00. Avro should have the option to be able to abandon the project after the remittance of any of these progress payments, although it is, of course, not anticipated that this will be necessary and would merely be included for legal protection.

The work carried out by BTZ on this particular project would be the property of Avro Aircraft Limited.

Signed: J. C. FLOYD

MINUTES OF THE MEETING WITH BUREAU
TECHNIQUE ZBOROWSKI AT BOUSSY-ST-ANTOINE,
NR. PARIS ON MONDAY, DECEMBER 5TH

Those present: Dr. Helmut Von Zborowski, B.T.Z.
Dr. Wilhelm Seibold, Chief Engineer, B.T.Z.
Mr. J.C. Floyd, Avro Aircraft Ltd.
Mr. J. McCulloch, Avro Aircraft Ltd.
M. J. Waechter, Franco-Britannique
M. Rapoport, Engineer & Interpreter,
Franco-Britannique

The Purpose of the Meeting

The purpose for the meeting was to ask B.T.Z. whether they would undertake some design study work for Avro Aircraft on a Target Drone Aircraft.

Mr. Floyd opened the meeting by saying that he wished to discuss the Coleopter principle and if possible to have proof that it worked and in particular that the stability was acceptable. If he could be convinced of these two things then he proposed to offer a contract to B.T.Z. for the design study of a high speed drone.

Dr. Zborowski replied that he would first run through the main uses of the Coleopter, which were as follows:

- i) Supersonic Interceptor (man controlled or otherwise)
- ii) Turboprop, Civil or Military
- iii) Guided weapon, (to take up to 20g)
- iv) Ground attack - a light aircraft with good maneuverability (Dr. Zborowski said it was debatable whether the Coleopter was the best aircraft to do this job.)

Although Dr. Zborowski had not mentioned a drone in his list of possible uses for the Coleopter, he went on to say that a drone corresponded to an unmanned Interceptor from the point of view of the Coleopter application and already he had made studies on both a subsonic drone and a supersonic drone. He went on to qualify this statement by adding that it was in the supersonic drone range that the drone was similar to the interceptor.

Mr. Floyd then stated that the specification in which he was interested was for a supersonic drone capable of a subsonic performance, and both Dr. Zborowski and Dr. Seibold agreed that this could be done. After consulting several brochures, Dr. Seibold said that a Coleopter could be produced, having a total flight duration of 25 to 30 minutes, which would include two supersonic bursts of 5 minutes duration each at $M = 1.5$. This drone could also be used for a purely supersonic mission with an endurance of eight minutes at $M = 2$.

Dr. Zborowski then summed up the type of performance he thought would be possible, in the following way:

- (a) Subsonic flight at a Mach Number of .9 at 50,000 ft. for 50 minutes duration, including take-off, climb and landing.
- (b) Take-off and climb to 50,000 ft. followed by supersonic flight at $M = 2$ for a duration of eight minutes, followed by descent and landing.
- (c) Subsonic flight at $M = .9$ at 50,000 ft. with two periods, each of five minutes duration, at $M = 1.5$. Total duration of flight 30 minutes.

Weights for the preceding missions:

A.U.W.	= 3,000 lb.
Structural Weight	= 1,500 lb. approx.
Engine	= Bristol Orpheus

Mr. Floyd then asked how the directional and lateral stability was achieved, to which Dr. Zborowski replied control was achieved by a jet stream and spoilers. Dr. Seibold said that as the C.G. was at 7% of the wing chord from the leading edge, there was quite a large static margin, which of course improved things and most certainly this was better than the results one obtained from a delta configuration.

Dr. Zborowski then stated that they had simulated the response in a wind tunnel and on a free flight model. Over 300 tests have been carried out on a small 40 lb. thrust pulse jet engine. The efficiency of the deviating jet stream had been measured and it had been found that the response of the

spoiler control was 1/10 second whilst the response of the jet stream was 1/100 second. The tests had shown that the Coleopter did not require automatic stability even with the pulse jet.

Mr. McCulloch then asked what were the advantages of the Coleopter over a delta configuration employing ram-jets at the wing tips, to which Dr. Seibold replied that whilst the drag coefficient of the Coleopter might be larger than for the delta, there were distinct aerodynamic gains, which only a detailed design study could demonstrate, e.g. an annular wing could be made as stiff as a delta wing for less structural weight. Mr. McCulloch then asked if he could see some of the wind tunnel results and asked specifically:

- i) What tunnel testing had been done to date,
- ii) Who made the models, and
- iii) In whose tunnels were the models tested.

Mr. McCulloch also asked at what Reynolds Number the tests were run.

Dr. Seibold then produced some low speed tunnel test results and said that supersonic testing had only been done at a Mach Number of 1.4 and a Reynolds Number of 1×10^6 . The testing had been done at SNECMA, who had the license for the Coleopter in France.

After looking through several brochures and drawings, Mr. Floyd decided to take the meeting into its second stage and a contract was next discussed.

Discussions prior to contract for Subsonic Target Drone Aircraft

Initially B.T.Z. could carry out a design study using existing wind tunnel results and test rig data. Later, if necessary, they could make tests on a model in the wind tunnel. The third phase would be to test engines on a full sized test rig.

Mr. Floyd then asked Dr. Zborowski if he would agree to a fixed price, to which Dr. Zborowski replied that he would. Dr. Zborowski then went on to say that he thought

the design study would take about three months and that the price would be \$30,000. This would not include the study of the electronics involved, nor would it involve engine testing or additional wind tunnel testing.

Mr. Floyd then stated that his total allocation for this research was \$25,000 and would Dr. Zborowski agree to this figure.

Dr. Zborowski agreed to this and stated that although the program would cost him more than \$25,000, he was keen to set up an agreement with a reputable firm like Avro Aircraft Limited. He also stated that he thought the next stage should be for B.T.Z. to put on paper exactly what Avro Aircraft would get for the \$25,000. He added that he would also carry out some wind tunnel testing for us at no additional expense. Mr. Floyd then stated that he thought this sounded a good arrangement and that on receipt of B.T.Z.'s proposal, it would be reviewed by the Board of Avro Aircraft and if they agreed, Mr. Morley, the Vice-President of Sales and Service, would handle the contract for Avro Aircraft.

Finally, the following action was decided upon:

- (i) B.T.Z. are to prepare a statement showing what Avro Aircraft's \$25,000 will cover.
- (ii) If B.T.Z. do a design study for us on a supersonic drone project, this work should be completed in three months, during which time B.T.Z. would agree to liaison with Avro Aircraft Engineers, who would assess the work being done.
- (iii) That for the period of four months from commencement of the work Avro Aircraft would have an option in North America on the Coleopter formula for a drone project.

In the meantime, B.T.Z. have agreed that no discussions will take place with anyone on the North American Continent without Avro Aircraft's prior knowledge.

Signed: J. MCCULLOCH