

*Review and discuss + review  
SPB 25 Oct 54*

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**SECRET**

Minutes of a Meeting held on 14 July  
1953 at St. Giles Court to discuss  
AVRO CANADA Project "Y".

Present:

Mr. E.T. Jones, PDSR(A) Chairman  
Dr. A.J. Skey, Canadian Joint Staff  
Mr. S.D. Davies, A.V. Roe  
Mr. A.A. Hall, D/RAE  
Dr. D. Cameron, AD/RD Proj.  
Mr. E.R. Alexander, Eng. RD.1  
Mr. T.D. Earl, A.V. Roe (Canada) Ltd.  
Mr. J.C.M. Frost, A.V. Roe (Canada) Ltd.  
Sir William Farren, A.V. Roe Limited  
Mr. A.E. Clarke, ARD/Res Secretary

*Bousfield*

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## INTRODUCTION

THE CHAIRMAN began by referring to a previous meeting held to discuss a MOS analysis of Project "Y". Although there were some differences about details, in general the NGTE supported the performance claims for the radial flow engine and the RAE confirmed the estimates of performance for the aircraft. It remained to be shown whether Project "Y" would be better than more conventional types of aircraft likely to be available eight years hence, when it was anticipated that development of Project "Y" would reach fruition. It was, therefore, agreed that an analysis of a similar configuration with conventional engines should be made and Dr. Solandt of the Canadian Defence Research Board suggested that, with the exception of wind tunnel tests, experimental work on Project "Y" should be suspended pending the outcome of the comparative analysis. This comparison was now available. It had been made by the Project Dept. of A.V.Roe and the brochure now presented gave the results.

### Comparison of Project "Y" and Conventional Aircraft.

Turning to the Firm's aircraft studies, THE CHAIRMAN commented he thought that, for a given military load and short duration the all-up-weight of Project "Y" would be lower than that of a similar airframe with axial engines. However, the Firm's study of a delta wing aircraft with two RB.106 engines (known as the AVRO 724) was actually appreciably lighter. Both MR FROST and DR. CAMERON felt that the weight of the 724 had been under-estimated although MR DAVIES was confident it could be substantiated on the basis of assumptions common to both Project "Y" and the 724. After some discussion of the weight aspect and its repercussions on vertical take-off, MR HALL suggested that any detailed discussion of weight at the initial design study stage might be misleading and that the really fundamental issues should be considered. He believed that an aircraft with airframe and engine integrated would probably have the advantage of lightness, but was a thermodynamic advantage claimed for the engine? He thought that Project "Y" was very vulnerable to projectiles and basic issues of this sort would have to be evaluated and equated. As at the previous meeting, there was disagreement about whether a weight advantage would or would not result from the integration of airframe and engine but MR. FROST felt that although no thermodynamic advantage was claimed for the engine there was a real aerodynamic advantage in Project "Y" in that the drag at supersonic speeds was less and the properties at low speed better. He was able to show a preliminary record of the results of wind tunnel tests carried out in the A.V.Roe tunnel at Woodford which indicated a large increase in  $C_L$  due to the peripheral jet flow, and no true stall up to 60° incidence. SIR WILLIAM FARREN felt that further experimental work on the aerodynamics was needed.

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Claims for conventional types of aircraft could be substantiated on the basis of past experience. This was not true on Project "Y" and there were many problems needing clarification such as those associated with getting the gases in and out of the aircraft. In his opinion experimental evidence was needed before any decision on the future of Project "Y" could be made. If the superiority of the aircraft was great it should be obvious without unduly extensive tests.

THE CHAIRMAN agreed with Sir William's remarks but drew attention to the fact that the 724 analysis constituted the first real challenge to the weight advantage claimed for Project "Y". With moderate reheat it was apparently possible to achieve the same thrust-weight ratio as the "Y". MR. HALL said that two fundamental disadvantages for Project "Y" could be seen, these being the loss of design flexibility resulting from integration of engine and airframe and the vulnerability. MR FROST said that these could be countered by the advantages of high thrust-weight ratio and simplicity, resulting in low aircraft cost. He stressed the fact that the radial engine without reheat could directly compete with an axial engine with reheat. MR HALL suggested that this was really a question of size of engine but MR FROST did not accept this. A Gyron engine with similar thrust would not give comparable aircraft performance because of the different engine shape. It had been stated that the air intake added to the engine cross-sectional area for the radial flow engine and not for axial flow type. This was true but the drag of the air intake could be made very low. A new one had been designed for Project "Y" with a twenty per cent reduction in drag. MR. HALL felt that the advantage claimed for the radial flow engine was really a reduction in weight arising from the fact that it fitted into the airframe better, and this suggestion was generally agreed.

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SIR WILLIAM FARREN said that when first confronted by Project "Y" he had been impressed by the fact that Frost and Earl had tackled a new problem and believed it could be solved in no other way. As a result of the analysis leading to the 724 it now appeared that there was a more conventional solution and which was the better methods had now to be resolved. He then wondered whether it was wise to do something quite novel on a layout which could not be further developed readily. The conventional 724 could have changes incorporated easily and lack of corresponding flexibility could be a serious disadvantage in Project "Y". MR. EARL still had doubts whether the required slow speed flight could be achieved in any way other than that adopted on Project "Y". Wind tunnel tests had shown it was not possible to stall the aircraft due to the peripheral jet flow. He did not think the 724 was safe for slow vertical flight and had doubts about the possibility of deflecting a reheat tailpipe complete with variable nozzle, as was necessary on the 724. MR. DAVIES was certain that the proposal was realistic but MR. FROST stressed that a most difficult piloting technique was involved in vertical take-off and landing which was made acceptable by the gyroscopic effects of the engine on Project "Y". MR. HALL said that there was adequate thrust on both Project Y and the 724 to make vertical take-off possible and this manoeuvre could then be made with the fuselage either vertical or horizontal and so gyroscopic stability was not a fundamental requirement. Project "Y" had the disadvantages of design inflexibility and vulnerability and the probable advantages of light weight and simplicity. These had to be equated and a fairly substantial advantage shown to warrant the project proceeding. To this equation MR. FROST added a subsonic aerodynamic advantage. MR. HALL agreed that there might be this aerodynamic improvement arising from filling in the normal momentum discontinuity by the jet efflux. His personal opinion was that the possible weight advantage did not warrant proceeding with the project but that the aerodynamic improvement if substantiated, radically altered the situation. THE CHAIRMAN agreed and added that it was possible to foresee the end of some types of manned military aircraft and so it was undesirable to start a costly, new and entirely novel concept which had only a restricted military application. If the radial flow engine gave an aerodynamic advantage of the kind described, civil applications became a possibility and in this field combat vulnerability did not arise. SIR WILLIAM FARREN was attracted by the fact that the engine could again become an adjunct of the aircraft, so restoring design flexibility. An engine exhausting its gas stream around its periphery was clearly more suitable than an axial flow type for filling in the aerodynamic momentum discontinuity. MR. HALL considered that the preliminary results needed to be critically examined and if the trends indicated were confirmed further experiments should be made. Model tests would be needed in any case before a detailed design of Project "Y" could proceed and so no unnecessary delay was caused by concentrating on proving the aerodynamic advantages. MR. FROST said that if the aerodynamics were proved, the engine would be needed and so fundamental work necessary for the engine, such as investigation of the bearings and seals should also proceed. This was agreed. SIR WILLIAM FARREN stressed the fact that this decision had arisen from available experimental evidence and this re-emphasized the importance of a research programme.



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It was felt that the Canadian authorities would be eager to carry out the required wind tunnel tests with their own facilities. However, the matter was thought to be of such importance that it should be investigated in British tunnels if the Canadian were unable to do so. Details, such as priorities, would have to be worked out if a request for British work should arise.

#### RECOMMENDATIONS

Preliminary wind tunnel tests indicate that the combination of a radial flow engine with a delta or a near-circular wing is likely to have aerodynamic advantages of importance. A further set of tests is required, with large scale models on which the engine operating conditions are simulated as closely as possible, to prove conclusively that aerodynamic advantages exist. Concurrently fundamental engine design and tests on such items as the bearings and seals should be carried out since the development of these might well prove to be holding items in an engine development programme.

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