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VOLUME ONE

# DOCUMENT HISTORY OF DISCOVERER

HISTORY OFFICE
CHIEF OF STAFF
SPACE AND MISSILE SYSTEMS ORGANIZATION
AIR FORCE SYSTEMS COMMAND

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# DOCUMENT HISTORY OF DISCOVERER

Prepared under the provisions of Air Force Regulation 210-3 and Air Force Systems Command Supplement No. 1 thereto as part of the United States Air Force Historical Program.

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# DOCUMENT HISTORY OF DISCOVERER

## VOLUME 1

Prepared by

S. A. Grassly

November 1971

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History Office

CHIEF OF STAFF

SPACE AND MISSILE SYSTEMS ORGANIZATION

[redacted]

WDD/AFBMD/SSD/SAMSO

# DOCUMENT HISTORY OF DISCOVERER

## VOLUME 1

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LIST OF SUPPORTING DOCUMENTS

HISTORY OF DISCOVERER

1. ARDC Weekly Activity Report, 4 Feb 1957 (Integration of Qualitative Personnel Requirements Activities at Western Development Division).

2. ARDC Form 111 (C/Gp3), Title: Advanced Reconnaissance System, 31 Jan 57.

3. R-W Document GM67.3-49, subj: Proposed Use of IRBM as Booster for Multi-Stage Vehicles, 1 Apr 1957.

4. DD Form 613 (C/Gp3), Project Number: 1764, 2 Apr 57.

5. DD Form 613 (C/Gp3), Project Number: 8727, 2 Apr 57.

6. Ltr, The Ramo-Wooldridge Corporation to Col E. N. Hall, from R. F. Mettler, subj: Transmitting copy of GM67.3-49, 3 May 57, w/o Inclosure. /See inclosure under date of 1 Apr 57/.

7. Memorandum for Colonel Terhune, subj: AFPTRC Support of WDD System Development, 23 Jul 57.

8. Memorandum for WDT and WDO, subj: Joint WDTN and WDOTA Staff Visit Report to Hq ARDC on Elimination of AFPTRC as a Separate Center of ARDC, 19 Nov 57.

9. Memorandum for the Record, subj: Telephone Call from Colonel Nunziato to General Ritland, 31 Dec 57.

10. Msg, from Comdr AFBMD to Comdr Hq ARDC, WDG-1-2, 3 Jan 58.

11. Ltr (C/Gp3), Lockheed Aircraft Corporation to MajGen Bernard A. Schriever, subj: Contract AF 04(647)-97, Proposal for Acceleration of WS 117L Program, 6 Jan 58.

12. Development Plan (C/Gp3), cover and introduction only for WS 117L, 6 Jan 58.

13. Conference msg regarding ARDC Five Year Projected Astronautics Program, 6 Jan 58.

14. Ltr (C/Gp3), WDP to Chief of Staff USAF, subj: Thor Program Acceleration, 6 Jan 58, w/4 Inclosures: 1. Program Summary; 2. Fund Summary; 3. Augmented Schedules; 4. Fund Summary (R&D Augmentation).

15. Ltr, ARDC (RDTHW) to Comdr AFBMD, subj: Elimination of AFPTRC and Assignment of Specific Human Factors Functions to AFBMD, 13 Jan 58.

16. Memorandum for the Record, WDTD, subj: Long-Distance Call from Colonel Attwood - ARDC - re "Recoverable Package," 13 Jan 58.

17. Memorandum for the Record, MCPTA, subj: Plan for Acceleration of the WS 117L Program, 21 Jan 58.

18. Msg, from Hq USAF to Comdr AFBMD, Cite AFCGM 55420, 211805Z Jan 58.

19. Msg, from Hq USAF to Comdr AFBMD, cite AFCGM 39578, 222106Z Jan 58.

20. Msg, Hq USAF to Comdr ARDC, info Comdr AFBMD, Cite AFDDC-SP 55521, 222214Z Jan 58.

21. Weekly Diary - 16 thru 23 Jan 58 from MCPTA to MCPT [AMC/BMC], 23 Jan 58.

22. Memorandum for Record, WDTIM, subj: Lockheed/Douglas WS-117L Co-ordination Meeting, 27 Jan 58, 28 Jan 58.

23. Msg, Hq USAF to Comdr AFBMD, info Comdr AFBMC/AMC, Cite AFCGM 56224, 061543Z Feb 58.

24. Memo to File, subj: Thor-117L Integration, 12 Feb 58.

25. Memorandum for the Secretary of Defense (C/Gp3), subj: Thor and WS-117L Program, 14 Feb 58.

26. Msg, Attn: Colonel F. C. E. Oder, WDTR, from F. W. O'Green, Lockheed Missile Systems Div Palo Alto Calif, subj: WS 117L - Reconnaissance Capsule, 18 Feb 58.

27. Memorandum for the Director of Guided Missiles, OSD, sgd Malcolm A. MacIntyre, Under Secretary, 21 Feb 58.

28. GO No. 11, ARDC, 27 Feb 58.

29. OSD Memorandum (C/Gp3), for Secretary of the Air Force, subj: Reconnaissance Satellites and Manned Space Exploration, 28 Feb 58.

30. Msg (C/Gp3) from Comdr AFBMD to Lockheed Aircraft Corporation, 12 Mar 58.

31. Memorandum for the Record, WDGE, subj: Call from Colonel Oder in Washington to Colonel Hamilton, 13 Mar 58.

32. WDTSR Memorandum for Major General Funk (C/Gp3), subj: Reorientation WS 117L Program IIA, 14 Mar 58.

33. Memorandum for the Director, ARPA, OSD, subj: Air Force Man-in-Space Program, 19 Mar 58.

34. Memorandum for Vice Chief of Staff, sgd MajGen J. S. Mills, subj: Man in Space Program, 20 Mar 58.

35. WDTSR Memorandum for Colonel Terhune, subj: Reply to Inquiry, 24 Mar 58.

36. Msg from Comdr ARDC to Comdr AFBMD, Cite TWS 03-24-06, 242015Z Mar 58.

37. WS 117L Project Office New Phone Extensions, 17 Apr 58.

38. Memorandum for Colonel Evans, sgd Col C. H. Terhune, Jr., subj: Man in Space Responsibilities, 28 Apr 58.

39. WDGO Memorandum for Col Terhune, sgd BrigGen O. J. Ritland, subj: Bio-Medical, Thor Boosted WS 117L Program, 5 May 58.

40. Ltr from Lockheed Aircraft Corp to Comdr AFBMD, subj: Contract No. AF 04(647)-181 Biosatellite Flight Plan, 6 May 58.

41. Ltr (S/Gp3), ARDC (RDZGW) to Comdr AFBMD, subj: Support of Bioastronautics Program, 22 May 58.

42. GO No. 18, ARDC, 22 May 58.

43. Functional Statement - Human Factors Division, 12 Jun 58.

44. Memorandum for the Director, ARPA (C/gp3), sid Malcolm A. MacIntyre, Under Secretary, 12 Jun 58.

45. Department of the AF Memorandum for the CofS, USAF, (C/Gp3), 24 Jun 58.

46. Msg from OSD to Comdr BMD, DEF 944944, 171759Z Jul 58.

47. WDT Memorandum for Colonel Riepe, sgd Col Charles H. Terhune, Jr., subj: Schedule Slippage 117L Program IIA, 28 Jul 58, w/1 Incl, Memo for Gen Schriever, subj as above, no date.

48. DF from MCPTA to MCPT, subj: Authorization for Type of Contract, 30 Jul 58, w/o atch.

49. Msg from Comdr, AFBMD to Comdr ARDC, 1 Aug 58.

50. Msg (C/Gp3) from Hq USAF to Comdr AFBMD, info Comdr ARDC, AFCGM 54161, 061938Z Aug 58.

51. Ltr, ARDC (RDTH) to Comdr Air University, subj: Responsibilities of School of Aviation Medicine in the ARDC Biosatellite Program, Sub-System L WS-117L, 12 Aug 58.

52. Ltr, AFBMD (WDTSR) to Lockheed Aircraft Corp., subj: Contract 04(647)-181, Internal Air Force Responsibilities Concerning Biosatellite Programs, 4 Sep 58.

53. ARPA Order No. 17-59, 4 Sep 58.

54. Msg from Comdr AFBMD to Comdr PMR, info AF Liaison Office, PMR, WDTWI-9-14-E, 14 Sep 58.

55. ARPA Order No. 17-59, Amendment No. 1, 29 Sep 58.

56. ARPA Order No. 17-59, Amendment No. 2, 17 Oct 58.

57. ARPA ltr (C/Gp3), to Comdr ARDC, no subj, 25 Nov 58

58. ARPA Order No. 17-59, Amendment No. 3, 26 Nov 58, w/2 Atch: 1. Preparation of Monthly Progress Report; 2. Vehicle Requirements List.

59. Msg from Comdr ARDC to Comdr AFBMD, RDZGW-11-39-E, 262100Z Nov 58.

60. ARPA Memorandum for the Secretary of the AF, (C/Gp3), subj: WS-117L Program, 4 Dec 58.

61. ARPA Memorandum for the Under Secretary of the Air Force (C/Gp3), subj: Discoverer-Thor Project and Sentry Programs, 5 Dec 58.

62. Msg from Hq USAF to Comdr AFBMD, info Comdr ARDC, 37375, 052240Z, Dec 58.

63. Msg (C/Gp3), from OSD, ARPA, to Comdr ARDC, info Comdr AFBMD, DEF 951903, 0522223Z

64. ARPA Order No. 48-59 (C/Gp3), 16 Dec 58, w/1 atch: Preparation of Reports.

65. WDZW Memorandum for Gen Schriever, subj: Discoverer Launchings, 30 Dec 58.

66. Msg (C/gp3) from Hq USAF to Comdr AFBMD, info Comdr ARDC, AFDAT 54519, 3015207 Dec 58.

67. Chart, Financial Management Status, Lockheed AF 04(647)-97, 181, 31 Dec 58.

68. Contractor Manpower Status Lockheed-AF (04(647)-97-181, 31 Dec 58.

69. Msg from Comdr AFBMD to Comdr 1st Missile Div, info AFBMD Field Office, WDTI-1-38-E, 3 Feb 59.

70. Msg from Comdr Missile Div to Comdr AFBMD, info AFBMD Field Office, Vandenberg AFB, 052358Z Feb 59.

71. Ltr (C/Gp3), WDZW to Comdr ARDC, subj: WS 117L Program, 11 Feb 59.

72. ARPA Order No. 48-59, Amendment No. 1, 16 Feb 59.

73. Msg from Comdr AFBMD to CofS, USAF, info Comdr ARDC, WDPP-3-1, 7 Mar 59.

74. Msg from Comdr AFBMD to Dir ARPA, Info CofS USAF, Comdr ARDC, Lockheed Missiles and Space Div, Ch, AFBMD Field Office, Palo Alto, WDZW 3-15-E, 17 Mar 59.

75. Msg from Hq USAF to AFBMD, Info ARDC, AYAPF 57888, 181447Z Mar 59.

76. Ltr, AFBMD (WDTI) to Mr. Donald W. Douglas, Jr., President, Douglas Aircraft Company, Inc., no subj: 18 Mar 1959.

77. ARPA Order No. 48-59, Amendment No. 2, 24 Mar 59.

78. ARPA Order No. 48-59, Amendment No. 3, 1 Apr 59.

79. ARPA Order No. 17-59, Amendment No. 4, 10 Apr 59.

80. ARPA Order No. 17-59, Amendment No. 5, 13 Apr 59.

81. Ltr, AFBMD (WDG) to Mr. L. Eugene Root, no subj, 20 Apr 59.

82. Msg (C/Gp3) from Hq Usaf to Comdr AFBMD, AFDAT 59353, 272059Z Apr 59.

83. WDD Routing Slip, 29 Apr 59.

84. Msg from AFBMD-ARDC/AMC-BMC to Lockheed Aircraft Corporation, LBJP-4-15-E 29 Apr 59.

85. Ltr AFBMD (WDZW) to The Honorable Malcolm A. MacIntyre, no subj, 1 May 59.

86. Discoverer Monthly Program Progress Report, 8 May 59.

87. ARPA Order No. 17-59, Amendment No. 6, 18 May 59.

88. AFBMD (WDZ) Memorandum for AFBMD Directors, subj: ARPA Order 17-59 (as amended), 18 May 59.

89. Ltr (C/Gp3), AFBMD (WDTR) to Director of Laboratories, WADC, subj: Short Title: ICBMCOD, 3 Jun 59.

90. Para 4, Weekly Diary - 11 thru 18 Jun 59 from BMC (LBJ) 18 Jun 59.

91. ARPA Order No. 17-60, Amendment No. 8, 1 Jul 59.

92. ARPA Order No. 48-59, Amendment No. 4, 20 May 59.

93. Discoverer Progress Report, 31 May 1959, dated 8 Jun 59.

94. ARPA Order No. 48-59, Amendment No. 5, 23 Jun 59.

95. ARPA Order No. 48-60, Amendment No. 6, 20 Jul 59.

96. Discoverer Program Progress Report, 31 Jul 59, dated 7 Aug 59.

97. AFBMD Ltr (WDZPB, to MajGen Otis O. Benson, Jr., Commandant USAF School of Aviation Medicine, no subj, 18 Aug 59.

98. Discoverer Program Progress Report, 31 Aug 59.

99. ARPA Order No. 48-60, Amendment No. 7, 8 Oct 59.

100. AFBMD Ltr, (WDG), subj: Investigating Committee, 29 Oct 59.

101. Discoverer Program Progress Report, 9 Nov 59.

102. Management Report, Advanced Reconnaissance System, 13 Nov 59.

103. Secretary of Defense Memorandum for the Secretary of the AF subj: Transfer of the Discoverer Development Program to the Department of the Air Force, 17 Nov 59.

104. SO Number 20, AFBMD, 27 Nov 59.

105. ARPA Order No. 48-60, Amendment No. 8, 3 Dec 59.

106. SOD Memorandum for the Asst Secy of Defense (Comptroller) (C/Gp3), 7 Dec 59.

107. Msg, S/Gp3) from Hq USAF to AFBMD and ARDC, AFABF and AEDDP 73993, 271712Z Feb 60.

108. Ltr (C/Gp4) from AFBMD (WDZYD, subj: Procurement of Four Follow-on Agena Vehicles for Discoverer Program, 14 Mar 60.

109. Ltr (C/Gp4) from AMC/BMC (LBZJR, subj: Discoverer Schedule Revision, 4 Oct 60.

110. Ltr (S/Gp3), Dept AF (AFDSD-AT) to ARDC, subj: Exploitation of Initial SAMOS Data, 1 Jun 60.

111. Ltr (C/Gp4), AMC/BMC (LBZJR to LBZJP, subj: DISCOVERER Schedule Revision, 4 Oct 60.

112. Msgs from Hq ARDC, RDGP-12-10-2 and RDGP-12-10-1, 12 Oct 60.

113. Msg from AFBMD to Missiles and Space Div Lockheed Aircraft Corp, WDE 24-10-179, 24 Oct 60.

114. Msg from Hq USAF to ARDC, info AFBMD, AF Air Museum, SAFOI 90547, 282054Z Oct 60.

115. Ltr Hq AMC to LtGen B. A. Schriever, 2 Dec 60.

116. Ltr ARDC (RDE), subj: Anniversary Flight Ceremonies, 7 Dec 60.

117. Msg from ARDC to AFBMD, RDEP 7-12-16, 071924Z Dec 60.

118. Msg from Hq ARDC to AFBMD, RDEI 8-12-19, 082043Z Dec 60.

119. Msg from AFBMD (WDEC) to WDG, subj: Presentation of Discoverer XIV Capsule, 9 Dec 60.

120. Suggested Remarks for MajGen O. J. Ritland Commander, AFBMD, at the Wright Day Luncheon, 16 Dec 60.

121. News Release 61-30, subj: Mackay Trophy for 1960.

122. SAFOI-3B Biomedical Release, 12 Jan 61.

123. Discoverer Program Chronology, 1 Jul - 31 Dec 60, (C/Gp4), 24 Jan 61.

124. 552 Airborne Early Warning and Control Wing (ADC) News Release: 1-4, 17 Feb 61.

125. Ltr, AFBMD (WDZJS-1, subj: Request for PR Initiation, 13 Mar 61.

126. AMC (LBZJP) ltr, subj: Authorization for Type of Contract, 28 Mar 61.

127. Ltr (S/Gp3), from Comdr, PMR to Comdr AFBMD, subj: Bioastronautics Orbiting Space System (BOSS) Development Plan; comments on, 28 Mar 61.

128. Msg (S/Gp4) from Hq AFSC to SSD LosA, SCG 10-5-27, 102210Z May 61.

129. Ltr (S/Gp3) from AFSC (SCRBS) sgd LtGen B. A. Schriever, to Hq USAF (AFDDC), subj: Bioastronautics Development Plan, 16 May 61.

130. Ltr (C/Gp4) from SSD (SSP) to LtGen B. A. Schriever, subj: Development Plans in Support of Five-Year Space Plan, 31 May 61.

131. Ltr (S/Gp3) from Hq USAF (AFDRT) to ATC and AFSC, subj: Radiation Shielding, 8 Jun 61.

132. Ltr (S/Gp3) from Hq USAF (AFFDDC) to AFSC, subj: Bioastronautics Orbital Space Program (BOSP), 12 Jun 61.

133. Ltr (S/Gp3) from Hq AFSC (SCRBS) to SSD (AFSC) and ATC, subj: Bioastronautics Orbital Space Program (BOSP), 22 Jun 61.

134. Discoverer Milestones, 12 Jul 61.

135. MFR (C/Gp4), SSRBT-2, subj: Preliminary Data on Disc 27 Flight Failure, 24 Jun 61.

136. Memorandum for MajGen Ritland, subj: Routine and Special Investifa-tions and Analysis of Discoverer Operations, Aug 61.

137. Msg (C/Gp4) from G. A. Devine, Sunnyvale, Calif, to SSD/SSZD, subj: ROM Quotation for Additional Discoverer Vehicles Nos 1129, 1130 and 1131 to Discoverer Contract AF 04(647)-673, 112135Z Aug 61.

138. UPI press release, 28 Aug 61.

139. DOD Instructions, subj: Policy on Experimental Animals in Department of Defense Research (No. 3216.1) 1 Sep 61.

140. Ltr, Department of State, Washington, to Mr. Huntoon, 15 Sep 61.

141. Msg (S/Gp3) from OSAF to AFSC, DCAS, LosA, SAFS 83174, 042206Z Dec 61.

142. UPI and AP News Releases, 12 Dec 61.

143. Ltr (C/Gp4) from Hq PMR to Comdr SSD, AFSC, subj: Space Program 698AA (BOSS) Development Plan; comments on, 11 Jan 62.

144. ADO No. 35 (C/Gp3), subj: Advanced Development Objective for a Bioastronautical Space Test Program, 18 Feb 62.

145. Ltr from SSD (SSZDB) to SSVX, subj: Discoverer Performance Improvement, 27 Feb 62.

146. Ltr from SSD (SSVXE) to SSVXX, subj: Thorad Jr DSV-2C Study for Discoverer, 2 Mar 1962.

147. Ltr (uncl w/o atch) from SSZDT to SSEH, subj: 622A Program Summary -- Historical Report, 23 Jul 62, w/1 atch: 622A Historical Report.

148. Memorandum for the Under Secretary of the Air Force, subj: Joint Air Force/NASA Bioastronautics Program (698 AA), 23 Jul 62.

149. Msg (C/Gp4) from Hq USAF to SSD LosA and MFSA, AFRAE-S-4, 122147Z Sep 62.

150. Msg (C/Gp4) from Hq USAF to AFSC, OAR, info SSD, LosA and AFCRL, AFRST 82769, 142119Z Sep 62.

151. Msg (C/Gp4) from Hq USAF to AFSC and SSD LosA, AFRAE-S-4, 041435Z Dec 62.

152. History Program 162 CY 1962, (C/Gp4).

153. Relocation List, 31 Jan 63.

154. Background of Biomedical Capsule Development, Jun 63.

155. History of Program 162, 1 Jan 63 to 30 Jun 63 (S/Gp4).

156. Ltr from SSD (SSZ) to AFSC (MSF), subj: AF Support of Bioastronautics Program 698AA, 2 Aug 63.

157. Ltr sigd MajGen Ben I Funk to AFSC (MSF), subj: Air Force Support of Bioastronautics Program 698AA, 26 Nov 63.

158. Ltr from AFSC (SCG) to SSD (SSG), subj: Program 698AA, 9 Dec 63.

159. Ltr (C/Gp4) from AFSC (SCG) to SSD (SSG, Gen Funk), subj: Manned Space Program, 16 Dec 63.

160. History of Program 162, 1 Jul-31 Dec 63, 8 Jan 64, (C/Gp4).

161. Msg (C/Gp4) from AFSC to SSD LosA, MSF 3-3-2, 032229Z Mar 64.

162. Msg (C/Gp4) from SSD LosA to MSF, SSGO -3-7, 6 Mar 64.

163. SO PB-17, SSD, 1 Apr 64.

164. SO PB-22, SSD, 22 Apr 64.

165. History of Program 162, 1 Jan 64 to 30 Apr 64, 21 Aug 64.

166. News Release 65-149, 31 Aug 65.

167. Appendix to History of Discoverer, List of Launches, 21 Jan 59 to 27 Apr 64.

COPY

(UNCLASSIFIED) INTEGRATION OF QUALITATIVE PERSONNEL REQUIREMENTS ACTIVITIES AT WESTERN DEVELOPMENT DIVISION:

(UNCLASSIFIED) In May 1956, AFPTRC established a liaison office at WDD for the purpose of coordinating Qualitative Personnel Requirements activities. Since that date, personnel and training requirements studies have been initiated on all weapon systems being developed by WDD. Two formal reports have been issued on System 107A-1, and an initial report published on System 315A. An initial report on System 107A-2 is scheduled for April 1957. The impact of these studies on development activities is much greater when ARDC has been assigned responsibility for the Initial Operational Capability since ARDC becomes the implementing agency in these cases. The QPRI reports have been used to prepare manning documents, determine over-all training requirements, plan training courses, and to provide a source of data for technical manuals. In view of the above, it is apparent that a satisfactory and useful QPRI program has been established at WDD. (RDTDJT, Capt. Nichols, ext 32).

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copied from ARDC Weekly Activity Report dated 4 February 1957 WDSIT-57-468 C7-40605, pages 6 and 7.

MAR 6 1957

(3) Reviews reports of progress and findings received from contractor or other agencies pertaining to personnel requirements, training and personnel evaluation. Makes recommendations for acceptance of these reports and for implementing R&D outcomes in system operations.

(4) Determines requirements for technical assistance, information and services of various AFPTRC agencies, or other Air Force agencies, and provides technical assistance as required by WDO. Makes appropriate requests for assistance in the planning and conduct of work for which WDO is responsible.

(5) Coordinates personnel and training R&D activities with other offices of WDO, and with other Air Force agencies participating in the human factors program.

(6) Establishes procedures for the mutual exchange of information between WDO and AFPTRC.

D R A F T

AFPTRC DIRECTIVE

SUBJECT: AFPTRC Participation in WS-107A and WS-315A

1. Purpose. The purpose of this document is to define the participation of AFPTRC in WS-107A and WS-315 and to indicate a manner of integrating this effort with the other portions of the human factors program.

2. Scope. This document reflects the methodology and procedures to be employed in the human factors program as visualized at this time.

3. Responsibilities. AFPTRC is designated the responsible agency for the completion of the tasks defined in ARDC Reg 22-14. The tasks which are of greatest interest to this project are:

a. Qualitative Personnel Requirements Information (QPRI)

b. Proficiency Standards and Evaluation - both individual and team.

c. Command Communications Operability.

d. Control of Morale Factors.

e. Social and Community Relation Studies.

4. Integration. The accomplishment of some of the tasks listed above will be aided by the use of a dynamic system mockup, a simulation device or array of devices that will react to controls and display information in the same manner as the operational system. This dynamic mockup will also be used for other human factors work such as human engineering, and may also be used in the training of cadre personnel. To obtain optimum results, the dynamic mockup willbe built under the sponsorship of WDD and will be controlled by a staff representing all interested agencies. The location of the mockup and the exact composition of the operational effectiveness staff have not been decided at this time; the planning in progress now is aimed at providing the most complete and efficient program.

5. Immediate Procedures. Until such time as the entire human factors program has been approved and implemented, the following steps should be taken by AFPTRC:

a. Generation of QPRI from the data provided them by the associate contractors. The Technical Directive establishing the procedures for the Contractors to provide this information has been issued to those major contractors associated with WS-107A.

b. The establishment of a Special Project Officer in residence at WDD, to be empowered to represent AFPTRC on all matters within the scope of an approved WDD human factors program. The representative will be attached to WDO. Administrative support for the office will be provided by WDO, however, the nature of program development and the functions involved require that this officer's services be available to all staff agencies of WDD. His duties will be as follows:

(1) Provides information to WDO staff agencies on status, plans and progress of all activities of personnel and training R&D activities related to weapon system development for which AFPTRC is responsible. Specifically, these activities include:

(a) Qualitative personnel requirements information.

(b) Participation in operations and personnel analysis program.

(c) Individual and team training studies.

(d) Relevant portions of the AFPTRC technical program.

(2) Formulates and recommends requirements to WDO pertaining to R&D activities in the personnel and training area.

(3) Reviews reports of progress and findings received from Contractor or other agencies pertaining to personnel requirements, training and personnel evaluation. Makes recommendations for acceptance of these reports and for implementing R&D outcomes in system operations.

(4) Determines requirements for technical assistance, information and services of various AFPTRC agencies, provides personnel technical assistance as required by WDO and/or makes appropriate requests for such assistance in the planning and conduct of work for which WDO is responsible.

(5) Coordinates AFPTRC personnel and training R&D activities with other offices of WDO, and with other Air Force agencies participating in the human factors program.

(6) Establishes procedures for the mutual exchange of information between WDO and AFPTRC.

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2

1. ☐ ACTION REQUIRED ☐ CHANGE ☐ SIGNIFICANT EVENT ☐ RESULTS

**MANAGEMENT REPORT**

☒ SYSTEM ☐ PROJECT ☐ TASK ☐ ENGINEERING SERVICE

2. REPORTS CONTROL SYMBOL

PAGE 1 OF 2 PAGES

3. DATE: 31 January 1957

4. TITLE: (U) Advanced Reconnaissance System

5. NUMBER: WS 117L - MR #3

6. PREPARING AGENCY: HQ ARDC - WDD

7. RESP ORGN: WDD-WDTR

8. PARTICIPATING CENTERS: AFCRC, WADC, RADC, AFPTRC

9. PROGRAM STRUCTURE: 100

10. PARTICIPATION/COORDINATION/INTEREST:
USAF/AMC-P, APGC-P, ATC-P, SAC-C, ADC-C
USN/CND-I, USA/C/S-I, Other /. CIA-I

11. TECHNICAL GROUP: 02

12. APPLICABLE AREAS

A. ☐ TECHNICAL B. ☐ TEST C. ☐ FUNDS D. ☐ MATERIEL E. ☐ FACILITIES
F. ☐ MANPOWER G. ☐ PERSONNEL H. ☐ TRAINING I. ☒ CONTRACTS J. ☐ AIRCRAFT

13. NARRATIVE

a. Authorization to obligate an additional $2,000,000 beyond the $3,000,000 previously authorized for System 117L was received 7 December 1956, in TWX, HQ USAF, AFDDP-B 33590.

b. Letter Contract AF 04(647)-103 was let with the Massachusetts Institute of Technology on 25 Jan 1957. Work to be performed is in the Guidance and Control problem area. Funds allocated against this contract total $500,000.

c. Authority to obligate up to a total of $10,000,000 for FY 57 on the WS 117L program in TWX, HQ ARDC RDSCBC-1-16-E, dated 15 Jan 1957, was received.

d. Subsystem Project Plans are in the process of being written and Project number and task number assignments have been established. Upon completion of the writing of the Project Plans, a revision will be made to the System Development Plan. Target date for completion of these actions is the anniversary date of the WS 117L Development Plan, 2 April 1957.

e. Inclosed is a list of project number and task number assignments made during the process of writing Project Development Plans.

f. (1) PR #57-WDD-196-I dated 22 Jan 1957 was initiated to add $5,563,000 to the Lockheed Aircraft Corporation Contract AF 04(647)-97.

(2) OA #57-17 dated 25 Jan 1957 was initiated to transfer $320,000 to RADC for continued effort in the Data Processing and Dissemination area for WS 117L.

(3) OA #57-15 dated 25 Jan 1957 was initiated to transfer $195,000 to WADC for continued effort in research on conversion equipment for nuclear auxiliary power units and for continued research on solar auxiliary power units for WS 117L.

(4) OA #57-16 dated 25 Jan 57 was initiated for transfer of $422,000 to AFCRC for continued research in the Geophysical Environment Area for WS 117L.

[redacted]

WD-57-00437

g. The summary of FY 57 funds initiated on WS 117L is:

| | | |
|---|---|---|
| Lockheed Aircraft Corporation | AF 04(647)-97 | $8,563,000 |
| Massachusetts Institute of Technology | AF 04(647)-103 | 500,000 |
| WADC | OA #57-15 | 195,000 |
| RADC | OA #57-~~15~~ 17 | 320,000 |
| AFCRC | OA #57-16 | 422,000 |
| TOTAL | | $10,000,000 |

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1 Incl
Project Number Assignment
1 page (SECRET)

Charles H Terhune

CHARLES H. TERHUNE, Jr., Colonel, USAF
Deputy Commander, Technical Operations

[redacted] [redacted]

**PROJECT NUMBER ASSIGNMENT**

| Project # | Project | Task #'s |
|---|---|---|
| P 1755 | Airframe | 39750 - 39767 |
| P 1756 | Propulsion | 39768 - 39782 |
| P 1757 | Auxiliary Power Unit | 39783 - 39790 |
| P 1758 | Guidance and Control | 39800 - 39811 |
| P 1759 | Visual Reconnaissance | 39812 - 39821 |
| P 1760 | Ferret Reconnaissance | 39822 - 39831 |
| P 1761 | Infra-Red Reconnaissance | 39832 - 39839 |
| P 1762 | Ground Space Communication | 39840 - 39854 |
| P 1763 | Data Processing | 39855 - 39862 |
| P 1764 | Geophysics | 39791 - 39799 |
| P 1765 | Unassigned | |
| P 1766 | Unassigned | |
| P 1767 | Unassigned | |
| P 1768 | Unassigned | |
| P 1769 | Unassigned | |
| P 8728 | QPRI | 39863 - 39864 |

[redacted]

WD-57-00437

[redacted]

COPY



H. R. Lawrence | A. F. Donovan
P. Dergarabedian | 1 April 1957

Proposed Use of IRBM as Booster For Multi-Stage Vehicles | J. B. Kendrick

The accompanying data sheets cover the work done to date on three new designs using the IRBM as booster for the following multi-stage vehicles:

Test Vehicles

1. Two-Stage Re-entry Test Vehicle M = 23 Payload 500 pounds.

2. Two-Stage Test Vehicle M = 25 Payload 0 pounds.

3. Four-Stage Test Vehicle M = 29 Payload 90 pounds.

Satellites

1. Two-Stage Vehicle. Payload 50 pounds. Orbit at 190 mi. altitude.

2. Three-Stage Vehicle. Payload 200 pounds. Orbit at 300 mi. altitude.

These combinations of vehicles are attained by uniting the Thor and the RTV in various stages. A brief study of the interstage connection between Thor and RTV reveals no major modifications needed to make the connection. The spin-rocket system of the RTV is also utillized in those designs (with streamlined fairings). The Thor guidance system is replaced by a simpler, lighter system for these designs. In view of the simplicity of these modifications, it is expected that the development costs involved in the above proposals will ve very nominal.

The performance and payload capabilities of these arrangements seem to justify further consideration of their potential uses. Please let us know if we can be of further assistance in the development of the idea.

J. B. Kendrick

JBK:gg

See Transmittal letter 3 May 57

[redacted]

[redacted]

## SUMMARY

1. The present proposal is to assemble multi-stage rocket vehicle using the IRBM "Thor" as first stage or booster, and the T-65 as second stage. The plan appears to be feasible without extensive changes to the booster or to the T-65 (see Figs. 1 and 2). The nose cone of the Thor may be removed and the interstage adaptor attached at Sta. 50. The standard T-65 motor and spin rocket installation as used on the RTV are assumed for the second stage. Some weight saving modifications to the guidance and control equipment aid power supply are assumed, and specified.

2. The payload-velocity-range characteristics of the resulting two-stage vehicle are as follows:

| Payload, lbs. | Max. Velocity, ft/sec. | Max. Range, n mi. |
|---|---|---|
| 0 | 25,400 | - |
| 500 | 23,300 | 5,300 |
| 1,000 | 21,500 | 4,150 |
| 2,500 | 18,700 | 2,800 |

3. The bending moment imposed on the interstage connection by the sudden application of 3° motor tip at burnout of Stage 1 is about 500,000 in.lb applied load. This imposes a stress on the booster at Sta. 141 of 2500 psi and on the T-65 motor of 6000 psi. These moderate stresses are higher than any gust load condition would impose, but seem to indicate that the structural problems involved in the proposal would not be critical.

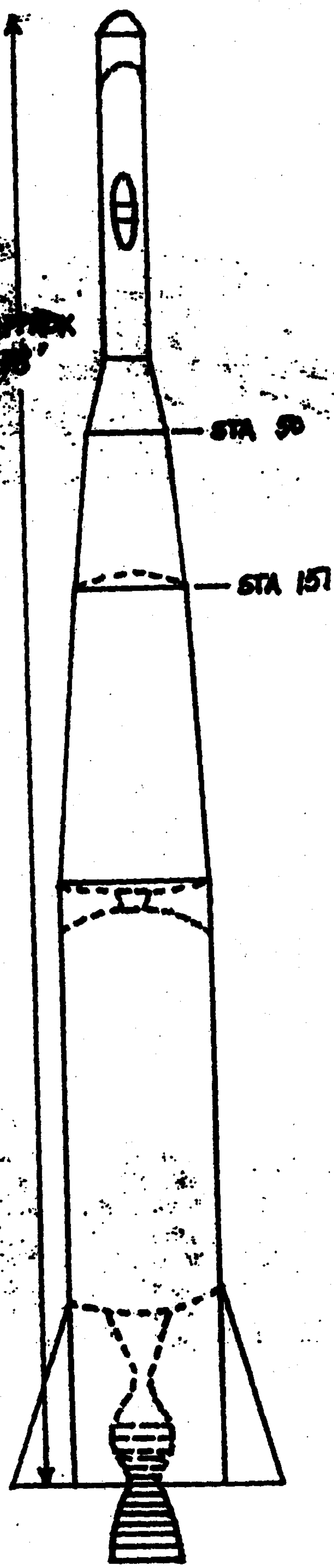
4. Given the IRBM booster and the T-65 motor with spin-up rocket installation as used on the RTV, the cost of assembling the two-stage vehicle is seen to be very nominal. In fact, this is the lowest cost rocket vehicle havin a range of about 5000 miles which has come to the author's attention.

5. In addition to its suggested use as a Re-entry Test Vehicle for tests on a half-size nose cone of the ICBM, many other applications may be devised, such as a weapon, decoy or reconn. vehicle. By virtue of the ease of adaptability from available parts, the latter possibilities should be given further consideration. Some interesting possibilities can also be obtained by use of three-and-four-stage combinations of available parts.

6. A two-stage satellite vehicle capable of orbiting a payload of 50 lbs. can be obtained, by modifications to the Thor guidance, autopilot and power supply, and be use of an 18:1 expansion ratio nozzle on the T-65. With similar modifications, a three-stage satellite capable of carrying a payload of 200 lbs. can be obtained.

7. If a four-stage vehicle is assembled with the IRBM booster and all three stages of the RTV, a Mach number of M = 29 can be attained with a payload of 90 obs. Using the low-thrust attitude-control system after Stage 1 burnout, it is possible to provide re-entry angles of 20 degrees or less with range values of about 2000 miles.

FIGURE 1




**PROPOSED TWO-STAGE ROCKET VEHICLE**

**USING IRBM BOOSTER**

**WITH T-65 SECOND STAGE**

| | |
|---|---|
| Payload | 500 lbs |
| Maximum Range | 5,300 n mi |
| Stage 1 Burnout Altitude | 210,000 ft |
| Stage 1 Burnout Velocity | 12,600 ft/sec |
| Stage 2 Burnout Altitude | 400,000 ft |
| Stage 2 Burnout Velocity | 23,300 ft/sec |
| Apogee | $4x10^6$ ft. |
| Re-entry Angle | 20./ degrees from horizontal |

## Plan of Operation

Fire Stage 1. Climb vertically for 10 seconds, then programmed turn to angle of 20 degrees using programmer and autopilot mounted in Stage 1. Conventional Stage 1 controls with vernier & anti-roll to stage burnout and for 6 seconds thereafter.

Separate and fire spin-up rockets to get 4 revs/sec.

Fire Stage 2, after separation and spin-up initiated by programmer. Spin velocity will maintain constant attitude to about 1 degree.

Separate nose cone by pyrotechnic or mechanical expulsion unit, initiated by time fuse, after burnout of Stage 2.

Nose cone has no attitude control; hence will re-enter at any angle and will tend to oscillate.

Stability, damping, temperatures, pressures and radiation effects can be measured under conditions comparable to ICBM re-entry.

Data can be telemetered to ground stations.

## TWO-STAGE TEST VEHICLE PROPOSAL

The present proposal is to assemble a two-stage rocket vehicle using an IRBM as booster, with a standard T-65 motor as the second stage. This two-stage vehicle might be used as a Re-entry Test Vehicle, capable of carrying an ICBM nose cone (one-half size) weighing 500 lbs., with a re-entry Mach number of about M - 23.

The basic Thor vehicle is not changed except to remove the nose cone and replace it with an adaptor which supports the second stage (see Fig. 2). The gross weight of the two-stage vehicle is about 5000 lbs. greater than the orignal Thor, but the burnout velocity of Stage 1 is still about 12,600 ft/sec. with the two-stage missile carrying 500 lbs. payload. The original guidance and autopilot system is assumed to be repalaced by a lighter system for such tests.

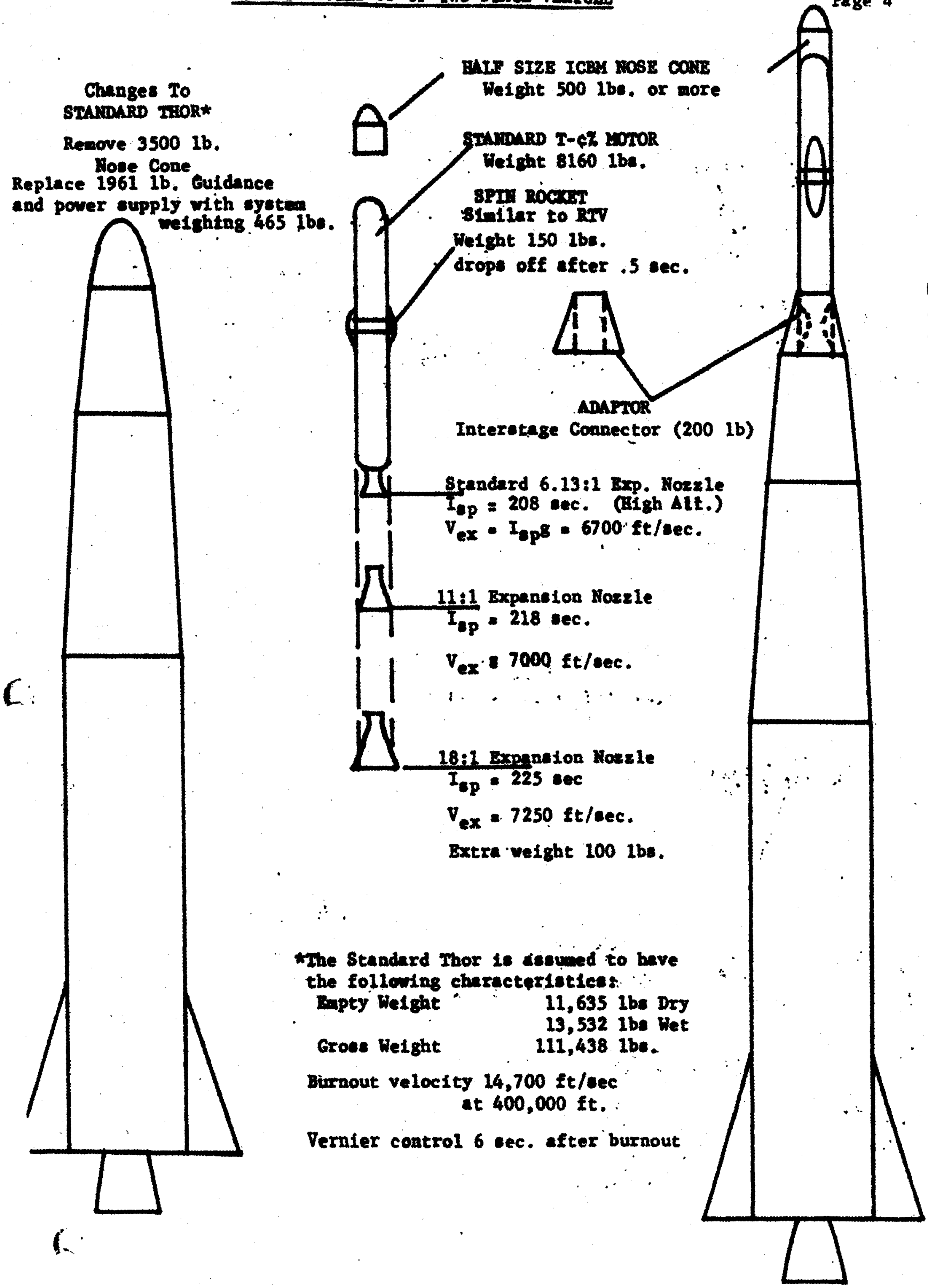
The flight plan (see Fig. 1) is to use the conventional IRBM controls and anti-roll & verniers through the boost period and for 6 seconds thereafter, then to separate and fire the second stage immediately. The RTV spin rocket system gives 4 revs/sec., which provides stability and attitude control during the second stage burning period. After burnout the nose cone separates and continues on trajectory without attitude control. Its shape is believed to provide sufficient stability to cause it to align itself with the flight direction on re-en Temperature effect and stability characteriestics may be measured and telemetered to the ground.

The ICBM nose cone weighing 3500 lbs. consists of approximately fifty (50) percent warhead and an equal amount of shell and structure. The same deceleration would be obtained on a model in which the drag/weight ratio was held constant. For a half size model, the drag is reduced by a factor of four due to the reduction in size, and the weight should also be reduced by a factor of four, to give the same deceleration. Hence, the weight of the half size model would be 875 lbs., or of a one-third size model 390 lbs. The weight of a scale model varies as the cube of the scale; hence the half size model would weigh 1/8 of 1750 lbs. or 220 lbs., while the 1/3 size model would weigh only 65 lbs. Ample weight is then available for extra skin gage and for telemetering equipment

The re-entry angle can be varied from values of the order of 20 degrees corresponding to the ICBM to much higher angles, by adjusting the autopilot programmer during the launch phase. The similitude conditions to be expected for the proposed Re-entry Test Vehicle are as follows:

| Similitude Condition | ICBM | Re-entry Test Vehicle 1/2 Size | Re-entry Test Vehicle 1/3 Size |
|---|---|---|---|
| Re-entry Velocity, ft/sec | 23,000 | 23,300 | 23,300 |
| Re-entry Angle, degrees | 18 | 18 - 90 | 18 - 90 |
| Reynolds Number | $R_o$ | 1/2 $R_o$ | 1/3 $R_o$ |
| Max. Deceleration. "g's" | 60 | 60 | 60 |
| Heating Period, sec. | $t_o$ | $t_o$ | $t_o$ |

# ...EP IN BUILD-UP OF TWO-STAGE VEHICLE




*The Standard Thor is assumed to have the following characteristics:

| | |
|---|---|
| Empty Weight | 11,635 lbs Dry |
| | 13,532 lbs Wet |
| Gross Weight | 111,438 lbs. |

Burnout velocity 14,700 ft/sec at 400,000 ft.

Vernier control 6 sec. after burnout

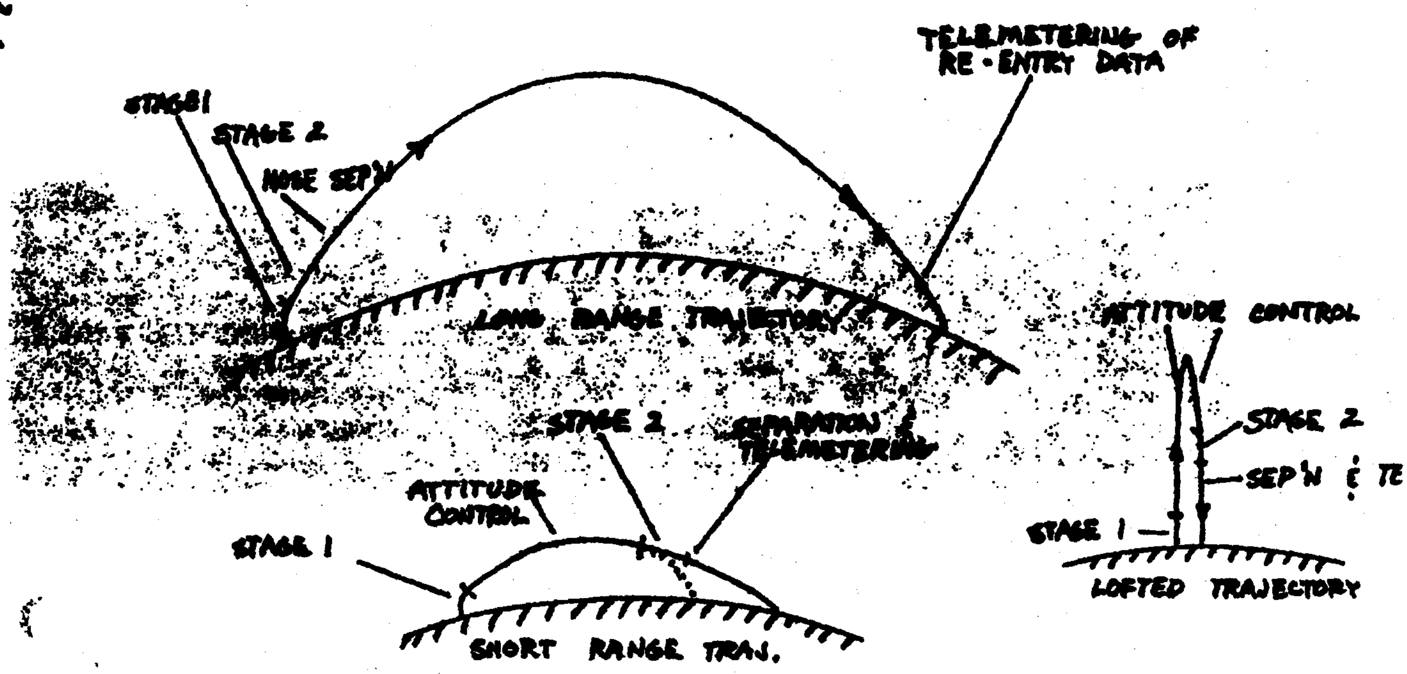
## TRAJECTORIES AND GROUND STATIONS

Long Range Trajectories. The two-stage test vehicle can be launched a long range trajectory of about 5300 n. mi. by tipping over to an angle of about 20 degrees near the end of Stage 1 burning period and holding that angle constant during Stage 2 burning period, which is assumed to commence about 6 seconds after Stage 1 burnout. Ground stations for this type of operation may [illegible] as [illegible] for the ICBM [illegible] trajectories. The [illegible] to impact within about 100 miles of the aiming point [illegible] during [illegible] should be several hundred miles, [illegible] stations should be within telemetering range [illegible]

Short Range Trajectories. In case it is desired to reduce the range of the test vehicle, one effective method is to fire the first stage, then [illegible] to apogee and beyond using low-thrust attitude-control nozzles, then to fire the second stage on the downward leg, at whatever re-entry angle is desired, and at such altitude that burnout will occur above an altitude of 400,000 ft. This procedure will reduce the range to about 2000 miles for 20 degree re-entry angles.

Lofted Trajectories. By firing the first stage nearly vertical, and delaying Stage 2 firing until the downward leg, the range may be reduced to any small value desired. This technique is feasible by use of low-thrust attitude-control nozzles, utilizing the remaining LOX tank gas pressure. Such lofted trajectories will give rather steep re-entry angles, of course, but such may be desired for some tests. The attitude control may work in two ways:

1. Maintain the missile nose up until ready to fire Stage 2. Then separate, spin-up and fire Stage 2, which points downward.
2. Tip the missile over to nose down attitude. Then separate, spin-up and fire Stage 2. (The latter technique requires gyros capable of operation through a range of about 180 degrees change in attitude.)



# WEIGHT SUMMARY AND PERFORMACE ESTIMATE

## TWO-STAGE RE-ENTRY TEST VEHICLE WITH SPIN-UP

| | | | |
|---|---|---|---|
| Present weight empty of IRBM (Dry) | 11,635 lbs. | | |
| Residual Propellant | 1,897 | | |
| Present weight empty of IRBM (Wet) | 13,532 lbs. | | |
| Usable Propellant | 97,906 | | |
| Gross weight of present IRBM | | 111,438 lbs. | |
| Items to be removed | | -5,461 | |
| Nose cone | 3,500 | | |
| Structure forward Sta. 151 | 382 | | |
| A C guidance unit | 991 | | |
| Autopilot units, supports, batteries | 227 | | |
| Reduce size of vernier tanks | 200 | | |
| Items to be added | | +465 | |
| Autopilot and programmer | 150 | | |
| Power supply | 115 | | |
| Adaptor for T-65 | 200 | | |
| Net weight of Stage 1 | | 106,442 lbs | (0 lb. Pay |
| Add T-65 and 500 lb. Payload | | 8,810 | 8.310 |
| Model payload and fitting 500 | | | |
| T-65 with standard nozzle 8160 (including 6978 lbs. propellant) | | | |
| Spin-up rocket installation 150 (drop off after .5 sec) | | | |
| Launch weight of Stage 1 | | 115,252 lbs. | |
| Less usable propellant | | 97,906 | |
| Empty weight of Stage 1 | | 17,346 lbs. | 16,846 |
| Estimated Burnout Velocity - Stage 1 ** | 270,000 ft | 12,600 ft/sec | 12,800 |
| Velocity increment - Stage 2 = $6700^{*}\lg\frac{8660}{1682} - 285 =$ | | 10,700 | 12,600 |
| Estimated Burnout Velocity - Stage 3 | | 23,300 ft/sec | 25,400 |
| | | (M = 23.9) | (M = 26. |

$$^{*}I_{sp} = \frac{1.309 \times 10}{6978} \times \frac{1.66}{1.494} = 208; \quad I_{sp} \times g = 6700 \text{ ft/sec.}$$

(Standard 6.13:1 expansion nozzle)

**dv/dw = -.44 ft/sec/lb. See Fig. 4

# WEIGHT SUMMARY AND PERFORMANCE ESTIMATE

## TWO-STAGE SATELLITE VEHICLE

| | | | |
|---|---|---|---|
| Present weight empty of IRBM (Dry) | | 11,635 lbs. | |
| Residual Propellant | | 1,897 | |
| Present weight empty of IRBM (Wet) | | 13,532 lbs. | |
| Usable Propellant | | 97, 906 | |
| Gross weight of present IRBM | | | 111,438 lbs. |
| Items to be removed | | | -5,461 |
| Nose cone | | 3,500 | |
| Structure forward Sta. 151 | | 382 | |
| AC guidance unit | | 991 | |
| Autopilot units, supports, cables | | 161 | |
| Power converter, supports, batteries | | 227 | |
| Reduce size of vernier tanks | | 200 | |
| Items to be added | | | +485 |
| Autopilot and programmer | | 150 | |
| Power supply | | 115 | |
| Adaptor for T-65 | | 200 | |
| Control of attitude - system*. | | 20 | |
| New weight of booster stage | | | 106,462 lbs. |
| Add T-65 and Orbiter installation | | | 8,460 |
| Orbiter payload and fittings | 50 | | |
| T-65 with 18:1 nozzle** (including 6978 lbs propellant) | 8260 | | |
| Apin-up rocket installation | 150 | | |
| Launch weight of Stage 1 | | | 114,922 lbs. |
| Less usable propellant | | | 97,906 |
| Empty weight of Stage 1 | | | 17,016 lbs. |

Estimated Burnout Velocity - Stage 1 12,750 ft/sec@ 275,000 ft 10,750@$10^6$ft.

Velocity Increment - Stage 2 = 7250**ln $\frac{8310}{1332}$ = 13,250

Earth's Rotational Velocity 1,500

Estimated Burnout Velocity - Stage 2 25,500 ft/sec

Required Orbit Velocity at $10^6$ft. (190 mi) 25,400 ft/sec

*Standard vernier system (6 sec. after burnout) continues until altitude is about 350,000 ft. Long duration jet system may utilize LOX tank gas to turn body to horizontal and hold it for about five (5) minutes, while coasting to apogee.

$$**I_{sp} = \frac{1.309 \times 10^6}{} \times \frac{1.790}{} = 225; \quad I_{sp} \times g = 7250 \text{ ft/sec.}$$

(18:1 expansion nozzle)

## STRUCTURAL CONSIDERATIONS

(See Figure 3)

Case 1. Consider bending moment on interstage connection due to sharp edge side gust of 60 ft/sec., applied at maximum dynamic pressure condition of $q_{max}$ = 800 lbs/sq ft., Altitude = 35000 ft., Velocity = 1500 ft/sec.

Change in angle of attack = 60/1500 = .04 rad.

Side force on nose = $C_L$ qS = 2.0 x 800 x 4.9 x .04
= 315 lbs.

Bending moment at rear of Sgt. = 315 x 300
= 100,000 inch lbs. (applied)

Case 2. Consider bending moment at interstage connection due to suddern application of control on the main motor. One degree tip of main nozzle gives a moment of

$$M_{cg} = \frac{153,000}{57.3} \times 45 = 120,000 \text{ ft lbs/0}$$

Angular acceleration about the center of gravity will be

$$_{cg} = \frac{M}{I} = \frac{120,000}{300,000} = 0.4 \text{ rad/sec}^2\text{/0 (near burnout)}$$

Moment at interstage connection will be

$$M/o = I = \frac{Ml^2}{3} = \frac{9000}{3 \times 32} \times 20^2 \times 0.4 = 14,400 \text{ ft lb/o}$$
$$= 172,000 \text{ in lb/o}$$

*Present T-65 is designed for hoisting moment of 505,000 in lb. and hence could take at least 3 degrees of motor tip.

$$\text{Bending stress on Sta. 151; } f = \frac{My}{I} = \frac{500,000 \times 37}{\pi 37^3 \times .05}$$
$$= 2500 \text{ lbs/sq in}$$

This corresponds to an increase in tank pressure of about 7.5 psi.

$$\text{Bending stress on rear of T-65} = \frac{500,000 \times 15.5}{\pi\ 15.5^3 \times .125}$$

$$= 6000 \text{ lbs/sq. in.}$$

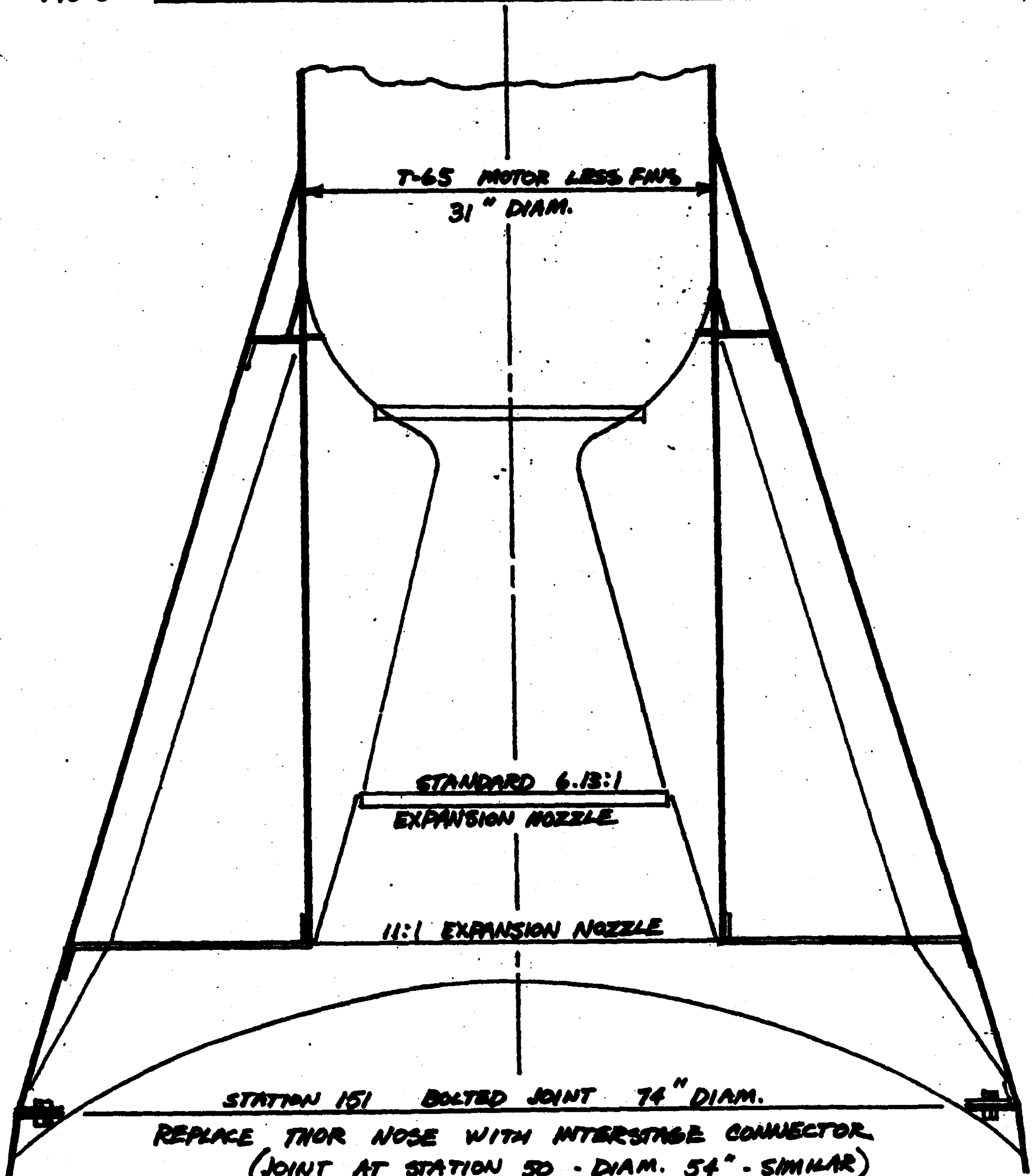
Reaction to resist Bending Moment R = M/d

$$\text{Where d} = 36 \text{ in. } R = \frac{500,000}{36} = 14,000 \text{ lbs.}$$

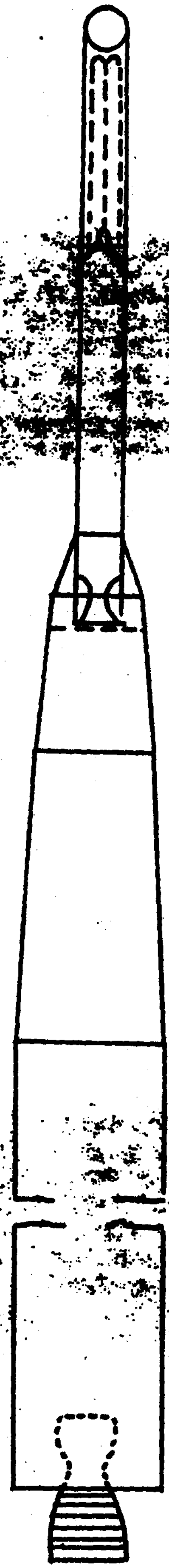
It is simple to carry this load on two rings of adaptor.

*For further analysis of T-65 load conditions, refer to Thiokol Report SP - 59 "Preliminary Model Spec, Rocket Motor, Solid Prop. T-65, 24-KS-50,000. SP-59". 5 July 55. (Conf.)

FIG 3 INTERSTAGE CONNECTION - T-65 TO THOR




SEPARATION OF STAGES: REMAINING GAS IN FUEL TANK MAY BE DUMPED INTO CYLINDER BEHIND T-65



PROPOSED THREE-STAGE SATELLITE VEHICLE
USING IRBM BOOSTER
WITH TWO STAGES OF RTV

| | | |
|---|---|---|
| Payload | | 200 lbs. |
| Stage 2 and 3 weight | | [illegible],980 lbs. including payload |
| Booster burnout velocity | | 12,050 ft/sec |
| Stage 2 | | [illegible],000 |
| Stage 3 | | 5,700 |
| | Earth's Rotation | 1500 ft/sec |
| Total Velocity Stage 3 | | 23,930 ft/sec |

## Plan of Operation

Fire Stage 1. The vehicle then executes a programmed turn to horizontal at apogee, using autopilot. Conventional controls to burnout, with low-thrust vernier to apogee for attitude control.

Separation, Spin-up and Stage 2 Ignition. The second stage is ejected using pyrotechnic or mechanical ejector unit, initiated by programmer on Stage 1. Motion of separation causes spin-up rocket ignition. Stage 2 motor ignition, and initiation of time fuze for Stage 3 ignition.

Stage 3 Ignition. After time fuze ignites Stage 3 it is launched through guide rails attached to empty Stage 2, thus minimizing its dispersion.

Payload Separation. Depending on the purpose of the flight, paylpad may or may not be separated from its empty rocket case.

## WEIGHT SUMMARY AND PERFORMANCE ESTIMATE

### THREE-STAGE SATELLITE VEHICLE WITH SPIN-UP

| | | |
|---|---|---|
| Present weight empty of IRBM (Dry) | 11,635 lbs. | |
| Residual Propellant | 1,897 | |
| Present weight empty of IRBM (Wet) | 13,532 lbs. | |
| Usable Propellant | 97,906 | |
| Gross weight of present IRBM | | 111,438 lbs. |
| Items to be removed - Same as p. 7 | | -5,461 |
| Items to be added - Same as p. 7 | | -485 |
| Net weight of Stage 1 | | 106,462 |
| Weight of Stage 2 | | 9,980 |
| Satellite Payload | 200 | |
| Three Recruit Cluster (including 3 x 263 lbs. propellant) | 1,270 | 1470 Gross Wt. Stage 3 |
| T-65 motor with 18:1 nozzle (including 6978 lbs. propellant) | 8,260 | |
| Spin-up rocket installation | 150 | |
| Launcher for Stage 3 | 100 | |
| Launch weight of Stage 1 | | 116,442 lbs. |
| Less usable propellant | | 97,906 |
| Empty weight of Stage 1 | | 18,536 lbs. |

Estimated Burnout Velocity - Stage 1 12,050 ft/sec@255,000ft 7,730 @ 300 mi

Velocity increment Stage 2 = 7250 $\lg \frac{9830}{2852}$ = 9,000

Velocity increment Stage 3 = 7400 $\lg \frac{1470}{680}$ = 5,700

Earth's rotational velocity 1,500

Estimated Burnout Velocity - Stage 3 23,930 ft/sec

Velocity required to orbit at 300 mile altitude 23,900 ft/sec.

## DISPERSION OF STAGE 2

Deviation from direction of launch $= \phi = \frac{M}{Aw^2} \frac{\sin a\,wt - a \sin wt}{1 - a}$

where M = unbalanced moment - ft. lbs. (various causes)

A = polar moment of inertia about longitudinal axis - slug ft$^2$

B = moment of inertia about lateral axis thru cg.

$a = \frac{A}{B}$

w = spin frequency in rad/sec.

Cause 1 = Malalignment of thrust axis 1/4 degree = .0044 rad.

So $M = 50{,}000 \times .0044 \times 12' = 2640$ ft. lbs.

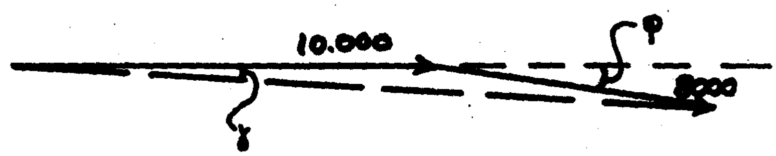
$A = 2 \times \frac{10{,}000}{32.2} \times 1 = 620$ slug ft$^2$ to 120 slug ft$^2$ (at burnout)

$B = \frac{10{,}000}{32.2} \times 25^2 = 195{,}000$ slug ft$^2$ to 39000 slug ft$^2$

a = .0032 .0032

$w = 2\pi \times 4 = 25$ rad/sec using spin-up rockets.

Then $\phi = \frac{2640}{620 \times 25^2} = .0068$ rad. $= .39^\circ$ .034 rad.




Dispersion angle $= .034 \frac{8000}{18{,}000} = .0152$ rad. $= 0.87^\circ$

Cause 2 - Unbalanced mass distribution; i.e. dynamic unblance.
The empty motor can be balanced to the order of $10^{-6}$ rad.

The loaded motor can also be balance to the order of $10^{-6}$ rad.

This cause of dispersion is thus seen to be several orders of magnitude less that Cause 1 above.

Cause 3 - Tip-off from booster. The attitude of the booster is assumed to be held accurately to .001 rad. * Ejection of Stage 2 and spin-up in 0.5 sec. are expected to increase this value to .002 radian; i.e. 45% of Cause 1.

Conclusion: $\epsilon\, y_1 = \sqrt{y_1^2 + y_2^2 + y_3^3 + \ldots\ldots y_i^2}$ is believed to be of the order of 1 degree for Stage 2.

*Such guidance accuracy may require heavier equipment than assumed in the weight summary.

## DISPERSION OF STAGE 3

Cause 1 - Difference in ignition timing for three (3) rockets. It may be assumed that all 3 rockets ignite, but one of them ignites .005 sec. before the others, thus giving an increment of thrust (say 1/3 of 37,000 lbs) for .004 sec. at moment arm of 3 inches.

$$M = M\frac{\Delta t}{t} = \frac{37{,}000}{} \times \frac{.0005}{1.53} \times \frac{1''}{4} = 30.\ \text{ft. lb.}$$

$$A = \frac{2 \times 1770}{32.2} \times 4^2 = 17.5\ \text{slug ft}^2 \text{ to } 8.0\ \text{slug ft}^2$$

$$B = \frac{1770}{32.2} \times 8^2 \qquad = 3500\ \text{slug ft}^2 \text{ to } 1700$$

$$a = \qquad .005 \qquad .005$$

$$\phi_1 = \frac{30 \times}{8 \times 25^2} - .0048\ \text{rad.}$$

$$\gamma_1 = .0048\ \frac{5200}{23{,}000} = .0011\ \text{rad.}$$

Cause 2 - 2% difference in thrust of one of three motors

$$M = .02 \times 37{,}000 \times \frac{1}{4} = 185\ \text{ft. lb.}$$

$$\gamma_2 = .0011 \times \frac{185}{30} = .0068\ \text{rad.}$$

Cause 3 - Malalignment of thrust line of one motor $1/4^\circ$ = .0044 rad.

$$M = 37{,}000 \times .0044 \times 6 = 980\ \text{ft. lb.}$$

$$\gamma_3 = .0011 \times \frac{980}{30} = 0.035\ \text{rad.} = 2^\circ \text{ (Probably less)}$$

Conclusion: $\Sigma\, Y_1 = \sqrt{(Y_1^2)_1 + (Y_1^2)_2 + (Y_1^2)_3}$ is believed to be

of the order of 2 to 3 degrees, according to the above analysis. This will vary as $1/w^2$; hence a slight increase in spin rate would be desirable.

## WEIGHT SUMMARY AND PERFORMANCE ESTIMATE

### FOUR-STAGE VEHICLE WITH IRBM AND RTV

| | | |
|---|---|---|
| Present weight empty of IRBM (Dry) | 11,635 lbs. | |
| Residual Propellant | 1,897 | |
| Present weight empty of IRBM (Wet) | 13,532 | |
| Usable Propellant | 97,906 | |
| Gross weight of present IRBM | | 111,438 lbs. |
| Items to be removed - Same as p. 7 | | -5,461 |
| Items to be added - Same as p. 7 - | | -485 |
| Net weight of Stage 1 | | 106,462 lbs. |
| Weight of Stage 2 | | 10,500 |
| RTV 1st Stage 10,500 lbs (less fins) including 6978 lbs propellant plus spin-up rockets 150 lbs. which drop off after .5 sec. | | |
| RTV 2d Stage 1770 lbs. including 3 x 263 lbs propellant | | |
| Launch Weight of Stage 1 | | 116,962 lbs. |
| Less usable propellant in Stage 1 | | 97,906 |
| Empty weight of Stage 1 | | 19,056 lbs. |
| Estimated Burnout Velocity of Stage 1 | | 11,800 ft/sec |
| Velocity increment Stage 2 = $7250 \log \frac{10,350}{3,372} - 285$ = | | 7,800 |
| Velocity increment Stage 3 = $7400 \log \frac{1,770}{980}$ = | | 4,400 |
| Velocity increment Stage 4 = $7400 \log \frac{500}{240}$ = | | 5,400 |
| Estimated Burnout Velocity - Stage 4 | | 29,400 ft/sec |

# APPENDIX

## METHOD OF COMPUTING PERFORMANCE

The performance of Stage 1 was computed on the 1103 Computer in the same detailed manner as for the IRBM. Four values of burnout weight were used; i.e., the nominal weight of the standard missile and three higher values. Burnout velocity and altitude is plotted in Fig. 4 as a function of burnout weight for the case of 97,906 pounds of usable propellant.

For later stages, the velocity increment is shown in Fig. 5 as a function of mass ratio for various vlues of effective exhaust velocity. The effect of gravity and drag for Stage 2 operation in a long range trajectory was computed on the 1103 Computer, and found to be 285 ft/sec. The velocity increments determined from the chart should therefore be decreased slightly for gravity and drag.

Range as a function of burnout velocity is shown in Fig. 6 for the IRBM family of missiles. The four points computed on the 1103 Computer are distinguished by asterisks.

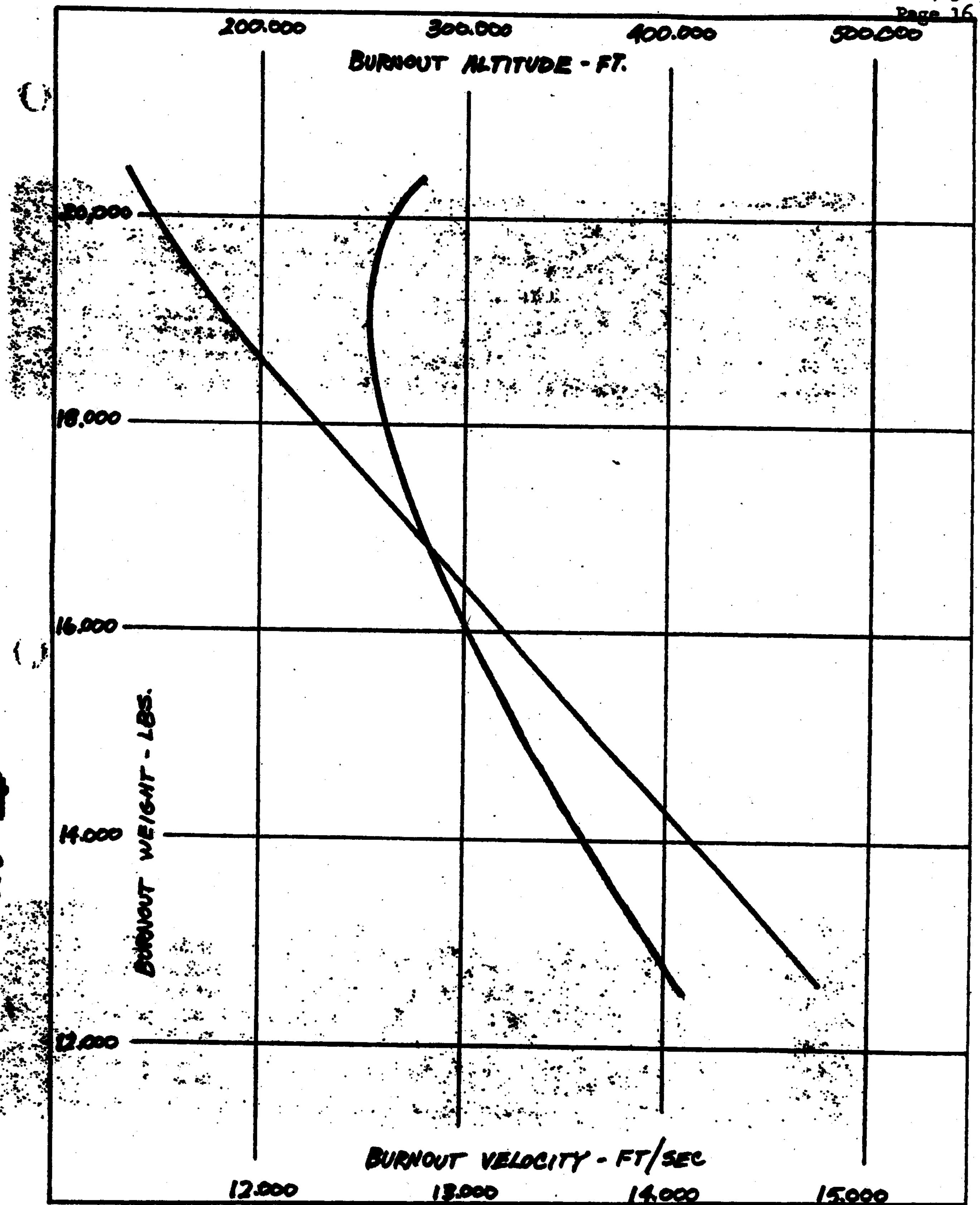



FIG. 4 BURNOUT VELOCITY AND ALTITUDE VS WEIGHT FOR STAGE I

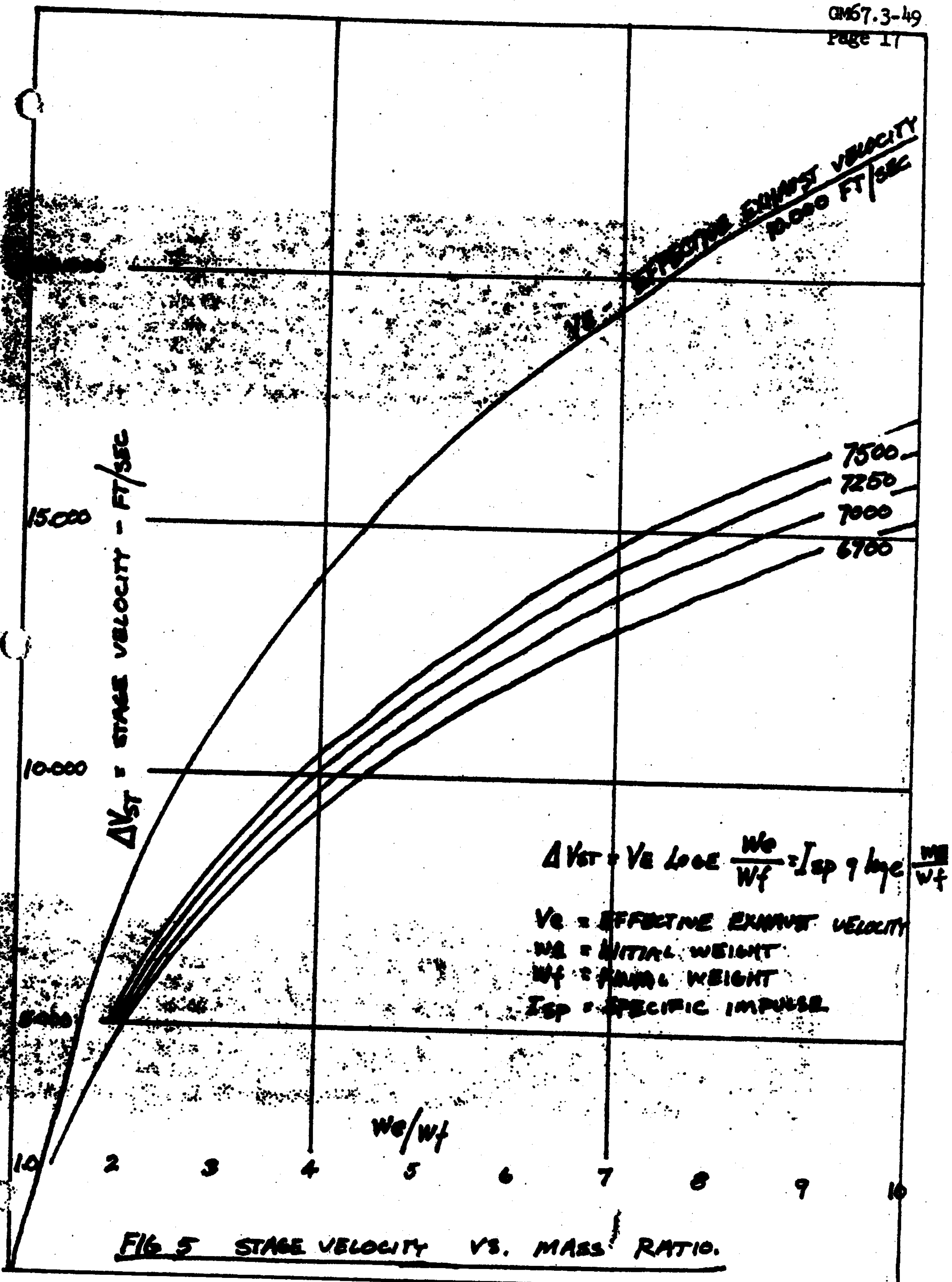



FIG 5 STAGE VELOCITY VS. MASS RATIO.

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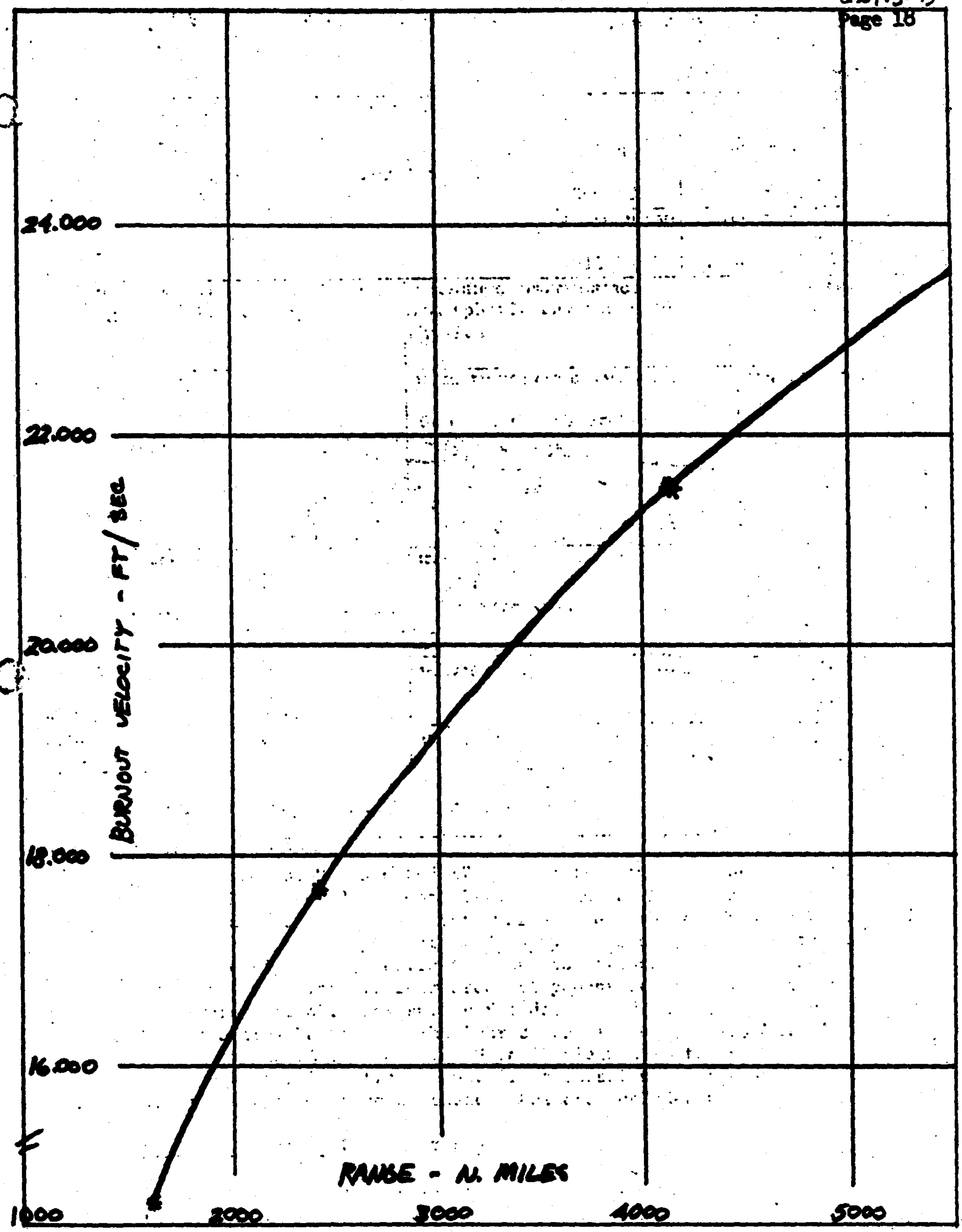


FIG. 6 RANGE VS. BURNOUT VELOCITY

[redacted]

AF-WP-L-29 MAY 53 5M

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4

**RDB PROJECT CARD**

| TYPE OF REPORT | REPORTS CONTROL SYMBOL |
|---|---|
| New Project | DD-RDB(A)48 |

| 1. PROJECT TITLE | 2. SECURITY | 3. PROJECT NUMBER |
|---|---|---|
| (UNCLASSIFIED TITLE) Geophysical Environment Data for ARS, WS117L<br>Short Title: ARS Environment | SECRET | 1764 |
| | 4. INDEX NUMBER: 2-117L | 5. REPORT DATE: 2 April 1957 |

| 6. BASIC FIELD OR SUBJECT | 7. SUBFIELD OR SUBJECT SUBGROUP | 7A. TECH. OBJ. |
|---|---|---|
| Strategic Air Warfare System 117L | Atmospheric Physics - 7B Physics | SA-9A, 9B, 10 IO-9 |

| 8. COGNIZANT AGENCY | 12. CONTRACTOR AND/OR LABORATORY | CONTRACT/W.O. NO. |
|---|---|---|
| ARDC | Geophysics Research Directorate | - |
| 9. DIRECTING AGENCY: GRD, AFCRC | See 21c | See 21C |
| OFFICE SYMBOL: CRZA / TELEPHONE NO.: HL 2-7730 X-9 | | |

| 10. REQUESTING AGENCY | 13. RELATED PROJECTS | 17. EST. COMPL. DATES |
|---|---|---|
| HQ, USAF | WS 117L | RES. 1957 |
| | | DEV. 1958 |
| | | TEST 1959 |
| | | OP. EVAL. |

11. PARTICIPATION, COORDINATION, INTEREST

| USAF | USN |
|---|---|
| AMC-P ATIC-I | CNO-I |
| SAC-I | USA |
| ADC-I | C/S-I |
| APGC-I | Other |
| ATC-I | CIA-I |

14. DATE APPROVED

| 15. PRIORITY | 16. |
|---|---|
| 1A | A(Missiles) |

| 18. FY | FISCAL ESTS. (M $) |
|---|---|
| Prev | 160M |
| FY57 | 422M |
| FY58 | 1000M |
| FY59 | 1410M |
| FY60 | 425M |
| Total | 3417M |

INFORMATION COPY

19. This is the initial report on this project

20. REQUIREMENT AND/OR JUSTIFICATION

System Requirement No. 5 dated 17 October 1955 and subsequent letter directive from WDD dated 23 December 1955 assigned to AFCRC the responsibility for providing environmental data which affect the design and testing of ARS vehicles. Based on independent studies by the Geophysic Research Directorate the three design study contractors and conferences with personnel of the WSPO, it was concluded that in four areas of geophysical environment insufficient data were available for successful design and test of the Advanced Reconnaissance System Vehicles. The four so considered are (a) Meteor Physics (b) Density at Orbital Altitudes, (c) Solar Radiation in the U.V. and X-ray Region and (d) Thermal Radiation. Specific discussions of requirements for additional design data in each of these areas are included under each task.

21 a. Brief and Military Characteristics

The objective of this project is to provide environmental data considered essential to insure and simplify the design of a successful Advanced Reconnaissance System.

[redacted]

| 22. RDB [redacted] | IC & P | X. | I. | C. |
|---|---|---|---|---|

[redacted]

DD FORM 613



265-57-01140

[redacted]



21 b. Approach

See individual Tasks. (21c)

21 c. Tasks

1. (a) T-39791 - Solar Radiation Program in Ultraviolet and X-ray Region for ARS

(b) This task will be accomplished through a combination of "in-house" and contractual effort. Currently the contractual effort is by Comstock and Westcott, Inc., under Contract AF 19(604)-1889. Other contractors contemplated at the moment are: University of Chicago, Chicago, Ill. and Radio Corporation of America, New York, N. Y.

(c) Task objective is to determine the intensity of Solar U.V. and Soft X-ray radiation as it would strike the satellite and the extent of damage due to collisions of molecules, atoms and ions with the satellite surface.

Requirement and/or Justification

Vehicle design will be affected by radiation in the solar ultraviolet and X-ray region. It has been shown by GRD that the quantum yield of photoelectric effect on metals exposed to short wavelength ultraviolet is about 250 times as great as that of the conventional photoelectric effect in the visible an near UV. Thus, since a vehicle traveling at 500 km is essentially receiving unfiltered solar radiation of low wavelength, one must consider a possible "charging-up" of the metal due to the loss of photoelectrons from the surface. This charge can theoretically rise to a high voltage, depending on the wavelength and intensity distribution of the incident radiation. Such a charging-up could influence the telemetering or other electronic functions of the equipment in the vehicle. Also, it is known that short wavelength ultraviolet causes deterioration of a plastic surface. This could fog plexiglass and damage rubber-like materials. Present data are inadequate to evaluate this effect simply because we do not know within several factors of ten the solar intensity above the atmosphere at wavelengths below 1500 Angstrom Units and we believe that design purposes can therefore not be satisfied.

The effect of atmospheric composition at 500 km is difficult to assess. There might be heating of the vehicle to contend with, due to recombination of atoms on the surface as well as impacts with other atoms and molecules. Such a heating effect would be super-imposed on that due to solar radiation and would act even at night when the vehicle is shielded from the sun by the earth. Since solar ultraviolet and X-ray radiation is part of the total picture of the integrated interaction of the sun and the earth's atmosphere and data of this kind are extremely scarce the measurements of these variables at vehicle altitude would be unique. These measurements would give us information as to the physical mechanisms operating in the ionosphere and delimit in an essential fashion the ionospheric functioning by giving us a better understanding of the nature of atmospheric ionization. This would assist in the forecasting of ionospheric propagation and could contribute toward the solution of the satellite communications problem.

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(d) Approach

At the present time, there are two main areas of research:

(1) A laboratory investigation of the effect of collisions of particles, atoms, molecules and ions on solid surfaces (sputtering) conjoined wit the effect of recombination of atomic species on solid surfaces.

This laboratory study will be carried on mainly in-house, but with modest contract let for auxiliary studies.

Primary in this research will be the problem of developing ultra high vacuum mass spectrometer tubes for study of the effect of ion bombardment of surfaces. Such a tube would require suitable component parts, valve sealants, tubing and pumps to obtain this vacuum. This is necessary to duplicate in the laboratory pressures at satellite altitudes. The feasibility of this development has already been established by in-house work. About half of this is finished, leaving principally design engineering.

Different techniques, among them molecular beams, will be used for the acceleration of the non-charged particles on receiving test plates the nature of which will be determined by vehicle design. In particular, the effect on metals will be examined. The plates will be tested by a variety techniques, microscopes, etc., for possible damage due to momentum transport (sputtering).

(2) Solar ultraviolet and X-ray study -- The goal set in this research is the measurement of absolute intensities of the solar spectrum from 1500 Angstroms down to a few Angstroms. This program is divided into three phases, laboratory investigations, measurements of solar intensities in rockets and finally, construction of the satellite instrumentation by miniaturization of rocket instrumentation.

This region of the spectrum is relatively unexplored; hence, a whole new system of monochromators, sources and detectors must be constructed. First, there must be the calibration against a primary detector, thermocouple not calorimetric. These secondary detectors must be reliable and reproducible. In type, they may be dependent upon the interaction of radiation with a filling gas or on the effect of radiation upon a cathode. Therefore, laboratory work will be needed to select adequate detectors.

The monochromators to be constructed are unique in design and rather elaborate in the equipment necessary to perform the desired calibration. They have already been designed and are presently under construction. To put them into actual operation will take an extensive period of working-out of the manifold details and problems involved.

The construction of detectors will be to a large extent under contract.

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Because the interaction of matter with radiation in this region is as yet little understood, the objectives can only be reached by an extensive deepening of our insights into the nature of these processes. For example, a predicted phenomena is that of photoconductivity effect. This, when more fully investigated, may yield a possible secondary type of detector.

The process of building suitable detectors can only go on simulateneously with this type of exploratory research. After the laboratory phase, the instruments will be flown in Aerobee-Hi rockets to measure the radiation intensity above the earth's atmosphere. The number of flights necessary will be at least six, possibly increasing to eight or nine depending on results.

2. (a) T-39792 Interplanetary Matter and Meteor Physics in <u>Relation to ARS</u>

(b) This task will be accomplished through a combination of "in-house" and contractual effort. Currently the following contracts are in effect:

(1) - AF 19(604)-1894 - Temple University
(2) - AF 19(604)-1908 - Oklahoma A and M
(3) - AF 19(604)-1901 - Smithsonian Observatory
(4) - AF 19(604)-1892 - Stanford Research Inst.

No other contracts are contemplated at the moment.

(c) The objective of this task is to determine the possible hazard from meteoric bombardments to a vehicle above the earth's atmosphere and to provide data as to the spatial distribution, size, composition, and velocity of micrometeoric matter.

<u>Requirement and/or Justification</u>

The hazard from meteoric collision with a body essentially in interplanetary space, unprotected by the earth's atmosphere is not very well known. The probability of collisions intense enough to destroy the vehicle or affect its operation is very important in the design of a protective "meteor bumper" to insure proper operation of the vehicle. These meteoric collisions may result in dangerous surface erosions affecting heat exchange properties and optical windows. Stability, temperature control, reliability may all be influenced by meteoric bombardment.

Information regarding the influx of meteoric material into the earth's atmosphere has been collected by the following methods: visual observations, photography, radio reflections from meteor trails, and telescopic observations. From such studies and measurements, the diurnal and seasonal variations in the influx of sporadic meteors, velocities and radiants of shower meteors, velocity distribution of sporadic meteors, mass distribution of meteors, and spatial density of meteors have been determined. These measurements give a value for the rate of influx of interplanetary material into the earth's

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atmosphere of $5 \times 10^6$ gm per day. However, these ground-based methods are limited and a grave anomaly, of importance to the ARS, exists. Since the visual and photographic methods are only sensitive to meteors of visual magnitude +5 ($10^{-2}$ grams mass, $10^{11}$ ergs energy) and the radio and telescope methods to visual magnitude of the order of +8 (mass x $10^{-4}$ gm, energy $6 \times 10^9$ ergs), information derived from these methods regarding meteoric particles with mass less than $10^{-4}$ gm is seriously lacking. These smaller particles are far more numerous and therefore have a high probability of encountering a vehicle above the earth's atmosphere.

The anomaly on the influx of interplanetary matter arises from various indirect measurements of the fine interplanetary matter. These measurements include determination of the density of matter in the zodiacal cloud, or the interplanetary dust cloud, by S. C. Van de Hulst and C. W. Allen; measurements of the nickel content in deep sea ocean sediments by H. Pettersson and H. Rotsch; and initial rocket soundings from V-2 and Aerobee rockets. These measurements indicate a rate of accretion of interplanetary matter by the earth as high as $5 \times 10^{10}$ gm per day, up to a factor of $10^4$ times higher than predicted from regular methods of observation. It seems, also, that this high rate of influx may be necessary to explain the presence of the E region ionization during the night. This higher rate leads to a'probably encounter for visual magnitude 15 (energy $10^{10}$ Bev) of one hit per square meter per second. Such impact rates are significant for a vehicle with a required lifetime of about a year. These impact rates may possibly be further increased by a factor as great as $10^4$ to $10^6$ if geomagnetic focusing of cosmic dust particles, suggested also by S. F. Singer, was detected experimentally.

From the standpoint of ARS, the hazard to space vehicles in an interplanetary environment seems closely dependent upon the effects of interplanetary matter, as well as such other factors as cosmic radiation, atmospheric drag, and energetic solar radiation. On the one hand, relatively large impacts may result in penetration of the vehicle surface and subsequent destruction of important equipment, affecting the usefulness of the vehicle, while smaller impacts would result in an abrasion affecting the usefulness of lenses and photosensitive surface areas, etc.

It is therefore necessary to determine the probability of collisions with interplanetary particles as a function to time, and the effect of the individual collisions on the vehicle in order to determine design criteria for ARS. These requirements may be fulfilled by a measurement program involving high altitude rockets and satellite type vehicles, and direct laboratory studies of high speed impact interactions. Related studies that would support direct probing methods are also of interest in order to afford a higher degree of validity to the experimental results.

(d) Approach

The areas of investigation in this task may be broadly divided into rocket and satellite experiments and laboratory studies.

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(UNCLASSIFIED TITLE) Geophysical Environment . Data for ARS, WS117L 2 April 1957
Short Title: ARS Environment Proj 1764

(1) Determination of the influx of meteoric material by rocket experiments

This includes the design and construction of equipment and launching of rockets containing this equipment for the detection of meteoric material. The equipment for detecting meteoric material will operate on the principle of detecting the vibrational energy generated upon impact. This apparatus includes piezoelectric accelerometer, an amplifier, and a telemetering system with its associated ground-based receiver-recorder. Aero bee and/or Nike-Cajun rockets will be used to carry out the program. It is important that a statistically valid sample of meteoric material be obtained for final design of the ARS.

The program of research for direct rocket probing of interplanetary matter involves first the design and development of a basic piezoelectric accelerometer capable of measuring the spatial distribution and mass of interplanetary particles. Such equipment has been used by Prof. Bohn in 1949 and was used again during 1955. Hence, only minor develepement and calibration methods are required prior to construction of the basic unit. Such equipment is sensitive enough to detect particles of visual magnitude 25. Approximately ten to twenty detection units will be built on a semi-mass production basis. Approximately five to ten successful experimental firings from Holloman Air Force Base using Aerobee rockets are required prior to establishing a weighted statistical figure for the intensity and probability of a particle impact with a vehicle. About five successful firings at a high latitude would be required to establish the extent of a latitude dependence particularly by small meteoric particles.

(2) Design and development of equipment for detection of meteoric material for inclusion in the ARS.

It is expected that development work in the rocket phase of detection of meteoric material will aid greatly in the development of equipment of a similar nature to be included in the early oribiting and non-orbiting ARS test vehicles. It is important that the apparatus be designed with a high degree of reliability, yet be lightweight, and have a low power requirement.

(3) Theoretical and laboratory studies and high speed impact phenomena

Essential to the measurement of interplanetary matter is a knowledge of the relation of the intensity and frequency distribution of the accoustical energy generated by high speed meteoric impacts to the mass, the mass density, and the velocity of collision with the meteoric particle. Thereby, the surface erosion and the distribution function of meteoric material in space may be determined from the ARS measurements. Polished plate experiments on rockets that may be recovered will yield some information, but high speed impact measurements in the laboratory for the study of collisions of solids with gases and surfaces are required to support this subtask. In addition, optical and radio measurements of meteor influx and atmospheric interactions will also assist in the direct experimental studies.

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High speed impact studies of particles with surfaces are possible at this time only by a method using shaped charges, since only by this means have particle velocities comparable with meteor velocities been generated in a laboratory basis. The physics of high speed interactions is not well understood, and experimental measurements at velocities up to 50 km/sec are highly desirable. Even then, it is difficult to predict the degree of success of this technique, but this approach is presently available at relatively low cost. Because the energy density of the impacting reactions may be as much as a hundred times greater than previously observed, considerably different effects than theoretically predicted are to be expected.

(4) Theoretical studies

This subtask is concerned with the correlation and application of various data applicable to the problem of determining the hazard from interplanetary matter upon ARS. Where possible, information from shock tube studies, radio and optical meteoric studies, investigations of meteoric craters, deep see ocean sediments, microchemical analysis of rare gas constituents, etc., that contribute to the overall problem of the determination of the hazard from interplanetary matter will be considered. In this manner, the reliability of the information derived from the direct experimental program may be further evaluated.

The primary emphasis of the approach of the 4 subtasks, therefore, is the determination of the spatial distribution of interplanetary matter, the size distribution, and the mass density of this material, and thus with suitable laboratory studies to be able to predict the probability that meteoric material may penetrate a given thickness of satellite skin per unit time, and the rate of erosion per unit area for a surface exposed above the earth's atmosphere. An improved understanding of the physics of hypersonic interactions in the velocity range equivalent to an energy of 50 to 1000 electron volts is also of importance.

The rocket program for detection of meteoric particles would require approximately ten successful rocket flights up to altitudes as high as 150 km before sufficient data to make a satisfactory estimate of the rate of influx of interplanetary matter. It should be stressed that ten successful flights corresponds to a total measuring time of about a quarter of an hour above altitudes of 50 km. (Measurements below this altitude would be contaminated by terrestrial material). From considerations of the normal difficulties experienced in past experimental programs using high altitude rockets, probably instrumentation for fifteen rockets will be necessary. The estimated cost of development and construction of this instrument is 60M to 100M based on cost of 5M per instrumentation. The cost of rockets for this work based on 30M for a single Aerobee rocket would be 450M for 15 Aerobees. However, since the meteoric detection equipment may be used on a Nike-Cajun rocket system, also, the overall rocket cost is expected to be much lower than the

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estimate using Aerobee because the Nike-Cajun system when it becomes available would cost less than half as much as an Aerobee. The fund requirements however, are based upon rocket requirements using Aerobees.

Upon availability of an ARS vehicle as a platform for the measurement of meteoric particles, a relatively large sampling time for making measurements of interplanatary matter will be available. It is therefore of importance that meteoric detection equipment be mounted on such an early test vehicle. Such equipment must be very reliable and capable of operation over a long period of time, while its weight should be kept to a minimum. The development of equipment for the ARS is estimated to cost 50M over a two-year period, while flight and rocket testing would involve an additional 40M.

The program on research on high speed impact phenomena will be based on studies using shaped charges, and also investigations of dynamic interactions of meteoroids in the atmosphere. The estimated cost of the initial phase of this work is 80M over a two-year period.

3. (a) T-39793 - Atmospheric Density Determination at Altitudes of Artifical Earth Satellites.

(b) This task will be accomplished through a combination of "in-house" and contractual effort. Current contracts in effect are as follows:

(1) AF 19(604)-1871 - University of Michigan
(2) AF 19(604)-1890 - University of Michigan

(c) The objective of this task is to obtain reliable values of atmopheric density, pressure and kinetic temperature between the altitudes of 200 to 400 miles.

Requirement and/or Justification

The primary objective of this task is to obtain reliable values of atmospheric density, pressure and kinetic temperature in the vicinity of 200 to 400 miles altitude, the altitude of a proposed satellite system. These data are needed in solving various problems on the design of the ARS vehicle. Some of these problems are:

1. What altitude must be maintained by a satellite vehicle of specified size and shape in order that the atmospheric drag be sufficiently small to permit a minimum specified life time of the satellite.

2. How does temperature rise on the skin of the satellite vehicle due to aerodynamic heating (friction between itself and the molecules of the atmosphere) vary with altitude below 400 miles altitude.

3. What is the minimum value of mass to cross-section area ratio of a satellite which will permit the required lifetime to be achieved at specific

orbiting altitudes. The present estimates of the magnitudes of these properties are quite uncertain. Pressure and desnity may be in error by factor of 100 or 1000 at 350 miles altitude because they are based on extrapolation of values at 100 miles and on unconfirmed theories. Extension of measurements to 200 miles or 250 miles altitude would greatly improve the reliability of extrapolation to 300 miles, while measurements at 300 miles would be even better.

The task involves the study and implementation of two basically different methods for obtaining the necessary data. The first method involves the direct measurement of the drag force on a sphere falling from great altitudes after its ejection from a rocket. This method is of special interest since it is the drag force on the satellite which ultimately determines its life Results of this measurement are free from effects of contamination from the rocket. The limiation of this method lies in the fact that the sphere must fall from an altitude of 10 to 20 percent higher than that for which the drag data are desired.

The second method for obtaining these data involves a selective ionization gauge for measuring number density of particular constituents as well as total number density. This method in principle may be used to the peak of rocket trajectory but is adversely affected by contamination from the mother rocket. Various outgassing and ejection techniques under study will minimize this limiation.

A secondary objective of this task is to develop the necessary techniques and devices for measuring pressure, temperature and density from ARS test vehicles. This phase depends in part upon the success of the primary objectives, although the conditions for outgassing are sufficiently different to materially simplify the accomplishment of this objective.

(d) Approach

At this writing, the task appears to involve eight steps.

(1) Feasibility study of two proposed methods for measuring the required parameters.

The feasibility of two methods for the measurement of atmospheric density, pressure and temperature are being explored. These methods are (1) an extension of the falling sphere experiment and (2) the ionization gauge experiment currently being employed up to altitudes of 75 to 100 miles.

The present falling sphere experiment involves the ejection of a sphere from a rocket at high altitudes, and the measurement of the drag force of the atmosphere on the sphere as it moves though space. (It may be ejected anytime after the end of rocket powered flight and hence will rise to a peak slightly lower than that of the rocket.

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The sphere contains an accelerometer which measures drag acceleration as a function of time to 1% accuracy, independent of orientation. The sphere also contains a radio transmitter which relays the accelerometer signal to a ground recorder. The double integration of the total acceleration yields sphere altitude as a function of time to a reasonable accuracy for high angle flights. An independent complicated analytical reiteration method yields sphere velocity and altitude versus time independently. The determination of atmospheric density depends upon a knowledge of drag coefficient at the mach numbers and Reynold's numbers experienced by the sphere. These values of drag coefficient have been measured in ballistic ranges and hypersonic wind tunnels.

The present ionization gauge experiment involves the measurement of ion current from ionized air molecules on one or more chambers on the surface of a rocket. The knowledge of air pressures around conical surfaces with known orientation to the air stream leads to a value of ambient pressure and to temperature if the relative velocity of cone to air is known. This sytem requires some kind of tracking for high accuracy although integration of pressure and temperature values results in approximate altitudes.

Extending the sphere experiment to higher altitudes involves increasing the area to mass ratio of the sphere, shifting the range of the accelerometer to very low values (this essentially eliminates its use at higher accelerations, corresponding to lower altitudes). The system does not work at or near zenith since the velocity is too low (approaching zero for a verital flight) for drag to be measurable.

The extension of the ionization gauge method involves three main steps: (a) Adapting to rocket use existing ionization gauges designed for ver low pressures (Alpert type); (b) eliminating the effect of contamination of the measurement from rocket outgassing by housing the gauges in a separate thoroughly outgassed body which will be spring ejected from an evacuated cavity at high altitude; (c) Eliminating the uncertainty of molecular dissociation by making the gauge sensitive to only one or two specific molecular species through simple mass spectrometer techniques.

The feasibility study of the use of these methods at high altitudes is currently under way and involves a study of (a) the theoretical limitation (b) inherent sources and estimates of errors (c) engineering difficulties (d) space and weight requirements (e) estimated cost per flight. An analysis of these studies will determine which method has the better chance of success, but at present it appears that both should be tried. Perhaps both may be flown simultaneously in each rocket vehicle.

(2) Design and construction of preliminary models of equipment for one or both methods

This step of the task involves the design and construction of the equipment which is expected to be flown in the initial series of rocket

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flights. This step may include wind tunnel tests or rocket flight tests of specific portions of the total instrumentation for the method, as well as the final packaging of at least two sets of the equipment for the rocket flights of each of the two methods.

(3) <u>Initial rocket flights of the equipment for one or both methods</u>

This step includes the field operation involved in preparing the equipment for actual rocket flight together with the necessary operation of the rocket flights for each method. The preparation for two flights is insurance against rocket or other failure during the first flight.

(4) <u>Evaluation of flight performance and necessary redesign of equipment</u>

This step involves the detailed study of the telemeter record of the flight to determine the performance of the various parts of the measuring equipment, as well as the transcription of recorded data to usable form for computation of the required atmospheric parameters. Deficiencies in the performance of the equipment detected by the record are then to be removed by suitable redesign. Because of the urgency of the program, major portions of the equipment should already have been constructed at this point for the series of data-gathering flights and it will be necessary to take the chance of having to modify some of the components at this stage of the task.

(5) <u>Major series of data gathering rocket flights</u>

This step of the task involves the flying of three to ten sets of instrumentation for density and or pressure measurements in special 300 mile altitude rockets presently being designed for AFCRC or in non-orbiting ARS Weapons System test vehicles or both. Contact will be made with the ARS Weapon System office to obtain space in these test vehicles. If the first three flights indicate sufficient self-consistency the balance of the data gathering flights can be cancelled.

The special 300 mile altitude rocket is a multi-stage system made up of existing rocket components, i.e., Cajun rockets and Nike boosters. An engineering study presently contracted for will result in engineering drawings for the necessary fins and coupling devices and nose cone necessary to combine the propulsion system into an atmospheric data gathering rocket system capable of carrying 40 lbs. of instrumentation to 200 - 300 miles. Upon completion of this engineering study, engineering drawings will be available from which the necessary parts and propulsion units may be built and purchased at an estimated cost of $20,000 per rocket system.

(6) <u>Analysis of data and preparation of revised atmospheric model</u>

This step of the task involves the reading of telemeter records, the computation of the values of the atmospheric parameters, and

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the compilation of these data into consistent atmospheric models. This step is not necessarily limited to follow step (5) chronologically, but will follow each rocket flight from which usable data results.

(7) Repackaging of equipment for test satellite vehicles

This step involves the electrical mechanical redesign of the equipment used in the rocket firings of step (5) or planned in steps (1) and (2) to make that equipment suitable for gathering desired atmospheric data from ARS test vehicle.

(8) Installation and flight of density and pressure measuring equipment in satellite vehicle

This phase involves the field operation of a program for measuring atmospheric density and pressure at orbital altitudes of satellite test vehicles, and would be followed by a reapplication of step (6).

4. (a) T-39794 - Thermal Radiation Program for ARS

(b) This task will be accomplished through a combination of "in-house" and contractual effort. Present contractor is the University of Colorado under Contract AF 19(604)-1899. Additional contracts are contemplated.

(c) The objective of this task is to measure the intensity of irradiant heat sources above the atmosphere.

The radiation environment is one of the external conditions which may grievously affect the period during which information can be obtained from an oribiting satellite.

To be operational, the design of the satellite must be engineered so as to maintain within pre-determined limits the temperatures of vital communication components, such as electronic units, batteries, etc. If and when nuclear sources are used for power, then the excess energy must be radiated away from an external heat exchanger; its design requires a knowledge of the radiation exchange environment.

The temperature of a satellite in orbit at given times and places can be calculated. Required for these calculations are a knowledgeof the interstellar heat sink into which it is radiating energy -- thus cooling it -- and a knowledge of the intensities of the thermal fluxes which tend to warm it. Estimates of the equilibrium temperature of the satellite can be verified only by measurements within the orbiting satellite. Under the worst condition the

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temperature within the communication equipment may cause it to fail before any information is received. A slightly more favorable but undesirable condition would be a premature failure of communcation, (Thus, should the absorptivity--equal to emissivity--of the skin of the satellite change while in orbit, the equilibrium temperature of the satellite might differ drastically from that calculated on the basis of design specifications.)

The objective of this task is, then, the development and testing of devices adequate for the measurement of the three irradiant sources--direct solar energy, solar energy reflected jointly from earth and atmosphere (I.E., albedo) and earth emissivity (in the infrared)--and the flux from a satellite into interstellar space.

It is proposed that flux measuring devices should be installed on the earliest test vehicles so that flux measurements can be obtained so long as communication with the satellite is continued. Should communications then cease, and should the thermal, flux measurements seriously disagree with the values in the design calculations, at least one source of possible trouble should be identified.

During the development and testing of the devices for measuring the three sorts of radiation, balloon and rockets equipped with these devices will be flown. As scientific by-products of the testing program, some confirmation of current estimates of the intensities of the three sources will be obtained. Our present information on the radiation environment is next summarized.

Reliability of Present Estimates of the Solar Constant and
<u>the Albedo and Infrared Emission of Earth Plus Atmosphere</u>

a) The solar constant is believed to lie between 1.946 and 2.05 gram calories centimeter $^{-2}$ minute $^{-1}$, a deviation of 3% from the mean of 2.0 gm cal cn$^{-2}$ min$^{-1}$(1,396 watts meter $^{-2}$).

b) For this discussion, the term albedo applies to the solar radiation reflected directly from the earth's surface and scattered and reflected from the atmosphere with its content of clouds. From point to point in the orbit of a satellite with orbital distances as now stated the albedo will be highly variable. Deviations may be expected of at least plus or minus 20 - 30 per cent from the mean value of the albedo which may be taken as lying between 36-56 per cent (I.E. approximately 36-56 per cent of the solar constant is diffusely reflected or scattered back from the earth).

c) The infrared emission of the earth may be estimated by theory. Current estimates for the various zones of latitude obtained by deduction may well be in error by 20 to 50 per cent; on the average energy to about 32 per cent of the solar constant is diffusely emitted as infrared radiation from the unit consisting of earth and atmosphere.

[redacted]

(d) Approach

I. Introduction

The following subtasks are foreseen:

(1) The design, development, testing and calibration of devices for the measurement of radiation of the following kinds.

(a) Total radiation from 0.27 to 2.7 microns (By "total" is a single detector which integrates the energy in the specific spectral region non-selectively -- i.e., recording to heating value, not by number of photons.)

(b) Total radiation from 4 to 20 microns.

(2) The design, development, testing and calibration of temperature sensors.

(3) Considered, but at present neither planned, funded nor contracted, would be the study of the temperature of a model of the satellite in a simulated radiation environment in a test chamber in the laboratory, or balloon-borne to an altitude where the air pressure approximates ten millibars (about 100,000 feet).

(4) A subtask within scope of this task, but deserving separate discussion will result in new techniques, design experience, and data important to ARS as vehicles for reconnaissance. This subtask is amplified specifically in Section II, Activities in "(4) Activities -Infrared Background Studies".

II. Activities

(1) Activities - General

The statement of the task may be amplified by noting that the satellite in its orbit will be warmed by energy from sun and from earth and cooled by radiating energy outward. Its native temperature will vary between upper and lower limits determined by intrinsic qualities (skin absorptivity and emissivity for various parts of the spectrum from ultraviolet through far ultraviolet and the heat capacity), and the trajectory (portion of period of orbit when irradiated by sun plus earth, or in the eclipse shadow of earth wher irradiated by earth emission only; and the distances from earth at apogee and perigee, and whether these occur in sunlight or in shadow.

Further, it is probably that various other sources of heat may be added as the development of the satellite proceeds from the preliminary phases of design, construction, and test to the more sophisticated, complex designs. For example, possibly a fission reactor may serve as source of power for attitude control and for electronic equipment. The introduction of such a heat source will complicate the engineering considerations because the efficiency of the removal of the excess heat will depend on the thermal environment of the heat exchangers.

(2) Activities --- Model Study

A possible activity which, as noted above, has not passed beyond the discussion stage, is that of the Model Study for obtaining approximate values of the equilibrium temperatures under working conditions a simulated satellite might be studied. By appropriate choice of the model, which would incorporate such devices as quartz windows inserted into the sphere, probably supplemented by isolated heat - detecting receivers, it is probably that significant information could be obtained. Such a model could be tested in a "Stratospheric Chamber" equipped with appropriate radiant heat sources. Or, the model satellite could be carried by balloon to high altitudes ---about 100,000 feet where pressures approximating 8 mm Hg. would minimize convective cooling.

In such studies numerous experimental details would have to be carefully watched. For the receivers consideration would have to be given to the absorption of radiation by the receiving surfaces ("blackness" to different spectral regions to the "color temperature" of the radiant flux), also to the conditions for the conductive removal of heat, and to the necessary precautions against convective cooling, since in the satellite at orbital altittudes there would be no convective cooling.

Departures from anticipated temperature by the satellite in its early history would be reason to look for unique influence -- heating by collision with meteoric matter, shortwave radiation with more than the expected intensity of gamma radiation.

Such a model might lend itself to experimental work in the design of a satellite to be powered by a fission device.

(3) Activities -- Design and development of the temperature and radiation sensing equipment

It is recognized that measuring the temperature of the skin and of the important points within the satellite in order to confirm the adequacy of the design is primarily the concern of the contractors. However, the themal flux sensors and the temperature sensors both will most likely be built around thermistors, hence, for reasons of design efficiency they would be parts of a common system. All thermal flux devices have high temperature coefficients, and the design will require a reference standard for absolute temperature determination.

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It has been noted the type of thermal flux detector used should be "total" and "non-selective." As distinguished from photo-conductive detectors, the preferred type would be the "temperature" detector, i.e., the absorbed energy is measured by temperature change using a thermocouple or a thermister or equivalent.

Hence, the development and testing (including calibration) of the radiation sensors involves the use of the same accessory electronic equipment for imparting information to the telemetering system as would be used when thermistors are employed for obtaining temperature data within the satellite. A minor activity from the viewpoint of both man-hours and dollar costs, is therefore involved adding the responsibility for development, testing and calibration of the temperature sensing devices to the identical responsibilities for the devices for measuring thermal flux.

Timely and detailed reports of progress on this task will be provided so that designs of the temperature sensors and accessory electronic equipment will be available to the prime contractor for his use in instrumenting early test vehicles.

Approximately six months have passed since Contract AF 19(604)-1899 for $40,000 was awarded to the University of Colorado for work on this task. Relatively good progress has been made in the design of compact lightweight transistorized thermal flux detectors available soon for testing in high altitude balloon flights. However, for quantitative thermal flux measurements one accepted technique is alternately to expose the radiation sensor to the thermal flux to be measured and then to view a reference standard or flux (a black-body) determined by its absolute temperature. It is the development and testing of these assemblies of components which will demand the major effort.

(4) <u>Activities -- Infrared Background Studies</u>

In reconnaissance "vision" is involved. With the eye as the detector, the significant bandwidths used in vision are 0.4 to 0.7 microns. "Vision" in the ultraviolet involves a detector in the range 0.2 - 0.4 microns. In the infrared, "vision" comprises wavelengths from 0.7 to 25 microns. It is obvious that "vision" is the discrimination of an object viewed with a given bandwidth against a "background" also "seen" by the detector. Further, radiation scattered toward the detector by material between the object and the detector obscures vision (cf. visibility through fog).

Reconnaissance by use of far infrared introduces another factor not unlike the scattering effect in visibility through fog. That is, the radiation from the object and its background will be veiled by the energy emitte by the strata of atmosphere between object and detector. In the region from

[redacted]

[redacted]



4 to 24 microns knowledge of temperatures, spectral emissivities (equal absorptions) of the specific gases of the atmosphere are required. Much is known about the pressure dependence of the absorption but easy calculation is not yet possible.

Both experimental and theoretical phases under this infrared background study are planned:

Experimental:

(1) The design and construction of a far-infrared spectrometer to be borne aloft by balloon capable of measuring the terrestrial thermal flux, spectrally resolved from 4 to 24 microns, etc. The work to be contracted.

(2) Design and construction of balloon borne equipment to measure attenuation of the infrared solar flux in the region of 0.8 to 9 microns at various altitudes from 5,000 to 100,000 feet, with sun at low altitudes to increase the path length through the atmosphere. The work to be contracted.

Theoretical:

(3) The thermal emission from model atmosphere corresponding as closely as possible to the terrestrial atmosphere will be calculated using the latest available and suitable modified laboratory transmission functions. The emission will be computed for various heights to be later specified in the atmosphere. The work to be contracted.

Possible contractors, and the possible Principal Investigators are:

Johns Hopkins University, Prof. John F. Strong
University of Utah, Prof. J. V. Hales (with Prof. W. Elsasser, Consultant, Scripps Institute of Oceanography)
Aerotronics, Glendale, Calif., Dr. Gilbert N. Plass
University of Colorado, Prof. W. S. Rense
University of Denver, Mr. David Murcray
Ball Bros. Research Institute, Dr. David Stacey

(5) <u>Activities - By-Products Directly Applicable to ARS</u>

The main groups of by-products of the program of work on the Thermal Radiation program may be anticipated for ARS. One group is the reduction in the uncertainty in the three sorts of radiation intensities

[redacted]

[redacted]



noted as important -- the solar constant, the albedo associated with various physiographic features of the earth (both the earth surfaces itself and cloud cover meteorologically and physiographically determined), and the infrared emission. During the testing of the thermal radiation sensors during ballon and rocket flights data will necessarily accumulate which may reduce the error in present estimates of the intensity of these radiations.

The studies undertaken during the assessment of the radiation environment of the satellite will produce new knowledge about the energetics of the planet earth and its atmosphere. The new knowledge, as well as the sensors and accessory equipment from the task on thermal environment, will be of advantage to the contemplated Weather Reconnaissance Project in the event that is undertaken. Hard and fast lines cannot be drawn separating the work on thermal flux sensors from the work on the sensors which could be used on the Weather Reconnaissance Project. To the extent that work on this task (T-39794) advances the work on the Weather Reconnaissance Project, this later progress may be considered a by-product. However, under the Weather Reconnaissance Project would be required the production of sensors specifically adapted for installation in aircraft, and following the flights, reduction and study of the data. Such work is not contemplated in the budget proposed for this task.

5. (a) Task 39795 - Rocket and Instrumentation Support

(b) This task will be accomplished through a combination of "in-house and contractual effort. The type of effort required by this task is being carried on by AFCRC under GRD P-7659. In P-7659 several contractors have been used and have attained a competence in their respective areas (See Approach) In view of this competence, many of the same contractors will be used to accomplish the objectives of this task. Contemplated contractors include:

1.) Aerojet - General Corporation
2.) Wentworth Institute
3.) Oklahoma A and M
4.) New Mexico A and M

(c) The task objective is to instrument and launch research rockets in support of the objectives of the other tasks in this project.

Requirement and/or Justification

The requirement for this task is delineated in the approach of each of the other tasks of the project.

(d) Approach

[redacted]

[redacted]



The instrumentation and launching of research rockets require

(1) The provision of vehicles and launch facilities suitable to each experiment.

(2) The instrumentation of the nose cone. This effort may vary from simple attachment to the rocket to adaption of the experimental equipment to the vehicle and its support instrumentation.

(3) Collateral instrumentation for tracking, telemetering, range safety, data recording, parachute recovery, special sequencing and command of experiments, orientation of sensing devices (biaxial pointing control) and others.

(4) The provision of suitable ground data recording equipment.

Techniques and procedures have been established under GRD P-7659 to accomplish the desired results in the above areas of effort. In order to meet the requirements of the other tasks of this project, the same techniques and procedures will be followed under this task. In particular, the same contractors and facilities will be used, where applicable, and coordir tion with necessary test facilities will be carried out in the same manner as under P-7659.

In order to efficiently and effectively make use of system test vehicles close coordination will be established with the prime contractor. Such liaison is necessary to adapt the experiment to system test vehicles from the standpoint of size, weight, available telemeter, power, etc.

d. Other Information

Not applicable

e. Background History

System Requirement No. 5 dated 17 October 1955 subsequent letter directive from WDD placed on AFCRC the responsibility of providing environmental data effecting the design and test of ARS vehicles. Studies by the Geophysics Research Directorate, AFCRC, the design study contractors and the ARS Weapons System office determined that in certain areas the state of the art was such that additional data would be required to satisfy the design requirements of ARS. In December 1955 and January 1956 Tasks 76971, 76972, 76973 and 76974 under Project 1115 were prepared by Geophysics Research Directorate, Air Force Cambridge Research Center. These tasks were, with certain exception approved by WDD 3 July 1956. This project constitutes a rewrite of these tasks under Project 1764 in support of WS 117-L.

[redacted]

[redacted]



f. Future Plans

This project is for the specific purpose of providing environmental design data for the Advanced Reconnaissance System, therefore, the various task and subtasks will be terminated, with concurrence from the WS 117L WSPO, when it is apparent that sufficient data has been obtained in a particular field to satisfy design requirements or to determine a no hazard condition to the ARS vehicle and operational subsystems.

Conversely close coordination will be maintained with the WSPO and prime contractor so that new tasks can be timely instituted to meet requirements generated by the introduction of new design conception.

g. References

ARDC System Requirement No. 5 dated 17 October 1955
Secret Letter WDD to AFCRC sub: Support of Advanced Reconnaissance System (U) dated 23 December 1955.
WS 117L Advanced Reconnaissance System Development Plan dated 2 April 1956.
ARDC System Development Directive Advanced Reconnaissance System dated 17 August 1956.

SIGNED

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SIGNED

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Director
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[redacted]

1. Special Annex for Mission Support Funds

2. Reports Control Symbol

Page of page

3. DATE: 2 April 1957

4. TITLE

5. Initial

6. NUMBER - 1764

(UNCLASSIFIED TITLE) Geophysical Environment for ARS, WS 117L

SHORT TITLE: ARS Environment

1a. $4255. of P-690-02 funds will be required in the performance of task 39721 in FY 57.

| | | |
|---|---|---|
| (1) | 6 trips to Los Angeles and Palo Alto, Calif. at $400. | $2400. |
| (2) | 3 trips to Chicago, Ill. at $125. | 375. |
| (3) | 12 trips to New York, N.Y. at $40. | 480. |
| (4) | Miscellaneous travel | 1000. |
| | | $4255. |

b. This travel will be essentially to monitor contracts and coordinate with other Centers. The requirements for FY 57 will continue through FY 58 and FY 59.

c. In FY 58 six (6) additional trips to HADC at $400. each will be required to arrange rocket tests.

d. In FY 59 twelve (12) additional trips to HADC or Patrick AFB at $400. each will be required for rocket tests on apparatus.

e. Therefore, for FY 58 P-690-02 $6655.

FY 59 $9055.

2a. $8000. of P-690-02 funds will be required in the performance of T-39792 during FY 57. Specifically it is contemplated.

| | | |
|---|---|---|
| (1) | 12 trips to Holloman Air Development Center, N.M. at $450. each | $5400. |
| (2) | 4 trips to San Francisco, Los Angeles area, Calif. at $400. each | 1600. |
| (3) | 3 trips to Philadelphia, Pa. at $50. each | 150. |
| (4) | Miscellaneous travel; $850 | 850. |
| | TOTAL | $8000. |

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b. Travel to Holloman Air Development Center will be performed in carrying out high altitude rocket experiments. Each rocket experiments. Each rocket firing requires at least two (2) personnel for a period of a week to ten (10) days.

c. It is contemplated that some of the shaped-charge experiments may be performed by the Poulter Laboratories in the San Francisco area. Research on High Speed Impact Phenomena will be coordinated with Rand Corporation in Santa Monica. Temple University in Philadelphia has developed acoustical apparatus for the detection of meteoric impacts.

d. The travel requirements for this task thru FY 59 will probably remain at about $8000. per year.

3a. $5970. of P-690-02 funds will be required in the performance of Task T-39793 in FY 57.

| | | |
|---|---|---|
| (1) | 2 trips to Los Angeles, Calif. at $400. each | $800. |
| (2) | 4 trips to Ann Arbor, Mich. at $125. each | 500. |
| (3) | 8 trips to HADC, N.M. at $400. each | 3200. |
| (4) | 2 trips to Chicago, Ill. at $125. each | 250. |
| (5) | 8 trips to New York area at $40. each | 320. |
| (6) | Miscellaneous travel | 1000. |
| | Total | $6000.00 |

b. This travel will be essentially to monitor contracts and coordinate with other Centers. The requirement for FY 57 will continue through FY 58 and FY 59.

c. In FY 58, 7 additional trips to HADC at $400. and 2 additional trips to Los Angeles at $400. will be required to participate in rocket data gathering flights and monitoring contracts.

d. In FY 59, 4 additional trips to HADC at $400. will be required to participate in rocket data gathering launchings.

3. In FY 60 travel will be required as follows:

| | | |
|---|---|---|
| (1) | 2 trips to Los Angeles at $400. each | $800. |
| (2) | 2 trips to Chicago at $125. each | 250. |
| (3) | 3 trips to New York at $40. each | 120. |
| (4) | Miscellaneous travel | 300. |
| | Total | $1470. |

Therefore,

| | P690-02 |
|---|---|
| FY 58 | 9570 |
| FY 59 | 7570 |
| FY 60 | 1470 |

[redacted]

[redacted]



4. $3,225.00 of P-690-02 funds will be required in the performance of task T-39794 during FY 57. Specifically we contemplate:

| | | |
|---|---|---|
| (1) | 3 trips to Los Angeles, California at $400. each | $1200. |
| (2) | 4 trips to Baltimore, Maryland at $60. each | 240. |
| (3) | 3 trips to Chicago, Illinois at $125. each | 375. |
| (4) | 2 trips to Holloman ADC, N.M. at $400. each | 800. |
| (5) | 2 trips to WADC, Dayton, Ohio at $100. each | 200. |
| (6) | 2 trips to RADC, Rome, N.Y. at $55. each | 110. |
| (7) | Miscellaneous travel: $300. | 300. |
| | | $3225. |

a and b Travel to the Los Angeles area and to the Baltimore area is predicted on the assumption that the contractors, at least for the vehicles for scientific measurements, will be in either or both areas. Also, at least one visit to WDD is contemplated.

c. Travel to the Chicago area is included on the assumption that contractor for the temperature and radiative transfer sensors might quite probably be in Chicago or equally distant from Boston, Mass.

d. Travel to Holloman ADC looks forward to preliminary testing of instrumentation in the upper atmosphere by balloons or rockets, or both.

e. Travel to WADC and to RADC will be required to coordinate the various Center efforts. It is possible that the number listed is a minimum and that more will be required.

f. Miscellaneous travel to discuss specific problems with experts at various Universities will be required.

g. After FY 57 we anticipate that because of the increased activity the travel requirement will be increased to an average $4,500. per year.

h. An annual average of $1000. of P-690-03 funds will be required to transportation of instrumentation units during FY 58 and FY 59.

5a. $14,000 of P690-02 funds will be required in the performance of task T-39795 during FY 58.

| | | |
|---|---|---|
| (1) | 12 trips to HADC at $500. each | $6000. |
| (2) | 4 trips to Los Angeles, Calif. at $400. | 1600. |
| (3) | 8 trips to Palo Alto, Calif. at $450. each | 3600. |
| (4) | 4 trips to Patrick AFB, Fla. at $200. each | 800. |
| (5) | Miscellaneous | 2000. |
| | Total | $14,000. |

[redacted]

[redacted]



b. Travel to HADC will be performed to participate in launching of high altitude rockets.

c. Travel to Los Angeles will be performed for coordination of program with WSPO.

d. Travel to Palo Alto will be performed for liaison in obtaining technical information on use of system test vehicles.

e. Travel to Patrick AFB will be performed for coordination and participation in launching of system test vehicles.

f. The travel requirements in this task are expected to remain essentially the same for FY 59 and FY 60.

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1\. 

# R & D SCHEDULE [redacted]

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2\. REPORTS CONTROL SYMBOL

3\. DATE 2 April 1957

4\. TITLE (UNCLASSIFIED TITLE) Geophysical Environment Data for ARS, WS 117L
Short Title: ARS Environment

5\. INITIAL ☒ CHANGE

6\. NUMBER 1764

| SCHEDULE | | CALENDAR YEARS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TITLE | PROJECT OR TASK NR. | 1955 | | | | | | 1956 | | | | | | | | | | | | 1957 | | | | | | | | 1958 | | | | 1959 | | | | 1960 | | | | TO COMPL | | | |
| | | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| ARS Environment | 1764 | | | | | | | | | | | | | 1 | | | | | | | 3 | | | 4 | | | | 6 | | | 7 | | | 9 | 5 | | | | 11 | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | 8 | | | | | | | 10 | | | | | | | | |
| Solar U.V. and X-Ray | 39791 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Intensity Measurement | | | | | | | | 3 | | | 4 | | | | | | | | | | | | 6 | | | | 7 | 7 | 7 | 7 | | | | | 11 | | | | | | | | |
| Sputtering | | | | | | | | | | | | | | | | | | | | | 3 | | 4 | | | | | 6 | | | | | | | 11 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Interplanatary Matter & Met. | 39792 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rocket-Meteor Impact Studies | | | | | | | | | | | | | | 4 | | | | | 5 | 7 | | 7 | 7 | | | 7 | 5 | 7 | 7 | 7 | 5 | | | | 5 | | | | | | | | |
| ARS Meteor Detecting Studies | | | | | | | | | | | | | | | | | | 4 | | | | | | | | 7 | 5 | 8 | | | 5 | | | | 5 | | | | 11 | | | | |
| High Speed Impact Phenomena | | | | | | | | | | | | | | 3 | | | | | 5 | | | | | | | | 5 | | | | 5 | | | | 5 | | | | | | | | |
| Theoretical Studies | | | | | | | | | | | | | | 3 | | | | | 5 | | | | | | | | 5 | | | | 5 | | | | 5 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Satellite Altitude Density | 39793 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| In-House Studies | | | | | | | | | | | | | | 3 | 10 | | | | | | | | | | | 10 | | 10 | | 10 | | | | 10 | 10 | | | | | | | | |
| Evaluation of Two Methods | | | | | | | | | | | | | | 1 | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Instrumentation & Rocket Test | | | | | | | | | | | | | | | | | | | | | | 4 | | | | | | 7 | 7 | 7 | 7 | | | | | | | | | | | | |
| ARS Test Vehicle Program | | | | | | | | | | | | | | | | | | | | | | | | 4 | | | | | 7 | 7 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Therm RAD for ARS | 39794 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Temperature Sensors | | | | | | | | | | | 4 | | | 5 | | | 5 | | | | | 6 | 7 | | | | | | | | 7 | 9 | 9 | 3 | 11 | | | | | | | | |
| Radiation Sensors | | | | | | | | | | | 4 | | | 5 | | | 5 | 6 | | 7 | | | | 7 | | | | | | | 7 | 9 | 9 | 9 | 11 | | | | | | | | |
| Background Studies | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Theoretical | | | | | | | | | | | | | | | | | | | | | | | | 4 | | 5 | 5 | 5 | 5 | | 5 | | | 11 | | | | | | | | | |
| Experimental | | | | | | | | | | | | | | | | | | | | | | | | 4 | | 5 | 6 | 7 | 7 | | 7 | 9 | 9 | 10 | 11 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rocket Support | 39795 | | | | | | | | | | | | | | | | | | | 7 | | 7 | 7 | | | 7 | 7 | 7 | 7 | 7 | 7 | | | | | | | | | | | | |

Schedule Key:

1 - Let Study Contract
2 - Termination and Tech Rept (Study Contract)
3 - Begin In-house Studies
4 - Development Contract Awarded
5 - Technical Report
6 - Apparatus Tested in Lab
7 - Test & Data Gathering Flights
8 - Satellite Instrumentation Complete
9 - Measurement on ARS Flight
10 - Analysis of Data
11 - Final Report

ARDC FORM 103 PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE [redacted]

2VD-57-C11YC

553 [redacted]

| 1. R & D MANPOWER ANNEX<br>☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER | 2. REPORTS CONTROL SYMBOL<br>PAGE 26 OF PAGES<br>3. DATE<br>2 April 1957 |
| --- | --- |

| 4. UNCLASSIFIED TITLE | 5. | 6. NUMBER |
| --- | --- | --- |
| Geophysical Environment Data for ARS, WS 117L<br>Short Title: ARS Environment | INITIAL ☒<br>CHANGE | 1764 |

| 7. ORG COMP CODE | 8. ORGANIZATION TITLE | 9. TYPE ORG | 10. ACTUAL MAN-QTRS LAST QTR | 11. PROJECTED DIRECT MAN-YEARS FY 1957 AVAL | FY 1957 RQRD | FY 1958 AVAL | FY 1958 RQRD | FY 1959 RQRD | FY 1960 RQRD | TO COMPL. RQRD |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GRD | Geophysics Research Directorate<br>AFCRC | R | 4.5 | 5.0 | 24.5 | 5.0 | 29.0 | 32.0 | 26.0 | |
| | TOTAL | | 4.5 | 5.0 | 24.5 | 5.0 | 29.0 | 32.0 | 26.0 | |
| | Total Manpower Dollars | | 7,938 | 36,400 | 178,360 | 36,400 | 211,120 | 232,960 | 189,280 | |

Manpower Justification Attached:

[redacted]

⇒ 54 [redacted]

# R & D MANPOWER ANNEX

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2. REPORTS CONTROL SYMBOL

PAGE OF PAGES

3. DATE: 2 April 1957

4. UNCLASSIFIED TITLE: Geophysical Environment Data for ARS, WS 117L
Short Title: ARS Environment

5. INITIAL ☒ CHANGE ☐

6. NUMBER: 1764

| 7. ORG COMP CODE | 8. ORGANIZATION TITLE | 9. TYPE ORG | 10. ACTUAL MAN-QTRS LAST QTR | 11. PROJECTED DIRECT MAN-YEARS FY 19 57 AVAL | FY 19 57 RQRD | FY 1958 AVAL | FY 1958 RQRD | FY 1959 RQRD | FY 1960 RQRD | TO COMPL RQRD |
|---|---|---|---|---|---|---|---|---|---|---|

1. Task 39791 will require the services of a total of eight physicists (civilian or military) of qualifications equaling those of GS-12 or higher. Two of these are now available, both GS-13, and therefore six additional physicistswill be required, beginning immediately and extending through the duration of the project.

2. The manpower requirements on Task 39792 for measuring the influx of interplanetary matter is estimated on the basis that three physicists and one electronic engineer (GS-11 to GS-13) will be required during the initial phase of the program during the remainder of FY 57. As test firing increases in FY 58 and FY 59 an additional mathematician (GS-11) will be required in the analysis of this data. This research team will be reduced to three (3) through the completion of the task.
This group will be responsible for the overall planning of the program and the experimental rocket and satellite program. The application of significant experimental laboratory data, and the establishment of significant experimental laboratory data, and the establishment of theoretical design criteria will be made up by this group also. The preparation and prosecution of general scientific plans, coordination, monitoring of contractual research and development, the preparation of summary and technical reports will be handled by this team. It is believed that the scope of the problem involving acoustics, electronics collision theory, meteor physics and other basic studies should be handled by a team, with a minimum size of at least five (5) people. At this time, the magnitude of this program may not be determined until the first phase of the research has been completed.

[redacted]

(UNCLASSIFIED TITLE) Geophysical Environment Data for ARS,WS117L 2 April 1957
Short Title: ARS Environment Proj 1764
R&D Manpower Annex (Cont.)

3. Manpower to perform research on Task 39793 will be divided into the following listed three (3) experimental teams:

a. Falling-Sphere Density Experiment Team

This team will consist of one task scientist (GS-12), one physicist (GS-11), and one engineer (GS-9)

b. Pressure Gauge Density Experiment Team

This team will consist of one deputy task scientist (GS-12), one physicist (GS-11), and one engineer (GS-9).

c. Data Reduction Team

This team will consist of one secretary (GS-3), and one computer (GS-9).

4. Responsibility of the 3 experimental teams will be as follows:

a. Falling-Sphere Density Team

(1) The responsibility of the Falling-Sphere Density Team will be to modify the existing Falling-Sphere Density Measuring Technique and scientifically develop, test and launch a modified instrumentation for density measurement at altitudes up to 500 Km.

(2) The responsibility of the task scientist is to plan and direct the over-all task program. In addition, he will directly administer the program of the Falling-Sphere team. He will consult with and advise the physicist and engineer in the theoretical study, design, development, laboratory testing, and contractual procurement of the flight model instrumentation; and will serve as Field Director at experimental test grounds.

(3) The physicist will be responsible for carrying out the team program of theoretical work on the applied and background research pertaining to the Falling-Sphere Density Experiment. He will be concerned with the evaluation of the theoretical aspects of the experiment, and all experimental progress in related fields of research. He will consult with, advise and assist the engineer in the laboratory experimental phases of the team program, and the electronic and mechanical design of instrumentation. He will be responsible for the preparation of scientific reports and papers as required in the experimental program.

(4) The engineer will be responsible for the team laboratory experimental program, the electronic and mechanical design and construction of instrumentation. He will initiate procurement of instrumentation. He will



248-57-01140

[redacted]



initiate procurement of and will monitor a contractor construction contract to build the final instrumentation for rocket installation. He will serve as field engineer during proving ground experimental tests.

5. Pressure Gauge Density Experiment Team

a. The responsibility of the Pressure Gauge Density Team will, in consideration of present methods limited to altitudes of about 130 km, scientifically plan, develop, test, and launch a rocket borne pressure gauge instrumentation for density measurement at altitudes up to 500 km.

b. The responsibility of the deputy task scientist will be to plan, direct and administer the program of the team. He will consult with and advise the physicist and engineer in theoretical study, design, development, laboratory testing, contractual procurement of the flight model instrumentation and will serve as Field Director at experimental test grounds.

c. The Physicist will be responsible for carrying out the team program of theoretical work on applied and background research pertaining to the Pressure Gauge Density Experiment. He will be concerned with the evaluation of the theoretical aspects of the experiment, and all experimental progress in related fields of research. He will consult with advise and assist the engineer in the laboratory experimental phases of the team program and in the electronic and mechanical design of the instrumentation. He will be responsible for the preparation of scientific reports and papers, as required in the experimental program.

d. The Engineer will be responsible for the ream laboratory experimental program, the electronic and mechanical design and construction of instrumentation. He will initiate procurement of, and will monitor a contractor construction contract to build the final instrumentation for rocket installation. He will serve as field engineer during proving ground experimental tests.

6. Data Reduction Team - The responsibility of the Data Reduction Team will be to reduce telemetered, photographic, and other transmitted data that may be supplied from airborne density instrumentation; and to present this data in useful form for geophysical interpretation.

7. The Task 39794 Planning and Supervision will be under the direction of a Task Scientist. Throughout the period of the task, he will be responsible for the preparation and prosecution of the general scientific plans and for the coordination of work of the contributing agencies of the entire program. He will be responsible for all the phases of the program, including selection of contractor, approval of proposals, supervision of both contractual

[redacted]

and in-house efforts contributing to design, fabrication, test, calibration and data reduction and interpretation -- in short, the integration of the results of the contract program and the in-house programs. The Task Scientist is currently available.

8. a. The manpower requirements for T-39795 for Rocket and Instrumentation Support are estimated on the basis that four Research Engineers, (GS-11 to GS-13) will be required during FY 57 to accomplish instrumentation for the required program. During FY 58 an additional two Research Engineers will be required to absorb the load of frequent field trips to rocket launch sites and to maintain the heavy schedule of rocket preparation and firings. In FY 59 two additional Research Engineers will be required to conduct liaison on instrumentation of orbiting and non-orbiting test vehicles.

b. This group will be responsible for the instrumentation of all rocket experiments in the program for coordination with launch sites, for collection and recording of data from rocket flighs and for liaison and planning with prime contractor in use of system test vehicles.

[redacted]

# R & D CONTRACT FUNDS ANNEX

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2. REPORTS CONTROL SYMBOL



3. DATE: 2 April 1957

4. TITLE
(UNCLASSIFIED TITLE) Geophysical Environment Data for ARS, WS 117L
(Short Title) ARS Environment

5. INITIAL ☒ CHANGE ☐

6. NUMBER: 1764

| 7. ITEM | 8. PROJ OR TASK NR | 9. END ITEM CAT | 10. CONTRACT NUMBER | 11. BPSN | 12. PREV YRS 600 | OTHER | 13. FY 57 600 | OTHER | 14. FY 58 600 | OTHER | 15. FY 59 600 | OTHER | 16. FY 60 600 | OTHER | 17. TO COMPL 600 | OTHER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ARS Environment | 1764 | R&E | Various | 2-117 | 160M | | 422M | | 1000M | | 1410M | | 425M | | | |
| P-100 Funds: | | | | | | 6M | | | | 950M | | 470M | | | | |
| P-200 Funds: | | | | | | | | | | | | 50M | | | | |
| Sub-Totals: | | | P-600 | | 160M | | 422M | | 1000M | | 1410M | | 425M | | | |
| | | | P-100 | | | 6M | | | | 950M | | 470M | | | | |
| | | | P-200 | | | | | | | | | 50M | | | | |
| TOTAL | | | | | 160M | 6M | 422M | 0M | 1000M | 950M | 1410M | 520M | 425M | | | |

ARDC FORM 110 PREVIOUS EDITIONS OF THIS FORM ARE OBS[redacted]

218-57-01140

G 59 [redacted]

# R & D COST ESTIMATE RECAPITULATION

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2. REPORTS CONTROL SYMBOL

PAGE 32 OF 32 PAGES

3. DATE: 2 April 1957

4. UNCLASSIFIED TITLE: Geophysical Environment Data for ARS, WS 117L
Short Title: ARS Environment

5. INITIAL ☒ CHANGE

6. NUMBER: 1764

| ITEM | | A. PREVIOUS YEARS 600 | A. PREVIOUS YEARS OTHER | B. FISCAL YEAR 57 600 | B. FISCAL YEAR 57 OTHER | C. FISCAL YEAR 58 600 | C. FISCAL YEAR 58 OTHER | D. FISCAL YEAR 59 600 | D. FISCAL YEAR 59 OTHER | E. TO COMPLETE 600 | E. TO COMPLETE OTHER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7. CONTRACT | A. TOTAL | 160M | 6M | 422M | | 1000M | 950M | 1410M | 520M | 425M | 0 |
| | B. AVAILABLE | 160M | 6M | 422M | | | | | | | |
| | C. NEW REQ | | | | | 1000M | 950M | 1410M | 520M | 425M | 0 |
| 8. MATERIEL | A. TOTAL | | | | | | | | | | |
| | B. AVAILABLE | | | | | | | | | | |
| | C. NEW REQ | | | | | | | | | | |
| 9. FACILITIES | | | | | | | | | | | |
| 10. MANPOWER | | 7.9M | | 36.4M | | 178.4M | | 36.4M | | 422.2M | |
| 11. TRAINING | | N/A | | | | | | | | | |
| 12. TEST ITEMS | | N/A | | | | | | | | | |
| 13. TEST SUPPORT AIRCRAFT | | N/A | | | | | | | | | |
| 14. SUBTOTAL | | 160M | 6M | 422M | | 1000M | 950M | 1410M | 520M | 425M | 0 |
| 15. TOTAL | | 173.9M | | 458.4M | | 2128.4M | | 1966.4M | | 847.2M | |

ARDC FORM 116 PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE. 32 [redacted] WD-57-01140

**R&D PROJECT CARD** [redacted] Rewritten Project

REPORT CONTROL SYMBOL DD-R&D(A)119 **5**

**1. PROJECT TITLE** (UNCLASSIFIED Title) a. PERSONNEL OPERATIONS SUBSYSTEM FOR THE ADVANCED RECONNAISSANCE SYSTEM (SYSTEM 117L) b. (SYSTEM 117L POSS)

**2. SECURITY OF PROJECT** SECRET

**3. PROJECT NO.** 8728

**4. INDEX NUMBER** 2-117

**5. REPORT DATE** 2 April 1957

**6. BASIC FIELD OR SUBJECT** Strategic Air Warfare System (117L)

**7. SUB FIELD OR SUBJECT SUB GROUP** Personnel Utilization, 65

**7A. TECH. OBJ.**

**8. COGNIZANT AGENCY** Air Research and Development Command Western Dev.Div.

**9. DIRECTING AGENCY** AFPTRC

**10. REQUESTING AGENCY** Hq USAF

**12. CONTRACTOR AND/OR LABORATORY**
Lockheed Aircraft Corp
Office for QPRI
Maintenance Laboratory
Operator Laboratory
Personnel Laboratory

**CONTRACT/W. O. NO.** AF04(647)-97

**11. PARTICIPATION AND/OR COORDINATION**
AMC (I) ACIC-I
APGS (I) USN/CND-I
ATC (I) USA/C/S-I
SAC (I) Other/AEC-P
ADC (I)
CIA (I)

**13. RELATED PROJECTS** WS-117L

INF ORMA COP

**14. DATE APPROVED**

**15. PRIORITY** 1A

**16. MAJOR CATEGORY** A(Missiles)

**17. EST. COMPLETION DATES**
RES.
DEV. Dec 1960
TEST
OP. EVAL.

**18.**

| FY | FISCAL ESTIMATES |
|---|---|
| 56 | .2M |
| 57 | 22.8M |
| 58 | 156.0M |
| 59 | 164.0M |
| 60 | 124.0M |
| | |
| Total | 467.0M |

**19. REPLACED PROJECT CARD AND PROJECT STATUS** This rewritten report supersedes New Project Report on this project dated 28 February 1956

**20. REQUIREMENT AND/OR JUSTIFICATION** Requirement for this project was established by ARDC System Requirement No. 5, dated 17 October 1955, which directed this Center to support the preparation of a System Development Plan. Responsibility for technical support in the execution of the WS 117L Development Plan was assigned under the provisions of ARDC System Development Directive No. 117L, dated 17 August 1956. Specific approva for inclusion of project for development of Qualitative Personnel Requirements information (QPRI) was contained in Amendment No. 2 to SDD No. 117L, dated 1 October 1956. ARDC Project Development Directive No. 8728, October 1956, directed implementation of this Center's plan for development of QPRI (Project Development Pl No. 8728, dated 28 February 195S) for WS 117L. Requirement for re-writing the original plan for development of QPRI for WS 117L was established as a result of two separate actions First: the Weapon System Project Office (WDD) directed eac Center concerned with the development of WS117L to rewrite project development plans to align objectives in consonance with the Statement of Work which was prepared recently for contractual negotiations, reference 211(7). Second: the application of existing research techniques in the areas of job analysis and description, training programming, training equipment requirements and evaluation will provide valuable support to the development of the personnel sub-system of WS117L. This project is designed to yield optimum information needed by planning agencies concerned with the personnel and training aspects of weapon system 117L.

**22. OASD (R&D)** SN. CN. C. X. L. C.

DD FORM 1 APR 55 613
REPLACES DD FORM 613, 1 JAN 52, WHICH MAY BE USED.

UNCLASSIFIED



GPO

[redacted]

[redacted]

(UNCLASSIFIED Title) a. PERSONNEL OPERATIONS SUBSYSTEM FOR THE ADVANCED RECONNAISSANCE SYSTEM (SYSTEM 117L). b. (SYSTEM 117L POSS)

21a. <u>Brief of Project and Objective:</u>

The development of this project will utilize the technical and operational capabilities of the Air Force Personnel and Training Research Center in the production of systematic information relevant to the personnel and training requirements of the total weapon system 117L development plan.

21b. <u>Approach</u>:

This project will require both contract and inservice efforts to facilitate correlation between personnel subsystem development and equipment development. Initially, great reliance will be placed upon the prime contractor to develop and systematically integrate information derived from conceived equipment design. Information will be prepared by the contractor with consultative and technical monitoring effort on the part of the AFPTRC project officer. Contract work in support of task efforts and in-service efforts are indicated below.

21c. <u>Tasks of the Project</u>:

(1) Task 87151-IMPLICATIONS OF DESIGN.

(a) Contractor: Work under this task will be accomplished primarily by the prime contractor, with consultative and technical guidance furnished by Project Officer, this Headquarters.

(b) Objective: To provide the preliminary data needed to prepare an early report, or reports, which will forecast the general personnel subsystem requirements and the personnel and training problems that adoption of the system may generate.

(c) Approach: Since this weapon system does not readily lend itself to the concept of control by a major air command or primary interest by a single agency of the Air Force, consideration will be given to the thorough exploration of the personnel implications under various operating-controlling conditions. Basically, the report(s) will attempt to define problems which will be generated by both operational plans and equipment design In so doing, consideration will be given to the relationship of WS-117L to WS-107A-1 and possibly WS-107A-2 and the findings of previous research in support of these latter systems.

(UNCLASSIFIED Title) a. PERSONNEL OPERATIONS SUBSYSTEM FOR THE ADVANCED RECONNAISSANCE SYSTEM (SYSTEM 117L) b. (SYSTEM 117L POSS)

(2) Task 87300-QUALITATIVE PERSONNEL REQUIREMENTSJINFORMATION.

(a) Contractor: Data will be collected and assembled by the prime contractor for the production of reports which will be phased with equipment design and development.

(b) Objective: To provide manning document information, position descriptions, and personnel selection information regarding the total personnel subsystem of WS117L.

(c) Approach: Effort in this area will be directed toward the development of information which can be used to describe technical jobs associated with the operation and maintenance of the system. From these descriptions, forecasts of required skills and knowledges will be made. Early identification of skills and knowledges and subsequent classification, if possible, within the Air Force personnel system will permit forecast of training requirements. Information derived in the development of the foregoing area will be used for manning information when operational and maintenance concepts are stabilized

The QPRI report will comprise four sections: General Information, Manning Document Information, Training Equipment Requirements Information, and Information on Special Problem Areas. The format of the report will be patterned after AFPTRC QPRI reports which have been published for ballistic missile systems.

Section one, General Information, will describe the general purpose and function of the system, as well as stated or assumed concepts of operation and maintenance.

Section two, Manning Document Information, will: identify all equipment-associated operator and maintenance positions; indicate tasks performed within each job-position; indicate skill levels required for those positions requiring new personnel skills; and reference Air Force specialties which most nearly identify the job-positions.

Section three, Training Equipment Requirements Information, will identify in general terms the special training devices which will be needed to impart new skills required for the operation and maintenance of the weapon system. Further action in this area is defined in a subsequent task.

Section four, Special Problem Areas, will include an expansion of the problem areas (identified in the "Implications of Design" report) which can be isolated under a specific set of conditions. This portion of the report will identify personnel problems of an organizational and/or command nature.

(UNCLASSIFIED Title) a. PERSONNEL OPERATIONS SUBSYSTEM FOR THE ADVANCED RECONNAISSANCE SYSTEM (SYSTEM 117L) b. (SYSTEM 117L POSS)

(3) Task 87152-TRAINING PROGRAMS AND PROCEDURES.

(a) Contractor: None.

(b) Objective: To make recommendations for the training program and training procedures to be used to obtain skills required by operator and maintenance personnel of the system.

(c) Approach: Recommendations for specific training procedures will be made in consonance investigative findings from prior tasks. Emphasis will be given to those areas in which the training of skills may prove particularly significant and difficult.

(4) Task 87153-TRAINING EQUIPMENT CHARACTERISTICS.

(a) Contractor: Preparation of a report on the training characteristics of required trainers will be an in-service effort. Previous contractual efforts will be used, if applicable.

(b) Objective: To identify the special training devices required for the WS-117L training program and define the characteristics of the individual trainers.

(c) Approach: Consideration will be given to the adaptation and/or modification of research instruments into prototype training devices. Also, attention will be given to the possible use and/or adapting of special training devices, developed for the ballistic missile training program, which possess characteristics identified by this task effort, e.g., Radar Tracking and Guidance Computer Trainer.

[redacted]

(UNCLASSIFIED Title) a. PERSONNEL OPERATIONS SUBSYSTEM FOR THE ADVANCED RECONNAISSANCE SYSTEM (SYSTEM 117L) b. (SYSTEM 117L POSS)

(5) Task 87154-PROFICIENCY TEST DEVELOPMENT.

(a) Contractor: To be determined. Partial in-service effort by Personnel and Maintenance Laboratories monitored by this Headquarters.

(b) Objective: To provide valid tests of the job knowledge, skill, and achievement varity for measuring the progress and/or proficiency of operating and maintenance personnel.

(c) Approach: This activity will consist essentially of establishing, monitoring and evaluating the test materials to be produced on a contract basis.

(6) Task 87155-HANDBOOKS AND JOB AIDS

Further detail on this task will be provided as the system progresses.

(7) Task 87156-TRAINING EQUIPMENT TESTING

Further detail on this task will be provided on this task as system development progresses.

21d. Other Information.

(1) General. The information basic to the preparation of reports required by Task 87151 and Task 87300 efforts will be obtained through contractual effort. Publication of these reports on a contractual basis may be accomplished with this Headquarters acting in a consultative and monitoring capacity It is anticipated that contract funds in the amount indicated in ARDC Form 110 will be programmed through funding action to be taken by the Weapon System Project Office for WS 117L.

Tasks 87152, 87153, 87154, 87155, and 87156 have been included under the assumption that Tasks 87151 and 87300 will produce information which indicates further effort should be expended to meet an Air Force requirement for information in the areas covered by these tasks. However, further development effort will not be expended in those task areas in which the associated final activities are purchased by the Air Force as a contract-service, e g. Task for development of handbooks and job aids will not be undertaken if it is determined manning on a contractual basis is required or desired.

(2) Survey of Existing Standardize Equipment or Techniques.

None except as discussed in Task 87152 and Task 87153.



[redacted]

(3) Survey of Similar Equipment in Progress of R&D.

Survey will be made to determine possible adaptation of research instruments into special training devices. Similar exploration will be made in the area of trainers being developed for ballistic missile systems.

(4) Replacement Recommendations. None.

(5) Statement of Effects.

This project will yield information useful to the agencies responsible for programming the personnel and training programs required to properly man WS 117A.

21e. Background History and/or Progress.

Since the writing of the initial project card, several visitis have been made to WSPO to determine funding status and to obtain general information on status of system development. As previously mentioned, representatives from this Center participated in preparation of statement of work for contractual negotiations. WSPO clearance was obtained to make initial contacts at contractor facility to discuss development plan relevant to the personnel subsystem. System contractor personnel were familiarized with the QPRI program and the nature of tasks involved in the development plan for personnel and training problems. Visit to contractor revealed that competent staffing has been accomplished to perform the caliber of work desired. Arrangements have been made to furnish contractor with format guides for reports to be published under this development project.

21f. Future Plans. Tentative arrangements were discussed with prime contractor for publication of Task 87151 report during June 1957. Also discussed were plans for publication of initial QPRI report (Task 87300) during December 1957 or early January 1958.

The project officer will maintain close contact with WSPO to establish proper phase relationships of project effort with equipment development status which is, in turn, largely dictated by funding action.

21g. References.

(1) ARDC System Requirement No. 5, dated 17 October 1955.

(2) Project Development Plan No. 8728 (DD Form 613), 28 February 1956.

(3) WS 117L Development Plan (WDD), 2 April 1956.

(4) ARDC System Development Directive No. 117L, 17 August 1956.

(5) Amendment No. 2 to ARDC SDD No. 117L, 1 October 1956.

(6) Project Development Directive No. 8728, October 1956.

(7) Letter WDTR, Hq ARDC, 18 December 1956, subject, "Meeting of Technical Advisors to WS 117L".

21h. <u>Coordination and Signature Block</u>.

Responsible Center, AFPTRC.

Fred Roberts Lt Col

For STANLEY VALCIK
Major USAF
QPRI Project Officer

Thomas Wildes

THOMAS WILDES
Col USAF
DCS/Operations

Frederic C. E. Oder

FREDERIC C. E. ODER
Colonel, USAF
Assistant for WS 117L
Technical Operations (WDD)

1\. **R & D SCHEDULE**

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2\. REPORTS CONTROL SYMBOL

3\. DATE: 2 April 1957

4\. TITLE (UNCLASSIFIED Title) a. PERSONNEL OPERATIONS SUBSYSTEM FOR THE ADVANCED RECONNAISSANCE SYSTEM (SYSTEM 117L) b. (SYSTEM 117L POSS)

5\. INITIAL ☐ CHANGE #1

6\. NUMBER: 8728

| SCHEDULE: TITLE | PROJECT OR TASK NR | CALENDAR YEARS 1957 | | | | | | 1958 | | | | | | | | | | | | 1959 | | | | | | | | 1960 | | | | 19 | | | | 19 | | | | TO COMPL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| System 117L QPRI | 8728 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | |
| Implications of Design | 87151 | | | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| QPRI | 87300 | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | | | | |
| Training Programs & Proc | 87152 | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | |
| Training Equipment Char | 87153 | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | |
| Proficiency Test Devel | 87154 | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | 2 | | | | | | | | | | | | | | |
| Handbooks & Job Aids | 87155 | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | |
| Training Equip Testing | 87156 | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | 2 | | | | | | | | | | | | | | |

1-Contract Awarded

2-Technical Documentary Report Received.

7768

# R & D MANPOWER ANNEX

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

1. REPORTS CONTROL SYMBOL

PAGE 1 OF 1 PAGES

3. DATE 2 April 1957

4. UNCLASSIFIED TITLE a. PERSONNEL OPERATIONS SUBSYSTEM FOR THE ADVANCED RECONNAISSANCE SYSTEM (SYSTEM 117L) b. (SYSTEM 117L POSS)

5. INITIAL ☐ CHANGE #2

6. NUMBER 8728

| 7. ORG COMP CODE | 8. ORGANIZATION TITLE | 9. TYPE ORG | 10. ACTUAL MAN-QTRS LAST QTR | 11. PROJECTED DIRECT MAN-YEARS FY 19 57 AVAL | FY 19 57 RQRD | FY 19 58 AVAL | FY 19 58 RQRD | FY 19 59 RQRD | FY 19 RQRD | TO COMPL RQRD |
|---|---|---|---|---|---|---|---|---|---|---|
| PTQ | Office for QPRI | R | .3 | .9 | 2.2 | .2 | .4 | 3.5 | | |
| PTF | Operator Laboratory | R | # | .2 | .3 | .2 | .4 | 1.6 | | |
| PTR | Maintenance Laboratory | R | # | 1.5 | 1.5 | 3.8 | 3.8 | 4.8 | | |
| PTS | Office for Social Science Programs | R | # | | | | .5 | | | |
| | Total Manpower | | .3 | 2.6 | 4.0 | 4.2 | 5.1 | 9.9 | | |
| | Total Estimated Manpwr Dollars | | 1M | 21M | 34M | 36M | 43M | 84M | | |

69

UNCLASSIFIED

| 1. CONTRACT FUNDS ANNEX [ ] SYSTEM [X] PROJECT [ ] TASK [ ] OTHER | | | | | | | | 2. REPORTS CONTROL SYMBOL / PAGE 1 OF 1 PAGES / 3. DATE 2 April 57 | |
|---|---|---|---|---|---|---|---|---|---|
| 4. TITLE (UNCLASSIFIED Title) a. PERSONNEL OPERATIONS SUBSYSTEM FOR THE ADVANCED RECONNAISSANCE SYSTEMS (SYSTEM 117L) b. (SYSTEM 117L QPRI) | | | | 5. INITIAL [ ] CHANGE #1 | | | | 6. NUMBER 8728 | |
| 7. ABBREVIATED TITLE | 8. SYSTEM PROJECT OR TASK NUMBER | 9. BUDGET PROJECT SERIES | 10. PRIOR YEARS (In thousands) | 11. FY 57 (In thousands) | 12. FY 58 (In thousands) | 13. FY 59 (In thousands) | 14. FY 60 (In thousands) | 15. TO COMPLETION (In thousands) | |
| System 117L QPRI | 8728 | | | 12.8M | 156.0M | 144.0M | 81.0M | | |
| 16. TOTAL | | | | 12.8M | 156.0M | 144.0M | 81.0M | | |

2370

# R & D COST ESTIMATE RECAPITULATION

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

1.

2. REPORTS CONTROL SYMBOL

PAGE 1 OF 1 PAGES

3. DATE 2 April 1957

4. UNCLASSIFIED TITLE a. PERSONNEL OPERATIONS SUBSYSTEM FOR THE ADVANCED RECONNAISSANCE SYSTEM (SYSTEM 117L) b. (SYSTEM 117L QPRI POSS)

5. INITIAL ☐ CHANGE #1

6. NUMBER 8728

| ITEM | | A. PREVIOUS YEARS 600 | A. PREVIOUS YEARS OTHER | B. FISCAL YEAR 57 600 | B. FISCAL YEAR 57 OTHER | C. FISCAL YEAR 58 600 | C. FISCAL YEAR 58 OTHER | D. FISCAL YEAR 59 600 | D. FISCAL YEAR 59 OTHER | E. TO COMPLETE 600 | E. TO COMPLETE OTHER |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7. CONTRACT | A. TOTAL | | | 12.8M | | 156.0M | | 144.0M | | 81.0M | |
| | B. AVAILABLE | | | | | | | | | | |
| | C. NEW REQ | | | 12.8M | | 156.0M | | 144.0M | | 81.0M | |
| 8. MATERIEL | A. TOTAL | | | | | | | | | | |
| | B. AVAILABLE | | | | | | | | | | |
| | C. NEW REQ | | | | | | | | | | |
| 9. FACILITIES | | | | | | | | | | | |
| 10. MANPOWER | | | | 10M | 11M | 14M | 20M | 20M | 23M | 40M | 44M |
| 11. TRAINING | | | | | | | | | | | |
| 12. TEST ITEMS | | | | | | | | | | | |
| 13. TEST SUPPORT AIRCRAFT | | | | | | | | | | | |
| 14. SUBTOTAL | | | | 12.8M | | 156.0M | | 144.0M | | 81.0M | |
| 15. [illegible] | | | | [illegible] | 11M | 170M | 20M | 164M | 23M | 124M | 44M |

THE RAMO-WOOLDRIDGE CORPORATION GM67.3-49

LOS ANGELES 45, CALIFORNIA re: GM67.3-49 6

INTEROFFICE CORRESPONDENCE

TO: Col. E. N. Hall  CC: H. R. Lawrence  DATE: 3 May 1957

[redacted]

SUBJECT: Transmitting copy of GM67.3-49  FROM: R. F. Mettler

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Attached to this transmittal memo is a copy of R-W Document GM67.3-49 entitled "Proposed Use of IRBM as Booster for Multi-Stage Vehicles" which you requested.

Please note that this is a preliminary document, the technical content of which has not been checked or reviewed by Dr. Dunn's office. I would suggest that questions on the technical content of this memo be referred to Mr. H. R. Lawrence.

R. F. Mettler

R. F. Mettler

Enclosure:
GM67.3-49, Secretary Copy #1 Dis under date 1 Apr 1957

Classification of this letter may be ... with ... reference to ... with... of the class... enclosure.

[redacted]

[redacted]

FORM NO. 180-12

WD-57-02958

JUL 23 1957

MEMORANDUM FOR COLONEL TERHUNE

SUBJECT: AFPTRC Support of WDD Systems Development

1. In response to your comments and suggestions, further investigation reveals the Missile Research Unit, Maintenance Laboratory Field Extension Number 3, under Lt Colonel Beers is presently in being at AFBMD. QPRI Project Officers for the various missile systems will begin reporting for duty 29 July 1957. Tentative scheduling calls for the WS 117L Project Officer to report during August 1957.

2. The establishment of the Field Extension Unit and the scheduled manning of that office is in response to paragraph 2 of General Schriever's letter of 10 April 1957. A copy is inclosed for your reference.

3. Responsibility for AFPTRC conduct of the WS 117L QPRI was made by SR #5, dated 17 October 1955. Major Stanley Valcik of AFPTRC has been active as the WS 117L QPRI Project Officer for the past year. Some of the current difficulties in other missile programs, in the QPRI area, may be directly traced to a lack of appreciation of the importance of early attention to QPRI problems. Assessments of the anticipated work load in this area as meriting a resident Officer, and the timing of such an assignment was left to the discretion of the Commander, AFPTRC.

4. We have not concurred in any proposed action which has not already been implemented in AFBMD, nor which is contrary to present planning within the Field Extension Unit.

5. If manning the QPRI Project were to be made with AFBMD personnel, I personally would place higher, immediate priority on manning other projects within WS 117L. In view of the fact that manning is to be done by AFPTRC from AFPTRC personnel resources, I request your signature to the letter.

FREDERIC C. E. ODER
Colonel, USAF
Director, WS 117L

1 Incl
Cy letter to AFPTRC
subject as above
with inclosures

Above ltr returned to Col Oder 25 Jul 57.

AIR FORCE BALLISTIC MISSILE DIVISION
HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND

WDTN - WDOTA  19 November 1957

MEMORANDUM FOR WDT AND WDO

SUBJECT: (U) Joint WDTN and WDOTA Staff Visit Report to Hq ARDC on Elimination of AFPTRC as a Separate Center of ARDC

1. General: Col H. L. Evans, WDTN, and Capt A. A. Gomes, WDOTA, visited Hq ARDC on 14-15 November 1957 for the purpose of attending a conference on the elimination of the AFPTRC, and distribution of the AFPTRC functions and manpower spaces within the ARDC structure.

2. Persons Contacted: Brig Gen Flickinger, Col McKerley, Lt Col Ritter, Maj Wilcox, Maj Stobie, Maj Wertz, Dr. Gayne and Mr. Christensen.

3. Discussion and Comment: Lt Col Ritter, Hq ARDC, presented the proposed elimination of AFPTRC as a separate Center of ARDC, and the ARDC actions necessary to integrate the AFPTRC functions and manpower spaces within the ARDC organization structure. The significant items covered by Lt Col Ritter and a statement of required AFBMD actions are presented below:

a. Hq USAF has directed that the AFPTRC be eliminated as a separate ARDC Center.

b. ARDC will retain responsibility for the functions presently assigned to AFPTRC with certain reductions in the present program and [redacted]npower spaces as follows:

(1) Hq AFPTRC is to be eliminated, and the office for QPRI [redacted]ill be added to the human factors program at WADC.

(2) The Personnel Laboratory will remain at Lackland Air Force Base as a detachment of Hq ARDC. All future programs and projects for the Laboratory will be validated and approved by the DCS/P and DCS/D, Hq USAF.

(3) The programs and projects of the Operator Laboratory will be integrated with the work of other ARDC centers most directly concerned. The laboratory will vacate the space now occupied at Randolph Air Force Base.

(4) The programs and projects of the Maintenance Laboratory will be integrated with the Personnel Laboratory and other ARDC centers. That support furnished the AFBMD will be integrated into the AFBMD organization. The laboratory will vacate the space now occupied at Lowry Air Force Base.

(5) Hq USAF has proposed a reduction of 275 manpower spaces from the 704 spaces presently authorized AFPTRC. This will

result in a net manpower authorization of 158 spaces for the Personnel Laboratory and 271 spaces for the efforts in support of W/S development. These new manpower levels are to be effective 1 January 1958.

(6) The recommended distribution of the 271 spaces within the existing ARDC structure are as follows:

| | |
|---|---|
| Manned Space Vehicles - - - - - - - - - | 30 |
| AFAC, W/S Support - - - - - - - - - - - | 12 |
| AFCRC, W/S Support - - - - - - - - - - | 20 |
| AFBMD, W/S Support - - - - - - - - - - | 46 |
| AFMTC, W/S Support - - - - - - - - - - | 7 |
| AFSWC, W/S Support - - - - - - - - - - | 10 |
| AFMDC, W/S Support - - - - - - - - - - | 7 |
| RADC, W/S Support - - - - - - - - - - - | 26 |
| WADC, HF Laboratory - - ) - - - - - - - W/S Support - - ) | 113 |
| Total Spaces | 271 |

(7) The ARDC proposed breakout of the 46 spaces assigned to AFBMD are indicated as:

BALLISTIC SYSTEMS SUPPORT

HF Group at AFBMD:

Job Design & Engineering - - - - - - - 14

1. Design Specifications - - - 2
2. Design Analysis - - - - - - - 3
3. Hardware Development Monitoring - - - - - - - - - - 5
4. Personnel Evaluation - - - - 2
5. Safety and Protection - - - 2

Manning Information - - - - - - - - - - 10

Operational QPRI

Job Aids - - - - - - - - - - - - - - - - - 6

Training Equipment Requirements

Total 30

BMD-HF Field Extension at Cooke AFB:

Evaluation - - - - - - - - - - - - - - - - - 16

ICC Site Design - - - - - - - - - - - 3
Functional checks (Man-Machine) - - 3
Reliability and System Tests - - - 10

1. Personnel Sub-system - - - - 8
2. Safety and Protection - - - 2

Total 16

(8) The following items are noted regarding the 46 total spaces listed above:

(a) The recommended AFBMD spaces include:

26 - officers
18 - civilians
2 - airmen

(b) ARDC indicated that the spaces are separate from the emergeny augmentation and FY 58 manpower requirements heretofore stated by AFBMD.

(c) ARDC indicated that the spaces are to provide for normal human factors support required for the present AFBMD mission and no additional missions in the area of human factors technical programs will be imposed on AFBMD.

(d) Two medical officers - One Occupational Health, and one Industrial Hygiene Engineer are included in the officer spaces.

(e) The total civilian spaces include support types, clerical, etc.

(f) A total of 70 human factors officer spaces exist in ARDC of which 26 or 37% have been allotted to AFBMD. ARDC requested that AFBMD consider replacing some of our officer spaces with professional civilians, if possible, in order to relieve the shortage of human factors officers in the other ARDC centers.

(9) It was agreed that AFBMD would provide Hq ARDC with the following information by 25 November 1957:

(a) Organization structure or distribution of the 46 human factor spaces into the existing AFBMD organization.

(b) Manning Information:

Functional area descriptions
Rank and civilian grade spread
Job titles
Job description

4. Required Actions:

a. WDTN and WDOT will develop the information indicated in paragraph 9 above for delivery to Hq ARDC on 25 November 1957.

b. WDTN and WDOT will ~~prepare~~ recommend on appropriate internal AFBMD policy on the integration of the human factors support function within AFBMD.

HARRY L. EVANS
Colonel, USAF
WDTN

ANTHONY A. GOMES
Captain, USAF
WDOTA

9

0900

**MEMORANDUM FOR THE RECORD** 31 December 1957

SUBJECT: Telephone Call from Colonel Nunziato to General Ritland

<u>5 Year Program on Astronautics</u>. Colonel Nunziato advised that yesterday, ARDC sent in a package on the astronautics program in which everyone was quite disappointed -- in the approach and everything else. As a result, Colonel Nunziato stated that unfortunately we have a crash program now to come up with something by Monday for General Putt as a supplemental package to the FY 58 and 59 programs. The ARDC package was not considered adequate because it didn't cover the necessary things, it didn't start from where we are at present, and it was not projected out. Some new guide lines will be given ARDC right away.

Colonel Nunziato said they were faced with coming up with something which would be a quick solution, for example, the special projects [redacted] and any others such as the bottom part of that one for an ICBM. They want to talk about the 117L, and perhaps using the "quicky" for a test vehicle -- what we want to do with it and how soon. ARDC will be working on the technical development and research and BMD will have the systems approach -- the complete vehicle with the exception of the X-16 and the Dinosaur; these will be included in the development and research package.

The figure for FY 58 is $66AM for R&D and for FY 59, $719M R&D. They want to know how much we need over and above that and what can be done with $15 additional million toward the highest priority programs in the technical development and research areas. If we got from $15 to 25 Million in FY 58 and from $30 to 50 Million in FY 59, what would be the highest priority things we would do.

General Putt needs the above information by Monday for the Johnson hearings since the ARDC material is not usable. They want to know what we would do with the additional money and some of the characteristics -- in other words, what could be accomplished such as the bottom part of the special project for an ICBM, the special project with various kinds of heads on them, acceleration of the electronic part of the 117L, construction of the track stations, and perhaps a test vehicle program. It is not necessary that the above be in great detail. It might be said that there are a lot of other things we want to do but that they are still being reviewed. The projects mentioned are the main (?) things which we want to do right away. Colonel Nunziato would like the above information by Friday morning.

vh

JOINT MESSAGEFORM

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FROM: COMMANDER AIR FORCE BALLISTIC MISSILE DIVISION INGLEWOOD, CALIFORNIA

SPECIAL INSTRUCTIONS

TO:

COMMANDER HQ ARDC
BALTIMORE, MARYLAND

[redacted]

(SECRET) FROM WDG-1-2

OK.

ON 31 DEC 57, ~~COLONEL RALPH NUNZIATO~~, HQ USAF, REQUESTED AFBMD RECOMMENDATIONS FOR AN EARLY ASTRONAUTICS CAPABILITY, INCLUDING COSTS AND SCHEDULES.. THIS INFORMATION IS TO BE USED BY GENERAL PUTT ON 8 JANUARY IN CONNECTION WITH THE JOHNSON HEARINGS. IN ORDER TO ACHIEVE SIGNIFICANT PERFORMANCE RESULTS DURING CALENDAR YEARS 1958 AND 1959, ALREADY DEVELOPED BOOSTERS AND GUIDANCE COMPONENTS WILL BE REQUIRED. THOR PLUS THE VANGUARD SECOND STAGE IS PROPOSED AS THE BASIC BOOSTER UNIT. WITH THIS VEHICLE, THE FOLLOWING TYPE MISSIONS COULD BE PERFORMED: A. PHOTO RECONNAISSANCE SATELLITE WITH A RECOVERABLE DATA CAPSULE. WE BELIEVE THAT

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JOINT MESSAGEFORM

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FROM: COMMANDER AIR FORCE BALLISTIC MISSILE DIVISION
INGLEWOOD, CALIFORNIA

SPECIAL INSTRUCTIONS

TO:

(SECRET) FROM WDG-1-2 (CONTD)

AN ORBITING TEST COULD BE ACHIEVED BY AUGUST 1958 WITH TELEMETRY EQUIPMENT BUT NO CAMERA. THE FIRST RECOVERABLE PHOTO DATA FLIGHT COULD BE ACHIEVED BY SEP 1958 FOLLOWED BY FOUR ADDITIONAL FLIGHTS THE REMAINDER OF FY 59, A TOTAL OF SIX VEHICLES. THESE EARLY FLIGHTS ARE TECHNICALLY FEASIBLE UTILIZING THE BOOSTERS AND RECOVERABLE DATA CAPSULE TECHNIQUES THAT ARE ALREADY DEVELOPED. AN IMMEDIATE GO-AHEAD IS NECESSARY HOWEVER. B. RECOVERABLE ANIMAL SATELLITE USING RHESUS MONKEYS. THE FIRST FLIGHT WITH ANIMAL RECOVERY COULD BE ACCOMPLISHED BY JANUARY 1959 FOLLOWED BY THREE ADDITIONAL FLIGHTS DURING THE REMAINDER OF FY 59. LUNAR MISSIONS COULD ALSO BE ACCOMPLISHED WITH A HIGH PROBABILITY OF SUCCESS BY ADDING THE VANGUARD THIRD STAGE TO THIS VEHICLE. TWO

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FROM: COMMANDER AIR FORCE BALLISTIC MISSILE DIVISION INGLEWOOD, CALIFORNIA

SPECIAL INSTRUCTIONS

TO:

(SECRET) FROM WDG-1-2 (CONTD)

TYPES OF MISSIONS COULD BE ACCOMPLISHED. C. HARD IMPACT ON THE MOON WITH BEACON OR OTHER DEVICE TO PROVE ACCOMPLISHMENT OF MISSION. FOUR VEHICLES SHOULD BE PROGRAMMED FOR THIS MISSION. THE FIRST FLIGHT COULD BE ACCOMPLISHED THE LAST QUARTER OF CY 1958 FOLLOWED BY THREE AT TWO MONTH INTERVALS. D. CIRCUMLUNAR FLIGHT WITH MEANS OF PROVING ACCOMPLISHMENT. FOUR VEHICLES SHOULD BE PROGRAMMED FOR THIS MISSION. THE FIRST FLIGHT COULD OCCUR BY JANUARY 1959 FOLLOWED BY THREE DURING THE REMAINDER OF 1959. THE ESTIMATED COSTS OF THIS PROGRAM ARE AS FOLLOWS: MISSION A - 6 VEHICLES FY 58 $6.9 MILLION FY 59 $7.8 MILLION. MISSION B - 4 VEHICLES FY 58 $3.0 MILLION, FY 59 $7.6 MILLION. MISSION C - 4 VEHICLES FY 58 $6.4 MILLION, FY 59 $3.7 MILLION. MISSION D - 4

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FROM: COMMANDER AIR FORCE BALLISTIC MISSILE DIVISION INGLEWOOD, CALIFORNIA

SPECIAL INSTRUCTIONS

TO:

(SECRET) FROM WDG-1-2 (CONTD)

VEHICLES FY 58 $2.5 MILLION, FY 59 $11.3 MILLION. AN ADDITIONAL LAUNCH COMPLEX CONSISTING OF TWO STANDS AND A BLOCKHOUSE WOULD BE REQUIRED AT A COST OF APPROXIMATELY $8 MILLION WHICH WOULD BE REQUIRED IN FY 58. THE TOTAL FOR ALL FOUR PROGRAMS IN FY 58 $26.8 MILLION, FY 59 $30.4 MILLION. THESE COSTS INCLUDE THE COSTS OF THOR AND VANGUARD BOOSTERS AS WELL AS THE DEVELOPMENT, PROCUREMENT AND TEST OF PAYLOAD AND ASSOCIATED GROUND EQUIPMENT. THOR PRODUCTION WOULD HAVE TO BE INCREASED TO EIGHT PER MONTH IMMEDIATELY IN ORDER TO PROVIDE THE ADDITIONAL THOR BOOSTERS REQUIRED. THE FIRST FLIGHT DATES ARE PREDICATED ON MAXIMUM AIR FORCE PRIORITY FOR ONLY ONE PROJECT OF THE FOUR BEING IMPLEMENTED. SIMULTANEOUS IMPLEMENTATION OF MORE THAN ONE PROJECT WOULD RESULT IN SLIPPAGE OF THESE DATES.

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FROM: COMMANDER AIR FORCE BALLISTIC MISSILE DIVISION INGLEWOOD, CALIFORNIA

SPECIAL INSTRUCTIONS

TO:

(SECRET) FROM WDG-1-2

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O. J. RITLAND
Brigadier General, USAF
Vice Commander

WDG-58-2

DD FORM 173, 1 MAY 55 REPLACES DD FORM 173, 1 OCT 49, WHICH WILL BE USED UNTIL EXHAUSTED.

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FROM: COMMANDER AIR FORCE BALLISTIC MISSILE DIVISION INGLEWOOD, CALIFORNIA

SPECIAL INSTRUCTIONS

TO:

COMMANDER HQ ARDC
BALTIMORE, MARYLAND [redacted]

(SECRET) FROM WDG-1-2

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FROM:
COMMANDER AIR FORCE BALLISTIC MISSILE DIVISION
INGLEWOOD, CALIFORNIA

TO:

SPECIAL INSTRUCTIONS

(SECRET) FROM WDG-1-2 (CONTD)

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FROM: COMMANDER AIR FORCE BALLISTIC MISSILE DIVISION INGLEWOOD, CALIFORNIA

SPECIAL INSTRUCTIONS:

TO:

(SECRET) FROM WDG-1-2 (CONTD)

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FROM:

COMMANDER AIR FORCE BALLISTIC MISSILE DIVISION
INGLEWOOD, CALIFORNIA

TO:

SPECIAL INSTRUCTIONS

(SECRET) FROM WDG-1-2 (CONTD)

VEHICLES FY 58 $2.5 MILLION, FY 59 $11.3 MILLION. AN ADDITIONAL LAUNCH COMPLEX CONSISTING OF TWO STANDS AND A BLOCKHOUSE WOULD BE REQUIRED AT A COST OF APPROXIMATELY $8 MILLION WHICH WOULD BE REQUIRED IN FY 58. THE TOTAL FOR ALL FOUR PROGRAMS IN FY 58 $26.8 MILLION, FY 59 $30.4 MILLION. THESE COSTS INCLUDE THE COSTS OF THOR AND VANGUARD BOOSTERS AS WELL AS THE DEVELOPMENT, PROCUREMENT AND TEST OF PAYLOAD AND ASSOCIATED GROUND EQUIPMENT. THOR PRODUCTION WOULD HAVE TO BE INCREASED TO EIGHT PER MONTH IMMEDIATELY IN ORDER TO PROVIDE THE ADDITIONAL THOR BOOSTERS REQUIRED. THE FIRST FLIGHT DATES ARE PREDICATED ON ONLY ONE PROJECT OF THE FOUR BEING IMPLEMENTED. SIMULTANEOUS IMPLEMENTATION OF MORE THAN ONE PROJECT WOULD RESULT IN SLIPPAGE OF THESE DATES.

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JOINT MESSAGEFORM

SECURITY CLASSIFICATION [redacted]

SPACE BELOW RESERVED FOR COMMUNICATION CENTER

[redacted]

| PRECEDENCE | | TYPE MSG (Check) | | | ACCOUNTING SYMBOL | ORIG. OR REFERS TO | CLASSIFICATION OF REFERENCE |
|---|---|---|---|---|---|---|---|
| ACTION | PRIORITY | BOOK | MULTI | SINGLE | | | |
| INFO | | | | | | | |

FROM: COMMANDER AIR FORCE BALLISTIC MISSILE DIVISION INGLEWOOD, CALIFORNIA

SPECIAL INSTRUCTIONS

TO:

(SECRET) FROM WDG-1-2

ALL COST FIGURES ARE PRELIMINARY AND SUBJECT TO REFINEMENT.

| DATE | TIME |
|---|---|
| 3 | |
| MONTH | YEAR |
| JAN | [illegible] |

[redacted]

WRITER

SYMBOL

TYPED NAME AND TITLE (Signature, if required)

PHONE

SECURITY CLASSIFICATION [redacted]

RELEASER

SIGNATURE

TYPED (or stamped) NAME AND TITLE

O. J. RITLAND
Brigadier General, USAF
Vice Commander

DD FORM 1 MAY 51 173 REPLACES DD FORM 173, 1 OCT 49, WHICH WILL BE USED UNTIL EXHAUSTED