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HISTORICAL REPORT

WEAPON SYSTEM 117L

1 January - 31 December 1956

WESTERN DEVELOPMENT DIVISION
HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND

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WEAPON SYSTEM 117L

In October 1955 Lt General Thomas S. Power, Commander, ARDC, directed that responsibility for managing the development of Weapon System 117L, the Advanced Reconnaissance System (nicknamed PIED PIPER), be transferred from WADC to the Western Development Division.[1] Brig General B. A. Schriever, Commander, WDD, was instructed to prepare a system development plan for the weapon system. Since the weapon system was then undergoing a critical phase in design studies, General Schriever and Brig General Howell M. Estes agreed that, in order to prevent possible program disruption, the transfer of management responsibility for the system from Dayton to WDD would be carefully phased. The intent was to effect the transfer smoothly and at a time period consistent with the workload of the program.[2]

Under these agreements, Colonel Otto Glasser and Commander Robert C. Truax, of the Division, aided by former members of the Dayton WSPO, prepared a preliminary WDD Development Plan for WS 117L in January 1956.[3] This preliminary plan was prepared in response to an urgent request from General Power that a plan be presented on that portion of the ARS which could be used to demonstrate an orbital capability within the International Geophysical year and shortly thereafter. It appeared that this program could insure a "backup" capability to Project VANGUARD.

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WDD development study of the possibility of a "backup" capability for VANGUARD indicated that this would be feasible providing implementing actions were taken at an early date, together with the necessary funding and priorities.

The Advanced Reconnaissance System has had a long and interesting research and development history.[4] In 1945 German research in the field of earth-circling satellites came to the attention of the Armed Forces. As a result, the U. S. Navy contracted with the Glenn L. Martin Company to continue studies in this field. In 1946, under Air Corps sponsorship, the then newly created RAND Corporation also undertook feasibility studies of earth satellites. In September 1947, RAND determined that a satellite was technically feasible. Both the Navy and the Air Corps continued to sponsor research in the satellite area during 1947.

Early in 1948 the question arose as to whether the Navy or the Air Force should continue their efforts in the field. The Research and Development Board approved Air Force sponsorship of the project, after the Navy had withdrawn their claim to sole rights to earth-circling satellite development. Immediately thereafter the Air Force requested the RAND Corporation to establish a program for investigation of possible satellite development. The Research and Development Board concurred in Air Force sponsorship of this program, and indicated that the RAND Corporation should be the agency utilized. The Navy then cancelled the Glenn L. Martin satellite program and withdrew from the field, to concentrate

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on other upper atmosphere projects.

In the next few years RAND studied the problem, which was given the code name Project FEEDBACK. RAND issued serial reports on the major aspects and components for a satellite system, and investigated the utility of a satellite for military purposes. Their studies indicated that a space vehicle could be placed on an orbit to the earth by a rocket powered booster. This space vehicle, with appropriate instrumentation and links with ground stations, could be utilized for area reconnaissance and for geophysical purposes. To perform this reconnaissance function a television system together with communication links which would transmit information and pictures to ground stations would be utilized.[5]

RAND personnel recognized the fact that numerous system component development problems existed. Many of these development problems were major, but they could be solved by applied develop-ment efforts. Chief among these problems were the development of power sources to operate the satellite's equipment, the develop-ment of television and communication components, and of an orbital attitude sensing and control system which would keep the satellite properly oriented on its orbit, say at 300 miles above the earth, and would keep its sensors pointed in the right direction for the transmittal of intelligence to ground stations.

These were only a few of the specific problems which were uncovered and identified by the RAND Corporation studies. There

were many more; nearly all were problems of first magnitude. Yet the RAND researchers continued to investigate system needs and, in 1954, published a final Project FEEDBACK Summary Report.[6] Again in the Summary Report, the reconnaissance utility of the satellite was emphasized, with the observation that hardware development would not require radically new technology or enormous cost. Key value of the system was felt to be for photographic reconnaissance intelligence, mapping intelligence, and weather intelligence. RAND estimated that complete development and initial operation could be accomplished in about seven years at a cost of $165 million. Cost estimate was believed reliable within a factor of two, for a ..."minimum pioneer" (visual) reconnaissance system.[7]

Just prior to the issuance of the final RAND reports, in the latter half of 1953, the Air Force established a research and development program on an advanced reconnaissance system.[8] The designation Weapon System 117L was reserved for use in ultimate system development. This program was documented by WADC under ARDC Manual 80-4, and assigned from the System Planning Office, where it was known as Project MX-2226, to the Bombardment Missiles Branch of the Weapon System Division, as Project 1115. A Weapon System Project Office was established, with Lt Colonel Quenten A. Riepe as Office Chief. Lt Colonel Riepe was succeeded as office chief in August 1955 by Lt Colonel William G. King, Jr.

During 1954, the Project Office initiated tasks to advance the state of the art in project areas, and intensive feasibility studies were undertaken by contractors and by ARDC Centers. For

example, by November 1955, "in house" Advanced Reconnaissance System tasks within ARDC included:

Task No.	Task Title	Project Engineer, Center
21010	Design Study Advanced Reconnaissance System	Mr. F. Runge, ARDC
21011	Special Research Studies	Capt J. Coolbaugh, ARDC
15000	Intelligence Parameters Study	Mr. R. Johnson, RADC
15001	Study of Intelligence Processing Methods	Mr. R. Johnson, RADC
15002	Acquisition, Tracking, Ground Air Communications and Command Portion of the ARS	Mr. F. Fallik, RADC
44147	Attitude and Guidance Control	Mr. F. K. Guenthner, WADC
50558	Attitude and Guidance Control	Lt W. O. Covington, WADC
41261	Television Techniques	Mr. J. Huckaby, WADC
30291	Auxiliary Power Plant	Lt Carl Johnson, WADC
70843	Solar Electrical Energy Converter	Mr. B. C. Reynolds, WADC
41700	Effects of Nuclear Radiation on Electronic Components	Capt M. Griffith, WADC
41262	Radiation Reconnaissance Capability Study	Mr. Reck, WADC
41644	Electronic Component Part Application Criteria for 10,000 Hour Reliable Operation	Mr. S. Sereda, WADC
30205	Liquid Rocket Engine Technology	Capt R. Decker, WADC
	Flight Control Laboratory	Lt M. Malcomson, WADC
	Training Equipment and Ground Support	Maj L. Bowen, WADC
	Materials Laboratory	Mr. L. Salzberg, WADC
	Geophysical Program and Weather Forecast	Lt Col George Jones, and Mr. Norman Sissenwine, AFCRC

As indicated earlier, there were a number of critical component development areas for the Advanced Reconnaissance System which faced the new Project Office. Among these were those of providing auxiliary electrical power to operate satellite equipment. For this purpose nuclear reactors, as well as solar and chemical energy sources, were investigated. A second problem area was that of achieving component reliability in a satellite environment in which components would have to provide trouble-free operation over long periods of time. A third problem was that of acquisition and tracking of the vehicle as it passed around the earth on its orbit. A fourth problem was that of data acquisition and storage. A single satellite vehicle would be capable of producing up to a hundred thousand pictures daily. These would have to be transmitted and stored, and then interpreted. These were only a few of the component problems which faced ARS development. In fact, to solve such problems, the development of System components required work in nearly every field of science.

However, with the intensive effort applied to the project, by 1955 sufficient data had been obtained from these "in house" ARDC feasibility studies to insure that the problems were not insurmountable. This allowed the embarkation on design studies for the system, and on the study of integration of the various space-borne and ground components into a workable reconnaissance system.[9] Moreover, such development effort could be carried out as a coherent part of the over-all ARS program.[10]

Consequently, in the spring of 1955, in addition to "in house" ARDC tasks, the WSPO initiated design study contracts with Radio Corporation of America, Glenn L. Martin Company, and Lockheed Aircraft Corporation.[11] Purpose of these design studies was to determine if a system of this type could be developed within a reasonable enough time scale to warrant a full scale development effort.

The design studies submitted by RCA, Martin, and Lockheed indicated that the system could be developed. Consequently, upon transfer[12] of responsibility for system development to the Western Development Division early in 1956, action was taken to set up a WS 117L project office under the Deputy Commander for Technical Operations. Col Otto J. Glasser was named Assistant for WS 117L, with Commander Robert C. Truax as Deputy Assistant. On 13 August 1956 Lt Col Fredric C. E. Oder succeeded Col Glasser as Assistant for WS 117L. Other personnel initially assigned to the office were Capt J. S. Coolbaugh, Capt W. O. Troetschel and Lt J. C. Herther. These latter were officers who had been associated with the program at Dayton prior to its transfer. Organization and key personnel of the WS 117L Project Office are shown on the opposite page.

Initial actions of the new project office included activity in evaluating and selecting a prime contractor for WS 117L. Early in March a Contractor Evaluation Board was established to study the RCA, Martin, and Lockheed design studies, and to recommend a contractor.[13]

WEAPON SYSTEM 117L

The Contractor Evaluation Board for WS 117L included:

Colonel William H. Baynes, HED ARDC, President
Lt Colonel R. C. Holub, HED AMC
Commander R. C. Truax, WDD
Lt Colonel W. G. King, Jr., HEDARC
Lt Colonel V. M. Genez, HED ARDC
1/Lieutenant R. S. Washburn, HED AMC
Mr. R. S. Blocker, HED AMC

The Board convened at Wright-Patterson AFB, from 12 - 20 March 1956 and submitted a report to General Schriever recommending Lockheed as the systems contractor. This selection was approved by General Schriever, General Power, and Headquarters USAF agencies.

Following approval of the prime contractor selection, personnel from the project office, assisted by other members of the WDD staff and personnel from the former project office, prepared a Development Plan for WS 117L. Completed on 2 April, the Plan was presented to ARDC and USAF Agencies, and on 10 May 1956 to Secretary of the Air Force, Donald A. Quarles.[14] A few months later the President's Science Advisory Committee was also briefed on the proposed WS 117L Development. Response on the briefings of May - June 1956 ranged from "...interested to enthusiastic."[15]

The WDD Development Plan for WS 117L envisaged a step by step attainment of objectives leading toward increased utility of the system. Stages of development embraced (1) an Engineering Prototype Test System to establish the feasibility of orbital operation; (2) a Pioneer System; (3) an Advanced System; and (4) an Ultimate System. These were further divided into a total of eight programs.[16]

The Development Plan called for a two stage vehicle which could be launched from United States territory. The "booster" or first stage would be an ICBM which would fall away on burnout approximately 3000 n. miles from launch. The second stage would be the orbiting vehicle, which would have a propulsion system to supply the necessary power to bring the vehicle to orbiting speed. It would ascend to an altitude of about 300 nautical miles, where an orbit would be established, and internal controls would orient the vehicle in the proper attitude. The appropriate sensing equipment (visual "ferret" or infra-red sensing, depending on objectives) would be activated, and the signals received from the sensing equipment would be stored on film, tape or some other media. As the vehicle orbited to within the range of a ground station, this recorded data would be transmitted to the ground station, processed, and transmitted to the using agencies.

At the altitude of 300 n. mi., the vehicle would "circle" the earth in approximately 90 minutes. Because the orbit would be relatively fixed in space while the earth rotated inside it, successive passes over the earth's surface would be displaced approximately 22½ degrees. This would permit a single vehicle to view the entire earth in successive passes. The total time required would depend on the width of the view desired.[17]

A "pioneer" satellite, utilizing a film recording - electronic read-out, would be capable of physiographic mapping. It could report data with a resolution of 100 feet, and give

some indication of the scope of military operations. This same "pioneer" utilizing different electronic equipment would be able to furnish information on the characteristics of high frequency electronic emissions. This latter mission was considered to be of great value since high frequency electromagnetic radiations are not reflected to the earth, but are radiated into space, and consequently cannot be monitored by normal means.[18]

The system could be improved through development experience. Advanced versions of the reconnaissance system would provide physiographic resolution to 20 feet or less, or more detailed information on the characteristics of electromagnetic signals, extending to infra-red radiations. Targets could be located with an accuracy of 1/10 mile.

Finally, the ultimate system could embrace daily scrutiny of the world, including detection of long-range missiles after launch, and detection of aircraft operations.

In addition to what might be considered strictly military values, the reconnaissance system offered significant scientific values for geophysical investigations. Weather phenomena, upper atmosphere research, meteor and cosmic ray activity, as well as solar and stellar spectra, could all be investigated from the space platform. Thus the system had important basic scientific value in addition to military utility.

As a result of these briefings, development of the ARS was approved.[19] Three million dollars in FY57 P-600 funds was made available for system development.[20] An initial letter contract

for system development was let with the Missile Systems Division of Lockheed Aircraft Corporation on 5 November 1956.* However, P-600 funds available for system development were considered inadequate, and presentations were made to General Putt and his staff at DCS/D, Hqtrs. USAF, requesting additional funds.[21]

Authorization to obligate an additional two million dollars was received on 7 December 1956.[22] Early in 1957, authority to obligate up to a total of ten million dollars for FY57 was received.[23] Receipt of authority to obligate these funds in the P-600 budget category eased the "fund famine," and enabled Lockheed Aircraft Corporation to begin system development work on a more effective scale, although of necessity fund limitations tended to channel activity into component rather than total system development. Moreover, this funding obligation authority did not solve fund problems in other areas. No funds were made available in the P-100 and P-200 areas, areas in which funds were needed in order to provide a "...balanced system oriented approach to the development of essential components of WS 117L." At the end of

*One significant difference in the WDD management concept for the WS 117L in comparison with WS 107A and WS 315A programs was the fact that Lockheed occupied the position of a prime system contractor for the Advanced Reconnaissance System, whereas in the case of the ICBM and IRBM, the Ramo-Wooldridge Corporation was fulfilling the management role usually assigned the prime system contractor. Role of the Ramo-Wooldridge Corporation with respect to WS 117L was that of furnishing technical aid to the Division on an "as requested" basis.

the year, funding in these areas had not been resolved.

With these funds available, the Division Project Office took action to initiate a contract with Massachusetts Institute of Technology on ARS guidance and control. WADC research activities on nuclear and solar auxiliary power units were continued. In yet another area, AFCRC was authorized to continue research in the geophysical environment area for the weapon system. Finally, subsystem project plans were drafted and project and task number assignments were established.[24] The RAND Corporation initiated studies of preliminary operational concepts for the system.

The approval of funds allowed Lockheed Aircraft Corporation to undertake work as the system prime contractor. Progress during the period consisted of activity in system technical management, project direction, and system research development and operation.[25]

Development planning for master scheduling of initial R and D hardware mock-ups was underway. Design studies for the orbital test vehicle airframe were initiated. Studies designed to utilize a propulsion system which had early availability were well advanced. Sources of auxiliary power were under investigation, as were guidance and control, visual and electronic, and data processing studies. Lockheed's subcontractors, Eastman Kodak and C B S Laboratories also report progress in these latter areas. It appeared that the program was off to an auspicious start.

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FOOTNOTES

WEAPON SYSTEM 117L

1. Ltr, Maj Gen Albert Boyd, Deputy Commander, Weapon Systems, ARDC to Maj Gen B. A. Schriever, 7 Nov 55. No definite reason for the transfer was given. However, the system was dependent on the availability of an ICBM for a booster, and thus was closely tied to the ICBM program.

2. Maj Gen B. A. Schriever, Memorandum of Understanding, Subj: "ARS Management," 16 Nov 1955 (Secret)
Memorandum of Understanding between Maj Gen B. A. Schriever and Brig Gen Howell M. Estes, Jr., Subj: "Transfer of Functional Responsibility for ARS Program," 13 Jan 1956 (Conf)

3. WDD(ARDC) Development Plan, Weapon System 117L Preliminary Development Plan (Initial Test Phase) Advanced Reconnaissance System, (Secret) WDD-56-00088

4. Background material for this sketch was taken from Historical File, WS 117L Office, WDD, publications of the RAND Corp., and from an interview with Lt Col Quenten A. Riepe, WS 117L Project Office. For an additional account of the genesis of WS 117L, see History of ARDC, 1 July - 31 December 1955, Ch VIII, 325-359.

5. Project RAND, J. E. Lipp and others, Utility of a Satellite Vehicle for Reconnaissance, RAND 217, April 1951 (Secret). The report stated as a general conclusion that "...television satellites are feasible and that they would be useful if built and operated."

6. R-262 (Secret), 1 Mar 54, 2V, FEEDBACK was the code name used for the RAND project during the period. Volume I contains a full bibliography of all reports issued by RAND.

7. Ibid.

8. WADC Project 409-40.

9. ARDC System Requirement No. 5, 29 Nov 1954 (Secret) Amendment 1 to SR #5, 8 August 1955. These gave authorization to proceed with full design studies by industry.

10. Ibid.

11. Bell Telephone Laboratories, though invited, declined to submit a proposal.

12. System Requirement #5, Hed ARDC, 17 Oct 1955.

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FOOTNOTES
(contd.)

13. WDD Special Orders #6, 5 March 1956.

14. Memo to WDTX, Subj "Major Events of CY 1956 for WS 117L." (Secret), 25 January 1957.

15. Early briefings on the utility of the Advanced Reconnaissance System contained the thought that today, in the age of "Atomic plenty," with long range missiles a thing of the near future, the strategy of surprise attacks will become more and more important. This strategy can be used most easily by absolutist governments. One of the chief means of guarding against this would be through a system like the ARS which could keep military activities such as long range missile sites under surveillance. (Comdr R. C. Truax, Briefing on WS 117L, 6 April 1956).

16. WDD Development Plan, WS 117L, 2 April 1956 (Secret, RD) General Design Specifications.

17. DD Form 613, WDD Development Plan, WS 117L, Advanced Reconnaissance System, (Secret, RD) 2 April 1956.

18. Ibid.

19. USAF Development Directive 85, 3 August 1956 (Secret). ARDC System Development Directive 117L, 17 August 1956 (Secret).

20. Since no FY56 funds were available for the Lockheed contract, action was taken by ARDC (TWX 12 May 1956) to authorize reprogramming and expenditure of remaining project 1115 funds so that Lockheed could begin engineering studies on the system. These funds, to the sum of $322,000.00, allowed Lockheed to begin work without delay.

21. Since no Fy57 or beyond funds had been programmed, reprogramming action was necessary to obtain this money. Moreover, in view of fund limitations on the program, the fear was voiced that this would force a program of component and sub-system development, rather than complete system development.

22. TWX, USAF AFDDP-B.

23. TWX ARDC RDSCBC-1-16-E 15 Jan 1957 Indications were that the same amount would be available for FY58.

24. WS 117L Management Report, 31 Jan 1957 (Secret).

25. Missile Systems Division, Lockheed Aircraft Corp., WS 117L Semi-Annual Technical Program Report - Period 1 Oct-31 Dec 56 (S).

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