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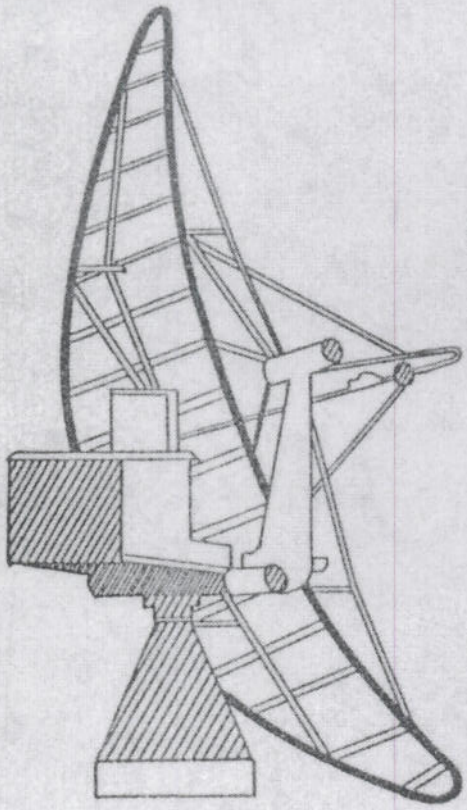
HISTORY

Rome Air Development Center
Air Research & Development Command
United States Air Force



Griffiss Air Force Base,
New York

1 July 1957
31 December 1957

[redacted]

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CONTROL NO. 58-1732
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[redacted]

This document prepared in accordance with provisions of AFR 210-3 (11 May 55), AFR 210-1 (15 Sep 52), Editorial Style Sheet for Air Force Military History (Oct 54), and AFR 205-1 (3 Jan 56).

[redacted]

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5477

CS-31630

(UNCLASSIFIED)

H I S T O R Y

OF

ROME AIR DEVELOPMENT CENTER

GRIFFISS AIR FORCE BASE

NEW YORK

1 July - 31 December

1 9 5 7 .

VOLUME I

NARRATIVE

Approved by:

[redacted]

D. P. GRAUL
Brigadier General, USAF
Commander

Prepared by:

[redacted]

PHILIP A. SMUCKER
Center Historian

AIR RESEARCH AND DEVELOPMENT COMMAND
United States Air Force

Control No. 58-1732

Forward

The Center history makes no attempt to trace the progress of all of the hundreds of projects or activities of each of the offices at Rome. Rather it strives to present broad topics of general significance to the Center whether in the field of administration or in the more technical areas. Where ever possible, the historian has endeavored to focus attention on the fact that the project and system work of the Center is a function of many individuals and many groups working together as a team. Not infrequently it arises that even those persons directly engaged on a particular project are not fully aware of the efforts that other groups are contributing nor are they always entirely clear as to where the project fits into the general picture of the Center research and development program. It is hoped that the Center history may serve to set in better perspective the general research and development activity of the Center.

In order to bring the RADC historical program up to date, the present history has been prepared concurrently with the preceeding volume which covers the period 1 January 1957 - 30 June 1957. The chronological limits for the two histories have consequently been interpreted liberally. Although both histories respect the strict chronological limits for topics which are discussed in both, other chapters draw rather freely on events which occurred throughout 1957. In the former category are the chapters on Center management and Missile Defense. In the latter category are all the other chapters which, it will be noticed, treat topics that do not repeat in the two histories. Thus the chapter in the January-June History on the "Scientist at RADC" will include materials from the rest of 1957 too. While the chapter on the "DEW Line" in the July-December 1957 History will provide background activity from the earlier period. Since these chapters are in the nature of special studies, it is believed that this treatment will, under the circumstances, give a better grasp of the topics and provide a fuller coverage than otherwise possible.

Copies of the RADC semiannual histories are forwarded to Headquarters of the Air Research and Development Command and to Air University along with the accompanying volumes of supporting documents. Inside the Center, distribution is made to staff and directorate heads for their reference.

The historian would like to express his appreciation to the members of the staff at all echelons of authority in the Center for their patient and invaluable willingness to discuss the operations of their offices and clarify points of uncertainty. Although it would be impractical to mention all those who have aided in the preparation of this history, the historian would like to single out Lt. George F. Alexander, the Information Services Officer at RADC for his never failing cooperation and Mrs. Betty Bulcko for her editorial skill and her dexterity in typing the manuscript for publication.

[redacted]

PHILIP A. KNACHEL
Center Historian

CONTENTS

ILLUSTRATIONS

CHRONOLOGY

23 January 1950	– Air Research and Development Command established
26 September 1950	– President Truman signed bill authorizing move of Watson Laboratories to Rome, N.Y.
14 February 1951	– Transfer of Watson Laboratories to to Rome, N.Y. completed
2 April 1951	– Griffiss Air Force Base shifted from jurisdiction of AMC to ARDC
1 June 1951	– Rome Air Development Center designated
1 July 1951	– Griffiss Air Force Base transferred back to jurisdiction of AMC
1 July 1956	– Directorate of Communications activated
1 July 1957	– Colonel Daniel B. White relieved Major General Stuart P. Wright of command of RADC
15 July 1957	– Captain Henry F. Spinney becomes Commander of Headquarters Squadron Section
1 August 1957	– Brigadier General D.F.Graul assumed command of RADC
1 August 1957	– Colonel Daniel B. White becomes Deputy Commander of RADC
16 August 1957	– Lt. Colonel Harry W. Coggshall becomes DCS/Comptroller
25 September 1957	– 2nd Lt. George F. Alexander becomes Information Services Officer

22-24 October 1957	- Electronic Countermeasures Symposium
30 October 1957	- Joint Agreement Letter drafted by commanders of RADC & AFCRC
6-7 November 1957	- Aeronautical Communications Symposium
13 November 1957	- Visit of Lt. General Samuel Anderson, Commander of ARDC to Center
16 November 1957	- Mr. Warren Dunn becomes acting Director of Intelligence and Electronic Warfare

CHAPTER I

CENTER MISSION & PERSONNEL CHANGES

Mission

A perennial problem of the Air Research and Development Command has been the parcelling out of responsibilities among the Centers without creating areas of overlap, either of mission or of projects. This has been particularly troublesome in the domain of electronics in which ARDC maintains three Centers charged with various phases of the Air Force electronic research and development effort. Through the years, two of the Centers, Rome Air Development Center and the Cambridge Research Center, have come under unusually close scrutiny in this regard.

Prior to the transfer of Watson Laboratories at Redbank, New Jersey to Rome in 1950-1951, it had been planned at one time to include the research laboratories at Cambridge, Massachusetts in a consolidation of Air Force electronic activity. At the last moment, however, the Cambridge transfer was quashed and the Watson group moved into Rome unaccompanied by their colleagues from Cambridge.[1]

The picture at that point did not appear too complex. Rome concerned itself with research and development of ground electronic equipment and systems while Cambridge concentrated on basic and applied research. Wright Air Development Center, the third point of the electronics triangle, assumed responsibility for airborne equipments and systems. But then in June of 1952 the Cambridge mission was expanded to include not only research but development and test. Talk of a Rome-Cambridge duplication began to revive sharply. By 1953 both Centers were at work on tasks associated with air defense ground environment systems, tactical air control systems and data links.[2] Confusion mounted and the storm clouds of a new crisis in the relationship of the two Centers had gathered by 1954 when on July 1st of that year Rome was converted into a tenant organization at the Griffiss Air Force Base. A plan to carry the reorganization a step further and subordinate RADC to Cambridge was on the verge of execution. Although it was not intended that RADC be physically moved to Cambridge, it was proposed that RADC be placed under Cambridge supervision instead of reporting directly to Headquarters of the Air Research and Development Command. This would have spelled the end of RADC as an independent Center. Before the change could be effected this proposal, too, was countermanded.[3]

But though both Cambridge and Rome had weathered successive attempts to merge their activities, an ultimate solution to the basic problem of overlap was still to be found. Revised mission statements governing the two Centers did nothing to lessen the fear. Understandably enough, Center leaders were as anxious as those at higher command levels to eliminate the confusion, whether real or apparent. At a meeting 17 April 1957 between the Commanders and Technical Directors of the two Centers, this question came under discussion. The two commanders, Major General William B. Morgan of Cambridge and Major General Stuart Wright then heading RADC, determined upon a fresh study to identify any undesirable duplication in the technical programs of the two Centers. A three man committee was created, composed of Mr. Irving Wiman, Associate Director of Research and Development at RADC, Mr. Robert M. Barrett, Deputy Director, Electronics Research Directorate, Cambridge and Dr. Alan Gerlach of the Geophysics Research Directorate, Cambridge.[4]

For eight weeks in May and June 1957 the committee subjected the programs of the two Centers to the most searching examination.[5] But even as the committee was formulating its final conclusions and recommendations, several important changes of command took place. At the local level Brigadier General D. J. Gaul assumed command of RADC in replacement

of General Wright, 1 August 1957, while General Anderson similarly relieved General Power as commander of the Air Research and Development Command. In spite of these shifts in authority, the work of the committee continued uninterrupted to its proper conclusion. On August 13, 1957, members of the staff of the Commander ARDC attended a verbal briefing on the findings of the committee. A written summation was assembled later.[6]

The committee discovered no significant technical overlap between the two Centers which it could not resolve. In areas where overlap was identified, mutual agreements were arrived at for the transfer of the work to one or the other of the two Centers. As a result, the build-up of a High Power Test Facility at Cambridge was eliminated and the equipment transferred to RADC. A similar transfer of responsibility for the development of the "Identification Friend or Foe" program to RADC was arranged. And it was further understood that the Electronics Research Directorate of Cambridge and RADC together would handle future Geophysics Research Directorate electronics requirements.[7]

The principal overlap was found to be an artificial one - a problem of semantics - in that the mission statements for the two Centers did not correctly define their actual capabilities

or existing work. This confusion of mission was noted in the areas of Communications, Air Traffic Control, Intelligence and Aircraft Control and Warning. And in some cases, it was observed, the missions were not properly implemented by directives from Headquarters AFDC. Committee members after establishing these and other facts of life, boldly advanced nineteen recommendations to help clarify the relationship of RADC and Cambridge.[8]

There was no doubt, they felt, but that new mission statements were required - mission statements at once definitive and free of ambiguities. They were further convinced that, once published, the mission statements must command conformity from all those concerned in research, technical development and systems. Although the committee was grappling at the moment with the relationship of Rome and Cambridge, it underscored the futility of trying to solve the whole problem if the Wright Air Development Center were not also brought under consideration. In short, Wright needed a new mission statement just as did the other two Centers.[9]

In principle the committee recommended that all Electronics Research and Technical Development work be the responsibility of Cambridge while all Electronics Operational Development, Systems Requirements and

Electronic Supporting Systems Work at the Center of ESAC. It emphasized that prime responsibility for those functions should fall upon a specifically designated Center. While the responsible Center could have a significant portion of the program conducted at another Center, the task of planning, coordinating and managing the program would be its own.[10]

The Committee endorsed the organizational separation of research from operational development, but it pointed out that this simply intensifies the need for an adequate interchange of scientific information and personnel between the Centers. Both Centers recognized this as a particularly difficult management problem. Working level liaison and coordination groups were clearly a must. Active work groups for Antennas, Radomes, Tubes and System 2191 already in operation had demonstrated how desirable and indeed necessary it was to have similar groups in other fields.[11]

The Committee did not feel that a relocation of facilities would be required and it did not envisage a physical move during what was termed the Phase I period.

It did, however, recommend that no new work or new facilities be started beyond fiscal year 1958 that were not in harmony with the newly assigned mission statement. For long range planning, the committee suggested that in from five to seven years the center of gravity of electronic work be shifted to one Center.*

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*Report, RADC-CRC Study, May-June 57. Compare the new and old mission statements of RADC as contained in the "Organization and Functions of the Rome Air Development Center."

A) The old - 1 Dec 56: a) To accomplish applied research, development and testing of electronic systems, ground electronic techniques, components and equipments in the functional area of detection, control identification, countermeasures, navigation, communications, data transmission, and radio intelligence collection and processing, as directed.

b) To perform applied research and development of ground based intelligence and reconnaissance systems and components. To perform system engineering on air-ground data transmission systems for intelligence and reconnaissance purposes. (Note: Research and development of aircraft and missile-borne equipments are the responsibility of the Wright Air Development Center.)

c) To establish and operate an ECM test facility to support all ARDC centers in accordance with existing instructions and to support other agencies as directed by Headquarters ARDC.

B) The new - 1 Jan 58: a) To accomplish operational development and test of electronic supporting systems, subsystems, components, and associated equipment, as directed; and provide related engineering and procurement data support to ADC. To conduct technical development as directly connected with and required to accomplish the operational development of mission. (Note: Development of aircraft and missile-borne equipments are specifically excluded.)

b) To provide and operate an electronic countermeasures (ECM) test facility to support ARDC centers and other government agencies in ECM and ECM vulnerability testing.

In an interesting side light to the Committee findings, Mr. Harry Davis, Scientific Director of RADC wrote 17 August 1957 in a Center Newsletter that the Committee had discovered the electronic effort at RADC to be "several times greater than that of AFCRC and that we do the bulk of the electronic work for ARDC." Referring to the committee's recommendation that a single Air Force electronic Center should be established later, he noted, "While we would be the main Center under such a plan, it would not be necessary to move the Research Directorate here..." This is where the situation stood in early August.[12]

Meanwhile General Anderson, the new commander of the Air Research and Development Command, evinced interest of his own in the possibility of combining RADC and Cambridge and he directed the two Center Commanders, Generals Graul and Morgan, to work on the problem.[13] There followed a period of more study and review of the findings of the three man committee. Finally an understanding by the two Center commanders was reached 30 October 1957 to send a Joint Agreement Letter to Headquarters ARDC outlining their common views on the subject. On November 5, 1957 the letter, over the signatures of General Graul and General Morgan, was on its way to Baltimore.[14]

Although members of General Anderson's staff had been briefed on the earlier RADC-Cambridge committee report in August, an opportunity had not presented itself to bring the report to the personal attention of General Anderson. In their joint letter to him, the two Center Commanders based their own conclusions on the findings of the committee and extracted for this purpose the basic outline of the report with its more salient recommendations. These followed closely the points already mentioned. No reference was made, though, to the committee's long range suggestion to shift the center of gravity ultimately to one Center.[15]

Indeed, the more responsible leaders of the two Centers wrestled with this nagging problem, the more firmly they rejected either the possibility of moving Cambridge to RADC or RADC to Cambridge. Instead both Centers chose to seek a modus vivendi, satisfactory to both yet free of overlap and confusion. The original committee report and the later Joint Agreement letter had detailed various ways in which improvement could be achieved. Many of these required action by Headquarters ARDC. In the meantime it had been possible to brief General Anderson more fully on the situation at the time of his visit to RADC November 13, 1957.[16]

The joint letter of the two Center Commanders received a careful review by appropriate members of General Anderson's staff at Baltimore. On January 17, 1958 the AMTC Commander sent to General Traul of RADC an outline of the actions already taken or underway by his headquarters. Most important, General Anderson disclosed that his staff endorsed the fundamental premise upon which Generals Traul and Morgan had based all their recommendations - the conclusion that "no significant technical overlap between the two Centers remains unresolved." Turning then to specifics, General Anderson's reply showed that some, though by no means all, of the recommendations forwarded to him by the commanders of RADC and Cambridge had been accepted at Headquarters.[17]

On the positive side, General Traul was informed that a new mission statement had been published for the Wright Air Development Center and that new mission statements had been written for RADC and Cambridge and would be published two weeks hence. According to word from Baltimore, the statements were definitive "and will clearly indicate where this Headquarters desires both the mission responsibility and the Center competence to reside." RADC was designated the primary Ground Electronic Development Center in the new mission statements.[18]

Baltimore agreed with the suggestion that the Centers should not undertake construction of new facilities or major reorganization unless in consonance with the intent of the new Center missions. It was added that such a policy is now in effect.

In addition to the existing working groups created for the interchange of information, Headquarters announced it was considering the establishment of an effective Working Group to cover the field of electronics generally. This group would coordinate the efforts of the individual area groups and would consider problems larger in scope than the responsibilities of the area groups.[20]

In answer to the request for a clarification of the authority to be exercised by Centers assigned specific Center responsibility for T.D.'s, Baltimore cited the AFSC Manual 80-4. In instances where responsible and supporting centers could not thrash out mutually agreeable solutions to problems arising from this work, the responsible Center was directed to bring the problem to Headquarters for resolution.[21]

On the negative side, however, Baltimore rejected the neat partition of effort recommended by RAND and Cambridge which would have apportioned Electronic Research and Technical

Development to Cambridge and Ground Operational Electronic Development to RADC. Headquarters preferred it said, to assign work which was consistent with demonstrated Center competence and mission responsibility. This meant among other things that RADC will not be restricted from technical development in direct support of its mission or from the early phases of technical development outside the responsibility of Cambridge.[22] Baltimore also rejected the assignment of prime responsibility to a specific Center of R&D's, IPPD's and of systems since it believed that they embraced so wide an area and were of such complexity that their overall management should be the responsibility of Headquarters AFSC.[23]

Nor did AFSC believe that when Research or Technical Development is required as part of a Weapon System or Supporting System, it should be assigned for management control to the Center having responsibility for that particular Research or Technical Development program. AFSC argued that frequently technical decisions are not the determining factors. Therefore Headquarters affirmed that while all technical recommendations from the laboratories will be taken into consideration, the systems office will study other factors as well in order to arrive at the best possible decision.[24]

The details are contained [illegible] points which will be examined in the following Contents of Volume II of this History. Naturally the effectiveness of these decisions reached at Headquarters AMC cannot be assessed at this early date.

Key Personnel Changes

While the organizational structure of the Center remained with only slight modification as it had stood, some rather important personnel changes could be noted. On July 1, 1957 Colonel Daniel P. White, Deputy Commander of RAMC, relieved Major General Stuart P. Wright of command of the Center.[25] A month later Colonel White relinquished command in turn to Brigadier General D. N. Graul on 1 August 1957 and returned to his assignment as Deputy Commander.[26] Mr. Harry Davis, the Scientific Director, continued in that function.

Several new faces could be observed on General Graul's staff by the end of 1957. Captain Henry F. Spirry relieved Major John Kiernan of his duties as commander of the Headquarters Squadron Section 15 July 1957[27] and Major Kiernan was similarly relieved of his extra duty as Information Services Officer on 25 September 1957 by 2nd Lt. George F. Alexander.[28] Direction of the Comptroller's Office was shifted when Colonel John F. Donley left his post there as Deputy Chief of Staff and was

succeeded by Lt. Colonel Harry W. Coggshall 26 August 1957.[29]
Colonel Robert E. Keating, the deputy chief of staff/Operations
was replaced by Mr. William P. Bethke, acting deputy chief of
staff/Operations.[30] Finally, Colonel James W. Anderson,
Director of Intelligence and Electronic Warfare, was succeeded
by Mr. Warren S. Dunn who on 16 November 1957 was named
Acting Director of Intelligence and Electronic Warfare.[31]*

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* Key Center Personnel as of 31 December 1957

Brigadier General D. F. Grael	Center Commander
Colonel Daniel P. White	Deputy Commander
Mr. Harry Davis	Scientific Director
Mr. James Clayman	Inspector General
Major John Kiernan	Adjutant
2nd Lt. George F. Alexander	Information Services Officer
Captain Henry P. Spinney	Commander, Hqs Squadron Section
Major Verle T. Hopkins	DCS/Personnel
Mr. William P. Bethke	Acting DCS/Operations
Lt. Colonel Leo F. Fielder	DCS/Materiel
Lt. Colonel Harry W. Coggshall	DCS/Comptroller
Colonel Howard Durham, Jr.	Director of Procurement
Colonel Otto Quarrud	Director of Control & Guidance
Mr. Warren S. Dunn	Acting Director of Intelligence & Electronic Warfare
Mr. Oliver Tallman	Director of Technical Services
Colonel Daniel A. Harvey	Director of Communications
Major Robert B. Barney	Director of Flight Test

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1. Interview by the author with Mr. James Wayman, Inspector General, 16 Jan 58.

2. History of Air Force Cambridge Research Center, 1 Jan 55 - 30 Jun 55, p. 6.

3. Interview by the author with Mr. James Wayman, Inspector General, 16 Jan 58.

4. Ltr, Comdr. AFCRC and Comdr RADC to Comdr ARDC, subj: (U) Duplication in Electronics Research and Technical Development, 30 Oct 57.

5. Ibid.

6. Ibid.

7. Ltr, Comdr AFCRC and Comdr RADC to Comdr ARDC subj: (U) Duplication in Electronics Research and Technical Development, 30 Oct 57.

8. Report, RADC - CRC Study, May-June 57.

9. Report, RADC-CRC Study May-June 57.

10. Ibid.

11. Ibid. See also ltr, Comdr. AFCRC and Comdr. RADC to Comdr. ARDC, subj: (U) Duplication in Electronics Research and Technical Development, 30 Oct 57.

12. Technical Information Letter RADC, 15 Aug 57, p. 4.

13. Interview by the author with Mr. Irving Kirman, Associate Director of Research & Development, 16 Jan 58.

14. Ltr, R. V. Richardson Col, AFCRC to Lt. Harry Davis, Scientific Director NAIC, subj: (U) Duplication in Electronics Research and Technical Development, 1 Nov 57, also 1st Ind by Lt. Harry Davis to Comdr AFCRC, 5 Nov 57.

15. Ltr, Comdr AFCRC and Comdr NAIC to Comdr ARDC, subj: (U) Duplication in Electronics Research and Technical Development, 30 Oct 57.

16. Interview by the author with Mr. Irving Wirman, Associate Director of Research and Development RADC, 16 Jan 58.

17. Ltr, Comdr ARDC to Comdr NAIC, subj: (U) Duplication in Electronic Research and Technical Development, 27 Jan 58.

18. Ibid, with Incl. #1, pp. 1,3.

19. Ltr, Comdr ARDC to Comdr NAIC, subj: (U) Duplication in Electronic Research and Technical Development, 17 Jan 58.

20. Ibid.

21. Ibid.

22. Ltr, Comdr ARDC to Comdr NAIC, subj: (U) Duplication in Electronic Research and Technical Development, 17 Jan 58.

23. Ibid.

24. Ibid.

25. NAIC General Order #8, 27 Jun 57.

26. Ibid, #11, 1 Aug 57.

27. Ibid, #10, 24 Jul 57.

28. Ibid, #15, 2 Oct 57.

29. Ibid, #12, 14 Aug 57.

30. Ibid, #13.

31. RADC General Order #16, 15 Nov 57.

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Overshadowing all research and development activity at the Rome Air Development Center in the last half of 1957 was the all important question: Center Growth. The quality of research and development, the particular projects to be continued and initiated, even the manner in which the research is to be carried out, depended in the final analysis on the [illegible] dollars the Center could spend.

Prior to fiscal year 1958 the general trend of the Center had been one of expansion and it was called upon to assume additional responsibilities. Thereby it would be possible to measure Center growth by the advances in research and development which this expansion had made possible and the increased capabilities which resulted for the United States Air Force. But since research and development often involve intangibles impossible to represent statistically, the picture can be shown only indirectly and rather inadequately by indicating

ills that would inevitably follow.[5]

The general trend, then, at Rome to July 1, 1957 can be characterized as one of expansion. The Center had grown internally and it had increased its outside obligations. Under normal circumstances it could be assumed that in fiscal year 1958 the Center would require a relatively large expenditure authorization to discharge previously incurred obligations and would also require a relatively large budget for the expanded programs.

Adjustments to Expenditure Limitations

With the arrival of the new fiscal year 1958, however, the pattern was to alter abruptly. In rapid succession a series of expenditure ceilings were imposed upon the Center in August and September of 1957, each one lower than that which had preceded. Just prior to these limitations the office of the Comptroller had prepared estimates which looked to the spending of $43,737,000 in I-600 research and development funds during fiscal 58.[6] But at a conference held August 27, 1957 by Progress and Budget personnel of Headquarters, Air Research and Development Command, representatives from Rome learned that these estimates would have to be discarded.[7] A follow up teletype from

Headquarters ARDC dated August 23, 1957 set a limit of 39.4 million dollars of 1-600 funds that could be expended by Rose during fiscal year 1958. This amounted to a ceiling of 19.7 million dollars for the first half of fiscal 58.[8] Instructions which accompanied the ceiling limit set off in quick and continuing reaction, drastic adjustments of all kinds as the Center strove to pull anticipated expenditures down to the 19.7 million dollar limit.

For purposes of analysis the actions taken by the Center might be placed in two categories: actions to lower expenditures within the Center and actions to reduce expenditures on research and development contract work outside the Center.

In the first category, civilian payroll cuts at the Center figured high on the list. Even before, Rose had planned a gradual decrease in the number of assigned civilian personnel throughout fiscal year 1958 to level off at 1299 assigned positions by June 30, 1958.[9] However, the teletype from Headquarters ARDC of August 19, 1957 directed a five percent or more reduction in payroll expenses by 31 October 1957.[10] Not only did the Center have to accelerate its planned reduction of personnel, but it had to shift emphasis from a decrease in the numbers of positions to a reduction in the actual payroll expenditure.

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But the step which seemed to arouse the greatest resentment was the proposal to defer payment of bills. Ordinarily companies did not possess sufficient reserves of cash on hand to take them over a period of any length. In the event of deferred payment they would be obliged to turn to their normal sources of finance. This meant they would have to borrow money because of the governments action. Yet because of Armed Services Procurement Regulations they could not obtain reimbursement from the government for their interest. Contractors were therefore of the opinion that in effect they were being asked by the government to lend it money until payments were resumed after January 1 1958. As an alternative, some of the larger companies were threatening to pass along deferred payments to their own vendors or subcontractors. If the threat were put in execution it would thus be small business, least able to roll with the punch which would be hit hard. This again might force some of them out of business. Center leaders were understandably worried about the unfavorable reactions which these various actions had aroused.[39]

It might be added that there was some questioning at the Center, too of the ultimate economy of some of the recent cuts. Project cancellation could mean in some instances the total loss of funds which had already been invested in them.

Projects whose natural rhythm had been interrupted by stretch-out or cancelled projects which would be resumed at a later date might actually cost the Air Force more in the long run than would have originally been the case. It should be added as well that time is a precious commodity which should be figured in the overall cost. Even if all the previous Center programs should be suddenly reinstated, the original time schedules and target dates could not be restored.

Sputnik and After

During those moments when Center leaders were most gravely disturbed about the cutbacks in Center operations, the beep-beep of Russia's first satellite launched October 4, 1957 electrified the world. With the successful launching of a second even larger satellite a month later on November 3rd, the public clamor for economy had disappeared as by magic. Many who only a short time before could not comprehend the reason for spending billions of dollars on research and development now demanded to know why the United States seemed to have fallen behind the Soviet Union in the race for space. In concrete terms the awakened public interest took away much of the pressure which had attended Air Force research and development spending for fiscal '58. It did not, however, miraculously eliminate all economy measures. With these

expended $4,196,139 of an allowable $12,295,400 for the entire fiscal year.[42]

Because NACA was freed from its straight jacket of 13.6 million dollars not all of the pessimistic predictions made in October came to pass. For example it was unnecessary by and large with the 1st spending "target" to ask contractors to accept deferral of payment in December as originally planned. This avoided a situation which, as previously mentioned, Center leaders had viewed with particular misgiving.[43]

The number of active research and development F-600 contracts which had sunk to a low of 297 in October, had now bounced back to 385 in early January 1958 as the more important of the terminated contracts were reinstated.[44] While this was still well below the 473 active F-600 contracts of July 1, 1957, it was a decided improvement.[45]

The problem of morale at the Center took a turn for the better, too, as a result of the new budget outlook. Promotion actions of deserving persons at the Center were unfrozen and some ninety-four civilians were promoted in November and December 1957. Hiring at the Center was unblocked and twenty-five civilians were taken into the Center during these same months. The Center, whose total civilian and military personnel ceiling was 1300, actually counted 1280 persons at work at the

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This was accomplished in part by eliminating some established positions and generally the withdrawal of all unestablished positions and cancellation of positions vacated while reduction in force procedures were underway. To facilitate the reduction in force, all promotion actions were frozen until 30 September 1957 with position actions at GS-12 and below to continue frozen until October 31, 1957.[11] Later an order was issued, however, freezing all position actions until further notice. These measures had succeeded in eliminating thirty nine clerk jobs and fourteen were typist positions for a total of fifty-three positions.[12]

For those who remained, strict controls on overtime were included in a Financial Plan drawn up for each staff agency on a monthly basis.[13] An exact cost record was also ordered compiled for each civilian employee with an itemized breakdown including base pay, social security, civil service retirement and federal employees group life insurance.[14]

Travel funds were severely limited for each staff agency and a strict control assured by requiring a review of all travel requests for essentiality by the staff agency concerned. In this connection too, the Accounting Division was directed to make a recording of estimated travel costs at the time of issuance of a request for travel.[15]

22

[illegible] requirement by the various staff agencies was scrutinized in the first instance by a 1st quarter ceiling of $[illegible] and was subjected additionally to minute scrutiny by insistence upon a system of triple review. The staff agency in question had to pass on the essentiality of the item, and the request had then to be reviewed by the DCS/Material for inventory availability, and by the DCS/Controller for fund availability.[16]

The Center strove to do, moreover, that quarter that every dollar spent was applied to greatest advantage. A concerted effort was made to acquire computer even beyond those plotted for by spending less than the allowable ceiling. An example of this could be found in the Directorate of Flight Test and Instrumentation. The directorate was allotted $[illegible] for the flight test program in fiscal year 1958. This figure was not too much lower than the amount actually spent for this purpose the previous year. By avoiding excessive use of the more expensive to operate aircraft such as the B-47 and by insuring that only the most essential flights were authorized, it was hoped that the flight test requirements of the Center would be adequately served without need to expend the entire sum. Whether successful or not, certainly all possible economy went [illegible] was extended to accomplish this.[17]

of procurement [illegible] detailed plan covering the various phases of the operation.[illegible]

In the contract surveys, the plan demanded an investigation to determine what costs had already been incurred under the contract, but which the government had not yet been asked to pay. These costs represented fixed charges which had already been incurred under the contract, but which the government had not yet been asked to pay. These costs represented fixed charges which had to be provided for in any allocation of funds. It was manifestly necessary for planning purposes to know what expenditures were contemplated in the future by the contractor. Fortunately the Bureau of Development Center had for approximately one year required of all its contractors a forecast of future expenses at the time of letting the contract. At monthly intervals thereafter the contractor was obliged to submit a record of his actual expenditures for the month. If the contractor observed within any reporting period that the original forecast of expense for the contract would have to be revised, he was required to submit a new non-standard forecast of his expenses. This information, which made it far easier to anticipate actual disbursement of funds, had proved an

outstanding success and importance at this point [illegible] various refinements were introduced to bring forecasted expenses closer together.[20]

With this contract cost information available, the Center then proceeded to examine the contract in terms of its priority of importance. The PCO/Operations already maintained a Center priority listing of Center projects but for this operation a revised evaluation was undertaken. The ultimate technical pay off of the contract and the record of its past successful performance was considered along with the policies in this regard of the Air Research and Development Command and the United States Air Force. Study of all of these factors then made it possible to arrive at a decision on contract action.[21]

Making a decision was only the first step. Complex controls had to be provided for to see to it that authorized spending was not exceeded. Change orders were dispatched to all contractors informing them of their expenditure limits. It was made quite clear to the contractor that if he spent beyond the authorized amount, he would run the risk of not being reimbursed. Thus in the first instance it was to the contractor's own best interest not to exceed the limit. Since the contractor would continue to furnish monthly expenditure

reports are clear as to amount if appropriate, an additional [illegible] fund. Nevertheless a complex web of interlocking responsibility to maintain political checks was defined, including specific duties of control spelled out to the preparing contracting officer, the payment contracting officer, the accounting officer and the finance officer. [illegible] later time of increase in the contract allocation was authorized by proper authority, notification had to be received nonetheless from the accounting officer that the funds were actually available.[2]

The administrative machinery was purposely designed as flexible as possible to permit rapid adjustment to change of all kind. Center precedence lists were maintained on a current basis to note any change in the priority of contracts which might in turn cause a revision of expenditure allocation. The payment contracting officer and accounting officer were keeping records of expenditures and rates of expenditures and in the meantime the Center was receiving the monthly expenditure reports and revision of expenditure forecasts from contractors. The Center consequently had available to it up-to-date information which would permit quick adaptation to changes in technical priorities, to changes in contract expenditures as well as to changes in Center expenditure

Center to obtain or such a waiver. Center representatives
discussed this question in early September at Headquarters
AFSC in the hope that the ceiling might be waived or some
other solution found. Headquarters personnel were sympathetic
due to the matter, but they were unable to authorize an up-
ward revision of expenditure limitation. Representatives from
Ames were told, though, that their Center's plight was by
no means unique and that other centers of the Corps would
unhappily be in the same economic boat at about the same
time. The centers advised the Center to notify contractors
that their bills had been received, but that payment could
not be made until after January 1, 1958. If the contractor
was unwilling to accept deferred payment, the contract should
be terminated. Obviously called for too, were additional cuts
in expenditures, a need made more imperative by the new ceiling
of September 30, 1957.[26]

The measures adopted by the Ames Center during the months
of August and September resulted in a steady lowering of the
anticipated debt for the first half of fiscal year 1958 in spite
of the progressively lower ceilings. At the beginning of
September the anticipated debt had shrunk to 5.9 million
dollars and by the end of September it had diminished still
further to 3.9 million dollars as a result of further re-
ductions, stretch outs and terminations.[27]

statistically, however, it was sometimes difficult to see clearly the improvements which had been registered. For example, the total number of P-600 contracts listed on Center books on September 30, 1957 was 641, exclusive of the 379 P-600 contracts listed for July 1, 1957. On the basis of these figures alone, one might easily conclude that the Center had stepped up its contractual activity instead of diminishing it. The discrepancy results from the fact that contracts which have been completed or cancelled cannot necessarily be wiped off the Center books immediately thereafter. Questions of patent rights, legal points and especially the processing of the final voucher may prevent final disposition of the contract for up to six months and sometimes as much as two years. Thus insofar as numbers of contracts are concerned, the true picture is represented not by the total number of contracts shown on the Center books but by the number of active contracts. Taking these latter figures it is revealed that on July 1, 1957 there were 473 active contracts and by September 30, 1957 only 315.[28]

A similarly distorted picture would be gained if only the face value of the contracts is examined without supplementing it with figures of the unresolved dollar balance. Thus the total face value of Center P-600 contracts on July 1, 1957 was $5.3

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million dollars and by September 30, 1957 it had risen by 100 million dollars - again an apparent increase of contractual activity. But as before the real story is told by the decline in uncovered dollar balance from 78.6 million dollars on July 1, 1957 to 75.9 million dollars by September 30, 1957.[29]

Yet even when the statistical confusion was cut away and the real requirements of Center position revealed, it was still not enough. Representatives of the Rome Air Development Center who attended another meeting at Headquarters ARDC in early October 1957 were told that under new policy, the Center could not defer bills over thirty days. For the Rome Air Development Center this meant that the dept could not rise above 6.3 million dollars if this requirement were to be observed. Still more drastic cuts were, therefore, in order.[30]

By the October the Center succeeded in reducing its anticipated deficit for the first half of fiscal year 1958 to 2.3 million dollars. By October 15, 1957 it had terminated 31 contracts at an estimated reduction of expenditures by $2,841,000 for the first half of fiscal 58. It had cut forty-two effort type contracts anywhere from five to thirty percent for a reduction of $347,000 for the first half of fiscal 58. Twelve other contracts were "stretched out" with

13. DF, SCC to SCT, subj: ICSC Expenditure Controls, 23 Aug 57, p. 1.

14. Interview by the author with Lt. Col. [redacted], ICS/Comptroller, 23 Oct 57.

15. DF, SCC to SCT, subj: ICSC Expenditure Controls, 23 Aug 57, pp. 1-2.

16. Ibid.

17. Interview by the author with [redacted], Director of Flight Test and Instrumentation, 21 Oct 57. Also interviewed by the author with Maj. [redacted], SCCC, 21 Oct 57.

18. Interview by the author with Col. Howard Burhanna, Director of Procurement, 21 Oct 57.

19. Msg, Comdr SAAC to Comdr AMC, 12 Sept 57.

20. DF, SCA to all Staffs/Directorates, 15 Aug 57.

21. Interview by the author with Col. Howard Burhanna, Director of Procurement, 21 Oct 57.

22. DF, SCE to all Staffs/Directorates, 15 Aug 57.

23. Interview by the author with Lt. Col. [redacted], ICS/Comptroller, 23 Oct 57.

24. Msg, Comdr AMC to Comdr SAAC, 5 Sept 57.

25. Msg, Comdr AMC to Comdr SAAC, 26 Sept 57.

26. Interview by the author with [redacted], Associate Director of Research and Development, 24 Oct 57.

27. Ibid.

28. Ibid. See also msg, Comdr SAAC to Comdr AMC, 28 Oct 57.

29. Msg, Comdr SAAC to Comdr AMC, 22 Oct 57.

30. Interview by the author with Col. Howard Burhanna, Director of Procurement, 21 Oct 57.

31. Interview by the author with Dr. [redacted] Associate Director of Research and Development, 24 Oct 57. See also Ltr, Comdr RADC to Chief AFDC, 2 Oct 57.

32. Interview by the author with Dr. [redacted] Associate Director of Research and Development, 24 Oct 57.

33. Interview by the author with Dr. John Burgess and Col. Otto Quarnstrom, Technical Director and Director of the Directorate of Control and Guidance, 22 Oct 57. Also interview by the author with Dr. Irving Kirman, Associate Director of Research and Development, 24 Oct 57.

34. Ltr, Comdr RADC to Comdr AFDC, subj: (U) Preparation of Replies to 1957 Technical Requirements, 4 Oct 57.

35. Interview by the author with Dr. John Burgess and Col. Otto Quarnstrom, Technical Director and Director of Directorate of Control and Guidance, 22 Oct 57. Also interview by the author with Dr. Irving Kirman, Associate Director of Research and Development, 24 Oct 57.

36. Interview by the author with [redacted] DCS/Materiel, 23 Oct 57.

37. Interview by the author with Dr. [redacted] Assistant DCS/Personnel, 24 Oct 57.

38. Interview by the author with Dr. John Burgess, Technical Director, Directorate of Control and Guidance, 22 Oct 57.

39. Interview by the author with Col. Howard Durhamm, Director of Procurement 21 Oct 57 and also with Lt. Col. Mary W. Coggshall, DCS/Comptroller, 23 Oct 57.

40. Interview by the author with Lt. Col. [redacted], DCS/Comptroller, 8 Jan 58.

41. Interview by the author with Col. Howard Durhamm, Director of Procurement, 14 Jan 58.

42. Interview by the author with Lt. Col. [redacted] DCS/Comptroller, 8 Jan 58.

43. Interview by the author with Col. Howard Durhamm, Director of Procurement, 14 Jan 58.

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[redacted]

arrive over their targets in the United States, such a line could flash back a report of the penetration.[1]

A DEW line would clearly pose difficult problems of a technical and logistics nature, however. It would have to stretch 3,000 miles through some of the most rugged and inaccessible terrain in the world. Equipment and personnel would be subjected to extremes in cold, snow, ice and wind conditions. Auroral disturbances and other phenomena peculiar to the Arctic threatened to play havoc with some of the electronics equipment. This latter problem was grave because of its impact on communications in the region. A radar line incapable of sending back word of a penetration was obviously of no use to anyone, but ordinary High Frequency radio communication was unreliable in the Arctic because of auroral disturbance. On the other hand the terrain was so difficult that it would be impractical to lay and maintain wire connection or construct and maintain microwave relay stations at the line of sight distances they required. Fortunately, scatter radio techniques just being brought forward in this period appeared to make possible adequate communication support for a DEW line. Tropospheric scatter communication had proved successful in the POLE VAULT operation linking up Baffin Island and Newfoundland. Nevertheless there were still honest doubts on the part of some whether a DEW Line could be successfully built and operated.[2]

[redacted]

[redacted]

Consequently [illegible] was [illegible] to construct a radar line with [illegible] radar [illegible] cation in the Point Barrow, Alaska area in 195[illegible] to test feasibility. The project was assigned to Western Electric Company because of their past experience in integration work and in dealing with difficult terrain and climatic conditions. After evaluation of the experimental Alaskan segment completed in November 195[illegible] and after the completion of area surveys of the Far North, Headquarters USAF and the Royal Canadian Air Force recommended that the 3,000 mile DEW Line be started immediately. [illegible]'s for the operation were issued 7 September 195[illegible]. [redacted]

A prime contract was awarded to Western Electric to engineer and install the DEW Line including the requisite radar and communications equipments. This was [illegible] in a sense as a quick fix interim solution to provide an operational radar fence by July 1957. [redacted]

Western Electric, the prime contractor, later to call signals for over 4,500 United States and Canadian suppliers for the necessary equipments, relied on its own Bell Telephone Laboratories for technical counsel. In a parallel move by the Air Force, the Air Materiel Command which represented the Air Force in the contractual and logistic phase of the effort called in the Air Research and Development Command

Control No. [illegible]

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Administrative Procedures

Because of the wide range of problems which the Rome Center could foresee in this support role, a team of specialists from appropriate fields at the Center was organized to assist. To coordinate the team [redacted] from DCS/Operations was designated as "team captain" in which post he remained until the summer of [illegible]. At that point, it was determined to shift Mr. [redacted] of the Communications Directorate, already the communications specialist member of the DEW team, into the post of Coordinator for [illegible] on RADC assistance to DEW. [redacted]

No small part of the credit which Rome could later claim for having expedited the DEW [illegible] was due to the streamlined procedures by which the group at RADC was permitted to function. This was particularly significant because DEW responsibilities were assigned to Center personnel in addition to their normal work load, thus making speed not only desirable, but absolutely essential. The Coordinator who represented the Center vis-a-vis the DEW Project Office in New York City, was authorized to consult directly with the members of his team regardless of what directorate they happened to be in. He was in a position to brush aside the usual "through channels" requirements which in an operation of this kind could have proved so time consuming.[8] [redacted]

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Test Facilities

Would the electronics equipment being produced for DEW actually work properly when placed in the harsh environment of the Arctic? A rather important consideration, this, as every one agreed, and another example of how WADC, this time through the Test Facilities Laboratory, was able to [redacted] a hand on the DEW undertaking.

A start had been made in February 1945 from the Bell Telephone Laboratories for work in testing the antenna of the AN/FPS 19 radar under low temperature conditions. This antenna, measuring thirty eight feet across the face was not the sort of item that could be casually slipped into the ordinary cold chamber, obviously. But since the large though lightly constructed antenna was delicate, it was particularly important to have adequate test data for it. [redacted]

WADC could not provide facilities at the Center for testing the antenna either. But though Test Facilities personnel at Rome were [redacted] to do the whole work, they immediately started about to find a suitable facility. One was finally located at the Detroit Tank Arsenal in March 1945. When the antenna was ready to leave the contractor's plant in August 1945, WADC personnel were on hand to examine it. They were also present in Detroit

Project No. 54-132

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January 1957 to run from King Salmon, Alaska, its western terminus, was scheduled for full operation in mid 1959. In actual fact, it may become operational by late 1958. At the other end of the DEW Line, an extension from Cape Dyer was planned to a point still to be determined precisely in Iceland. Named "DEW East", this extension was programmed for operation in the summer of 1960. Some unexpected delay developed in 1959 but it was hoped that "DEW EAST" importance to the newly created Ballistic Missile Early Warning System - 224A - would result in the original goal being attained after all. In any case there seemed no doubt but that "DEW EAST" would be operational by 1961 at the latest. RAND personnel continued to provide the same kind of technical support for these extensions of the DEW Line they had given to the original project.[40] [redacted]

Future Planning

But even as Rome and the other organizations concerned in the DEW program were coming within sight of their original goal - a DEW Line operational by July 1, 1957, - planning was already underway for modification of the line. Military capability obviously cannot remain static. A DEW Line able to meet an enemy challenge in 1957 could easily become obsolescent within a few years thus unless altered to keep pace. It was this consideration which prompted the Air Force to let two important six month study contracts in early 1956.[41]

[redacted]

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[redacted]

[illegible] changes would have to be [illegible] operational [illegible] estimates of [illegible] time and [illegible]. One of the [illegible] by Headquarters ARDC to Bell Telephone Laboratories [illegible] 1956, an organization [illegible] well regarded from long participation in the [illegible] program. [illegible] from [illegible] contract of [illegible] the same study three months later [illegible]. Before the two independent studies were completed, the operational requirement of 1960 was [illegible] advance in Soviet [illegible] made a [illegible] [illegible] in October 1956 and submitted final written reports in November [illegible] month. [redacted]

Bell Telephone Laboratories and AFCCP agreed that a [illegible] was a must. They differed [illegible], however, in their estimates of what types of [illegible] would be needed. RADC received the assignment of [illegible] reports and [illegible] setting up its own [illegible] to Headquarters ARDC. Work on this assignment, coordinated by [redacted] was headed by [redacted] of the Directorate of Control and Systems. It was RADC's conclusion that the Bell Telephone recommendations [illegible] over all Air Force

[illegible] No. 56-[illegible]

[redacted]

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[redacted]

requirements and would cost substantially less than the AVCO proposals.[redacted]

According to the Bell conception, all AN/FPS-19 search radars would be replaced by a new type radar called the "Advanced Sentinel." The "Advanced Sentinel" was to be an extensively modified version of the "Sentinel" radar (later designated the AN/FPS 30) developed by Lincoln Laboratories for the original DEW Line. The "Sentinel" AN/FPS 30, had not been used on the original DEW Line because production could not be accomplished quickly enough. As modified, the AN/FPS 30 would be able to [redacted] [redacted] Examining the Bell plan more closely, it became apparent to engineers at Rome that the modified AN/FPS-30 could be fitted into the DEW Line in such a way that only every other AN/FPS-19 would have to be replaced by the AN/FPS 30 instead of all. This was a decided advantage since it required procurement of only half as many new search radars and allowed salvage of half of the AN/FPS 19 radars as spares for those which would remain in the Line at alternate search sites.[45]

Bell also recommended development of a special "assessment radar" at a cost of roughly seven million dollars to be installed at each search radar site. Purpose of this radar, as a back up to the others, was threefold. It would

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Although revision of the detection equipments held the center of the stage, it was also believed that communication support would have to be reworked. Improvements were envisaged for lateral communication in the DEW Line. Improvement in the rearward communication of POLE VAULT running from Baffin Island to Newfoundland as well as more thorough integration of the DEW complex into the WHITE ALICE Alaskan communication system appeared to deserve attention. While Mr. [redacted] and his associates were studying the detection problem at the Hope Center Mr. [redacted] DEW Line Coordinator, and Mr. [redacted] Jr., Chief of the Operational Planning Branch of the Communication Directorate, analyzed communication deficiencies and prepared a series of recommended requirements.[48]

After a number of meetings of SADC personnel and Headquarters ADC people beginning in March of 1957, an abbreviated system development plan for DEW System 474L had been hammered out and was forwarded to USAF for approval in August 1957. By early 1958 no formal System Development Directive had been received at SADC. However, it was anticipated at the Center that the newly consolidated Ballistic Missile Early Warning System 494A would probably incorporate the communication changes into its own system. The recommendations, then, would probably be

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NOTES

1. Interview by the author with Mr. [redacted] RCUO, 6 Dec 57.

2. Interview by the author with Mr. [redacted] RCDAT, 30 Jan 58.

3. Interview by the author with Mr. [redacted] RCUO, 6 Dec 57.

4. Interview by the author with Mr [redacted] RCEEMD, 29 Jan 58.

5. Interview by the author with Mr. [redacted] 6 Dec 57.

6. Interview by the author with Mr. [redacted] 6 Dec 57.

7. Interview by the author with Mr. [redacted] 27 Jan 58.

*Since a great number of persons at the Rome Center contributed to the DEW project to a greater or lesser degree it would be impractical to list all. However on 7 Aug 57 Major General J. W. Sessums, Jr., Vice Commander of ARDC, wrote letters of appreciation to certain individuals at the Center who had made particularly outstanding contribution. These individuals are: Mr. [redacted] DEW Line Coordinator
Mr. [redacted] Detection Systems
Mr. [redacted] Detection Equipment
Mr. [redacted] CW Detection Equipment
Mr. [redacted] Radar Equipment
Mr. [redacted] Test Equipment
Mr. [redacted] Equipment Nomenclature
Mr. [redacted] Terminal Equipment
Mr. [redacted] Structural Equipment
Mr. [redacted] DEW Line Coordinator

8. Interview by the author with Mr. [redacted] 6 Dec 57.

9. Ibid

10. Interview by the author with Mr. [redacted] RCWIO, 27 Jan 58.

11. Interview by the author with Mr. [redacted]
6 Dec 57.

12. Interview by the author with Mr. [redacted] RCUAT.
30 Jan 58.

13. Interview by the author with Mr. [redacted] RCUO.
6 Dec 57.

14. Interview by the author with Mr. [redacted]
6 Dec 57.

15. Interview by the author with Mr. [redacted]
27 Jan 58.

16. Technical Report RADC [illegible] Supplement #1 to Ground Radar Sets, Systems and Related Components, Feb 57. [illegible]

17. Interview by the author with Mr. [redacted]
27 Jan 58. Also written comments of Mr. [redacted]
[illegible] 13 Feb 58 in files of Center Historian.

18. Interview by the author with Mr. [redacted] RCERHM.
27 Jan 58.

19. Interview by the author with Mr. [redacted] RCUO.
6 Dec 57.

20. Interview by the author with Mr. [redacted] RCERHM.
27 Jan 58.

21. Technical Report RADC [illegible] Supplement #1 to Ground Radar Sets, Systems and Related Components, Feb. 57, pp. 68-7[illegible].

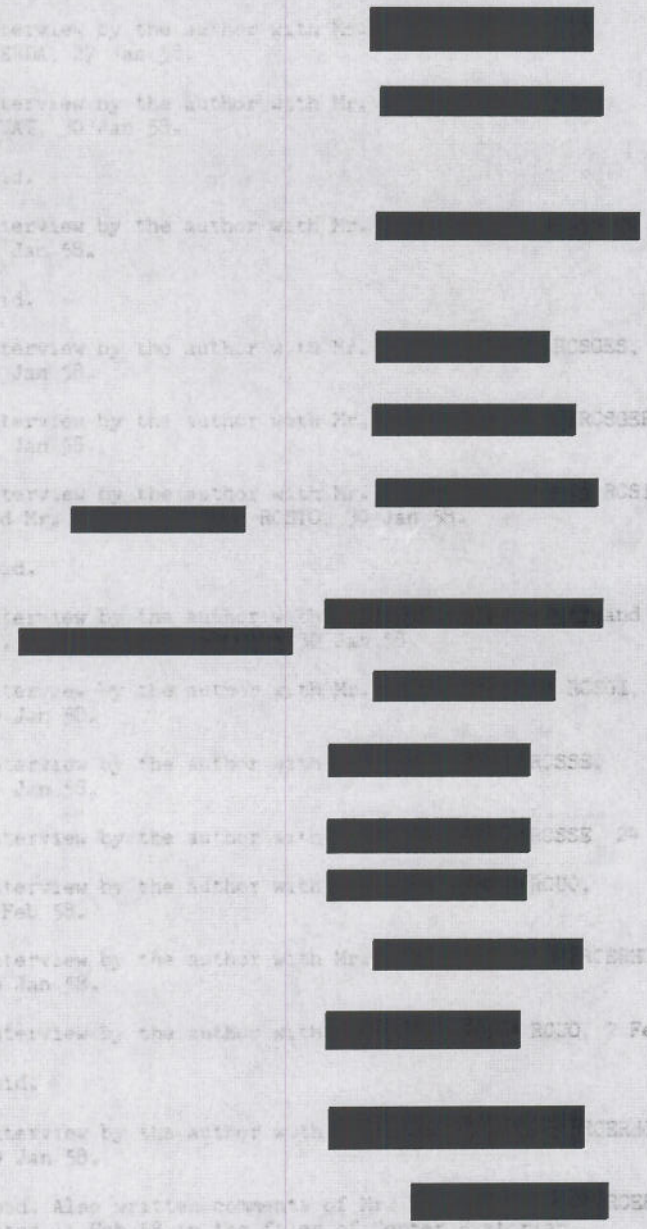
22. Interview by the author with Mr. [redacted] RCERDA,
27 Jan 58.

23. Ibid.

24. RADC Activity Report

25. Interview by the author with Mr. [redacted]
27 Jan 58.

26. Technical Report RADC [illegible] Supplement #1 to Ground Radar Sets, Systems and Related Components, Feb 57, p. 43.



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C H A P T E R IV

Long Range Communication

Introduction

Extending the effective distance of radio communication was but one of many concerns which occupied those of the Communications Directorate at the Rome Air Development Center. Integrated communication systems, communication support for missile work and dozens of other special projects made important claims on time and effort. Nevertheless long range radio communication projects of various sorts enjoyed high priority. This chapter will attempt to pick out high lights of accomplishment in the research and development of equipments in this area during 1957 and will indicate broadly some of the advanced thinking being done at the Center of still more radical techniques to be explored for future application.

Single Sideband

One of the big areas of research and development in the Communications Directorate was a program to determine the best system of modulation under various conditions of operation.

In this connection the latter was testing single sideband suppressed carrier synchronous detection, compatible single sideband and reduced carrier phase-locked single sideband equipments.

Single sideband was the long distance voice radio communication system for which Rome had prime responsibility. This was the system for which Collins Radio Company had contracted during the fall of 1956. A system intended to operate initially at distances of the order of 2,500 miles and eventually up to 7,000 miles. Toward the end of 1957 it appeared that single sideband had made progress such that it could be recommended for standard classification by the fall of 1958. This meant that all the single sideband equipment would have been fully tested and that it could be ordered into production. Already by early 1958 certificates of standard classification had been ordered for the exciters, transmitters, receivers and for the airborne ARC-38 single sideband unit. Thus these equipments were awaiting only final testing. Service testing was programmed for June 1958.[3] Tests began in July 1957 which were to continue into the summer of 1958 and already satisfied the Center that single sideband suppressed carrier was tolerable for voice for any applications programmed within the Air Force in the foreseeable future. Climatic hot and cold tests of the single sideband amplifier and flight tests of the airborne set

AN/ARC-38 had also given good results.

One of Rome's main concerns in 1957 had been to ready the sites for the single sideband test program. Three major ground sites had been planned; the Ava/Stockbridge, New York site, the Offutt Air Force Base site in Nebraska and the Thule site in Greenland. These plans were altered somewhat though to substitute for the Thule site a location at the Barksdale Air Force Base in Louisiana. Equipment originally earmarked for shipment to Thule was thus redirected to Barksdale instead. Because both the Offutt and Barksdale sites were also Strategic Air Command bases, directives were issued that the capabilities of these two single sideband sites should be increased and that they become operational as soon as possible. Contracts to accomplish this were about to be let in early 1958.

The Ava/Stockbridge site in New York, the particular concern of the Rome Center had been scheduled for completion 1 November 1957. Unfortunately however, the economy exercises of 1957 resulted in crippling fund cancellations. To ready the site Rome personnel were obliged to work in temporary buildings at first without heat, and in general under distinctly adverse conditions. A directive arrived rather late in the game, too, requiring installation of microwave facilities between Ava and Stockbridge. At the close of 1957 these microwave facilities

[redacted]

were still not satisfactory. For this combination of reasons the Ava/Stockbridge single sideband site was not expected to be completed until May 1958 - amounting to a slippage of about seven months. Meanwhile Rome was arranging for single sideband sites which were expected to participate in the test plan drawn up jointly by the Air Research and Development Command and the Air Proving Ground Command.[5]

Long Arm and Quick Silver

Two other important long distance radio communication systems, Long Arm and Quick Silver, though the primary responsibilities of the Wright Air Development Center received the active support of RADC regarding their ground equipment requirements.[6] [redacted]

Both Long Arm and Quick Silver differed from the RADC Single Sideband System in that they were designed for transmission of binary information, such as teletype, whereas Single Sideband was to accommodate voice transmission. This difference reflected the difficulty of arriving at a basic communication system satisfactory for all purposes. Operations people in the Air Force frankly favored voice transmission because of its psychological advantages. Pilot and ground operator could communicate by voice in a more personal, humanly satisfying way. This advantage was particularly desirable in pilot training exercises. On the other hand the binary systems

[redacted]

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such as Long Arm and Quick Silver could boast of greater efficiency through narrower band width requirements and they offered a better chance that the transmission would get through to its destination. As high speed teletypes are perfected, binary systems will also offer higher transmission speeds than possible by voice.[redacted]

Because both voice and binary communication systems had advantages and disadvantages peculiar to their nature, the Air Force had resolved to proceed with the development of both. This decision engendered at the outset a somewhat negative competition between the proponents of voice and binary transmission and led to a certain amount of rivalry among the Centers responsible for them. As late as mid-1956 those working on these programs at Rome expressed hope for a redirection of effort "toward a mutual and unbiased search for the best long range communication system"...so that..."the operational requirements should be the directing factor, not the various individual systems themselves." As mentioned in the 1956 RADC History efforts to merge all these programs had failed. Nevertheless attempts to bring about maximum compatibility of all the systems were yielding concrete results as will be seen.[8] [redacted]

Long Arm, initiated approximately 1954, was intended as a long range (3,000 - 5,000 mile range) highly reliable binary communication system with good anti-jam features. Information

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rates of sixty words per minute via teletype were planned. Originally conceived to meet requirements of the Strategic Air Command, the system was being adapted to meet other requirements as well.[9] [redacted]

By mid 1957 the experimental and developmental stages of the Long Arm program had terminated. In August of 1957 the service test phase of the program could begin after a contract was awarded to Hughes Aircraft for that purpose. Hughes was scheduled to start installation for the service test in October of 1958.[10] [redacted]

The RADC Ava/Stockbridge, New York sites being readied for the Single Sideband test program were to be pressed into service also for Long Arm. This was somewhat symbolic of the efforts being made to insure as much compatibility as possible between Long Arm and Single Sideband. The Communications Directorate at RADC in addition to its duties of monitoring the ground equipment for Long Arm also acted as coordinator between Hughes Aircraft, the contractor for Long Arm and Collins Radio Company contractor for Single Sideband. This coordination paid off through utilization in Long Arm equipments of Single Sideband exciters, transmitters and remote control devices.[11] [redacted]

A more advanced binary system, similar to Long Arm, was Quick Silver and for which RADC gave similar support to the

Contract No. AF30(602)-1720

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[redacted]

Wright Air Development Center. Employing techniques similar to those of Long Arm to achieve reliability and anti-jam capabilities, Quick Silver was designed to accommodate much higher data rates - on the order of 2,000 bits per second compared to Long Arm with a maximum of 1,000 bits per second. This would give Quick Silver a theoretical capability to transmit up to 2,000 words per minute if such high speed teletypes could be developed. Or, Quick Silver could digitalize voice information by use of a "vocoder." [redacted]

A unique by product of both the Long Arm and Quick Silver contracts is the method of packaging components and sub assemblies. The design layout and assembly method chosen allow the minute modules to be assembled, connected and soldered by automatically controlled machinery according to the latest concepts of automation. A large percentage of these modules will be of the "throw away" type. This means that if a module becomes defective it will be replaced by another one - rather than repaired. The modules are so designed that both time and money will be saved in maintenance by replacing defective modules rather than trying to repair them. [redacted]

Quick Silver was running about one to one and a half years behind the schedule of Long Arm. At the close of 1957 Quick Silver was still in the development stage while Long Arm had since August 1957 begun to prepare for the Service Test phase.

Contract No. 30-1730

[redacted]

Hughes Aircraft Company was contractor for both Quick Silver and Long Arm. RADC has provided assistance to the Wright Air Development Center in the ground aspects of the Quick Silver program through the preparation of exhibits and purchase requests and it has coordinated the ground aspects of Quick Silver with those of Long Arm and the Single Sideband Program.[13] [redacted]

Tropospheric Scatter Communication

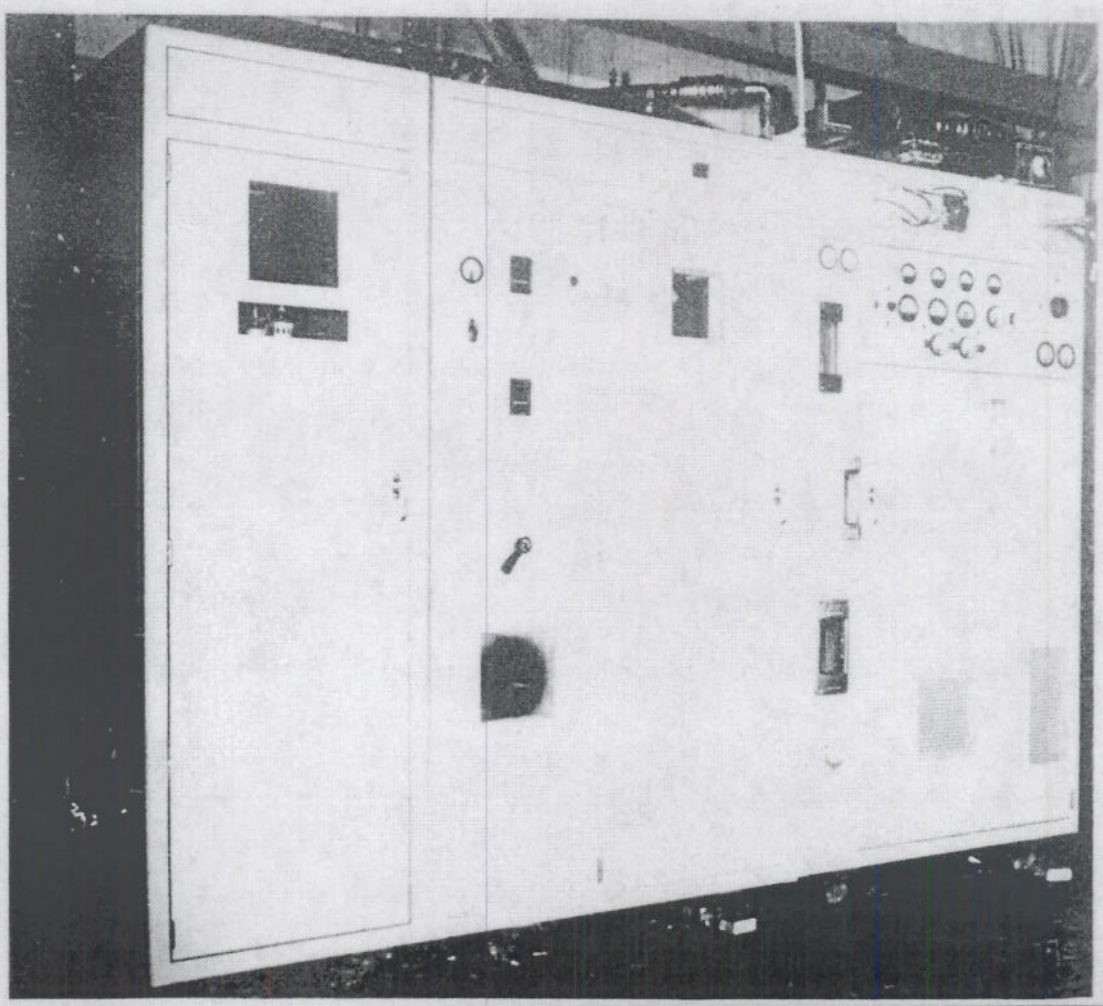
The newly developed technique, outlined in the 1956 RADC History, of bouncing radio signals off the troposphere for point-to-point long distance communication continued to advance in 1957.[14] One of the tropospheric equipments being developed for RADC on contract by RCA was the AN/FRC-39(V) - a [redacted] set. After some initial delay the target date for delivery had been placed at January 1958. Work during 1957 proceeded on schedule and permitted the delivery of the equipment at the appointed time. Installation of the equipments at sites in Iceland and in Labrador to serve as gap fillers for the Pole Vault Communication line could thus get underway. Shake-down tests at the Iceland sites were expected to begin in March of 1958. Similar tests were also projected for the Labrador sites, which in early 1958 were already fifty percent completed.[15]

Control No. 58-1732

A second tropospheric equipment, the AN/FRC-50(V), virtually identical with the AN/FRC-39 [redacted] had been initiated by RCA for the Center in early 1957. The equipment, intended for use at Texas Tower installations, was virtually completed by early 1958. Shakedown tests for this equipment were expected to begin shortly.[16]

Interest for future development centered on a set, probably to be nomenclatured the AN/FRC-66(V), that would satisfy requirements laid down in late 1956 by the Tactical Air Command. Needed was an equipment that could [redacted] for tropospheric or microwave line of sight transmissions, light enough to be transportable by helicopter, reliable and versatile for field use and so constructed that it could be set up in a minimum of time. RADC in 1957 outlined a system that could be designed around these requirements employing [redacted] which was considered more suitable for short one hundred mile hops. A fourteen foot inflatable paraballoon antenna that could be erected and aligned in less than an hour was also a possibility under consideration.[17]

At the Rome Air Development Center specifications had been written for the paraballoon antenna which may be incorporated in the set. The fact that the paraballoon antenna appeared so expensive (somewhere between $100,000 and $150,000 compared to an aluminum antenna in the neighborhood of $1,000) cast some doubt as to whether the weight and bulk reduction actually would justify the very appreciable difference in cost. However, the



fact that the price of the installation antenna seemed to be shrinking, gave some hope that it might still be considered financially practical. The Center had also drafted specifications for the radio set itself. This planning and advance spade work accomplished by the Center in 1957 made possible the submission of a purchase request for the equipment in early 1958, preliminary to awarding a contract for the work.[18]

The Center was further interested in obtaining data on tropospheric communication techniques which could help give direction to planning for future work in the field. Tropospheric communications experts were almost uncertain as to the relative merits of using Frequency Modulation or Single Sideband techniques of transmission in the equipments. Anxious to have actual operational data on the comparative performance of the two techniques to complement their theoretical estimates, RADC engineers resolved in 1957 to institute a test link between Verona (an off-base site near Rome) and Liberty Dam, Maryland -- a distance of 206 miles. Plans called for transmission to Liberty Dam by FM and reply to Verona by Single Sideband all at 2,000 megacycles. Westinghouse Electric Corporation was built for RADC in 1957 the appropriate equipments for the experiment. These included the AN/FRC-53 Single Sideband Tropospheric equipment and its counterpart the AN/FRC-54, an FM Link set which had been adapted specially for the experiment from an AN/FRC-[illegible]. Both of these

equipments, the AN/FRC-53 and the AN/FRC-54, were being installed at the two sites in 1957. Installation was complete by the close of the year. Operational testing began in January 1958 to collect comparative data.[19]

Ionospheric Scatter

In the realm of ionospheric scatter, the transmission method which could hop still farther than tropospheric scatter, the Center was principally occupied in establishing a UHF ionospheric test link. One of the first orders of business of the Lab would concern the improvement of ionospheric scatter equipments already developed. The Collins ionospheric AN/FRC-54 used in the DEW Line was a case at point of an equipment which was not entirely satisfactory and which needed some modifications.[20]

In June 1957 the Center contracted with Page Communications Engineers to set up the link. A site at Carabelle, Florida some eighty miles from the Tyndale Air Force Base was selected as the southern terminus. Collins AN/FRC-54 equipments, made available without cost to the Center by the Rome Air Force Depot, were installed and were being modified as required. Preparations were also in progress to erect antennas on two hundred foot high towers.[21]

The northern terminus of the link to be in New York State had not, however, been firmly decided in the "57" period. Original calculations looked to the use of Sampson, New York, a former U. S. Government installation, for the program, but

[redacted]

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[redacted]

[redacted]

over which it could transmit up to 2000 miles), and its security of transmission due to the short time the transmission would be on the air. Unless one knew when and where to look it would be extremely hard to pick out. Also meteoric scatter required lower average power for transmission because of the on-off keying method used and because of the lower path losses from meteor trail propagation.

[redacted]

The Communication Directorate, competent of course simply with the communications aspects of the meteoric scatter, had pinned an original target date for equipment completion of May 1957 on the contractor, Hoffman Laboratories. Slippages occurred through which set the completion date back to March 1958, in the opinion of RADC. The slippage had resulted in part from a four month delay in receiving the proper frequency allocation from the Federal Communications Commission. The remainder of the delay occurred in large part because of difficulties in setting up the two test sites necessary for the program. One site located near Los Angeles, California at Palos Verdes formed the western terminal, the eastern terminus was located at Lubbock, Texas a distance of approximately one thousand miles. RADC furnished personnel to assist the contractor in the technical aspects of setting up the Lubbock site. Nevertheless the actual beginning of tests between the two sites could not begin until approximately 1 January 1958. It was anticipated that extensive debugging would

[redacted]

[redacted]

have to be accomplished two beyond the expected March 1958 completion date.[25] [redacted]

As a matter of fact, RADC was already planning an improvement program for the AN/GRC-27. By early 1958 purchase requests for the program had been submitted by the Communications Directorate.[26] [redacted]

The Center was interested too in combining the best features of ionospheric transmission with those of meteoric scatter. Previously ionospheric designers had attempted to avoid the effects of meteors in transmission because of fear that reflections of the transmissions would cause poor reception in ionospheric equipment.[27] [redacted]

However, in 1957 feeling in the Communications Directorate was that a combination of the best points of the two systems could be devised which would at least double the information handling capacity of the ordinary ionospheric equipments. Under this conception meteoric scatter techniques would be used to take advantage of meteors when present. When they were not present ionospheric transmission would then carry the load in a continual switching back and forth between the two techniques.[28] [redacted]

This meteoric capability could be incorporated in the Collins 13-101 ionospheric equipment previously referred to by the addition of black boxes. A modification kit, MX-365 (AN-1)/FRC-60 seemed to be the solution. Contract processing

[redacted]

[redacted]

to Rome in late 1957 and early 1958 was sufficiently advanced that RADC expected to be able to go ahead by April or May 1958 on this project. Testing of the combined atmospheric and meteoric equipment could then take place in the Ionospheric Scatter Test Link between Stony Point, New York and Carabelle, Florida.[29] [redacted]

Advanced Communication Analysis

The projects described above relating to communications hardware in various stages of research and development do not, however, reveal the most advanced theoretical work being done at the Center. An Advanced Analysis Branch of the Communications Directorate had as its express purpose the determination and exploration of areas in communication where major contributions or "break through" could be made. Experience seemed to show that most communication equipments were developed to meet more or less immediate Air Force needs or were improved versions of an existing piece of hardware. As a result by the time the state-of-the-art were developed, engineered for field use and debugged, the equipments might be two or more years behind.[30]

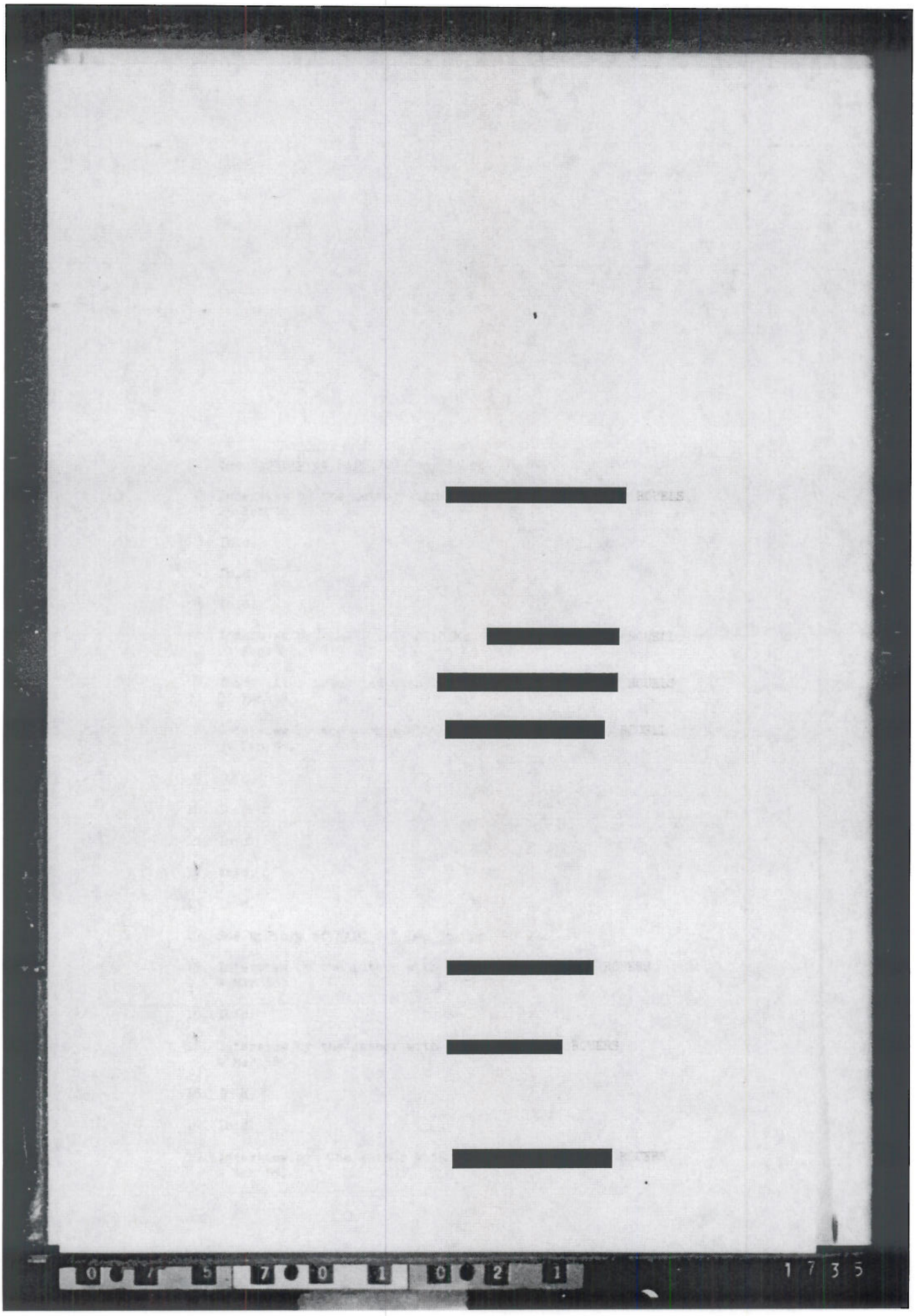
While this branch was busy with numerous problems besides that of long range communication in 1957, it was exploring several new theories or techniques which could have real impact in the field of long range communications.

[redacted]

Preliminary discussions, for example by personnel from the Advanced Analysis Branch with Dr. Jack Oliver of the Lamont Geological Observatory, indicated that a communication channel may exist along rock boundries underneath the earth's surface. Instead of operating above the earth, then long range communication might run from one point on the earth to another following these underground rock channels. This manner of communication seemed to have several advantages to recommend it. The mode of propagation being mechanical rather than electromagnetic, no new spectrum space would be required. Nor would rock channels communication interfer with other types of communication or be interfered with by them. Finally, by its nature, rock communication may be a low loss channel since the losses are a function of range rather than the range squared.[3]

Other theories of interest were round up with the utilization of ionized gases in communication. Vehicles traveling in space at high speeds will ionize the gas around them and thereby become enshrouded in an ionic sheath. This sheath, it was proposed, might be used as an antenna for reception and transmission for communication in the coming space age.

Or again simultaneous filtering in time and space might be used to increase the range of communication. This theory was predicated on the assumption that internal receiver noise was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CHAPTER V.

Ballistic Missile Defense

Introduction to the Problem

Those who must plan for ballistic missile defense have repeatedly confronted battle environments that have made hard and fast decisions difficult to render. As more information becomes available, revisions may have to be made in system parameters, [illegible] criteria, and target goals. Many of the scientific tasks are quite unlike those first attempted involving as they do little known fields such as propagation, high power components and the like and while the world [illegible] expect to face tasks in an endeavor as new as this. And indeed there are many of this category, but they have not been alone [illegible] creating areas of doubt or uncertainty for the planners. Deciding on a site set date for an operational ballistic missile defense system is, for example, more than a purely scientific or engineering problem since it depends as well on [redacted]

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studies. [redacted]

Preliminary notice of the integration of the two systems was received by the Commander of RADC from Headquarters Air Research and Development Command 11 September 1957.[4] A teletype from Headquarters ARDC dated 27 September 1957 made the change over official, instructing the Commander at RADC to combine passive detection(219L) and active defense (222A) into a single integrated system to be known as Ballistic Missile Defense System 32(A). At Rome the ballistic missile team which had been organized the previous November and placed under the charge of [redacted] had already, however, done much to integrate the two systems, insofar as Rome itself was concerned. [redacted]

Setting the Dates

In the summer of 1956 it had been concluded at Headquarters ARDC that even a passive ballistic missile warning system could not be made operational in 1960 without involving huge expenditures of money and incurring large technical risks. The QMR issued in 1956 had accordingly dropped 1960 as the target date. When it came, then, to an evaluation by RADC of studies prepared by

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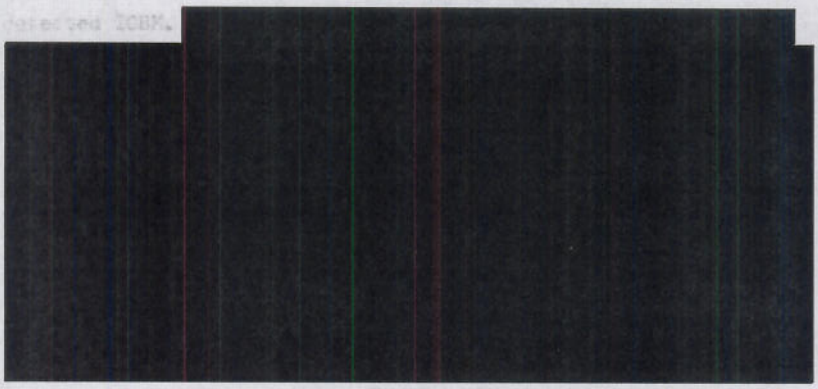

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[redacted]

directed that the 1960 operational date be restored.[10] Meetings of RADC personnel, along with those of other organizations, were being held at Headquarters of the Air Research and Development Command in August 1957 to review the objectives of the program in the light of the expedited activity called for.[11] In a later meeting at Headquarters ARDC at which RADC again participated, word was brought back to the Center that about sixty million dollars for System 220A was to be released immediately. January 1, 1960 was then proposed as the contract date for the system. In the meantime RADC was to come up with an initial program and plan for the whole system by 12 November 1957.[12] [redacted]

The official timetable which was to govern System 220A at the close of 1957, noted as System 220A QCR #136 and issued 7 December 1957, divided the problem of ballistic missile defense into two phases. Phase I of the QCR was concerned with the requirements for ballistic missile early warning while Phase II which will be discussed later deals with active defense. Some of the more outstanding points covered in the Phase I detection contained the 1960 operational date, a ten minute minimum warning for ICBM detection and identification, detection for all possible trajectories, 200 percent reliability

[redacted]

[redacted]

of detection, detection in the presence of counter measures, communications for transmitting warning alert and automatic authentication. [redacted]

Filling in the Outline for BMEWS

By December of 1957 BADC had completed a rough draft work statement for Project [redacted] System 474L and BMEWS ballistic missile early warning system, which details the requirements established by higher headquarters. The work statement is of interest not only because it calls for [redacted] at that point at the Rome Air Development Center to the detection problem and what could be done about it, but also because the work statement reveals how past experience and work in other parts of the Center was being [redacted] a better system. [redacted]

Setting out to [redacted] at the latest possible moment at which the system must be operational, BADC then proceeded to outline the threat envisaged. This would consist of [redacted] which might be fired in a [redacted] spoofers employed by the enemy for countermeasures as well as several hundred satellites orbiting the earth could be

Contract No. AF 30(602)-1738

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that the system would have to have growth potential so that it could handle threats throughout the 1960's and early 1970's as presently foreseen. And it was further recognized that to increase the reliability of the system to make positive identification of all targets it would be imperative that within one year [redacted]

[redacted]

The system would also have to be tied to the control monitoring station in the United States for receipt of satellite data and give data on radar targets as they are detected. The communication from each site, it was specified, would have a primary scatter link and an alternate separate routed link. The whole operation from detection to the actual display of an enemy target after correlation at the central monitoring station would have to be fully automatic with no human in the chain. [redacted]

As with other aspects of the system, RADC had subjected the communication needs of the missile warning system to searching inquiry. Communications had been crucial to the success of the DEW Line and promised to be equally vital in this one. The Operational Planning Office of the Directorate of Communications was furnishing active support in this area. At a meeting at

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[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

components for maximum reliability. Where standard parts were not available or their price proof would delay the operational date, components meeting high quality commercial standards might be used through, as has been done in the IBM Linc project. Reflecting, too, RADC's interest in radiation hazards of high power equipments, were directions for the minimizing of such hazards. An expanded or counter-countermeasures would naturally

[redacted]

Down Range Site

Significant back up for BMEWS effort was anticipated from experiments, work of various kinds, on Down Range site at Trinidad under RADC [illegible] and expected to add more needed data from observation of missile firings at Cape Canaveral and by other experiments. General Batt of Headquarters USAF had 26 July 1957 urged that development and installation of the Trinidad Down Range site [illegible] be accelerated so that data can be available for the development and procurement of an operational system. [illegible] Reference to the preceding semi-annual history of RADC will recall that the Center in mid 1957 had eyed early fiscal year 1959 as the point at which

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that eventually, enough data could be collected so that statistical conclusions could be drawn. On contract for RADC

[redacted]

Contract Terminations

Mention has been made before that System 272A was not immune to the vagaries of budget adjustment which struck the Center in the fall of 1957. By 15 October 1957 there were three casualties among the contractors who had been working for RADC on aspects of the ballistic missile detection problem because of the ceilings placed on F-600 research and development funds. Sylvania's Electronic Stacked Beam Radar, Stanford Research Institute's Upper Atmospheric Clutter study and AVCO's SARAC. These contracts were among those directly connected with missile detection, this does not include other contracts indirectly related. Three contracts continued active, however, University of Alaska's Aurora Phenomena, Cornell University's Radio Noise and Atmosphere Refraction at UHF and VHF;and the Down Range Facility contract of the General Electric Company.[30] [redacted]

[redacted]

[redacted]

When the Department of Defense began its second look at defense spending late following the furor over Sputniks, some contracts were reinstated, however. Among these was the Stanford Research Institute's Upper Atmospheric Clutter study in November.[31] [redacted]

Active Defense 222A

A meeting at the Pentagon 5 August 1957 attended by representatives of Rome in company with those of the Scientific Advisory Board and the ARDC Evaluation Committee was held to evaluate System 222A, active defense against long range ballistic missiles. A number of topics discussed at the meeting were naturally of vital interest to Rome's participation in the active defense program. It was noted, for example, that none of the three contractor teams which had completed studies for a ballistic missile defense in December 1956, had proposed a solution entirely satisfactory to the Air Force. At this meeting, however, it emerged that the Scientific Advisory Board and the ARDC Evaluation Committee were both agreed that the most logical course of action was to initiate immediate development of a system based on the Convair/RCA concept as offering the best chance of providing a defense of the Strategic Air Command in the

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1963-1965 period. Convair/RCA, as was explained in a previous RADC history, had devoted considerable attention to the countermeasure decoy problem. Failure to make adequate provision for countermeasure tactics from the enemy had obliged experts at RADC to reject as unsophisticated the suggested approaches of several other groups.[32] [redacted]

The meeting brought out too the requirement for active USAF budget support of a vigorous and expanding research and development program aimed at gathering basic ZZZA data and the critical information required for evolution of area defense capability

[redacted]

CORA

In furtherance of the objectives set forth at the August Pentagon meeting, RADC was already moving ahead as planned on the Coherent Radar Array. A contract had been signed by the Center with Hughes Aircraft on 11 July 1957 for a twelve-fourteen month feasibility study program.[34] It must be added, though, that in the fall the CORA contract with Hughes was among the victims of the Department of Defense economy drive., the contract was cancelled.[35] The period of contract reinstatement which then followed

[redacted]

were highlights of the new directive. [redacted]

Dissemination of the Recommended Rome
ADLA Program

On the basis of the new O.C.R. and the study and analysis at the Rome Center, RADC was in a position to present at a meeting at Headquarters ARDC 16 December 1957 a suggested program of research and development in support of Phase I and Phase II of System 224A to be carried on by the Rome Air Development Center. All told, the RADC recommended program would cost approximately 280 million dollars. This in itself is suggestive of the dimensions of the task which RADC envisaged before it. And it was recognized at the Center that if these recommendations were accepted by higher headquarters, a "tremendous work load and responsibility may be placed on this Center." Admittedly this would depend to a great extent on what activity would be picked to manage the program. In an event, Rome was eager to assume whatever additional responsibilities might be delivered to it. [redacted]

ORDIR

Although placed here after the discussion of System 224A,

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logically ORDIR might better precede it this because ORDIR precedes in time of origin the 22kA system and because development of the ORDIR program had had great impact on System 22kA. Unlike System 22kA, lodged in the Directorate of Control and Guidance, ORDIR was a program upon which the [redacted]

The program took its beginning from the 1951 period, arising initially from collective thinking by [redacted] Scientific Director of the Center and [redacted] the Directorate of [redacted] effort widened as a team of scientists from the Electronics Research Laboratories at Columbia University were put to work on these ideas through contracts to the Rome Air Development Center. The ORDIR program could be considered launched. [redacted]

[redacted]

study. Briefly, however, it may be said that ORDIR has devised

[redacted]

underlined the satellite danger. Required was an exploratory study of a weapon system to combat hostile satellites. There has already appeared in the press so much speculation on the possible military uses of satellites that no attempt will be made here to enlarge upon the obvious. ARDC set as its major requirements a system that could render useless satellites orbiting around the earth at heights up to at least 300 miles. This would have to be done on or before the second pass of the satellite over the defense system. [redacted]

An in-the-house study of the problem at the Rome Air Development Center produced a technical report by [redacted] of the Directorate of Control and Guidance and which was published by the Center in December 1957. The report outlined a typical anti-satellite system and provided estimates of the types and parameters of the equipments that would be required in the system. [redacted]

[redacted]

Sufficient information concerning [redacted] was lacking. The

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NOTES

1. Ltr, [redacted] Hq. ARDC to Comdr RADC, subj: (U) System 222A Evaluation, 9 Jul 57.

2. Memo, [redacted] fication given) Report [redacted] 2 Oct 57.

3. Ltr Lt. Gen. D. L. Putt Deputy Chief of Staff USAF to Comdr ARDC, subj: (U) Ballistic Missile Detection Program, 25 Jul 57.

4. Ltr [redacted] to Comdr RADC, subj: (U) RADC Experimental Radar Program 219L, 12 Sept 57.

5. Msg Comdr ARDC to Comdr RADC, 27 Sept 57.

6. Memo, subj: (U) Evaluation of Proposals 219L - July 1956, in files of RCNR, 2 Aug 57.

7. Ibid.

8. Technical Report RADC [redacted] subj: (U) A Quick Fix Ballistic Missile Warning System.

9. Ltr Lt. Gen. D. L. Putt, Deputy Chief of Staff USAF to Comdr ARDC subj: (U) Ballistic Missile Detection Program, 25 Jul 57.

10. Msg Comdr ARDC to COFS, Hq USAF, 18 Nov 57.

11. Memo [redacted] RADC to RCNH, subj: (U) Report of trip to Hq ARDC on 29 Aug 57 to 6 Sept 57.

12. Memo [redacted] RADC to RCNH, subj: (U) Report of Trip to Hqs ARDC on 29 Oct 57, 20 Dec 57.

13. Rough Draft Work Statement, subj: (U) System 224A, probably Dec 57.

14. Ibid.

15. Ibid.

16. Ibid.

17. Ibid.

18. Memo [redacted] RADC to RCNH, subj (no Class. given) Report of Trip to Alaska, 30 Aug 57.

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19. [illegible] [redacted] to Comdr RADC, subj: no Class given: System [illegible]

20. Monthly Activity Report [illegible] [illegible] 57.

21. Rough Draft [illegible] Statement [illegible] System 224A, probably Dec 57.

22. Incl.

23. Incl.

24. Memo [redacted] [illegible] RADC to RCNH, subj: no Class given: Report of Trip to Hq ARDC, [illegible] Sept 57.

25. Memo [redacted] RADC to RCNH, subj: no Class given: Report of Trip to Hq USAF, [illegible] Dec 57.

26. Rough Draft [illegible] Statement [illegible] System 224A, probably Dec 57.

27. Ltr, Lt. Gen. [illegible], Deputy Chief of Staff, USAF, to Comdr ARDC [illegible] Ballistic Missile Detection Program, 25 Jul 57.

28. Ltr, Lt. Gen. [illegible], Comdr ARDC to Deputy Chief of Staff, Development, USAF, [illegible] Ballistic Missile Defense, 10 Sept 57.

29. Monthly Activity Report [illegible]

30. Draft [illegible] [redacted] to Comdr ARDC [illegible]

31. Monthly Activity Report [illegible]

32. Incl.

33. [illegible]

34. Monthly Activity Report [illegible]

35. Incl.

[redacted]

37. Ltr [redacted] RADC to Comdr ARDC, subj: no Class given: System 224A [illegible]

38. Rough Draft [illegible] Statement [illegible] System 224A, probably Dec 57.

39. Memo [redacted] of R&D RADC to RCNH, subj: no Class given: Report of Trip to Hq ARDC, 30 Dec 57.

[redacted]

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[redacted]

40. Interview by the author with [redacted] 2 Apr 58.

41. Report (RDIR An ICBM Defense Radar prepared by Columbia University Electronics Research Laboratories.

42. DD Form 613 subj: U Omni Range Digital Radar Techniques 2 Jul 57.

43. Interview by the author with [redacted] 2 Apr 58.

44. Report (RDIR An ICBM Defense Radar prepared by Columbia University, also interview by the author with [redacted] RCWIL, 2 Apr 58.

45. Ibid.

46. Interview by the Author w.[redacted] 2 Apr 58.

47. Technical Report RAD [redacted] subj: (U) [redacted] Dec 57.

48. Ibid.

49. Ibid.

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CHAPTER VI

The Electronic Viewing Threat

Admittedly, electronics have come to occupy a crucial position in our defensive-offensive capability. Because of this one of our prime objectives in time of attack will be to jam the enemy's electronic equipments and particularly his radars. We can certainly be sure that the enemy will seek just as fervently to jam our own. The struggle then, will in part resolve itself into an electronics duel in test of strength between more efficient jammers and more jam resistant radars.

Ideally, of course, we should black out the enemy's radars while maintaining our own in perfect operating condition. While this ideal may not be completely attainable, the Rome Air Development Center strove with equal vigor in 1957 to provide the Air Force with less jammable radars and more effective jammers and electronic counter-measures (not to mention counter counter measure equipments.

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128

Frequency Diversity Radars

Wherever possible and feasible RADC attempted to engineer Air Force radars as jam proof as science could make them. But beyond this the Center, through its Directorate of Control and Guidance, supervised a special radar program which was particularly well suited to reduce the jamming threat. This was the Frequency Diversity Radar Program. [redacted]

Some idea of the significance attained by the Air Force to the Frequency Diversity Radar Program can be gained from a statement of the Commander of the Air Research and Development Command in mid 1957. In the annual effectiveness report of 31 July 1957 dispatched to the Chief of Staff, Major General Sessums then commanding ARDC noted most significantly that in the field of radar, the frequency diversity program was most outstanding.[1] [redacted]

This program, begun in 1955 under supervision by the Rome Center, was intended to furnish frequency diversity radars for operation at widely scattered frequencies and so force the enemy to spread his total available jamming power over the widest possible spectrum. Of the seven frequency diversity radars which had come under study, the list of those for which service test models were to be procured had narrowed to five by 1957.[2] These five radars collectively made up a family of frequency radar capability and included the AN/FPS [redacted]

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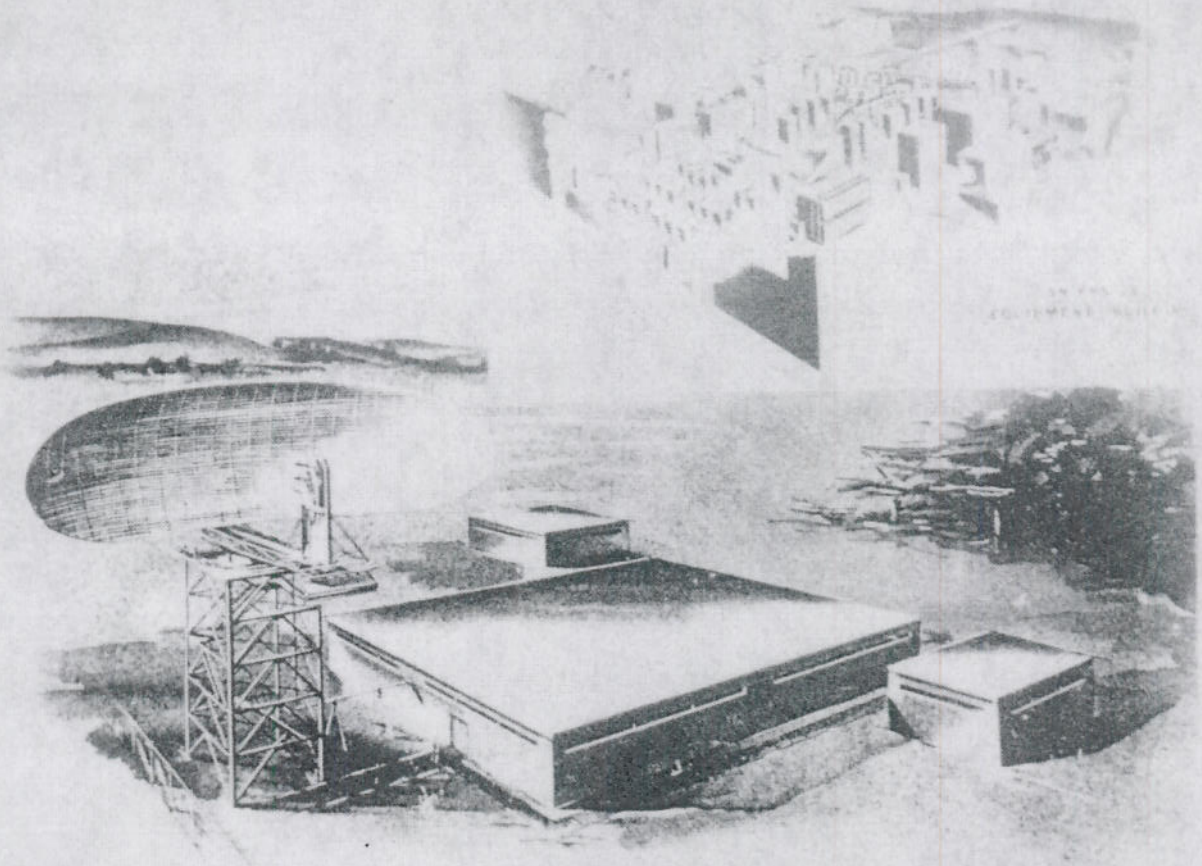

AN FPS-[illegible] RADAR SYSTEM

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Progress By Mid Year 1957

The frequency diversity program was being managed at the beginning of 1957 with the idea of having components of the first four radars mentioned previously completed by September 1958.[4] In reviewing the progress of the program at the half way point in 1957, the Center noted that some slippages were showing up in the schedule. [redacted]

The AN/FPS-26 was generally on schedule but the rather slow delivery of tubes from Sperry Gyroscope Company had aroused concern at the Center that a slippage might ensue. For the AN/FPS-27, under contract to Westinghouse Electric Corporation, a slippage of four to five months seemed a reasonable estimate because of a hold order placed on the antenna design and fabrication in January 1957.[5] Headquarters of the Air Research and Development Command had informed the Center in January that before proceeding to the antenna design for this radar, which Headquarters would like to see with stacked beam capable of height finding and high angle coverage, a delay should intervene until data from flight test of the AN/MPS-20 stacked beam radar was in. The opinion was expressed that the AN/MPS-20 flight tests would be conducted in time for this purpose.[6] However, by late June 1957 the flight tests had still not begun - hence the delay in the AN/FPS-27.[7] Work by Raytheon Manufacturing Company, contractor for the AN/FPS-26, was advancing on schedule.

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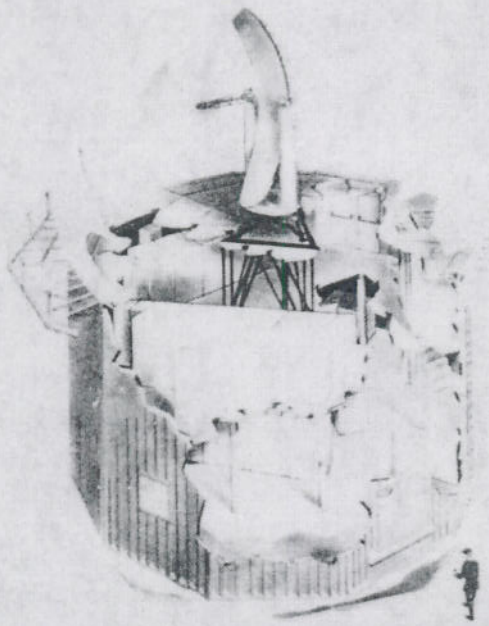
[redacted]

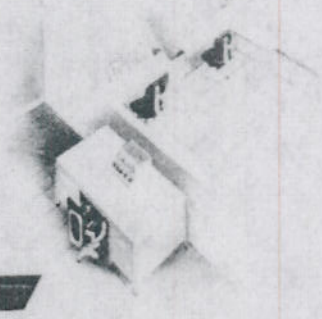
Unfortunately though some contractual snarls were encountered in negotiating plant rearrangement funds and Rome anticipated some slippage from this cause. The contractor was then estimating a three month delay.[8] [redacted]

The AN/FPS-35 occupied a somewhat special place in the RADC program since this radar had until early 1957 been the responsibility of Lincoln Laboratory. Headquarters of the Air Research and Development Command had transferred this radar to the Rome Frequency Diversity Program, though, by a letter of 21 March 1957. In the weeks following that date Rome set up close liaison with Lincoln Laboratories to insure a smooth transfer with minimum loss of time on the project.[9] By the summer of 1957 the Center had completed the specifications for [redacted] was being taken at the Center to expedite the procurement and installation of four AN/FPS-35's in the SemiAutomatic Ground Environment.[10] What happened to the AN/FPS-35 was important too because of its impact on another frequency diversity radar, the AN/FPS-24. This latter radar under contract by the General Electric Company was generally on schedule with the exception of the antenna components. A stop order had been placed on its antenna and rotary joint work in April. Headquarters had previously recommended that

Control No. 58-1732

[redacted]





[redacted]

the AN/FPS-24 and AN/FPS-35 radars be designed to use a compatible antenna system. This action had resulted in a two month slippage by mid 1957 and was entailing additional cost in order to keep the contractor on "stand-by" during this period.[11] [redacted]

Video Processors

Personnel at Rome had observed previously that practically all of the contractors engaged in frequency diversity work had recommended use of the same kind of moving target indicator devices. RADC personnel were also aware that normally all of the contractors involved subcontracted their moving target indicator units. At the same time the Center wanted something that went beyond the normal moving target indicator and would tie into the data processing of the SemiAutomatic Ground Environment and enhance its capability. The latest techniques which Rome wanted to see engineered into the moving target indicator, or Video Processor as the equipment was to be known because of its required added qualities, had been proven out by the Airborne Instruments Laboratory. Putting all of these considerations together, it was concluded at the Center that rather than have each of the frequency diversity contractors independently design his own video processors, a single contract with Airborne Instruments Laboratory, already thoroughly conversant with the techniques, would be the better course.[12] [redacted]

Control No. 58-1732

[redacted]

[redacted]

A number of important advantages pointed to this decision. Manpower both of the Center and of the several contractors would be economized by bulking all of the video processor work into a single package rather than asking for separate units from each contractor. Additional profit would be reaped in having a common nomenclatured video processor for all the frequency diversity radars which would simplify logistics and maintenance. It would allow use of common technical orders, too. These actions would, of course, force costs down. Consequently Rome let a contract to Airborne Instruments Laboratory for the video processors in May 1957.[13] [redacted]

Frequency Interference

The problem of frequency interference and frequency allocation was a generally difficult one for the program. The previous history of the Rome Air Development Center has discussed some of the questions raised on this score in 1956. The problem continued to haunt the program in 1957.[14] [redacted]

Representatives of the Center attended a conference at Headquarters USAF 10 July 1957 to justify the use of the AN/FPS-28 frequency. The Center stressed the advantages of a radar at this frequency in terms of moving target indicator capability against chaff and remarked further that in normal peace time [redacted] band since frequency jumping would be needed only in case of

[redacted]

[redacted]

enemy jamming. The Center's primary objection to a change of frequency so late, though, arose from the delay in delivery and the increase in costs which a change of system parameters would certainly cause. [redacted]

Actually, though, the more serious difficulty of frequency

[redacted]

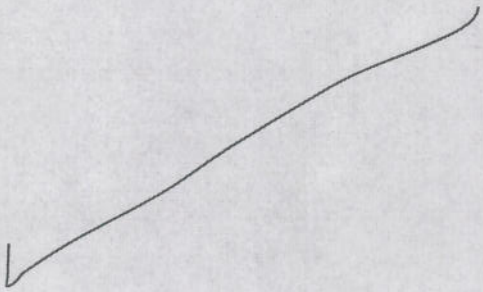
for a decision on the matter, a directive at length came from Headquarters ARDC in December 1957 changing the frequency of

[redacted]

Test Program and Site Selection

Originally it was intended to test the frequency diversity equipments at the plants of the contractors. In January 1957, however, the plan was altered to allow testing of the equipments in an Air Defense Command environment in an area yet to be selected. This shift of tactics was expected to bring savings of time and money to the Air Force. The test program would cover not only all normal performance and environmental conditions but would emphasize flight and laboratory tests against diversified types of jammers to assure effectiveness under jamming conditions. The first phase of the test program

[redacted]



[redacted]

was planned to test each of the radars separately. The second phase of the program would test the marriage of each of the radars to the SemiAutomatic Ground Environment System. In the third and final phase of testing, all of the frequency diversity radars would be tested as an integrated system with SAGE.[17]

Following a conference held at the Rome Center 21 May 1957, Rome personnel drafted a proposed test plan for submission to headquarters of the Air Research and Development Command. This plan, drawn up with the cooperation of Lincoln Laboratories and the AIDS Project Office, was submitted to Headquarters 19 June 1957. It outlined a program general in nature that could be applied to any area designated by the Air Force for the purpose. The Center emphasized, however, that the frequency diversity radars to be used in the test were to be service test types not operational equipments.[18] [redacted]

In the summer of 1957 representatives of Rome in company with their counterparts from the Eastern Air Defense Force, Corps of Engineers and 657 Air Control and Warning Squadron undertook a survey of the proposed frequency diversity sites in the Montgomery Air Defense Sector to define more clearly the installation requirements and to locate the frequency diversity radars on the proposed sites. The usual complex of problems associated with radar site location had to be carefully

Control No. 58-1731

[redacted]

[redacted]

considered such as interference with [redacted] and other communication means.[19] [redacted]

In order to expedite tooling and provide frequency diversity contractors with definite positions for the erection of the radars the Center urged that a decision be reached in several letters in September and October 1957. These decisions were forthcoming 8 November 1957 by joint action of the Air Research and Development Command and the Air Defense Command.[20] [redacted]

Year End Status of the Frequency Diversity Radars

By the end of 1957 the Center appeared to be coming close to achievement of the basic obligation of delivering component tested frequency diversity equipments by September 1958. Looking at the program as a whole there appears from this date (as on the order of two months with November 1958 now tagged as the date for delivery.[21] [redacted]

The remarkable thing about the frequency diversity program was the relative absence of major technical problems. Most of the delays which had occurred were traceable to administrative causes, not technical ones. Considering that the frequency diversity radars were being built at frequencies never before employed in radar equipments, the comparative smooth sailing met in the technical execution of the program is indeed pleasant to record.[22] [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

originally scheduled to start [illegible] July 1957, the date for the test was later moved back to [illegible] October 1957. A test requirement directive had been formally prepared by 1 May 1957.[19] (S)

To save time that would otherwise be required in establishing fixed installations for the jammers, it was decided to mount them in vans for rapid deployment at the individual sites chosen in the Springfield-[illegible] test area. Power needed for each of the jammers would be supplied by trailer mounted engine generator sets. The system control center and all staging for the tests was to be accomplished from Westover Air Force Base, Massachusetts. Personnel from RADC were actively engaged in helping to complete the early arrangements. Arranging for permission to use specific frequencies for operation of the jammer equipments are only a few examples of what this involved. [redacted]

The tests, to begin 1 October 1957, were to last approximately sixty days and involve roughly one hundred flights of Strategic Air Command aircraft to test out the [illegible] massive jamming environment.[20] (S)

[redacted]

of aircraft warning and installations could serve as a kind of

[illegible] 58-1732

[redacted]

[redacted]

[redacted]

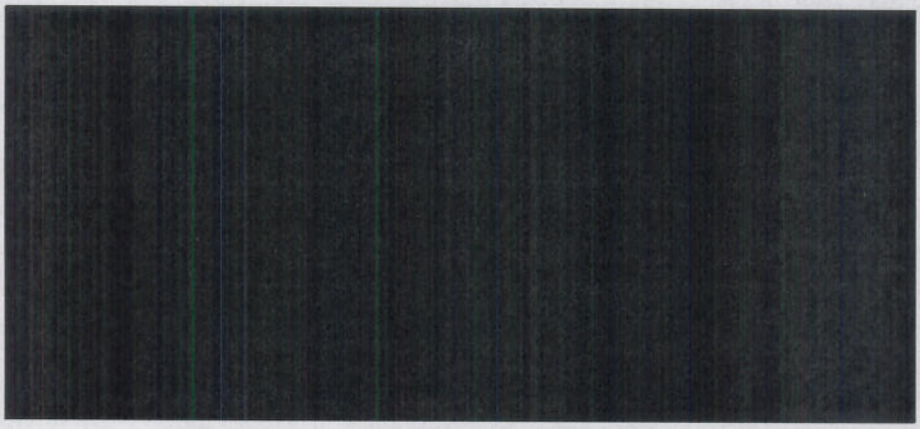
As reported in the 1956 July-December RADC History, the [redacted] 1956 and early 1957 with an aircraft whose [redacted] could fully meet Air Force requirements. Various Centers of the Air Research and Development Command [redacted] Heidelberg.

The Center was planning to participate in a joint services program for evaluation and development [redacted] measurements were to be followed by firing tests at the Marine Corps Development Center, Quantico, Virginia in 1958.[34] (S)

[redacted] had on RADC contract investigated characteristics required for

Section No.58-73

[redacted]



[redacted]

NOTES

1. Ltr, Maj. Gen. J. W. Sessums, Jr., Comdr ARDC to Gen. Thomas D. White, Chief of Staff, subj: (U) Headquarters ARDC Annual Effectiveness Report, 31 Jul 57.

2. History of RADC 1 Jul 56 - 31 Dec 56, pp. 72-75

3. Briefing Session attended by author, of RCER, 13 Aug 57.

4. Ltr, Maj.Gen.J.W. Sessums, Jr., Comdr ARDC to Gen. Thomas D. White, Chief of Staff, subj:(U) Headquarters ARDC Annual Effectiveness Report, 31 Jul 57.

5. Ltr, Comdr RADC to Comdr ARDC, subj:(U) Status of Frequency Diversity Radars, 19 Jun 57.

6. Memorandum, Headquarters ARDC, subj:(no classification given) Frequency Diversity Program, 14 Jan 57.

7. Ltr, Comdr RADC to Comdr ARDC, subj: (U) Status of Frequency Diversity Radars, 19 Jun 57.

8. Ibid.

9. Ltr, Col. Otto G. Quanrud, Director of Control & Guidance RADC to Comdr ARDC, subj: (U) AN/FPS-35 Radar, 17 Apr 57.

10. RADC Activity Report, Sept. 57, p. 8.

11. Ltr, Comdr. RADC to Comdr. ARDC, subj: (U) Status of Frequency Diversity Radars, 19 Jun 57; also Memorandum Headquarters ARDC, subj: (no classification given) Frequency Diversity Program, 14 Jan 57, also Ltr, Col. Otto G. Quanrud, to Comdr. ARDC, subj:(U) Status of Frequency Diversity Radars, 19 Jun 57.

12. Interview by the author with Mr. Arthur Frohlich, RCERHM, 3 Apr 58.

13. Ibid.

14. History of RADC 1 Jul 56 - 31 Dec 56, pp. 74-75.

15. Ltr, Mr. William T. Pope, RCER to Maj. L. Wynne, Hqs USAF, subj: (no classification given) Justification for AN/FPS-28 Frequency, 17 Jul 57 and incl Memo.

[redacted] Control No. 58-1732

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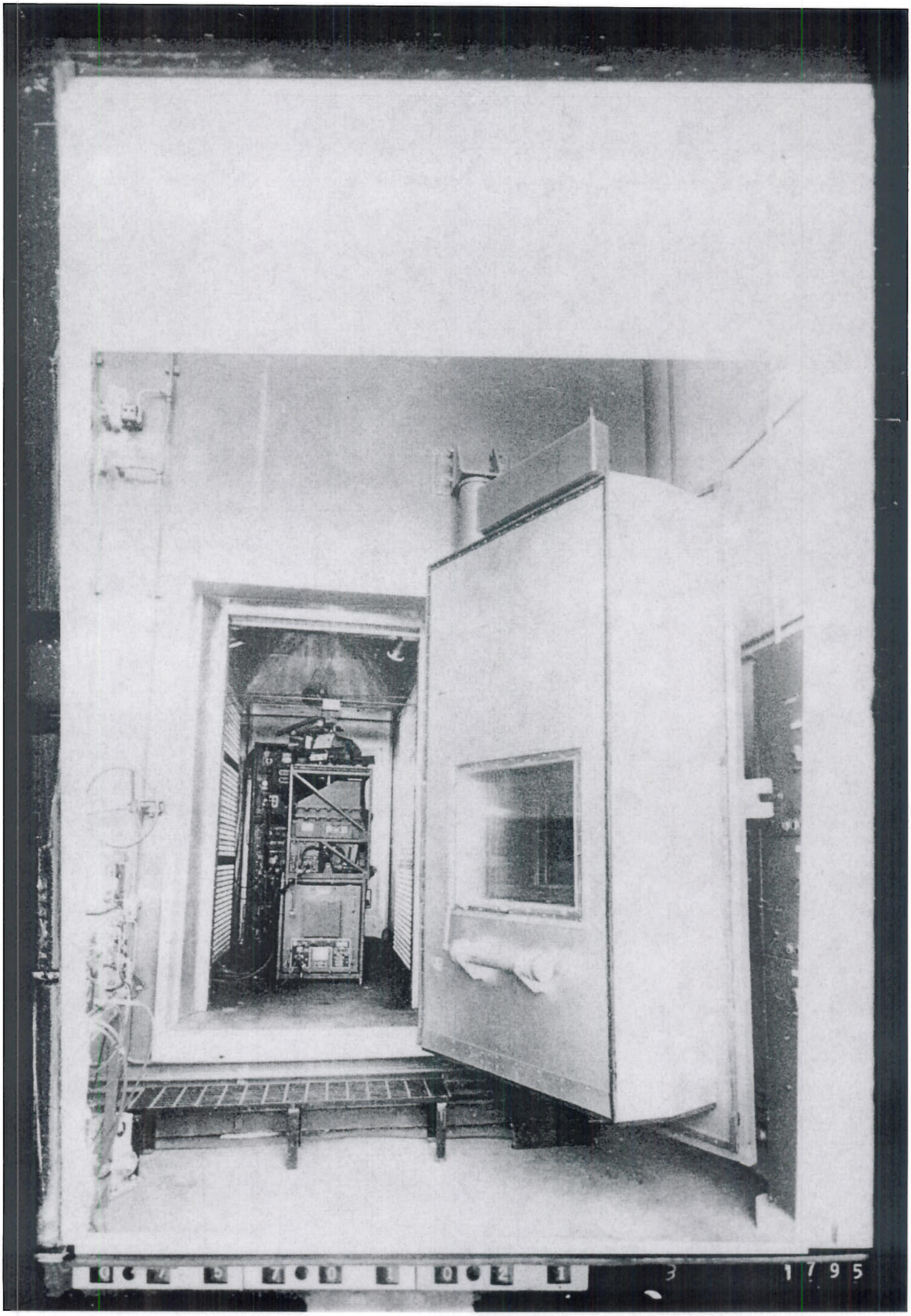
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Organization of the new facility brought an appreciable saving of time and money to the Air Force. On the average it permitted fifty percent of time spent on a research problem in Human Engineering to be lopped off with an accompanying reduction of man hours and dollar savings. This was so because frequently equipments could be used many times for different projects without need to be reconstructed or reassembled each time a new problem arose. In instances where new equipments had to be provided, the head of the research facility, often in coordinated effort with other psychologists from the Human Engineering Laboratory, with project engineers and with members of the General Engineering Laboratory, arranged as best suited individual requirements for the design and construction of the equipment in the house at RADC.[16]

To give some appreciation of the nature of the facilities, there is for the study on vision a light sealed, air conditioned dark chamber with an RADC visual acuitometer at hand. Adjoining this chamber is an acoustically treated and air-conditioned sound chamber and an auditometer for investigating characteristics of human hearing. Various other facilities involving such instrumentation as projectors, timing devices, simulated radar displays are similarly available.[17]

Flight Test and Instrumentation

One entire directorate at [illegible] AADC composed of 243 military and civilians provided flight test support for Center groups and for other agencies. Missions flown by planes of the directorate covered virtually all sections of the United States and ranged out to areas as far from home as Trinidad, Bermuda, Panama, the Azores and Alaska. In the last half of 1957 some 4200 flight hours were logged, only a slight reduction from the past due primarily to budget restrictions.[18]

To give more efficient and effective support the policy of the directorate in 1957 has been to phase out reciprocating engine aircraft for obvious reasons and to cut the inventory of single engine aircraft. The principal advantage of single engine aircraft for testing purposes in the past had been the higher altitudes to which they could fly. But with the delivery of B-47's to the Center this advantage had become negligible and, of course, multi-engine craft could boast of greater range of operation. Elimination of single engine aircraft would also have the advantage of reducing the number of types of aircraft needed by the directorate and would lessen problems of maintenance and supply in proportion. A year and a half previously, the Center had maintained twelve different types of aircraft. By the close

of 1957 that figure had been pared to seven; the ultimate goal was to settle at three or four types. This was to be accomplished in part by phasing out the single engine F-102's at the Center and the C-97.[19]

Aircraft available to the directorate at the close of 1957 included four B-47's, one C-97, two C-47's, one VC-47, four C-131's, one T-33 and three F-102's. To fly these aircraft the directorate could count on twenty-four duty pilots and four navigators. Maintaining the aircraft occupied 111 airman and 92 civilians of the directorate.[20]

Off Base Developmental Sites

An important adjunct to research and development at the Rome Air Development Center are the off base sites which the Center uses to further its developmental program. Four of them, the AN/FPS-17 high power radar site at Laredo Texas, the Ionospheric communication facility at Carrabelle, Florida the chaff test site at Malabar, Florida and the Down Range Missile observation site at Trinidad were located at obviously considerable distances from the Center. However in the Rome area, the Center also maintained 14 off base sites. These sites close to the Center represented an acreage of 3,073 whose cost of replacement was estimated at $12,798,000, including installations and equipment. Frequent reference has been made in other sections of the RADC history to the specialized (S)

[redacted]

functions performed by these sites and no attempt will be made here to give a detailed breakdown of the developmental activities being performed at each.[21]

For the local sites material support was provided through the DCS Material of the Center. Technical aspects of developmental programs were of course under the supervision of the project engineers whose project was outfitting the site facilities. If the usefulness of the site for a given project should come to an end the site can be transferred for use to other projects, or if the site has no further usefulness to the Center steps can be taken to dispose of it as surplus property.[22]

A list of the local off base sites including their size and cost of replacement as represented in the records of the DCS Material will supply a better idea of the extensive nature of these off base site facilities.[23]

Off Base Sites

DistArt Sites (5)

Laredo, Texas	-	ALFPS 17 site
Malabar, Florida	-	Chaff testing site
Carabelle, Florida	-	Ionospheric communication site
Trinidad, B.W.I.	-	Down Range Missile Observation Point

(Cont'd on next page)

[redacted]

Local Off Base Sites*

Site	Acres	Cost to Replace
Verona	511	$1,000,000
Floyd	51	150,000
Forestport	182	1,500,000
Jervis Avenue	985	111,000
Navarre	528	1,000,000
Newport	25	300,000
Ava	350	900,000
Steckbridge	400	[illegible]
Quaker Hill	7	25,000
Starr Hill	7	25,000
Vienna	7	25,000
Dean Hill	7	[illegible]
Clark Hill	7	[illegible]
Peterboro	7	[illegible]

20. Ibid.

21. Taken from files of RCMP 21 Jan 58 by the author.

22. Interview by the author with Mr. Carl Facci, RCMP 21 Jan 58.

23. Taken from files of RCMP, 21 Jan 58, by the author.

GLOSSARY *

AFCRC	Air Force Cambridge Research Center
AFR	Air Force Regulations
AICBM	Anti Intercontinental Ballistic Missile
AMC	Air Material Command
AM & F	American Machine & Foundry Company
APGC	Air Proving Ground Command
ARDC	Air Research and Development Command
Asst	Assistant
BMD	Ballistic Missile Defense
BMEWS	Ballistic Missile Early Warning System
Brig Gen	Brigadier General
Col	Colonel
Comdr	Commander
Comm	Communications
CORA	Coherent Radar Array
DCS	Deputy Chief of Staff
DD	Development Directive
Dep	Deputy
Dir	Director or Directorate
ECM	Electronic Countermeasures
EW	Electronic Warfare
GAFB	Griffiss Air Force Base
GE	General Electric Company
Gen	General
GOR	General Operation Requirement
ICBM	Intercontinental Ballistic Missile
Ind	Indorsement
Intell	Intelligence
JAN	Joint Army Navy
Lt	Lieutenant
Ltr	Letter
Maj	Major
MC	Military Characteristics
Memo	Memorandum
PSRACE	Professional & Scientific Recruiter
RSMACT	Civilian & Military Career Development Branch

Msg	Teletype
MTI	Moving Target Indicator
No.	Number
PPI	Position Plot Indicator
RADC	Rome Air Development Center
RAFD	Rome Air Force Depot
R & D	Research & Development
RCA	Radio Corporation of America
RCA	Adjutant
RCC	DCS/Comptroller
RCF	Directorate of Control & Guidance
RCFM	Missile Support Laboratory of above
RCFMB	Ballistic Missile Branch of above
RCFMI	Missile Instrumentation Branch
RCFMS	Missile Systems Implementation Branch
RCFN	Control Laboratory
RCFNC	Control Equipment Branch of above
RCFNG	Guidance Branch
RCFNS	Special Devices Branch
RCER	Radar Laboratory
RCERA	Antenna & Microwave Components Branch
RCERD	Advance Development Branch
RCERH	Search & Height Finding Branch
RCERR	Radio Frequency Transmitter Branch
RCF	Directorate of Flight Test
RCH	Commander, Headquarters Section
RCI	Inspector General
RCK	Director of Procurement
RCM	DCS/Materiel
RCN	Office of Information Services
RCNH	Center Historian
RCO	DCS/Operations
RCP	DCS/Personnel
RCS	Directorate of Technical Services
RCSC	General Engineering Laboratory of above
RCSH	Human Factors Laboratory of above
RCSST	Technical Information & Intelligence Branch
RCSSTL	Library Services Section
RCST	Test Facilities Laboratory
RCT	Scientific Director
RCTD	Director of R & D
RCTDM	Associate Director, R & D

ACS	Directorate of Communications
ACSA	Advanced Development Laboratory - Dir Comm
ACSE	Equipment Laboratory - Dir Comm
ACSO	Operational Planning Office - Dir Comm
ACW	Dir of Intelligence & Electronic Warfare
ACWE	Electronic Warfare Laboratory - Dir Intell & EW
ACWI	Intelligence Laboratory - Dir Intell & EW
AFC	
Apt	Report
C	Secret
CARAC	Steerable Array
CD	Supporting Document
CJ	Staff Journal
CR	System Requirement
Subj	Subject
TACAN	Navigational System
TPYD	Technical Plans & Programs Documents
TR	Technical Report
U	Unclassified
UHF	Ultra High Frequency
USAF	United States Air Force
Vol	Volume
WADC	Wright Air Development Center
WSPO	Weapons System Project Office

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* Personal symbol identification has in general been carried only to branch level. This is adequate for identification of personnel cited in the notes as sources of information to the historian

G A Z E T T E E R

Alpine, New Jersey
Anchorage, Alaska
Ava, New York
Azores, North Atlantic Ocean

Baffin Island, North East Canada
Baltimore, Maryland
Bermuda, West North Atlantic

Cambridge, Massachusetts
Cape Canaveral, Florida
Cape Dyer, Arctic
Carrabelle, Florida

Detroit, Michigan

Fairbanks, Alaska
Floyd, New York

King Salmon/Naknek, Alaska

Laredo, Texas
Liberty Dam, Maryland
Los Angeles, California
Lubbock, Texas

Malabar, Florida
Montgomery, Alabama
Munich, Germany

New York City, New York
Nikolski, Arctic

Palos Verdes, California
Point Barrow, Alaska

Quantico, Virginia

Redbank, New Jersey

Sampson, New York
Springfield, Massachusetts
Stockbridge, New York
Stony Point, New York

Thule, Greenland
Trinidad, British West Indies

Verona, New York

Westover AFB, Massachusetts

APPENDIX A

Technical Reports, Notes and Memorandums published at DASC
(July - December 1957)

July 1957

RADC-TR-57-132 - Subj: (U) Final Article Survey of Electron Tube Noise (Literature) DASF Vol 2a & Vol 2b.

RADC-TR-57-141 - Subj: (U) Investigation of Properties of Lossable Materials at the Resonance Absorption Point - Absorber.

RADC-TR-57-155 - Subj: (U) Nuclear Bursts Effects.

RADC-TR-57-167 - Subj: (U) A Self-Contained Interference Plotter for Radar Receivers.

RADC-TR-57-244 - Subj: (U) DASC Reliability Program, Past, Present, & Future.

RADC-TR-57-256 - Subj: (U) The DASC Visual Densitometer.

RADC-TR-57-1 - Subj: (U) A Low Noise UHF Amplifier

August 1957

RADC-TR-57-211 - Subj: (U) Radar Visual Interference Tests

RADC-TR-57-1 - Subj: (U) Preliminary Study on the Implementation of ICC Alien Projectory Measuring System.

RADC-TR-57-2 - Subj: (U) Use of Z-Plane in Determining Velocity Response for Integrated MTI.

RADC-TR-57-1 - Subj: (U) Circulatory Interpolation Achieved with use of Low Speed Digital Computer

September 1957

RADC-TR-57-238 - Subj: (U) Theory of Scattering & Evaluation of Prob. of Intercept for CW FM-CW.

RADC-TR-57-257 - Subj: (U) A Preliminary Survey of Tropospheric Microwave Refraction at Rome, N. Y.

RADC-TR-57-251 - Subj: (U) Site Survey for Microwave Relay System.

RADC-TR-57-2 - Subj: (U) Cloud Coverage at Rome, N. Y.

RADC-TR-57-3 - Subj: (U) The Effects on Radio-Astronomical Measurements Due to Ionospheric Refraction in the Presence of Field Aligned Ionization.

October 1957

RADC-TR-57-247 - Subj: (U) Traits of Certain Electronic Components Relative to Reliability & Improved Techniques from the Design Viewpoint.

RADC-TR-57-154 - Subj: (U) Visual Acuity & Light Adaptation.

RADC-TR-57-155 - Subj: (U) The Electroforming Technique Used in the Fabrication of A Broad Band Circle Tapped Antenna.

RADC-TN-57-317 - Subj: (U) Covelant Amplitude Search.

November 1957

RADC-TR-57-248 - Subj: (U) Lab Four Microwave Filters.

RADC-TR-57-257 - Subj: (U) Evaluation of 5721-115 Traveling Wave Tube.

RADC-TR-57-156 - Subj: (U) Ultrasonic Microwave Delay.

RADC-TR-57-349 - Subj: (U) The Small Lab Life Program.

[illegible]

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APPENDIX B

Civilian Personnel Status As Of 30 November 1957*

Total Permanent Authorization	1293	
Total Assigned Personnel	1284	
Percentage Of Engineer Assigned	28%	
Percentage of Engineering Aids Assigned	3%	
Percentage of Engineering Technicians Assigned	6%	
Percentage of Admin & Clerical Assigned	38%	
Percentage of Wage Board Assigned	19%	
Number and Percentage of Promotions	27	2%
Number and Percentage of Gains	9	.01%
Number and Percentage of Loss	24	2%
Downgrades	0	
Rate of Turnover	1.2%	
Total Vacancies	1	

* Statistics Taken From a Report of the Office of DCS/Personnel of 30 November 1957.

APPENDIX C

Military Personnel Status as of 4 October 1957*

I. Personnel:

a. Strength	Authorized	Assigned
R & D Officers	76	65
Pilots	26	20
Navigators	5	7
Other	46	38
	153	130
Airmen	138	154
Civilians	1301	1339

* Statistics Taken from Monthly Personnel Status Report issued by DCS/Personnel, 4 Oct 57.

I N D E X

A

B

C