

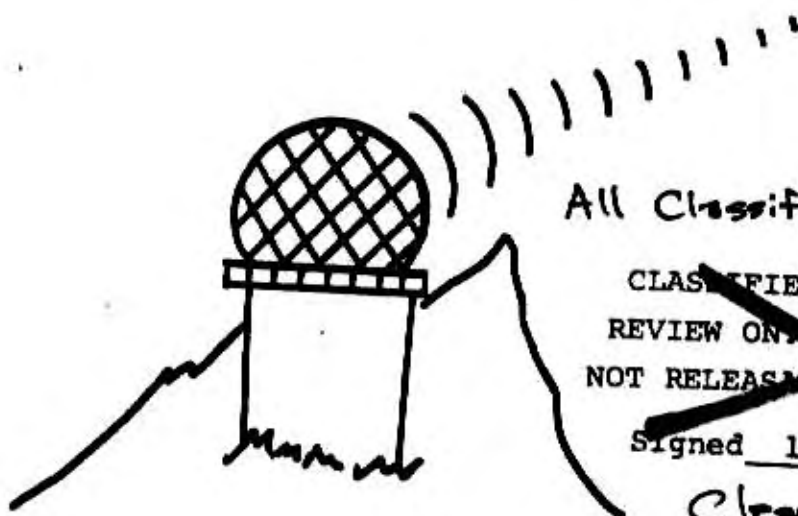
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# 412L Aircraft Warning and

## Control System (U)

1959 ~ 1980



All Classified Material Removed

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(U) This report contains information that is NOT RELEASABLE TO FOREIGN NATIONALS. This is found on pages 43 and 44. However, this restriction ends on 31 December 1982 in accordance with downgrading instructions in footnote 66.

(U) In accordance with Executive Order 12065 this document should be reviewed for declassification no later than 24 December 2005.

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# 412L AIRCRAFT WARNING AND CONTROL SYSTEM

1959 - 1980

BY

SSGT MANUEL E. SISO

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REVIEW ON: 24 DECEMBER 2005  
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601ST TACTICAL CONTROL WING

UNITED STATES AIR FORCES IN EUROPE

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## INTRODUCTION

(U) For the past 15 years, the 412L Air Weapons Control System existed in southern Germany to manage air defense activities for NATO's Fourth Allied Tactical Air Force. Although the 412L was directly responsible to NATO, the 601st Tactical Control Wing supervised the day-to-day activities of USAF units that had a part in its operation. We choose now to write this story while the 412L is being phased out and replaced by modern components.

(U) After addressing the frustrations and problems in making it an operational system, this monograph covers important milestones of the 412L era. These include transfer of most sites to the German Air Force, formation of joint German/American management functions, Salty Net, and Constant Keystone. It ends, most appropriately, with an introduction to the German Air Defense Ground Environment (GEADGE) system that would replace the 412L during the 1980s.

(U) The documents used for preparing this narrative came out of historical archives at Headquarters USAFE, Seventeenth Air Force, and the 601st TCW. Naturally, it was written from the European perspective with references to stateside developments only when appropriate. The author, SSgt Manuel E. Siso, was completely objective in telling it like it was. This should be a worthwhile historical reference for years to come.

  
LEON W. BABCOCK, JR., Brigadier General  
Commander, 601st Tactical Control Wing

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## PREFACE

(U) This monograph, the first in several years from a Seventeenth Air Force subordinate wing, was by no means a solo effort. In fact, several people played a major part in getting this narrative done. I would like to single out four of them. Mr. Lyle Herbaugh (GS-12), the 412L maintenance contract monitor at the 601st Tactical Control Wing, deserves the most credit for his technical and inspirational guidance. This work never would have gotten off the ground without his contributions of time and three boxes of supporting documents that he "never had the heart to throw out." Colonel Richard Morain, 601st TCW Deputy Commander for Command and Control (and former 615th Aircraft Control and Warning Squadron commander), also gave his time generously always leaving his door open for countless inquiries. More than 25 times I entered his office with "just a quick question" when simple answers were not possible. Another person who deserves recognition for this work is our typist, Sgt David L. Jones, who retyped this manuscript three times for proofreadings at wing-level for the most technical review; and the Seventeenth Air Force, USAFE, and Headquarters USAF history offices. Finally, the biggest thanks go out to my counterpart in the 601st TCW History Office, SSgt Steve Toepfer, who provided invaluable guidance on topic selection. He also carefully proofread each draft. My heartfelt thanks to all of these people.

*Manuel E. Siso*

MANUEL E. SISO, SSgt, USAF  
601st TCW Historian

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## 412L MILESTONES

| <u>Date</u>     | <u>Event</u>                                                                                                                                                                                                                                                | <u>Page</u> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 15 August 58    | (U) The United States European Command assigned operational control of all U.S. Army and Air Force air defense forces to CINCUSAFE.                                                                                                                         | 2           |
| 21 July 59      | (U) CINCUSAFE, Gen F.F. Everest, signed an agreement at Wiesbaden Air Base, Germany, calling for the transfer of six radar sites to the German Armed Forces. The German Federal Minister of Defense signed the document at Bonn, Germany, two days earlier. | 37          |
| 10 September 59 | (U) USAFE turned the Tuerkheim radar site over to the German Air Force. The Germans removed it from the active air defense net turning it into a training school.                                                                                           | 37          |
| 4 November 59   | (U) Regensburg became the second site turned over to the Germans. However, operational control was not given until 1 November 1960 after German controllers passed a tactical evaluation there.                                                             | 37          |
| 13 April 60     | (U) Air Force officials at the Pentagon approved expansion of the 412L project to include six sites instead of three.                                                                                                                                       | 11          |
| 4 January 61    | (U) The German Air Force took over manual radar operations at Freising.                                                                                                                                                                                     | 39          |

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| <u>Date</u>    | <u>Event</u>                                                                                                                                                                                | <u>Page</u> |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 6 July 61      | (U) A major agenda item at the USAF Weapons Board meeting was the possible deployment of two mobile GPA-73 units in Germany.                                                                | 17          |
| 7 September 61 | (U) The USAF Weapons Board approved one mobile GPA-73 for deployment at Erbskopf.                                                                                                           | 17          |
| 30 October 61  | (U) Facility construction of earth-covered igloos completed at Kindsbach.                                                                                                                   | 15          |
| 8 December 61  | (U) The USAFE Facilities Review Board approved emergency funds for interim power requirements at Doebraberg, Wasserkuppe, and Giebelstadt.                                                  | 18          |
| 12 December 61 | (U) The chief of the German Construction Agency announced that because of excessive delays, no more design changes would be allowed at the Boerfink bunker.                                 | 14          |
| 10 February 62 | (U) Installation of mobile GPA-73 started atop Erbskopf mountain.                                                                                                                           | 17          |
| 1 March 62     | (U) Construction at Wasserkuppe completed.                                                                                                                                                  | 15          |
| 12 March 62    | (U) An agreement between the Electronics Systems Division and USAFE established the 412L European Task Organization as the primary point of contact for 412L construction and installation. | 12          |
| 1 June 62      | (U) Construction at the Freising bunker was completed.                                                                                                                                      | 15          |
| 1 July 62      | (U) Doebraberg construction was completed.                                                                                                                                                  | 15          |

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| <u>Date</u>    | <u>Event</u>                                                                                                                                                        | <u>Page</u> |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 31 August 62   | (U) With construction at Boerfink and Giebelstadt done, all 412L building projects were finished.                                                                   | 19          |
| 1 September 63 | (U) The 412L Site Activation Task Force was activated at Wiesbaden Air Base to coordinate the 412L testing program.                                                 | 25          |
| 6 November 63  | (U) USAFE and the Electronics Systems Division of AFSC signed a 412L system turnover agreement.                                                                     | 26          |
| 15 March 64    | (U) Following system turnover readiness testing, ESD turned five 412L radar stations over to USAFE (Boerfink, Wasserkuppe, Doebraberg, Giebelstadt, and Kindsbach). | 28          |
| 15 April 64    | (U) USAFE received Freising from ESD.                                                                                                                               | 28          |
| 4 January 65   | (U) The 412L system assumed control aspects of the 4 ATAF air defense mission. The manual system remained operational as a back-up for the next two months.         | 32          |
| 4 March 65     | (U) American manual sites at Giebelstadt, Freising, Doebraberg, Langerkopf, Schoenfeld, and Wasserkuppe ceased operations after the 412L proved reliable.           | 32          |

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| <u>Date</u>    | <u>Event</u>                                                                                                                                                                                               | <u>Page</u> |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 15 December 65 | (U) The German Air Force assumed control of Freising 412L operations. The 604th Aircraft Control and Warning Squadron was inactivated.                                                                     | 40          |
| 1 September 68 | (U) The German Air Force opened the Lauda bunker as a 412L reporting post.                                                                                                                                 | 41          |
| 1 December 68  | (U) The operation at Lauda was upgraded to control and reporting post. Accordingly, U.S. radar operations at nearby Giebelstadt ceased and the 602d Aircraft Control and Warning Squadron was inactivated. | 41          |
| 5 October 72   | (U) After a long delay, the German Air Force agreed to take over Doebraberg by 31 December 1974 and Wasserkuppe at an unspecified later date.                                                              | 44          |
| 9 October 73   | (U) A joint German/American agreement went into effect to establish the 412L Steering Committee and the Joint Direction Staff.                                                                             | 47          |
| 1 July 74      | (U) 412L operations at Doebraberg were turned over to the German Air Force. The 606th Aircraft Control and Warning Squadron was inactivated.                                                               | 44          |

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| <u>Date</u>  | <u>Event</u>                                                                                                                                                                                                                                                                     | <u>Page</u> |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 1 October 74 | (U) The Joint System Management Group was activated at Birkenfeld to manage day-to-day operations of the 412L system. Group manning consisted of 40 percent American and 60 percent German. Detachment 1, 601st Tactical Control Group, was activated to provide manpower slots. | 48          |
| 1 October 74 | (U) Philco Worldwide Services started contract maintenance at Wasserkuppe on a test basis.                                                                                                                                                                                       | 57          |
| 1 May 75     | (U) The Sacramento Air Logistics Center turned over the program depot maintenance program to Philco Worldwide Services.                                                                                                                                                          | 58          |
| May 75       | (U) Gen John W. Vogt, Jr., CINCUSAFE, identified the interoperability of fixed and mobile radar elements as a key objective for Allied forces in Europe. Thus, project Salty Net was set in motion.                                                                              | 50          |
| 1 July 75    | (U) USAFE, with 4 ATAF approval, downgraded operations at Wasserkuppe from a control and reporting post to reporting post.                                                                                                                                                       | 45          |
| 2 July 75    | (U) The 615th Aircraft Control and Warning Squadron temporarily stopped 412L operations at Boerfink during the Constant Keystone modification.                                                                                                                                   | 56          |
| 18 July 75   | (U) The 615th AC&WS began manual control and reporting post operations at Erbskopf. This would continue for the duration of Constant Keystone.                                                                                                                                   | 56          |

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| <u>Date</u>   | <u>Event</u>                                                                                                                                                                                        | <u>Page</u> |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 1 October 75  | (U) Philco Worldwide Services received its third 412L maintenance contract adding the consolidated intermediate maintenance facility at Sembach Air Base.                                           | 58          |
| 20 October 75 | (U) Air Force Systems Command published a plan identifying essential elements and milestones for Salty Net.                                                                                         | 51          |
| October 76    | (U) Three separate Salty Net tests involving mobile and fixed radar units took place. IBM 4 Pi-CP2 computers (Salty Net Buffers) were used to provide interface.                                    | 51          |
| 29 January 77 | (U) Salty Net Buffers at four mobile control and reporting posts were declared operationally ready.                                                                                                 | 52          |
| 10 June 77    | (U) NATO accepted the completed Constant Keystone project.                                                                                                                                          | 57          |
| September 77  | (U) The 615th AC&WS resumed master control and reporting post operations (with one-third the space) in the Boerfink Bunker.                                                                         | 57          |
| 1 October 77  | (U) All U.S. 412L maintenance responsibilities were combined into the 412L Omnibus Maintenance Contract and awarded to Aeronutronics Services Corporation (new name for Philco Worldwide Services). | 58          |
| June 78       | (U) The Salty Net project progressed with the interface of the airborne warning and control system through message processing centers.                                                              | 52          |
| 13 August 78  | (U) A technical radar evaluation at Wasserkuppe was terminated because of ineffective maintenance and management procedures.                                                                        | 59          |

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| <u>Date</u>     | <u>Event</u>                                                                                                                                                                                                                                                                                   | <u>Page</u> |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| 18 August 78    | (U) The 412L maintenance contract monitor at Wasserkuppe was removed from his position due to maintenance problems there.                                                                                                                                                                      | 59          |
| 22 August 78    | (U) The 412L contract manager at the 601st TCW issued a "cure notice" for Aeronutronics Services Corporation to improve its performance at Wasserkuppe.                                                                                                                                        | 59          |
| 18 September 78 | (U) The 609th Tactical Control Squadron (a 407L mobile radar unit) started a two-month test for conducting all Salty Net interface objectives within message processing centers.                                                                                                               | 52          |
| 21 September 78 | (U) Aeronutronics Services Corporation met all specifications of the "cure notice" issued a month earlier (except where parts were not available).                                                                                                                                             | 60          |
| 1 January 79    | (U) 412L reporting post operations at Wasserkuppe were turned over to the German Air Force. The 616th Aircraft Control and Warning Squadron was inactivated.                                                                                                                                   | 45          |
| 15 June 79      | (U) The 412L contract manager plus members of the USAFE contracting office met with the Aeronutronics Services Corporation director of operations to discuss dissatisfaction over maintenance practices at Boerfink. Specific improvements were requested in management and training programs. | 61          |
| 1 October 79    | (U) The 601st Tactical Control Wing declared message processing centers operationally ready.                                                                                                                                                                                                   | 52          |
| 1 September 80  | (U) NATO temporarily closed fixed radar operations at Boerfink for transition from 412L to German Air Defense Ground Environment.                                                                                                                                                              | 62          |

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## THE EARLY DAYS

### THE PRE-412L ERA

(U) After 1953, when the Union of Soviet Socialist Republics (U.S.S.R.) developed its nuclear force, the most dangerous threat to western Europe in the event of war was a surprise nuclear attack either directly from the Soviet Union or one of its satellite nations. This was particularly true for West Germany; it was located so close to the threat that a few minutes could mean the difference between survival and total destruction. Military leaders at Supreme Headquarters Allied Powers Europe (SHAPE)--the military arm of the North Atlantic Treaty Organization (NATO)--believed that such an attack, if successful, could make western Europe untenable as a base for military operations. They also felt that protection of the counter atomic force was a prerequisite to the success of Allied war strategy. <sup>1</sup>

(U) Before the Soviet nuclear threat existed, NATO military leaders accepted political arguments in favor of maintaining air defense forces on national levels for reasons of national sovereignty. But, the nuclear threat gave cause for these leaders to voice their views and push for the joining of air defense forces as a single body under NATO control. Air Chief Marshal Sir Basil Embry, the Allied Air Forces Central Europe (AAFCE) commander between 1953 and 1956, put it clearly. He

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wrote, "The sum of individual national air defense contributions, operating on their own, could not compare with what might be achieved by welding them into a single coordinated system." The fundamental concepts for such a structure were set forth in Military Committee (MC) 54, a SHAPE planning document which the NATO Standing Group approved in the spring of 1956.\* The main objective of MC 54 was SHAPE's gradual assumption of Europe's air defense role on an evolutionary basis. <sup>2</sup>

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\* (U) After a drawn out, nation-by-nation approval process, NATO assumed this function in 1961.

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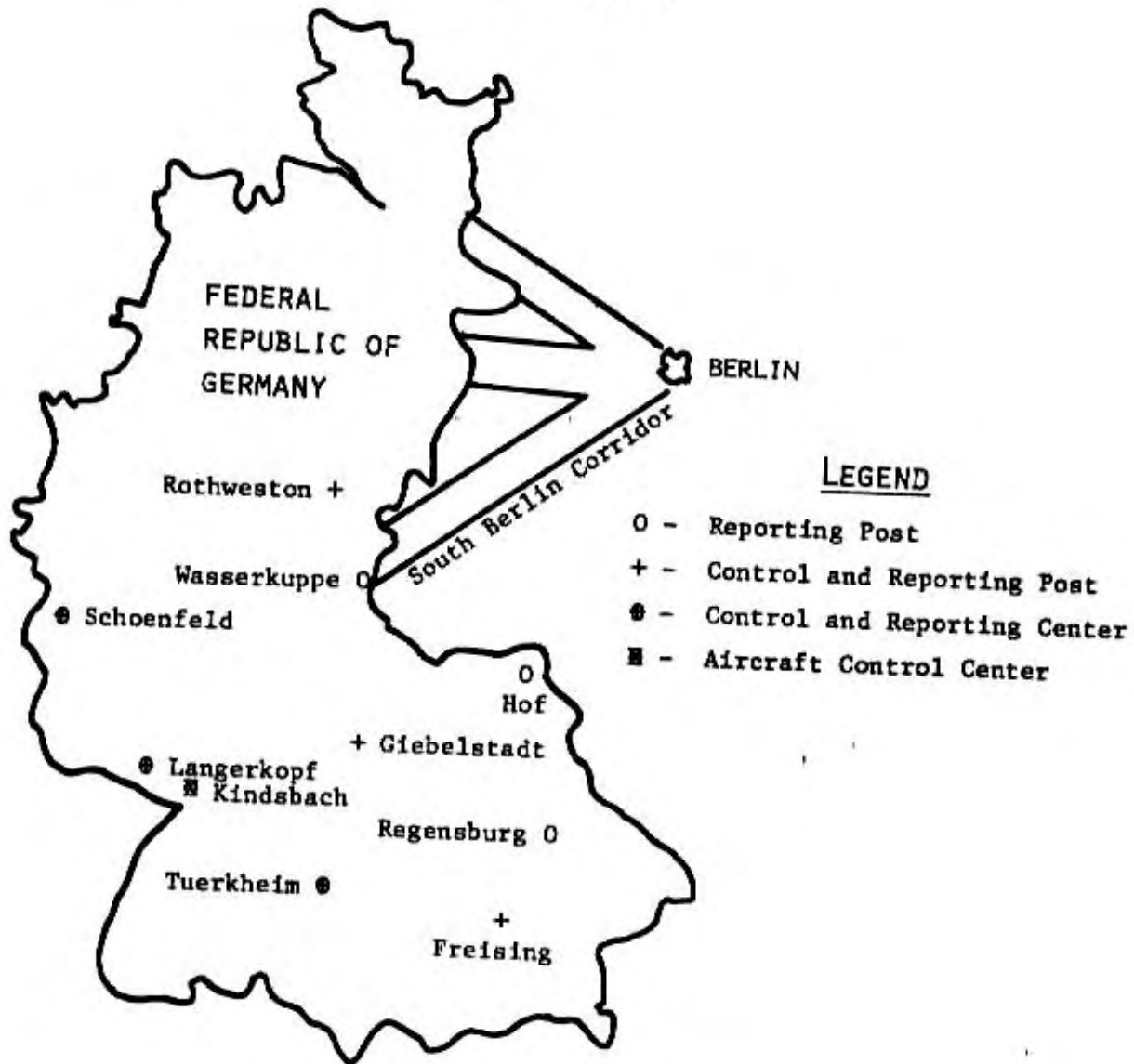
(U) Primary functions of reporting posts included radar surveillance and the acquisition of early warning information which aircraft controllers transmitted directly to their respective CRCs via telephone. Control and reporting posts did these same jobs plus an added aircraft control mission using radar intelligence and ground-to-air radios. Control and reporting centers performed these identical tasks and that of identifying targets, committing air defense, and supervising their respective CRPs and reporting posts. Also, centers had authority to scramble interceptor aircraft on identification missions. In turn, CRCs reported to the overall airspace managers at the Kindsbach aircraft control center. <sup>5</sup>

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(U) Figure I

**Manual Aircraft Warning and Control Sites  
(U.S. Only - 1958)****UNCLASSIFIED**

# INTRODUCTION OF THE 412L IN EUROPE

(5)

## THE PLANNING STAGES

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(U) This time-consuming manual network remained in use as the primary early warning and aircraft control system for southern Germany through 3 January 1965 while USAFE and the German Air Force (GAF) phased in the 412L semiautomatic radar system. The 412L equipment in a typical control and reporting center consisted of complex data processing computers, display consoles, and communications equipment. The primary elements included GPA-73 consoles (27/28 series) for surveillance and identification. Signals from these consoles flowed into

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an FSA-12 detector/tracker which converted raw radar returns into digital data which was then stored in the FSA-21 computer until needed for intercept computations. In this case, data proceeded to FSA-21 consoles (60 series) where controllers guided friendly interceptors against the intruding aircraft. Army controllers also operated FSA-21 scopes (63 series) as part of missile control activity at selected 412L stations. Both the FSA-12 detector/tracker and the FSA-21 computer fed inputs into a site-to-site data link for instantaneous transmissions to and from other 412L locations.\* Additionally, the 412L system included an FSA-23 jammer tracking module (with associated console) for detecting and tracking aircraft despite the presence of electronic counter measures (ECM). For communications with other sites, air bases, missile sites, aircraft, and command elements; the semiautomatic system contained an electronic switching center (ESC) telephone network. (The diagram on the next page graphically depicts the outlay of 412L equipment.) Also, though not specifically included in the 412L equipment inventory, search and height finding radars were an integral part of fixed radar operations. 7

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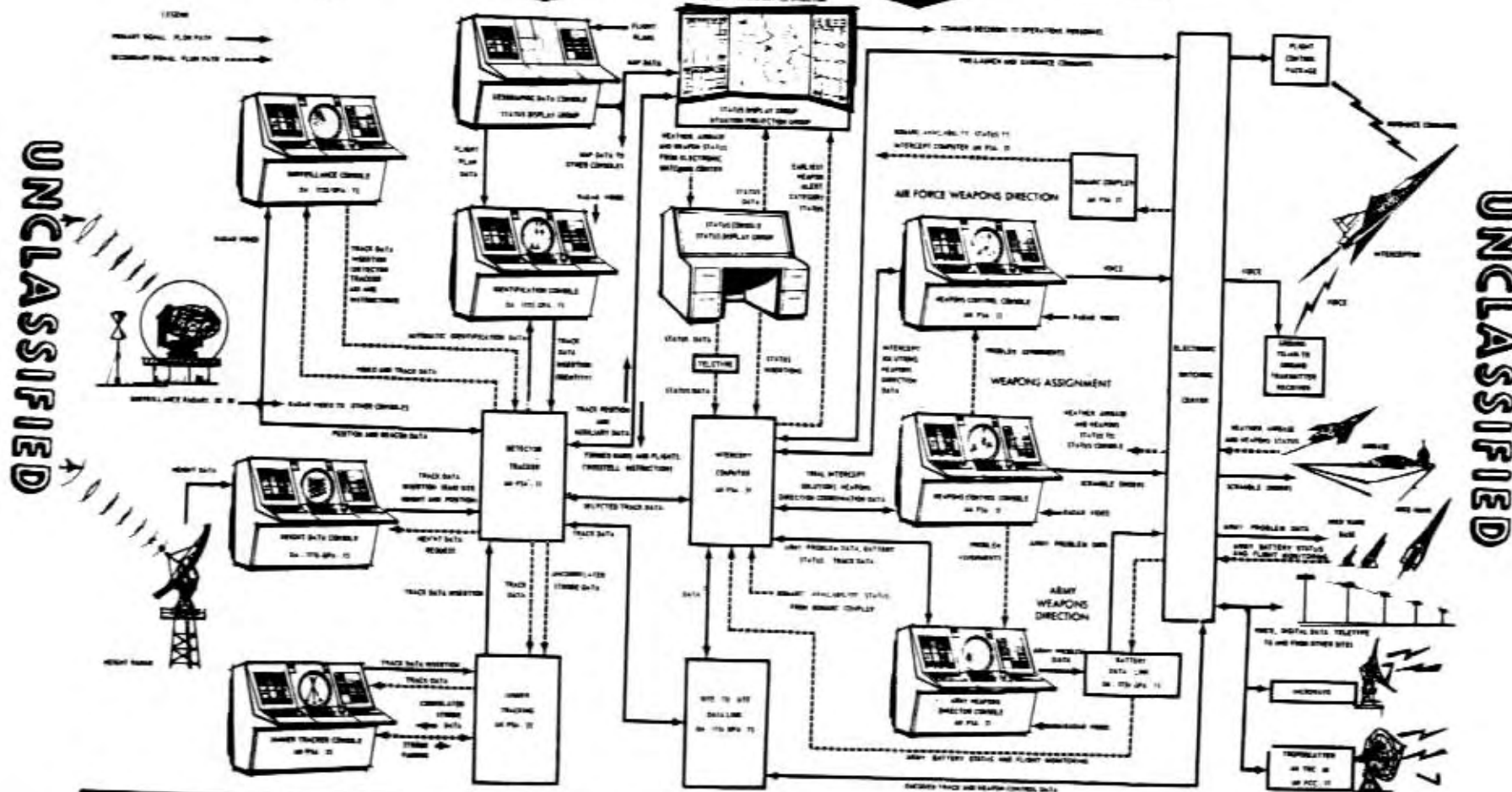
\* (U) System improvements in the late 1970s enabled the 412L sites to exchange signals with other types of radar systems within NATO channels. This topic is discussed more fully beginning on page 49.

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Figure II

412L System Equipment Outlay

SURVEILLANCE IDENTIFICATION WEAPONS CONTROL



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Figure III

412L Radar and Supporting Sites  
(1965 - 1980)

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(U) Through June 1962, the primary point of contact for solving 412L problems was the USAFE 412L Working Group which included representatives from USAFE staff agencies, Seventeenth Air Force, the 86th Air Division

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(Defense), NATO's Fourth Allied Tactical Air Force (4 ATAF),\* the GEEIA, and the 412L European Task Organization (ETO). The ETO was formed in September 1961 after the Seventeenth Air Force project officer suggested that the USAFE 412L Working Group was incapable of managing the system phase-in unless it became a full-time job. The Electronics Systems Division commander, Brig Gen Otto J. Glasser, subsequently recommended the formation of the 412L ETO to coordinate installation and implementation of the new radar system. After studying this proposal, the USAF weapons board approved it. <sup>12</sup>

(U) Officials from USAFE, Seventeenth Air Force, the Electronics Systems Division, Air Force Logistics Command, and GEEIA comprised the 412L European Task Organization. This organization participated in the 412L Working Group until mid-1962 when it became the primary contact point for 412L problems. The ETO had four specific tasks as outlined in a 12 March 1962 memorandum of agreement with USAFE: <sup>13</sup>

- coordinate the installation of GPA-73 and allied equipment, and integrate it with radars provided by USAFE and the GAF.

- insure the meeting of operational dates as specified in USAFE Operations Plan 131-61 (Red Ruby).

- determine that 412L equipment met operational requirements as established by USAFE.

- operate as an integrated organization for installing and checking out the equipment.

In the meantime, USAFE ensured the fulfillment of USAFE-GAF agreements pertaining to construction completion dates,

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\* (U) This NATO command was responsible for air defense activity in southern Germany.

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and made decisions and provided guidance on policy matters which affected 412L system capabilities.

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\* (U) During stateside testing, Air Force engineers found 412L components too fragile for mobility purposes. However, with certain modifications it was acceptable for fixed radar operations. The Tactical Air Command subsequently rejected the GPA-73 as part of its mobility forces. This left USAFE with the only operational 412L equipment worldwide.

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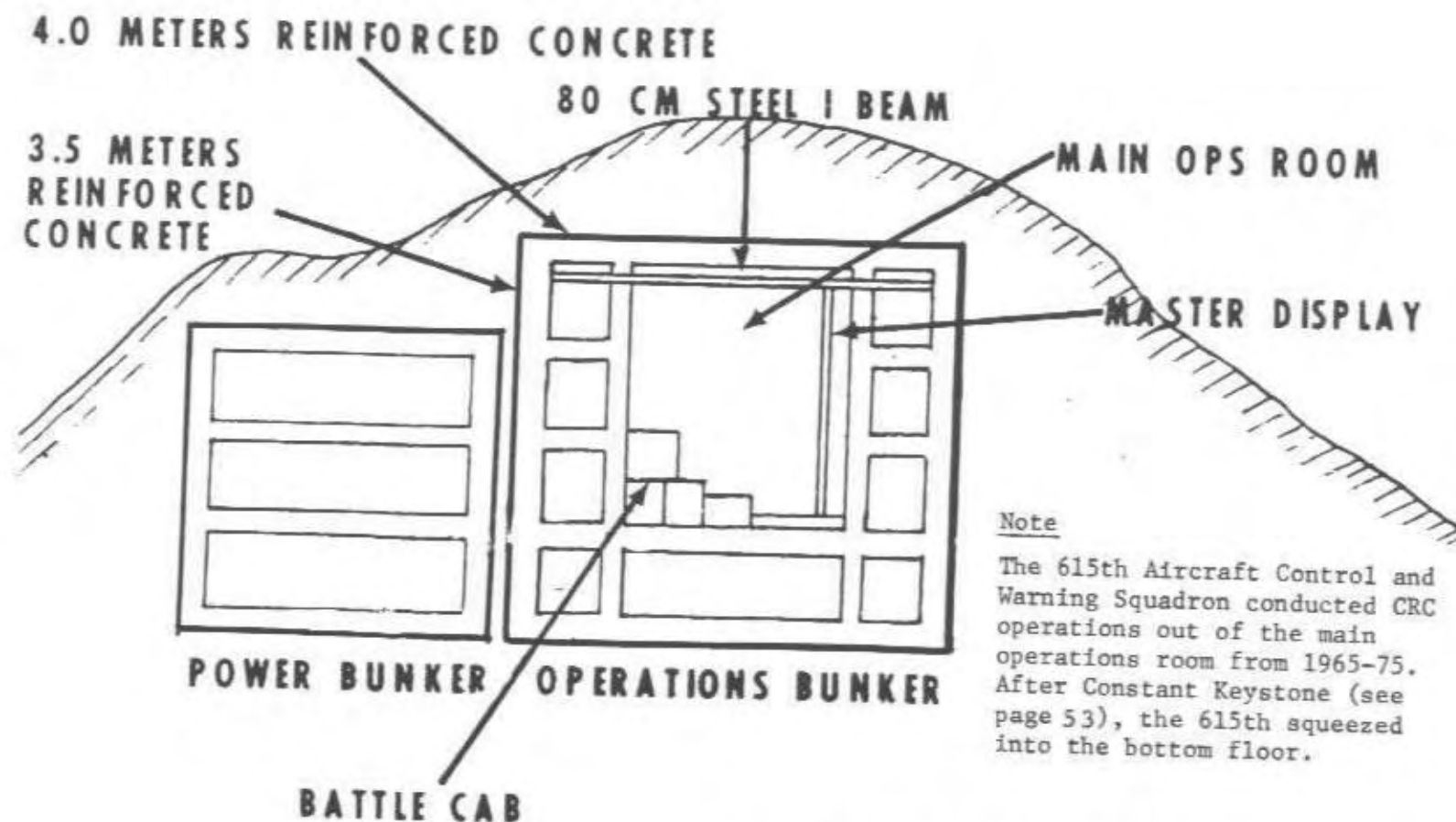
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Figure IV  
Cutaway View of the Boerfink Bunker

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CONTROL AND REPORTING CENTER

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TESTING THE SYSTEM

(U) The first of these tests involved an electronic checkout which ESD engineers performed on both single-site and multiple-site basis. This test was designed to align the system and verify whether or not it could electronically perform its intended functions. The second set of tests, called computer program design verification, were given to ascertain if the computer programs were adequate for the European theater. Finally, system turnover readiness tests (STRT) constituted a group of dynamic situations that determined if the 412L was capable of performing its operational mission. 25

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\* (U) Documents from 1963 cited this high number without further explanation. However, a single system modification could utilize 100 kits, or more.

\*\* (U) MITRE Corporation was a non-profit organization working exclusively for the United States government.

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(U) The direct construction and testing slippages had on USAFE and its subordinate units were noteworthy. Personnel trained specifically on 412L equipment began arriving in Germany during late 1962 but had no place to work. These assignments resulted from the first set of scheduling revisions (during the construction phase) which later proved optimistic. As a result, the 86th Air Division (Defense) declared them as "temporary surplus" and trained many of them to work with existing manual radar equipment. Others were offered for temporary duty at other USAFE bases. The command wanted to retain them in Germany for immediate reassignment to

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412L stations once operational. Another problem related to this involved the extension of manual operations at an extensive cost in manpower and money. This was absolutely essential since it remained the only aircraft control and early warning medium for southern Germany. Officials at the Air Force Systems Command estimated a budget override of \$14-15 million to complete the program. <sup>27</sup>

(U) As a result, USAFE and the Electronics Systems Division took energetic measures to keep the 412L project on its revised schedule once testing began. First, they limited air exercises to permit accelerated system testing. Next, USAFE programming guides were updated with strong emphasis given to a newly established 412L System Acceptance Task Force (SATAF). Finally, to clip soaring contractor costs, USAFE officials agreed to accept the five-site network at the completion of system turnover readiness tests provided there were no "major" problems. In addition, a more optimistic date for operational readiness was moved up to 15 August 1964. <sup>28</sup>

(U) On 2 July 1963, General Glasser visited USAFE from his headquarters at Hanscom Field, Massachusetts, to meet with USAFE officials for the specific purpose of setting a 412L testing schedule that could be met. According to the ESD commander this trip contributed as a major turning point of the program. Both sides agreed to accelerate system testing primarily by reducing operational exercises and by eliminating some scheduled maintenance which tended to pre-empt radar equipment from

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the 412L testing program.\* On 15 July 1963, Lt Gen R.M. Montgomery, Vice CINCUSAFE, advised General Glasser that USAFE would make every effort to meet ESD's objectives concerning the limitation of exercises and that he would make the same request of 4 ATAF. General Montgomery also pledged to keep radar overhauls to an absolute minimum. Finally, GE technicians would be pressured to increase maintenance efforts on the 412L equipment. <sup>29</sup>

(U) In return, General Montgomery asked General Glasser to minimize test schedule changes since it took 48 hours advance notice to task aircraft sorties for testing the 412L. The Vice CINCUSAFE also expressed concern over the pending system turnover readiness tests which would begin in December 1963. With regard to this vital phase, the general stated, "It appears that in spite of our objections, AFSC agencies continue to water down this phase of testing until we are no longer certain that the tests will indicate the system's ability to perform the required operational mission." He requested General Glasser's assurance that the 412L would perform as designed when turned over to USAFE. <sup>30</sup>

(U) Headquarters USAFE left the July-September 1963 period virtually free from scheduled exercises deferring numerous air operations to allow a long test period virtually free of interruption. However, on 29 August, Lt Gen C.E. McCarty, USAFE Chief of Staff, who was in charge of coordinating 412L business, advised the commander

---

\* (U) The manual and semiautomatic systems utilized the same radar equipment. Accordingly, when maintenance crews worked on this equipment, the 412L equipment could not be used except via site-to-site data links. However, most tests at this stage only involved individual radar sites.

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of Detachment 9, Electronics Systems Division, that USAFE could not continue to defer exercises while operational forces in the manual system needed training to remain proficient. He noted that exercise Lion Vert would take precedence over 412L testing for three days in September. In the second half of 1963 USAFE scheduled 990 aircraft sorties for the required tests with just 407 actually flown. Only 22 of the scheduled flights were aborted while General Electric's engineers requested cancellation of the others due to equipment malfunctions. 31

#### 412L SITE ACTIVATION TASK FORCE

(U) One of the most significant results of General Glasser's July visit was the agreement to form the 412L SATAF. This group had the authority and responsibility to coordinate efforts of all participating agencies to ensure timely completion of program objectives. On 16 August 1963 General Gabriel P. Disosway, CINCUSAFE, informed General Glasser; Lt Gen T.P. Gerrity, USAF Deputy Chief of Staff for Systems and Logistics; and Lt Gen H.M. Estes, Jr., AFSC Vice Commander, that he supported the intent and purpose of this new management team. Three days later CINCUSAFE informed General Estes that in spite of an Inspector General report which raised doubts of the 412L to perform its mission, "...we must press on with all possible speed to bring the system to an OR [operationally ready] state." To accomplish this objective, General Disosway designated General McCarty to "ramrod" 412L activity in USAFE. He also authorized the 412L SATAF commander free access to his deputies and chief of staff. With USAFE support in hand ESD officially established the 412L Site Activation Task Force at Wiesbaden Air Base

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on 1 September 1963. General Glasser assigned Col J.J. Dishuck to head this new function. On 1 September SATAF activated the Dynamic Action Management Operations (DYNAMO) office to provide a means for accelerating problem solutions. DYNAMO personnel focused on specific road blocks that normally delayed progress when standard administrative procedures and command channels were used. This office also recorded 412L programming milestones. <sup>32</sup>

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(U) Mounting 412L costs threatened a funding overrun of the entire program. The 412L SATAF informed General Gerrity during his November 1963 visit to Germany that GE had established a completion cost estimate that ran \$9.5 million over the 1964 and 1965 412L budget of \$12.5 million. The addition of the Berlin reporting post and the Giebelstadt overhead facility accounted for some of the excesses. But General Electric also had an estimated 669 employees working on the project in August 1963; the contractor felt this number of people was necessary to make the 412L operational at the earliest possible date. With CINCUSAFE support, General Gerrity advocated on 6 December 1963 that USAFE place military personnel into the acceptance and checkout program as quickly as possible. This would permit earlier phase-out of GE workers, reduce costs, and enhance the transition to a military operation. Furthermore, the 412L system program officer suggested the advancement of ESD's date for the full eight-site turnover from 15 October to 15 August 1964 by combining Freising and Messtetten into the same STRT phase. <sup>36</sup>

(U) These ideas were incorporated into a 412L program change dated 20 December 1963 and approved by Headquarters USAF in early 1964. The cost overrun was thus reduced by \$5 million. Another \$1.2 million savings resulted from GE's reduced equipment modification estimate.

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Overall, these total actions reduced General Electric's expected cost excesses to \$3.3 million compared to the original \$9.5 million approximation.<sup>37</sup>

### SYSTEM TURNOVER READINESS TESTS

(U) When 1963 ended, USAFE was still bound to take over the 412L upon ESD's completion of system turnover readiness tests. Nonetheless, General Disosway expressed certain doubts as to the system's potential reliability. With such apprehension he ordered the manual radars to remain on line for as long as it took the semiautomatic sites to prove reliable. As already noted, the STRTs were designed to confirm technical system capabilities when conducted under conditions closely simulating an operational environment. Plans called for the first five sites to undergo testing simultaneously for turnover on 15 March 1964. USAFE accepted the sites on this date, but the simulation of an operational environment was not achieved. In fact, few of the tests were completed successfully. These items were placed on waiver status for post-turnover clearance. The sites at Kindsbach, Boerfink, Wasserkuppe, Giebelstadt, and Doebraberg were turned over on 15 March 1964; and Freising on 15 April 1964.<sup>38</sup>

(U) The Electronics Systems Division assured USAFE that the system turnover readiness tests proved the 412L as technically operable assuming that operations and maintenance personnel did their jobs correctly. This was especially important since testing of the equipment in the United States had never been completed due to money and time limitations. Limited stateside tests also showed

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a definite lack of system performance. These facts made the STRT even more important in proving 412L reliability. USAFE officials adopted a wait-and-see attitude. <sup>39</sup>

(U) The USAFE staff worked with the 412L SATAF to provide a comprehensive test schedule which AFSC broke down into technical and operational phases. In yet another effort to reduce spending, operational tests were eliminated leaving just eight technical tests to prove reliability. Later, the 412L SATAF eliminated two of the tests which pertained to aircraft crossing each other's path, and low-altitude tracking through radar clutter. The SATAF contended that these capabilities would be demonstrated during other tests. The tests that did occur were conducted in a closely controlled, near-laboratory environment. They were done with a minimum load of 12 targets during tracking tests, and six targets with 10 interceptor aircraft during the interceptor tests. However, the majority of interceptor aircraft were simulated as self-generated sorties within the computer. Tracking evaluations consisted of straight-line flight paths with one 90 degree turn, one 60 degree turn, and one 45 degree turn. Some targets also flew triangular "emergency" patterns and elliptical "hold" patterns. During intercepts all targets flew on a straight line with constant velocity and altitude except one which descended from high to low altitude. This latter target was never intercepted. Electronic counter-measure testing was performed with one aircraft repeating the tests a number of times. Results progressively improved throughout the test period with some intercepts totally successful including the return-to-base phase. Of importance, one successful run occurred after the ultrahigh frequency (UHF) radio in the aircraft

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failed. The entire mission was accomplished by time division data link (TDDL) control only. Such tests provided both operators and maintenance personnel with valuable training experience. <sup>40</sup>

(U) As a result of these tests, USAFE officials believed that adequate performance of the weapons control program using two different computer programs was repeatable. Interceptor correlation by automatic IFF/SIF (identification friend or foe/selective identification feature) procedures also improved. The surface-to-air missile checks were also satisfactory communications interruptions between the weapons assignment officer and the fire unit being the main problem. One component, proved to be completely useless and beyond maintenance, was a large geographic data display. With intensive attention by GE's experts, the display only worked in a satisfactory manner over short spurts. However, during testing periods the equipment malfunctioned too often making it virtually useless. Officials at AFSC agreed that the display was inadequate and decided not to turn it over to USAFE when the other testing was completed. Many people felt this display was a bonus item and that its removal would not hamper air defense operations. <sup>41</sup>

(U) Tracking was one of the main difficulties during system turnover readiness tests. Though tracking stability improved, controllers experienced variations in aircraft velocity from 50 knots to 3,000 knots and heading vectors off up to 60 degrees. These discrepancies all occurred on straight-line, constant velocity flights. Sometimes, track dots on the scopes jumped to other

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positions for no apparent reason. Since this occurred on both targets and interceptors, intercept points provided from the FSA-21 computer often varied radically. Almost constant manual override was needed on the majority of the tracks imposing a great workload on surveillance personnel. <sup>42</sup>

(U) Also, the emergency SIF false alarm rate was high at eight per hour versus the desired zero. This meant the 412L would be subject to false emergency "squawks" at the rate of one every seven or eight minutes. Each situation could be verified manually, but the rate was still not satisfactory since it precluded adequate attention to valid emergencies. <sup>43</sup>

(U) Obviously, there were many problems which had to be worked out before the 412L could replace the manual radars. Although turned over to USAFE, the system did not possess a total operational capability by mid-1964. Many of the problems were solved during day-to-day operations; but some self-imposed and NATO live exercises were also testing grounds. General Electric personnel corrected most problems at the first six sites while the Electronics System Division continued testing at Mess-tetten. Final elements of the 412L Aircraft Weapons and Control System were turned over to USAFE on 10 August 1964--five days ahead of the revised schedule. After turnover, USAFE Programming Plan 561-64 implemented an operational evaluation and training program to form the 412L sites into a fully operational system. This program revealed additional shortcomings, but most of them were minor in nature and correctable with engineering assistance furnished by the ESD 412L field office. <sup>44</sup>

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(U) Although some 125 deficiencies in the system still existed in December 1964, USAFE officials felt they were minor in nature and would not hinder the air defense operation. Therefore, General Disosway established 4 January 1965 as the date the 412L Aircraft Warning and Control System would assume the air defense mission for the 4 ATAF region in southern Germany. As prescribed, the manual system remained on line as a back-up until 4 March 1965. During this 60-day period, the staffs at the 86th Air Division (Defense), Seventeenth Air Force, and United States Air Forces in Europe were satisfied with the performance of the semiautomatic radars. As a result, manual operations at Hof, Pruem (Schoenfeld), Langerkopf, Freising, Wasserkuppe, and Giebelstadt were discontinued.\* The sites which had both manual and semi-automatic systems simply phased out the older equipment. However, USAFE terminated operations at Pruem and Langerkopf turning those sites over to USAREUR. The following chart depicts the organizational alignment of the USAFE controlled radar stations as of 4 January 1965:

| <u>Unit</u>  | <u>Functions</u> | <u>Location</u> |
|--------------|------------------|-----------------|
| 602d AC&WS** | CRP              | Giebelstadt     |
| 604th AC&WS  | CRC/MCC          | Freising        |
| 606th AC&WS  | RP               | Doebraberg      |
| 615th AC&WS  | CRC/MCC/SOC      | Boerfink        |
| 616th AC&WS  | CRP              | Wasserkuppe     |

\* (U) On 29 October 1964, the 601st Tactical Control Group was activated. The mobile radar units of this group later served as back-ups to the fixed sites.

\*\* (U) Aircraft Control and Warning Squadron.

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### THE BERLIN CONNECTION

(U) An interesting sidelight on the development of the 412L within Europe involved radar operations in the isolated city of Berlin. Each of the four major Allied powers (United States, Great Britain, France, and the Soviet Union) occupied a portion of Germany and its capital city following World War II. The situation in Berlin soon irritated the Soviets because the city was located in the heart of their zone. In an effort to reunite Berlin through submission, the Soviets imposed a blockade in 1948 that closed off all land access routes into Berlin. The United States and Great Britain responded with a constant flow of aircraft into the city to deliver food, coal, and other necessities until Russia removed its blockade in mid-1949. Radar stations in both West Germany and Berlin helped insure that aircraft remained on course within Berlin's air access corridors.<sup>46</sup>

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## RADAR TRANSFERS TO GERMAN AIR FORCE

THE MANUAL SITES

(U) There have been several references of shared responsibilities between German and American air forces regarding the construction of 412L facilities. Until 1959 USAFE owned and operated all nine manual radar sites in southern Germany. But in mid-1959, at about the same time that initial 412L programming plans were completed, the CINCUSAFE and Germany's Federal Ministry of Defense (FMOD) finalized an agreement calling for the transfer of six manual sites to the German Bundeswehr (Armed Forces). Both sides negotiated in the light of SHAPE planning document 54/1, an amendment to the original NATO air

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defense policy directive. The amendment stated, in part, that early warning radars should be a host-nation responsibility. The agreement specified the Tuerkheim would be turned over within 45 days of the document signing and Regensburg 45 days later.\* The transfer of the remaining sites at Hof (later Doebraberg), Wasserkuppe, Freising, and Giebelstadt pended further negotiation. The overriding factor influencing subsequent transfers was the training of German controllers since there was to be no loss in air defense capability. The German Minister of Defense (MOD), Franz Josef Strauss, signed the document at Bonn on 19 July 1959, and CINCUSAFE, General Frank F. Everest, followed suit at Wiesbaden Air Base two days later. It would be almost 20 frustrating years later, on 1 January 1979, when the German Air Force took over Wasserkuppe to complete the accord. <sup>53</sup>

(U) Headquarters USAFE intended to transfer the radar stations in two phases. The first period involved the two sites specifically stated in the contract. The command fulfilled this commitment by turning over Tuerkheim on 10 September 1959 and Regensburg on 4 November 1959. However, USAFE retained operational control of the stations until the Germans demonstrated a capability to fully operate them. Accordingly, USAFE kept some 65 personnel at Tuerkheim to assist German controllers and maintenance personnel in establishing an effective instructor cadre. The site was removed from the active air defense net, but remained on call as a backup while serving as the formal training school for German controllers. Regensburg remained active with both USAF and GAF controllers through most of 1960. In September USAFE

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\* (U) Refer to the map on page 5 for the locations of nine manual radar sites.

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administered a tactical evaluation of the German controllers. They passed and operational control was given to the GAF on 1 November 1960. Still, eight American advisors remained there providing technical aid and advice to newly trained controllers and maintenance personnel. <sup>54</sup>

(U) Although the transfer agreement left out specific turnover dates for the remaining stations, USAFE had hoped to transfer them at the earliest possible date. The German Air Force left little hope for the fulfillment of this objective when it proposed in December 1959 to stretch it out through 1965. This was based on a high percentage of one-year German Air Force conscripts that made it difficult to maintain a sufficient number of trained personnel to operate the radar stations. Headquarters USAFE later worked out a verbal understanding with the Germans to transfer Freising and Hof in 1960, and Wasserkuppe and Giebelstadt the following year. However, the GAF later made a formal request to the USAF Chief of Staff that it take over Freising only at the end of 1960 and to postpone the others until 1964. On 13 April 1960, GAF and USAFE officials met to clarify their positions. Basically, the Germans reemphasized their expected shortages in trained personnel. But USAFE representatives pointed out that 412L construction projects at Giebelstadt, Doebraberg (Hof), and Wasserkuppe had already been cancelled based on the earlier verbal agreement and that the deferment would now impact 412L progress. <sup>55</sup>

#### FREISING

(U) Subsequent meetings over the next three months resulted in a German Air Force commitment to receive

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Freising at the end of 1960. In addition, the GAF would assume all operations and maintenance funding for the other three sites beyond 1962. The two air forces also established a joint working group to resolve problems involving future transfers. The group held its first meeting in Bonn on 3 June 1960 at which time the Freising transfer occupied most of the agenda. Conferees also determined that USAFE would again fund 412L construction projects at Giebelstadt, Hof, and Wasserkuppe in view of GAF plans to build a \$25 million bunker for the CRC at Messtetten.<sup>56</sup>

(U) Following this meeting the GAF started gradual assignment of personnel into Freising's manual operation. By December 1960 enough controllers had arrived for USAFE to conduct a tactical evaluation. After successfully completing this inspection, the German Air Force took over the site with complete tactical control on 4 January 1961. NATO's 4 ATAF retained operational control. This was the first turnover of a site that would eventually have 412L operations. But this site takeover only applied to the manual equipment. A second transfer involving the Freising 412L operation took place in 1965.<sup>57</sup>

(U) In the years following the first transfer of Freising, it became apparent the USAFE and GAF officials viewed the 1959 transfer agreement differently. The Germans felt it applied only to manual sites, while USAFE contended that it applied to all sites; USAFE expected the GAF to takeover the complete 412L system (except Berlin) at the earliest possible date. During 1962 and 1963 the German Air Force was content with training sufficient controllers to operate the Messtetten CRC in its entirety and Freising as a joint operation.

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Due to space limitations and language differences at 412L schools in the United States, very few GAF personnel attended them. Thus the training process was not only slow but depended totally on USAFE augmentation at Freising during the first year of its operation. Considerable progress was made throughout 1965 until the GAF finally assumed control of the Freising CRC on 15 December 1965. <sup>58</sup>

(U) According to the 1959 transfer agreement and subsequent amendments to it, the German Air Force had an option to purchase USAFE-owned equipment at each of the transferred sites. For unknown reasons the GAF chose to buy radar and communications equipment at Freising but not the GPA-73. As a result USAFE was left responsible for custodial and supply support on this equipment. The American command set up an operational location that first operated under the 86th Air Division (Defense) and, after 1968, the 601st Tactical Control Wing. This set a precedent which was followed for the next two transferred sites. <sup>59</sup>

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(U) The Germans opened the Lauda bunker as a reporting post on 1 September 1968. Over the next seven months, responsibilities there increased until Lauda assumed full control and reporting center operations. When it advanced to control and reporting post status on 1 December

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\* (U) See pages 35-38.

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1968, the 602d Aircraft Control and Warning Squadron was discontinued at Giebelstadt. <sup>62</sup>

(U) In conjunction with this move 4 ATAF also wanted to move the Giebelstadt overhead facility which had since been renamed the System Program Analysis Test Site (SPATS). Through 1967 it was planned to move SPATS into the new Lauda bunker. But this facility was only two-thirds the size of Boerfink. On 27 January 1968, limited space plus air conditioning problems at Lauda prompted an FMOD request to move SPATS to Boerfink. Approving this move, 4 ATAF subsequently transferred the Sector Operations Center to Kindsbach where it remained through 1980. <sup>63</sup>

#### DOEBRABERG AND WASSERKUPPE

(U) For seven years following 1967 both Germany and the United States continued to operate three fixed radar facilities in southern Germany. All other air defense radars throughout NATO, including those in northern Germany, were strictly a host nation responsibility. Until 1972 the United States continued to accept the German Air Force logic of personnel shortages for not taking over the remaining sites. But in that year USAFE officials began to take a harder look at the situation and came to realize the Germans possessed sufficient personnel with experience and skills to operate the entire system. Accordingly the German Air Force offered to take over just one more site--Boerfink--by December 1974. This proposal was made in the context that Germany be relieved of taking over the other two sites. <sup>64</sup>

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(U) On 4 October 1972, a newly appointed Minister of Defense, Georg Leber, met with Secretary of Defense Melvin Laird in the United States. One of the topics covered during this courtesy visit was U.S. dissatisfaction over delays in transferring 412L stations to the GAF. Prior to this meeting, the United States Commander-in-Chief Europe (USCINCEUR) suggested that Secretary Laird propose the German takeover of both Wasserkuppe and Doebraberg by December 1974 and leave Boerfink operations under USAFE. This was most advantageous to the United States because Doebraberg and Wasserkuppe were remote sites on the East German border causing unique support and morale problems. Furthermore, Boerfink was the master control and reporting center (MCRC) in southern Germany and supervised the rest of the 412L system. As such the United States had to retain a certain number of personnel there to make peacetime decisions that agreements between the United States, Soviet Union, France, and Great Britain prohibited Germany from making. For instance, German air weapons controllers could not commit a weapon (aircraft or otherwise) to fire against an airspace intruder before a certain phase of war was reached. Also, they could not order the scramble of nuclear-armed aircraft or missiles.\* <sup>65</sup>

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(U) On 5 October 1972, the Germans shifted position after a meeting between the USAFE deputy chief of staff for operations (Brig Gen W.L. Creech) and two German generals (Heinz and Monreal) in Bonn. The GAF now agreed to assume full responsibility for Doebraberg "as rapidly as possible" but no later than 31 December 1974. In addition, the Germans would accept Wasserkuppe at an unspecified later date. When USAFE officials looked at the situation strictly from the German viewpoint, they saw there was little incentive to speed up the process. Indeed, Germany reaped full benefit of American facilities at United States' expense. <sup>67</sup>

(U) The German Air Force accepted Doebraberg on 1 July 1974 after a six-month phase-in period. The 606th Aircraft Control and Warning Squadron inactivated on this date. However, the Germans again refused to purchase GPA-73 equipment so the 601st Tactical Control Wing had to establish a three-person operating location there to provide liaison, supply support, and equipment custodialship. <sup>68</sup>

(U) The situation was somewhat different at Wasserkuppe as the Germans remained reluctant to take over its

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operation. In early 1975 US FE announced plans to inactivate the 616th AC&WS on 1 July 1975. But as this date approached USAFE instead received 4 ATAF approval to downgrade the site from a CRP to a reporting post. This reduced 52 manpower authorizations with most slots coming out of the operations area. This action made it easier to negotiate the site turnover. In the meantime, the German Air Force was beginning plans to replace the now aging 412L equipment with the more modern German Air Defense Ground Environment (GEADGE) system beginning in 1980.\* Subsequently, talks between the representing military commands of the two nations finally resulted in the turnover of Wasserkuppe and inactivation of the 616th AC&WS on 1 January 1979. However, the United States would provide contractor maintenance there until the site began a complete GEADGE operation sometime in 1983.\*\* The contractor provided its own supply support so there was no need to establish an operating location there. <sup>69</sup>

## 412L ACTIVITIES IN THE 1970'S

### SYSTEM MANAGEMENT

(U) During the hand over of fixed radar stations, management for the overall system gradually degraded. Looking back, the 86th Air Division (Defense) served as the single manager of the 412L system from 1964 through 1968. But, in 1968, the air division fell prey to one of many USAFE manpower reductions caused by a Congressional order to reduce military spending. On 14 November the 86th Air Division (Defense) was inactivated with 412L operational responsibility transferred to Seventeenth Air

\* (U) See page 62.

\*\* (U) See page 57.

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Force; the 601st Tactical Control Wing gained maintenance responsibilities. In addition, the German control of Lauda beginning in late 1968 made the 2d Air Division of the German Air Force more active in the control of the system. In effect, central system management was eliminated. 70

(U) Management became further fragmented in 1972. Personnel reductions on the Seventeenth Air Force staff prompted a change over of operational responsibilities to the 601st TCW. But, the wing only had national authority over its own elements. Various management functions were divided among staffs at 4 ATAF, USAFE, SOC III, German Air Force Tactical Command, 2d Air Division (GAF), Seventeenth Air Force, and the 601st TCW. Actions taken by these various echelons of command often conflicted adversely affecting overall air defense management. 71

(U) The status of the 412L system was a matter of mutual concern from 1968 through 1972. Despite efforts to coordinate management decisions, degradation of the system continued. This unfortunate circumstance resulted in the formation of a 412L "Peaking Team" in early 1973. Comprised of both USAFE and GAF technical experts, the objectives of this team were: (a) to determine the current status of the 412L system; (b) document their findings; (c) develop appropriate corrective actions; and (d) implement restoral actions at each site. Their findings at Boerfink, Wasserkuppe, and Lauda confirmed the suspected troubles. Over the years there had been a subtle degradation of the system which resulted in

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site registration errors,\* data links that did not function as expected, and overall less than optimum performance throughout the system. In addition, lack of central control and standardized maintenance procedures was evident. Based on these findings, GAF and USAFE officials agreed to establish a joint system management effort. <sup>72</sup>

(U) This agreement, which went into effect 9 October 1973, established a common structure for 412L system management and formally established Programming Center Birkenfeld (PCB) as a bi-national activity to provide guidance and procedures for operation, maintenance, logistics, management, and personnel training required for 412L equipment. In addition, the PCB absorbed the functions of the System Program and Analysis Test Site. The joint agreement also formed two new management agencies. The 412L Steering Committee consisted of two colonels representing the USAFE staff and the German Federal Ministry of Defense. This committee managed all common air defense tasks within SOC III jurisdiction except those specifically under NATO control. The other agency was the 412L Joint Direction Staff (JDS) and served to implement steering committee decisions and directives. There were four voting on the JDS including American officers from Seventeenth Air Force and the 601st Tactical Control Wing, and Germans from the 2d Air Division and the GAF Tactical Command. Specific responsibilities of this staff included:

- continuation of the 412L Peaking Team.
- establishment of computer software configuration control board procedures.

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\* (U) Site registration errors meant that when one site identified an aircraft at one location on the consoles, other sites would show it at different locations.

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-- development of an on-going radar quality control program.

-- supervision of engineering studies of air defense communications links.

-- assumption of responsibility over Programming Center Birkenfeld.

-- providing a permanent management activity.

Meetings of the JDS were attended by all American and German military organizations which had a hand in 412L operations. 73

(U) Another key provision of the 1973 agreement authorized the formation of a technical advisory staff to assist the Joint Direction Staff. After a few JDS meetings, which took place at six-week intervals, it was apparent that a full-time 412L management activity was required. Accordingly, on 31 January 1974, the JDS proposed the activation of the Joint System Management Group (JSMG) to provide responsive management for the entire system. On 19 February, the Seventeenth Air Force commander, Maj Gen John C. Giraudo, authorized 601st TCW staff members to meet with 2d Air Division officials to develop an agreement on the formation of this group, but not to commit U.S. personnel or funds without USAFE approval. On 1 October 1974 the JSMG became a reality with 40 percent American manning and the rest Germans. Detachment 1, 601st Tactical Control Group was activated at Birkenfeld to provide personnel for both the JSMG and Programming Center Birkenfeld.\* 74

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\* (U) The 615th Aircraft Control and Warning Squadron previously provided manning for the PCB.

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SALTY NET

(U) Shortly after the 412L took over air defense warning and control responsibilities in the 4 ATAF region on 4 January 1965, six semiautomatic radar sites also became operational in the 2 ATAF area with one station in Belgium, one in the Netherlands, and four in northern Germany. Together these sites were called NATO Air Defense Ground Environment or NADGE. Each site was configured similarly to the 412L sites with data display consoles, detector/tracker sets, electronics switching center communications, and site-to-site data links. The heart of this Hughes Aircraft-built system was the HM-3118 computer. NADGE and 412L data links were compatible to allow an exchange of radar intelligence between the two. Also in the early 1960s, USAFE introduced a mobile radar network called the 407L to provide tactical control for offensive forces, and a limited air defense capability in either a garrisoned or deployed configuration. Over the first several years the 407L used manual radar processing equipment. By 1973 the largest mobile units, called control and reporting posts, had received a semiautomatic capability with the addition of TSQ-91 mobile operations centers and their Hughes Aircraft HM-4118 computers. The mobile CRPs also possessed site-to-site data links but they were not compatible with the fixed systems. There were five such CRPs throughout Germany following expansion of 407L operations into northern Germany in 1976-77. Additionally, USAF developed an airborne warning and control system (AWACS) radar in the early 1970s that would further strengthen command and control of NATO forces in the 1980s. Obviously, commanders at war headquarters

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locations such as SOC III would reap great benefits if data from all three systems could be integrated into a single display. <sup>75</sup>

\* (U) This was a different AAFCE than the AAFCE that existed from 1952-1967. This NATO echelon was established on 28 June 1974 and, in effect, combined 2 ATAF and 4 ATAF into a more unified fighting force. The CINCUSAFE served as commander AAFCE (COMAAFE) in a dual-hatted role.

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(U) The Salty Net Buffer package was about the size of a typing table with a teletype console on top.\*\* The unit matched up different computer message formats and transmission speed rates so they could be transmitted between sites regardless of origin. The first 4 P1-CP2 computers arrived in Germany in early October 1976 and testing started almost immediately. In the first test the 603d Tactical Control Squadron (407L) at Sembach Air Base linked with the Lauda CRC (412L) from 6-10 October. Next, the 603d tied into the NADGE site at Uedem, Germany, from 18-21 October. All three radar stations were united for the final testing phase from 25-29 October. Test results proved favorable pointing to an early operational

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\* (U) This was the same type of computer already in use within the TSQ-9L mobile operations center at the CRPs.

\*\* (U) The actual computer was a suitcase-size commercial item that had been adapted for military use. Some 400 of them were in use throughout the Air Force during this time.

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date. Four mobile CRPs received Salty Net Buffers over the next few months and became operationally ready in this configuration on 29 January 1977. 78

(U) In the meantime, Electronics Systems Division officials asked USAFE to eliminate testing between the AWACS and the second 4 Pi-CP2 computer based on their completed modification of the message processing center. Headquarters USAF approved this plan revision because it would cause only minimal delays while saving some \$2 million in the Salty Net project. The revised second phase moved forward in 1977. In-place buffers were connected with MPCs by June 1978 completing the interface. Nonetheless, Salty Net was not yet completed since a computer program change (or software adjustment) would allow the MPC to perform the task of the first 4 Pi-CP2 computer thus eliminating an excess piece of equipment. With this modification radar interoperability would depend on just one interfacing system. The 609th TCS at Bad Muender conducted MPC tests with the software change from 18 September through 15 November 1978 interfacing with as many as two NADGE and two 412L stations simultaneously. These tests proved successful except for minor computer program difficulties. The Electronics Systems Division returned the program to Hughes Aircraft for needed corrections. After completing these changes the message processing centers took over the complete interoperability tasking on 1 October 1979. After a brief period the Salty Net Buffers were returned to the Air Force Systems Command for disposition. 79

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(U) Constant Keystone had a major impact on the aircraft warning and control system. Before this program, three 412L agencies operated out of the Boerfink Bunker. These included the master CRC, an alternate sector operations center, and Programming Center Birkenfeld. The MCRC occupied the upper three floors of the underground, four-story complex; while the alternate SOC occupied a few offices in this area. The programming center worked out of the bottom floor. After Constant Keystone the master control and reporting center remained in the bunker with most of the same equipment. However, smaller status display boards were installed because the larger ones in the old operations area (a large two-story room) would not fit on the bottom floor where it was moved. The 615th AC&WS also moved its administrative function to Neubruecke because there was not enough room for it. Finally, the PCB and the alternate SOC transferred their operations to nearby Heinrich-Hertz Kaserne at Birkenfeld.\* 82

(U) Before the alternate SOC could function on its own away from the bunker, it needed an FSA-12 detector/tracker set plus consoles to display the sector aerial situation. There were no extra ones anywhere in the world. One proposal the 601st TCW staff developed involved the transfer of certain equipment from the CRC to the alternate SOC and downgrading the 412L operation at Boerfink to that of a reporting post. The wing staff also suggested leaving the back-up SOC within the bunker and moving the radar unit to Birkenfeld. However,

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\* (U) The German Air Force's 2d Air Division, which supervised the German-operated 412L sites, was located here. The division commander also served as alternate SOC commander.

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Headquarters USAFE did not agree and instead requested the removal of the FSA-12 from the 412L maintenance school at Keesler Air Force Base, Mississippi, for use at the alternate SOC. Headquarters USAF approved this since most 412L maintenance was being contracted out.\* 83

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\* (U) See page 57.

\*\* (U) Amounts in millions of dollars.

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(U) Meanwhile, certain aspects of Constant Keystone advanced. The 615th Aircraft Control and Warning Squadron ceased operations in the bunker on 2 July 1975 to remove 412L equipment and store it at the Hanbollenbach Army Depot. To stay operational the unit set up manual UPA-35 consoles in a GAF-owned warehouse on Erbskopf mountain adjacent to the radar sensor equipment. Operations in this configuration started 18 July 1975. Although the unit could not perform MCRC functions in a manual mode, the 615th AC&WS did operate as a CRP with 412L interface via the voice net. The transition from semiautomatic to manual operations created a need for new operating instructions (OIs) and lesson plans for training purposes. The 615th AC&WS recinded 25 sets of OIs and rewrote 35 others. The unit also updated 32 lesson plans and developed 10 new ones. 85

(U) With the temporary closure of the Boerfink Bunker, the 615th AC&WS relocated most of its master functions to the Messtetten CRC. The MCRC provided ground environment system management over the 412L system by implementing tactical decisions made by SOC III commander. Specific duties transferred to Messtetten included weapons allocator, master display controllers, master identification officer, system technical director, and system master controller. The Kindsbach SOC absorbed master scheduling duties. The 615th did not altogether give up these tasks but instead sent personnel to each location on a rotating schedule. The unit provided eight

  
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crews (15-17 people) at Messtetten. Augmentation at Kindsbach involved just four air weapons controllers. 86

(U) With manual control operations and 615th augmentation well under way, plus U.S./German financial matters resolved, construction finally started in February 1976. The bunker was completely gutted by June when reconfiguration began. Four months later the project progressed to where installation of certain electronics equipment could begin. On 10 June 1977, NATO accepted the bunker as AAFCE's Static War Headquarters. 87

(U) Installation of 412L components back into the bunker progressed more slowly. By mid-August 1977 the master control and reporting center was finally ready for operational acceptance evaluations to ensure system capability. These tests yielded satisfactory results. An environmental inspection team from Hahn Air Base evaluated the new working area on the bottom floor to determine whether or not conditions had become cramped. Floor space was found within acceptable standards. By the end of September 1977 the 615th AC&WS ceased personnel augmentations and restored its own MCRC operation. 88

#### CONTRACTOR MAINTENANCE

(U) From the beginning of 412L operations in 1965 through 1974, active duty military personnel maintained equipment at American 412L sites. This was finally viewed as a waste of valuable resources since the 412L was never installed anywhere else in the world. In a cost-reducing effort USAFE requested that the NATO Air Material Supply Agency (NAMSA) at Capellan, Luxembourg,

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administer contract maintenance services at Wasserkuppe beginning 1 October 1974 on a test basis. The 601st TCW paid for the contracted services through this agency. NAMSA contracted Philco Worldwide Services of Willow Grove, Pennsylvania, for the job of maintaining USAF-owned 412L and radar assets at Wasserkuppe. Philco assigned 34 civilians to replace 88 military people without affecting the operational mission there. This was possible because civilians worked strictly within their specialty while active duty personnel had numerous work interruptions like work details, additional duties, and 30 days annual leave. To the contrary, Philco employees with the company more than two years got just 10 vacation days annually. Military maintenance personnel remained at Wasserkuppe through the end of 1974 while Philco gradually assumed full maintenance duties. During 1975, NAMSA awarded two additional contracts. On 1 May, the Sacramento Air Logistics Center turned over program depot maintenance (PDM) after determining it was cheaper than conducting its own program. The depot funded this portion of the contract. Then on 1 October, Philco took over the consolidated intermediate maintenance facility at Sembach Air Base. <sup>89</sup>

(U) The United States Air Forces in Europe continued using NAMSA as a "middle man" for the 412L maintenance contract through September 1977. However, USAFE concluded this arrangement on 1 October due to conflicting NATO and USAF procurement regulations. At USAFE request the NAMSA staff had already written two additional contracts adding Boerfink and Kindsbach. Before new contracts were signed, USAFE interceded turning the contract over to its own contracting office. This office combined separate 412L

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contracts into the 412L Omnibus Maintenance Contract and awarded it to Aeronutronics Services Corporation effective 1 October 1977.\* This agreement covered two years plus a USAFE option on a third year. The 601st Tactical Control Wing established a 412L maintenance contract monitor position to ensure full terms of the contract would be met. 90

(U) Over the first several months of the omnibus contract, Headquarters USAFE and the 601st TCW viewed contractor performance as satisfactory. Had it not been for the pending transfer of Wasserkuppe to the German Air Force at the end of 1978, this unofficial rating would have continued. But the Germans requested a technical radar evaluation as a prerequisite to taking over. The purpose of the evaluation was to determine maximum 412L capabilities at that site. It started on 14 July 1978, but was cancelled ahead of schedule on 13 August 1978 because radar equipment did not meet technical order specifications. Repeated deficiencies pointed directly toward ineffective maintenance and management procedures. Problems were further complicated by the on-site contract monitor's failure to report known equipment failures to proper authorities. The director of maintenance at the 601st TCW (and 412L JDS representative), Col Robert L. Curry, removed this monitor from his position on 18 August 1978. 91

(U) As an added measure the 412L contract manager at the 601st TCW, Mr. Lyle E. Herbaugh, issued the Aeronutronics Services Corporation (ASC) a "cure notice"

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\* (U) Aeronutronics Services Corporation was a new name for Philco Worldwide Services.

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on 22 August 1978. The contractor was given 30 days to correct deficiencies in the following areas: (a) technical skills; (b) training program; (c) radar workcenter management; (d) quality control; and (e) performance of radar equipment at technical order standards. The 601st TCW sent a team of experts headed by Mr. Herbaugh to monitor corrective actions and ensure that all 412L equipment worked according to specifications. By 21 September 1978, all equipment affected by the cure notice was tested and accepted except those items which needed parts (i.e. search radar, selective identification feature, and height receiver). The wing allotted five additional days for each item once the parts arrived. 92

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(U) Another major problem with regard to the omnibus contract occurred at Boerfink where two complete quality control inspections were necessary during 1978 and 1979 before minimal equipment performance was obtained. Because of this and the earlier cure notice served at Wasserkuppe, 601st TCW officials did not want to extend the contract into the option year. On 22 June 1979, Brig Gen Leon W. Babcock, Jr., 601st TCW commander, requested the USAFE Deputy Chief of Staff for Logistics, Brig Gen J.T. Edwards, to review the possibilities of hiring a new contractor. General Babcock pointed out that it could cost an additional \$400,000 but that additional money could be turned into higher wages and thus attract more highly qualified maintenance technicians. A week earlier, Mr. Herbaugh plus members of the USAFE contracting office met with the ASC director of operations to discuss overall dissatisfaction over maintenance at Boerfink. The inability of the 615th AC&WS to fully perform its mission was the primary topic. Air weapons controllers there often had to revert to manual control techniques to complete aircraft taskings. Wing and USAFE officials felt that management deficiencies and a low skill level of workers were the primary causes of maintenance deficiencies. <sup>94</sup>

(U) Before the meeting ended the ASC director made two pertinent decisions: (a) he replaced the maintenance manager at Boerfink; and (b) he laid the groundwork for a more vigorous training program there. Although somewhat

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satisfied, General Babcock did not withdraw his request for a review of the current contract. General Edwards felt that advantages gained by changing contractors would be lost because of long training periods, and that there was no guarantee of improved performance. He also felt ASC deserved a chance to improve its quality of work based on feedback from the operations director. Maintenance performance improved throughout 1979 and 1980 to the extent that the 601st TCW offered ASC another contract extension beginning 1 October 1980. This contract would remain in effect until American involvement in the 412L system ceased due to transition to German Air Defense Ground Environment equipment. <sup>95</sup>

#### GEADGE AND 412L PHASEOUT

(U) The first day of September 1980 marked the beginning of the end for 412L operations in southern Germany. On that date, 4 ATAF shut down the first site--Boerfink--in preparation for installation of GEADGE equipment. The one-of-a-kind 412L was becoming increasingly difficult and costly to maintain. This was particularly true since the system was of 1950s technology and components were no longer made on a routine basis. The problem was further compounded because no other radar system in Europe was compatible with General Electric's GPA-73 in so far as spare parts were concerned. <sup>96</sup>

(U) GEADGE would not significantly improve radar capabilities in aircraft height and range data. Rather, it was needed to replace aging equipment. The heart of the new system was the Hughes Aircraft HM-5118 computer

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which combined the intercept computer and detector/tracker chores. It should be remembered that the NADGE system in 2 ATAF used the HM-3118 computer while mobile CRPs and message processing centers operated with the HM-4118 computer. Under GEADGE all data processing consoles (including those earmarked for Army missile control) plus electronic switching center equipment would be replaced. <sup>97</sup>

(U) Since the German Air Force became the primary user of 4 ATAF fixed radar sites, it would pay all equipment and construction costs. Accordingly, it would own the complete GEADGE system including the American control and reporting center at Boerfink. This would relieve USAFE from most of its commitments to the existing system. For instance, the omnibus maintenance contract would terminate; and liaison supply detachments at Doebraberg, Freising, and Lauda would inactivate. American participation at Programming Center Birkenfeld plus the various joint working groups and committees would also end. Detachment 1, 601st Tactical Control Group would thus inactivate. On the other hand, American operational requirements at SOC III remained valid and would relocate back into the Boerfink Bunker.\* This agency would absorb master controlling functions reverting the 615th AC&WS to a CRC. However, this last American operational unit in the 412L system would continue master CRC chores during the GEADGE transition period. <sup>98</sup>

(U) Several options were examined to keep the 615th AC&WS operational during the GEADGE modification. Headquarters 4 ATAF considered using the same mobile configuration as used during Constant Keystone. However, the

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\* (U) Due to modern technology, GEADGE equipment would not take up as much room as 412L equipment did.

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Salty Net project made it possible for the 615th to use one of the semiautomatic mobile CRPs instead. In November 1979, 4 ATAF received official approval from Headquarters USAFE to augment most MCRC operations at the 603d Tactical Control Squadron. The SOC III at Kindsbach would absorb the master display center function. However, the 603d was not manned for 24-hour peacetime operations so the 615th AC&WS would have to provide augmenting air weapons controllers. Other mobile radar units around Germany would also have to send maintenance personnel to the CRP near Sembach Air Base. The mobile unit also had to task another CRP for an extra TSQ-91 cell to house Army missile control activity.\* 99

**SUMMARY**

(U) Many of the problems that hampered 412L progress during its construction and installation phase were not expected during GEADGE transition. The GPA-73 started out as mobile equipment but was adapted for fixed radar operations in southern Germany. Resulting modifications delayed construction, reduced stateside testing, and created cost overruns. To the contrary, the Hughes Aircraft HM-5118 had been installed and tested in Spain as part of the Combat Grande project during the late 1970s, passing all operational tests. Officials at the 601st TCW had no reason to expect GEADGE problems similar to those of the 412L. 100

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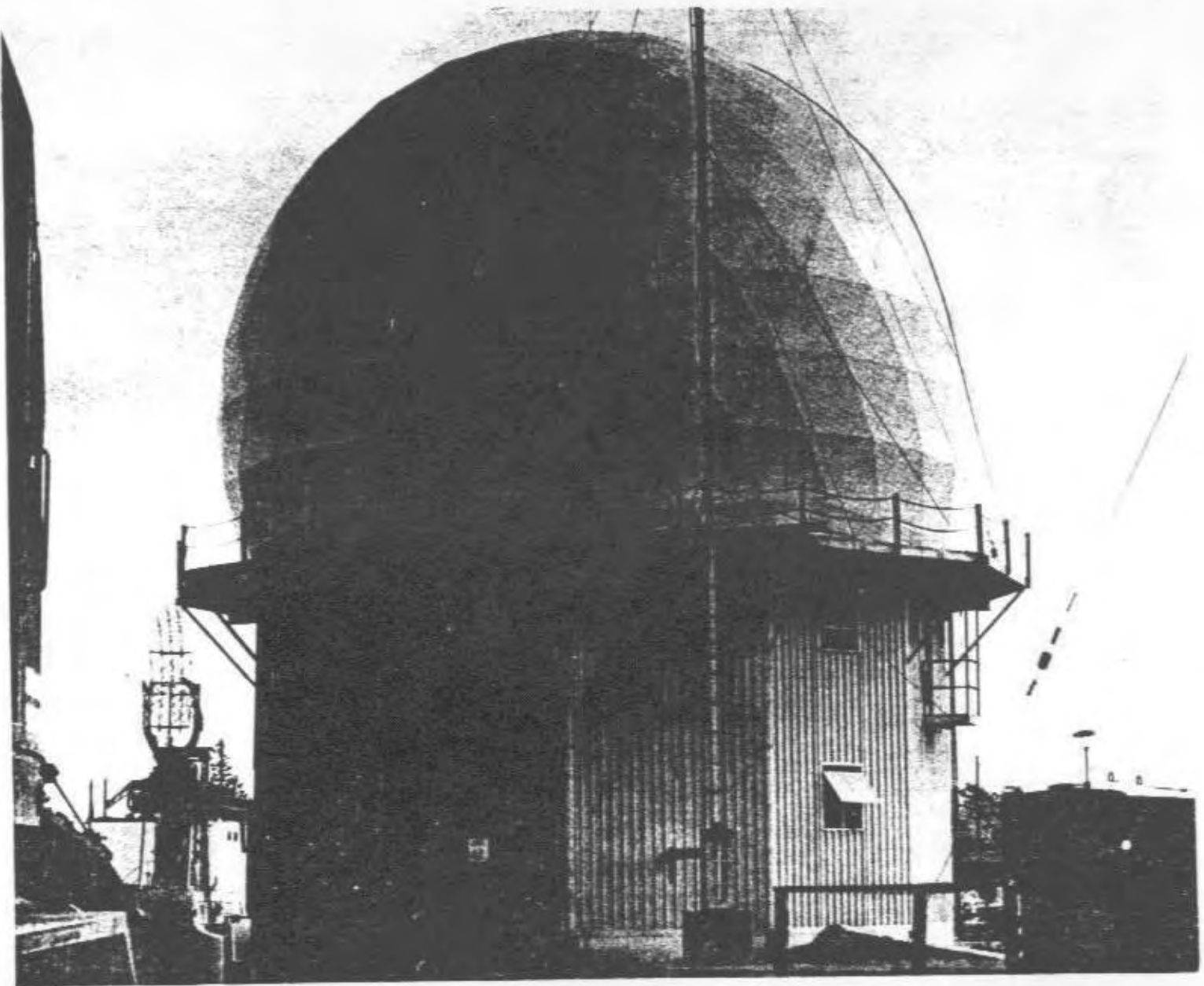
\* (U) The TSQ-91 was a three-celled inflatable building used as an "operations central" by 301st TCW mobile CRPs. In this instance, one of the three cells of the TSQ-91 at the 602d TCS was used by the 603d TCS.

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(U) Radar domes such as this one that housed an AN/FPS-67A Search Radar characterized the 412L site at Wasserkuppe. This equipment provided azimuth at ranges up to 220 nautical miles.

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This AN/FPS-6C Height-finder Radar added the third dimension of an aircraft's position so that air weapons controllers could pinpoint their locations. (USAF Photo)

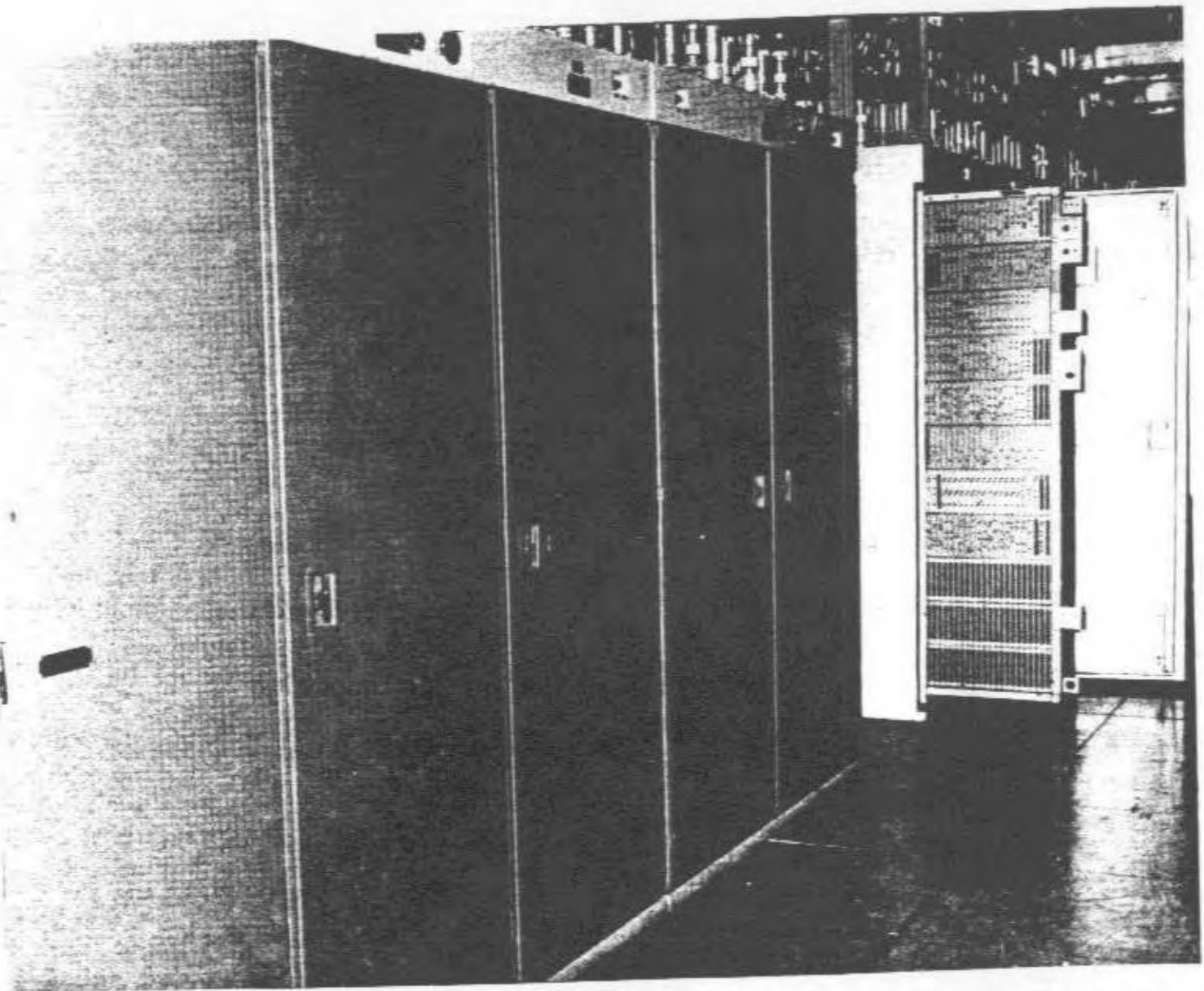
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(U) Radar intelligence data was processed through AN/GPA-73 components such as these at the 412L Aircraft Warning and Control sites.

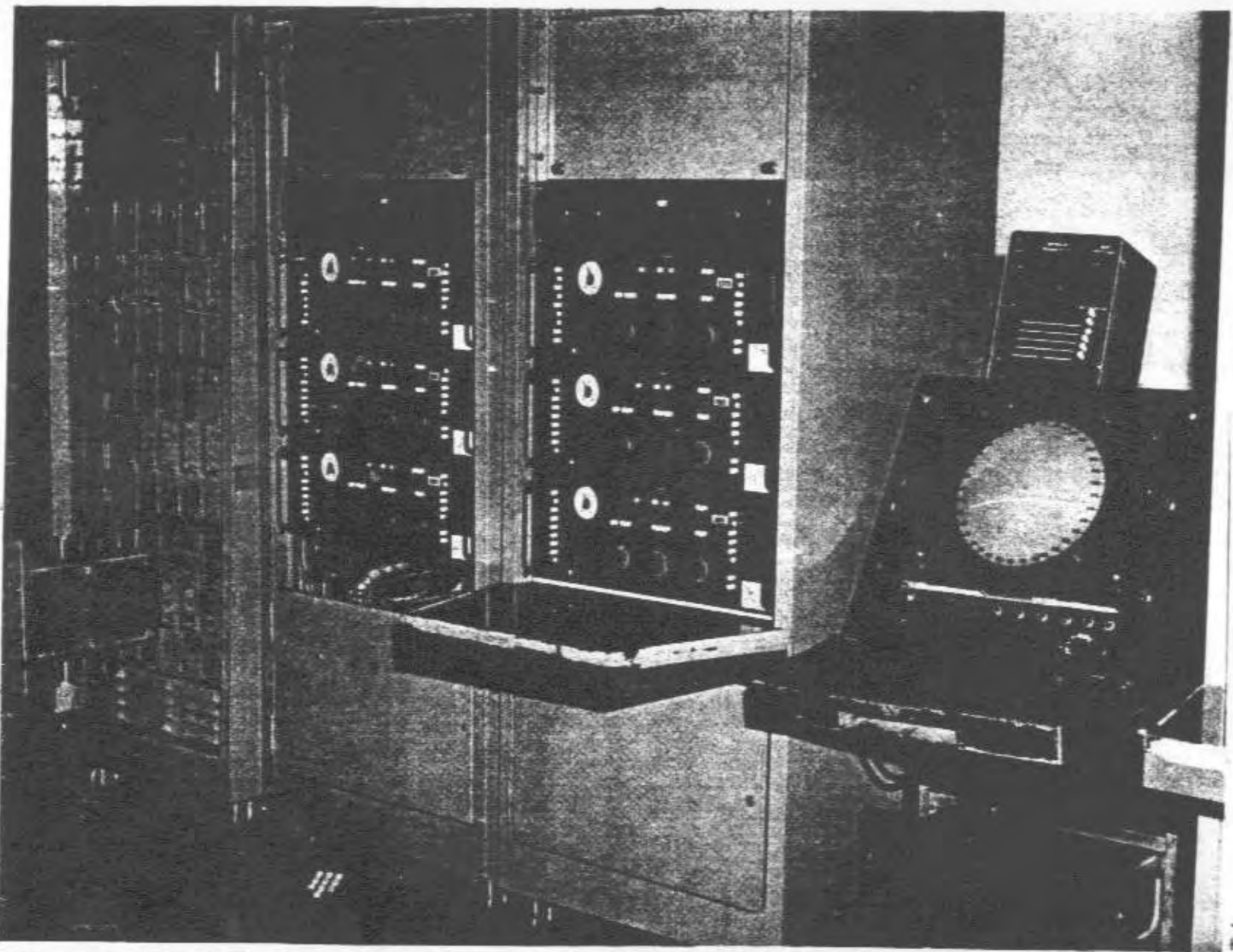
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(U) The AN/GPS-T8 Radar Target Simulator generated targets representing flight characteristics of interceptor aircraft for radar operator training exercises.

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\* (U) Colonel Morain was a captain when assigned to the 602d Aircraft Control and Warning Squadron from 1965-67. Thereafter, he served on the 412L operations staff at the 86th Air Division (Defense) until its inactivation in November 1968.

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## GAZATTEER\*

|                      |                                                                                                                                                              |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Berlin               | Former capital of Germany.                                                                                                                                   |
| Birkenfeld           | (49°39' N - 7°10'E) Heinrich-Hertz Kaserne; home of Det 1, 601st TCG and German Air Force 2d Air Division.                                                   |
| Boerfink             | 412L master control and reporting center, near Birkenfeld.                                                                                                   |
| Capellan, Luxembourg | (49°38'N - 5°59'E) Six miles from Belgium border; location of NATO Air Material Supply Agency                                                                |
| Doebraberg           | 412L reporting post; small village near Hof on East German border (see Hof).                                                                                 |
| Erbskopf             | (49°44'N - 7°05'E) Radar site for Boerfink's 412L operation; town, west central Germany, east of Trier.                                                      |
| Freising             | (48°23'N - 11°44'E) 412L control and reporting center; city, 30,000 population, 20 miles northeast of Munich.                                                |
| Giebelstadt          | (49°39'N - 9°56'E) Former 412L control and reporting post; small town, 12 miles due south of Wuerzburg.                                                      |
| Hof                  | (50°18'N - 11°55'E) Former radar site (manual reporting post); industrial city, population over 50,000, northeast of Nuernburg, six miles from East Germany. |
| Kindsbach            | 4 ATAF Air Defense Operations Center and Sector Operations Center; small town, 10 miles west of Kaiserslautern.                                              |

\* (U) Unless otherwise stated, all locations were in West Germany.



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|                   |                                                                                                                                                          |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Langerkopf        | Former radar site (manual control and reporting center); within 10 miles of Kaiserslautern.                                                              |
| Lauda             | (49°34'N - 9°41'E) 412L control and reporting center; small town 25 miles southwest of Wuerzburg.                                                        |
| Messtetten        | (48°11'N - 8°58'E) 412L control and reporting center; small village in southwest Germany, 40 miles north of Switzerland.                                 |
| Ramstein Air Base | (49°27'N - 7°33'E) Headquarters, United States Air Forces in Europe; near Kaiserslautern.                                                                |
| Regensburg        | (49°01'N - 12°06'E) Former radar site (manual reporting post); city of 130,000 inhabitants on Danube River, 35 miles from Czechoslovakia.                |
| Rothweston        | Former radar site (manual control and reporting post); village close to East German border near Kassel.                                                  |
| Schoenfeld        | (50°12'N - 6°25'E) Former radar site (manual control and reporting center); town, 12 miles from Belgium border (also the location of Pruem Air Station). |
| Sembach Air Base  | (49°29'N - 7°95'E) Headquarters, 601st TCW; 10 miles from Kaiserslautern.                                                                                |
| Tuerkheim         | (48°03'N - 10°38'E) Former manual radar control and reporting center, small town 25 miles south of Augsburg.                                             |
| Vienna            | (48°13'N - 16°20'E) Capital of Austria.                                                                                                                  |
| Wasserkuppe       | (50°30'N - 9°56'E) 412L reporting post; town in central Germany, five miles from East Germany.                                                           |

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Wiesbaden Air Base

(50°05'N - 8°14'E) Former location of Headquarters USAFE (until 1972); capital of German state of Hesse, 25 miles southwest of Frankfurt.

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## GLOSSARY

|     |                                                                            |                                                                                                                                                                                                                                                                                    |
|-----|----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A - | AAFCE<br>AC&WS<br>ADOC<br>AFLC<br>AFSC<br>ASC<br>ATAF<br>AWACS             | Allied Air Forces Central Europe<br>aircraft control and warning squadron<br>air defense operations center<br>Air Force Logistics Command<br>Air Force Systems Command<br>Aeronutronics Services Corporation<br>Allied Tactical Air Force<br>airborne warning and control system   |
| C - | CIMF<br><br>CINCUSAFE<br><br>CINCUSAREUR<br><br>COMAAFCE<br><br>CRC<br>CRP | consolidated intermediate maintenance<br>facility<br>commander-in-chief, United States Air<br>Forces in Europe<br>commander-in-chief, United States Army<br>Europe<br>commander, Allied Air Forces Central<br>Europe<br>control and reporting center<br>control and reporting post |
| D - | DYNAMO                                                                     | dynamic action management office                                                                                                                                                                                                                                                   |
| E - | ECM<br>ESC<br>ESD<br>ETO                                                   | electronic counter measures<br>electronic switching center<br>Electronics Services Division<br>European task organization                                                                                                                                                          |
| F - | FMOD                                                                       | (German) Federal Ministry of Defense                                                                                                                                                                                                                                               |
| G - | GAF<br>GE<br>GEADGE<br>GEEIA                                               | German Air Force<br>General Electric Company<br>German Air Defense Ground Environment<br>Ground Electronics Engineering<br>Installation Agency                                                                                                                                     |
| H - | HQ                                                                         | headquarters                                                                                                                                                                                                                                                                       |

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|     |                                                                         |                                                                                                                                                                                                                                                                                                                    |
|-----|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I - | IOC<br>IFF                                                              | initial operational capability<br>identification friend or foe                                                                                                                                                                                                                                                     |
| J - | JDS<br>JSMG                                                             | joint direction staff<br>joint system management group                                                                                                                                                                                                                                                             |
| M - | MC<br>MCC<br>MCRC<br>MITRE<br><br>MOD<br>MPC                            | military committee<br>missile control center<br>master control and reporting center<br>Massachusetts Institute of Technology,<br>Research Engineering<br>(German) Minister of Defense<br>message processing center                                                                                                 |
| N - | NADGE<br>NAMSA<br>NATO                                                  | NATO Air Defense Ground Environment<br>NATO Air Material Supply Agency<br>North Atlantic Treaty Organization                                                                                                                                                                                                       |
| O - | OI<br>OPS<br>OR                                                         | operating instructions<br>operations<br>operationally ready                                                                                                                                                                                                                                                        |
| P - | PCB                                                                     | Programming Center Birkenfeld                                                                                                                                                                                                                                                                                      |
| R - | RP                                                                      | reporting post                                                                                                                                                                                                                                                                                                     |
| S - | SAGE<br>SAM<br>SATAF<br>SHAPE<br><br>SIF<br>SOC<br>SPO<br>SPATS<br>STRT | semiautomatic ground environment<br>surface-to-air missile<br>system acceptance task force<br>Supreme Headquarters Allied Powers<br>Europe<br>selective identification feature<br>sector operations center<br>system program officer<br>System Program and Analysis Test Site<br>system turnover readiness testing |
| T - | TAC<br>TACS<br>TADS<br>TCS<br>TCW<br>TDDL                               | Tactical Air Command<br>tactical air control system<br>tactical air defense system<br>tactical control squadron<br>tactical control wing<br>time division data link                                                                                                                                                |

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|     |           |                                              |
|-----|-----------|----------------------------------------------|
| U - | UHF       | ultrahigh frequency                          |
|     | US        | United States                                |
|     | USAF      | United States Air Force                      |
|     | USAFE     | United States Air Forces in Europe           |
|     | USAREUR   | United States Army Europe                    |
|     | USCINCEUR | United States, Commander-In-Chief,<br>Europe |
|     | USEUCOM   | United States European Command               |
|     | USSR      | United Soviet Socialists Republic            |

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