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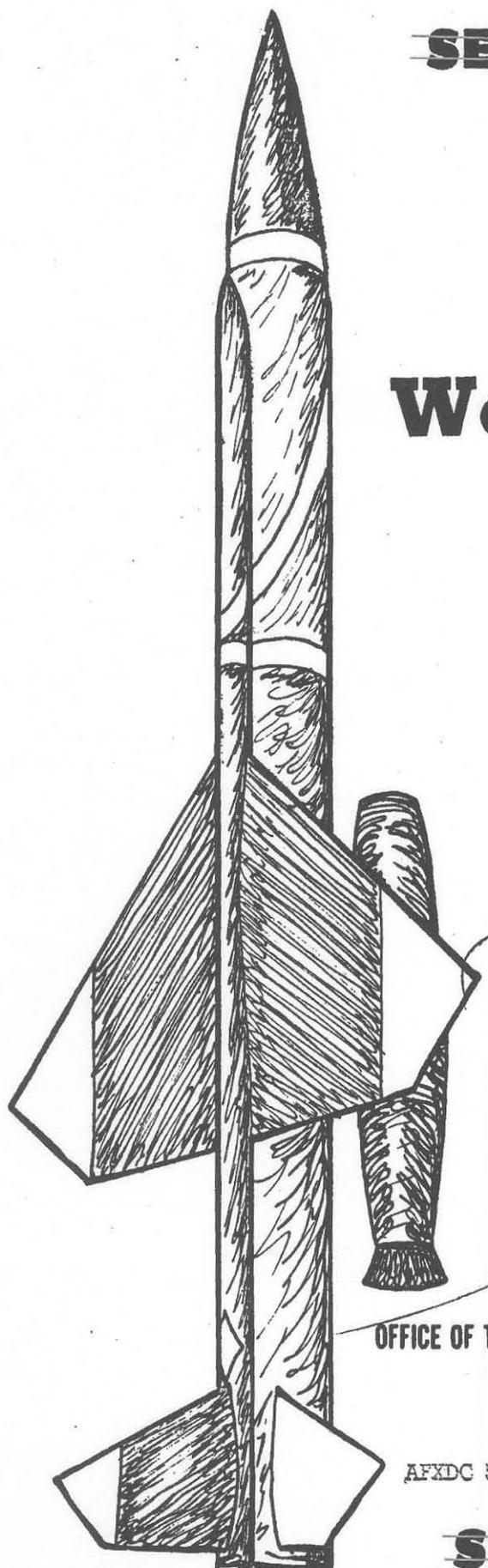
# IM-99

## Weapon System

A SURVEY CONDUCTED BY THE DIRECTORATE OF READINESS AND MATERIEL INSPECTION UNDER THE PROVISIONS OF AFR 123-1

26 October - 28 November 1958

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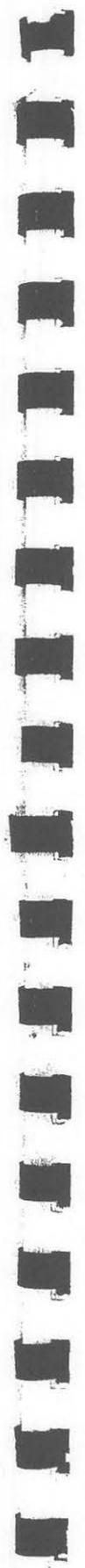


TABLE OF CONTENTS

PART I

	Page
SECTION I - PURPOSE AND SCOPE . . . . .	1
SECTION II - SUMMARY . . . . .	1
SECTION III - FINDINGS . . . . .	3
SECTION IV - ADMINISTRATIVE DETAILS . . . . .	5

PART II

SUPPLEMENTARY DATA

TAB A - OPERATIONS . . . . .	7
TAB B - COMMUNICATIONS-GUIDANCE . . . . .	9
TAB C - PROCUREMENT . . . . .	13
TAB D - SUPPLY . . . . .	15
TAB E - PERSONNEL AND TRAINING . . . . .	17
TAB F - INSTALLATIONS . . . . .	19
TAB G - MAINTENANCE . . . . .	21
TAB H - WARHEAD . . . . .	23

**SURVEY OF THE  
IM-99 WEAPON SYSTEM**

The **SECRET** classification is required on this survey for the protection of information, the unauthorized disclosure of which, standing alone, could jeopardize the Air Defense of the United States.

26 October - 28 November 1958

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SURVEY OF THE IM-99 WEAPON SYSTEM  
26 October - 28 November 1958

SECTION I - PURPOSE AND SCOPE

1. The purpose of this survey was to evaluate those conditions which might affect the timely and economical introduction of the IM-99 weapon system into the Air Force inventory and the capability of the system to perform the intended mission. In addition, followup action was taken on deficiencies reported previously relative to the IM-99 weapon system. The scope of this survey included a review of the responsibilities and performance of the Air Force and contractor activities concerned with the IM-99 weapon system. All pertinent aspects of the system consistent with its current program development were considered. (UNCLASSIFIED)

SECTION II - SUMMARY

2. The programs for the IM-99A and IM-99B missiles were adequate to provide a limited operational capability on the scheduled operational readiness dates. The programs were hampered by limitations of the Air Defense electronic environment, inadequate and delayed funding, and failure to procure spare parts for FY 59. Target drones capable of testing the missile had not been programmed. The factory individual training program was inadequate. (SECRET)

3. The facts supporting the above evaluation are submitted under Section III, "Findings." (UNCLASSIFIED)

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SECTION III - FINDINGS

4. OPERATIONS

a. The IM-99A missile program was adequate to provide a limited operational capability by the scheduled operational readiness date of 1 September 1959. (CONFIDENTIAL) (Ref page 7, pars 1a and b.)

b. The USAF drone program did not include target drones with adequate performance characteristics to test the IM-99A or the IM-99B at design altitudes, design airspeeds, or against a realistic airborne electronic countermeasure environment. (CONFIDENTIAL) (Ref page 7, par 1c.)

5. COMMUNICATIONS AND GUIDANCE. Limitations of the Air Defense electronic environment, development uncertainties, and lack of development funds indicated that the full IM-99B capability, as envisioned in the ADC operational employment plan, would not be realized on the scheduled operational dates. (SECRET) (Ref page 9, pars 1a and b; page 10, par 1c; page 11, 1d; page 12, par 1e.)

6. FUNDING AND PROCUREMENT. Late and inadequate funding had initiated cost increases in the FY 59 program and had resulted in a serious gap in the production of tactical and training equipment spares. (CONFIDENTIAL) (Ref page 13.)

7. SUPPLY

a. Special test equipment required to check out and maintain the ground-to-air transmitters had not been programmed. (UNCLASSIFIED) (Ref page 15, par 1.)

b. Government furnished vehicles were not available in the quantities and types required in support of the BOMARC program. (UNCLASSIFIED) (Ref page 15, par 2.)

8. PERSONNEL AND TRAINING

a. Graduates of special training courses conducted by Boeing Airplane Company had not attained skill levels as established in ATC course standards. Consequently, the potential capability of the first operational IM-99 unit to perform its intended mission had been impaired. (UNCLASSIFIED) (Reg page 17, par 1.)

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b. Adequate training equipment had not been allocated to the technical training facility at Eglin Air Force Auxiliary Field Number 9. (~~CONFIDENTIAL~~) (Ref page 17, par 2.)

9. INSTALLATIONS. During the installation, calibration, and check out of weapon support equipment at the first four IM-99A operational sites it will be necessary to spend an estimated \$1,100,000.00 for temporary sources of heat and power because of the late construction phasing of the heat and power buildings. This construction was scheduled to be completed in time to meet the operational dates. (UNCLASSIFIED) (Ref page 19.)

10. MAINTENANCE. Maintenance concepts and procedures for missile and weapon support equipment were adequate to meet programmed testing and operational dates. (UNCLASSIFIED) (Ref page 21.)

11. WARHEAD. The IM-99A and IM-99B warheads (W-40) with allied fuses, and the testing and handling equipment for both warheads and fuses, were programmed satisfactorily to meet the operational dates of 1 September 1959, and 1 March 1961, respectively. (~~SECRET~~) (Ref page 23, pars 1 and 2.)

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SECTION IV - ADMINISTRATIVE DETAILS

12. This survey was conducted under the provisions of AFR 123-1, The Inspection System, 12 April 1956. (UNCLASSIFIED)

13. The itinerary for this survey was as follows:  
(UNCLASSIFIED)

<u>ARRIVED</u>	<u>UNIT AND LOCATION</u>	<u>ACTION</u>	<u>DEPARTED</u>
	Norton AFB, Calif	Travel	26 Oct 58
26 Oct 58	Boeing Airplane Co, Seattle, Wash	Briefing & Inspect	30 Oct 58
30 Oct 58	OOAMA, Hill AFB, Utah	Briefing & Inspect	1 Nov 58
2 Nov 58	Hq ADC, Ent AFB, Colo	Briefing & Inspect	5 Nov 58
5 Nov 58	Hq ATC, Randolph AFB, Tex	Briefing & Inspect	6 Nov 58
7 Nov 58	Hq APGC & 4751st ADMWg, Eglin AFB, Fla	Briefing & Inspect	13 Nov 58
13 Nov 58	AFMTC, Patrick AFB, Fla	Briefing & Inspect	14 Nov 58
15 Nov 58	Hq ARDC, Andrews AFB, Md.	Briefing & Inspect	19 Nov 58
19 Nov 58	Hq ADSID, L.G. Hanscom Fld, Mass	Briefing & Inspect	20 Nov 58
20 Nov 58	Hq EADF, Stewart AFB, NY	Briefing & Inspect	22 Nov 58
22 Nov 58	Hq AMC & Det #1, ARDC, W-P AFB, Ohio	Briefing & Inspect	27 Nov 58
28 Nov 58	Norton AFB, Calif		

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14. Critiques were held at all headquarters and bases on dates shown opposite stations listed in the itinerary above.  
(UNCLASSIFIED)

15. Distribution of this survey has been made to The Inspector General, USAF; Commanders, AMC, ADC, ATC, and ARDC.  
(UNCLASSIFIED)

WILLIAM W. PERRY  
Colonel, U. S. Air Force  
Inspector General

Approved.

17 DEC 1958

WILLIAM G. HIPPS  
Brigadier General, U. S. Air Force  
Director, Readiness and  
Material Inspection  
The Inspector General

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**PART II**

**SUPPLEMENTARY DATA**

SURVEY OF THE  
IM-99 WEAPON SYSTEM

26 October - 28 November 1958

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TAB A

OPERATIONS

1. The IM-99A missile program was adequate to provide a limited operational capability by the scheduled operational readiness date of 1 September 1959. Factors limiting the operational capability were: (~~SECRET~~)

a. Special test equipment required to check out and maintain the ground-to-air transmitters had not been programmed. The ground-to-air transmitters were required to relay guidance and control signals to the missiles during mid-course guidance. Transmitter failure would thus prevent SAGE from controlling BOMARC. (~~UNCLASSIFIED~~)

b. Procurement of spare parts for missiles and support equipment had been delayed. (~~CONFIDENTIAL~~)

c. The USAF drone program did not include target drones with adequate performance characteristics to test the IM-99A or IM-99B at design altitudes, design airspeeds, or against a realistic airborne electronic countermeasure environment. The weapon system project office had stated requirements for 859 flights of high performance drones during the 1959 - 1963 time period. With the exception of the QX-10, the only target drones available to test the BOMARC weapon system were the QF-80 and QF-17 aircraft, which do not possess the characteristics required to test adequately the BOMARC under realistic conditions. There was a program underway to modify B-47 aircraft to a drone configuration; however, none would be available before mid 1959. The QB-47 would not simulate effectively the threat aircraft. This problem was covered in USAF Inspector General Survey of Air Force Target Drone Program, 17 August - 12 September 1958. (~~CONFIDENTIAL~~)

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TAB B

COMMUNICATIONS AND GUIDANCE

1. Limitations of the Air Defense electronic environment, development uncertainties, and lack of development funds, indicated that the full IM-99B capability, as envisioned in the ADC operational employment plan, would not be realized on the scheduled operational dates. Factors affecting the ultimate utilization of the improved IM-99B inherent design features were: (SECRET)

a. Lack of an active funded program for a timely "Aerial Long Range Input" capability. In January 1958, Hq USAF directed that a sea level altitude intercept capability be included in the IM-99B missile at the earliest possible date. This improvement had been designed into the missile and would allow effective low altitude intercepts up to approximately 250 nautical miles, or even further with a somewhat lesser kill probability. Utilization of this capability, however, was dependent upon the low altitude search capabilities of the ground environment radars. Unless an approaching target could be observed at low altitude, and a track established through the SAGE direction center, the low altitude capability of the IM-99B could not be employed. The SAGE coastal radar coverage was limited to approximately 37 nautical miles at 500 feet altitude. (SECRET)

b. Development of techniques and equipment that would allow effective use of "Pattern Patrol." The IM-99B had been designed to include a "Pattern Patrol" type operation. Missiles could be launched in multiples, or at very close intervals and guided in a line abreast type formation with target seekers operating on search mode. This would provide a capability to patrol a given area where targets were suspected, but where definite tracks had not been established. Most effective use of this feature could be made in the presence of electronic countermeasures. However, its employment was limited by the capability and vulnerability to electronic countermeasures of the ground electronic environment. Methods for obtaining a pattern patrol capability under consideration were a manual technique, a modified pattern patrol, and a fully automatic technique. Air Defense Command had emphasized that a fully automatic technique was a firm requirement. Achievement of this type capability would require extensive modification to SAGE direction centers and FST-2 equipment, development of new equipment, and changes in computer programs. (SECRET)

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c. Resolution of frequency interference problem ground and airborne equipments. In addition to the Mark I beacon problem, there were several other areas where frequency interference was having a major impact on the BOMARC/SAGE capability. Eastern Air Defense Force indicated that the scatter communications from Texas Tower #2 had failed, and inputs to the SAGE system were unsatisfactory. No early resolution was anticipated. It was evident that the same problem would exist with Texas Towers #3 and #4. Eastern Air Defense Force was preparing a request to return the tropo scatter system to the research and development stage, and replace with submarine cable. Without a useable communication input to the direction center, these towers were of little value to the Air Defense electronic environment and would degrade the IM-99A and IM-99B operational capability in this area. (SI

(1) Eastern Air Defense Force further expressed extreme concern over the serious radar interference experienced in the Langley AFB - Norfolk, Virginia area. Part of this interference was being processed by the SAGE data processing equipment (AN/FST-2). Cooperative and working agreements with other agencies operating in the same area had been unsuccessful in materially reducing the problem, and there was no known electronic fix. This situation would provide extremely poor SAGE data, in the face of enemy countermeasures and seriously degrade the IM-99A and IM-99B operation from the Langley area. ~~(SECRET)~~

(2) All SAGE ground/air radio sites had been programmed to be located on existing aircraft control and warning sites or at direction center locations wherever possible. With the advent of the frequency diversity radar and the time division data link, frequency interference problems had been forecast between the frequency diversity ultra high frequency radar and the ground/air communications network. Initially, it was believed that the two equipments could not be located within line of sight of each other. In addition, airborne manned or unmanned interceptors at high altitude would be within line of sight of at least one ultra high frequency radar and be faced with interference, even though the ground problem was solved. At a frequency interference reduction conference at Rome Air Development Center, on 5 - 6 November 1958, it was agreed that high powered transmitter and receiver filters for the FPS-24 and FPS-35 radars could be developed. Consequently, it appeared feasible

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to locate the frequency diversity radars, time division data link, and voice communications equipment at the same site, if a minimum separation between the radar and communications facilities of 1000 meters was maintained. There were, however, many areas of uncertainty which remained to be proven with actual operational type equipment. It was also estimated that any relocation, as a result of the 1000 meter limitation, could introduce a delay up to one year in the air/ground site availability dates. ~~(SECRET)~~

d. Development, Siting, and Timely Procurement of the High-Power Directional Antennas for the Time Division Data Link. The directional high-gain data link antenna appeared to be the only means within the state of the art that would provide an acceptable operational capability in an electronic counter-measure environment. This was especially important for the perimeter control of the IM-99B. The missile could be flown utilizing the omni-directional backup antenna; however, it was estimated that the control range would be limited to a radius of approximately 50 miles. In order to meet the 1 March 1961 operational date, the time division data link equipment was required on site by June 1960. This left only 18 months to prepare specifications for, design, test, and procure the antennas. Air Force Cambridge Research Center had contracted to design, manufacture, and install a prototype directional antenna system at South Truro, Massachusetts. Installation had been scheduled for September 1958, but was delayed as was the start of the service test. Neither specifications nor design of the antenna switching unit had been completed. Due to the tremendous size of the antenna array, composed of 16 stationary segments in a circular pattern 60 feet high, it was evident that many of the proposed SAGE locations could not support, physically or technically, this size equipment. This problem was aggravated by the criteria requiring 1000 meter separation from the ultra high frequency/frequency diversity radars. Headquarters USAF indicated support of the ADC requirement for the high power directional antenna, but approval for the power output had not been issued. Headquarters USAF further stated that directional antennas would be authorized only after careful study of individual SAGE sectors based on operational requirements, siting criteria, and interference resolution. In no case would production be authorized until frequency and power clearances were obtained. Maximum effort must be placed on development and testing, as well as the resolution of siting, power, and frequency requirements, if this antenna is to be available by March 1961. ~~(SECRET)~~

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e. Resolution of Mark X Selective Identification Feature Problem and The Requirement For a Secure IFF (Identification Friend or Foe). There were several areas of uncertainty concerning the reliability of the Mark X beacon system with the selective identification feature and its effectiveness in the BOMARC/SAGE environment. The system was vulnerable to electronic countermeasures, very susceptible to all kinds of interference, and had presented an "over interrogation" problem. If the missile transponder was triggered at a rate greater than approximately 1000 times per second, it would cause an overload condition and the transponder would be shut off to the point where friendly interrogators would be unable to see it. A major portion of this problem was caused by side lobes of both the ground and air transmitters. Several methods of side lobe suppression had been developed and were being tested in the New York area. Of these, the Setrin fix was considered to be the most logical solution to the problem; however, until the completion of the New York tests in 1959, there was no assurance that it would be a final fix. In order to prevent delays, the weapon system project office had elected to proceed with the design and test of the XIM-99B beacon and guidance equipment on the assumption that the Setrin fix would be the final solution. If the system did not prove to be satisfactory, delays in the IM-99B program could be expected. The Mark X system will be tested for the first time with SAGE on a high mach vehicle at Eglin AFB, Florida, in mid 1959. There was some concern as to whether the interference problems would be solved to the point where the system would be effective for BOMARC, which must operate in several very high signal density zones. The Mark X was not a secure system, even with the selective identification feature, and would be used only to identify friend from foe. Air Defense Command has had a requirement since 1956 for an air-to-air secure IFF. This capability had not been incorporated in the IM-99B. Recent studies by Boeing and the weapon system project office concluded that there would be a minimum of one year slippage in the first IM-99B operational date if an air-to-air IFF requirement was established for the IM-99B missiles. In addition, the IM-99B configuration would have to be changed to allow more space, and there would be a weight increase of about 50 pounds with a loss in range of approximately 40 nautical miles. Air Defense Command had since gone to Hq USAF reiterating this same requirement for all fighter interceptor aircraft and interceptor missiles in the ADC inventory during the 1960-1963 time period. Prolonging the final decision on the IM-99B IFF requirement could only result in further delays to the program or a greater degradation of the overall Air Defense capability. (SECRET)

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TAB C

PROCUREMENT

Late and inadequate funding had initiated cost increases in the FY 59 program and had resulted in a serious gap in the production of tactical and training equipment spares. Late and limited release of weapon system project office commitment and obligation authority by Hq USAF had hampered procurement. As a result, both the IM-99A and IM-99B missiles procured in FY 59 were being produced without concurrent production of support spares for the missiles or training equipment. In addition, the six month limitation of procurement authorization, imposed upon the weapon system project office by Hq USAF, had initiated cost increases projected to reach an estimated \$13,000,000.00 in the FY 59 program. Preliminary procurement authorization and precontractual negotiations were based upon an FY 59 buy of 175 IM-99A missiles and 116 IM-99B missiles. Subcontractors who had negotiated with Boeing for the larger program had informed Boeing that they needed contractual coverage for the balance of the FY 59 requirements by early December 1958, in order to forestall cost increases. The need to reschedule production, which would result in higher unit costs, was given as justification for the increased cost. Procurement authorization for the balance of the FY 59 program was required by the weapon system project office by 1 December 1958, in order to prevent this \$13,000,000.00 cost increase. (SECRET)

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TAB D

SUPPLY

1. Special test equipment required to check out and maintain the ground-to-air transmitters had not been programmed. Procurement leadtime was such that subject test equipment would not be available to meet the installation, calibration and check out schedule for the first two operational sites. The BOMARC requirements were not included in the initial procurement of the special test equipment under Air Force Contract 30/635/-6894 with the General Electric Company. This untimely programming resulted in a requirement for additional expediting funds to support the program. The ground-to-air transmitter furnishes the final control link between the SAGE system and the IM-99A missile. A failure of the transmitter would result in the SAGE system being unable to control the missile. (~~CONFIDENTIAL~~)

2. Government furnished vehicles were not available in the quantities and types required in support of the BOMARC program. Vehicles had been programmed on the basis of the ADC tentative unit authorization list; however, procurement had not been affected due to restrictions on procurement of initial issue vehicles and lack of funds. As a result, deliveries of required vehicles, especially during the installation, calibration and check out phase, had been delayed. New requirements had been prepared in an effort to redistribute, on an expeditious basis, any available assets within USAF. The impact on the BOMARC program would not be known until complete available USAF assets for redistribution have been determined. (UNCLASSIFIED)

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TAB E

PERSONNEL AND TRAINING

1. TRAINING: Graduates of special training courses conducted by Boeing Airplane Company had not attained skill levels as established in ATC course standards. Consequently, the potential capability of the first operational IM-99A unit to perform its intended mission had been impaired. Special training courses were not compatible with the objectives, methods, and implementing procedures of the ATC school system. Course outlines existed; however, syllabi and lesson plans were only 25 percent complete. Training projects were inadequate. A lack of bench and spare parts for training had resulted in little or no work application by trainees. The end result was inadequate training and inadequate capability to test the training. (UNCLASSIFIED)

a. The 4751st Air Defense Wing (Missile) had programmed individual proficiency training until an acceptable graduate was assured from the special training courses. There was no assurance that this training could be conducted effectively. The technical training facility at Eglin Air Force Auxiliary Field Number 9 was programmed for change to IM-99A production configuration during the same period of time that the first operational unit was programmed for training. (CONFIDENTIAL)

b. Many of the problems encountered during the IM-99A training program were expected to reappear during the IM-99B training program. The leadtime on some of the components of the IM-99B model extended beyond the commencement date of training for the IM-99B program. (UNCLASSIFIED)

2. Adequate training equipment had not been allocated to the technical training facility at Eglin Air Force Auxiliary Field Number 9. No IM-99A training missiles had been programmed or allocated to this facility. Deficiencies in special training had established a definite requirement for increased emphasis on individual skill proficiency. The allocation of an IM-99A missile for training purposes was considered essential by the training staff of the 4751st Air Defense Wing (Missile). Annual retraining of IM-99A units, programmed to be conducted at Eglin Air Force Auxiliary Field Number 9, could not be conducted on operational equipment if an IM-99A missile was not allocated to the technical training facility. (CONFIDENTIAL)

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TAB F

INSTALLATIONS

During the installation, calibration, and check out of weapon support equipment at the first four IM-99A operational sites it will be necessary to spend an estimated \$1,100,000.00 for temporary sources of heat and power because of the late construction of the heat and power buildings. This construction was scheduled to be completed in time to meet the operational dates. The published construction schedules indicated that all facilities, except the heat and power building, would be available in increments which were phased properly with the schedule for installation, calibration, and check out of weapon support equipment. The heat and power buildings were phased too late to supply heat and power during the early portions of the installation, calibration, and check out phase. For example, at McGuire AFB, the heat and power building was scheduled to be complete four months prior to the site delivery date; however, heat and power were required eight months prior to this date. The missile system contractor was therefore required to supply temporary heat and power. The late availability of the heat and power buildings was attributed, in part, to the numerous conferences held in an effort to reduce the design plant capacity to the minimum required to operate the site.

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TAB G

MAINTENANCE

Maintenance concepts and procedures for missile and weapon support equipment were adequate to meet programmed testing and operational dates. The weapon system maintenance concept included interceptor missile maintenance policies, weapon support equipment maintenance policies, and weapon control equipment policies. The missile maintenance concept consisted of using automatic test equipment, when possible, as a substitute for human skills in testing the missile. Repair of the missile was accomplished by removing and replacing faulty assemblies. The test equipment maintenance concept consisted of using built-in self-check features in this equipment for condition determination and fault isolation, with repair limited to replacing faulty assemblies. Government furnished weapon control equipment was to be maintained in accordance with applicable USAF procedures.  
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TAB H

WARHEAD

1. The IM-99A warhead (W-40) with its allied fuse, test, and handling equipment was programmed satisfactorily to meet the operational date of 1 September 1959. The W-40 warhead, furnished by the Atomic Energy Commission, was on schedule with production scheduled to commence during April 1959. The IM-99A fuse was undergoing evaluation for certification as to compatibility with the warhead. Test, handling, and technical publications were programmed to be available prior to the first unit operational date. (SECRET)

2. The IM-99B warhead fuse development and production contract was let to the Bendix Company, York, Pennsylvania. This improved fuse provided several additional and desirable features not available with the IM-99A warhead fuse, such as, lower altitude intercept, better radar definition, and a 3,000 foot fuse radar range. The IM-99B warhead fuse prototype was scheduled to be available 1 January 1959 for a four month evaluation period. Flight test was scheduled for 1 April 1959 and production to commence thereafter. The IM-99B warhead fuse program was adequate to meet IM-99B operational date of March 1961. (SECRET)

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