

PLH 835

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 MASSACHUSETTS INSTITUTE OF TECHNOLOGY
 LINCOLN LABORATORY
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L-102

OPERATING PROJECT LINCOLN

DD 254
 Date: 5-5-60

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MEMORANDUM

From: Jay W. Forrester
 Subject: Bomarc Meeting with AFCRC, WADC, and Boeing

A letter of May 6 from ARDC to AFCRC instructed AFCRC to promptly examine the relationship of the Bomarc ground control system to the Transition System, to see that the performance of the Bomarc system would be adequately provided for as economically as possible, and to recommend a plan to be followed by the Air Force to provide proper Bomarc control equipment. Recommendations from AFCRC to ARDC are due not later than 1 July 1953. A meeting to discuss this subject was held on June 15-18. The meeting on June 15 was between Lincoln, AFCRC, and WADC. Boeing was present on the second and third days. The fourth day was devoted to the WADC representatives meeting with me, later with AFCRC, and last with Read of Boeing and me. The following persons attended the Tuesday meeting:

- | <u>AFCRC</u> | <u>WADC</u> | <u>Boeing</u> |
|---------------------|------------------------------|--------------------|
| Chaffee, M. A. | Chandler, John S. (Lt. Col.) | Bryant, William H. |
| Dempsey, V. S. | Dietrich, Fred A. (Major) | Mock, Elliot V. |
| Galt, G. T. (Major) | Johnston, Guy R. (Major) | Montgomery, R. A. |
| Greene, John L. | | Read, R. W. |
| Marchetti, J. W. | | Smith, C. R. |
| Schecter, H. | | Wood, Lysle A. |
| Smith, W. J. | | |
-
- | <u>MIT</u> | |
|---------------------|--------------------|
| Arnold, J. A. | Hopkins, Robert C. |
| Everett, Robert R. | Smulowicz, B. |
| Forrester, Jay W. | Wells, W. I. |
| Jeffrey, Richard C. | Wieser, C. R. |

Discussions on the first two days were quite general and rambling and helped to introduce the people to one another's viewpoints and to define the problem.

The Boeing Airplane Company has a subcontract with Westinghouse Electric Company for development of a production prototype (G-20) which would be followed by production equipment (G-31). This consists of manual target tracking stations, the manual or automatic missile tracking stations, the Bomarc course computer, and necessary connections to ground-to-air data links.

*General Maude, Valley, Harrington, Sherman were present Monday.

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The following notes on the discussions held during the third day summarize the meeting at that time but were reversed by the WADC men between the third and fourth days as shown by the attached letter.

1. For the sake of discussion, the first question was based on the assumption (with the understanding that the assumption was not necessarily accepted as fact) that the Transition System could control the Bomarc without G-20 or G-31. The first question then was: If the Transition System can technically do the G-20 job, should G-20 still be developed? Produced?

It was pointed out that the weapon control part of G-31 that goes from radar video to data link information will represent about 8 percent of the total cost of the Bomarc program. Everett summarized the possible reasons for wanting to continue G-20 development, even if the Transition System would do the job, as follows:

a. As a development back-up or second line of equipment. As a subsidiary part of this, the question arises whether a program of the magnitude of Bomarc should be fully dependent on an outside development such as the Transition System.

b. Decentralization. Arguments could be advanced for a decentralized weapon control system for Bomarc just as these arguments apply to Nike and anti-aircraft.

c. Autonomy. Although not a part of the proposed Bomarc program, it might be that Bomarc installations would be called for in areas where Transition System equipment is not to be installed.

d. Timing. Will G-20 equipment, if necessary for testing, be available to Bomarc before Transition System equipment would be available?

e. Testing. It might be that G-20 should be developed for the purposes of testing Bomarc units. There seemed to be general agreement that this would not be a principal reason for developing G-20. Adequate testing of single missile flights can be done with the G-12 equipment, such as is being supplied by the University of Michigan. Standby equipments of this type could be built with respect to the testing program. The only necessity for G-20 would be to control several simultaneous Bomarc flights.

f. Load on the Transition System. An argument for G-20 equipment might be advanced if it carried a load beyond that which the Transition System could handle. It was pointed out that this was not a compelling reason since the Transition System can install as much computing capacity as is required and can probably do it more efficiently than G-20 type equipment.

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2. The second question for discussion was whether or not the G-20 and Transition System are capable of working together and being compatible if it is decided that both should exist in the same area. It was agreed that in general they are compatible and can certainly be made so. It was agreed on Wednesday that Boeing and MIT would work together to determine how G-20 and the Transition System could be coordinated if G-20 is used. Everett at MIT and Montgomery at Boeing were appointed as key coordinators on this point.

3. The next question discussed was whether or not the Transition System can do the required control job for Bomarc. This was discussed at many times during the three days with not enough information to reach firm conclusions. Boeing has some calculations showing required track accuracy for various types of courses, all based on the assumption that a final interception probability of 95 percent was to be achieved. I stressed the necessity for knowing how these figures change with probability of success, as well as with the other parameters. If probability of success goes down only slightly as errors increase, (and this is indicated by some of the data) Transition System using only SDV data might be good enough. On the other hand, if probability of interception falls very rapidly with increases in errors, there is substantial question whether either the G-20 system or the Transition System with manual fine tracking added will provide adequate control.

Boeing and MIT will explore these questions further and will work up various tests and reexamine available data to give a more useful picture of required accuracy. Read at Boeing and Wieser at MIT will coordinate this phase of the program.

4. The following are miscellaneous general comments arising during part of the discussion:

Westinghouse worked from July 1952 to January 1953 preparing a proposal. Since January 1953 they have had a contract for this work. They are now working out specifications and boundary conditions for each piece of equipment so that individual design groups can go to work. The proposed digital course computer for G-20 is specified to be along the lines of that in G-12 which is now being assembled by the University of Michigan. The G-12 model should be complete in three or four months and shipped to Florida in five or six months.

For G-20 it is not now known how much computer redesign will be called for nor who will do it. Westinghouse proposes to subcontract the computer part of the system. Some of the Boeing people expect to get the G-20 computer by the fall of 1954, but Chandler and others raised the question of whether or not the fall of 1955 might not be more realistic considering that a subcontractor has not yet been finally picked.

The G-12 University of Michigan course computer has a 32 bit word length, a three-address order code, 256 words of internal Williams tube storage, using parallel storage access and series-parallel arithmetic.

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5. Chandler summarized the meeting as it stood Wednesday evening and suggested the answer to the Headquarters, ARDC, letter as follows (see section 6 for reversal of recommendation):

a. Undertake to determine by December 1, 1953, what must be done to the Transition System to permit it to control Bomarc (for example, if manual fine tracking at the radar set were valuable, what would this involve? There are numerous other less important questions.)

b. By February 1, 1954, compare cost, weapon capability, time of availability, and pick from these a final system for the way Bomarc is to be handled.

c. Continue the present G-20 program until the above discussions are arrived at.


It was agreed that the initiative for carrying out these studies rests with Boeing. MIT will assist where possible and make specific tests to which we agree. These tests will be scheduled when possible, but it was pointed out that many of them must wait until fall. Boeing is responsible for keeping WADC informed on the work they are doing with us.

Chandler will initiate action on the part of other weapons people at WADC to similarly coordinate their work with the Transition System.

We will undertake to send voluntarily to Boeing such printed information as we believe will be helpful to them. It was pointed out that the primary and most useful source of information would be through direct contact.

6. Thursday morning when I arrived at the office the WADC representatives were waiting to discuss a proposed reversal of their thinking of the day before. The attached letter draft proposal covers the latest available thinking of WADC.

A meeting is scheduled for Friday, June 26, Building 22 conference room at 9:30 a.m. The enclosed agenda was prepared by Major Galt.


Jay W. Forrester

JWF:eg
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CC: A. G. Hill
G. E. Valley (4 copies)
R. R. Everett
C. R. Wieser
Planning & Control Off.

General R. C. Maude
J. W. Marchetti
M. A. Chaffee, AFCRC, through Planning &
Control Office (3 copies)
Major G. T. Galt

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DRAFT

SUBJECT: Recommendation Pertaining to Lincoln Transition System--
Bomarc Weapon System Development

TO: Commanding General
Air Research and Development Command
Post Office Box 1395
Baltimore 3, Maryland

1. Reference is made to your letter, subject: Revision of Command Policy Pertaining to Lincoln Transition System, dated 6 May 1953. In reference to Paragraph 5 of cited letter, the recommendation of this Center is that the presently planned (G-31) ground weapons control portion of the Bomarc Weapon System should be terminated. This recommendation is based on the assumptions that:

a. The Bomarc Weapon System must operate with the Lincoln Transition System ADEE in order to allow maximum utilization of the Bomarc Weapon System.

b. The Air Defense System employing Bomarc Weapon (F-99), consists of surveillance and detection, of data processing and storage, of threat evaluation, of weapon assignment, of weapon control, and of the F-99.

2. WADC concurs with the above action provided:

a. That the FSQ-7 be modified to meet the guidance requirements of the F-99. The minimum objectives of the guidance modification should be to control the Bomarc Weapon as well as the presently planned G-31 ground weapon control and to optimize, as much as practicable, weapon performance. The FSQ-7 modification objective should be accomplished and available for operational use by January 1957. These actions require that paragraphs 1a and b be clearly recognized as being significantly important.

b. That an FSQ-7 be provided as soon as practicable for use at the Air Force Missile Test Center as a test facility.

c. That development of fine tracking be continued and phased into Transition System as required.

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A G E N D A

The Conference on 26 June 1953 will include WADC, Boeing, Lincoln, and AFCRC.

Purpose of the Meeting:

1. To determine whether or not the Transition System can and will absorb the guidance requirements of Bomarc.

2. Consider:
 - a. Fine tracking development responsibility
 - b. Development of Transmission system to CIC if fine tracking is required
 - c. Possible reorientation of Lincoln program to include responsibility for Ground Control environment of Bomarc
 - d. Recommendations concerning operational requirement for autonomous operation of Bomarc.

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