TAB A

10 April 1963

MEMORANDUM FOR: Deputy Director, Support

SUBJECT   : Selection and Acquisition of IBM 7090 Computer

This paper is in three parts:

Part I   - Reasons for Selecting the IBM 7090 Computer

Part II - CIA Tasks for the IBM 7090 Computer

Part III - Immediate Steps to Procure and Install an IBM

7090 by July 1963

Part I - Reasons for Selecting the IBM 7090 Computer for
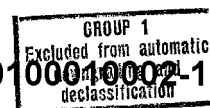
CIA's Scientific Computing Requirements

I. Summary

Many of the Agency's scientific computing applications may

be characterized as follows:

(a) large-scale

(b) tight real-time constraints

(c) short deadlines

(d) relate to external computing activities

(e) involve advanced levels of decision theory.

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The most immediate of the Agency's scientific computing

support needs are those of the DD/R. The DD/R has requested an

initial operational capability of August 1963. To achieve a

scientific computing production capability within the next few

months, it is necessary to choose an appropriately configured

computer with large proven reliability, a computer already pro-

grammed by a large number of scientists/mathematicians, and,

most important of all, a computer having extensive software in

the fields most significant to the Agency. The IBM 7090 meets

these specifications in far fuller measure than any other

machine on the market.

II. Hardware Considerations

    A. Minimum specifications (with some possible trade-offs)

        should be as follows:

        1. Arithmetic rather than character type.

        2. Minimum add time of 10 microseconds.

        3. Minimum of 25k word memory. (Less memory throws many

           matrix programs onto auxiliary storage, thus blowing

           process time.)

> (Most of the externally-generated source
> data which CIA will use in its various
> scientific computing applications will
> have been generated on 36-bit word ma-
> chines. If CIA processes these data on
> other than 36-bit word equipment, dis-
> crepancies will occur between CIA results
> and the results obtained on the original
> 36-bit word equipment.)

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4. Indirect addressing (real-time consideration).

5. Floating point.

6. Tape transmission speed of at least 50,000 characters
    per second. (Real-time considerations might raise this
    to 100-300 numerics per second.)

Several large-scale computers (not to count such very
large-scale machines as STRETCH, LARC, and CDC-6600) meet
the above specifications; e.g., Burroughs-B5000, CDC-1604,
MH-1800, IBM-7044, PHILCO-2000, UNIVAC-1107, CDC-3600 and
IBM 7090/94.

B. Reliability

The basic engineering of 1962-63 models of the above
computers probably is top level. However, in an operational
environment the reliability of a computer system will also
be determined by (1) the compatibility of the central pro-
cesser with its on-line peripheral gear, (2) the extent to
which the reliability of all component parts has been proven
through extensive and varied usage, and (3) experience and
competence of the maintenance engineers.

(1) The IBM 7090 system contains only IBM peripheral
     equipment. Thus, maximum compatibility is assured.

(2) The IBM 7090 alone does about 60% of all scienti-
     fic computing in the world and consequently is by
     far the most thoroughly checked out scientific
     computer available.

(This is a particularly important consideration
when an early operational capability is required.
Other less seasoned computers, although having
features perhaps indicative of the next computer
generation--such as, the Burroughs B5000 with its
list, stack, and Polish notation features--are not
acceptable as initial computers in a "crash"
environment. Such machines should be analyzed
carefully for possible subsequent incorporation,
however, into an operating center.)

(3) As for maintenance, there are more experienced main-
tenance engineers for the IBM 7090 than for any other
machine. Also, the earlier workhorse for scienti-
fic computing, the IBM 704, is basically an IBM 7090
prototype. Thus, not only do more trained engi-
neers exist, but the average scientific computer
experience level per IBM 7090 engineer is greater.

C. Special Hardware Considerations for CIA

The IBM 7090 is an excellent data processor and is an

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ideal complement to the ▆▆▆ IBM 1410 which is now servic-
ing many CIA computing requirements. The IBM 7090 can run
IBM 1410 programs through an available simulator WITHOUT

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REPROGRAMMING, and can share the SAME ▆▆▆1301 disc file.
(Solving of real-time problems within predicted future con-
straints may well depend on such sharing to provide manipu-
lation of pre-computed tables.)

III. <u>Software Considerations</u>

Software may be divided into four categories: (A) Systems Programs, (B) Manufacturer's Library, (C) Users' Libraries, and (D) Customer's Library.

As for systems programs, the IBM 7090 has the most sophisticated and thoroughly debugged programs of any large computer in the world. In the other three software categories, IBM 7090-type programs comprise about 90% of all available scientific software in the free world. Many hundreds of man-years of programming effort are available to the Agency if an IBM 7090 is acquired. And the machine costs for debugging and testing these programs can be considered equivalent to the labor costs. Thus, the IBM 7090 gives the Agency free access to millions of dollars of software. --In short, the software resources of the IBM 7090 are so great relative to comparable machines as to overwhelm any and all other considerations, given the nature of the Agency's needs, present and anticipated.

Most scientific programming in the U. S. is done in some version of FORTRAN (sometimes intermixed with symbolic machine code) which is the most used algebraic compiler language for the IBM 7090. Most unbiased students of machine scientific compiler languages consider FORTRAN somewhat inferior to ALGOL or ALGOL-type languages such as NELIAC, JOVIAL, MAD, etc. Academic circles commonly use ALGOL as the standard form of algebraic expression and communication. Yet when they actually <u>run</u> their

problems on the machine, they use FORTRAN. Thus, de facto,
FORTRAN as used on the IBM 7090 must be accepted as the scienti-
fic man-machine language standard, at least for the immediate
and intermediate future.

A. Systems Programs

To reiterate, the IBM 7090 Systems Programs posture is
without compare. These programs are too numerous to list.
One example: the IBSYS Executive Processor monitors debug-
ging and production and supplies all utility programs
FORTRAN IV, COBOL, and 9PAC (Report Generator which sorts
before generating) are included in the IBSYS package.

B. Manufacturer's Library

The SHARE library contains approximately 1200 programs
(mainly scientific) which will run on an IBM 7090. Most of
these require modification to run on other machines.

C. Other Users' Libraries

1. NSA has the largest library of stream processing pro-
grams in the U. S., most of which are for the IBM 7090.
Subroutines and techniques from this library are avail-
able and will be used in the Agency. Also, NSA has
automatic ELINT processing programs for the 7090 which
can be used in support of OEL, DD/R.

2. DIA has 7090 trajectory analysis programs of possible
use to OSI. CIA also has extensive intelligence files
which are created, maintained, and retrieved by 7090
programs.

3. NASA, STL, NORAD, and SAC have 7090 programs of present

use or possible future use to OSI and to other Agency

components.

4. ██

cessing. The 7090 version has had extensive use.

5. ██

████████(used only on IBM 704/709/7090) which is used for

string processing and symbol manipulation. ████████is

probably the most powerful existing compiler for re-

search in machine translation of natural languages (of

interest to████.

6. ██

7. Naval Electronics Lab (NEL) has written NELIAC, which is

a self-compiler and fast. This language and its trans-

lator, accepted only in limited circles, has had two

years of shakedown on the 7090. NELIAC, while no great

improvement over older languages, incorporates some

advanced features and will probably be used more exten-

sively in research environments in the near future. Few,

if any, machines other than the IBM 7090 can be consid-

ered to have seasoned production reliability in this

8. WECEN (Air Force Weather Central, Omaha) has a vast collection of IBM 7090 programs which concern orbital, trajectory, and geographic-space analysis. Some of these programs will produce answers for the Agency and in many cases, modifications or extractions will give adequate initial answers.

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9. ███████████████████████████████████

███████ has programs similar to WECEN (plus extensive tracking programs) which feed data automatically into an IBM 7090. Since most of these programs were written under U. S. Government contract, they are presumed available to the Agency.

D. Customer's Library (CIA)

1. OSI/DD/I - External contractors are using 709/7090 programs in support of OSI's scientific interests. Pro-

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grams written in Project ████ for OSI have been written for the 1410 and the 709/7090 (all of which can be run on the 7090 without change).

2. COMMO/DD/S - ADPS has just completed 74 hours of production runs on a 7090 at NSA for COMMO's radio propagation job. This task will require henceforth two hours of 7090 time weekly. The 7090 programs for this application are on hand, of course. Other identified COMMO problems not yet programmed will borrow heavily from the 7090 subroutine library at NSA.

3. DD/P - The programs for a special DD/P application are now being written in FORTRAN-II...which is compatible with the IBM 7090.

4. DD/R - All programs existing outside the Agency but being studied now for the DD/R applications can be run on the IBM 7090. (They have been written in either FORTRAN or 7090 machine code.) All DD/R programs converted by ▆▆▆▆ to the IBM 1410 are written in FORTRAN and will also run on the IBM 7090.

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Part II - CIA Tasks for the IBM 7090 Computer

I. DD/R

Two 7090-type projects have been identified to date:

(1) Operational support to OSA. (See special channels memorandum from the DD/R to the DD/S, dtd 4 April 1963, citing critical need for 7090 support to this effort.)

(2) Experimentation with general-purpose computer processing of ELINT data for OEL using programs developed at NSA.

II. DD/I

OSI has the principal requirement within the DD/I for 7090 support. the AD/SI is anxious to set up in-house computing capabilities to (a) cut back on production-type computing now being done under external contracts and (b) provide more immediate and flexible computing support to OSI analysts.

The major areas of DD/I interest are:
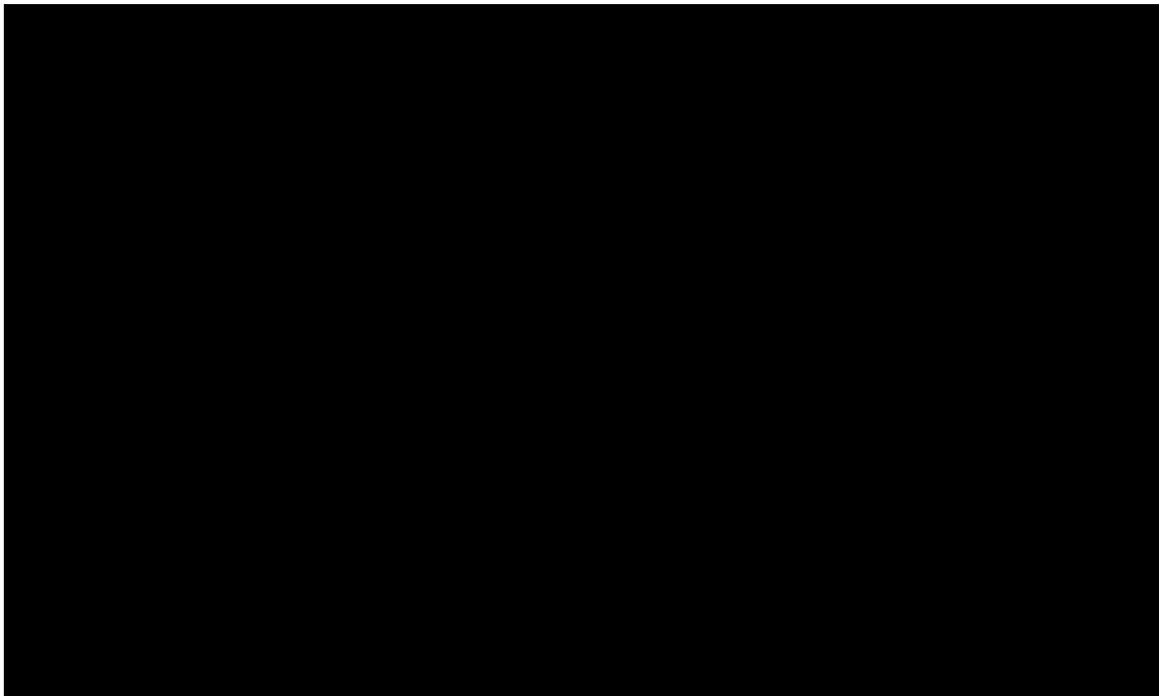
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III. DD/S

There are four 7090-type areas of interest presently identified in the DD/S:

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(1) Predictions of Useful Radio Frequencies (COMMO)

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Radio Propagation Graphs and Charts
(████ supported)

(2) Randomizing Suitable Frequencies (COMMO)

(3) Cryptographic Support (COMMO)

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(4) Engineering support to COMMO Laboratory, ████████████████
(COMMO)

IV. DD/P

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Project ████ is being programmed under external contract in
FORTRAN-II, an IBM 7090 language. Although a small scientific
computer will be used during the laboratory development of Project

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████ IBM 7090 support to this project is feasible and may
occur after techniques and procedures have been set.

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Part III - Immediate Steps to Procure and Install

an IBM 7090 by July 1963

1. **Approval and Authorization**

   Agency management must approve priority acquisition of an IBM 7090 and authorize ADPS to place a priority order with the IBM Corporation now.

2. **Equipment Order**

   ADPS must determine suitable hardware configuration and place a formal order with IBM for priority delivery in July 1963. The IBM Sales Representative has indicated that the IBM Corporation can deliver a 7090 to CIA in July 1963 if the order is placed with IBM by 30 April 1963.

3. **Space**

   A suitable site in the Headquarters Building for the Computer Center must be designated. This Center will house the 7090, the ███████1410/1401, and the Project ███████ computers. These machines will be operationally interdependent (███████ partially excepted) and must therefore be collocated.

Computer Room	5,750 sq. ft.
Tape Library	700
Supplies	400
Operations Personnel	600
Key Punch Room	1,200
IBM Service Engineers Room	350
	9,000 sq. ft.

   The present ███████ Computer Center (1410/1401) now occupies Rooms GE0418, GE0418A, and GE0430A, totaling 2700 square feet.

   The site for the Computer Center must be designated by early May 1963, so that site preparation (false floors, power, air conditioning, etc.) can be completed in July 1963.

4. **Personnel**

   Because the ADP Staff can draw on skills already on board to staff in part for this major extension of CIA computing capabilities, only twenty-five additional ceiling positions will be required.

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Programmers   20

IBM 7090 Operators   5
                        25 ceiling positions

(Systems analysis, additional programming, data preparation, and management skills will be drawn from on-board skills.)

5. Budget

FY-64 funds must be earmarked for this acquisition as follows:

IBM 7090 . . . . $ 750,000

Supplies   50,000

Site Preparation   75,000

Personnel.   225,000
   (25 @ $9,000)   _____
                                 $1,100,000

6. Hardware installation

25X1A   Installation in the Computer Center of the IBM 7090, and relocation of the ███████1410/1401 (already in Headquarters Building) should be completed in July 1963.

7. Recruitment and Training

ADPS will continue its recruitment and training of skills required for scientific computing on the IBM 7090.

████████████████████████████   25X1D

                    Chief
        Automatic Data Processing Staff

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