JOHNSON
STRIER

JOINT USAF-NASA XB-70
FLIGHT RESEARCH PROGRAM

AIR FORCE FLIGHT TEST CENTER
PARTICIPATION

28 June 1965

INTRODUCTION

This package presents information regarding the level of effort that the Air Force Flight Test Center (AFFTC) is anticipating on the Joint USAF-NASA XB-70 Flight Research Program that may be conducted from April 1966 through April 1968.

It is recognized that there will be a large amount of contractor (North American Aviation, Inc [NAA] and the General Electric Company [GE]) services required, especially if the program is of only two years duration. These services are expected in maintenance, logistics, data calibration and sustained design engineering support. The test and evaluation will be planned and conducted jointly by the NASA Flight Research Center (FRC) and the AFFTC. The AFFTC will have the major responsibility for operating the two XB-70 aircraft and will conduct the systems engineering and performance evaluations. The FRC will have prime responsibility for achieving the research objectives set forth by the Air Force and NASA.

The main direct AFFTC effort will be from the Deputy for Systems Test (see attached information). Up to 16 engineering man-years may be expended per year. Technical support such as range facilities and data reduction will be provided on a scheduled basis. The Deputy for Maintenance will continue to provide a small group of flight line maintenance personnel and will continue to provide a large amount of shop support. Other base activities will continue to perform services and provide materiel (?) Jenks (i.e., fuel, oils, etc.) as they are doing for the present program (Reference AFFTC/NAA Services and Support Agreement).

The AFSC Test Site office is currently performing Contract Management functions and will continue to do so for the follow on program.

Depending on the criteria established for either testing or test bed application for the XB-70's following the two-year joint program the AFFTC is prepared to begin preparing a completely blue suit capability for operating the aircraft. This capability will, however, require additional manpower (up to 150 personnel).

EDWARDS AFB MANPOWER EXPENDITURES

ORGANIZATION	MAN-YRS/YEAR	
	Present (1 Acft)	Joint Use (2 Acft)
AFFTC		
Deputy for Systems Test		
XB-70A Joint Test Force Office	6.2	7
Directorate of Technical Support		
Data Systems Engineering Div.	1	2
Data Systems Div.	5.5	14
Engineering Measurements Div.	1.3	2.6
Photography Div.	1.2	2.2
Space Positioning Div.	1.2	3.6
Directorate of Flight Test Engrg.		
Systems Engineering Div.	2.2	4
Performance Engineering Div.	1.2	4
Flight Research Engineering Div.	-	8
Directorate of Flight Test Operations	1.1	2
DEPUTY FOR MAINTENANCE		
Organizational Maintenance Squadron	3	3 FTB Additional personnel
Field Maintenance Squadron / C & E Maintenance Squadron	12	24
6510 USAF HOSPITAL		
Environmental Section	1.7	3.4
AFSC TEST SITE OFFICE		
Contract Administration	.1	.1
Production	.1	.1
Quality Assurance	3.3	3.3
TOTAL	41.1	83.3

Note:
Present expenditures are based on data available from Sep 64 through May 65.

ENGINEERING

CONTRACTOR

The airframe and engine manufacturers will be contracted to provide design engineering support both onsite and in Los Angeles. Five onsite contractor engineers will be required to provide continuity between the existing contractor controlled program and the joint program. Speciality areas required are not precisely identifiable at this time; however, it is anticipated that engineering support will be required for the major subsystems (hydraulic, inlet control, flight controls, engines and electronics). North American Aviation and the General Electric Company will be required to continue detailed analysis of critical areas as pertain to flight envelope expansion. Additionally, a call or service contract will be required to provide design engineering support for modifications and repair.

AFFTC ENGINEERING

The Air Force Flight Test Center is cognizant of the importance of a follow on flight test program to research for the supersonic transport and other research for national interests plus the experience and capability that can be gained. The Center is highly interested in actively participating in and contributing to the XB-70A effort. Stated below are areas of Air Force effort that have been agreed upon with NASA-FRC. Personnel assignments are based on present workload forecast, but are not made without sacrifice of effort on Category I and II test programs to which these engineers would otherwise be assigned. The Deputy for Systems Test may require additional personnel to maintain the level of effort expected by the SPO's and using commands.

Systems Engineering

The systems evaluation will assume the nature of a Category I-II program which will demonstrate flight safety to provide an operational flying test bed. The systems will be evaluated to determine their capabilities or limitations in the environment presented by their aircraft. Flight planning in the systems area will be done by the systems engineers onsite. Data will be accumulated and tabulated from personal observations, cockpit recorders and cameras, and the air vehicle instrumentation package. Quicklook parameters of reduced data will be scanned after each flight and areas of concern would be identified by the applicable systems engineers. NAA design group would continue to pro-

vide detailed analysis in critical areas such as inlet control, flight control and structures. An Air Force systems evaluation report will be prepared. NAA will provide on call design engineering support for aircraft modifications and repair.

Systems Engineering can provide four engineers minimum to the program by Nov 65. A total of nine systems engineers will be required. Five of these engineers must be provided under contract with NAA unless additional slots are authorized. The systems engineering group will be used in the following areas:

	Systems Engineers
Environmental and escape systems	1
Engines and fuel system	2
Hydraulics, landing gear and brakes	1
Structure and a/c general	1
Electrical and flight instruments	2
Flight controls and AICS systems	1
Engineering supervision	1
	9

Performance and Stability and Control Engineering

The Performance Engineering Division, with the assistance of the Flight Research Division will conduct the performance flight tests and data analysis for the joint program. This Division will actively participate in flight planning and flight following. Data analysis will be performed by using AFFTC computer equipment. Existing North American Aviation and General Electric Company data analysis routines will be used and modified as required to meet the data requirements and to incorporate analysis techniques for new flight test methods. IBM programming and computing for this effort will be performed by the AFFTC Data Systems Division. Other technical support, such as pace aircraft and space positioning will be provided by the AFFTC. The Flight Research and Performance Engineering Divisions are currently developing techniques and analysis methods for nonsteady state performance testing. It is anticipated that a combination of the stabilized and nonsteady state performance testing will be used.

The Performance Engineering Division, while not responsible for the stability and control tests, will monitor this area and participate as negotiated and required at the time the tests are conducted. Techniques for extracting stability derivatives and employing them in flight simulation are unfamiliary to this Division; working with NASA and the Flight Research Division in these areas will advance the AFFTC's Capability for flight testing supersonic vehicles.

The Performance Engineering Division has anticipated assigning four personnel to this engineering effort.

Flight Research

The Flight Research Division is very interested in gathering useful information from the XB-70 follow on program in support of our present and forecasted mission. These areas include:

a. Exploration and development of flight operations procedures of high supersonic aircraft (considering the environmental effects, turn-radius, and sonic boom constraints in takeoff, climb, cruise, descent and approach).

b. Exploration of heating and cooling problems for the prediction, determination of temperatures involved and thermal stresses encountered and effects on subsystems.

c. Evaluation of capabilities as a test bed vehicle for future research programs.

d. Evaluation of characteristics of a Mach 3 configuration throughout its flight envelope.

e. Exploration of supersonic store separation characteristics.

f. Development of techniques for obtaining stability data, evaluating handling qualities, obtaining performance data with nonsteady state conditions and development of techniques for obtaining in-flight thrust measurement.

g. Development of techniques for subsystem performance evaluation and evaluation of unique test instrumentation such as transducers in a high temperature environment.

This office could apply two research engineers full-time (assuming all positions are filled and are not cut) for development of detailed flight test plans and monitoring of research results being obtained. An additional engineering effort of up to six or eight man-years per year would be available to work with the research results as results pertaining to our mission are obtained. This effort would include a relatively large simulator programming effort early in the program prior to the attainment of quantities of research data.

TECHNICAL SUPPORT

GENERAL

The following is a summary of support currently being provided to the B-70 Test Force and North American Aviation Company in support of the B-70 flight test program:

a. Data acquisition and transmission system (DATS) support

   (1) Communications
   (2) Telemetry (FM/FM)
   (3) Radar

b. B-70 test control (Display Facility)
c. Range control coordinator
d. Telemetry tape dubbing (NASA)
e. Telemetry tape recording
f. Closed circuit TV display
g. GRC-27 communications backup (local area)
h. Use of various display facilities

   (1) Offner display
   (2) Brush records
   (3) Console display
   (4) Radar display
   (5) Digital display

i. Takeoff and landing data reduction
j. Radar data reduction as required
k. Main Range Askania data reduction as required
l. Range data analysis support
m. Telemetry van (loan)
n. Computer facilities
o. Digital data processing in format radar data
p. Calcomp plots (range data)
q. Data Systems personnel as required to support the above functions.

Support which can and will be provided on a scheduled basis is as follows:

a. Range support as being provided at the present time. This includes radar, optical cinetheodolites, takeoff and landing towers, XB-70 control room in Bldg 3940, data acquisition and transmission system (DATS) microwave transmission of telemetry, voice communications, radar data for the Edwards Flight Test Range complex. For

the time period of the planned follow on program, this will provide support from Wendover, Utah - Edwards AFB - Air Force Western Test Range inclusive.

b. Technical facility support will include Weight and Balance facility, thrust stand, moments of inertia platform.

c. Complete photographic support will be provided. It will include support such as being provided now plus additional support in the areas of photography from photo-chase aircraft and in the area of still photography (i.e., hardware failures, etc.).

At the outset in April of 1966 it is requested that North American Aviation provide calibrated test data for data analysis. The Data Systems Division will attempt to ultimately develop a capability to accomplish this function at a later date.

Based on the increased workload caused by AFFTC responsibilities, the following minimum additional (above present level) personnel will be required in the following areas:

Mathematicians	3
Instrumentation	2
Photographer - Still	1

These are the minimum required and present unknowns could easily cause increased requirements. Either additional manpower authorizations can be provided or per direction, the job can be done with an equivalent reduction of support to other AFFTC programs. It is felt that additional man-hour effort above the additional personnel cited will be accomplished using available resources.

INSTRUMENTATION

Data Processing

The AFFTC will modify existing GE and NAA IBM programs to accomplish the data reduction and analysis for those functions assigned as AFFTC responsibilities (i.e. performance flight tests). At least for the initial phases of the program, North American Aviation will be required to provide calibrated data to NASA and the AFFTC for inclusion in the data analysis to be done at Edwards AFB.

The PCM ground station, calibration and scaling equipment is not presently available at NASA or the AFFTC. The AFFTC has programmed equipment that will be capable of receiving the PCM data; however, the maintenance of instrumentation calibration would remain a major contractor effort if the AFFTC became capable of providing the complete data processing operation. One Air Force instrumentation engineer will be provided to act as liaison between Flight Test Engineering and the contractor.