

EXHIBIT "A"

January 17, 1962

APOLLO OPERATIONAL CONTROL AND INFORMATION FLOW DESIGN AND DEVELOPMENT
CONTRACT

A. General Information

1. Project Apollo is the National Aeronautics and Space Administrations program for the development of a vehicle which will be capable of the following types of missions and return to earth:

- a. Earth orbital for extended periods.
- b. Highly elliptical cislunar flights.
- c. Circumlunar flights.
- d. Lunar orbit.
- e. Soft landings on the moons surface.

In all of these missions, the spacecraft will carry a three-man crew and it is anticipated that the soft landing on the moon's surface will also involve a rendezvous phase to achieve the necessary mission energy management. It is intended that optimum utilization shall be made of the crews capabilities in each of these missions.

2. The Manned Spacecraft Center of the National Aeronautics and Space Administrations has the following project responsibilities:

- a. Overall control and coordination of the project activities.
- b. Design and development of the spacecraft and its service modules.
- c. Control of the flight programs.
- d. Detailed performance specification for the ground operational support system.

Encl 1

e. Design specifications and the implementation of the mission control centers.

3. In support of the project described in paragraph 1 the contractor will work in conjunction with and assist the Manned Spacecraft Center in the areas described in paragraphs 2d and 2e.

B. Work Scope

1. The work scope of this contract will include studies related to the development of an information flow concept for the flight operations and the ground operational support systems associated with Project Apollo, and studies related to the design of the mission control center and its attendant facilities which will be required to support Project Apollo.

2. Establish the information flow requirements throughout the GOSS system and define the order of conditioning required and/or make recommendations in accordance with: enabling adequate mission control within the mission rules established by MSC, adequate handling of both spacecraft or ground system contingency situations, the available amount of communications bandwidth with respect to real-time information flow requirements. Establish the information flow requirements within the mission control center, the launch center, remote sites, and the landing and recovery centers to enable adequate preparation for and control of the various phase of the flight missions.

This will include the management and manning organizations within these facilities (excluding the personnel responsible for operating the support systems) the man/machine relationships, including mechanisms related to data interpretation, assimilation, decision, and subsequent action support, and

the interpersonnel communications including the interface communications requirements with the technical support of the systems supervisor.

3. Establish the information flow throughout the GOSS system in terms of actual data available at source versus data required at termination, required data flow rates versus available data flow rates, permissible error rates versus probable error rates, time sequencing of information versus real time commitments. This will include considerations of available systems performance capabilities, man machine interface advantages and limitations, data conversion requirements.

MSC will provide information pertinent to the contract including: the basic physical concept of the GOSS and the basic vehicle trajectories, the onboard vehicle systems analysis related to the systems performance monitoring requirements, modes of operation, probable failure modes, basic ground rules pertinent to the mission objectives, the abort, and recovery sequences and the landing sequences, elements of compatibility which must exist between the vehicle subsystem and the GOSS, basic instrumentation of the spacecraft. Provision of the above information does not preclude the contractors participation in developing certain of these aspects, neither does it preclude the contractors recommendations to revisions or changes to these aspects.

Work Effort

Phases: - The following phases will be completed in accordance with the schedules shown in Fig. 1.

Phase A. The contractor will work with the Manned Spacecraft Center in developing the general information flow requirements for the Apollo

missions. These requirements will be developed from basic concepts for the vehicle and the GOSS which will be provided by the MSC. During this phase of the contract the contractor will take full cognizance of the basic concepts and analyze them for over all project support compatibility and make recommendations as deemed necessary to the Manned Spacecraft Center.

Phase B. The contractor will work with the Manned Spacecraft Center in developing an integrated information flow plan which will include the operational aspects associated with Project Apollo and will incorporate the predetermined information flow requirements. The plan will be detailed to the extent that it will allow preliminary determination of the basic implimentation requirements associated with the information plan including limited mockups of some technical information facilities such as display consoles, etc.

Phase C. Subsequent activity not included within this contract will include construction of full-scale mockups and operational facilities to full demonstrate the information flow plan, its feasibility and practicability to this project, and leading ultimately to the design and evaluation of the mission control center.

4. This work statement specifically excludes responsibility for the following:

a. The geographical location of the ground operational support system facilities.

b. The design of the network support systems including tracking, acquisition, world-wide communications, all air/space ground RF systems, computational systems associated with tracking and trajectory determination.

- c. Trajectory analysis computation, and error analysis.
- d. Determination of mission objectives.
- e. The design of the spacecraft, the launch vehicle or the launch system

However, some design requirements for the implementation of certain of these aspects would be expected to be derived from the contract.

5. Definitions

Throughout the text of this work statement, and in response to the RFP the following definitions are applicable:

- a. Spacecraft: - The spacecraft consists of separate modules.
 - (1) Command module: - A recoverable module housing the crew and all the crew initiated control functions.
 - (2) Service modules: - Unmanned nonrecoverable modules containing the various propulsion systems required for the various Project Apollo missions.
 - (3) Space lab modules: - An unmanned habitable nonrecoverable module support special test equipment. This module would be associated with the earth-orbital phases of Apollo.
- b. Ground operational support system: - All ground based equipment associated with Apollo mission flight support including all tracking and data systems, the operational control centers, remote instrumentation sites, the communications systems, and the overall flight operations concept.
- c. Information flow: - As applied to this contract the term information flow includes all of the data and intelligence exchanged between the vehicle and the GOSS, and between all the elements which comprise GOSS in the support

of the various Apollo flight programs.

d. Launch. - The time period and activities associated with launch extend to the moment of lift-off of the launch vehicle.

e. Powered flight. - Anytime that the spacecraft is subjected to the change in velocity either from the launch vehicle or its integral service modules.

f. Insertion. - The placement of the spacecraft into an earth-orbiting capability.

g. Injection. - The achievement of earth-escape velocity, or the translation from earth orbit to a lunar transfer ellipse.

h. Landing. - Earth impact.

i. Operate. - Establish systems and equipment performance.

j. Operations. - A coordinated activity associated with flight control of any mission.

k. Mission. - Any activity which exercises GOSS in a manner pertinent to the support of manned space flight.

C. Technical Guidelines

The ground operational support system for Project Apollo will be large and the operation coordination of this system will be extremely complex. Basic to the operational coordination of the GOSS is the associated information flow.

The following description outlines some of the basic concept for Apollo as may be assumed pertinent in responding to the R. F. P.-

1. Ground Support Stations

a. Mission Control Center. - A mission control facility responsible for the coordinated support of the Apollo spacecraft. This center must be

implemented to allow real time support to the Apollo spacecraft and its crew, and to make the necessary control decisions with respect to the attainment of the basic mission objectives. This center can be assumed to support its own computational facilities and its own communications control facilities (data, teletype and voice).

b. Remote Sites.

Launch. - The launch site will be located at Cape Canaveral, together with the attendant facilities for preparation of the spacecraft, the booster and their assembly and preparation for powered flight. The site will include tracking, guidance, command, and other communications to support the powered flight phase following launch. Subsequent to launch and orbital injection, the launch site-tracking and communications facilities will act as a remote site.

Orbital Support. - Typical of the present remote sites for Project Mercury, these sites will support tracking, command, and other communications to the spacecraft.

Lunar Flight Support. - A limited number of sites such as the DSIF, or the possibly modified Mercury sites, will support specialized tracking and communication facilities.

Landing and Recovery. - A limited number of control centers located in the prime and secondary planned landing areas supporting specialized systems to assist the spacecraft during the landing phases.

2. Integrated Communications System

A network of data, teletype, and voice circuits, plus remote data conversion and processing systems as dictated by the information flow plan. This network will be engineered and programmed to support all phases of the Apollo program while at the same time affording maximum reliability

and performance in support of the mission objectives.

3. Basic Information Plan

a. Tracking. - Tracking information and the associated support information will be transmitted throughout the network for computation, display and operational application.

b. General Logistics. - Network and operational administrative traffic should be considered in determining data flow requirements.

c. Operational Information. - Routine information concerning the operational readiness of the GOSS and other data pertinent to establishing a compatible mission environment; information exchange associated with the real time operational support of the spacecraft and its occupants.

d. General Administration. - Routine information exchange between the many agencies and organizations associated with Project Apollo and its operational support.

4. Aspects of the information flow requirements include:

a. Data Source.

b. Application.

c. Routing.

d. Conversion.

e. Transmission.

f. Reduction.

g. Interpretation.

h. Action.

5. These aspects apply to:

a. Basic manning concepts associated with operational information flow.

b. Tracking and associated data.

- c. Vehicle telemetry data.
 - d. Ground transmitted data to the spacecraft.
 - e. Data exchanged between the remote sites and the -
 - (1) Mission Control Center.
 - (2) GOSS management organizations.
 - f. Voice communications between -
 - (1) Remote sites and the spacecraft.
 - (2) Remote sites.
 - (3) Remote sites and the Mission Control Center.
 - (4) Mission Control Center and the spacecraft.
 - (5) GOSS and its management agencies.
6. The types of communications used will include:
- a. Voice.
 - b. Teletype 60/100 words per minute.
 - c. H. S. data 2000-3000 Bit/Sec.
 - d. Facsimile.
7. The types of carrier mediums involved may include:
- a. Open line carriers.
 - b. Coax cable carriers.
 - c. HF carriers SSB/DSB.
 - d. Microwave carriers.
8. Terminations will include the following types of presentation:
- a. Printed page.
 - b. Projected copy.

- c. Audial.
- d. Strip charts.
- e. Visual displays.
- f. Recorders.
- g. Plotboards.
- h. Data conversion system inputs plus output routines.
- i. Computer inputs plus output routine.

9. The basic scope of Information Flow Requirements, are shown in Fig. 2.

D. Contract Management and Control

1. The contractor will be required to demonstrate and exercise original skills in satisfying the work statement, and the contractor will establish mechanisms to ensure that MSC Flight Control Branch is advised of all developments related to the contract. All work undertaken by the contractor will be subject to controlling inputs and directives from MSC Flight Control Branch.

2. Certain hardware as may be developed for MSC within the scope of the contract will be the property of NASA and shall be located at facilities to be specified by MSC.

3. The contract will be subject to formal monitoring by MSC, to ensure that contract progress is timely and compatible with the work requirements.

Contract monitoring will be achieved by the following:

a. Monthly report describing contract progress for the previous month and projected progress for the succeeding two months. The report will include schedules of all known milestones and technical meetings related to the contract, and funding expenditure statements of: Blanket contract expenditure to date, contract expenditure for current month, and projected contract expenditure for next two months: singularly large expenditures will be itemized.

b. Monthly informal presentations by the contractor to members of MSC. These presentations will be on the first Tuesday of every month, subject to mutual consent. These presentations will be informal and include routine perusal of the projected work requirements.

c. Three-monthly formal presentations by the contractor to MSC. These will include slides, charts, etc., and will reflect the contract activity for the previous three months and the projected three months.

E. Contract Relationship

1. The contractor will coordinate through MSC all meetings and correspondence with other NASA and DOD agencies relating to this contract.

2. The contractor will be directed only by Manned Spacecraft Center in matters relating to this contract.

3. The contractor outputs resulting from this contract will not be considered as proprietary information. The information contained therein may be distributed to other organizations but only at the discretion of MSC.

4. The contractor will establish a liaison group of persons within MSC facilities, and will make provision for periodic accommodations of not less than two NASA personnel within the contractor's facilities.

5. The contractor will not change the key personnel associated with this contract without the mutual consent of the MSC.

CONTRACT LET MID-MARCH 1962

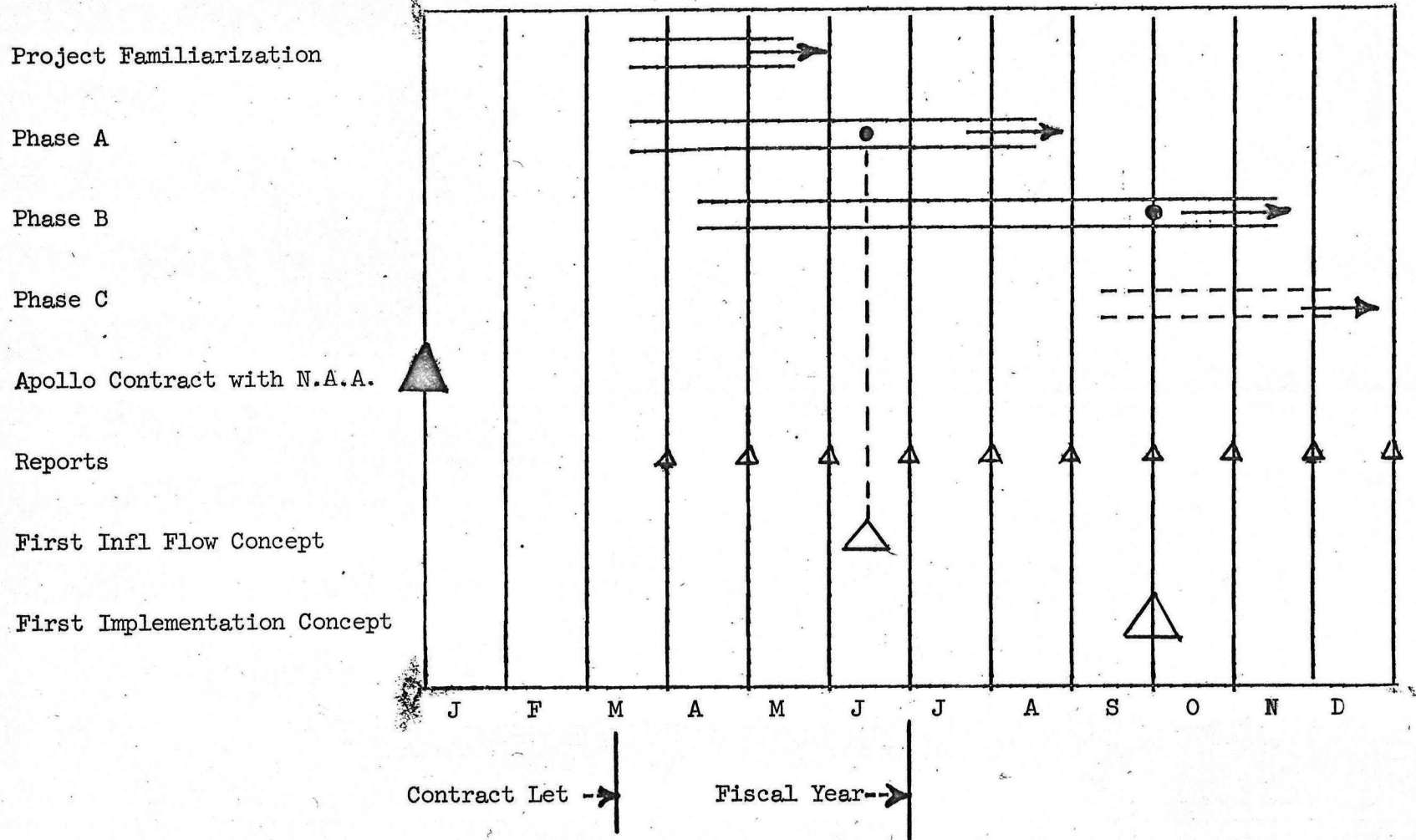


Figure 1 (1/20/62)

