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SECTION VI

PROGRAM MANAGEMENT

LUNAR EXPEDITION (U)

(LUNEX)

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6. PROGRAM MANAGEMENT

6.0 MANAGEMENT FOCAL POINT

The focal point for management of the Lunar Expedition Program will be a Lunex Program Office within the Space Systems Division, AFSC. The Director of the Program Office will coordinate, integrate, monitor and direct all activities of the Lunar Expedition Program. Subordinate to the Director will be managers for major parts of the program. A tentative organizational chart for the Program Office is shown in Figure 6-1.

6.1 RESPONSIBILITIES

a. The Earth Launch Complex Office will be responsible for the civil engineering aspects of building up the earth launch base. The immediate problem of this office will be a site selection survey.

b. The Earth Launch Vehicle Office will be responsible for all earth launch boosters required for this program.

c. The Lunar Landing and Launch Vehicles Office will be responsible for all development and testing of the Lunar Landing Stage and Lunar Launch Stage.

d. The Manned and Cargo Payloads Office will be responsible for the development of the 3-man Lunex Re-entry Vehicle and the Cargo Package. This will be one of the key offices in the entire program since it will be concerned with such major technical areas as life support equipment, re-entry problems, secondary power and structures.

e. The Communications and Data Handling Office will be responsible for establishing the communications network and centralized data handling organization. It will also concern itself with communications problems between the earth, the moon, and the Lunex Re-entry Vehicle and point-to-point on the lunar surface.

f. Guidance and Flight Control Office will be responsible for developing: ascent, mid-course, terminal, lunar ascent, and re-entry guidance equipment.

g. The Lunar Expedition Facility Office block (shown in dotted outline) indicates that that office will be established at a later time since the problems associated with the expedition facilities are not of immediate concern.

h. The Plans Office will be responsible for examining other potential uses of equipment developed for the Lunex Program. For example, the same equipment could be used for sending men around Mars and Venus, or perhaps effecting a landing on Phobos. Considerable planning also needs to be done regarding the exploratory phase of the Lunar Expedition.

i. Programming Office will be responsible for scheduling and budgeting of the entire program. This office will have under its control a network of computers designated as the PEP program.

j. The Technical Integration and Support Office will be responsible for insuring the technical compatibility of all components of the system, such as, that the vibration is within tolerable limits during the boost phase when all components of the system have been put together. This office will also provide technical assistance to each of the main component offices. The component office such as the Manned and Cargo Payloads Office will not rely entirely on the Technical Integration and Support Office for assistance, but will be free to obtain the best technical advice available in the nation from whatever source is necessary, such as other government laboratories or universities. This Technical Integration and Support Office will be manned by Air Force officers who will be responsible for the various disciplines and for technical support from the Aerospace Corporation.

k. The Reliability Office will insure that a strong reliability and safety program is followed by all contractors throughout the program. Since reliability and safety is of such extreme importance in this program every effort must be made to insure the reliability of the final equipment. This can only be done by giving proper recognition to the problem at a high organizational level where policies and recommendations can be recognized and implemented.

6.2 PROGRAM OFFICE MANNING

A Program Office must be established immediately after program approval if planned schedules are to be met. It is estimated that an initial buildup to 72 officers plus 35 secretaries will be required. A requirement for 100 MTS will be established with the Aerospace Corporation. In view of the magnitude of the program, which will build up to more than one billion dollars a year, a larger Program Office will be required. Planning for these increased manpower requirements will be accomplished by the Program Office, after it is established. Suggested initial distribution of personnel within the Program Office is as follows:

a.	Lunex Program Director	4
b.	Plans	4
c.	Programming	6
d.	Technical Integration and Support	20
e.	Reliability	2
f.	Earth Launch Complex	5
g.	Earth Launch Vehicle	5
h.	Lunar Landing and Launch Vehicle	5
i.	Manned and Cargo Payloads	15
j.	Communications and Data Handling	3
k.	Guidance and Flight Control	3

6.3 ORGANIZATIONAL RELATIONSHIPS

There will be a continual and energetic exchange of direction and information between personnel of the Lunar Program Office and development contractors. Because of the complex nature and magnitude of the program, the Program Director will be required to deal with many contractors from diverse technical areas. It is envisioned that an associate contractor will be selected for each major portion of the program, who will, in turn, use many supporting contracting various technological capabilities. Technical integration and support will be accomplished by the Aerospace Corporation under the overall guidance and control of the Program Office.

6.4 AIR FORCE DEVELOPMENT AND SUPPORT

The Lunex program office will work with the Technical Area Managers within AFSC. The Technical Area Managers have project responsibility for development of solutions to technical problems such as those associated with guidance, materials, rocket engine propulsion, life support, etc. Each Technical Area Manager will identify and emphasize those critical technical problems to which specific effort must be directed in order to attain a capability required by the Lunex program.

6.5 OTHER AGENCIES

Specific arrangements will be made with other agencies as requirements arise in the development of the Lunex program.

6.6 MANAGEMENT TOOLS

The basic philosophy of developing all elements of this program on a concurrent basis introduces rigid scheduling requirements. Specific tasks must be defined and scheduled. However, when development problems dictate that many factors be varied to keep abreast of advancing state-of-the-art, concurrency and even the end objectives are affected and possibly delayed. A management tool which uses an electronic computer will be used to support the Program Director in planning, operating, and controlling the Lunar Expedition Program. It will be initiated in the early stages of the Program and will continue to be used throughout the expedition phase. This management tool called Program Evaluation Procedure (PEP) will assist the Director by providing:

a. A method of handling large masses of data quickly, efficiently and economically.

b. The capability to locate, identify and this correct trouble spots.

c. A capability of integrating the many varied and complicated facets of the Lunar Expedition Program.

6.7 PEP

The PEP management tool is made possible through the use of an electronic digital computer. The scheduling and monitoring of many thousands of items required in the Lunar Expedition Program make the use of this computer technique imperative. The PEP approach employs linear programming techniques with a statistical concept in conjunction with the electronic computer. This procedure facilitates the analysis of interrelationships of many thousands of program elements. The results are presented as program summaries upon which the Director can base decisions. (See Fig. 6-3)

The first step in using the PEP management tool is to make a detailed analysis of the overall Lunex Program. Each major event, milestone, or accomplishment that must be achieved is listed in chronological order. The events must be well defined and should occur at an instant of time which can be identified. A network, or a program plan chart, is laid out in which the events are shown as points or circles whose positions roughly represent their chronological order. Interrelationships between the events (circles) and sequence of events are shown by connecting lines. The line between the events represents work that must be done to proceed from one event to the next (See Figure 6-4). The computer then totals all of the expected activity times along every possible (in the thousands) route of the network from start to the end event. The PEP computer then examines the total times of the large number of paths in order to find the longest which is called the critical path. The critical path defines the sequence of events which will require the greatest expected time to accomplish the end event.

The effects of a delay for any particular milestone or event on the entire program or on any other event can be quickly and efficiently determined so that corrective action can be taken if required.

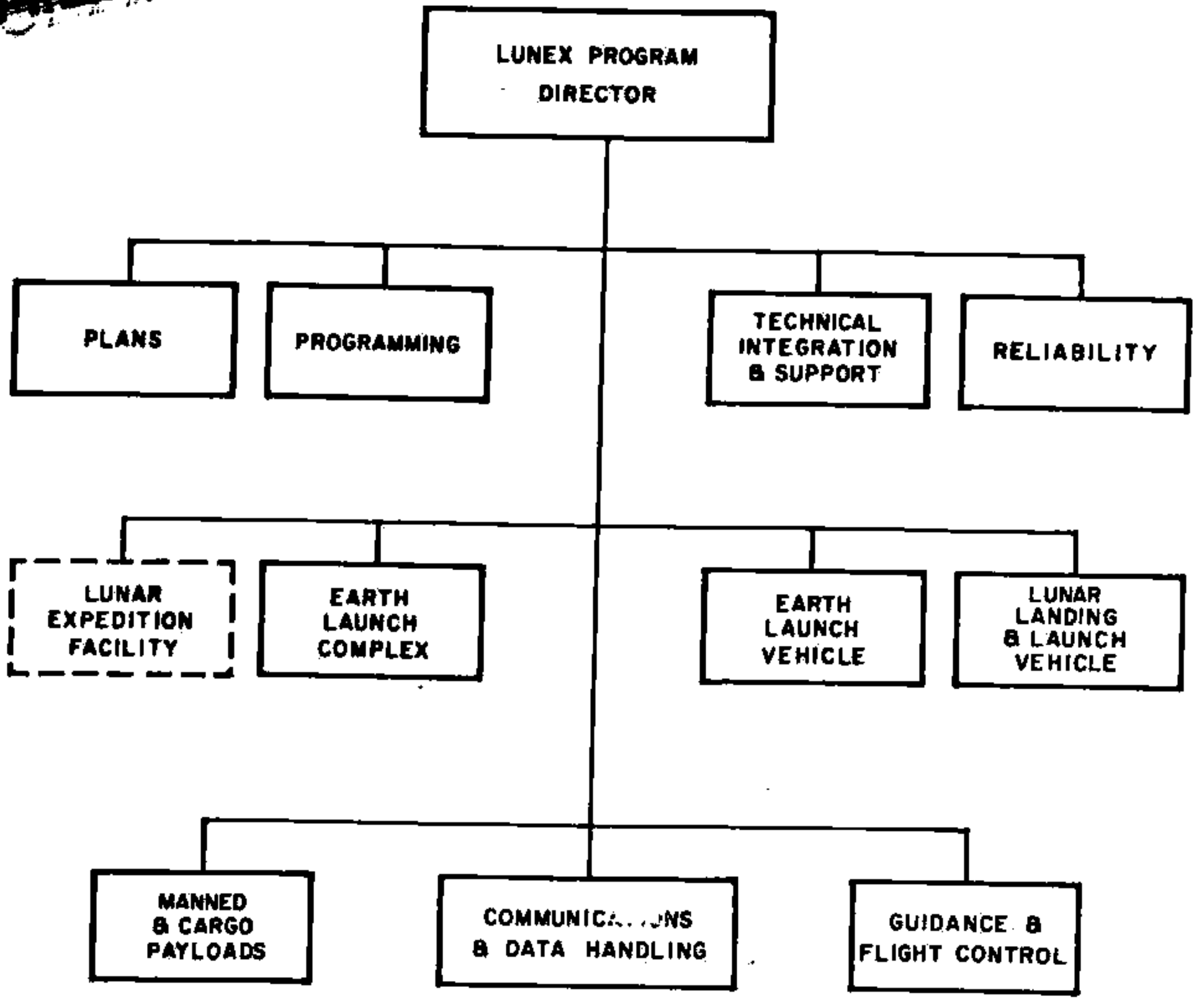

FIGURE 6-1 LUNEX PROGRAM OFFICE

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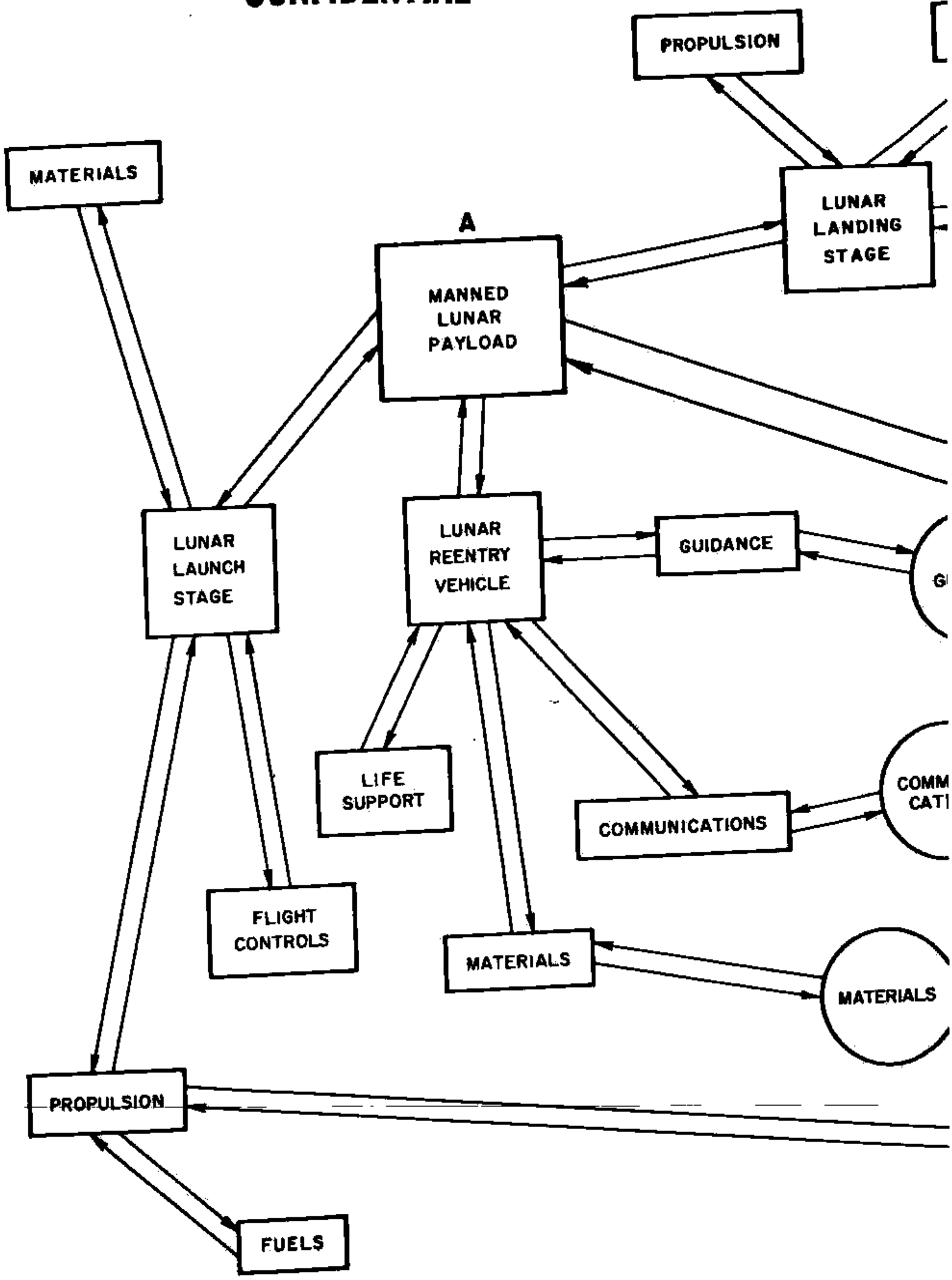

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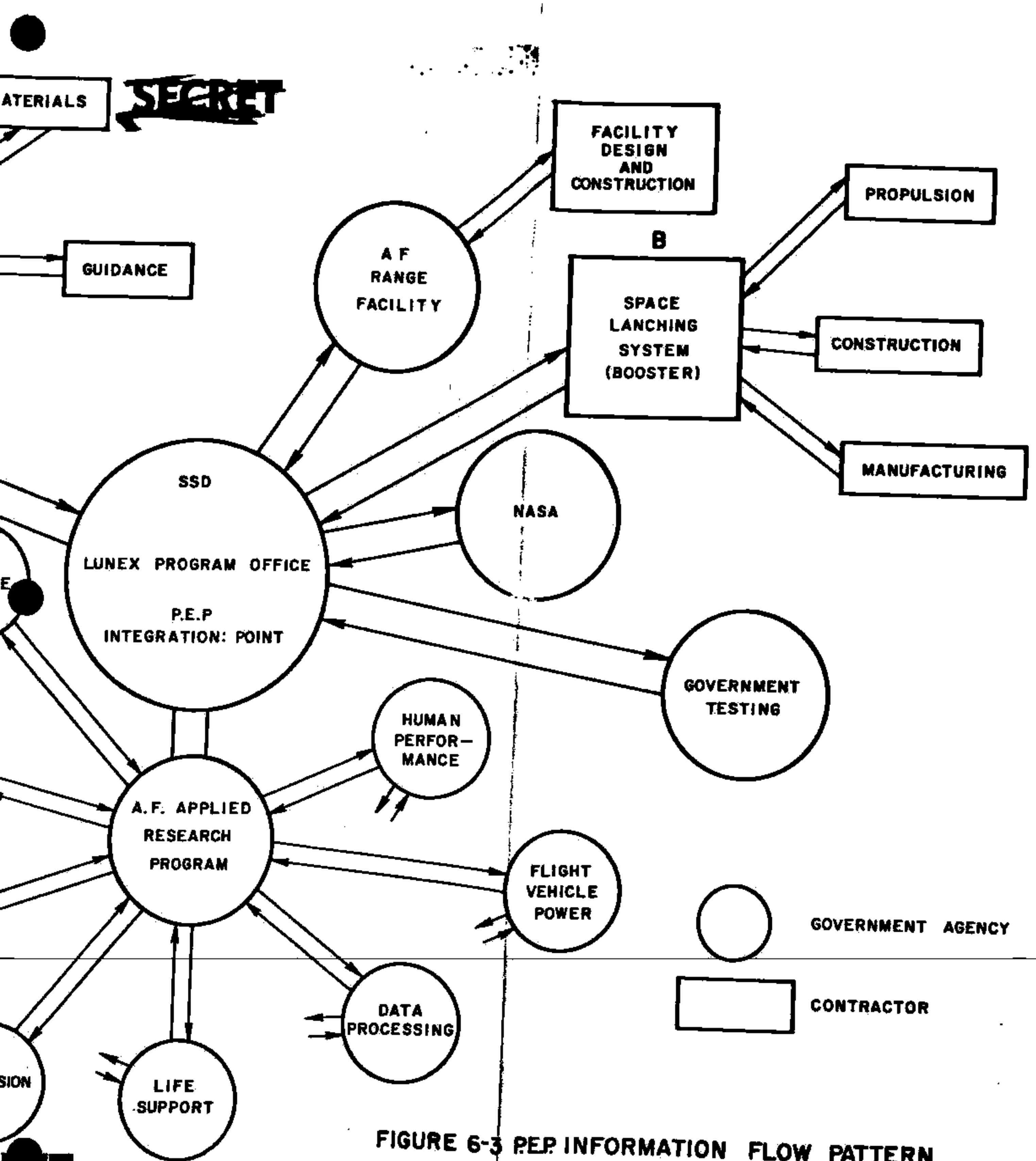

FIGURE 6-3 P.E.P INFORMATION FLOW PATTERN

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SECTION VII

MATERIEL SUPPORT

LUNAR EXPEDITION (U)

(LUNEX)

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7. MATERIEL SUPPORT

7.0 INTRODUCTION

It is intended that this program use two significant concepts that will result in better management of the materiel support program. These are the Delayed Procurement Concept and the Responsive Production Concept. Under the Delayed Procurement Concept, the ordering and delivery of high-cost insurance-type spares is deferred until the final production run must be made, allowing for the accumulation of maximum operational experience with the new item before a final spares order must be placed. Under the Responsive Production Concept, a portion of the requirement for high-cost operational spares is procured in unfabricated, unassembled form. When the spares demand can be more reliably predicted, based on actual usage experience, additional complete spare items can be produced within a very short lead-time period. When experience fails to justify a requirement for additional complete spares, the materiels and parts involved can be utilized in end article production. The policy shall be to buy minimum quantities of high-value spares and maintain close control over their transportation, storage, issuance, and repair until they finally wear out, or are no longer required. Simplification of procedures and relaxing of restrictions on low-value items will provide the means (man-power, machine time, etc.) for more precise management of high-value items.

7.1 SUPPLY

Maximum utilization will be made of existing assets. Where practical, equipment and parts will be reclaimed from completed test programs, repaired, modified and overhauled to suitable condition for use in later tests and operational tasks. The procedures and paperwork involved with procurement of spare parts must be streamlined to permit maximum flexibility in planning and responding to a continually changing configuration. Immediate adjustment of inventories and reorder points must result from test program and engineering changes. Selection of spare parts should be made at the time of initial design to enable procurement of spare and production parts concurrently to eliminate reorder costs resulting from separate procurements.

Determination of quantities, reparable-overhaul-modification planning, control etc., shall be accomplished and directed by a permanently organized and active group composed of personnel representing the engineering, production, materiel, reliability, quality control, procurement and contract departments, and the various affected sections within these departments such as design, test, planners, etc., attending as required. The AFPR will have a member assigned to this group for surveillance purposes and to provide logistic guidance on problems which may require advice from the Air Force.

Persons assigned to the group shall be well qualified by reason of experience and technical ability.

The procedures and paperwork involved shall be streamlined, taking due cognizance of the powers and capabilities of the above group to permit maximum flexibility in planning and the quickest possible response to changes and emergency situations.

The group will pay particular attention to control of hi-value items and items critical to the needs of the expedition and test program. Such items, particularly those potentially subject to imminent redesign, will be rigorously screened to assure economical inventory and the best possible repair, overhaul and modification planning at all times.

The group shall be responsible for the following:

a. Immediate adjustment of inventories and reorder points resulting from changes to the delivery schedule, the test program, and for engineering changes.

b. Inventory review and adjustment of initially established stock levels and/or reorder points in light of latest experience gained from the test program every time reorder or minimum stock levels are reached.

c. Review of stock levels, and adjustment and/or disposition of non-moving items on a continuing basis, but at intervals not to exceed sixty (60) days for any individual hi-value items and 180 days for other items, or at other intervals as agreed upon by the Contractor and the Contracting Officer. This is to include the return to production of any surplus quantities for rework to later design requirements.

d. Control of repair-overhaul-modification planning.

7.2 DISTRIBUTION

The Contractors shall develop internal working procedures which encompass the following requirements:

a. Inventory levels shall be programmed to vary with anticipated utilization. Shipments in advance of estimated requirements will not be made except when it is clearly in the best interest of the program to do so.

b. Stock levels shall be minimized by maximum economical reliance on repair, overhaul, and modification of reparable items. Repair, overhaul, and modification turn-around time will be a prime determinant in establishing the minimum stock-level period for each item.

c. Where feasible (with particular emphasis on hi-value and critical items), inventory cost will be minimized by stockage of repair, overhaul and modification bits, pieces and components (relatively low-cost items) in conjunction with a pre-planned and flexible expedited repair, overhaul, and modification program, as opposed to stocking sub-assemblies and end items themselves (the relatively high-cost items).

d. Stock levels will be determined on basis of overall program needs and will be independent of the site location of the stock. Maximum utilization will be made of available contracted air transportation to minimize "pipe-line" time.

7.3 STORAGE

Parts whether required for the test or expedition programs should not be segregated from production stock. This merely adds an unnecessary stockage cost-burden. By combining storage facilities with a co-mingling of stock, considerable cost savings can be effected. Spares and production stock serve as buffer stocks for each other. If multiple activities such as manufacturing, test, and the expedition are supplied from a single storage facility the chance of stockout would be minimized.

7.4 REAL PROPERTY INSTALLED EQUIPMENT (RPIE)

Each contractor is charged with the responsibility of identifying, as well as determining the criteria for all items required for successful mission accomplishment. When the requirements have been determined the responsibility for accomplishing the required RPIE materiel support program will be assigned. This materiel support will include the necessary selection of spare parts to be stored at the manufacturing facility or at the launch site.

7.5 MAINTENANCE

The proposed operational mode of the LUNEX program is unique in that it retains all the features of a research and development program. In the time period designated as "expedition", it can be expected that in addition to a variety of missions the systems will be modified and improved, the launch facilities and support equipment may require modification, and technical development may force program changes. Since the expedition period is actually a continuation of the development and test program it is apparent that the systems and techniques developed during testing may also be continued for the Expedition.

An evaluation will be made to determine the feasibility of having contractors support the program throughout its entire life. However, in determining the total task, consideration must be given to the available Air Force manpower, equipment and facilities that may be used to support the LUNEX program.

7.6 MANUFACTURING FACILITY CRITERIA

The equipment production facilities will preferably consist of an existing large aerospace plant convertible to LUNEX production with a minimum modification program. It may be necessary to find a facility that is adjacent to, or easily accessable to navigable waterways. The facility should obviously be located in an area containing an abundance of skilled manpower. Manufacturing Test Facilities adjacent to the manufacturing facilities would be very desirable to reduce transportation problem.

Certain items, such as the large liquid and solid boosters and propellant, will probably be assembled at the Lunex Launch Complex and special facilities for manufacturing these items will be required at the launch complex. Thus checkout and acceptance test facilities will also be required at the launch complex.

Many major manufacturing items, such as the Lunar Landing Stage and the Lunar Launch Stage, will be produced at the manufacturers' facility. This will require propellant storage, or a propellant manufacturing capability at the plant, plus various test and check out facilities to support manufacturing.

As an example, the following test facilities will be required to support the manufacturing of the Lunar Landing and Lunar Launching Stages:

a. Configuration--For each of the two stages a Propulsion Test Vehicle Test Stand and two Flight Acceptance Firing Stands will be required. In addition, cold flow test facilities consisteing of one pad and three structural towers will be required.

Two separate test complexes will be needed - one for each of the two stages. There will be only one centrally located blockhouse with control and instrumentation capability for operating both complexes. Each hot firing stand would be located in accordance with a 2 psi explosion overpressure criteria. An explosive force calculated on equivalent LH_2 caloric content to TNT, shows that the hot stands should be no closer than 2000' to any other hot or cold stand.

b. Test Pad Configuration and arrangement - - Each hot test pad will consist of a concrete pad containing the launcher structure. The stage is erected by a mobile commercial type crane, and personnel access for maintenance is by work stand and ladders, or a cherry picker. No service tower will be required.

c. Thrust Level Measurement - - Thrust levels will be determined by measuring the chamber pressure and applying the result to the engine manufacturer's calibration curve. Tanking level is determined by the Propellant Utilization System.

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d. Altitude Simulation Unit - - A plemum chamber, containing steam jets up stream of its exhaust bell, shall be attached to each engine for altitude simulation.

e. Flame Deflector - - The design is a conventional configuration elbow shaped shield cooled with a firex water injection system.

f. Propellant Storage and Handling Equipment - - A central LO_2 storage and transfer facility shall be provided for each of the two test facilities. The Lunar Landing Stage facility shall store 350,000 lbs. of LO_2. Spherical, vacuum insulated dewars shall be used. The transfer unit shall be a motor operated centrifugal pump with 500 gpm and 100 psi discharge head capacity. The Lunar Launch Stage Test Facility LO_2 storage shall contain 18,000 gallons in spherical dewars with a transfer pump capability of 200 gpm and 100 psi discharge head. Distribution lines for both complexes would be prefabricated, static vacuum, insulated steel pipe.

An LH_2 storage and transfer facility will be provided at each hot firing test stand and the cold flow test pad. The transfer system is an LH_2 gas generator system with air being the thermal source. Pressuring level in each tank would be 100 psi. The LH_2 storage capacity requirement for each Lunar Launch Stage facility is 15,000 lbs. and at each Landing Stage Site is 35,000 lbs. Again the storage facilities would be spherical dewars with segmented, prefabricated, static vacuum insulated stainless steel pipe distribution lines.

SECTION VIII

CIVIL ENGINEERING

LUNAR EXPEDITION (U)

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8. CIVIL ENGINEERING

8.0 INTRODUCTION

As part of the Lunar Transport Vehicle study, consideration was given to the facilities required for the launch and support of the Space Launching System and the Lunar Payloads. It was assumed that the manufacture of all boosters and the payload would be accomplished at existing factories. Facilities and equipment required for the manufacture of large boosters may be readily installed at factories having clearance sufficient to handle the booster. Large boosters such as required for this program must necessarily be transported over long distances by specially constructed barges. By selecting manufacturing facilities and launch sites adjacent to navigable waters, a minimum of overland transport would be required. A significant savings may be effected by providing launch capabilities at selective areas where existing support facilities, personnel housing, and assured tracking capabilities are available.

The logistic support for the launch rates indicated in this plan dictates that new propellant manufacturing facilities be constructed at the launch site and that transport barges and other vehicles be available to transport vehicle components from the manufacturing plants.

A modified Integrated Transfer Launch System is envisioned for the Lunar Transport Launch System. The size and weight of the Space Launching Vehicle, designated the BC2720, precludes the transfer of the entire Lunar Transport Vehicle after assembly, but the integrated transfer of upper stages and lower stages separately with a minimum mating and checkout on the launch pad may provide increased reliability and appreciable cost saving.

In order to achieve the highest launch pad utilization possible and to make maximum use of specialized capital equipment and highly skilled manpower, the application of operations research technology will be required. To handle the test load and the complex sequencing requirements presented by the three-stage Space Launching Vehicle plus the Lunar Payload, a computer controlled, integrated launch sequencing and checkout system will be needed. It is desirable to accomplish the maximum amount of systems testing in a protected environment prior to locating the vehicle on the launch pad, and to use the launch pad, in so far as is possible, for its prime purpose, that of preflight servicing and launching the vehicle.

8.1 LUNAR LAUNCH COMPLEX

The Lunar Transport Vehicle System has a requirement for launch and support facilities suitable for manned lunar flight of a vehicle using a BC 2720 Space Launching System. Investigation of the launch pad requirements for a launch rate of two per month indicates that from 4 to 6 launch pads would be necessary depending on the launch site location and the means available for handling the booster. There are no existing launch pads capable of handling this vehicle, nor are there, at this time, facilities capable of conducting static testing of the "C" booster and the launch of the complete Lunar Transport Vehicle. It is possible that by combining the capabilities for both static firing and launch in two of the pads required, a significant cost saving may be gained and an accelerated test program may be effected. This would provide a capability for the launch of the "C" booster with or without solid boost during R&D flight test and for early test missions of the Lunex Re-entry Vehicle. The development and flight test of the "B" booster is planned at AMR during the development program.

It was assumed in the Lunar Transport Vehicle study that the manufacture of all boosters and the payload would be accomplished at existing factories. New and added facilities and equipment such as large forming brakes, special welding jigs, fixtures and machines, and large processing facilities would be required. In plants of sufficient size these facilities and equipment could readily be installed. Further investigation comparing the relative economics of manufacture at the launch site versus manufacture at existing facilities is required to insure an economical choice.

Assemblies having a diameter exceeding 12 feet or weighing over 200,000 pounds cannot be transported over United States railways. A load of 78,000 pounds is considered to be the limit over selected highway routes. In as much as both the "B" and "C" boosters of the Space Launch Systems have diameters in excess of 14 feet, transport from manufacturing plant to the launch site must be by barge. The large quantities of boosters and the special environmental protection required suggest that specially designed barges be constructed to transport these assemblies. Harbors and docking facilities would be required near the manufacturing facility and at the launch site.

By locating the launch facilities at or near Cape Canaveral for an easterly launch significant savings may be effected. The use of existing administrative capabilities, personnel housing, assured tracking facilities, and technical support areas will provide a saving in costs and in leadtime required for construction of support facilities. Similar gains may be made by locating launch facilities at Point Arguello for polar launch. This does not mean that Cape Canaveral and Point Arguello are the only reasonable locations for the launch site. In fact, by extending the Atlantic Missile Range in a westerly direction across the Gulf of Mexico it is conceivable that a launch site in the vicinity of the Corpus Christi Naval Air Complex would provide the full use of AMR Range facilities with minimum overfly of foreign land masses. Likewise, extension of the AMR Range in a northerly direction to the coast of South Carolina would provide a similar accommodation.

8.2 LOGISTICS

The logistic support for the launch rates indicated in this study dictates that new propellant manufacturing plants be constructed at the launch site. Existing propellant manufacturing plants are inadequate and the launch rates mentioned would use the full capacity of a separate propellant manufacturing facility.

a. Propellant use rates for a 2 per month launch rate are estimated as follows:

(1)	Liquid Hydrogen manufacture	50 tons per day.
(2)	Liquid Hydrogen storage @ launch pad	1.5×10^6 pounds.
(3)	Liquid Oxygen/Nitrogen Manufacture	120 tons per day.
(4)	Liquid Oxygen storage @ launch pad	4×10^6 pounds.

Barges will be required for transport of boosters from the manufacturing plant to the launch complex.

8.3 AEROSPACE GROUND ENVIRONMENT

A modified Integrated-Transfer-Launch System is envisioned for the Lunar Transport Launch System. This approach would allow the complete integration and checkout of the "B" booster together with the Lunar Transport Payload in a protected environment simultaneously with the assembly and checkout of the C2720 booster combination at the launch pad. The size and weight of the BC2720 Space Launching Vehicle precludes the transfer of the completely assembled Lunar Transport Vehicle from an integration building to the launch pad. It is feasible, however, to mate and integrate the "B" booster with the Lunar Transport Payload inside the protected environs of an integration building and when completed transfer the "B" booster and payload assembly to the launch pad for mating with the C2720 assembly. (See Figures 8-1 and 8-2). This can best be accomplished by a cliffside location or extending a ramp from the integration building to an elevation at the launch pad approximately equal to the height of the C2720 stage. The assembly and checkout of the "C2720" vehicle may be accomplished in two ways depending on the specific location of the launch pad and its accessibility to navigable waters. For a launch pad having no direct access to navigable waters, the assembly and mating of the solid segmented motors to the "C" booster would be accomplished at the launch pad. The extended time necessary to accomplish this assembly and checkout accounts for the difference in the numbers of pads required. It is estimated that 6 launch pads would be needed for this plan. For a launch pad having direct access to navigable waters, the assembly and mating of the solid segmented motors to the "C" booster could be accomplished at an interim integration building located some distance away from the launch pad. After assembly and checkout, the "C2720" combination would be transported by a barge to the launch pad and mated to the "B" booster and payload assembly. By using this approach it is estimated that 4 launch pads would be adequate for the 2 per month launch rate. Final confidence checks and integration of the booster and facility interface would be accomplished at the launch pad.

The TNT equivalent of vehicle propellants was estimated in the following manner. The TNT equivalent of the liquid propellants was taken at 60% of the total LOX/LH_2 load for all stages. This is the figure currently used at AMR for TNT equivalence for LOX/LH_2. In this case, because of the great quantities of propellant involved, this degree of mixing is unlikely and the 60% figure would be conservative. Solid propellants are taken at 100% of the propellant weight. It is also considered that detonation of the solid propellants may cause the subsequent detonation of liquid propellants and vice versa; but, the simultaneous detonation of all propellants is not likely to occur. This philosophy resolves to consideration of TNT equivalents of liquid propellants and solid propellants separately and they are not additive. The TNT equivalent of one of the four segmented solid assemblies is 680,000 pounds. The 60% TNT equivalent of the total liquid propellant load is approximately 1,300,000 pounds. Using the highest TNT equivalent (1,300,000 pounds) the inhabited building distance must be approximately 2½ miles from the launch pad and minimum pad separation must be approximately 1 mile. For an inhabited pad adjacent to a launch operation, pad separation would be 2½ miles. It is obvious that the real estate problem will be extensive. For a coastal location of "C" launch pads up to 18 miles of continuous coast line would be required for a distance of 3 miles inland. These distances can be decreased by creating a buffer between the pads. Locating the launch pads in ravines or indentations in cliff side launch locations might substantially reduce the land areas required. The selective location and orientation of the integration building and other support facilities to take best advantage of topography would do much to decrease distances and reduce costs.

The repeated launching of similar payloads in the Lunar Transport Launching System and the extended time between launches from each pad indicates that a central launch control for all pads might be desirable. To avoid analog signal line driving problems and to allow greater distances than normal between the pads and the common blockhouse it is possible to use digital control for launch pad checkout and launch. Analog to digital conversion would essentially be accomplished at each launch pad and transmitted to the blockhouse via digital data link. With vertical mating, assembly and detailed checkout in the vertical assembly integration buildings, only gross, survey type testing or a simulated countdown and launch would be performed at the launch pad, since test and vehicle subsystem sequencing systems could be installed in both areas. Present day checkout methods, because of the many manual controls and long-time spans involved would not provide sufficient assurance of the high reliability of the complex integrated systems expected in the Lunar Transport Vehicle.

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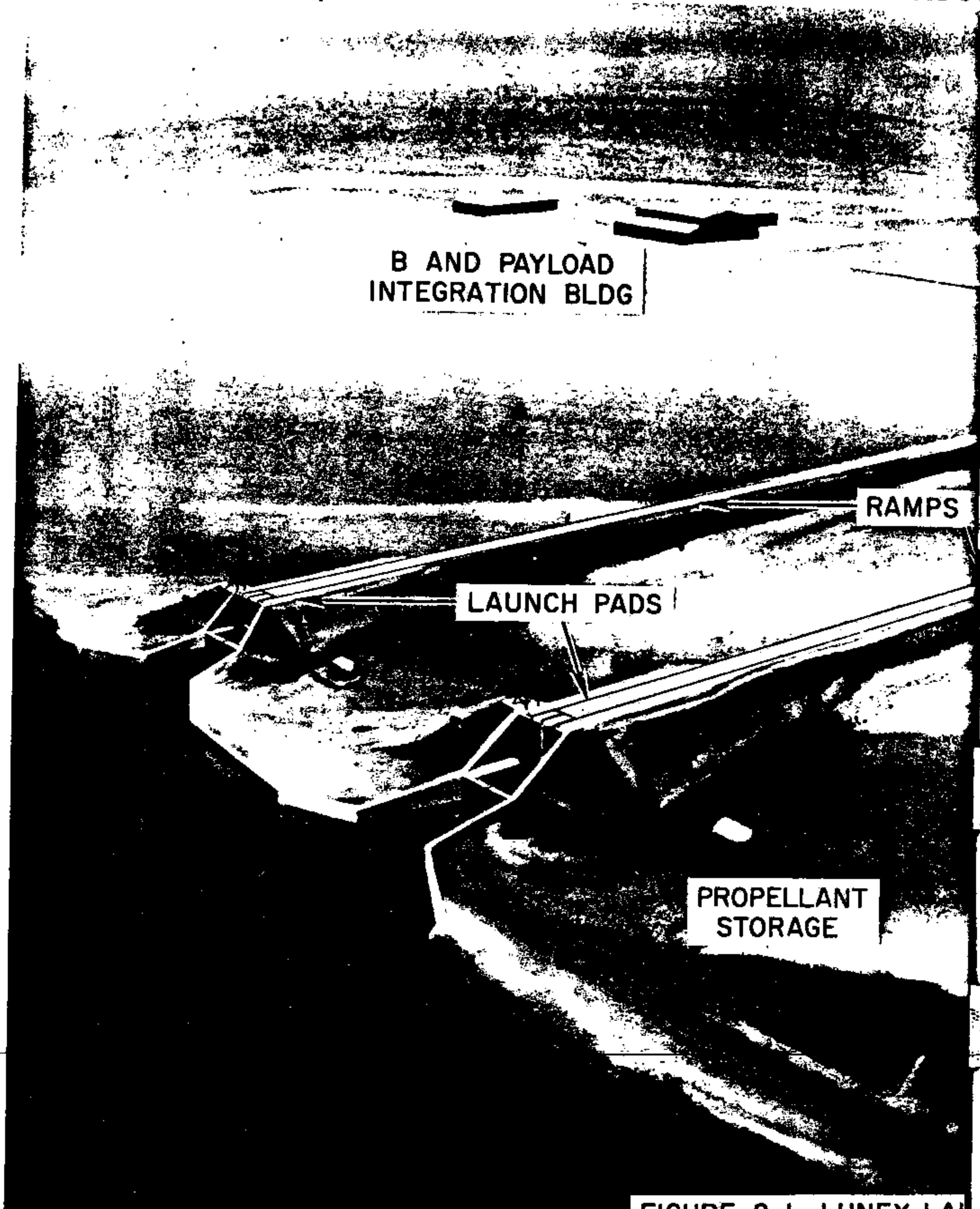

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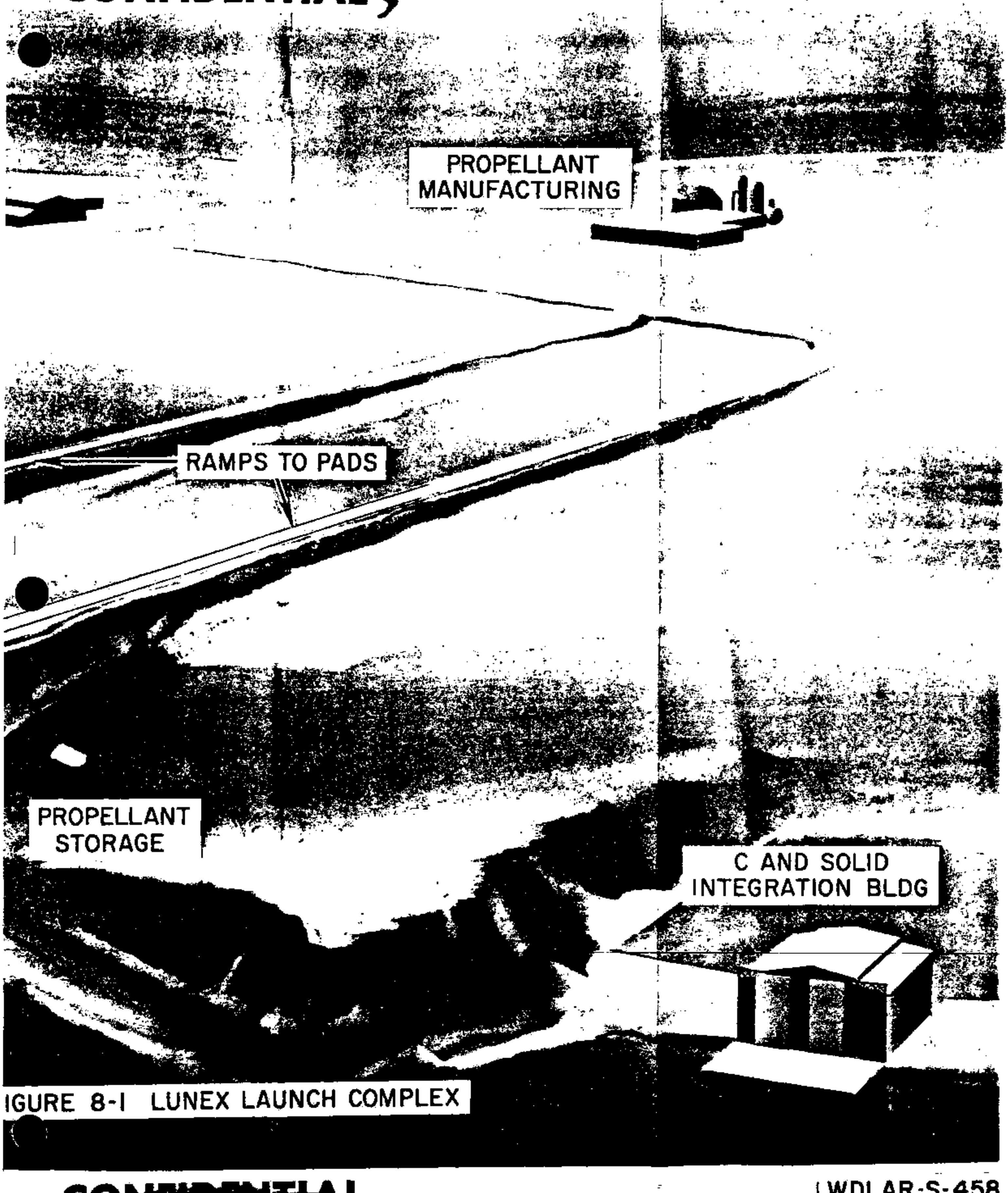

IGURE 8-1 LUNEX LAUNCH COMPLEX

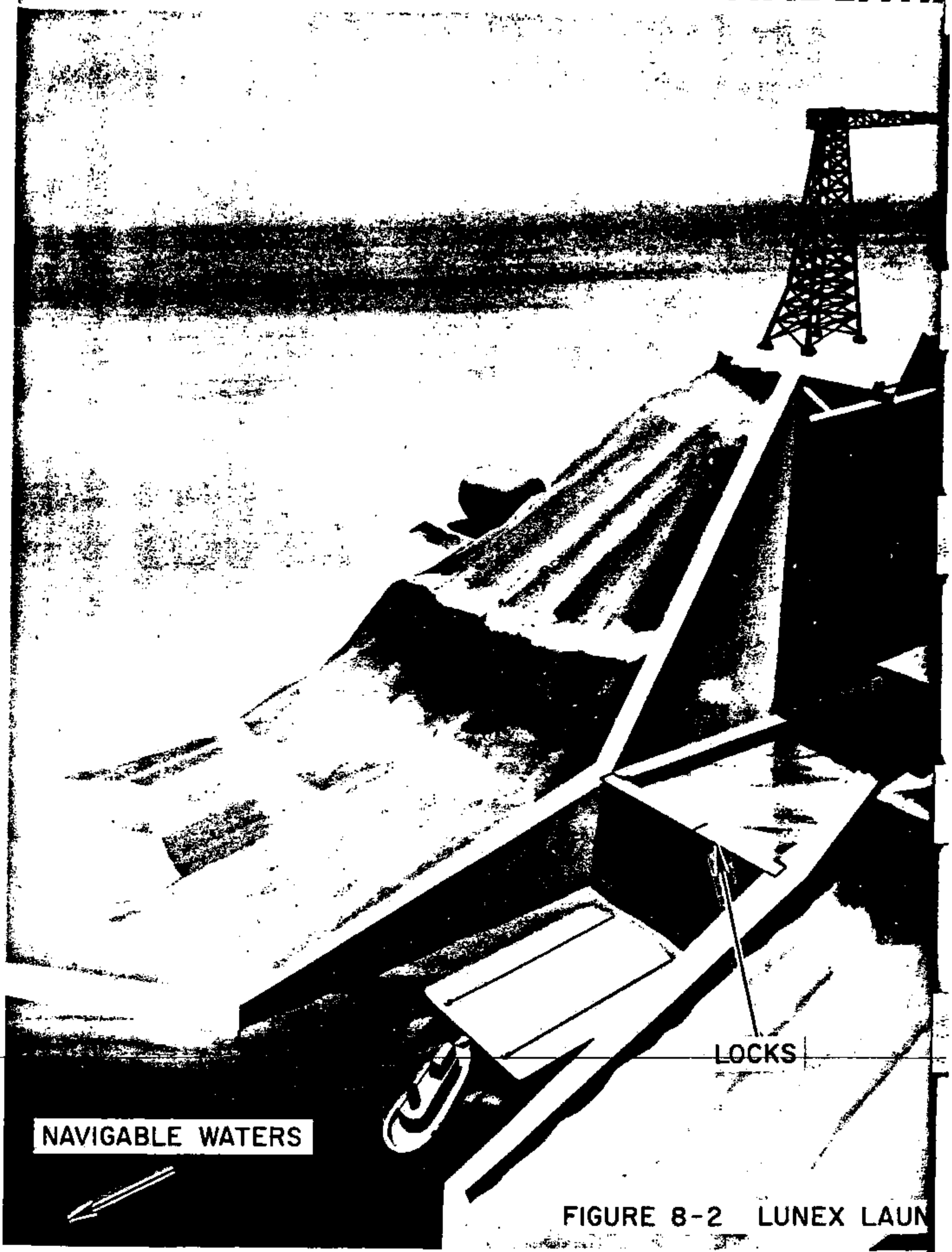

FIGURE 8-2 LUNEX LAUN

8-2 LUNEX LAUNCH COMPLEX