PROJECT AQUILINE

RESEARCH AND DEVELOPMENT STUDY

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AQUILINE

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RESEARCH AND DEVELOPMENT STUDY

29 August 1967

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TABLE OF CONTENTS

Small powered glider intelligence collection system . . .

Figure 2

Inboard Profile

MARK I

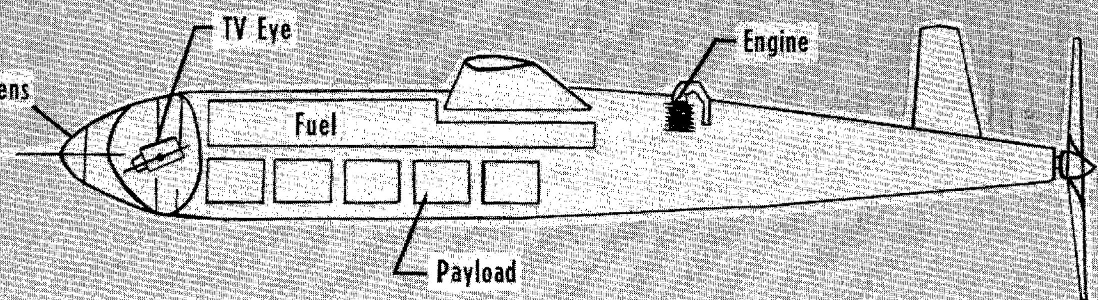
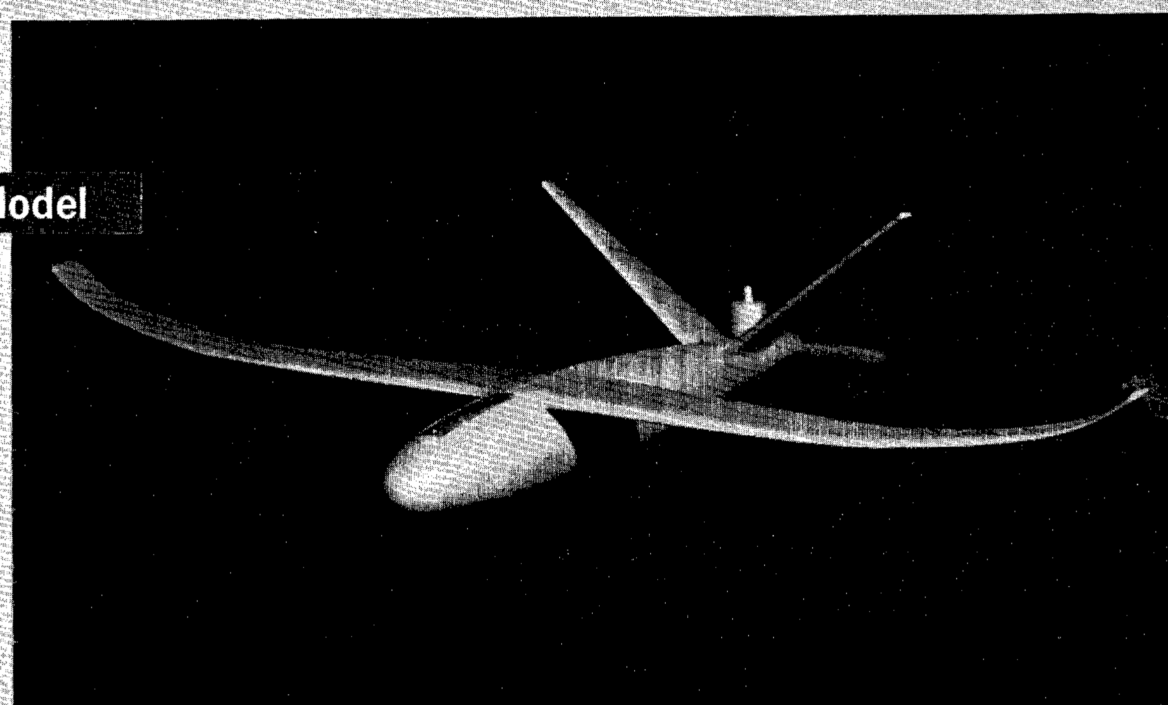


Figure 1

Radar Cross Section Model



Length - 4.75 feet

Wingspan - 6 feet

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PROJECT AQUILINE

RESEARCH AND DEVELOPMENT STUDY

I Nature and Purpose of the Study

In response to a Bureau of the Budget request, a research and development study has been prepared on Project AQUILINE. The AQUILINE system is a new concept in the collection of intelligence which encompasses development of the vehicle as well as the associated subsystems.

Research and development on the AQUILINE system was initiated to increase our capability for collection of intelligence against prime targets. Our present airborne collection systems are large and must fly very high and very fast to survive. The AQUILINE concept is to have a small vehicle which will fly low and slow and still have sufficient range. The successful development of the AQUILINE collection system depends heavily upon our ability to develop advanced microtechnology, microminiature sensors and power sources, sophisticated communications and control systems as well as an efficient, small aircraft.

This study is organized into four major sections. Section II presents a history of the program through fiscal year 1967

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including a description of its intelligence collection potential. Section III outlines the planned development program for fiscal years 1968 and 1969. Section IV presents a detailed description of the basic technology involved in the development and a summary of the development concept. The final section presents operational concepts and estimates program costs and timing.

II History

A. Program Initiation.

During the past four years, the Office of Research and Development has been investigating advanced concepts by which "black box" sensors could be emplaced at strategic targets in China, Russia, North Vietnam, and other denied areas. These emplaced "black boxes" would collect intelligence from missile test ranges, nuclear test facilities, BW/CW test areas, and other prime targets. The collected information could be sent in real time or be stored for later readout via radio to overflight aircraft or relay satellites.

A major difficulty in the present emplacement systems is that the emplacement vehicle must execute the penetration and drop the black box at a high altitude in order to avoid detection and/or interception. Consequently, black box payloads designed for emplacement in this manner are large and heavy--a few hundred pounds not being unusual. In addition, as the opposition develops more sophisticated defense systems, our opportunities to deliver black boxes using our present assets will be grossly limited.

A solution to our present difficulty would be to employ a system that would allow low altitude drops of small, light-weight, low power solid state sensors. This would enhance the probability of the black box surviving the emplacement as well as decreasing the probability of it being detected. At present, solid state and microminiaturization technologies have progressed to the point where these small, light-weight, low power black boxes can be developed. To emplace these black boxes, however, requires a small, low flying emplacement vehicle system capable of long range surreptitious penetration. The AQUILINE project was initiated out of this requirement.

B. Program Concept.

The AQUILINE concept encompasses a very small bird-like emplacement and collection system. To determine AQUILINE system feasibility, internal and external studies were conducted. The early conceptual studies were conducted by the Naval Ordnance Test Station (NOTS), Douglas Aircraft Company, and others (see Figures 1 and 2). Mission analyses and cost effectiveness studies indicated that the AQUILINE concept was feasible and held great promise as an advanced emplacement and collection system. Further, the studies established that the vehicle could exist for long periods of time in target areas and would be practically undetectable. Even if detected, it would be expensive and difficult to countermand. Its low altitude and low speed characteristics added to a long loiter time capability would permit detailed examination of the target areas and permit a wide variety of intelligence missions. Further, its small size and innocuous nature would make it more politically palatable in tense situations than conventional aircraft. It would be unmanned, smaller, and cheaper and, therefore, expendable on special missions. Because of these characteristics, it would be deployable against targets not accessible by any means at the present time. In early stages of development, it could complement existing high altitude systems by providing more detailed examination of selected short-range targets by flying below the cloud cover.

Concentrated studies have been performed on a wide range of aerodynamic lift devices including balloons, ballistic glider, powered glider and helicopter types for this application. The powered glider was selected because of the following considerations:

1. Vehicle. A small aerodynamically clean vehicle can be produced which will contain the miniature payloads and subsystems required for the mission contemplated.

2. Propulsion. A variety of propulsion systems such as two-cycle engines, four-cycle engines, fuel cell and radioisotope powered systems can be used to propel the vehicle. The four-cycle and radioisotope powered systems have a potential range of thousands of miles.

3. Observability. Tests of mockup models demonstrate that such a vehicle and its subsystems could have low enough observability (visual, acoustic, radar and IR) to immerse itself in the indigenous signal environment of the target area, loitering unobtrusively while performing its mission.

4. Guidance and Navigation. Several guidance and navigation systems such as CHECKROTE, radio direction finding, transit satellites and Loran or Omega could direct this vehicle to within a few miles of the distant target.

5. TV Eye. The development of a subminiature TV Eye is feasible both in the visible and IR. The TV Eye can be employed for guidance and navigation as well as surveillance duties.

6. Communication Link. Secure communications for data transmission and vehicle control can be achieved at line-of-sight ranges and are feasible over the longer ranges by using relays such as a small vehicle of the same type, satellites or CHECKROTE.

7. Payloads. Photographic, IR, ELINT, audio, [redacted] [redacted] and droppable black box payloads being developed by various divisions in ORD can be employed in this system.

8. Mobility and Flexibility. Because of its size,

weight, and speed, the vehicle can be launched from a small boat or aircraft or a simple portable launcher.

9. Range. A range of [redacted] for the Initial Operational Capability (IOC)* version can be achieved. However, with a four-cycle internal combustion engine or fuel cells ranges of thousands of miles can be provided. Radioisotope engine versions could have unlimited range (30-day flight duration, 36,000 miles).

10. Operations Research. Computer programs for vehicle configuration systems integration, systems vulnerability and mission analysis have been initiated and can be further developed to insure the effectiveness of operational systems. Eventually the computer programs can be carried out in the Intelligence Processing Research and Development (IPRD) facility of ORD.

C. FY 1967 Development Program.

During fiscal year 1967, development of an emplacement/collection system configured as a small powered glider (AQUILINE) began with a budget of [redacted] dollars. The development concept of the AQUILINE system was refined and improved with:

1. The initiation of an IOC prototype development program.

*Used to designate the first generation vehicle and associated subsystem.

2. The continuation of advanced system studies by Douglas Aircraft (System Contractor).

3. Institution of development programs in the sub-system areas of aerodynamics, propulsion, navigation, communications, antennas, survivability studies, intelligence collecting payloads, and ground control equipment.

A flight test range was established and instrumented to allow flight test of the airframe, its subsystems, and payloads under development. The flight of the fully instrumented IOC system is scheduled for October 1967. The IOC system will include remotely controlled autopilot, navigation and communications equipment (including a slow-scan TV camera and associated radio transmitter) and will be equipped to carry test payloads up to five pounds to a range of [redacted]

III Program Objectives

A. Overall Objective.

The AQUILINE development program is designed to be evolutionary, i.e., its collection capability will be increased as advances in technology become available. Specifically, the program will require advances in the state-of-the-art in the critical areas of aerodynamics, propulsion, navigation, communication and payload instrumentation. A major goal of the program is the ability to define an optimum collection system to be employed against a particular intelligence target using the technology currently available (see Figure 3). A more detailed description of this aspect of the program is contained in Section IV below.

By late fiscal year 1968, the initial operational vehicle will be capable of flying [redacted]. missions at altitudes up to 10,000 feet carrying a payload of five pounds. Prototype hardware will enable the vehicle to be positioned and controlled within a CEP of 70 feet at distances to [redacted]. These capabilities are sufficient to perform intelligence collection missions against typical peripheral targets in USSR, China, and Cuba.

Computer programs have been developed to supply the detailed design information needed to construct an AQUILINE vehicle and its subsystems. The computer program will optimize the vehicle and payloads for a specific mission against a specific target. and gives the probability of success for the mission.

B. FY 1968 Goals.

During fiscal year 1968, research and development on an Advanced Operational Capability (AOC) will be initiated. This program will consider four-cycle internal combustion engine designs, advanced subsystem elements, and payload instrumentation resulting from current microelectronics research and development efforts. The initial AOC goal will be for [redacted] round-trip missions. Possible target areas would be the coastal regions of the Barents Sea, China, Vietnam, and Cuba. Low altitude imagery, ELINT and SIGINT collection devices are typical payloads which could be carried.

C. FY 1969 Goals.

The AQUILINE system capabilities for fiscal year 1969 will be increased by an advanced four-cycle engine which will extend the range to [redacted] Emerging navigational technologies such as [redacted] OMEGA* will provide the capability of using the AQUILINE vehicles in one-way missions against Lop Nor, Shuang-ch'eng-tzu and Sary Shagan. One specific objective for fiscal

*A navigation concept which utilizes the long range Navy OMEGA radio transmissions, retransmitted through a synchronous satellite to the ground station for decommutation and position location.

year 1969 will be to emplace a black box within a CEP of 1/2 n.m. at 2400 n.m.

D. Ultimate Goals.

During fiscal year 1970 and beyond, research and development will be oriented toward increasing the range, navigational accuracy, data communication and storage capacities, loiter time at target and the overall reliability of the system. Improved payloads which are lighter in weight will be under development to collect a wider range of intelligence data under varying conditions. In addition, initial operational experience obtained from earlier deployed AQUILINE systems will be used to guide future AQUILINE development.

IV Program Plan

A. Approach.

The program plan used for development of an AQUILINE system during fiscal year 1967 will be replaced by an overall system's program in fiscal year 1968. This is necessary for a variety of reasons. During fiscal year 1967, there were three program areas:

1. IOC prototype development.
2. Interface (conceptual development)
3. Subsystem development

Three vehicles, each with increasing capability, were designed and constructed under the IOC prototype development program [redacted] If in fiscal year 1968 we were to follow this same schedule of building increasingly refined test vehicles, we would quickly exceed fiscal year 1968 funding of [redacted]. In addition, our increased understanding of the various subsystem requirements and a better estimate of the costs involved in achieving these requirements has placed ever increasing strain on our limited funds.

Further, mission analysis studies revealed that in order to achieve acceptable probabilities of success against any particular target, a specially designed vehicle system should be constructed and deployed. In an environment of continually changing intelligence requirements, it becomes extremely difficult and prohibitively expensive to predict the mission requirement and the operation schedule. To plan for an AQUILINE development which provides as milestones an increasing inventory of vehicle systems designed for general purpose missions seems to us to be an inappropriate and expensive approach to the Agency's particular problem. None of these vehicle systems, in all probability, would be the optimum vehicle required to perform an intelligence mission when the need arises. To adjust the AQUILINE development plan to the available funds and to the specific capability needs of the Agency, a new plan has been formulated and put into effect.

B. Development Plan.

As shown in Figure 3, the program emphasis is now being put on developing a capability in terms of the developing state-of-knowledge which can be assessed on command by management. This is done by establishing the two computer programs shown. The scheme works as follows. For fiscal year 1968 the control of the program is vested in the Advanced Conceptual Development team (Douglas Aircraft working under the direction of the Contracting Officer's Technical Representative*). The information library for the developmental program is a computer program endowed in its subroutines with all of the known or estimated (temporarily) characteristics of the IOC AQUILINE vehicle system. At the periphery of this information base are the various sub-

*COTR

system project engineers (Douglas) who are charged with generating requirements, subsystem development and updating and refining the information stored in that particular subsystem computer subroutine. The computer can at any time be instructed to read out the current capability of the IOC family of vehicles under development. This information, for instance, would include the range, payload capability and "signature" (i.e., IR, radar, visual and acoustic signal) emanating from the vehicle system.

A second computer program has been established in order to make maximum use of this information. The information for this computer is derived from reiterated survivability studies. The mission survivability computer program predicts the ability (probability) of the selected AQUILINE vehicle to penetrate undetected through the radar, visible, and acoustic defenses of a hostile country. In order to describe the radar defenses, the location and characteristics of each radar, including radar horizon and ground clutter, are read into the computer program. The visible and acoustic defenses are described by the population density distribution. A candidate mission profile and vehicle are then chosen for gathering intelligence from a selected target behind the defense system. The mission profile is described by the position-time-function of the flight path (altitude, velocity, position vs. time), the cloud cover, the background-sky contrast and the sun-aircraft relationship along the route. The candidate aircraft is described by its radar cross section (as a function of viewing angle), its physical size and the acoustic and infrared characteristics of the power plant. With these data, the computer program determines the probability of undetected penetration through the radar, visible and acoustic defenses. Should any of these probabilities prove unacceptable, a new mission profile and/or vehicle can be chosen which concentrates specifically on that aspect of penetration.

C. Flight Tests.

In order to assure that the information stored in the computer yields an accurate representation of the physical characteristics of the vehicle, two additional components of the development plan must be provided. These are the Prototype Systems Development (IOC) and Test Range Programs. Within the Prototype Systems Development Program, a number of test vehicles are designed and fabricated. (Five vehicles are planned for fiscal year 1968.) These vehicles are designed primarily to be test flown in a particular manner such as to augment or update the flight performance information stored in the computer. The vehicles are also used to carry developmental subsystems in experimental flight tests. The vehicles, then, are designed to be representative of the IOC family of vehicles, modified slightly to accommodate other requirements of the program.

A test range for flight testing the developing AQUILINE system has been established at Randsburg Wash, a secure range on the Naval Ordnance Test Station at China Lake, California. The facilities and facilities support are being supplied by the Navy under a task order from the Agency. The prime contractor (Douglas) has established and maintains the instrumentation on the test range.

D. Summary of Development Concept.

In summary then, what the program attempts to provide is a developing capability in intelligence collection systems which can be assessed on command by management at any time and from which they can define the optimum AQUILINE collection system for a specific current intelligence requirement.

In essence, the program plan is to develop a series of AQUILINE subsystems (Figure 4) which will be fabricated, tested in flight, and evaluated. The characteristics of these subsystems will be permanently stored in the computer memory. Each subsystem R&D program has its own goal milestones which are calculated to be integrated with the total system capability development.

Each of the major subsystems may be expanded to indicate the long-range plans in that area. In Navigation (Figure 4, Item III-C), for example, R&D programs are being carried out or planned for all of the fundamental techniques listed. This broad approach is necessary because no one technique currently offers the potential to satisfy all of the probable requirements.

In conjunction with the subsystem capability development, mission environmental information for some of the most likely targets is being collected from other offices and stored for evaluation and collation with specific system configurations. Sociological studies in conjunction with wildlife information would aid in a determination of the probability of detection and recognition. The population distribution would be a measure of likelihood of detection while the birdlife studies would reveal the likelihood of the vehicle registering as a bird or a normally appearing object to the observer. It also is obvious that survivability is dependent on current meteorological data, geographic features and intrusion defense posture. The political situation would affect the determination for detection and reaction of recognition by local governments, thus affecting the calculated risk that may be taken.

Collation of all the subsystem data and environmentals would be an impossible task without the aid of modern computer techniques. However, the computer technique used in this program can compare all the R&D results achieved to date and provide answers to optimize the future AQUILINE development plan for any of three alternatives:

1. Most efficient use of available R&D funds.

2. Most effective pacing of subsystem developments for orderly buildup of system capability.

3. Most effective combination of platform and subsystem elements in a possible crash program to develop a particular mission-oriented system.

E. <u>Management and Funding</u>.

During fiscal years 1966 and 1967, the program was broken down into its major components in accordance with Figure 5. During fiscal year 1967, although the funding was increased to [redacted] dollars including AQUILINE-related efforts, the program from an Agency management point of view had not progressed to the point where it was considered a system endeavor. (A system plan will be initiated in fiscal year 1968 and is discussed later.) The funding for the program was provided in a piecemeal fashion, project by project as the program areas became defined. In order to manage the many separate contract packages as an integrated program development, an AQUILINE budget sheet was used for funding control. Figure 6 is a representative copy of this budget showing the total budget funds, the office's plan to commit these funds, and the status of commitment of funds under the general program. By this means, management was kept apprised of the progress of the overall program and the effort that the new dollars committed were to fund.

The funding for AQUILINE in fiscal year 1968 is based on a master AP/ORD program with a system contractor (See Figure 3). Several individual AP/ORD support contracts with other contractors and a moderate number of AQUILINE related projects (mainly payload R&D) monitored by other divisions are funded separately in support of the program. The basic funding program supports many tasks in subsystem development, environmental studies, mission analysis, and flight testing. Individual funding of these tasks in fiscal year 1967 created unnecessary complications in contract negotiations and management as well as increasing the problems of coordinating and synchronizing the technical developments of each subsystem. A new technique will be used for fiscal year 1968 program funding and control. This plan will provide the required program development flexibility and still assure adequate control by the COTR of the rate of expenditure of funds.

A master contract will be let with the McDonnell-Douglas Company. The request for fiscal year 1968 funds to Agency management will indicate the total contract price and costs of the four major subcontract elements. This breakdown of costs will

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be similar to that shown in Figure 4. There are a number of major subcontracts which will be let by McDonnell-Douglas in fiscal year 1968. In fiscal year 1967 the composite fee negotiated with McDonnell-Douglas was [redacted] based on a ratio of Prime to Subcontract effort of approximately [redacted] A new composite fee will be negotiated with the prime contractor based on the new Prime/Subcontract ratio.

In addition, the master contract will establish a funding limitation on a quarterly basis. Within this funding limitation, McDonnell-Douglas will request funds on a task basis against which costs, technical milestones and delivery schedules will be submitted to the COTR. On approval by the COTR, the contract officer will authorize funds for the task. With this mechanism both the technical and financial progress of the program will be more closely monitored. At the same time, the COTR will have the required flexibility, found necessary during early stages of the program, to adjust the direction of the total effort in accordance with the developing technology.

The preceding plan was considered more appropriate to the AQUILINE development program than a PERT COST analysis. However, PERT TIME analysis is maintained on both the advanced system development and prototype system development elements of the program.

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The prime contractor has formulated a detailed fiscal year 1968 system program plan (Figure 8) for a [redacted] dollar budget. AP/ORD proposes to use this system plan by funding the highest priority tasks to a current budget ceiling of [redacted] dollars. Therefore, additional funding, if it becomes available throughout the year, can be wisely used and coordinated with the overall AQUILINE program. A summary of the projected AQUILINE costs through fiscal year 1973 is shown in Figure 9.

V Operational Development

The development of an operational AQUILINE system requires development of the aircraft system and payloads as well as ground control equipment, operations support facilities and personnel.

Although plans for fiscal year 1968 include study and parametric definition of the ground control equipment and operations support requirements, the plan is once again to develop only those components which have commonality to all possible missions.

All aspects of the problem would be researched, however, and a prototype of the basic ground control equipment would be developed. Keeping in mind that the costs of acquiring an operational capability are not funded, and that what is indicated is ORD's ability to respond technologically to a requirement for an operational system, the projected operational capability for AQUILINE is shown in Figure 7.

The development of the AQUILINE concept has required a hard look at the future of technical intelligence collection. As a result, it has been catalytic in the generation of a variety of new development projects. Although many of these new areas, i.e., small IR scanners, microminiaturization of ELINT receivers, recorders, communication and navigation equipment, etc., have application in the AQUILINE program, they also meet more general needs of the Agency. In any funding analysis it would be improper, therefore, to assess the AQUILINE program on a direct basis for the development costs in these areas. Figure 9 apportions the total costs of the program in accordance with this point of view.

The AQUILINE system is being designed to provide an unusual degree of flexibility in both the types of mission and the operational modes that it can accommodate. Therefore, without defining the type of intelligence to be collected, the target, and the operation scenario, it is difficult to project the costs of an operation.

ORD has, however, projected the cost of a 100 mission/1 year operation. The breakdown, shown in Figure 10, considers two alternate vehicles: a) an internal combustion engine propulsion system with a max. range of 2400 n.m.; and b) a radioisotope fueled engine propulsion system with 36,000 n.m. or 30-day flight duration capability.

The mix and quantity of payloads were selected to support 100 missions against typical targets of present and future interest. Spares are included in the quantities shown, with repair and maintenance included in O&M costs as shown.

Mission analysis studies have shown that 50 IC systems is a good estimate of the number of vehicles needed to conduct

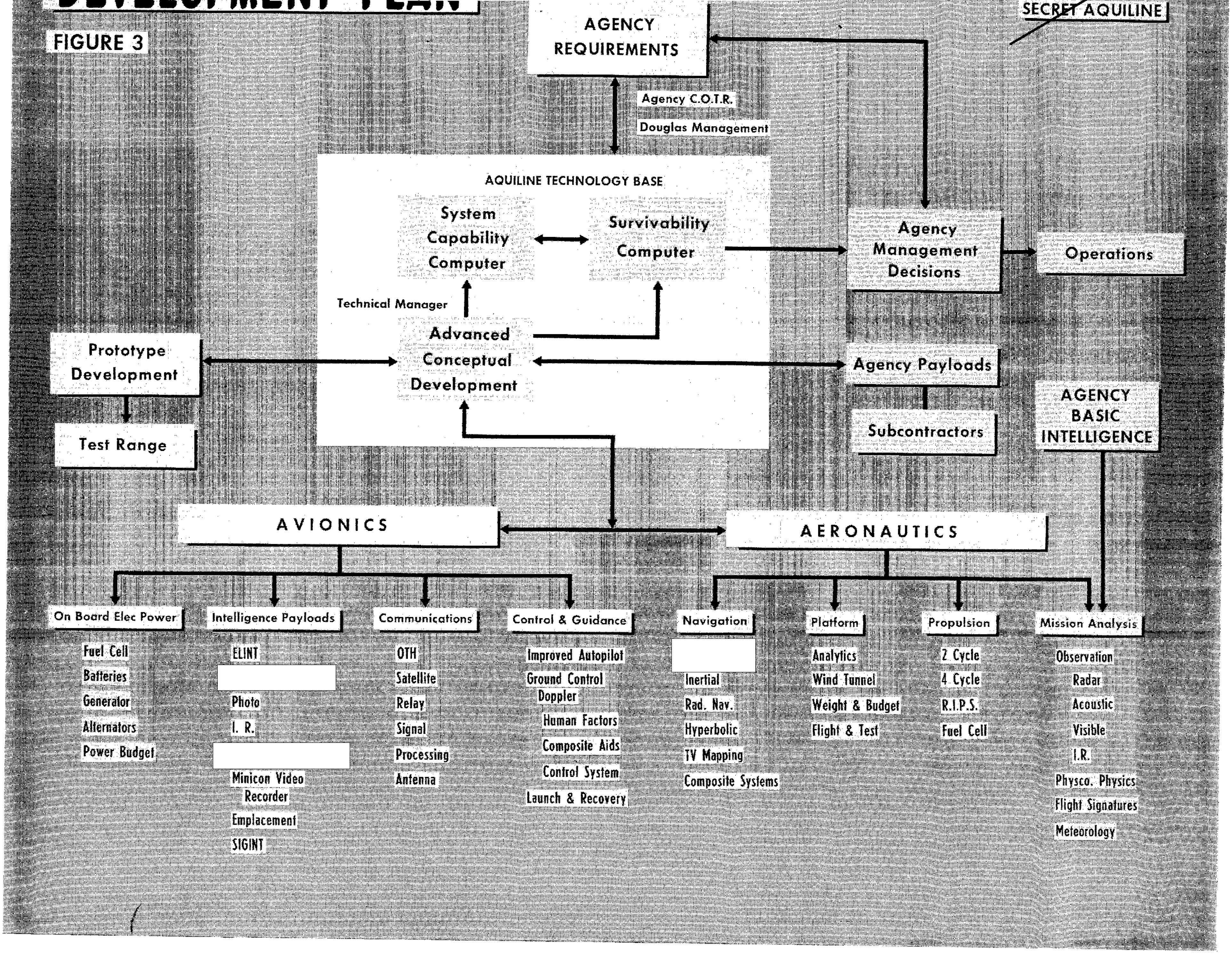
100 single target missions. Twenty-five radioisotope fueled vehicles would be required for the same number of targets since it is assumed that a system with a thirty-day flight endurance capability could cover more than one target/mission.

Although the total estimated cost of one year of sustained operations for the IC and RI systems is $[redacted] and $[redacted] respectively, one can, using Figure 10, determine the approximate cost of other mixes of payloads/missions, and/or vehicles should one desire. (Costs, however, are based on the quantity shown.)

DEVELOPMENT PLAN

FIGURE 3

SECRET AQUILINE



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AQUILINE BUDGET WORK SHEET

TITLE	PROJECT NO.	CONTRACTOR	FY 1966	FY 1967	BUDGETED FY 1968	UNBUDGETED FY 1968
I Prototype System Development	A-4001-A-01	Douglas	--	[redacted]	[redacted]	[redacted]
II Advanced Systems Definition Studies						
A. Douglas	A-4001-A-02	Douglas	[redacted]			
B. AP/ORD Conceptual Support/Other Contractors		TBD	--			
III Subsystem Development						
A. Advanced Aerodynamics						
1. Coanda Studies	A-4030-A-01	IITRI	--			
2. Advanced Vehicles	O-7020	TBD				
3. Wind Tunnel Tests	O-7020					
B. Advanced Propulsion						
1. Souped-up 2-Cycle Eng.		Marquardt				
2. 4-Cycle D&E	A-4001-A-01	DAC/Lyc				
* 3. 4 Cycle						
* a. Reciprocating	PC	Eng. Tech.				
* b. Wankel (Rotary)	PC	OMC				
4. Free Piston		SRI				
5. R.I.P.S.	A-4110-A-01	DAC/GM				
6. Coanda Thrust Generators						
C. Navigation Systems Dev.	A-4060-A-01	Litton	[redacted]			
1. Improved Autopilot		DAC				
2. Inertial Systems						
a. Component Develop.		Teledyne				
b. Radio Navigation Update		TBD				
3. Radio Hyperbolic Systems						
a. [redacted]-OMEGA [redacted]		DAC/RSI				
b. OMEGA, [redacted] Loran						
1) LOP		DAC/TBD				
2) Stored Phase Profile		DAC/TBD				
4. Radio Trilateration	A-4100-A-01	DAC/Cubic				

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Figure 4

GROUP 1
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AQUILINE BUDGET WORK SHEET---2

TITLE	PROJECT NO.	CONTRACTOR	FY 1966	FY 1967	BUDGETED FY 1968	UNBUDGETED FY 1968
5. Satellite Systems		DAC/TBD				
* 6. TV Mapping/Correlation Optics						
7. Altimeter						
a. Improved Barometric						
b. Radio		DAC				
c. Imagery Derived V/H						
D. Communications						
1. Signal Processing (Spread Spectrum, etc.)	TBD	TBD				
2. Data Storage/Handling	A-4120-A-01	Philco				
3. On-Board Electronics Development	A-4001-A-01	Douglas, ITT				
4. Detectability and Security Studies		DAC/TBD				
* 5. O.T.H. Communications		RP/EPL				
6. Satellite Commo		ESL				
7. Relays		TBD				
E. Antennas						
1. Integrated Antenna Study		DAC/TBD				
2. Antenna Development						
F. Survivability						
1. Vehicle Signature Studies and Configuration Iteration	A-4180-A-01	Douglas				
*a. Visual		TBD				
*b. E/M		TBD				
*c. Thermal		TBD				
*d. Acoustic	PC	Battelle				
2. Mission Analysis		DAC				
3. Meteorology		TBD				
G. Ground Control Station Dev.						
1. Equipment Requirements Study/RD&E						
a. Control & Guidance	O-7025-A-01					
b. Data Receiving and Processing						
*c. Man-Machine Interface	BMSD					

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GROUP 1
Excluded from automatic

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AQUILINE BUDGET WORK SHEET---3

TITLE	PROJECT NO.	CONTRACTOR	FY 1966	FY 1967	BUDGETED FY 1968	UNBUDGETED FY 1968
2. Launch & Recovery (Air, Land & Water) Requirements Study						
a. Prototype Dev.						
1) Air				[redacted]	[redacted]	[redacted]
2) Land	A-4200-A-01					
3) Water						
H. TV Eye						
* 1. Slow Scan	Optics					
* 2. Solid State (Mosaic)	AP					
* 3. Digiton	Optics					
* 4. IR Scanner	O-1210-A-03					
* 5. Real Time Vidicon	Optics					
* 6. Image Motion Compensator, Image Motion Stabilization, and Image Intensifier	Optics					
I. Payloads						
* 1. [redacted]	Optics					
* 2. ELINT	A-4210-A-01	Scope, T.I.				
* 3. TV Eye	Optics					
* 4. [redacted]	RP	Mitras				
* 5. SIGINT	AP	Telcom				
* 6. Photo Payload	Optics	TBD				
* 7. [redacted]						
* 8. Payload Emplacement System	AP	TBD				
* 9. Min. Video Recorder	AP	Ampex				
J. Operations Research		Winston				
IV Range Test Support	A-4160	Navy				
A. O&M on Facilities		Douglas				
B. O&M on Instrumentation		Douglas				
C. AQUILINE Test Bed Vehicles & Spares		Douglas				

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GROUP 1 Excluded from automatic downgrading and

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AQUILINE BUDGET WORK SHEET---4

TITLE	PROJECT NO.	CONTRACTOR	FY 1966	FY 1967	Budgeted FY 1968	UNBUDGETED FY 1968
D. Douglas Support of AQUILINE Related Projects		Douglas			[redacted]	
1. OMEGA WANDERING BOY						
2. [redacted]						
3. ELINT						
4. TV Eye						
5. [redacted]						
6. SIGINT						
7. Photo Payload						
8. Air Sampling						
9. Propulsion						
10. Payload Emplacement						
TOTALS: AQUILINE			[redacted]			
* AQUILINE RELATED						

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Conceptual Study
FY'66
Douglas

I.O.C.
FY'67
Douglas

A.O.C.
FY'68
Douglas

INTERFACE
FY'67
Douglas

Advance Veh.
- Douglas
- Battelle M. I.
- General Dynamics
- AP/ORD
- IITRI
- Lockheed

Propulsion
- TEECO (R.I.) (Deferred)
- Hittman (R.I.) (Deferred)
- G.M. (Sterling)
- Pratt & Whitney (4~)
- Douglas

Commo
- E.S.L.
- Philco
- Collins

Payloads*
- Scope, Inc.
- Texas Instr.
- TSD
- Honeywell
- PC
- LS
- Op Photo

Cont. & Guid.
- Cubic (DASA)
- Litton-Study
- T.I. (OPLE)

IR & TV Eye
- Teledyne T.V. (R.T.)
  - T.V. (S.S.)
  - Gnd. Mon.
- Fairchild
- Lt. Wt. I.R. Scanner

MAJOR COMPONENTS

Figure 5.

LEGEND
*Emplacement & Black Box Program

AQUILINE BUDGET

Project	R/D No.	FY'67 Budget	Committed Amount	Committed Date	Proposed Spending Amount	Proposed Spending Date	Contractor
VEHICLE SYSTEMS							
I. O. C.	A4011-A01			Nov.			Douglas Aircraft
Interface	A4000-A02			Nov.			Douglas Aircraft
CONTROL & GUIDANCE							
Navigation Study	A4060-A01			Oct. 10			Litton
Test Range Navigation Equipment	A4100-A01			Jan. 12			Douglas/Cubic
Inertial Navigation Systems Dev.	A4060-A02						
Radio Nav. [redacted] OMEGA)	A4130-A01					Feb.	Texas Instruments
COMMUNICATIONS							
Sensor (Data Storage & Processing)	A4120-A01			Jan. 16			Philco Corporation
Line of Sight Study	A4070-A01						
GROUND SUPPORT							
Test Range Support (NOTS)						As req'd.	To be determined
Launcher						Jan.	Douglas Aircraft
PROPULSION	A4110-A01						
4 Cycle I. C.						Jan.	Douglas/Pratt-Whitney
Radio-Isotope						Jan.	Douglas/General Motors
ADVANCED PLATFORMS	A4030-A01					Feb.	ITTRI/Douglas Aircraft
ANTENNA SYSTEM	A4180-A01						Radiation Systems, Inc.
IR AND TV EYE							
Real Time TV				Sept.		Jan.	Teledyne
Slow Scan TV						Jan.	Teledyne
Scan Conv. & Gnd. Mon.	O7025-A01					Jan.	Teledyne
Light Weight IR Scanner	O1210-A03						
TOTAL BUDGET							
TOTAL TO BE COMMITTED							

Figure 6.

AQUILINE OBJECTIVES

	1967	1968	1969	1970	1971
RANGE	600 N. M.	1200 N. M.	2400 N. M.	25000 N. M.	UNLIMITED
PROPULSION	2- Cycle Internal Combustion	4-Cycle Internal Combustion	Advanced 4-N Internal Combustion	Radioisotope	
TARGETS		Barents Sea Chinese and Vietnam Coastal Area Cuba	Lop Nor Shuang-Ch'Eng-tzu Sary Shagan 80% of Targets of Interest	USSR China Land, Sea and Air Launch	ANY TARGET
MISSION CAPABILITY		Reconnaissance Ferret Cep 4 N. M. Interim Commo	Black Box Emplacement Cep 1/2 N. M. Secure Commo	Black Box Emplacement Reconnaissance Cep 1/2 N. M. T. V. Terminal 100 Secure Commo Unlimited loiter	ADAPTIVE
INTELLIGENCE REQUIREMENT		Low Altitude Imagery Elint Sigint	Event Indicator Missile Telemetry Nuclear Staging and Yield	Monitor Missile and Nuclear Ranges Intelligence Processing	

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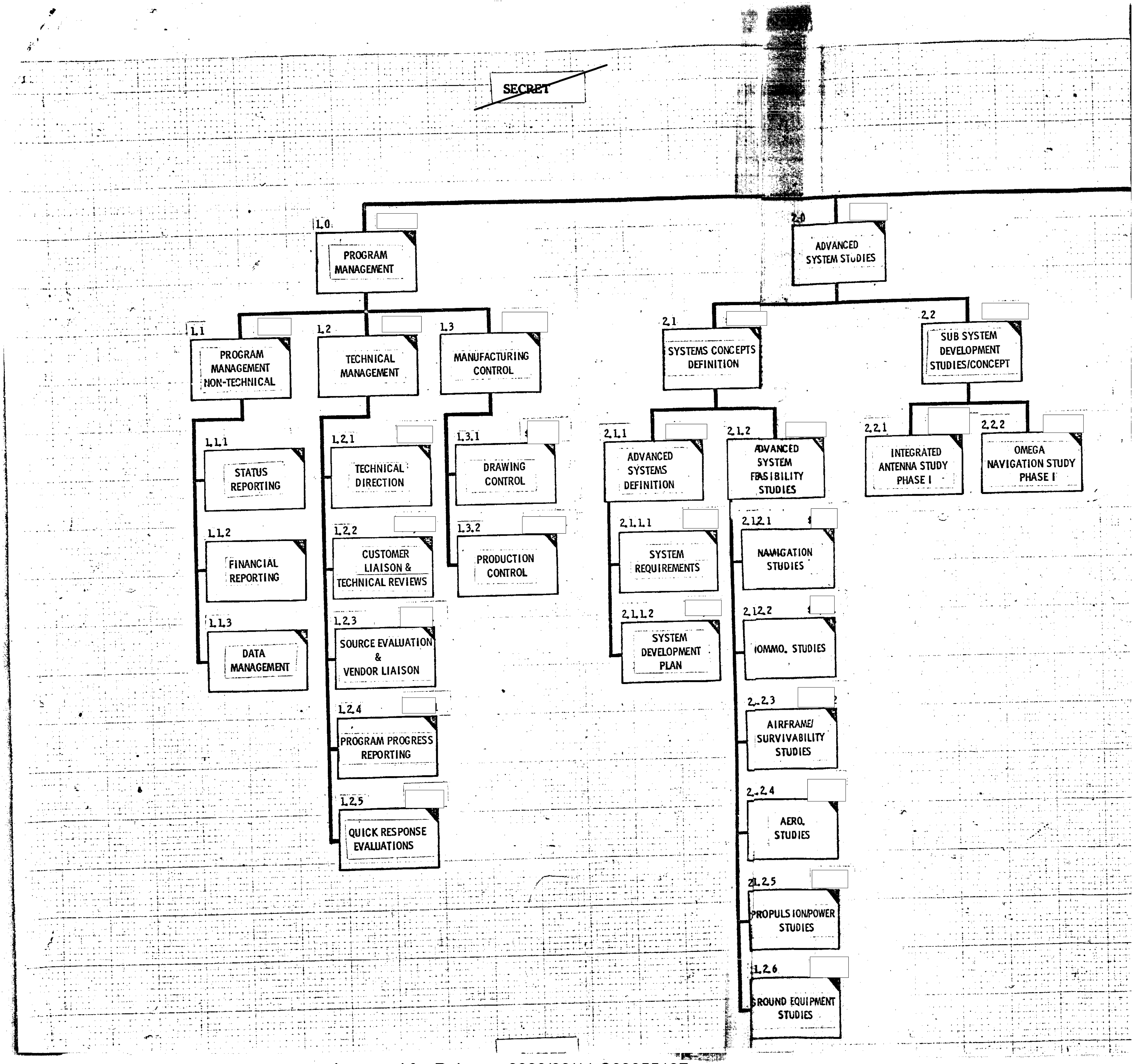
FIGURE 7


SECRET
1.0 PROGRAM MANAGEMENT
1.1 PROGRAM MANAGEMENT NON-TECHNICAL
1.1.1 STATUS REPORTING
1.1.2 FINANCIAL REPORTING
1.1.3 DATA MANAGEMENT
1.2 TECHNICAL MANAGEMENT
1.2.1 TECHNICAL DIRECTION
1.2.2 CUSTOMER LIAISON & TECHNICAL REVIEWS
1.2.3 SOURCE EVALUATION & VENDOR LIAISON
1.2.4 PROGRAM PROGRESS REPORTING
1.2.5 QUICK RESPONSE EVALUATIONS
1.3 MANUFACTURING CONTROL
1.3.1 DRAWING CONTROL
1.3.2 PRODUCTION CONTROL
2.0 ADVANCED SYSTEM STUDIES
2.1 SYSTEMS CONCEPTS DEFINITION
2.1.1 ADVANCED SYSTEMS DEFINITION
2.1.1.1 SYSTEM REQUIREMENTS
2.1.1.2 SYSTEM DEVELOPMENT PLAN
2.1.2 ADVANCED SYSTEM FEASIBILITY STUDIES
2.1.2.1 NAVIGATION STUDIES
2.1.2.2 COMMO. STUDIES
2.1.2.3 AIRFRAME/ SURVIVABILITY STUDIES
2.1.2.4 AERO. STUDIES
2.1.2.5 PROPULSION/POWER STUDIES
2.1.2.6 GROUND EQUIPMENT STUDIES
2.2 SUB SYSTEM DEVELOPMENT STUDIES/CONCEPT
2.2.1 INTEGRATED ANTENNA STUDY PHASE I
2.2.2 OMEGA NAVIGATION STUDY PHASE I

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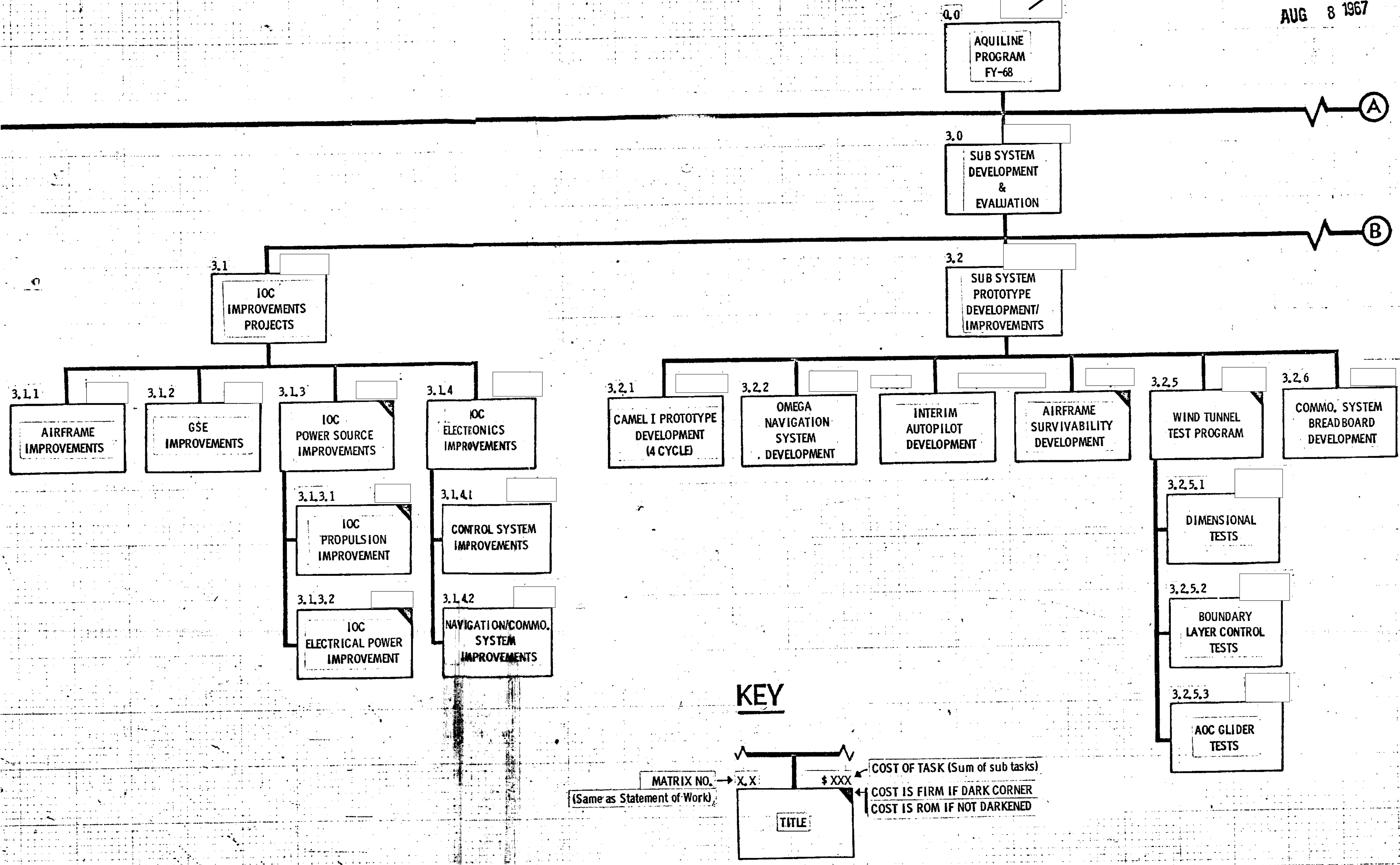
AUG 8 1967



WORK BREAKDOWN STRUCTURE
AQUILINE PROGRAM FY-68

EXCLUDED FROM AUTOMATIC REGRADING; DOD DIR 5200.10 DOES NOT APPLY
GROUP 1

DOCUMENT CONTROL
No. 790 Copy No. 1
DOUGLAS AIRCRAFT COMPANY, INC.

Fig 8

~~SECRET~~

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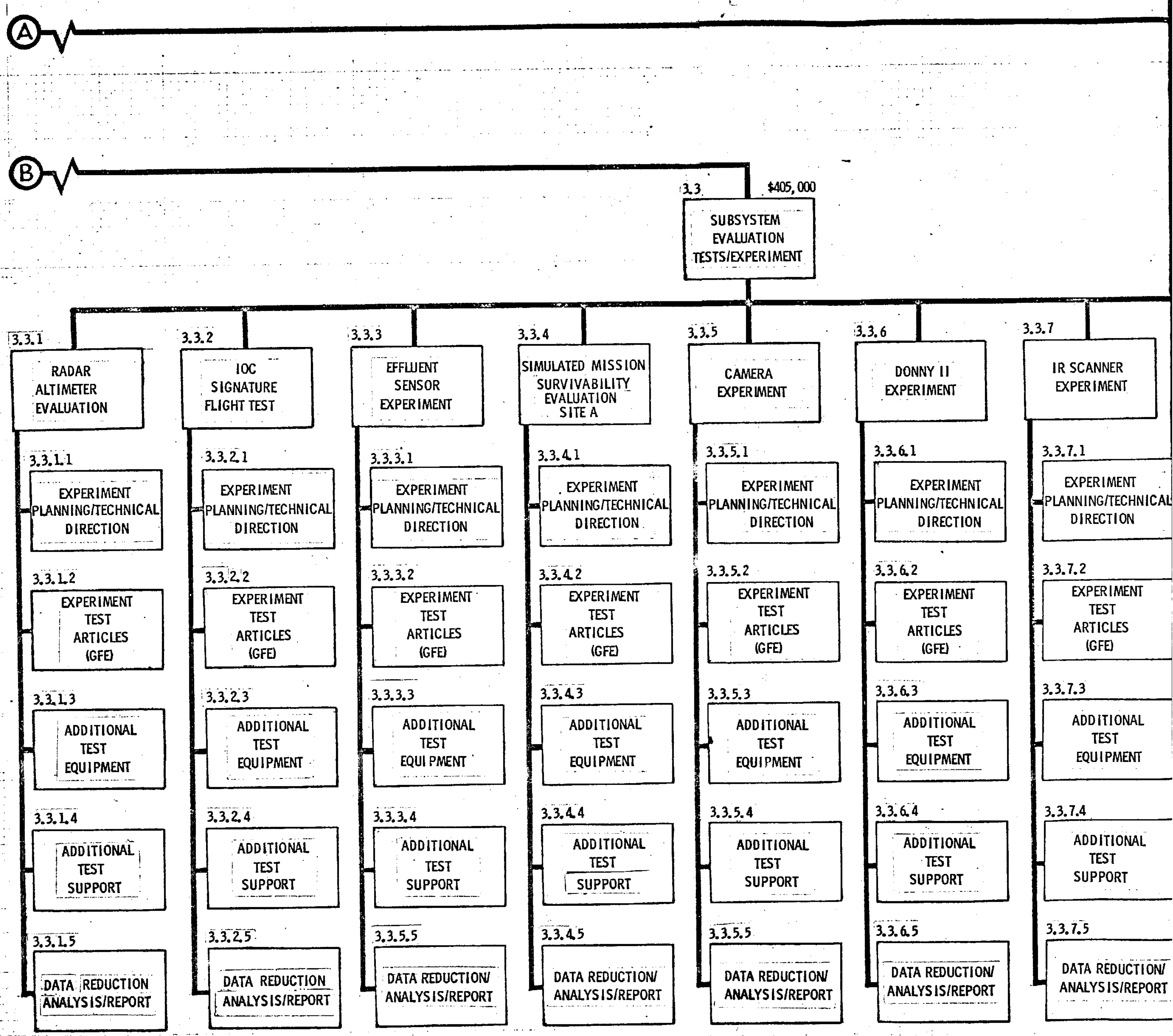

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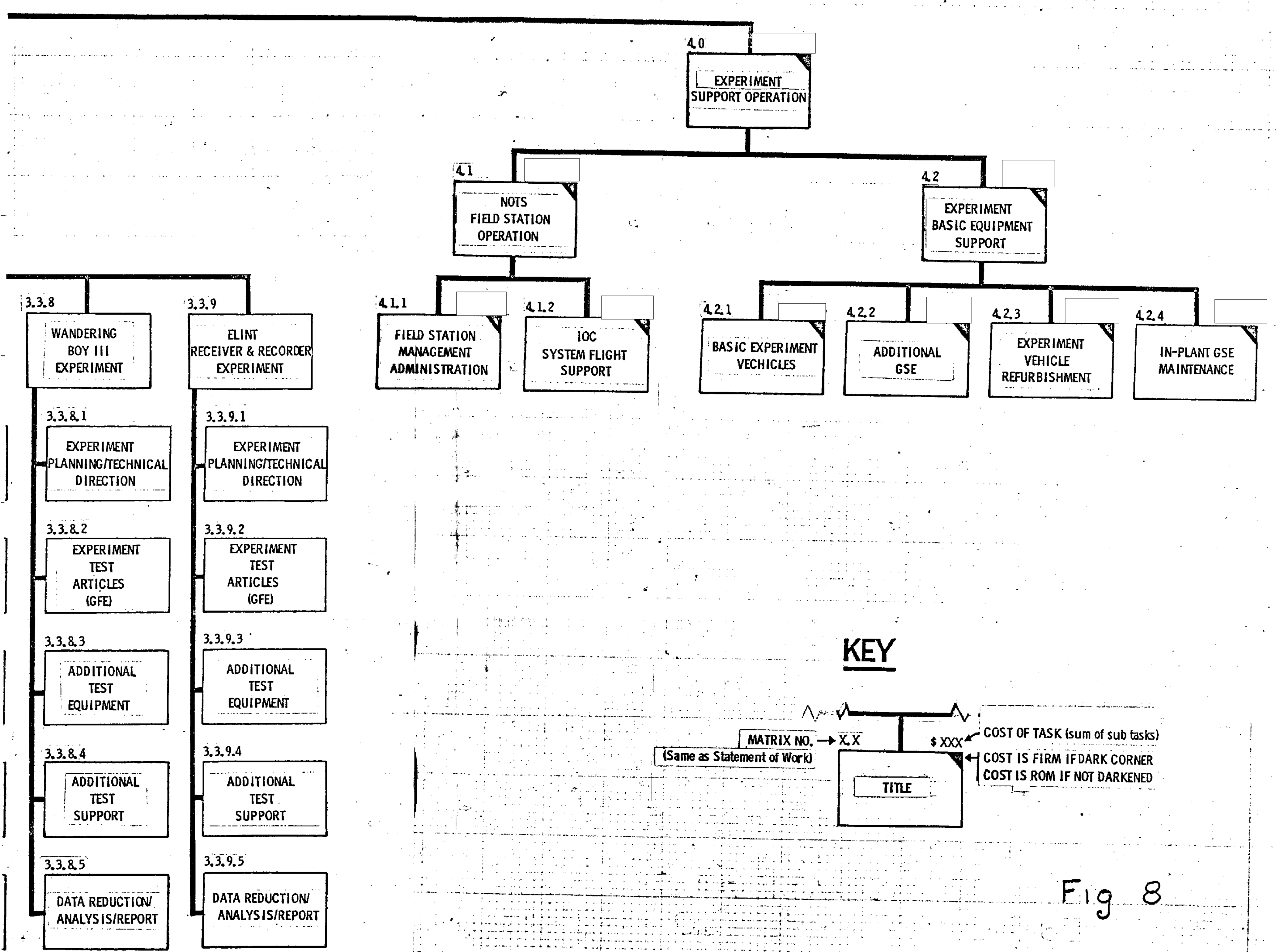

Fig 8

Note
THE ROM COST FOR 3.3 IS BASED ON AN AVERAGE COST OF $45,000 PER EXPERIMENT NOT ALL 9 EXPERIMENTS WILL BE STARTED DURING FY'68.

EXCLUDED FROM AUTOMATIC REGRADING; DOD DIR 5200.10 DOES NOT APPLY
GROUP 1

~~SECRET~~

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AQUILINE

Summary of Projected Costs (X 1000)

TITLE	FY'66	*FY'67	*FY'68	FY'69	FY'70	FY'71	FY'72	FY'73
BASIC SYSTEM DEVELOPMENT								
I Prototype Sys. Dev.								
II Advanced Sys. Def.								
III Subsystem Dev.								
IV Test Range								
Subtotal								
AQUILINE SUPPORT DEVELOPMENT								
III Subsystem Dev. Payload Dev.								
Subtotal								
TOTAL PROGRAM BY F.Y.								

*Budgeted

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Figure 9.

GROUP 1
Excluded from automatic downgrading and declassification

SECRET

PROJECTED AQUILINE OPERATIONAL COSTS

System Element	Costs (50 Vehicles 100 Missions) No. Req'd.	@ x $1000	Internal Combustion 600-2400 n.m.	Totals	Costs (25 Vehicles 100 Missions) No. Req'd.	@ x $1000	Radioisotopes 36,000 n.m. or 30-day Flt.	Totals
I Payloads	[redacted]							
[redacted]								
Camera								
Elint (Repeater)								
Elint (On-board record)								
[redacted]								
Nuclear BB/Empl.								
Missile BB/Empl.								
BB Interrogate								
1 yr. O&M and Training								
II Vehicle	[redacted]							
TV Eye								
Radio Navigation								
Electronics (Rec./Trans								
Autopilot and Contr.								
Airframe								
Altimeter								
Batteries								
Engine & Generator								
Fuel Inventory/Flt.								
1 yr. O&M and Training								

Figure 10.

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PROJECTED AQUILINE OPERATIONAL COSTS (cont'd)

System Element	Costs (50 Vehicles 100 Missions)				Costs (25 Vehicles 100 Missions)			
	No. Req'd.	@ x $1000	Internal Combustion 600-2400 n.m.	Totals	No. Req'd.	@ x $1000	Radioisotopes 36,000 n.m. or 30-day Flt.	Totals
III Ground Station (Comm. Cont., Data Storage & Readout)	[redacted]							
Mobile (Sea & Air)								
Land Based								
Satellite Piggyback Electronics								
Relays & Support Aircraft								
1 yr. O&M and Training								
IV Data Proc. & Mission Plan.								
Film								
Video								
Analysis								
Waveform								
GRAND TOTALS			[redacted]					

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