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ADVANCED RECONNAISSANCE SYSTEM

PROGRAM

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7 November 1955

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STRATEGIC AIR WEAPON SYSTEM

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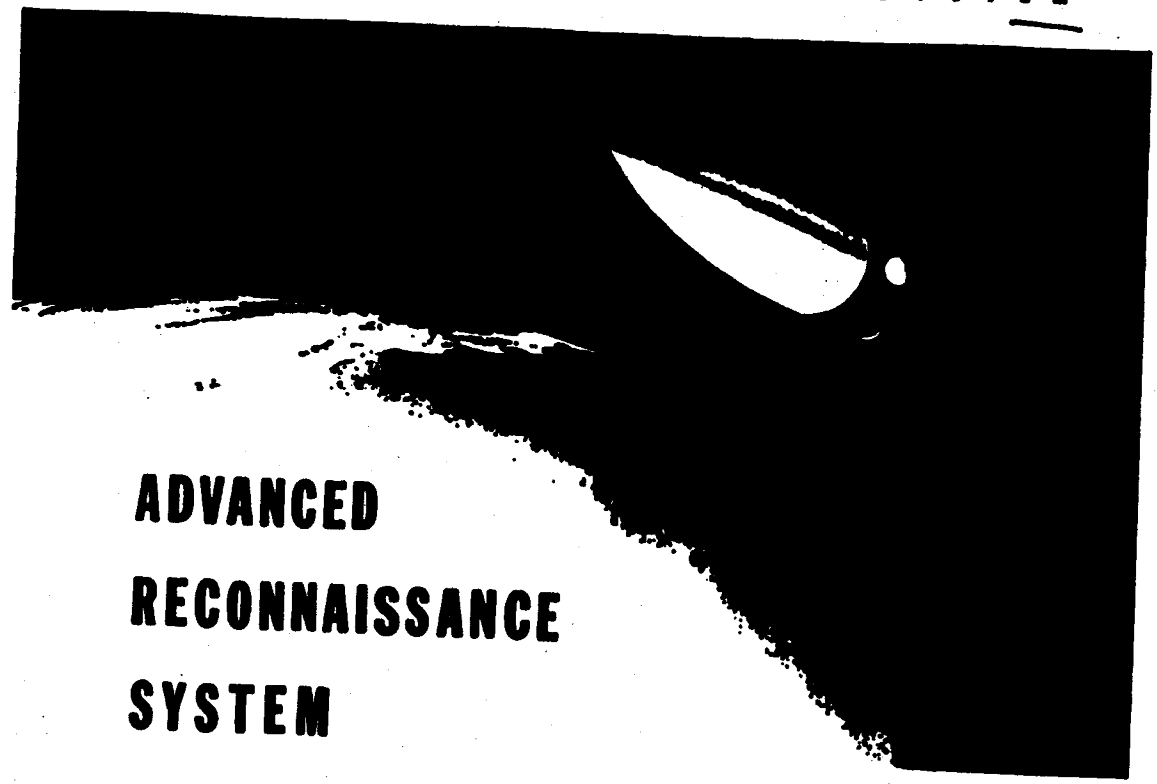

ADVANCED RECONNAISSANCE SYSTEM

Technical Development Program
Nickname "Pied Piper"

Project 1115
MX 2226

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AD 55 12792

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F O R E W O R D

7 November 1955

This brochure was compiled for the expressed purpose of making available to Brigadier General Schriever a compilation of the status of Advanced Reconnaissance System Program, Project 1115 (Pied Piper). Although it was compiled for this expressed purpose, its contents were drawn from the working documents to The Weapon System Project Office without alterations except to bring the material up-to-date as of the above date. The material was selected to supplement an oral presentation on 9 and 10 November 1955 at Western Development Division Air Research and Development Command. Under separate cover is being delivered one (1) copy each of the First Quarterly Reports of the Advanced Reconnaissance System Design Studies prepared by Radio Corporation of America, Lockheed Aircraft Corporation, and Glenn L. Martin Company.

Pending is the receipt of a new System Requirement which, it is understood, will establish a new Responsible Agency and Participating Centers and will give further direction to the Program.

WILLIAM G. KING, JR
Lt Colonel, USAF
Chief, MX-2226 Weapon System Project Office
[illegible] Missile Division
Directorate of Systems Management

Distribution:
WDD - Brig Gen Schriever
RDZPI - Lt Col Gomes

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Security Policy

Maintenance of proper security on this program is of paramount importance

A Top Secret

(1) All information which contains or implies a date of operational availability

(2) All information pertaining to the progress as a weapon system

B Secret

Other aspects of the ARS program, as well as exploitation of the Satellite

Security Policy

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ADVANCED RECONNAISSANCE SYSTEM
I N D E X

7 November 1955

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SUMMARY OF FEEDBACK PROJECT

In the Fall of 1945, at the conclusion of World War II, the Navy acquired the German work in the field of earth-circling satellites, and this work was used as a basis for a contract with the Glenn L. Martin Company to continue studies in this field.

In the spring of 1946, the Army Air Corps became aware of the Navy's efforts and as a result the first job undertaken by the newly formed RAND Corporation, then a part of the Douglas Aircraft Company, was the conduct of studies similar to those being conducted by the Glenn L. Martin Company.

In April 1947, the Bureau of Aeronautics of the Navy presented material to the Research and Development Board, showing why the Office of Naval Research should be designated as the coordinating agency for the "Earth Satellite Vehicle". This same letter to the Research and Development Board included a statement that "such a vehicle is technically possible". Later, in September 1947, the RAND Corporation, also determined that a satellite is technically feasible.

During January 1948, both the Navy and the newly formed Air Force presented arguments to the Research and Development Board which showed that each service should have sole responsibility for developing an earth-circling satellite. In reviewing the efforts of both services it was shown that the Navy spent most of its time on the very small details of such a system while the RAND Corporation emphasized the practical applications of existing state-of-the-art to such a vehicle. On 16 January the Navy withdrew their letter to the Research and Development Board, which claimed sole rights for satellite development. In February, 1948, the Air Force requested the RAND Corporation to establish a finite program for the study of satellite development. Shortly afterwards the

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Research and Development Board concurred with the Air Force's undertaking this program and stated that the RAND Corporation should have the sole responsibility in this field. The Navy and the Glenn L. Martin Company were phased out at this time.

RAND established what came to be known as Project Feedback, and at the request of the Chief of Staff of the Air Force, addressed itself to determining if a military use exists for a satellite vehicle and if so, to suggest one such military system, and to recommend its development when the technological state-of-the-art indicated that such action was practicable.

In completing the Feedback Project in 1954, RAND Corporation concluded that the conduct of visual or electronic reconnaissance is the most promising military use for an early unmanned satellite vehicle, and the final result of the Feedback Project is a suggested minimum pioneer visual reconnaissance system.

It must be emphasized at this point that this suggested system is not a design, but a summation of typical and feasible suggestions for individual system components.

The suggested satellite vehicle is seen as a two-stage rocket of conventional design, which propels a "Reconnaissance Head" to an orbit about 300 miles above the surface of the earth where this satellite will revolve around the earth about 15 times per day, and remain aloft for a period of one year or more.

At take-off, the total vehicle will be about 80 feet long with a diameter of about 9 feet and a gross weight of about 180,000 pounds. This weight is based upon the use of gasoline, liquid oxygen as a fuel.

The initial thrust requirement at take-off will be 285000 pounds provided by two 120,000 pound thrust rocket engines and two smaller gimballing engines of 22,500 pounds thrust each. After about 2 minutes of burning the booster will drop away and the second stage, with about 30,000 pounds thrust will power the satellite to the velocity necessary to coast to orbital altitude.

The take-off trajectory will be an optimum ascent path in the sense that it will have been calculated for a minimum gross take-off weight. The booster will burn for approximately 2 minutes and the vehicle will have an altitude of 29 miles and a velocity of 11,500 ft/sec. The second stage burning time, 2-1/2 minutes, will give an altitude of 66 miles and a velocity of 26,700 ft/sec. Then there is a long coasting period of 35 minutes duration, during which time the velocity will fall to 24,520 ft/sec. Finally, when the satellite has reached orbital altitude, four small vernier motors will provide the final velocity increment of about 500 ft per second to place it on its approximately circular orbit. The take-off distance totals about 7,500 nautical miles and the whole process from launching to orbit will take about 40 minutes.

The take-off guidance system is seen as a wholly self contained inertial system. A satisfactory orbit can be reached within an error of plus or minus 25 miles of altitude and 1/10th degree of azimuth.

Before going any further, some of the operational considerations leading to the choice of a particular orbit for a satellite should be reviewed.

First, the area of the earth which can be "seen" by a satellite is bounded by the latitudes equal to the angle which the orbital plane makes with the equatorial plane. Thus, the first parameter in the selection of the orbit will be governed by the latitude of the area which is to be examined.

However, the selection of the orbital azimuth is governed by another important factor. Assume, as RAND Corporation did, that the desired operational duration of the satellite is one year. If the orbital plane of the satellite is fixed in inertial space, daylight zones, representative of the seasons, move with respect to this plane. In winter, for instance, the satellite on a polar orbit would never get out of the twilight zone in the northern hemisphere and an entire 3 month visual reconnaissance season would be lost.

However, the oblateness of the earth causes a rotation of the orbital plane about the earth's axis, which, in the case of a retrograde orbit, is a "Regression of the Nodes". This regression rate, which is similar to the precession of a gyroscope, is a function of the inclination of the orbit to the equator, the period becoming infinite for an orbit which passes over the poles and decreasing southward to zero for an equitorial orbit. This regression rate has been calculated to be one degree per day for a retrograde orbit which is inclined at 83degrees to the equator. This means that the satellite would be on an orbit where daylight operation could be continuous all year round.

In choosing the orbital altitude for the satellite, a compromise has to be made between the advantages of the increasing altitudes, which give a greater duration in orbit and an increased line of sight distance for communication: and those of the lower altitudes, which decrease the size of the optical system needed to obtain visual detail and the decreased amount of energy required to establish the vehicle inits orbit.

All of these considerations led to the basic orbital altitude choice of 300 miles, this assumes that reconnaissance information can be recorded aboard the satellite and played back, at a selected time, to the ground.

The actual satellite vehicle will have a length of about 30 feet., a diameter of 8 feet., and at this stage, will weigh about 4500 pounds of which 1500 pounds will constitute its payload.

The major operating components of the satellite vehicle while on orbit are first, the auxiliary power plant. ✓ This is seen as a small nuclear reactor, in which the working fluid operates a turbine to drive an electrical generator. The power requirements of the satellite vehicle are estimated at about 2 to 3 kilowatts. All rejected heat from this and other satellite components must be radiated from the vehicle's skin, as conduction losses are not possible at this altitude due to the lack of an atmosphere of any consequence.

The second major operating component of the satellite is the attitude control system which keeps the vehicle oriented vertically to the earth. A vertical platform is established by a horizon scanner, in which an infrared photo tube detects the horizon through rotating optical system. This rotating system establishes the earth as a disk, and determines the instantaneous vertical to the center of that disk. The scanner actuates pitch and roll gyros. The yaw gyro senses the direction of the orbital plane. All three gyros actuate corresponding reaction wheels whose axis are constrained along the principal axes of the satellite vehicle and these in turn, correct perturbations imposed on the vehicle while on orbit.

Both of these components are in being to service the heart of this vehicle, which is the TV optical system. Before examining that, it is necessary to review the basic assumptions which served to establish the reconnaissance capabilities of the suggested system. As a result of study of simulated satellite television pictures, it was determined that a scale of 1/500,000 would represent a minimum plausible scale for pioneer type reconnaissance, which involves very broad coverage at a small scale. This picture scale of 1/500,000 would permit observations of:

A. Airfields

B. Industrial Concentrations.

C. Bomb Damage by High Yield Weapons

D. Harbors and Shipping

E. Major Lines of Communication

F. Urban Areas.

G. Large Military Installations.

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Through use of a 38" focal length lens in a TVCamera, utilizing a standard 3" image orthicon, a TV Picture on the photo cathode of 1/500,000 can be achieved by the satellite. This picture will cover an area roughly 10 x 10 miles. The space-borne TV optical system will consist of two basic parts:

A. The TV Cameras and Scanning Equipment

B. The Recording Equipment, Play Back, and Communications Link.

In the TV Camera equipment, two standard 3" image orthicons would be used in conjunction with a segmented in mirrored wheel which permits optical scanning on either side of the satellite's orbital path to a distance to 200 miles; in other words, the satellite will "sweep" a path 400 miles wide.

The second part of the system is the recording unit in which the photographs made over enemy territory would be stored after each pass and retransmitted to a USAF Ground Station or stations depending on location and orbit. The recorded information would be erased after each transmission and the tape reused on the next pass by the satellite.

A transmitter of about 10 watts output on a frequency of about 7500 MC is used for communication with the ground.

At the ground station the vehicle is tracked while transmitting and simultaneously it is receiving instructions from the ground regarding activities on its next pass. These instructions, resulting from atomatic computations, would cover, for instance, the time of TV operation for next pass of the satellite, and the satellite antenna position for making the next contact with the ground.

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The satellite's main input to the ground station will be in the form of TV images recorded on tape by the ground station. A monitor projector would permit immediate interpretation of selected scanned areas for targets, and perhaps the production of a small scale mosaic for weather analysis.

For full and detailed interpretation, however, the tape would have to be taken immediately to an intelligence center, which would also serve as a repository for all information gathered by the satellite. The intelligence center would be responsible basically for:

A. Data Handling.

B. Selection of Material for Complete Analysis

C. Preparation of Large Scale Mosaics.

D. Interpretation of Individual Pictures.

E. Preparation of Maps and Charts.

F. Finally, and most important, the dissemination of intelligence information to the using agencies.

To accomplish pioneer reconnaissance of the entire Soviet Union in a single day, a strip about 1,000 miles wide would have to be photographed on each pass. However, a compromise to a 500 mile strip width has been made to provide minimum photographic detail for our pioneer reconnaissance. Therefore, it would take something over 3 days for a single satellite vehicle to cover the entire Soviet Union. Also, the effects of cloud cover must be considered based on general knowledge of the soviet climatology on a year round basis, it is to be expected that the satellite would see about 95% of the Soviet Union in the first 15 days of operation, and would probably see essentially 100% by the end of the first 30 days.

Assuming that the straight line-of-sight horizon would limit communication between the satellite and the ground station, some ground station layouts, in which a 300 mile orbital altitude and an 83 degree orbital azimuth is used, should be examined.

All daylight passes over the USSR will come within the communications range of a single Alaskan Ground Station.

A second, and possibly more desirable arrangement from the standpoint of security and proximity to the intelligence center, involve two stations in the United States. Here it would be necessary to wait several hours for results of the two passes over the eastern USSR and this would require an additional tape storage capability; or another vehicle 12 hours out of phase with the first one.

In order to maximize the utility of a satellite type vehicle for reconnaissance purposes, it is very important that we foresee at least the possibility of utilizing this vehicle for surveillance purposes.

This type of operation would, of course, require photography at a much larger scale than would be acceptable for pioneer or first look type reconnaissance. In its investigation, Rand has assumed that a scale 1/125,000 is plausible for this purpose, on a minimum basis. With this scale some things on the earth that move can be seen. However, in achieving this greater detail, it is necessary that we give up a certain amount of coverage. For instance, to achieve a scale of 1/125,000, an optical system of 157" focal length would be needed and the strip on the earth scanned by the satellite during each pass would be reduced from 400 miles to approximately 25 miles. This type of reconnaissance would produce photographs about 2 miles on a side. However, in order to achieve this detail, about one year would be needed for complete coverage of the Soviet Union with one vehicle. Of course, in this case, the answer is to use a number of vehicles simultaneously.

It must be remembered that the system just described is not a system under development, as such, by the Air Force. Neither is it an ultimate in this type of system, but rather operational advance which appears to be feasible with a minimum of development effort. It is a concept for the use of typical and feasible components for a satellite borne system as envisioned by the Rand Corporation.

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ADVANCED RECONNAISSANCE SYSTEM

THE PIED PIPER PROJECT (PROJECT 1115) SUMMARY

6 November 1955

In carrying forward from the Feedback Program, a course of action was indicated which called for the accomplishment of two objectives: First, we have to establish that the critical components of this Satellite Reconnaissance System will, in fact, be obtainable and will perform the functions for which they are desired, and Second, we must ascertain that these components can be successfully integrated into a working reconnaissance system. Around these two objectives, the activities of the Advanced Reconnaissance System Weapon System Office are being aimed. The organization of the office itself is so arranged into two sections: One a Technical Program Section and a System Integration Section. Actually, and for the purpose of this presentation, the system problems and their related tasks for solution are also so arranged.

In many technical areas the Advanced Reconnaissance System Program will depend upon other Research and Development Programs to provide many of its basic components. Notably, from the Air Force's Intercontinental Ballistic Missile Program we expect to derive the rocket engines, fuels, and basic inertial guidance systems for placing the satellite on its orbit, in addition to the necessary ground launching equipment and techniques for the vehicle itself. From Project Lincoln and the Air Force's Information Data Handling System we expect to derive much in the way of techniques for data handling and processing. From the IGY Orbiters and the Scientific Community in general we plan to obtain some and probably a major portion of our Geophysical Data.

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The program of separate tasks aimed at advancing the State-of-the-Art is not a new one. Rand, having recognized that critical areas exist, had initiated studies to investigate these areas and solve the associated problems. Our present Technical Program continues Rand's work and extends it to investigate critical areas not covered by other Air Force Development Programs. It is important to note here that our program considers only items which are critical to the development of the Advanced Reconnaissance System. Areas which are not critical or which are under development by other Air Force Programs are not given consideration by our present program.

One of the critical items is that of providing sufficient auxiliary power. In 1951, at the request of the Air Force, the Atomic Energy Commission sponsored four separate contracts for first phase of feasibility studies of an Auxiliary Power Plant based on a nuclear source of energy. Two of the contractors studied the nuclear reactors as a heat source and two studied the use of radio-active materiel to provide heat. All four contractors indicated that a nuclear auxiliary power supply is feasible. On 1 September of this year, the Air Force in coordination with the Atomic Energy Commission, solicited proposals from outstanding members of industry to provide and develop the technical data necessary to establish a firm basis for the final design of Nuclear Powered Auxiliary Power Plant. Our efforts at this time will include, if necessary, the design, manufacture, and test of an experimental nuclear heat source, the equipment required to transform this heat energy into the required electrical power along with also the necessary power control equipment, and a heat sink capable of rejecting the entire heat output of the

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Satellite payload under its expected operating conditions. All of these equipments contained in this sub-system will be designed for long unattended operation in space. The proposals have been received and their evaluation completed from these proposals the Atomic Energy Commission and Wright Air Development Center will procure probably two contractor teams to carry out this task.

A little later in 1952, a contract was initiated by the Air Force with North American Aviation, Incorporated, to study ways of stabilizing a satellite vehicle while in orbital flight. This appeared to be necessary to permit its use as a military system. This study resulted in the proposed longitudinally stabilized system which you may have heard of in the past. This configuration utilizes a horizon scanner and reaction wheels. We now have a second naturally stabilized system which you see here in which the vehicle has a dumbbell or shoetree mass distribution and maintains a vertical attitude in flight. Under this contract, experimental models of the horizon scanner and the control wheels are being fabricated and the scanner will be tested on 15 November 1955 of this year. The horizon scanner will be carried to altitude (90,000 - 110,000 feet) by means of balloons to test its efficiency in determining the horizon. Further development of the attitude control system, including the necessary computers, is to continue at North American during Fiscal Year 1956. We expect this task to be terminated at the end of this Fiscal Year with complete design specifications for an attitude control and basic inertial guidance system.

The heart of this satellite system of course is its reconnaissance unit, and this equipment has been given considerable attention over the past several years. Also in 1952, the Air Force contracted with Radio Corporation of America to suggest a feasible visual reconnaissance system for the satellite. Their basic proposal is that incorporated in the Final Feedback Report. Since establishing the basic concept, much breadboard work has been done by Radio Corporation of America in an attempt to prove the feasibility of their ideas. At the present time they are building a laboratory model of a complete 38 inch Focal Length Optical System. This model is expected to be completed February 1956 and probably will be tested in Fiscal Year 1956. This will also be accomplished with the aid of high altitude balloons. In connection with the reliability problems expected as a result of long-term satellite operation, Radio Corporation of America has spent considerable time in the life-test of critical television components. Radio Corporation of America has spent part of their effort in the recording of TV information on magnetic tape. This is work in addition to their much publicized effort for the National Broadcasting Company. Radio Corporation of America has made considerable progress in this area and has demonstrated a frequency multiplexing technique for an eight megacycle recorder. In recognition of the complexity of the recording problem, a back-up effort is being undertaken. Through the Rand Corporation, a contract is currently being negotiated with the Ampex Corporation on the West Coast for the purpose of also studying and developing techniques which may provide a suitable solution to the wide-band recording problem.

The possibility of utilizing the sun as a source of auxiliary power for a satellite vehicle continues to merit consideration. Recent investigations with cadmium sulphide crystals show that they possess a relatively high photovoltaic efficiency. A contract with the Harshaw Chemical Company has resulted in a small solar battery utilizing cadmium sulphide crystals capable of producing up to fifty milliwatts of power. This contract is aimed at a solar power system which will provide moderate amounts of power; as an example, up to 100 watts at the beginning

There are good indications that one square meter of cadmium sulphide crystals exposed to sunlight will produce approximately this amount of power. The contractor expects to demonstrate this experimentally during this Fiscal Year. We are familiar with and are taking cognizance of work in this field that is being accomplished by other agencies. At the conclusion of the present contract in January 1956, further work in this area may be placed with a development and manufacturing company to proceed concurrently with the basic research program.

A parallel study of both the basic inertial guidance system and the attitude control system for the satellite vehicle was initiated with MIT last year. This study is being phased into the work currently under way at Massachusetts Institute of Technology on an inertial Guidance System for the ICBM. Through Fiscal Year 1956 this contract will carry through to completion from theoretical and experimental component fabrication to a finalized design of a complete single package inertial guidance control system. It should be noted that the Air Force, in recognition of the difficulty of this area, has initiated parallel studies and essentially placed the problem under competition. There is evidence that the Air Force has realized a benefit from this competition.

One of the more difficult problems in the establishment of any reconnaissance system is to strike a delicate balance between the user of intelligence and that which can be provided to him. This task for the study of intelligence parameters is designed to keep a continuing thumb on both the projected needs of the intelligence people and the expected capabilities of a satellite vehicle reconnaissance system. A further output of this task will be to make greater use of the information which a satellite system can provide. This task was initiated during Fiscal Year 1955 as an in-house study at Rome and is being carried out as a continuing project with contractual assistance this year. This has been one of the most active tasks since the commencement of design studies. Included as participants have been the DIO, USAF, ATIC, ACIC, Syracuse University, and Boston University. Work is included from the field of basic information content.

Probably one of the most important problems to be solved during the development of the Advanced Reconnaissance System will be that relating to the capability of the intelligence agency to utilize the vast amount of intelligence information which is potentially available from this type of system. When one considers that a single satellite vehicle of the type described in the Feedback Project may be capable of producing up to 100,000 pictures daily, and when one further considers that utilizing such vehicles for surveillance could possibly require numbers of vehicles to be operating simultaneously, one can quickly see that this information will swamp all currently known or considered means for processing such intelligence. This task has also become quite active since the commencement of the design studies.

It has long been recognized that radiations emanating from a nuclear fueled power supply would be quite likely to damage the satellite's components, particularly the electronic gear. To further study this problem, a task has been initiated, to be carried out in conjunction with the Aircraft Nuclear Propulsion Program, to determine the radiation damage threshold levels in electronic components. This information would be used to assist design engineers in the selection of adequate components and techniques to be included in future systems in order to insure optimum reliability. The end item of this particular task will be a comprehensive report presenting the threshold damage levels of all airborne electronic components which will be utilized by the USAF.

In the recent years, the Air Force has become increasingly aware of the potential value and importance of electronic reconnaissance. This technique has progressed far from its original state when it was simply used for ascertaining the type of chaff to drop during a bomb strike. It promises, in the future, to become a means of intelligence collection as important, if not more important, than photo or visual type of reconnaissance. The purpose of this task is to carry on from recently completed feasibility studies and provide techniques and experimentation leading to the development of equipment which will conduct electronic reconnaissance under unattended conditions aboard a satellite. The basic intent of this task is to provide an electronic reconnaissance capability for the Advanced Reconnaissance System. Current work is "in-house" at WADC. Qualified sources are being considered at this time and a contract is expected by 1 December 1955.

With component reliability as one of the major problems of satellite operation, this next task, planned for initiation in Fiscal Year 1956, will obtain design criteria for electronic components having an operational life of 10,000 Hours or more in the satellite's environment. The statement of work has been prepared and proposals will be solicited before 1 December 1955. Other work is planned in the field of mechanical components and overall system reliability. The Bell Telephone Laboratories, Ramo Woolridge, and Redstone Arsenal are under consideration for mechanical and overall reliability studies.

During Fiscal Year 1956, at Rome Air Development Center, a task has been undertaken to conduct in-the-house studies on the acquisition, tracking, and command equipment necessary for use with a satellite vehicle. These studies will be used to provide guidance to Weapo[redacted] Design Contractors and provide monitorship of the of the contractor's efforts in this area. Specific problems areas are to be investigated with contractual assistance.

An other task initiated during Fiscal Year 1956 is a general consultant service or special research study task. The development of a system such as the Advanced Reconnaissance System will encompass practically every field of science known to the Air Force, Industry, and the Scientific Community in general. Competence in these various fields will be utilized as required in a consultant and advisory capacity by the Weapon System Project Office and the participating Centers.

Not delineated, but under consideration are tasks to cover the problems of special fuels for air starts of successive stages of rocket motors, weather forecasting from satellite reconnaissance data, APU's for an interim or limited duration system, and special problems relating to expected environmental conditions.

North American Aviation, Inc. has been working with ammonia-liquid fluorine as a propellant pair for the past several years. The results of this work indicates that there is much to be gained by using this propellant combination for accelerating the various secondary stages of the Advanced Reconnaissance System's vehicle. The specific impulse of the combination is greater than 260 lb sec/lb, and the density of fluorine is relatively high when compared with other propellants.

This completes a description of the tasks which are under way to resolve the first of the Advanced Reconnaissance System Two-Fold Program --that of establishing that the state of the art will be such as to allow the development of the critical components necessary to do the reconnaissance job. Other tasks are to be initiated as it becomes evident that additional critical areas exist. Indicated on the accompanying organizational charts is the organizational "set-up" within the Weapon System Project Office for handling the Technical Program.

As a "LINE" organization under the weapon system officer, we find the Technical Program Section. This section is charged with the responsibility of exercising technical and management cognizance over the State-of-the-art program, and this is accomplished through the various Laboratories and Research Agencies of the Wright Air Development Center, Rome Air Development Center, and Air Force Cambridge Research Center. These agencies supply or provide the individual Technical Competence, Facilities, and Resources necessary to actually monitor and direct the technical tasks. Through these agencies the individual tasks may be found functioning either in industry under contract to the Air Force, or as individual and discrete technical tasks "in the house" of the Laboratories. By far, the major part of these tasks are out in industry or in the educational institutions of the nation. It is felt that this operating arrangement allows a relatively small number of people within the Weapon System Office to fully utilize the potential of the Laboratories and Research agencies of the Air Research and Development Command Centers and also to call upon industry to participate in the areas of their special aptitudes -- for it has been presumed that in the final system development, it will be industry, in one form or another, that will be a prime system manager.

Now, as to how the Weapon System Project Office is attacking the second major objective, that of integrating the various components, both space borne and ground based into a workable Advanced Reconnaissance System. It is within this area that major strides have been taken in the past year.

System Requirement Number 5 provided the authorization to proceede with detailed design studies by industry. The selection of the contractors from industry to be solicited for proposals for design studies was made by Headquarters Air Research and Development Command in coordination with the Air Materiel Command and Headquarters Air Force. Among the considerations for the selection of sources was the assumption that a principle advantage to the program can be gained by maintaining a secure program throughout its design and development. This essentially limited the number of sources solicited. Also considered was the fact that this is a reconnaissance system involving the launching of a vehicle into orbit for the ultimate purpose of collection and dissemination of intelligence information. Therefore, the problem of providing an air frame and engines need not be the sole guide to the type of contractors to be solicited. As the sources that were solicited is noted, it will be recognized that there were ostensibly two air frame manufacturers and two electronic manufacturers. Those solicited were the Lockheed Aircraft Corporation, The Radio Corporation of America, The Glenn L. Martin Company, and the Bell Telephone Laboratories. The Bell Telephone Laboratories declined to submit a proposal. Since the middle of June of this year, the other three contractors have been proceeding with Design Studies. The contractors are studying the entire system. The objective is to determine whether a military intelligence system aimed at satisfying the national requirements of the future can be foreseen at this time with sufficient definitude to indicate full scale development, and to establish the direction and magnitude of the technical programs needed to realize development. Here again, it will be recognized that the problem of proving feasibility is our primary one. The study encompasses the launching to the generation of the intelligence from the data collected. Again, it is emphasized that this is a system - "If ever there was a weapon system this is it".

The missions to be accomplished by the system are as follows:

First, that of providing physiographic pioneer and surviellence coverage of the USSR and its satellites. For the physiographic or TV type system, it should be capable of providing routine target reconnaissance mapping.

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WS 117L MISSIONS

- To provide physiographic pioneer & surveillance coverage of the USSR and satellites.
- To provide and maintain continuous and comprehensive surveillance of the electronic activities of the USSR.

Each mission carries a firm requirement for suitable data handling & processing capability both in the vehicle and on the ground.

The test prog. will involve firing instrumented test vehicles. One such satellite test vehicle will be a "Research Lab. Model" able to obtain & transmit to earth scientific data on the space environment.

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DESIGN STUDY OBJECTIVE

To determine whether a military intelligence system aimed at satisfying the national intelligence requirements of the future can be forseen at this time with sufficient definitude to indicate full development. and to establish the direction and magnitude of the technical programs needed to realize development.

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pioneer terrain reconnaissance, weather reconnaissance, and high yield bomb damage assessment. A second mission is that of providing and maintaining continuous and comprehensive surveillance of the electronic activities of Soviet Russia. Within this mission, it is expected to provide enemy order of battle, the capabilities of the enemies offensive and defensive systems, indication of enemy intentions, their electronic activities schedules, and their utilization of the frequency spectrum. It is also recognized that a test program will be involved and will require the launching of instrumented test vehicles. One such vehicle will be a Research laboratory model able to obtain and transmit to the earth scientific data on space environment. The Advanced Reconnaissance System has co-missions, physiographic and ferret, and involves a testprogram utilizing a satellite vehicle. These design studies are expected to culminate in a straightforward plan for the development of a complete reconnaissance system within the framework of the missions; along with the latest and most realistic estimates of full scale development, both time and costwise. This information is of vital importance to the final decision as to whether or not this nation is to have a satellite borne reconnaissance system.

Noting, the Program Implementation Chart it can be seen what was considered an appropriate program for the next few years. Note here that prior to 1 July of this year the program was carrying only individual tasks aimed at state-of-the-art advancement. Beginning with July this year (actually 15 June 1955) the design phase was undertaken and is currently under way with Lockheed, Radio Corporation of America, and Glenn L. Martin doing design studies. Concurrently, is the continuation of the state-of-the-art tasks under this project. On 1 July of next year, the Weapon System Project Office is scheduled to receive from the design study contractors, design studies from which may be prepared, if feasible, a development plan. This development plan may be expected to be completed by about 1 October of next year. From the

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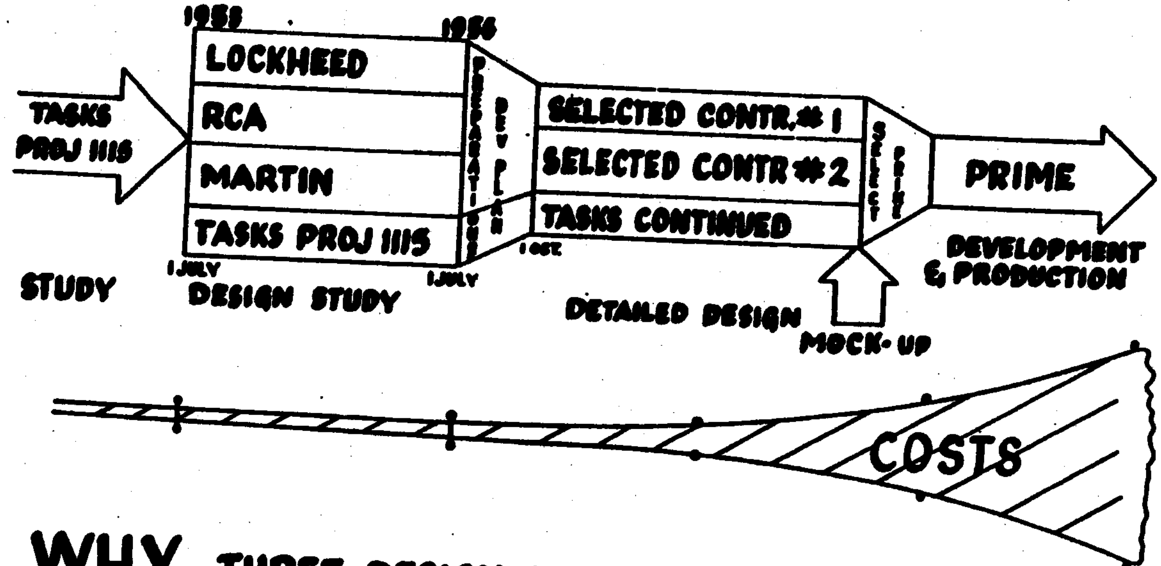
PROGRAM IMPLEMENTATION



WHY THREE DESIGN STUDY CONTRACTORS?

1. RELATIVE SMALL COST OF DESIGN STUDY TO DEVELOP COSTS
2. SUFFICIENTLY DIFFERENT APPROACHES TO PROBLEM INDICATED IN PROPOSALS
3. ENHANCES COMPETITIVE NATURE OF STUDY & DEVELOPMENT

[redacted]

problem of making a final evaluation of whether or not, from the design studies, it can be determined that a satellite form reconnaissance system is feasible and if a system is feasible, which of the design studies and their contractors reflect the best competence for continuing in the detail design phase. We must decide which of the design studies should continue. For this purpose there has been established an Advisory Group made up from the Centers and covering the various Technical Areas of the system and also containing people of sufficiently recognized overall stature to make a sound evaluation. This team, it is felt, will be able to follow the program throughout its design study phase and will be better able, at the time of receipt of the design studies, to make a best evaluation and recommendation.

Little has been said to this point of the problems that are foreseen or that are given considerations at this time. There are of course many, both technical and management-wise. The technical problems, can be attacked if they are recognized and those that are recognized are being attacked through our technical tasks. But have we recognized all of the critical areas which need to be investigated?

In recognizing that there may very well be critical areas that are not being covered the Weapon System Project Office is constantly vigilant for signs that indicate that we may be over-looking some area. As the program continues full use will be made of recognized leaders for guidance as to areas that should be covered. Notably, from our consulting service contract, it is expected that this type of competence to review our work will be gained.

Then of course the very nature of a satellite platform has its problems. There is a virtual absence of information as to the environment in which it will be operating. Therefore, the requirement for an early geophysical

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and environmental collection program is recognized, and in realization of this problem the project is anxious to participate with the scientific community in general, or others who may have programs under way which will provide us with these geophysical data. For only when this information is available can the designers proceed in the engineering manner to which they are accustomed. It is also recognized that if the scientific community in general, or others, do not have under way or do not plan to conduct programs which will provide this information, it will necessarily become an early part of this our program to collect geophysical information. It is felt that this system probably is the only military system that can logically place valid requirements for data collection against any orbiter that may come into existence.

Also, there is that problem of funneling, by one means or another, all the work that is being done in the state-of-the-art advance into the design studies and into the design itself. This is no simple problem. Here again both of the operating sections realize that this must take place and they are constantly striving to assure that work done by others reaches the design study contractor. It can be reported at this time that there has been a recognition on the part of the design study contractors that if they are to remain competitive they must utilize all information that is available from outside sources.

There is also the problem of the security of the program. As pointed out before, there is a genuine realization by the Weapon System Project Office that a principal advantage can be gained in the military application of the system if the program in its development can be kept secure; and the Weapon System Project Office is striving to carry out a

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secure program. Inherent in carrying out a secure program are a multitude of problems associated with the day to day activities of the management people. We are also constantly wary to assure that precedents relating to the use of satellite vehicles are not established which might hamper this system in its test phase of military application. We recognize that the satellites which may come about as a result of the IGY Program can provide the program with much of the environmental data. Again though, it is recognized that there may be precedents established which would preclude our own test programs and which might at sometime preclude the utilization of the system except in war time.

In conclusion, it is desired to highlight some of the points which it is felt have been important. First, the object of the Advanced Reconnaissance System Program, at this stage, is one of proving feasibility. (By experimentation and actual rigging). There is enthusiasm that a workable system will evolve. But, the door is open and all information will be entertained to support that this is an unfeasible concept and that further Air Force dollars should not be spent as such. (2) The program, at this time, is considering only such items as are critical to a satellite space-borne reconnaissance system. (3) Wherever it appears to be feasible, the element of competition is interjected and it appears at this time that through this competition that the Air Force has gained benefits. (4) The Program has a system concept. This is visualized as a system from the point of launching a vehicle into orbit for the purpose of the collection to the dissemination of the intelligence information. (5) The program at the present time is organized and carried out as a straightforward Weapon System Project Organization utilizing the services of the participating Center. (6) There are many problems and they can be summarized as follows: that of the lack of geophysical information upon which detail design can be initiated. It is recognized that the program may be deficient [redacted]rlooking critical [redacted] ...NTIAL

...ATED STUDY

RADC

CONTRACTOR UNDER NEGOTIATION

ENGINEER MR ... H ...

(?8: Provide guidance to the ARS project ... their contract ... in the design ... by furnishing ... all ... parameters ... present ... information ...

[redacted] [redacted]

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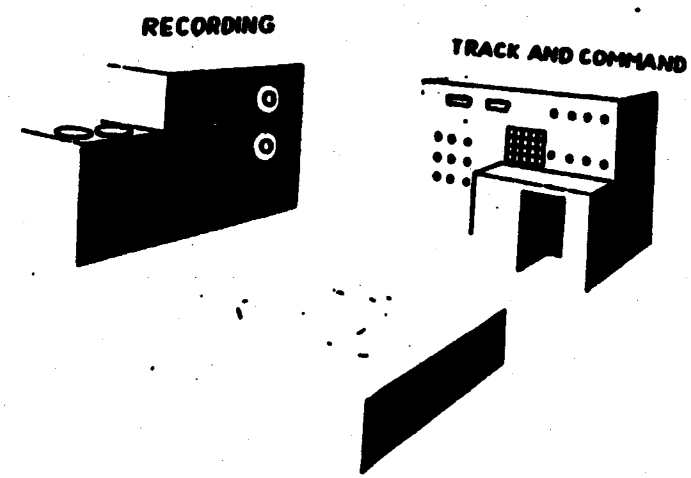
Study of Intelligence Processing Methods

TASK I

RADC



CONTRACTOR: TO BE SELECTED

ENGINEER: R.H. JOHNSON RADC

To determine systems and equipment design characteristics essential to the processing and dissemination of intelligence information relative to the ARS system.

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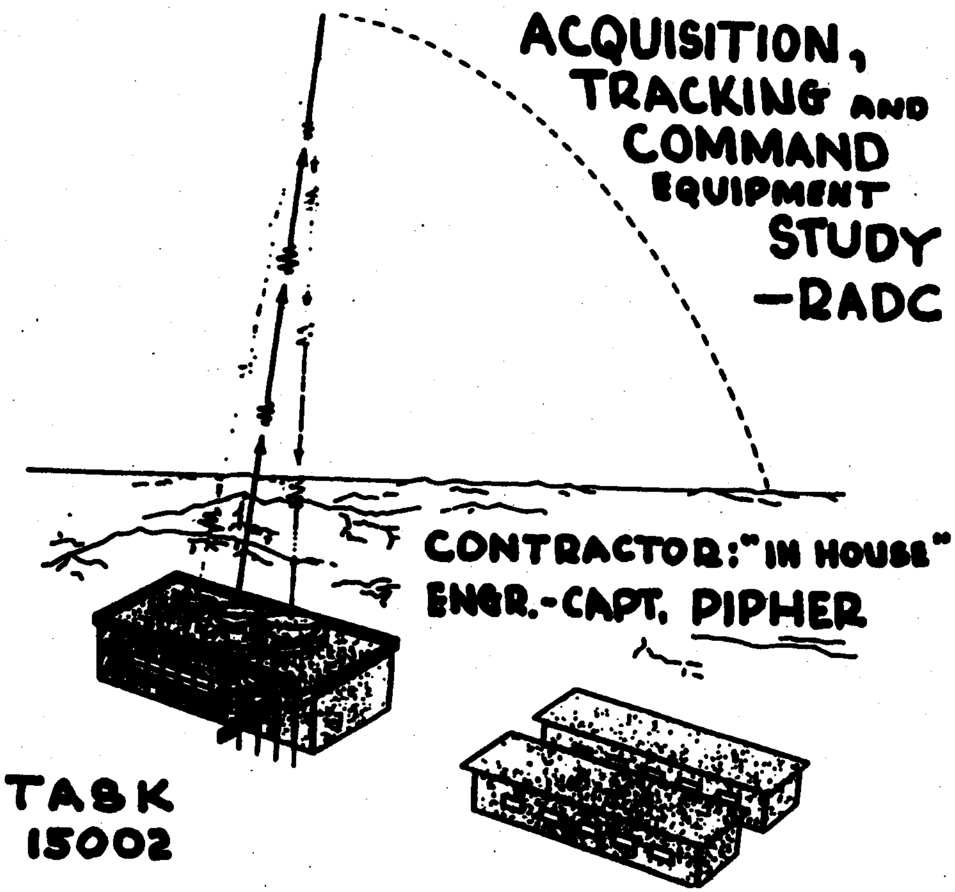

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DESIGN STUDY

ADVANCED RECONNAISSANCE SYSTEM MX 2226

TASK 21010

CONTRACTORS: GLENN L. MARTIN, LOCKHEED AIRCRAFT AND RADIO CORP. OF AMERICA.

ENGINEER : F.C. RUNGE

OBJECTIVE : To determine whether a military intelligence system aimed at satisfying the national intelligence requirements of the future can be forseen at this time with sufficient definitude to indicate full development; and to establish the direction and magnitude of the technical programs needed to realize development.

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SPECIAL RESEARCH STUDIES

TASK 21011

CONTRACTOR : NONE

ENGINEER : CAPT. J.S. COOLBAUGH

OBJECTIVE : SR No. 5 dated 29 Nov. 1954 directs that ARDC make maximum use of the scientific & technical competence within the nation. This competence should be recognized & utilized when required in a *CONSULTANT* and *ADVISORY* capacity by the Weapons Systems Project Office responsible for the Advanced Reconnaissance System.

[redacted]

55-RDZ-9554

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ADVANCED RECONNAISSANCE SYSTEM

TASK - 1115-30205

TITLE- COMPONENT DEVELOPMENT FOR ROCKET ENGINES USING HIGH PERFORMANCE PROPELLANTS (FLOURINE)

ENGINEER - Capt. R. S. Decker, Power Plant Lab, WCLPN, WADC

CONTRACTOR - NORTH AMERICAN AVIATION

OBJECTIVE:

Effort under this task will be devoted to basic experimental investigations and tests of high performance rocket engine propellants and the establishment of design parameters for the development of a 35000 lb. thrust chamber using a flourine-ammonia combination.

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ADVANCED RECONNAISSANCE SYSTEM

Brief

PHILOSOPHY OF ORGANIZATION

In carrying forward from the Feedback Program, a course of action is indicated which calls for the accomplishment of two major objectives;

First, we must establish that the critical components of this reconnaissance system will, in fact, be attainable and will perform the functions for which they are designed - we must establish a satisfactory state-of-the-art with respect to the critical components.

Second, we must ascertain that various components can be successfully integrated into a working reconnaissance system.

Both of these objectives being of the same importance to the success of the program, it is anticipated that each will require about the same amount of management personnel and direction. It is further anticipated that both objectives will be of a continuing nature for the next 2 or 3 years and will be generally definable within the program. There will be the requirement that they be closely coordinated. These two (2) general objective areas are delineated in the Project 111[illegible] Development Plan and in the System Requirement (SR-[illegible]) for the Advanced Reconnaissance System (ARS).

Predicated upon the discreteness of the two (2) objective areas, an organization of the ARS Weapon System Project Office will have a functional breakdown into two major sections to handle the two (2) objective areas. These two (2) functional sections are to be known as the Technical Program Section and the System Integration Section.

The Technical Program Section will [illegible] exercise technical [illegible] over the [illegible] technical program aimed at state-of-the-art advancement and [illegible] development [illegible]. [illegible] Integration Section will [illegible] and exercise technical [illegible] determination [illegible] and the direction [illegible] with [illegible] responsibilities and authority to be maintained between its members and others (including technical [illegible]) to insure the proper coordination of efforts within the policies and directives received from the Weapon System Project Officer, higher authority, and the approved Development Plan. Included in the authority assigned this section will be the authority to establish such technical tasks and/or projects as may be necessary. Technical tasks [illegible] underway in the laboratories at WADC will fall under the cognizance of Technical Program Section. The Acquisition Tracking & Command Equipment Task at RADC will also fall in this Section. [illegible] at RADC ([illegible] and Intelligence Processing) and the [illegible] Program at [illegible] will be under the cognizance of [illegible] System Integration Section as well as the Design Study Task. Future tasks will be under cognizance [illegible] Investigating Section.

As an adjunct to the [illegible] will be a minimum organization to serve in the sense of staff capacity. It [illegible] any [illegible] organization [illegible] operation [illegible] administration assistance to the responsible person. There are in effect in this program various operational [illegible] which must be coordinated to minimize [illegible] require [illegible] and [illegible] effectiveness. Generally, [illegible] reporting to higher headquarters requires a single [illegible] report for the various aspects of the [illegible]. This management reporting and coordination can best be effected through staff assistance to the Weapon System Officer. Our organization will have an "Operations & Administration" [illegible] for this "staff" assistance.

will recognize their ultimate responsibility for the technical adequacy of the system.

There appears to be a requirement for Officers (military or civilian) in a classification of R&D administrators to meet the two principle sections of the organization and their assignment should be divided to the [illegible] and the Air Force in the future. Beneath these heads, personnel with technical specialities appropriate to the system would be desirable. An R&D Staff Assistant should be assigned to the position the Operations and Administration "Staff."

A rather formal organizational and functional chart has been drawn up in an effort to define operations within the ARS WSPO. It is inadequate and many of the working arrangements of the organization remain implicit. There is nothing inflexible about the chart and changes will be necessary. Alteration and/or expansion of the organization will be studied from time to time in light of changes in objective, personnel assigned and relationships required.

A Technical Advisory Group, consisting solely of individuals with considerable scientific, technical, and management competence will be required to advise, counsel, and guide the overall integration of this system, and to evaluate, to this end, the contractor's progress in the design stage and system development. The enlistment of all available "real talent" to monitor the system progress is deemed the only solution to culturing the threshold state-of-the-art into the reality of a reliable system.