SPACE BUSINESS Daily

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PENAID MARK 1 TO AVCO. The Air Force Ballistic Systems Division is expected to enter into negotiations with Avco RAD of Wilmington for the research and development of the Mark 1 Penetration Aids. DOD is requesting $35 million in FY '67 for penetration aids development (compared with $15 million for FY '66) (SPACE Daily, Jan. 28).

SAM D TEST SLED ORDERED. The Army Missile Command has ordered the design and fabrication of a test sled for the **SAM D** anti-bomber weapon program from Inca Engineering of San Gabriel, California. The **SAM D** is one of the basic components of the current DOD plan for meeting the Soviet and Red Chinese missile and bomber threat (See page 184 and SPACE Daily, Jan. 28). The missile system, in predevelopment by Hughes and RCA teams (SPACE Daily, Aug. 4 & Nov. 1), was formerly known as the **AADS 70** program (SPACE Daily, March 22, '63). The **SAM D** will share defense damage limiting (DL) responsibilities with the anti-**SLBM**, the F-12, the **SIM** (Space Interceptor Missiles), the **SPRINT ABM** and the fallout shelters (See page 184).

AIR FORCE MOVING TO SINGLE 156 CONTRACTOR. The Air Force has apparently decided to select a single contractor to continue development of the 156-inch-diameter solid propellant rocket with the testing of actual strap-on stages. The AF budget for space and related equipment, cut by $173 million for FY '67 (See SPACE Daily, Jan. 25 & 26), provides around $7 million for the 156 development. The figure would include about $5 million in new obligational authority plus about $2 million of 156 funds reprogrammed from FY '66. The Air Force was not allowed to proceed to full-scale development however; there is no budget line item provided for the large rocket program.

There are at present two contractors in the 156 program: Lockheed, who is working on liquid injection and jet tab thrust vector control systems; and Thiokol, which is working on liquid injection and gimbaled nozzle thrust vector control. One of these contractors will be expected to develop the 156-inch stage which can be strapped on to the **TITAN III-C.**

AA SPACE SHUTTLE TEST POSSIBLE. The **AA** Experiment Program (SPACE Daily, Jan. 20), which must be considered by potential bidders for the **AA** integration contract, will include the re-entry from orbit of a scale model, unmanned, "high lift re-entry body" similar in configuration to the **HL-10** and **M-2**. Prospective bidders will consider the feasibility of a space shuttle concept in their proposals for the payload integration contract.

Douglas has "informally" discussed a plan with NASA which would locate the Space Shuttle model in an unused area in the **LEM** adapter atop the **S-IVB** stage. NASA is also considering the possibility of using scale models of an **HL-10** or **M-2** lifting body in some of the continuing series of **SCOUT** Re-entry tests (See elsewhere in this issue.) Another possibility for the sub-orbital re-entry shots is the use of a model of the Air Force **PRIME** configuration (See SPACE Daily, Jan. 26).

COMSAT GLOBAL CONFIGURATION FILING "IMMINENT". ComSat will file with the FCC this week or next its global satellite configuration and is expected to therein state that the satellite will be used at a synchronous altitude. Although ComSat required the configuration have the capability for any orbit between medium and synchronous heights (SPACE Daily, Aug. 18), it has always favored a synchronous system. Its contract with **TRW**, for example (SPACE Daily, Dec. 16), calls for delivery of four satellites by the end of 1967, a significant stipulation because the global system is to be operational in '68 and a synchronous network needs three payloads for global coverage.

SCHRIEVER NON-PROFIT REPORT STILL UNDER AF STUDY. Air Force General Bernard Schriever's report on non-profit corporations (SPACE Daily, Sept. 13), originally intended for release this month (SPACE Daily, Jan. 11), is still being evaluated by the Air Force and thus may not be cleared for disclosure until well within next month. It is presently at the level of Lieutenant General James Ferguson, AF deputy chief of staff for research and development, and will probably go next to Ferguson's boss General John McConnell, chief of staff, then to Dr. Alexander Flax, assistant AF secretary for R&D, and finally to AF secretary Harold Brown. Whether it will have to be reviewed by DOD officials is not yet determined.

SENATE SPACE CONFIRMS SEAMANS. After a short series of cursory questions on the management structure of NASA and the duties the position of Deputy Administrator now involve, the Senate Space Committee unanimously voted to recommend to the Senate the confirmation of Robert C. Seamans as Deputy Administrator to succeed Dr. Hugh L. Dryden. Seamans has been serving in that capacity since December 21, under a recess appointment by President Johnson.

5TH SCOUT RE-ENTRY TEST SET FOR FEB. 7. After almost a year and a half, another flight test of an experimental heat shield on a **SCOUT** vehicle will be conducted from Wallops Island on February 7. The payload will be a low-density, ablative, phenolic-nylon nose cone which will be accelerated on re-entry to over 18,000 mph for study of the material under extreme temperatures.

This will be the fifth such test flight. The fourth, conducted in August 1964, was "a complete success" (SPACE Daily, Aug. 19, '64). NASA-Langley designed the payload and manages the test program.

EXPLORER I'S EIGHTH ANNIVERSARY. Today is the 8th anniversary of **EXPLORER I**, the first United States entry into space.

U. S. COULD DEFEND ONLY 20-30 PERCENT. Defense Secretary Robert McNamara told Congress last week that presently planned U. S. defenses could not prevent the Soviet Union from killing 130-135 million Americans if Russia were to launch a surprise nuclear attack. American casualties would be 90-95 million even if the United States were to attack the Soviet Union first, McNamara said. Without these programs which are currently approved, a surprise attack by the Soviet Union would result in 160 million U. S. casualties, he said. All of the above figures are based on the currently approved U. S. defense program in 1970.

The presentation by McNamara to Congress revealed a series of alternate cost-effectiveness defense postures, utilizing fallout shelters and such weapons as **NIKE X, SAM D, SIM** (Space Interceptor Missiles - see SPACE Daily, Jan. 28), **SLBM** and **F-12** interceptors, which could be used by the United States in the 1975 time period to defend against a Soviet nuclear attack. Keep in mind when analyzing McNamara's defense charts that none of the above named weapons programs (or the fallout shelters) have been ordered into full development.

McNamara explained that DOD defense charts are based on two envisioned Soviet forces. "Threat I is basically an extrapolation of current Soviet forces reflecting some future growth in both offensive and defensive forces. Threat II is a major Soviet response to our deployment of a ballistic missile defense. It includes a large number of big, land-based missiles equipped with penetration aids designed to overwhelm our **ABM** defenses and a qualitatively improved and somewhat larger manned bomber force, and also assumes the deployment of a very sizeable, sophisticated **ABM** system."

The Defense and the Costs: Against Threat 1. U.S. defense system capable of insuring that we can deliver an assured destruction (AD) strike against the Soviet Union in 1975 would cost $22.4 billion (between 1966-75 fiscal years), with an additional $1.5 billion to limit U.S. casualties to 130-135 million if the USSR strikes first, or 90-105 million if the U.S. strikes first. The same defense with a fallout shelter program costing $3.4 billion (instead of $1.5 billion) would limit casualties to 110-115 million and 80-85 million, respectively.

Development of a new defense system would have considerable damage limiting (DL) results. This system would include: 1) A full civil defense fallout shelter program; 2) Antisubmarine **(SLBM)** defenses; 3) A force of improved interceptor aircraft, the **F-12**; 4) An improved bomber defense, the **SAM D** ground-to-air missile and, 5) An **ABM** system employing long range "exoatmospheric" **SIM** (Space Interceptor Missile) systems, along with lower altitude interceptors, **NIKE X/SPRINT**.

A DL posture costing $22.5 billion (A), along with the basic defense cost of $22.4 billion would limit casualties to 80-95 million in the event of a surprise attack, and to 25-40 million if the U.S. were to strike first. A DL system costing $30.1 billion (B) would result in casualties of 50-80 million and 20-30 million, respectively.

Against Threat II. Posture would involve a stepped up U.S. assured destruction spending of $28.5 billion and a damage limiting spending of $24.8 billion, resulting in casualties of 105-110 million due to a Soviet first strike, or 35-40 million if the U.S. attacked first. Posture D involved the AD spending of $28.5 million and a DL spending of $32.3 million, with resulting casualty totals of 75-100 million and 25-40 million, respectively.

MORE

U. S. COULD DEFEND ONLY 20-30 PERCENT-Contd

The Defense Secretary told Congress that the Defense Department is not making any decision now as to what level of spending is going to be made on U. S. defense systems for the 1975 period. McNamara reasons: "We should not now commit ourselves to a particular level of damage limitation against the Soviet threat-first, because our deterrent makes general nuclear war unlikely, and second, because attempting to assure with high confidence against all reasonably likely levels and types of attack is very costly, and even then the results are uncertain. Our choices should be responsive to projection based upon the observed development of the Soviet threat and our evolving knowledge of the technical capabilities of our own forces." (See page 188.)

WEBB TO HANDLE INTERNATIONAL NEGOTIATIONS

NASA Administrator James E. Webb is expected to assume the chief negotiator role in future international space cooperation efforts by the United States.

Dr. Hugh L. Dryden, had been the chief negotiator for the United States in efforts to negotiate an international space agreement, but current plans call for his successor Dr. Robert Seamans to continue to act as NASA's General Manager, leaving the international field to Webb.

Webb, who was named by President Johnson to head a delegation to discuss the "joint exploration of space" with European space officials (SPACE Daily, Dec. 22), met last week with the chairman of the Academy of Sciences of the USSR, and assured him (Blagonravov) that the United States will continue its efforts to reach some sort of agreement on the peaceful uses of outer space. No date was set during the informal meeting for the next working session between the US and the USSR. Working with Webb will be Arnold Frutkin, NASA assistant administrator for international affairs and United States representative to the Working Group of the UN Committee on the Peaceful Uses of Outer Space (See below).

UN AGREES ON SPACE CONFERENCE

A UN Committee on Space has reached agreement in principle to hold an international conference in 1967 to discuss the benefits of space exploration for the developing nations (SPACE Daily, Jan. 27).

The agreement adopted largely the United States' position calling for a conference with the specific objectives of defining the Earth applications of space exploration thereby rejecting the Soviet attempt to have a broad technical conference to review accomplishments in space exploration and to commemorate the beginning of space exploration by the Soviet Union in 1957.

The Soviet Union suffered a small defeat in the Committee since the final recommendation did not mention the 10-year commemoration of the beginning of space exploration by the USSR and set as the topic of the conference instead of space achievements the direct applications to "non-space powers" of space exploration, an area in which the U.S. believes that it is the leader.

Therefore, the conference is more likely to have a favorable propaganda advantage for the U. S. then the Soviet Union. The U. S. is also trying to advance the view that instead of a separate large conference with world-wide attention, it would be better to merely hold a special meeting of the UN Space Committee which would give a smaller propaganda stage on which the Soviet Union could display its latest space achievements.

FIRST S-IC APPROACHING TEST FIRINGS

As anticipated (SPACE Daily, Dec. 16), **S-IC-1**, the first flight-model **SATURN V** first stage, is now being prepared for its test firings at NASA-Marshall. Here it is being lifted into the test stand. At least two firings will be conducted before the stage is removed to its hanger and checked out prior to shipment to Cape Kennedy for launch at about this time next year (SPACE Daily, Jan. 24). The stand was previously occupied by **S-IC-T** (Tooling), a nonflight model that underwent 15 tests there (SPACE Daily, Dec. 23). The **S-IC** is 33 feet in diameter and 138 feet tall, uses five F-1 engines, and generates 7.5 million pounds of thrust. **S-IC-2** is being checked out at Marshall, where it and **-1** were fabricated, and will follow **-1** in the test stand.

TOSS (ESSA) LAUNCH SCHEDULED FEB. 2

First **TOSS** (**TIROS** Operational Satellite System) satellite is scheduled for launch February 2 from Cape Kennedy. The RCA-built satellite will be named **ESSA I** (Environmental Survey Satellite) if the launch is successful, replacing the **TOSS** designation. Program manager and director: ESSA, The Environmental Science Services Administration of the Department of Commerce. (See SPACE Daily, Jan. 28.) NASA will launch the satellite with a **DELTA** booster.

Information gathered by satellites in the **ESSA** system will be used by the Weather Bureau, an agency of ESSA, to improve daily weather analyses and forecasts, and also will be transmitted to weather stations of other nations. When **ESSA** is fully operational, two satellites, one employing a real-time APT (Automatic Picture Transmission) camera, and one with picture storage capability, will be in orbit at all times to provide both local and worldwide cloud cover pictures at least once a day.

US/SPAIN SIGN SPACE PACT

NASA and the Comision Nacional de Investigacion del Espacio (CONIE), the Spanish space commission, have reached an agreement for cooperative meteorological sounding rocket experiments. The Spanish agency will launch 16 boosted-**DART** and **ARCAS**-type sounding rockets carrying chaff (shredded tinfoil) for instrumented payloads from a launch site in Spain. NASA will train Spanish personnel, and loan the necessary radar and ground equipment, plus providing the rockets.

KENNEDY/HOUSTON AWARD SUPPORT CONTRACTS

NASA-Kennedy has finalized a $4.3 million modification to its existing cost-plus-award-fee contract with RCA to provide for planning, maintenance, and operation of the Kennedy Space Center Communications System. The modification is an extension for calendar year 1966 of RCA's previous contract and brings the total contract to $7,747,607.

NASA-Houston has awarded a $5,004,735 cost-plus-incentive-fee sole source contract to Brown and Root-Northrop for operation and maintenance support services.

NASA TO MEASURE SOLAR NOISES IN NOVEMBER

NASA-Cambridge has issued RFPs to six companies on a program to design, develop and build a system to measure the optical noise from the vicinity of the solar disk. Focal point of the program is Nov. 12 during the solar eclipse.

Invited to bid, with a due date of Feb. 10: Advanced Kinetics, Costa Mesa, Calif.; Block Engineering, Cambridge; GCA Technology Division, Bedford, Mass.; Melpar, Falls Church, Va.; Perkin-Elmer, Norwalk, Conn.; and Douglas Missile & Space, Santa Monica, Calif.

RYAN EARNINGS UP 12 PER CENT

Ryan Aeronautical and its Continental Motors Corp. subsidiary had sales of $234,-747,481 for the fiscal year just ended, compared with unconsolidated sales of $44,486,032 for FY '64. Ryan's unconsolidated sales for fiscal 1965 totaled $51,-316,455. Unconsolidated earnings were $3,088,163, an increase of approximately 12 per cent over the $2,761,988 reported last year. Consolidated earnings were $3,578,682.

PLANNING RESEARCH EARNINGS UP

Earnings of $360,121 on sales of $7,524,526 for the six months ended Dec. 31 have been reported by Planning Research Corp. Comparable figures for the last six months of 1964: $342,762 and $5,952,850. The company had 91 contracts in progress on Dec. 31 compared with 84 a year earlier. Proposal activity was reported up 30 per cent from a year ago.

EARNINGS OFF AT CONTROL DATA

Earnings for the six months ended Dec. 31 for Control Data Corp. dropped to $106,-241 from $4,198,653 for the comparable period in 1964. Sales, rental, and service income amounted to $73,704,858 for the 1965 period as compared with $78,006,402 a year earlier.

The company attributed the earnings decline to "a continuation of effects of competition and a number of technical problems, and the shift of incoming business toward leases rather than outright sales."

Backlog at Dec. 31 was up 30 per cent, with lease contracts comprising 65 per cent of the total backlog.

LEWIS EXTENDS ION THRUSTOR SYSTEM DUE DATE

NASA-Lewis has extended the due date for its experimental and analytical testing program of electron-bombardment Kaufman-type ion thrustor systems which use mercury as a propellant. Firms now have until today to submit their proposals to the Center. The original due date was January 21 (SPACE Daily, Jan. 13).

THE GENERAL NUCLEAR WAR PROBLEM

(The following is an excerpted transcript of remarks made by Defense Secretary Robert McNamara before a House Armed Services subcommittee last week in which he sketches the problems confronting the DOD planners in the selection of the offense/defense forces of the United States, remarks which bear on the selection, development and deployment of the nation's deterrent. McNamara's discussion is also a reflection of the rapidly changing concepts of the missile's role in the balance of international power and is reproduced for its general interest value to the space community.)

"Last year I pointed out that the general nuclear war forces should have two basic capabilities:

1. To deter deliberate nuclear attack upon the United States and its allies by maintaining, continuously, a highly reliable ability to inflict an unacceptable degree of damage upon any single aggressor, or combination of aggressors, at any time during the course of a strategic nuclear exchange, even after absorbing a surprise first strike.

2. In the event such a war nevertheless occurred, to limit damage to the population and industrial capacity.

"The first of these capabilities we call assured destruction and the second damage limitation.

"Viewed in this light, the assured destruction capability would require only a portion of the **ICBM's**, the submarine-launched ballistic missiles **(SLBM's)** and the manned bombers. The damage limiting capability would be provided by the remainder of the strategic offensive forces **(ICBM's, SLBM's**, and manned bombers), as well as area defense forces (manned interceptors, longer range anti-ballistic-missiles, and anti-submarine warfare forces), terminal defense forces (antibomber surface-to-air missiles and shorter range anti-ballistic-missile missiles), and passive defenses (fall-out shelters, warning, etc.). The strategic offensive forces can contribute to the damage limiting objective by attacking enemy delivery vehicles on their bases or launch sites, provided that our forces can reach them before the vehicles are launched at our cities. Area defense forces can destroy enemy vehicles en route to their targets before they reach the target areas. Terminal defenses can destroy enemy weapons or delivery vehicles within the target areas before they detonate. Passive defense measures can reduce the vulnerability of our population to the weapons that do detonate.

"The vital first objective, which must be met in full by our strategic nuclear forces, is the capability for assured destruction. Such a capability will, with a high degree of confidence, insure that we can deter under all foreseeable conditions a calculated, deliberate nuclear attack upon the United States or its allies. This capability must be provided regardless of the costs and the difficulties involved.

"Once enough forces have been procured to provide high confidence of an assured destruction capability, we can then consider the kinds and amounts of forces which might be added for reducing damage to our population and industry in the event deterrence fails. Such damage limiting programs could range across the entire spectrum, from one designed against a threat of a minor nuclear power–for example, the Chinese Communists in the 1970's–to one designed against the threat of a carefully synchronized surprise first strike by the Soviet Union on our urban industrial areas.

"With respect to the damage limiting problem posed by the Soviet nuclear threat, I believe it would be useful to restate briefly certain basic considerations which have guided our programs over the last several years.

"First, against the forces we expect the Soviets to have during the next decade, it will be virtually impossible for us to be able to insure anything approaching complete protection for our population, no matter how large the general nuclear war

MORE

THE GENERAL NUCLEAR WAR PROBLEM-Contd

"forces we were to provide, including even the hypothetical possibility of striking first. Of course, the number of fatalities would depend on the size and character of the attack as well as on our own forces. The Soviets have the technical and economic capacity to prevent us from achieving a posture which could keep our fatalities below some tens of millions; they can increase their first strike capabilities at an extra cost to them substantially less than the extra cost to us of any additional damage limiting measures we might take.

"Second, since each of the three types of Soviet strategic offensive systems (land-based missiles, submarine-launched missiles and manned bombers) can by itself, inflict severe damage on the United States, even a very good defense against only one type of system has only limited value.

"Third, for any given level of Soviet offensive capability, successive additions to each of our various damage limiting systems have diminishing marginal value. The same principle holds for the damage limiting force as a whole; as additional forces are added, the incremental gain in effectiveness diminishes.

"At the other end of the spectrum, it now appears to be technically feasible to design a defense system which would have a reasonably high probability of precluding major damage to the United States from an Nth country nuclear threat; e.g., Communist China in the 1970's. Such a defense system would also be effective against an accidental missile launching.

"It was with these considerations in mind that we have carefully evaluated the major alternatives available to us in meeting the two strategic objectives of our general nuclear war forces-assured destruction and damage limitation-in the light of the latest projections of the threats. In addition, we have given special attention this year to an analysis of Soviet threats considerably greater than those projected, so as to guard against the possibility that their technological progress may be more rapid than we currently believe to be likely.

"... Even if the Soviets in the 1970 period were to assign their entire available missile force to attacks on our strategic forces (reserving only refire missiles and bomber-delivered weapons for urban targets), our analysis shows that a very large proportion of our alert forces would still survive. And, of these surviving forces, a very large proportion could reliably deliver their payloads to their targets.

"The effective delivery of even one-fifth of the surviving weapons on Soviet cities would destroy about one-third of the total population and half of the industrial capacity of the Soviet Union. By doubling the number of delivered weapons, Soviet fatalities and industrial capacity destroyed would be increased by considerably less than one-third. Beyond this point, further increments of weapons delivered would not appreciably change the results, because we would have to bring under attack smaller and smaller cities, each requiring one delivered weapon.

"It is clear, therefore, that our strategic offensive forces are far more than adequate to inflict unacceptable damage on the Soviet Union, even after absorbing a well-coordinated Soviet first strike against those forces. Indeed, it appears that even a relatively small portion of these forces would furnish us with a completely adequate deterrent to a deliberate Soviet nuclear attack on the United States or its allies.

"A considerably smaller number of weapons detonated over 50 Chinese urban centers would destroy half of the urban population (more than 50 million people) and destroy more than one-half of their industry. Such an attack would also destroy most of the key governmental, technical and managerial personnel and a large proportion of the skilled workers.

MORE

THE GENERAL NUCLEAR WAR PROBLEM-Contd.

"Thus, without any use of the bomber forces, the strategic missile forces recommended for the fiscal year 1967-71 period would provide substantially more force than is required for an assured destruction capability against both the Soviet Union and Communist China simultaneously."

GENERAL DYNAMICS TO ACQUIRE DYNATRONICS

General Dynamics and Dynatronics, Inc. (Orlando, Fla.), a producer of advanced telemetry equipment, have reached an agreement whereby General Dynamics will acquire the company for a common stock transaction.

The General Dynamics stock to be paid will be computed by dividing $5,225,000 by the average closing price of General Dynamics shares on the New York Stock Exchange for the last ten trading days of February with not less than 77,400 or more than 96,760 shares of GD stock to be delivered.

Under the agreement, which is subject to approval of Dynatronics' stockholders, the company will become a part of General Dynamics/Electronics. Dynatronics president Parker Painter Jr. will become a vice president of Electronics and general manager of the Dynatronics Operation, reporting to R. A. Wilson, president of Electronics.

LOCKHEED ENVIRONMENTALLY TESTS PULSED SOLID

Successful test firing of a frozen, flightweight three-pulse solid propellant rocket motor after subjecting it to temperatures of 240 degrees F has been reported by Lockheed Propulsion. The test was designed to represent the temperature extremes to which an airborne missile might be subjected to on an operational mission.

Tested in a horizontal bay at Lockheed's Redlands Proving Grounds, the full-scale motor fired for three varied periods, with shutdown times simulating a flight mission. The three pulses were fired on command from an instrumentation bunker. Temperature of the center of the solid grains was minus 75 degrees F. Test was conducted under contract to the Rocket Propulsion Laboratory, Research and Technology Division, Air Force Systems Command.

GP SALES/EARNINGS/BACKLOG UP

General Precision Equipment's sales for 1965 were $240,600,000, up 10 per cent from last year's $219,465,962. Earnings rose 34 per cent from $3,774,991 to $5,100,000. The company's backlog hit an all-time high of $214 million, up 18 per cent from that recorded at the beginning of the year.

CSC SALES/EARNINGS REACH RECORD HIGHS

Computer Sciences Corp. (CSC) of El Segundo, Calif., had record-high sales and earnings for the 13-week and 39-week periods which ended December 31.

Sales for the 13-week period totaled $6,684,143, with net earnings of $742,550 on 2,040,939 shares outstanding. For the 39-week period, earnings increased to $1,902,276 on sales of $16,833,250.

Future Space Business

NICKEL-CADMIUM CELLS RECOMBINATION/CONTROL ELECTRODES

NASA-Goddard is planning to issue an RFP for a study of the characterization of recombination and control electrodes for spacecraft nickel-cadmium cells. The principal objective of the study will be to eliminate the weaknesses now present in independent third electrode systems.

The following firms are on the Center's original source list: Sonotone Corp. (Elmsford, N.Y.), GE, Union Carbide-Consumer Products, Yardney Electric Co. (New York, N.Y.), Electrochimica Corp. (Menlo Park, Calif.), Gould National Batteries (Washington, D.C.), Eagle Picher Co., Lockheed, Leesona Moos Laboratories, Servel-Burgess Battery, Catalyst Research (Baltimore, Md.), Allis-Chalmers-Defense Products, Tyco Laboratories (Waltham, Mass.), Monsanto Research-Boston Laboratories, Sundstrand Aviation-Denver, Gulton Industries, Electric Storage Battery Co. (Yardley, Pa.), Whittaker Corp., RCA, GT&E Laboratories, Douglas, Ion Physics Corp. (Burlington, Mass.), Ionics Inc. (Cambridge, Mass.), GM-Delco Remy, Electro-Optical Systems, NAA-Atomics International, Firestone Tire & Rubber, and B. F. Goodrich-Aerospace & Defense Products.

Contact: Procurement Division, Goddard Space Flight Center, Greenbelt, Md. 20771, Attn: Bruce A. Bodine, Code 247. Reference: RFP 716-89123. Due date: Jan. 31.

ULTRA-LOW VOLTAGE D.C. MOTOR GENERATOR

NASA-Goddard is funding the development of an ultra-low voltage, D.C. motor generator for use in spacecraft.

The following firms have been invited to bid: Sperry Farragut; GE-Armament & Control Products, Garrett-AiResearch, Fairchild Hiller, Cambridge Thermionic Corp. (Cambridge, Mass.), Herbert C. Roters Inc. (Kew Gardens, L.I., N.Y.), Varo Inc.-Electrokinetics, Textron-Dalmo Victor, Sperry Rand-Vickers Electric, Magnetic Technology (Van Nuys, Calif.), Westinghouse-Semiconductor, Honeywell-Military Products, Electro-Optical Systems, Lear Siegler-Power Equipment, Bendix-Eclipse Pioneer, Boeing, Kato Engineering Co. (Mankato, Minn.), Martin-Marietta-Aerospace, Reliance Electric & Engine Co. (Arlington, Va.), and Borg Warner-Pesco Products.

Contact: NASA, Goddard Space Flight Center, Greenbelt, Md. 20771, Attn: E. K. Cockerham, Code 247 Reference: RFP 720-97367(236). Due date: Feb. 7.

DOD NEGOTIATIONS

North American Aviation Inc., Rocketdyne Div.--with the Bureau of Naval Weapons for material and services necessary to evaluate in simulated critical air launched tactical missile flight condition a full scale packaged liquid engine.

Philco Corp.--with the Office of Naval Research for further technical services required in connection with satellite communications systems.

MORE

DOD NEGOTIATIONS-Contd.

Western Electric Co., Inc.--with Army Missile Command for additional research and development in connection with the **NIKE X** program.

Philco Corp., Aeronutronic Div.--with Army Missile Command for **SHILLELAGH** transmitter modification feasibility study.

Hughes Aircraft Co., Space Systems Div.--with Air Force Space Systems Division to provide infrared test chamber measurements.

Bendix Corp.--with Naval Research Laboratory for the **OSO-E** spectroheliograph.

NASA NEGOTIATIONS

Lockheed Aircraft Corp., Lockheed-Georgia Co.--with Marshall for the response of an elastic space vehicle to random disturbances.

RCA--with Goddard for a study of automatic picture taking systems (APTS).

Hayes International Corp.--with Marshall for a statistical analysis of wind profile data and application to large booster control.

North American Aviation, Space & Information Systems Div.--with Marshall for a study of longitudinal oscillations of propellant tanks and wave propagations.

Philco Corp.--with Goddard for a study to develop an advanced mission analysis computer program and continuation of associated applied research in advanced mission simulation techniques.

DOD CONTRACTS

Army

Firestone Tire and Rubber Co.--$1.2 million fixed-price contract for metal parts for the **SHILLELAGH** missile system.

Air Force

G E, Philadelphia, Pa.--$1.5 million initial increment to a $7.3 million contract for re-entry vehicle flight test program.

NASA CONTRACTS

Goddard

Hughes Aircraft--$495,300 for an engineering model of a high-gain multilobe electronically steerable antenna system.

NASA GRANTS

Harvard University -- $379,841 for theoretical and experimental investigations in radio astronomy and in long wavelength solar radio noise.

Cornell University -- $218,000 to construct and launch an infrared sounding rocket experiment.

Villanova University -- $30,240 for a study of computer-aided circuit analysis and designs.

Massachusetts General Hospital -- (new) $39,530 for experimental investigation of automated techniques for studying sequential learning and memory.

Yale University -- (new) $15,371 for an examination of the physical foundations of pre-biological evolution.

New England Medical Center Hospitals -- (new) $29,358 for study of biomagnetism and ferritin.

University of Arizona -- (new) $125,000 for cosmic ray investigations of elementary particle phenomena at very high energies.

University of Calif (Berkeley) -- $60,000 for advanced theoretical and experimental studies in automatic control and information systems.

Rice University -- (new) $19,680 for research on optimum hypersonic lifting wings.

University of Wyoming -- (new) $6,000 for study of chromospheric spicule structures and lifetimes.

UCLA -- $75,000 for feasibility studies of coordinated radiation experiments from meteorological satellites.

University of Cincinnati -- (new) $300,000 for multidisciplinary space-related research in the physical, engineering, life and social sciences.

University of Detroit -- $20,000 for synthesis of porphine-like substance from simple precursors.

Case Institute of Technology -- $12,530 for special functions and solution representations of partial differential equations.

University of Illinois at Chicago Circle -- (new) $60,000 for nitrogen chemistry significant to primordial systems.

University of Kentucky -- (new) $31,512 for thermo-mechanical investigations of non-Newtonian fluids.