Langley to Maintain R&D Leadership

MODERATE BUT STEADY expansion is the forecast for NASA's oldest research center, at Langley, Va.

Authorizations for plant modernization and new facilities over the Fiscal 1961-62 period total nearly $45 million. Improvements are expected to assure the center's continued leadership in materials and structures research and development for the space agency.

One-third of Langley Research Center's 3000-plus employees are scientists and engineers. Indicative of the in-house capability here is the relatively small outlay in contracts to industry for basic research—only $5 million out of a total of $60 million authorized for R&D. The rest goes for hardware procurement, including $30 million for *Scout* launch vehicles.

It is significant that Langley has served as a reservoir for highly skilled specialists from which the government has drawn over and over again to form new research facilities. Cadre for four research centers—Ames, Lewis, Wallops Station, and the Flight Research Center at Edwards AFB—were first provided by Langley.

Established nearly 45 years ago, this center has been involved with virtually every type of aircraft, missile and spacecraft built or presently conceived. When the first Mach-3 air transport or the *Apollo* or *Dyna-Soar* leaves earth, it will be due in no small measure to the research being performed here today.

• **Major programs**—By far the greatest research effort at Langley is the broad study of structures and advanced materials, a field in which it is considered the major NASA center. Scientists here wage a continuous many-pronged attack on high-temperature problems of re-entry.

In their Flight Re-entry Program, researchers will obtain flight verification of heating problems on typical lunar return vehicles. In general, the tests involved cannot be performed with ground facilities.

Five-stage *Scout* launch vehicles will be used to approach speeds up to 30,000 ft./sec. Three different payloads are now being built to study (1) total heat (convective and radiative), (2) separate radiative components, and (3) heat-shield materials.

FLOYD L. THOMPSON
Director of Langley Research Center

In cooperation with Lincoln Laboratory of Massachusetts Institute of Technology, the Center has been concerned for the past 2½ years with the Trailblazer program. Primarily, this is a signature study of ICBM trails during re-entry. The Trailblazer vehicle employs six stages—three for vertical boost upward, three for downward.

The program has been extended to relate mass and light intensity for media determinations up to 200 miles altitude.

Using the six-stage vehicle, velocities up to 23,000 ft./sec. have been achieved. A seven-stage vehicle also has been employed to fire a dime-size steel projectile to 37,000 ft./sec.

Other principal programs include:

—Development of the NASA *Scout* launch vehicle (since 1958).

—Design and development of *Echo* passive communications satellites. Follow-on to *Echo I* is the rigidized, 135-ft.-diameter *Echo II* now in final development. Langley is responsible for program contracting, as well as satellite and payload design.

—Coordination of instrumentation supplied by other NASA centers for the micrometeoroid-satellite program and for all the final payloads.

—Fundamental investigations of plasmas and plasma motions.

In addition to these and other smaller programs for which Langley has prime responsibility, the center also conducts basic research to support other centers.

• **Langley facilities extensive**—Over its 710 acres, Langley has planted more than $150 million worth of laboratories, shops, support facilities, and more than 40 major wind tunnels.

Ground facilities are supplemented by free-flight research facilities including use of full-scale aircraft and vehicles launched by rocket from Wallops Island on Virginia's Eastern Shore.

Tunnels range in size all the way up to one having a 30x60-ft. cross-section. Velocities obtainable vary from low-speed to Mach-30 in the Langley helium tunnel.

Hot-jet research facilities include one with a temperature capability reaching 16,000°F for re-entry simulation. A 10,000-kva power supply is used with the arc-jet systems.

A Langley-developed combined-loads machine is believed to be the only facility of its type in the world. It can apply combinations of loads and moments which include up to a 250,000-lb. axial load, 2.5 million-in.-lb. torsion load, and a 3 million-in.-lb. bending load.

Other major facilities include a landing-load track (for aircraft tests), vehicle control and lunar-landing simulators, and a 1.2-million-lb.-capacity hydraulic testing machine (for specimens up to 6 ft. wide x 18 ft. long).

Important new facilities authorized or in design and construction include:

—A Dynamics Research Laboratory (to study dynamics problems on boosters, spacecraft, etc., under true environmental conditions).

—A Hypersonic Aerothermal Dynamics Facility (to study hypersonic aerodynamic and aeroelastic problems under conditions of extreme temperature and velocity.

—An 8-foot-high, 4000°F temperature, Mach-7 structures research tunnel (to study problems of large test specimens under combined influence of aerodynamic loads and high temperature).

—A Lunar Landing Research Facility (to study stability, control, and instrument display problems of a man landing on the moon).

—A High-Intensity Noise Facility (to study the effect of noise on structures such as boosters).

—A Magnetoplasmadynamics complex. This includes a 10-megawatt arc tunnel now under construction that varies from 6 to 24 in. in diameter over its full length and will be capable of velocities as high as Mach 8.

Comparison of Expenditures by Langley Research Center for Fiscal Years 1961-62.

	'61	'62 (millions)	Change
Operating Costs (Salaries, etc.)	$30.4	$33	+$ 2.6
R&D contracts	46.8	60	+ 13.2
Facility construction contracts	24.8	20	— 4.8
TOTAL	$102.0	$113	+$11.0

• **Organization and responsibilities** —Organizational structure of the Langley Research Center resembles that of a centralized industrial complex. Functionally, it is comparable to a typical industry research and development operation.

Director Floyd L. Thompson has two senior assistants, C. J. Donlan and L. K. Loftin, Jr. His office is also supported by the usual senior scientific, technical and administrative staffs.

Five major functional groups, consisting of 18 operating divisions, comprise the principal structure at the Center. In addition, three special projects—*Scout* development, Flight Reentry, and Cooperative Projects—answer directly to Thompson's office.

The five major groups include Administrative Services, Technical Services, and three distinct R&D groups.

Project engineers for almost every task performed at the Center are drawn from the Engineering and Electrical Divisions of Technical Services. Prime concern of the Engineering Division is the engineering and design of research models and vehicles, research facilities, mechanical and chemical systems and controls. Electrical Division is concerned with electrical/electronic systems and subsystems design and engineering.

Each of the three R&D groups embraces three divisions and is headed by an assistant director.

The first, under John Stack, includes the Aero-Physics, Full-Scale Research, and Theoretical Mechanics Divisions. Principal efforts at Aero-Physics are in the areas of hypersonic vehicle performance, control, and stability; heat transfer and fluid dynamics; propulsion gas dynamics; magnetoplasmadynamics; space physics, re-entry phenomena and energy management, and advanced vehicle and mission analysis.

The evolution, improvement, and characteristics evaluation of aircraft, missiles, and spacecraft configurations and components are the domain of Full-Scale Research Division. Specialists here are particularly concerned with lift, drag, moments, static and dynamic loads, and aerodynamics of propulsion.

Stack's Theoretical Mechanics Division actually is split into two branches —astromechanics and mathematical physics. The first studies problems in navigation, guidance and control of both manned and unmanned spacecraft for lunar and planetary missions. The second is a small band of highly specialized scientists working on very fundamental problems in aerospace technology—such as the nature and influence of solar radiation fields, re-entry dynamics, and the nature of the lunar environment.

The second functional R&D group is directed by Eugene C. Draley and is concerned primarily with structures and materials research.

His Applied Materials and Physics Division covers a variety of studies of material problems in space. These include *Apollo*-type re-entry, free flight research, study of ionized flow fields (problems associated directly with radiopropagation attenuation and radar identification and tracking), meteoroid hazards, and large erectable space stations.

The Dynamic Loads Division is developing analytical and experimental methods for predicting and alleviating dynamic loads and aeroelastic instability phenomena on high- or specialized-performance flight vehicles. Scientists here also are investigating acoustics, landing and impact, vehicle dynamics, vibration and flutter.

Draley's third division is responsible for Structures Research. Its staff devotes its attention to weight and reliability characteristics of structures and materials in space vehicles and aircraft.

The last of the three R&D groups is under the direction of Hartley A. Soulé.

Guidance, stability, control, operating problems, and recovery techniques and systems in air and space are investigated by the Aero-Space Mechanics Division. Considerable emphasis is placed by the scientists on effective integration of man/machine systems. All types of booster and spacecraft recovery systems also are now under study.

A second division in the group is concerned with Analysis and Computation for the Center. Employing IBM 7070 and 7090 high-speed digital computers and plotters, the unit performs all necessary advanced mathematical computations and simulations for the other R&D divisions. It also handles tape storage and data retrieval.

The Instrument Research Division completes Soulé's group. It has responsibility for development and construction of electrical, mechanical, optical, and electronic instruments vital to aerospace research.

• **Contracting procedures** — Obviously, contracting and purchasing procedures are defined by Federal law. Within the framework of these provisions and regulations, Langley procurement is handled as follows:

Key procurement and contract negotiation officers include:

—Sherwood L. Butler, Procurement Officer.

—John Munick, Assistant Procurement Officer.

—Willis A. Simmons, Chief-Contract Negotiation and Administration Branch.

—William B. Hutchesan, Chief-Purchase Branch.

Formal advertising for competitive bids is employed particularly for purchase of supplies, materials, equipment, and construction when these items can be clearly defined by specifications and/or drawings.

When this is impractical—in R&D contracts, for example— procurement is made by negotiation with firms on a qualified bidders list in the desired purchase category.

Technical direction, including project officer supervision, is provided by Langley for all prime contracts under its cognizance. It also employs its own contract-negotiation and administrative staff.

Prime contracts are negotiated directly with the contractor. Langley does, however, retain a flexible procedure in contract administration; it uses either its own staff or the services of the Department of Defense or other government agencies when this is deemed necessary.

Simmon's group handles contracts for R&D procurement by negotiation; Hutchesan's group handles advertised contracts.

In the past, Langley has not made use of the "Quick-Reaction"-type of contracting procedure (QRC) used so effectively by the military. During the past year, however, the Center qualified its first contractors. Others, Langley officials say, will be qualified for different technologies or services.

The first contractor qualif ed was in the field of optics—the J. W. Fecker Division of American Optical Co. The arrangement with Fecker is in effect an open-end R&D contract—contracts valued at $100,000 or less will be issued like a simple purchase order.

Two other contracts will soon go into effect: one for analog-simulation services and the other for architecture

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and engineering services (for facilities on the station).

• **Information exchange**—The interchange of ideas and scientific and engineering advances in any organization is of major importance. In the vast nationwide complex of NASA installations, the problem is inherently difficult.

At Langley, all the standard methods of data exchange are employed. These include:

—Broad dissemination within and without of all formal NASA-originated technical reports and of all other pertinent formal reports issued by other Federal agencies, educational institutions, etc.

—Contributions to and attendance at appropriate technical conferences and symposia by as many Langley personnel as practicable within budget limitations.

—Similarly, visits by as many key personnel as possible to other NASA centers and industrial complexes. At the same time, the center encourages visits by others to Langley, to promote the exchange of ideas and advance technologies.

Because of the complexity of the task, information flow for the *Apollo* program will be handled through implementation of the *Apollo* Technical Liaison Plan, of which Langley is a part. Essentially the Plan involves systematic liaison between all associated NASA centers and outside organizations involved in the program.

Liaison groups in which Langley has primary interest have been formed for technical areas — including trajectory analysis, configuration and aerodynamics, guidance and control, heating, structures and materials, instrumentation and communications, human factors, mechanical systems, and onboard propulsion.

Langley officials expect to reap many advantages from the Plan. They have five main objectives:

1. To keep an up-to-date summary of all technical activities pertinent to each Center.

2. To summarize and disseminate all R&D projects and results as soon as possible.

3. To have a vehicle for the reporting of contractor activities to all group members.

4. To create a mechanism for solution of major technical problems as they arise.

5. To unearth problems and needed research areas before they become bottlenecks in the program.

• **Expenditures up**—Fiscal '62 expenditures by Langley are expected to reach $113 million. This total includes salaries and expenses for the operation and maintenance of the entire Center, R&D contracts, and facility construction contracts. It also covers the cost of managing some activities of other NASA centers and government agencies. (For example, Langley manages the establishment of the Project *Mercury* ground instrumentation and tracking network for Goddard Space Flight Center.)

The $113 million outlay is $11 million, or about 10%, higher than expenditures in FY '61.

The accompanying table provides a comparison of spending in the two years. While salaries and expenses show modest increase, costs for R&D have climbed over 25% in one year. New facility costs have dropped nearly $5 million, as construction slowly catches up with building requirements.

Personnel needs at the Center are expected to bring in an additional 400 persons, for a total of 3628, by next July. The new employment will be principally for administrative support rather than for scientific or engineering activities.

• **R&D contracts**—A close look at the funds to be expended during FY '62 for R&D reveals that the most of the $60 million will be allotted for hardware and materials.

Langley officials told M/R that half the total funds available will be used to purchase *Scout* launch vehicles. About $25 million will go for supplies, materials, and equipment needed to support in-house R&D programs. The remaining $5 million will support industry contracts for basic research.

• **Looking ahead**—The future for NASA's senior laboratory undoubtedly will match its long past, during which it has continuously been in the center of aviation/missile/space history.

Langley can trace its involvement in the missile field from its early experimentation in 1918 with the Navy's Aerial Torpedo—a modified Curtiss-Wright aircraft used as a drone carrying a 1000-lb. explosive package—down to its current research on para-gliders, *Dyna-Soar, Apollo,* and the Mach-3 air transport.

NASA Administrator James E. Webb stated recently that current expansion of the Center is only the beginning. During this fiscal year alone, over $20 million is authorized for expanding and modifying old facilities and building new ones.

A vital part of NASA's vast but still growing in-house scientific capability, a major center of materials and structures research; Langley will continue to advance the U.S. missile/space effort. ⁂