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STATEMENT OF DR. ROBERT H. CANNON, JR., ASSISTANT SECRETARY FOR SYSTEMS DEVELOPMENT AND TECHNOLOGY, DEPARTMENT OF TRANSPORTATION, BEFORE THE SENATE COMMITTEE ON AERONAUTICAL AND SPACE SCIENCES ON WEDNESDAY, MARCH 21, 1973.

Mr. Chairman and Members of the Committee:

I appreciate this opportunity to relate to you the Department of Transportation's (DOT) present and proposed uses of aeronautics and space technology and systems to carry out its responsibilities, and to discuss how space systems may be used to improve the civil aviation system and the maritime industry.

As previously reported to you, the joint DOT-NASA Civil Aviation R&D (CARD) Policy Study was completed in March 1971. As noted then, the publication of this Report did not represent the conclusion or the most valuable output of the activity which generated it. The study was comprehensive, and in the process of completing it, there developed a real in-depth collaboration between the National Aeronautics and Space Administration (NASA) and the Department of Transportation.

Cooperative activities between NASA and DOT were initiated and began to accure in value well before the completion of the report. These cooperative activities have continued with a high level of attention being given to areas of greatest interest and value to both NASA and DOT. For example, DOT and NASA maintain a Coordinating Committee to integrate our respective programs defined in the CARD Study.

To this date the most complete application of NASA's technological skills has been in the aeronautics program. To a lesser extent the space research implemented and derived from NASA's efforts is being applied in the very important communication and satellite system applications. The overall objective of our combined activities in the application of new technologies is the achievement of an improved quality of transportation -- quality in terms of economic and social value, efficiency and safety and full protection for our environment.

Substantial progress has been made, but we are not yet satisfied. Currently, both agencies are addressing high priority items that need immediate attention. These areas of activity which were highlighted in the CARD Study, as well as in other responsible evaluations of the total civil aviation situation, are discussed in more detail in the attachment to my statement. They are the urgent problems of noise and congestion and the economic viability of short-haul transportation. In these areas, there is well-coordinated joint activity between NASA and DOT, with each providing that contribution it is best qualified to.

NASA has strongly oriented much of its research activity at the Lewis Research Center to support quieting of engine components and developing of new cycles for propulsion systems which will assist the reduction of the noise problem at its source. In addition, several NASA flight research activities have been focused on developing new

techniques -- in procedures and in on-board equipment and displays -- which will contribute to improved terminal-area operation of transport aircraft without reduction in fundamental safety. These techniques were initially motivated by the effectiveness with which steeper approaches to airports could reduce noise-exposed areas, and they contribute to the potential relief of congestion by improving the use of air space in approach to the instrumented runways.

NASA, DOT and the Department of Defense (DOD) are actively engaged in cooperative efforts to develop a new microwave landing system that will be equally useful to military and civil aviation. In order to assure close coordination in this work, a NASA representative has been assigned to work with out microwave landing systems group. DOT and NASA have integrated their activities in this field of electronic development so that the Federal Aviation Administration (FAA) within DOT continues the navigation, guidance, ATC, and surveillance developments, and NASA engages in the evaluation and development of necessary avionics to permit aircraft utilization of the microwave landing system.

Finally, the FAA's quiet short-haul air transportation system (QSATS) program depends heavily upon the technology developed by NASA in STOL aircraft, modified conventional aircraft, and terminal-configured aircraft capabilities. The coordination techniques for this activity consist of interagency personnel details (a NASA representative is assigned to work with out QSATS office in FAA), a task force, and both ad hoc and formal committee activities.

In all cases the emphasis has been on getting the necessary work accomplished at the right time.

Much good has been accomplished; much more must be achieved. Our overall objective is to establish a process by which policy, fundamental characteristics and quality of transportation are more expeditiously and concisely identified by the Department of Transportation. The resolution of technical objectives and specific program goals is being accomplished jointly by DOT and NASA, and the implementation of the objectives and goals thus established is and will be on the basis of the best talent that can be brought to bear in either separate laboratory activities, joint task forces, or jointly located groups.

The Department of Transportation recognizes its ultimate responsibility to establish goals and priorities which must be set to effect an acceptable balanced transportation system. NASA has been most responsive to these objectives, and we have no doubt that they will continue bringing to the Department's attention opportunities for new systems as the technology becomes available. We believe that in the application of space technology to the surface transportation problems NASA will lead the way to important new opportunities.

The FAA's QSATS office, in carrying out the Department's responsibility, coordinates and integrates all activities related to aiding and improving short haul air service. NASA works very closely with this group, and some if its activities are directly contributing to the analytical process which is under way. Others of its activities are focused on

newly directed quiet operations. We support the need for such activity. We support the need for advancing the technology associated with terminal area operations.

In addition to the Short-Haul Air Transportation Office discussed above, the joint DOT/NASA Noise Abatement Office has continued to expand its activities with considerable success. In this office, the Deputy Director is, in fact, a NASA employee. Efforts stimulated by this group address noise reduction at its source, improved operational techniques and psycho-acoustic studies of response to noise environment.

Pollution control is another of our environmental concerns in which we depend heavily upon NASA and its capabilities to evaluate alternative power sources or cycles or techniques of power transmission that hopefully will reduce emissions in the atmosphere. Also, NASA is deeply involved in the work of our Climatic Impact Assessment Program (CIAP) which addresses the very complicated and insufficiently understood processes of chemistry and atmospheric dynamics that influence the quality of the atmosphere at high altitudes. This activity, while originally initiated because of the previous supersonic transport program, is of value to all types of long-range air transport operations as we find new ways to increase cruise efficiency and operating altitudes. NASA facilities engaged in various parts of the CIAP program are the laboratories at Ames, Goddard, Langley, Lewis, and JPL.

In the twenty-five years since the end of World War II, the growth of air transportation has been spectacular. It has provided a great

asset to this country. This rapid growth with all of its many benefits, has generated problems which are now inhibiting further progress. Joint DOT and NASA efforts are directed at solutions to these problems which will improve the potential growth of our economy, increase the national productivity, restore the environment, and improve the quality of life for all.

These joint DOT and NASA activities are seemingly automatic in the direct application of aeronautics technologies to civil aviation. However, we have pursued, of course, a vigorous examination, experimentation and evaluation of ways in which advance technologies can support better transportation generally. I would like to mention a few instances in which major advances have been applied in the translation of the aerospace skills to non-aeronautical services. Experimental traffic control systems have been put into effect, a good example being the one here in Washington. The first space-age Personal Rapid Transit (PRT) has begun test operations on the campus of the University of West Virginia in its home city of Morgantown. These programs make great use of both information processing and automation techniques which were developed as a part of the space program. A tracked air cushion research vehicle has been delivered to the test site in Pueblo, Colorado. Some of these accomplishments have been through direct collaboration by NASA and some through contractors who contributed to NASA's space activities. This is but a small beginning, but we consider it a major contribution and one of which we hope we will have many more examples in the years to come.

This completes my oral statement. I will be pleased to answer any questions you may have.

Department of Transportation Use of

Aeronautical & Space Technology & Systems

Specific Examples

for

Committee on Aeronautical & Space Sciences

United States Senate

For the Record - March 21, 1973

Civil Aviation Research and Development (CARD) Study

The DOT and NASA have a Coordinating Committee to integrate DOT and NASA programs defined in the CARD Study. The objectives of the Committee are to eliminate unwarranted duplication and to achieve maximum return from resources. The Committee has identified seven major areas for formal coordination: ATC, navigation, collision avoidance systems, communication satellite, V/STOL system development, noise, and advanced high-speed transports. In each of these areas, specific FAA/NASA representatives have been designated to act as points of contact for coordinating R&D programs.

The following major technical areas are highlighted in terms of NASA/FAA roles, achievements, and plans:

NASA/Ames Support

FAA established an FAA group at the NASA/Ames Research Facility for the joint use of this simulating facility, to develop certification criteria. Maneuvers can be made on the simulator for research and training purposes, and limitations of the man and/or machine defined. In FY 1974, this group will complete the simulator test pertaining to the high-speed certification requirements.

Short-haul Joint Program

The FAA and NASA have very recently established a formal agreement regarding the coordination of the entire short-haul program. All efforts proposed by either organization will be reviewed before formal approval is given by the proposing organization. Areas of duplication will be identified and resolved before any effort is undertaken. In addition to this overall program coordination, certain major areas have very specific project agreements. The DOT/NASA STOL operating experiments program establishes a detailed and specific test plan for evaluating navigation guidance, ATC, and surveillance requirements, including the procurement and operation of specific test vehicles. An Interagency Working Group composed of the FAA, NASA, CAB, DOD, and other offices of the DOT is investigating program directions for fostering the improvement of the short-haul air system. Additionally, NASA and the FAA have established a personnel interchange program to assist in the day-to-day program and information coordination.

Microwave Landing System

The National Plan for a Microwave Landing System was jointly signed by DOT/DOD/NASA in July 1971 and defines the closely related and complementary effort of the DOT and NASA participation.

FAA has program responsibility for the development program with industry. This program seeks to establish the design of ground and flight equipment to serve a broad range of users. NASA's principal role is the development and test of the necessary avionics to permit the utilization of the Microwave Landing System capabilities in STOL aircraft. This application will involve use of some of the most sophisticated flight profiles the Microwave Landing System is intended to accommodate.

NASA test facilities, aircraft, and personnel will be utilized in the Feasibility Demonstration phase field and flight tests of the Microwave Landing System. NASA personnel periodically participate in evaluations of the industry program and NASA has an on-site representative to insure continuing coordination of its efforts on this program.

Collision Avoidance System/Pilot Warning Instrument (CAS/PWI)

In addressing the nationally important problem of Collision Avoidance Systems/Pilot Warning Instruments (CAS/PWI), an Inderdepartmental Group for Collision Avoidance and Pilot Warning was formed by members of FAA/DOD/NASA.

Integration of some CAS/PWI activities and the close coordination of others was achieved via this day-to-day contact between working level personnel in FAA, DOD, and NASA, and by periodic meetings of the Interdepartmental Group on Collision Avoidance and Pilot Warning which has established objectives, provided policy guidelines, and tried to obtain the maximum return from available dollars via the joint FAA/DOD/NASA efforts on CAS/PWI.

These joint FAA/DOD/NASA efforts are moving ahead rapidly, on a broad front, in testing and evaluating competing CAS systems; in further refining PWI operational and system requirments; and in insuring the compatability of evolving airborne CAS and PWI systems with the ground-based Air Traffic Control (ATC) system.

Where possible, FY 1972 money was reprogrammed and plans were made by FAA/DOD/NASA to increase CAS/PWI funding levels in FY 1973, 1974, and 1975 so as to accelerate these programs and to speed up the decision making process.

The hoped for acceleration and augmentation in late FY 1972, and early FY 1973 took place just about as planned by the FAA, but was somewhat below expectations for DOD and greatly below projected spending levels for NASA. NASA has currently indicated the intention to phase out of the CAS/PWI activity, but has also indicated an availability to assist in technological coordination wherever practicable.

Flight Safety Criteria

FAA is developing improved aircraft certification criteria for all classes of aircraft. NASA is participating in this program in the special areas of V/STOL, SST aircraft, and general aviation aircraft by providing technical and facility support.

Accident Prevention

FAA is conducting R&D programs for the purpose of improving certification criteria. NASA is working jointly with the FAA and providing aerodynamic load data for FAA assessment of validity of current certification regulations. We expect NASA will continue to provide data to meet future certification needs.

Accident Survival

FAA is conducting R&D programs to improve techniques for fire and impact protection of occupants of all classes of aircraft. NASA is conducting tests to devlop applications of space technology to civil aircraft fire and impact protection. FAA programs are demonstrating that materials with improved flame resistance and reduced toxicity can be applied to cabin interiors and NASA has demonstrated exterior aircraft fire resistant coatings. This is a continuing FAA and NASA program.

The FAA program for mathematically modeling the crash energy absorption capability of the passenger, seat, restraint system, and integrated into surrounding fuselage will be validated with full-scale tests using NASA's facilities. This will provide a design base for improving general aviation crash survivability.

Wake Turbulence

The detection, tracking, and warning system for aircraft wake vortices is being developed by FAA. This is complementary to the NASA program for devising aircraft design fixes to dissipate or reduce wake vortices. In the event aircraft modifications are infeasible, the FAA program may proceed to a prediction and hazard resolution system within the automated air traffic control system, in which case NASA's basic efforts in wake vortex theory and modeling and aircraft control will be used in developing the prediction and hazard resolution algorithms.

Fog Dispersal

In the area of fog dispersal, FAA and NASA have an agreement to exchange information and data to keep all personnel abreast of the latest technological developments and prevent any duplicative activities. NASA has contracted for fog background measurements at Los Angeles and Vanderburg AFB areas leading to a fog computer model. Future NASA experiments are planned in dropplet physics using either the Space Shuttle or Skylab and ultimately the joint U.S.A./USSR Apollo-Sius Program. FAA intends to use, as applicable, the technical output of these NASA programs as major inputs to its own fog dispersal activities.

Fog Chamber

FAA/NASA have an agreement to conduct a study jointly that will develop the requirements for a new fog chamber facility. The current facility will be utilized for only a short additional time, and it is anticipated that the facility will be relocated with the title transferred to NASA. The relocated facility is scheduled to be jointly funded by FAA/NASA as a National Low Visibility Facility.

Air Traffic Control System and Operational Criteria

Although a large portion of the activities related to the FAA's responsibilities are associated with the application of aeronautical and space technology and establishing operational criteria and standards essential to the safe operation of aircraft, a larger activity is specifically a result of statutory responsibilities to operate the air traffic control system. NASA supports this latter activity with experimental work and technical expertise. The areas in which there is mutual interest are in systems development and criteria, instrument flight and navigation displays, systems and operational procedures, terminal control, aircraft safety, and aviation medicine. Our Fiscal Year 1974 budget requests for FAA research and development appropriations of interest to NASA in the areas just mentioned amount to approximately $40 million under the general headings of ATC Systems Design, Navigation, Collision Avoidance and Proximity Warning Systems, Approach and Landing, Airport Control, and Quiet Short-haul Transportation Systems and Criteria. In the application of aeronautical and space technology areas of mutual interest mentioned at the beginning of this section, the FAA fiscal year budget request includes another $4.7 million in aircraft safety and $6.7 million in environmental appropriations.

Aircraft Noise Abatement Activity

A Joint DOT/NASA Office of Noise Abatement, staffed by personnel from both agencies, has been established to assure that all activities, required to translate research and development in aircraft noise abatement are reviewed jointly to avoid duplication of efforts and to assure optimum use of resources and respective capabilities. The Joint Office role is essentially that of policy guidance and coordination; DOT/FAA role stems from its rule-making and regulatory authority; NASA role is that of assuring new and advanced technology for continuing aircraft improvements. The experience of the Joint Office over the past year has produced positive progress in aligning the respective activities along these lines.

The NASA jet engine refan program, part of an integrated DOT/FAA/NASA retrofit effort, will demonstrate feasible noise reduction possible in current JT8D-engined aircraft, and provide DOT/FAA with technical information on which to base future rule-making activities, intended to reduce the noise impact from older (pre-FAR Part 36) airliners.

FAA and NASA have an on-going program to refine operational procedures and demonstrate the operational feasibility of two-segment approaches to airports for noise abatement purposes. Such a program is necessary to evolve practical procedures which are acceptable to the airlines and pilots, and to define long-range objectives for path control and display avionics.

NASA, EPA, and HUD are cooperating with DOT in contractor studies of community noise conditions and annoyance factors. In its current phase, this work is preparing a long-range plan to measure existing community noise environment, and to understand how this impacts the citizenry. The objective is a prcedure to predict and evaluate alternative noise abatement procedures and the potential benefits which they will provide.

NASA and DOD are providing technical assistance to DOT in research to better understand jet engine noise generation mechanisms, and jet noise suppression concepts and techniques. NASA and DOD technical personnel have supported DOT in developing meaningful statements of work for this research, in evaluating and selecting a contractor, and in future monitoring of contractor performance.

NASA, DOD, and NSF have cooperated with DOT in sponsoring the first in a planned series of annual symposia on transportation noise research conducted by universities. Through these symposia, researchers with Federal funding will assemble to exchange ideas and describe the results of their work.

Through the auspices of the Joint DOT/NASA Office of Noise Abatement, discussions are underway, potentially leading to new joint DOT/NASA programs in the following areas:

- technology for new low-noise aircraft engine design(s)
- aircraft noise prediction procedures, extrapolating component ground test data to flight characteristics
- magnitude and reduction of aerodynamic airframe noise
- unique noise problems of short-haul (V/STOL) aircraft.

The NASA Wallops Island research runway, truck maintenance facilities and general housekeeping services were provided at no cost to the Department in the conduct of our extensive truck tire noise tests. Without such institutional support, our technical team would have been unable to conduct the tire noise tests so effectively and conveniently.

Climatic Impact Assessment Program (CIAP)

The Department of Transportation's Climatic Impact Assessment Program (CIAP) has explored and exploited the areas of expertise of the NASA people that could be utilized and engaged in support of the CIAP program. Through interagency agreements and transfer of DOT funds there are on-going programs being accomplished by the NASA for the DOT (CIAP) in the area of atmospheric and stratospheric modeling, studies, and measurements as follows:

1. The NASA/AMES/Stanford Research Institute will conduct ground test LIDAR measurements of the scattering properties of aerosol layers associated with the stratosphere. Periodic nighttime measurements of stratospheric aerosols using ground-based LIDAR containing a tunable dye laser and a pulsed ruby laser will be conducted over an 18-month period and will consist of approximately 100 instrumented observational hours.

2. The NASA/Goddard Space Flight Center is conducting a program for the Department of Transportation (CIAP) utilizing WB57-F aircraft, balloons, and sounding rockets for the measurements of UV in the stratosphere.

3. NASA, supported by the Jet Propulsion Laboratory, is modifying and adapting a high-speed interferometer for the measurement of trace gases on the British-French Concorde SST.

4. NASA Langley Research Center is conducting a study in support of the CIAP program of the feasibility of using a correlation interferometer for measuring nitric oxide (NO) and sulphur dioxide (SO_2) at stratospheric altitudes.

5. The NASA/AMES Research Center are engaged to support the CIAP in managing the activities to study global stratospheric constituents and their sources and are developing techniques for global surveillance to detect changes from a previously established "bench mark."

6. Modeling activities are directed toward the development of the 3-dimensional time dependent atmosphere that includes photo chemistry, mass transport and radiation transfer.

7. The NASA U-2 and the YF-12 aircraft are being utilized in a joint program to determine jet wake effluents.

There are many activities in NASA related to the general problem of air pollution measurement and reduction that are not funded by the DOT. These range from fundamental laboratory chemical experiments to long-term satellite monitoring of atmospheric constituents. A large effort is aimed at reducing emissions at the source through improved aircraft combustor design where the goal is to reduce the pollutants down to 1/4 of existing levels. This is being done at the NASA Lewis Research Center.

Meetings have been held between DOT (CIAP) and NASA since early 1971. This has been the vehicle for formal contacts and program reviews. In addition, an informal liaison is maintained between the NASA and CIAP staff. NASA is represented at all formal working group sessions of the CIAP program.

ATS-F and AEROSAT Programs

In August 1972, DOT formally transmitted to NASA the DOT proposed ATS-F satellite experiments in a report, "Air Traffic Control and Maritime Experiments, Demonstrations, and Tests Using the NASA ATS-F Satellite."

During February 1973, NASA responded to this proposal noting there was some duplication with programs of MARAD, ESRO, and Canada. The NASA reply also indicated that since the time available for L-Band experiments would be rather limited, coordination of the aeronautical and maritime program was essential.

Currently, the ESRO, Canadian and DOT programs are being coordinated for the air aspects of the tests. NASA is providing technical support in the design of the experiment. The final experiment design proposal must be submitted to NASA for coordination and approval. Coordination on the maritime aspects is being pursued concurrently. Equipment is also being procured including that required for FAA aircraft and USCG ships to be ready for start of the tests by June 1974. We understand that the ATS-F is expected to be available for DOT tests and other L-Band experiments for about 46 weeks starting in June 1974 and lasting until April 1975 with about 6-3/4 hours of L-Band time per week for a total of 310 hours of experimental activity.

While DOT will make the utmost use of ATS-F during this period, the short time available and other limitations will only allow the evaluation of L-Band space and avionics technology and not an evaluation of an improved ATC system. Since there is no follow-on of the NASA ATS-F Program, DOT is continuing pursuit of our proposed AEROSAT program with ESRO and Canada. International agreement on this program has almost been reached, but of course will not be effected until after formal presentation to both the House and Senate Appropriations Committees. We hope to be able to complete this agreement by early June 1973.

In this entire satellite program area, our Transportation Systems Center at Cambridge is providing us technical support and will also be involved in contracting for the aircraft on-board avionics required for the tests.