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Statement of

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United States Senate

Mr. Chairman and Members of the Committee:

Today I will cover three basic topics: First, I will describe the specific actions to be taken in relation to each of the Apollo 204 Board recommendations; second, I will highlight some of the additional actions to be taken that are not related to the Board's recommendations but that are desirable and appropriate in terms of the first manned flight of a Block II spacecraft; and third, I will summarize the planned steps leading to the first manned Apollo flight.

ACTIONS RELATING TO BOARD RECOMMENDATIONS

For clarity and completeness, I will cite each Board recommendation individually and then describe the NASA actions that relate thereto.

The Board recommended that:

> The amount and location of combustible materials in the Command Module must be severely restricted and controlled.

I will treat this matter under three categories -- selection, substitution, and stowage of nonmetallic materials.

Selection:

The criteria for use of nonmetallic materials for manned spacecraft operations, both in ground and in flight, are:

—To minimize possibility of ignition through material selection and placement.

—To so place nonmetallic materials that any fire that does occur will be restricted to a small and definable area.

—To so limit the weight of nonmetallic materials used in the cabin that its burning cannot increase cabin pressure or temperature to the point of damaging the spacecraft.

—To protect the crew from the effects of potential fires.

—To choose materials that, if burned, do not produce toxic fumes that could injure the crew.

Based upon the various uses to which nonmetallic materials may be put in the spacecraft cabin, a comprehensive set of guidelines has been developed to serve as the basis for the selection of new materials. Initial selection in terms of the guidelines will be made by the spacecraft contractor and approved by the spacecraft project manager at MSC. After a series of sequential tests, culminating in full-scale mockup testing, there will be sufficient information to make specific final selections and to specify in detail which material will be used for each application.

The attached Table I summarizes the categorization and flammability acceptance goals for nonmetallic materials. It is necessary to point out that the acceptance goals are extremely difficult to meet in some cases since it may be impossible to find materials, even metallic ones, that are in fact self-extinguishing once ignited.

Substitution:

Final recommendations on substitutions are not complete, but Table II provides an indication of the items that must be changed and the class of material that can be used to reduce flammability. Table III summarizes the characteristics of some of the new materials now to be used.

One example of the changes to be made is the substitution of new materials in the spacesuits. Current spacesuits are basically nylon inner and outer layers surrounding an airtight, pressurized bladder made of chloroprene. No substitute has been found for the chloroprene bladder, and it is therefore necessary to insure that both the inner and outer layers surrounding the bladder provide isolation of the chloroprene from a potential fire. A combination of nonflammable teflon and beta fabrics can provide this isolation, thereby rendering the suit virtually fireproof. In addition, underwear and flight coveralls can be manufactured from beta cloth. The work in this area has already been put to use by the Air Force who plans to use beta cloth suits for their personnel in space applications as well as for space simulation in ground test operations.

Associated with the suit changes, four of the nonmetallic materials used in the environmental control system suit loop will be replaced with fiberglass, beta cloth, or metal.

Stowage

There will be always some potentially flammable materials on board the spacecraft, such as food, which must be protected by fireproof containers. The specifications for such containers require that, if a fire occurs inside, the container is not to rupture nor is the fire

to be able to propagate outside of the sealed stowage. Mockups of such new containers have been completed and meet the required specifications. Figure IV shows some examples of new stowage containers for helmets, spacesuits, and similar equipment implaced in the spacecraft mockup.

Summary

In summary, the basic problem of materials in relation to fire hazard is to be met by removing bulk combustibles such as nylon netting and velcro, by replacing these and other flammable materials with new ones selected under more stringent guidelines associated with a detailed test program, by stowage of necessary flammables in fireproof containers, and by the requirement that a full-scale flammability test of the spacecraft interior in flight configuration be satisfactorily concluded prior to the next manned flight. The new criteria, specifications, guidelines, and tests are applicable to all manned spacecraft in the program.

°The Board recommended that:

> The time required for egress of the crew be reduced and the operations necessary for egress be simplified.

This area has two facets, modifications to the spacecraft and changes to the launch facility.

Spacecraft:

A new hatch has been designed for the spacecraft. This provides a single, outward-opening, quick-release hatch that replaces the separate pressure and heat shield hatches of earlier designs. This hatch can be manually released from either within or without the spacecraft. The

hatch sealing approach is similar to that successfully used in Gemini. For increased safety, the hatch is spring-, rather than explosively, assisted in opening, requiring positive action either by the flight crew or the ground crew and thus guarding against inadvertent opening. In addition, the hatch incorporates a locking device for operation in space. A schematic of the hatch design is illustrated here in Figure V.

Gound and flight tests are necessary to qualify the new hatch to assure its effective operation, integrity in the vibration environment encountered during launch and re-entry, compatability with crew requirements including EVA, and integrity during re-entry heating. These tests are to be conducted on ground test articles, on the thermal vacuum model, and on unmanned Saturn V heat shield qualification flights.

Facilities:

In order to accommodate the new hatch and to simplify the egress of the crew, a number of facility changes will be introduced. Principal among these changes is redesign of the adaptor hood which fits against the spacecraft and joins it to the "white room" located in the access arm of the launch facility, and modifications to speed up the repositioning of the access arm and white room against the command module in the event of an emergency prior to launch but after the access arm has been withdrawn. In addition, the steps, protuberances, one-way doors and angles in the path the astronauts would take upon leaving the spacecraft in an emergency are to be eliminated, and improved white room ventilation and lighting to cope with the possibility of smoke is to be provided.

°The Board recommended that:

Management continually monitor the safety of all test operations and assure the adequacy of emergency procedures.

Within the manned space flight organization, a new office of flight safety will be established. This office will report directly to the Associate Administrator for Manned Space Flight, working under the guidelines and standards established by the NASA Safety Office. This new office is to become the focal point within the Office of Manned Space Flight for continuing review and evaluation of safety provisions in all areas of manned space flight activity. A draft of the management instruction establishing this office is in "The Manned Space Flight Report of Actions Taken as a Result of the AS-204 Accident", which has been filed with the Committee. In addition, the safety offices at each field center will report directly to the Director of that Center, thus assuring continuing high-level management awareness of, and participation in, the flight safety effort. As a further check, the NASA Safety Office is responsible for assessing the overall safety programs.

Each safety office is proceeding with detailed reviews of all manned test and checkout procedures to identify possible hazards and to develop revised safety precautions where required. In particular, the safety office at the Kennedy Space Center is being enlarged and the scope of its activities increased. Launch pad personnel are being given increased training in areas of possible emergency, including use of a spacecraft mockup for rescue training. All test procedures are being reviewed and revised where necessary to include emergency

instructions. Responsible pad personnel meet weekly at each launch complex to review the activities of the past week and to prepare plans for up-coming activities that integrate improvements found possible in procedures and operations.

°The Board recommended that:

> All emergency equipment (breathing apparatus, protective clothing, deluge systems, access arm, etc.) be reviewed for adequacy.

The equipment for use by emergency crews and spacecraft technicians has been reviewed. Additional gas masks are being provided and more fire hoses are being added to the access arm. Protective clothing for the ground crews in the event of fire has been ordered and fire retardant materials have been substituted for flammable ones in the access arm and environmental chamber. Additional warning horns and lights and improved communications are being installed.

°The Board recommended that:

> Personnel training and practice for emergency procedures be given on a regular basis and reviewed prior to the conduct of the hazardous operation.

In addition to the training and drills discussed earlier, emergency procedures will be reviewed by the safety organization prior to any hazardous operation. In the case of manned spacecraft operations, the crew will practice egress under simulated emergency conditions prior to participation in the test itself.

°The Board recommended that:

> Service structures in the umbilical towers be modified to facilitate emergency operations.

As already noted, the access arm and white room are to be appropriately modified prior to the next manned operation in order to increase the capability of quick response to many different possible emergency conditions.

°The Board recommended that:

> The ground communication system be improved to assure reliable communications between all test elements as soon as possible and before the next manned flight.

A review of the ground communication system has indicated that, by limiting the number of individuals able to communicate over critical loops to those with a specific need to be tied together on the circuit, the present overload will be significantly reduced. In addition, minor design changes in such areas as the voice-operated switches, together with improved operational procedures, will assure reliable operation of the current system. The addition of a 4-wire, full duplex link connecting the crew on board the spacecraft directly to the Mission Control Center at Houston, to the test conductor in the Blockhouse and to the Spacecraft Checkout Station at Kennedy Space Center will insure uninterrupted 2-way voice communication among these critical elements.

°The Board recommended that:

> A detailed design review be conducted of the entire spacecraft communication system.

The Block II spacecraft communication system has been re-examined in detail and has been revalidated. It has been determined that no further changes are required in this system. The problems of concern

to the Board in the Block I system are already corrected in the Block II system by the inclusion of diodes that isolate certain circuits from each other and thereby prevent the "hot mike" problem, and by the redesign of crew umbilicals (cobra cables) to replace those of earlier design which caused difficulties during the pre-launch test.

°The Board recommended that:

> Test procedures and pilots checklists that represent the actual command module configuration be published in final form and reviewed early enough to permit adequate preparation and participation of all test organizations and that timely distribution of test procedures and major changes be made of constraints to beginning any tests.

We have issued a new test directive which establishes that all procedures are to be distributed at least one month prior to the test operation itself and careful controls restrict the number of changes and the period in which they can be made. For example, written revisions must be approved, available, and distributed no less than 48 hours prior to a test. Pretest conferences of all key members of the test team are then held before the test to insure that the hardware configuration, the documentation, and the test procedures are compatible. In the case of manned tests, a representative of the flight crew will approve the test and checkout procedures in order to insure that flight procedures and ground test procedures are compatible. Changes to procedures can only be made with the specific approval of the authorized representative of the center director.

In the conduct of test operations themselves, it is necessary to have the flexibility to permit real time changes or deviations; this authority is restricted to specific individuals designated by their center directors. After each test, formal review and follow-up procedures require the recording of any deficiencies noted during the test, the evaluation of necessary changes in procedure and plans, and the reporting of actions taken.

Detailed work implementing this basic outline is underway in both the development and test organizations and will be fully completed and exercised before the fall of this year.

°The Board recommended that:

> Full-scale mockups in flight configuration be tested to determine the risk of fire and that the fire safety of the reconfigured command module be established by full-scale mockup tests.

In the course of the Board's investigation, a significant new research and testing concept has been developed. This is the use of boilerplate or mockup spacecraft, with all flammables in place in which an ignition can be deliberately initiated in an atmosphere reflecting that of the condition being simulated. Over the past months, such full-scale mockup tests have been run, both in simulation of the Apollo 204 fire itself and with various of the new materials being evaluated as replacements and substitutes for those previously in use. Table VI

summarizes the testing completed to date. Note that these tests are being run at various cabin pressures, both with air and with pure oxygen. As testing continues and as prospective materials are accepted or rejected, ever increasing assurance can be developed that the final spacecraft interior will be as fire-safe as possible. Prior to the next manned spacecraft operations on the pad, final mockup tests will be run. All the materials proposed to be used, located as they would be either the test or the flight configuration, will be installed in a boilerplace spacecraft and deliberately ignited under the atmospheric conditions chosen for test and flight. The results of these boilerplate tests will determine whether or not it is safe to proceed with the next step of manned operation in the new spacecraft configuration.

°The Board recommended that:

> Studies of the use of a diluent gas to be continued with particular reference to assessing the problems of gas detection and control and the risk of additional operations that would be required in the use of a two-gas atmosphere.

A five PSIA, 100% oxygen atmosphere in the spacecraft cabin combines the greatest opportunity for mission success with safety for manned operations in space. For manned test operations on the ground, the previously used atmosphere of 16.5 PSIA of pure oxygen will continue to be used unless the boilerplate fire safety tests to be conducted with the new materials and the new configurations indicate that no significant fire hazard would exist under these conditions.

In order to provide an option to the use of oxygen on the pad in the event of an inability to find adequate fire-safe materials, the changes required to permit the use of air as a cabin atmosphere with oxygen in the crew's suit loop are being made. If air is used on the pad, it is necessary to insure that nitrogen not be allowed to leak into and collect within the suit circuit. A positive pressure system will be installed to keep the suit pressure above that of the cabin at all times. Again, if air is used on the pad, it is necessary to provide for venting air from the cabin when in space and then rapidly repressurizing the cabin with oxygen first to the safe limits for the crew and then to the 5 psia operational pressure level. Early spacecraft will provide this repressurization capability through use of an additional on-board container of pressurized oxygen; later spacecraft will have this capacity built in to the environmental control system. The Figure VII indicates the performance of the modified system in comparison with that of the current design. This change, in addition to permitting the air-on-the-pad option, improves the Apollo systems capability for extravehicular operations in space.

°The Board recommended that:

> <u>An in-depth review of all elements, components and assemblies of the environmental control system be conducted to assure its functional and structural integrity and to minimize its contribution to fire risk.</u>

The environmental control system provides the basic life support functions for the crew, being the source of the oxygen they breathe and the means of controlling and regulating the temperature of the spacecraft they inhabit. The heart of the system is the environmental control unit, which has been repackaged in the Block II spacecraft for easier accessibility and maintenance. This repackaging makes the unit easier to repair, adjust or replace than was the earlier model. This Block II design has been reviewed in depth and we have concluded that the basic design and operating mode of the system will not be changed. The coolant, and inhibited water/glycol mixture, will be retained. Tests have indicated that there is no improved coolant mixture that would reduce fire hazards or the corrosive potential of the coolant if spilled on wiring bundles and not properly cleaned up. Ignition tests of the present coolant have proved that it cannot ignite until most of the water component has evaporated. Tests at temperatures of up to 2,200 degrees Farenheit have not resulted in burning through aluminum tubing filled with water/glycol and therefore neither the coolant selection nor the use of aluminum plumbing for its routing through the spacecraft can be considered contributors to a fire risk unless extremely high temperatures have already been reached. Neither the coolant nor the aluminum tubing that carries it are to be changed.

The system will be improved by changing insulation and filter materials in accordance with the new guidelines mentioned earlier and by replacing, within the cabin, solder-jointed aluminum oxygen lines with brazed or mechanically joined stainless steel tubing. Aluminum will continue to be used for oxygen lines inside the environmental control unit itself. The piping, both for coolant and for oxygen, that was exposed to the spacecraft interior in the Block II design, will be protected by metal covers both during manufacture to prevent accidental damage during later installation of equipment as well as in the final flight configuration. Figure VIII shows these new protective panels and covers installed in an approved mockup spacecraft.

o The Board recommended that:

> Present design of soldered joints in plumbing modified to increase integrity or the joints be replaced with more structurally reliable configuration.

After replacement of the soldered oxygen lines with brazed steel, the only soldered joints in the plumbing system are those carrying the water/glycol coolant. A careful review of the methods of joining tubing carrying liquids under pressure has determined the soldered joint to be acceptable and safe as long as it is subjected to abuse, twisting, or compression. Therefore, all exposed soldered joints are to be armored by the addition of a strong structural collar that will prevent tension or torsion from being transferred to the joint itself. In addition, where possible, joints will be eliminated by combining several segments into longer runs of tubing without joints. As noted earlier, all exposed

plumbing is further protected by metal covers that prevent inadvertent damage during assembly, test, or flight operations.

o The Board recommended that:

> Deleterious effects of coolant leakage and spillage be eliminated.

The use of self-sealing quick disconnect fittings for those joints which must be occasionally parted for normal maintenance will substantially reduce or eliminate the incidence of leaks and spills.

In the event coolant is leaked or spilled, a new process for cleaning the wetted areas has been developed, as has a chemical test to identify any residue from the inhibitor. The present documentation process identifying coolant spills, clean up actions, and subsequent inspections is reliable and effective.

o The Board recommended that:

> Review of specifications be conducted, 3-dimensional jigs be used in manufacture of wire bundles and rigid inspection at all stages of wiring design, manufacture and installation be enforced.

The Block II wiring specifications have been reviewed by a joint team including personnel from NASA, Lockheed Aircraft Company, Douglas Aircraft Company, the Federal Aviation Administration, the Air Force, and North American Aviation; no major deficiencies in the Block II specifications were identified.

Whereas in the Block I spacecraft the wiring bundles were assembled on a flat surface and then installed in the spacecraft, the Block II wiring bundles are being assembled on three-dimensional jigs that

minimize the possibility of undue stress occurring in the wiring during installation. Furthermore, the Block II spacecraft umbilical connection is located quite differently than it was on the Block I. The umbilical connection, now being close to the major electrical equipment of the spacecraft, obviates the need for many of the wire bundles that in the Block I configuration had to be run across the floor.

The same protective metal covers discussed in connection with the environmental control system plumbing will serve to protect all interior spacecraft exposed wiring during manufacture, test, and flight operations. To ensure quality workmanship and adherence to standards, additional electrical testing and mandatory inspections at each phase of manufacture or after modifications have been instituted.

- The Board recommended that:

  Vibration tests be conducted of a flight-configured spacecraft.

An accoustic vibration test of a production line Block II spacecraft in flight configuration is to be completed at the Manned Spacecraft Center prior to the next manned flight. This test will determine the vibration levels within the spacecraft at each subsystem location, thereby providing an additional assurance that the qualification and acceptance testing of the subsystems already carried out does, in fact, reflect the vibration conditions expected to be encountered during

flight of the complete spacecraft system. Such testing also verifies the integrity of the interconnections, both electrical and mechanical, between the various spacecraft systems and subsystems. Tanks and plumbing will be under pressure during vibration testing.

- The Board recommended that:

  The necessity for electrical connections or disconnections with power on within the crew compartment be eliminated.

The Block II design already incorporates switches that eliminate the necessity for electrical connections or disconnections of cables while energized within the crew compartment. No design or connector changes to the Block II system are required.

- The Board recommended that:

  Investigation be made of the most effective means of controlling and extinguishing a spacecraft fire. Auxiliary breathing oxygen and crew protection from smoke and toxic fumes be provided.

The basic means of controlling fire within the spacecraft is through the selection of nonflammable materials where possible and through the placement of those flammable materials which must be carried on board in such a pattern that any fire that might occur would remain localized and small.

Many agents have been tested as possible candidates for extinguishing spacecraft fires. Solids, gasses, and liquids have all been tested, and after careful study it has been determined that water is the most effective fire extinguishing agent that can be used. A hose and nozzle

system will be incorporated in the Block II spacecraft, drawing water from the basic pressurized spacecraft water supply. In addition, investigations are continuing on the possible use of aqueous gells, either in blanket or in pressurized forms, for on-board fire fighting.

Aircraft type oxygen masks connected to the environmental control system will be added to provide crew protection from smoke or toxic fumes in the event of spacecraft fire. The new spacesuits mentioned earlier will have fire resistant outer and inner layers and the flight coveralls will be of nonflammable fibre.

- The Board recommended that:

  Every effort must be made to insure the maximum clarification and understanding of the responsibilities of all the organizations involved, the objective being a fully coordinated and efficient program.

In carrying out its investigation, the Board found instances where the documentation of responsibilities between organizational elements differed from the operating practices in force, instances where that documentation was either out of date or not sufficiently specific, and instances where documentation was not readily available to all parties involved. The management review carried out by the Apollo program office since the accident has noted no areas requiring major management or organizational change but has identified the need for compilation of directives and agreements to insure clarity of understanding. For example, a new consolidated program directive has been drafted to replace and consolidate previous individual directives and inter-center agreements. This directive clearly defines

the roles and relationships among the NASA Centers carrying major responsibility for manned missions. By removing possible ambiguities in the assignment of responsibilities between centers, this approach reinforces configuration control requirements and control of waivers and deviations. In addition, transfer of contractual responsibility for spacecraft checkout from MSC to KSC, has been identified as advantageous to improved working relationships at the Kennedy Space Center.

In addition, as mentioned earlier a complete review of test and checkout procedures and practices was instituted immediately after the accident. The results of the review are incorporated in a revised program directive on the preparation of test and checkout plans and procedures at Kennedy Space Center. This directive was issued on April 18, 1967. A copy of this directive which defines responsibilities and required actions is attached to the report filed supporting my statement. The key points of the revised directive are to assure uniform practices throughout the manned space flight organization and to define the level at which action decisions are to be made.

In summary, the development organizations -- the Manned Spacecraft Center for the spacecraft and service module and the Marshall Space Flight Center for the launch vehicle -- define the specific test and checkout requirements for the hardware systems for which they are responsible. These organizations provide the test specifications and the criteria upon which to judge whether or not the test, in fact,

has been adequately performed. Standardized formats simplify the process of documentation. The requirements and specifications are provided to the Kennedy Space Center four months prior to the delivery of the flight hardware.

The test, checkout and launch organization is the Kennedy Space Center and based upon the requirements from the development Centers, Kennedy prepares test and checkout plans and procedures. These plans and procedures are based upon those at the factory or test site that were used in the earlier testing of the same hardware. The test and checkout plans and procedures are then reviewed by the development Center and, if necessary, are revised to assure that their requirements are met. In addition, all procedures are independently reviewed and approved by the safety and quality organizations as an additional check and balance in terms of identifying and isolating possible hazards.

Other management actions include the documentation of test and checkout functions and the establishment of the flight safety office mentioned earlier. Continuing management analysis and clarification of organizational interfaces is a necessary element in the administration of large programs. As the program matures and changes, so must the organization and the inter- and intra-organizational relationships. The effort to insure clear understanding of responsibilities has been constant in the past and will continue during the life of the program.

OTHER APOLLO SPACECRAFT CHANGES

Moving now to the second of the three topics, I would like to discuss briefly some additional changes that we feel are appropriate

to make in the spacecraft prior to the first manned flight. Some of these are developmental changes that were in the process of being defined prior to the accident, others are adjustments made necessary by the changes already discussed above in relation to the Board's report, and still others result from the very detailed reviews and analyses carried out by the Apollo program office in seeking real and meaningful improvement of the spacecraft in terms of safety and mission capability. For example, a part of the R&D instrumentation to have been flown in spacecraft 012, the first planned Apollo manned flight, will now be flown in spacecraft 101, the first of the Block II series.

Examples of minor changes are the relocation of the ECS controls for easier access by the crew, modifications of the crew couches to simplify entrance and exit to the spacecraft.

Our continuing design review has found, for example, that an error during the ground checkout could possibly cause the inverter motor to malfunction; a small change now prevents this motor from being locked out. Experience with Gemini thrusters and the problems they encountered has led to the inclusion of new filters to prevent possible contaminants from holding the valves open. In the event of an abort from the pad, certain wind conditions have been identified that could result in the spacecraft landing on or near the beach instead of in the water as desirable; a modification of the timer which sequences the reaction control fuel system now permits longer controlled flight away from the shore in the event of a pad abort.

Perhaps the best example of the care and attention to detail which has gone into the program office review of possible safety features

for the next manned space flight is the analysis of the command module's water system. A schematic of this system is shown on Figure IX. In this system the water produced by the fuel cell in the course of operation, and which serves as the potable water supply for the crew, flows into a cylindrical tank. Inside the tank is a small bladder pressurized with oxygen. The force of the expanding bladder against the surrounding water is used to provide a positive, pressurized water flow to the crew even in zero G. Inside the oxygen-pressurized bladder is a small electrical device that permits measuring the amount of water in the tank, which is proportional to the inward or outward movement of the bladder wall. In the investigation of all potential ignition sources, the potentiometer inside the bladder was examined in light of every possible condition to determine if it could be considered a hazard.

Now the water flowing from the hydrogen powered fuel cell into the collection tank carries with it hydrogen in solution. This hydrogen, it was postulated, could possibly permeate and eventually pass through the water-tight bladder and thereby mix with the pressurizing oxygen within. Were this to continue until the unlikely concentration of 4% by volume of hydrogen was reached, an explosion could occur. A simple but ingenious redesign of the unit now makes this impossible; by permitting a very small flow of oxygen through the bladder, thereby venting the excess hydrogen to space, the build-up of a potentially explosive mixture is avoided.

STEPS TOWARD THE FIRST MANNED APOLLO MISSION

I would now like to turn to the third topic of my discussion, that of the steps necessary before the next manned flight operations.

The ground test program for the Block II command and service module has qualified the spacecraft through such means as aircraft drop tests, propulsion tests, structural tests and crew compatibility tests. We will perform vibration tests, and thermal vacuum tests before clearing for manned flight. In addition, the new hatch design is to be tested on the unmanned Saturn V missions planned for this fall. The command module fire test in the boilerplate spacecraft must be successfully completed. The various units and systems being changed must be requalified. Finally, all approved changes and modifications must be incorporated into the flight spacecraft and then it must be tested both at the Downey plant and at the Kennedy Space Center.

The delivery of the first Block II flight spacecraft is expected toward the end of this calendar year, some six months later than previously planned. A three to four month checkout period at the Cape is necessary, including the following major events: The command and service module will be mated; and the combined systems test will be run. There will then be the first manned test at sea-level conditions, followed by unmanned test in the altitude chamber; the last of the vacuum chamber tests will be with the spacecraft manned and the chamber simulating the changing environmental condition from launch to orbit. The spacecraft will then be moved to the pad and mated to the launch vehicle, where further tests will continue. The last tests

are the manned plugs in and plugs out tests and finally the countdown demonstration test. As Mr. Webb indicated toward the end of the first quarter of calendar 1968, we expect to be prepared to fly the Block II spacecraft, the first of the manned Apollo series, in an open-ended mission of up to two weeks in earth orbit to verify the combined performance of the spacecraft and the crew in accomplishing one of the major milestones leading to the eventual objective of the manned lunar landing and return.

Dr. Seamans will now outline the required changes to the manned space flight program and the effects this will have on the FY 1967 and 1968 budgets.