SKYLINE Vol. 26 No. 4

Published quarterly by the Aerospace and Systems Group of North American Rockwell Corporation for employees.

Printed in the U.S.A.

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Front cover by Bill James. Canyon of concrete symbolizes battle area as aerospace engineers join the fight on urban ailments. Page 26, FPG photo, model city, Tapiola, Finland. Page 27, Black Star photo, U.S. model city, Reston, Va. Page 29, NASA photo, view from space. Back cover by Ted Faux.

Art and Production, Executive Offices Services.

THE LAST SPOT ON EARTH

The final months are upon us. Soon, for two astronauts, the flat flaring beaches of Florida will be their last hard contact with Earth before they set foot on the dusty surface of the moon.

The pace of events has quickened.

The upward movement of the Apollo astronauts has started.

The three-man command modules are moving forward through the days of fabrication, delivery, preparation and launch. Major segments of the towering space vehicles, the Saturn Vs, are journeying relentlessly forward from California and Mississippi to the final meeting place at NASA's Kennedy Space Center in Florida.

This is the time of reckoning, the time for which the nation has waited, the transition from determination to actuality, the fruition of John Kennedy's words, uttered in 1961 — "We will go to the moon."

It is from this spot, this beach, this meeting of ocean and sand that the three men will depart — and the whole world will await their safe return.

Three to get ready

122 Days of Test and Mounting Tension Precede Launch of Apollo Module Outward to the Moon

By EDWARD A. HERRON

WHO actually makes the trip to moon orbit?

The three astronauts, of course, and the sleek command and service modules, and the stiff-legged lunar module.

But there is still another, an unseen voyager who makes the outward journey from Kennedy Space Center, who circles the moon, who descends to the surface, who lifts again and rejoins the circling command module for the triumphant return to Earth.

Systems reliability. It's a dry, interest-dulling term, but it is life-or-death, success-or-failure, go, or no-go for those concerned. Without systems reliability a space venture can be hobbled seriously; success can become marginal; and the venture can fail.

Cheek-to-Cheek Word

Systems reliability is a cheek-to-cheek word wherever two engineers gather, but nowhere does it take on more serious connotation than in Florida, at the NASA installation, in those action-packed months of final preparation for launch.

In a sense, the entire National Aeronautics and Space Administration installation at Kennedy is dedicated to a final proof of systems reliability. Lacking that proof NASA simply refuses to turn the key that sends a vehicle on its way into hostile space.

That rigid proof of reliability is asked of the big rocket engines; it's demanded of each of the three boost stages, the instrument stage, the lunar module, the command and service modules. From all over the nation these systems flow to the distant NASA launch site. Each one has already been tested and re-tested to near perfection during fabrication. Each one has undergone a final scrutiny before being certified and sent to Florida.

But the spaceport is the start of a new ball game. Here the units meet for the first time, second stage is mated to first, third stage to second. The lunar module takes up its waiting position beneath the top-ranked command and service modules. Stack one upon the other, higher and higher, and a new vehicle comes into being, one of the family of the soaring Saturn Vs. NASA demands proof positive that the meeting and the mating has been a happy one. All systems must prove themselves individually, and prove that they will work in concert with the newly coupled strangers, before the Space Agency will give the word.

Any one of the segments of the huge space vehicle could be selected for demonstration of the painstaking, inch-by-inch verification that precedes the dramatic mating. The command and service modules, developed for NASA by North American Rockwell's Space Division, are an example of the time of preparation.

Command, Service Modules

The command module, the unit that shelters the three astronauts, and the service module, the sleek, cylindrical unit that encloses most of the auxiliary equipment needed for the voyage, are built in the Space Division's plant in Downey, Calif. All during the 30 months of fabrication the 17 major systems and scores of sub-systems within the module are tested. At the completion of fabrication, the module undergoes a rigorous integrated systems scrutiny that includes 3,380 tests in 58 sequences.

At sea level, and in the soft warmth of Southern California, the systems are 'go'. But—how will they work when they become, in effect, orchestrated with hundreds of other systems in a score of other major units? How will they work in the

bitter cold of vacuum, in the searing heat of the unshielded sun?

Those are the questions that are asked in the final days.

The module is carried cross country in the oddly shaped Super Guppy aircraft. The bulbous craft floats to a landing on the skid strip, a black gash in a sea of stubby mangrove and sawtooth palmetto scrub. Within minutes the conical shaped Apollo command module is disgorged and starts on the five-mile trek to the Manned Spacecraft Operations Bldg., (MSOB), part of NASA's Kennedy Space Center.

Ideally, 122 days will elapse from the day the module is received at the Cape until the day of launch. The planned progress of the unit through every phase of testing, through mating with the fellow-components that make up Saturn V, and the last days of pre-launch activities are scored on huge charts that hang about the walls of large meeting rooms. On the charts are notations, emphasized by thick, black bars, and by silhouetted space vehicles. All the notations are in engineering shorthand: Shakedown Insp., GOX Service, ECS Sea Level Funct KL-0014, Cabin Lk Test, Demate D/S to Pol Fixt.

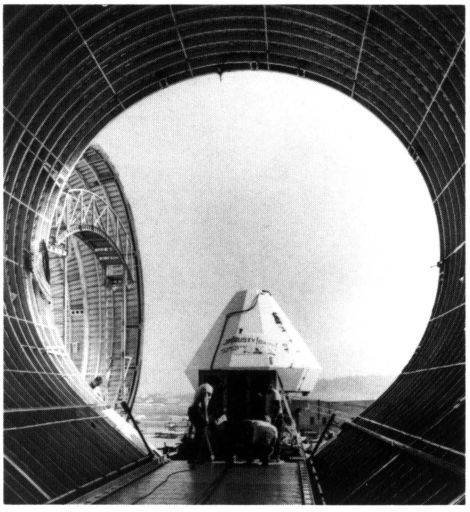
Symphony Orchestra

At first glance the charts look amazingly like the sheets prepared for a symphony. A North American Rockwell Space Division manager unwittingly gave strength to that comparison when he said reflectively, "It's a tremendous task preparing these spacecraft for launching. It's like getting four symphony orchestras to play together under one conductor."

There are 2,140 Space Division employees at the NASA Center. About 1,300 of these are directly involved in the testing of the modules; the remainder prepare the second-stage S-11 for launch.

The first close contact of men and metal in Florida comes in the MSOB building when the command module, re-joined with the service module, is placed in a gigantic vacuum chamber. Waiting for each command module as it appears is a test team custom-built for that unit alone, men who will stay with the unit until launch. The metal moon to them is a personal thing; it is 'their' module; they have their hands on tubes and wires with the same understanding touch of a doctor reading the pulse of a patient. To an outsider the North American Rockwell technicians and engineers are an endless flow of white-coated figures. To the men who guide them they are tightly knit groups — electrical systems, mechanical systems, site operations, systems specialists, quality inspectors, safety inspectors, and others.

The personal attention given each phase of the work is amazing in its detail. Every morning the key supervisors meet and examine the events of the previous day. In effect, each man says, "Here's what we did. Here was a problem. Here's how we solved it. Here's where we're going to need help to keep on schedule."



Initial journey is made by Apollo command module from Space Division's Downey, Calif., plant to Florida aboard odd Guppy aircraft.

Very definitely everyone works under pressure. A North American Rockwell official said, "When you've got a spacecraft here, you've got the eyes of the world on you. You've got to make schedule, but you can't push too hard."

The tests conducted inside the sealed altitude chamber become a stilted listing of engineering chores: evaluate fuel cell performance, evaluate environmental control system, evaluate instrumentation system, and so on. But for those involved each is meaningful, vital. A failure during these altitude chamber tests in the MSOB could cloud the entire launch.

Altitudes up to 250,000 feet can be simulated inside the chamber linked with the heat-and-cold interaction of outer space. As a safety precaution, the module is tested first without the crew, then, in a highly significant milestone, the three astronauts, (they have their offices just a few hundred feet from the chamber) go inside and the hatch door clangs firmly shut behind them, cutting off the entire world and the men who are helping them get ready. Just as in a space journey, the crew operates alternately in space suits and in shirt sleeve freedom. When the prime crew is satisfied and has complete confidence in the working of the complicated systems of the spacecraft, the backup crew enters the unit, shuts the door, and goes through the entire 8-hour exercise again.

Nothing is routine. Nothing is minor. If one of the astronauts requests a change in a handle position in order to achieve a more comfortable working area, the change is made. Inspectors monitor every operation. The integrity of each individual technician, engineer, and inspector is involved. Compliance with proper procedures is expected, but perfection comes from personal desire.

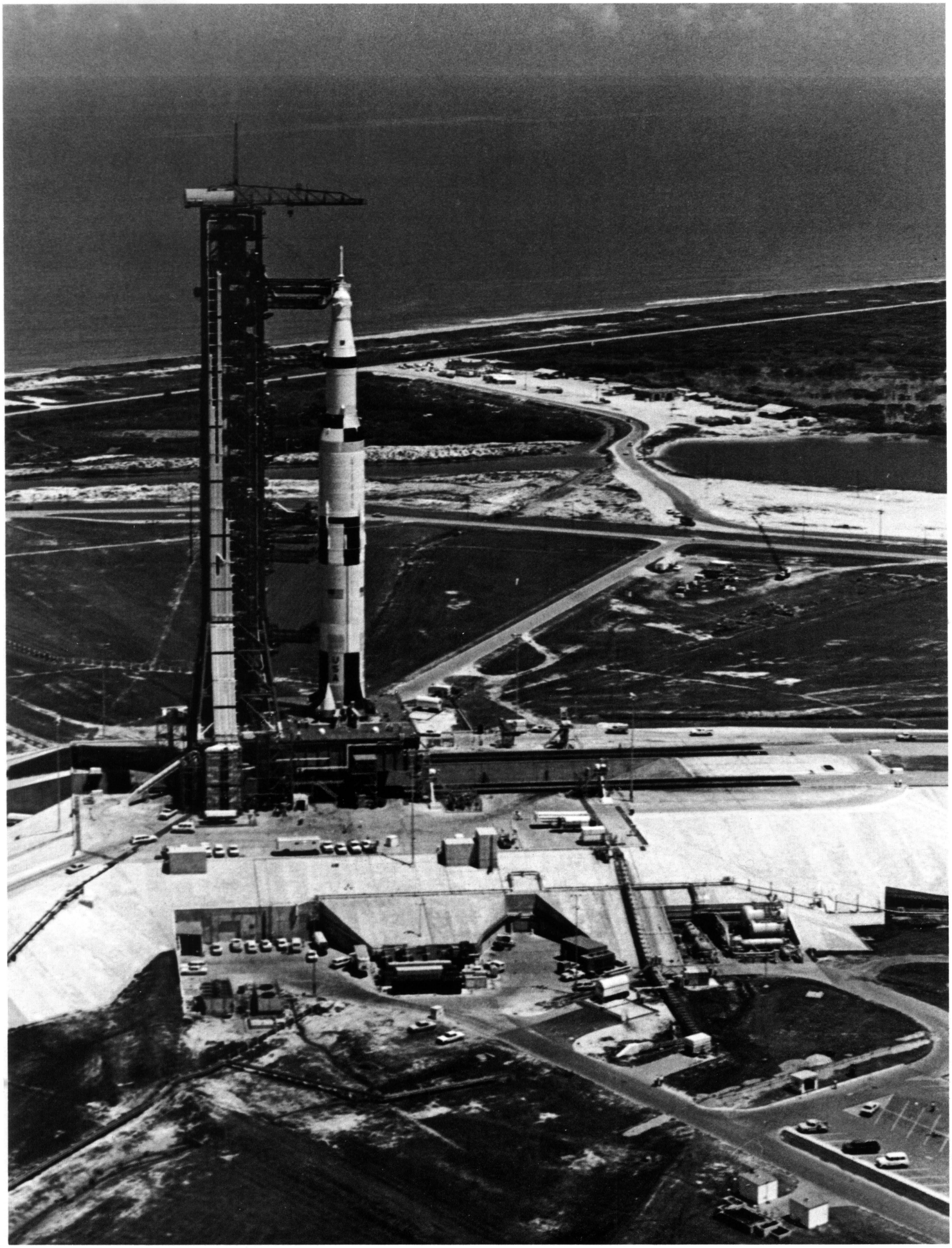
At the end of approximately 40 days of testing the men whose lives will depend on the spacecraft systems are satisfied. The unit is ready to move forward.

There is a 5 mile-per-hour journey over to the final man-made shelter, the VAB. There the complete package of command and service modules and beneath it the lunar module, hidden within its adapter, is slung high above the three booster stages. For the first time there is an entire package, a visible Saturn V, a massive giant that is caged within working platforms while men continue to swarm over it from top to bottom.

Infinite Detail

There is still an infinite amount of detailed testing remaining, all of it carefully charted. North American Rockwell Space Division, along with the major prime contractors, is heavily involved in the team effort on the complete unit. But time takes over; the milestones are met and passed, and the inevitable day of launch arrives.

In the eyes of the world it is one, unified, complete space vehicle. To the men who have worked on it, the thousands who have helped three men get ready to conquer space, the towering vehicle is not one, but a thousand intertwining, interdependent systems, each one proved, reliable, ready to work in the orchestrated harmony that spells success in space.



The end point for all hand-to-hand aid comes at Launch Complex 39 overlooking the spit of sand at Kennedy Space Center in Florida. From this time on the astronauts are alone, their safety entrusted to the smooth functioning of the multiple systems in the space vehicle.