Marshall’s Saturn Era Labs Focused on Making Moon Landing A Success

Wernher von Braun, the first director of the Marshall Space Flight Center, focused more on developing space hardware than on issuing policy statements. But he had one management policy that he championed more than any other: "Keep your hands dirty.” Von Braun called it “MSFC Management Policy #1.”

The famous rocket scientist had nothing against a lab chief or engineer or technician washing their hands, but advocated a hands-on approach to science and engineering and building rockets.

Von Braun and his civil service and industry team built the Saturn V rocket that lifted man on his journey to the surface of the moon 35 years ago this month. Today there are still those who remember their personal contributions to the mammoth rocket that stood 365 feet tall and lifted itself on the strength of five F-1 engines, each generating 1.5 million pounds of thrust. The credit for the success belongs to many, including those who pushed the paper, counted the dollars, bought the equipment, swept the floors and performed numerous other necessary tasks.

Program and project offices at Marshall directed the program. But another group at Marshall and in similar industry locations across the country held a special advantage point. These were the workers in Marshall Center laboratories where hardware was designed, built, tested and re-tested.

The organizational structure and sometimes even the names of the laboratories would later change. However, a 1967 document located in Marshall's history archives tells a lot about Marshall’s labs in the years just before Apollo 11. The Technical Facilities & Equipment Digest portrays "the capability of technical facilities and equipment" at Marshall. It surveys each of the eight laboratories then in existence at the Center. Add to this data, recollections from those who worked in the labs.

This is a glimpse of how some labs might have looked. One might see sheet metal, tubing, schematics, welding, brazing, fork lifts, cranes, mammoth facilities, machinery, cables, overhead cranes, test equipment, vacuum tubes, drawings as big as a ping pong table, electrical components, clean rooms, fittings, turbopumps, chambers, concrete, steel, consoles and tooling. And then add one more element, the workers, too numerous in function, skill or talent to categorize.

In the mid-1960s, the Marshall Center employed nearly 7,500 civil servants, not counting the thousands of on-site and off-site contractors. Von Braun, absolutely void of any ivory tower thinking, followed his own “dirty hands” dictate and showed up in the labs at any time of day, sometimes driven by nothing more than his own unrelenting curiosity to understand even the smallest detail. One veteran Marshall manager remembers working the swing shift in one of the labs one sweltering summer night and turning around to see Von Braun, dressed in Bermuda shorts, a ten-gallon hat and cowboy boots.

Described first in the Technical Facilities & Equipment Digest was Marshall Aero-Astrodynamics Lab. "The facilities of the Aero-Astrodynamics Laboratory, with the exception of some meteorological equipment, are devoted to fluid mechanics... Obtainable flow conditions range from free molecule to continuum flow." Marshall's Ann McNair served as chief of the lab's Mission Studies Section. Her work included Saturn flight trajectories and determining how long satellites might remain in orbit.

Marshall retiree Bill Snoddy was a member of Marshall's Research Projects Laboratory during the Apollo era. The digest points to the lab's capability for applied research in the fields of physics and astrophysics, space environment and others. Snoddy was part of a group that worked on the thermal characteristics of the Moon. The group studied the characteristics using telescopes set up at Marshall, Snoddy said. "We wanted to know more about the (lunar) environment and how the astronauts could be protected against that thermal environment." "I remember the third Sunday in July- July 20, 1969 just like it was yesterday," said Marshall's Dave McGlathery referring to the date the Apollo 11 astronauts walked on the lunar surface. During the Apollo era, McGlathery worked in the lab's Nuclear and Ion Physics Branch assisting senior scientists perform probabilistic radiation shielding/dosage calculations. McGlathery also helped determine by mathematical modeling and calculation; the relative debris distribution that would result if a spacecraft would have a hard, uncontrolled landing/impact on the surface of the Moon.

The digest also pointed out that "during 1967 the Computation Laboratory will acquire analog, hybrid and high speed digital computers, providing MSFC with the computation potential necessary in research and development of space vehicles and in efficient administrative management of the center." Computer historian James E.Tomayko has studied the work of the first person to direct Marshall's Computation Laboratory. He does so in an article entitled "Helmut Hoelzer's Fully Analog Computer." Tomayko refers to a fully "electronic general purpose analog computer that Hoelzer built as a member of Von Braun's German rocket team during World War II. "This computer is significant in the history, not only of analog computation but also of the formulation of simulation techniques." Hoelzer's foundational work and the work done in Marshall's Computation Lab "contributed to a system for rocket development that resulted in vehicles capable of reaching the moon."

Marshall's Richard Beckham and retiree E.C. Smith were employed in Marshall's Astrionics Lab during the Apollo era. According to the digest, that lab provided "a broad capability for developing and evaluating components and systems involved in aerospace communications, guidance and control, air-borne and ground instrumentation, vehicle and ground power, and electrical integration systems." Beckham recalls his involvement in developing software for the Apollo program. Guidance and navigation were key parts of the lab's operations, Beckham said. "It amazed me how our mathematicians could come up with the data logic on how to get to the moon." Smith performed laboratory simulation studies of the Saturn IB and Saturn V vehicle control system.

Marshall's Propulsion and Vehicle Laboratory focused on structures, mechanics, propulsion and materials as applied to launch and space vehicles and their payloads. Marshall's Ann Whitaker worked as a physicist in the lab. Her work during the Saturn era included studying lubricants and conducting research in surface physics. Part of her research included a series of high-load friction tests of metal surfaces coated with a dry film lubricant.

Marshall's Manufacturing Engineering Lab had large fabrication and assembly high bay areas and associated cranes, large access doors, machine shops, clean rooms and specialized equipment necessary for producing and refurbishing prototypes of large aerospace hardware systems. It included equipment for research and development in

advanced manufacturing techniques, methods and tooling for structural, surface finish, and pressure vessel applications. A major part of the work in this lab focused on developing a new alloy for use in the Saturn V, recalls retiree Bob Schwinghamer. He also pays tribute to the work done in the lab by Margaret "Hap" Brennecke. Hap, as she preferred to be called, was perhaps the first female welding engineer hired at Marshall. She determined the fabric of new alloys. She also tackled the challenges associated with welding the huge Saturn stages. "Welding a 33-foot circumference structure in one continuous weld was tricky," Brennecke recalled.

“Complete and thorough testing can be conducted for leakage, resistance, polarity, resolution, impedance and voltage drop," the digest said regarding the work done in Marshall’s Quality, Reliability and Assurance lab. Quality and reliability in the Saturn program were engrained in the fabric of the German-born lab directors and their U.S.-born engineering teams at Marshall. "If we had a valve that had to function ten times on a Saturn mission, we probably cycled it 50,000 times before hand," one Marshall machinist recalled. To some at NASA Headquarters, that kind of attitude regarding testing threatened meeting President Kennedy's 1961 call to land a human on the Moon before the end of the decade. For example, headquarters had difficulty convincing Marshall that plans for the Apollo 8 mission should include an astronaut crew. Marshall engineers finally agreed to the mission. But there would be no launch until engineers in Dieter Grau's laboratory went over the vehicle once again. Sure enough, numerous little mistakes and potential problems were uncovered, said Saturn historian Roger Bilstein. "We went through the vehicle from top to bottom. I think that was kind of a lifesaver," Grau later said regarding the ultimately successful mission.

Perhaps no laboratory at Marshall could attract more interest in its work than the famous Marshall Test Lab. Some called it the land of smoke and thunder. A geographic complex in its own right, the Test Lab was divided into two major areas -- east and west. The 1967 digest lists some of its components: its static-firing test stands, single-engine stands, ground support equipment test and checkout facilities, full-scale dynamic test stands, blockhouse control and measuring centers, model engine and component test stands and cells, industrial water reservoirs and pumping facilities, instrument development shop, test support shop, high pressure gas generating plants, high pressure gas storage and distribution systems, cryogenic and propellant storage and distribution systems and large stage land transporters. "The work was intensive," recalled Marshall retiree Bill Simmons who designed test fixtures for the lab. "Nobody had ever done this kind of work before," he added. Charlie Gillespie, another retired Marshall test lab engineer, recalled the challenges that still "bring back a lot of very good memories." It was in the West Test Area that Marshall test fired all five F-1 engines at once. The tests led one writer to describe Marshall as the "Land of the Earth Shakers." In the East Test Area, Marshall engineers vertically suspended a complete Saturn V in the lab's huge Dynamic Test Stand where it was subjected to a series of vibration tests to verify the complete dynamic integrity of the vehicle.

A complete survey of Marshall's scientific and engineering laboratories would encompass hundreds of pages. No survey could ever reveal the thousands of achievements that the men and women in Marshall's laboratories and elsewhere made to the success that America enjoyed when humans landed on the moon on July 20, 1969.

Marshall retiree E.B. May summed up the Saturn role at the center this way: "It was just a very exciting time; a lot of people working on the project and pulled together. Many nights we worked late. We went to work early and sometimes finished after dark." In short, May and others at Marshall and elsewhere kept their hands dirty.