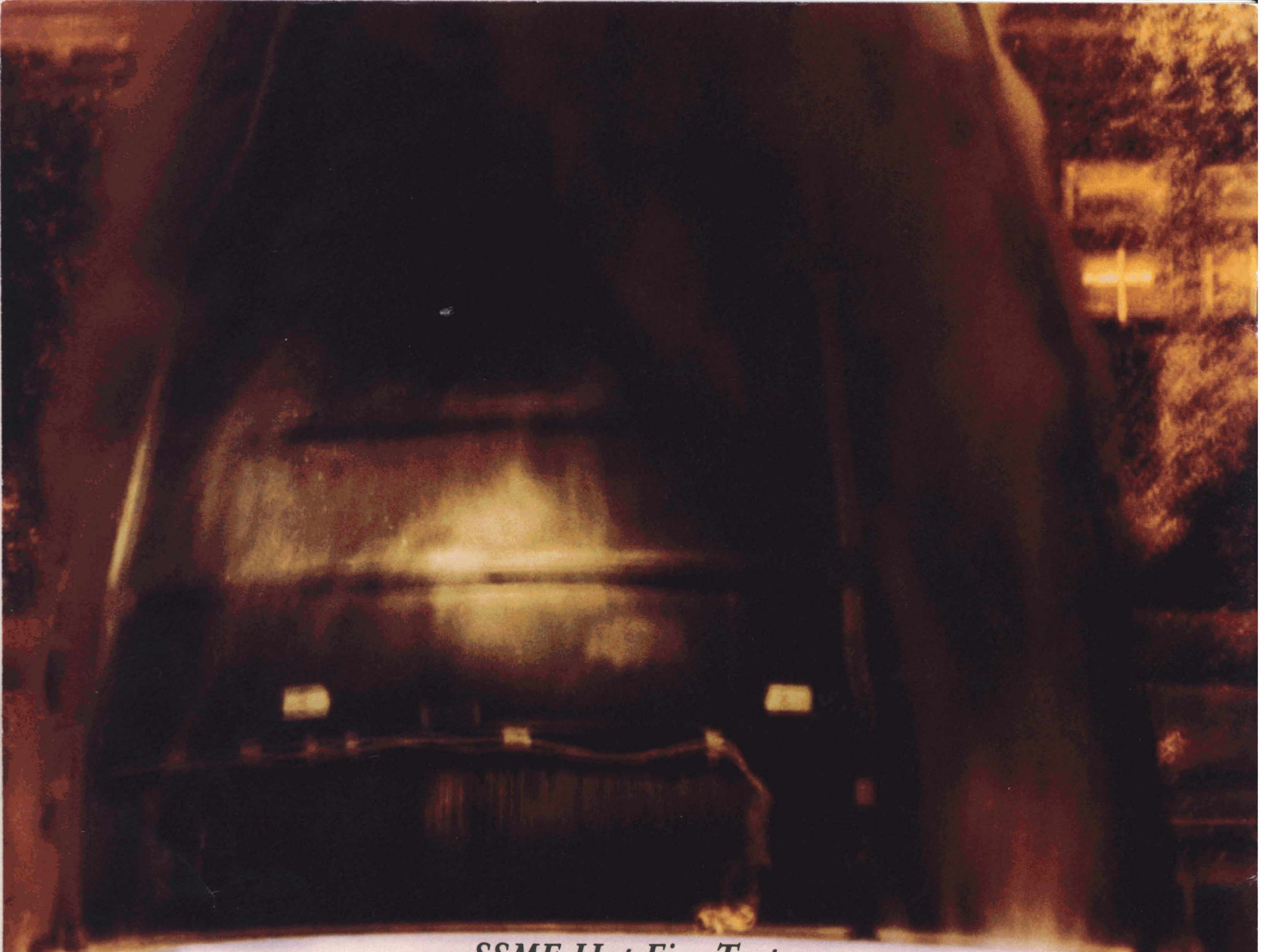
The Hill

SANTA SUSANA FIELD LABORATORY



SSME Hot Fire Test: A First Impression

A sharp, reddish orange flame punches into the air beneath the test stand with a report exceeding the loudest rock band you've ever heard. And it continues, permeating the air, making even shouted conversation virtually impossible. With amazing swiftness a surging white cloud builds at the base of the stand and billows skyward, dense and roiling as it carries upward hundreds of feet.

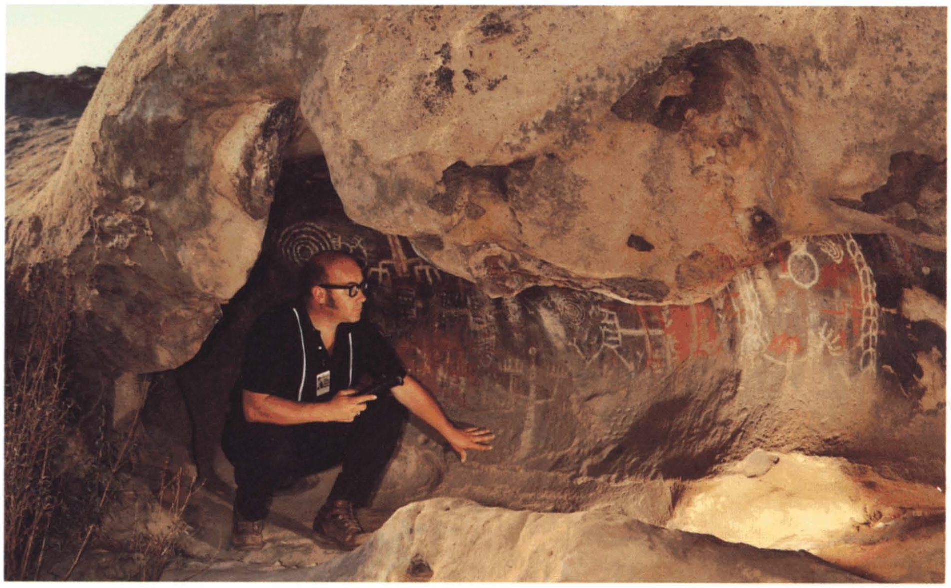
It is a supremely dramatic moment. The hundred or so people that watch silently from a reviewing stand a half-mile away visibly shrink from the sound and the fiery tongue that shatter the tranquil mountain air. Going in, the test stand seemed "awfully far away." Now the impression is that the action may be a bit too close.

The test duration is scheduled for 300 seconds, and you begin to imagine what it must be like to sit atop the shuttle itself as three of these engines are ignited at once, along with the solid rocket boosters, letting loose nearly five million pounds of thrust. You try to imagine what it must be like to be lifted into space by virtue of that kind of power.

Then the test suddenly and abruptly ends, the sudden silence as striking as the onset of the roar. The exhaust cloud has now begun to drift over the reviewing stand, and wonder of wonders, it begins to rain. *Small droplets that you initially dismiss as emanating from anywhere but the sky above you. But it continues. From the cloud. As you remember that the cloud is, in fact,* steam, *created by the propellants from the engine — liquid hydrogen and liquid oxygen. Absolutely as pure as bottled water.*

As we step down from the reviewing stand, a friend still has goose bumps the size of marbles. Much like mine.

Chumash drawings in a rock depression, one of several small sites that have been declared cultural landmarks and are now afforded both state and company protection.



We were not the first.

In a strangely prophetic way, a small tribe of American Indians called the Chumash occupied the rocky and somewhat forbidding hills that mark the northwestern corner of the San Fernando Valley at least 900 years before we shattered the stillness with the roar of rocket engines. Prophetic because the Chumash gazed upward from the two-thousand foot elevation in an ancient practice of astrology. At a distance of nearly a millennium, the people that lived on The Hill actively addressed the stars.

The methodology has changed. As the Twentieth Century rushes to a close, the Santa Susana Field Laboratory is still vitally involved in the mystery of the night sky. But here and now we're fashioning the transportation to actually approach the stars, as we have for almost forty years. Within our tenure, much of the essential history of the science of rocketry has been etched here in a continuing litany of smoke and fire, with the veritable household names of the American Space effort passing in review: Navaho, Atlas, Saturn, Thor, Delta, and the Space Shuttle Main engine. The Hill has been The Laboratory for the birth, growth and maturation of American Rocketry, and one of the Nation's foremost venues for proof-of-principle for the engines charged with providing access to Space.

The Island Community

Perched up there in the mountains that define the western boundary of the greater Los Angeles metropolitan area, The Hill is, for all intents and purposes, an island community. There is but a single road up or down, with all of the stuff of life and rockets moving upon this artery alone.

All of the necessary propellants for rocket testing are brought in by truck. During periods of heavy activity, four truck-loads of liquid oxygen are brought up a day, each accounting for nearly 4000 gallons. Liquid hydrogen, the propellant for the Space Shuttle Main Engine, requires another four truck-loads. Liquid nitrogen entails an average four truck-loads per month.

A ground-water purity testing unit. There are units like this one located at strategic points throughout the facility to sample ground water for possible contaminants.

Quality standards are administered by an on-site group, along with property and material services. Complete test documentation is handled by an on-site photographic service which provides stills and high-speed motion picture coverage of every test and related activities.

In addition to very genuine Indians that roamed the rugged environs of The Hill, very fictional cowboys — the movie kind — have also been frequent visitors. Over the years, countless westerns have used The Hill as an authentic backdrop, as well as numerous television shows. The location of your choice — 1880s Nevada, the Sahara, or even a distant planet have only been a matter of camera angle.

Fire protection for the entire Hill area is provided by an on-site fire unit.

Including the ETEC area, which occupies a small section of the property, better than 700 people populate The Hill, with community organization that includes a complete security staff, a fully equipped fire protection unit, a gas station, and a water and power distribution center. The only thing missing is a mayor.

All aspects of Hill operations are stand-alone. Supporting the engineering groups and functions are a complete equipment lab, a machine shop, a welding shop and a fully equipped instrument lab.

A scene from one of the countless "dusters" that have been shot on the Hill. Note the rugged background.

Premiere Test Site

The 2100 acres in the Santa Susana Mountains were first set aside in 1948 as the United States took its initial steps into the infant science of rocketry. In those early days the Redstone Arsenal in Huntsville, Alabama was just getting started under the leadership of Wernher von Braun, and much of the serious testing of engines and vehicles was confined to the White Sands proving grounds in New Mexico. And at the Santa Susana Field Laboratory — and quickly referred to as ''SSFL'' — a deep depression separating a circular arrangement of hills became the site of Rocketdyne's first three test stands. As direct copies of test stands that had been in use at the German WWII test facility at Pennemunde, they were designed to hold not only the engine to be tested, but the entire vehicle as well. The Bowl Area, as it was logically named, was soon joined by more test areas as Rocketdyne expanded further back into the mountainous terrain. Nearly forty years later, four separate sites have been created, with each designated and designed for specific functions. And each is a self-sufficient testing unit, with separate facilities for control, observation, and materials supply. In periods of extreme activity, this allows great flexibility and independence, and, of course, the capability of concurrent testing.

The Bowl Area in the early 1950s. A multiple exposure was used to capture the drama of all three stands operating at once.

The remoteness of the Hill, combined with its easy access from Rocketdyne's manufacturing facilities, is an ideal situation. SSFL's rustic environment is better than two thousand feet above the floor of the West San Fernando Valley and provides important seclusion for testing procedures, muting the roar of engines pulsing with as much as a half-million pounds of rocket power. At the same time, Rocketdyne's manufacturing facilities in Canoga Park are so close physically that the transport of a newly minted engine requires a mere 30 minutes, door to door.

Equally important, supplies — both for testing needs and the needs of the people conducting the tests — are close at hand.

Major Test Areas

Subsequent to the early use of the Bowl Area, four separate large engine test areas have been developed over the four decades of SSFL use: Alfa, Bravo, Coca, and Delta. Each area has been, and continues to be, developed for individual testing needs.

ALFA

An RS-27 during hot-fire testing.

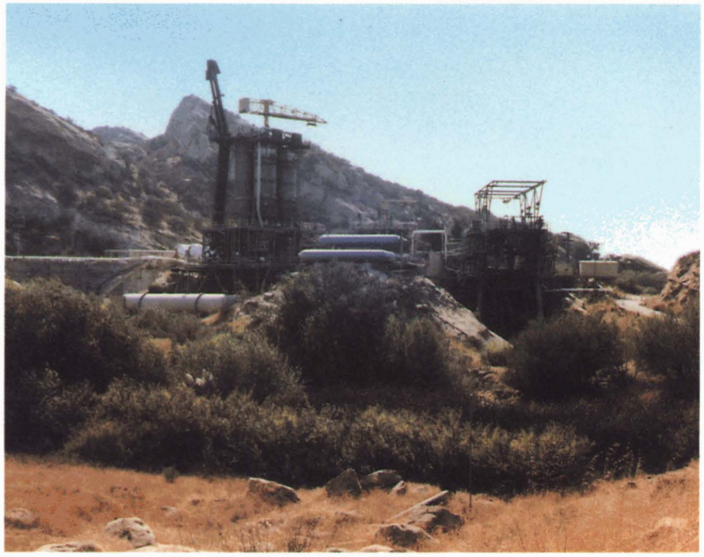
The two existing stands at Alfa in a panoramic shot looking northwest.

Alfa was constructed in the early 1950s as a site for Atlas and RS-27 (Thor) engine testing. Located about a mile to the northwest of the Bowl area, Alfa originally had three test stands, two of which are still in use today. Over the years, the facilities have been continuously modified and modernized, and are currently being used for ongoing reliability and verfication testing and acceptance testing of the RS-27 and the Atlas MA-5.

BRAVO

The Bravo test area, just over the next hill from Alfa, was initially constructed for the testing of F-1 turbopumps in the heyday of the Saturn program. It has recently been modified extensively for the RS-27 and Atlas programs to handle the acceptance testing of all turbopumps. Bravo will also be used to test the vernier engines for those programs.

The Bravo test site. Note the tall exhaust stacks at the top left of the structure, used for ducting the hot turbine exhaust gases away from the stand.



An Atlas roars aloft. Atlas turbopumps are acceptance-tested at Bravo.

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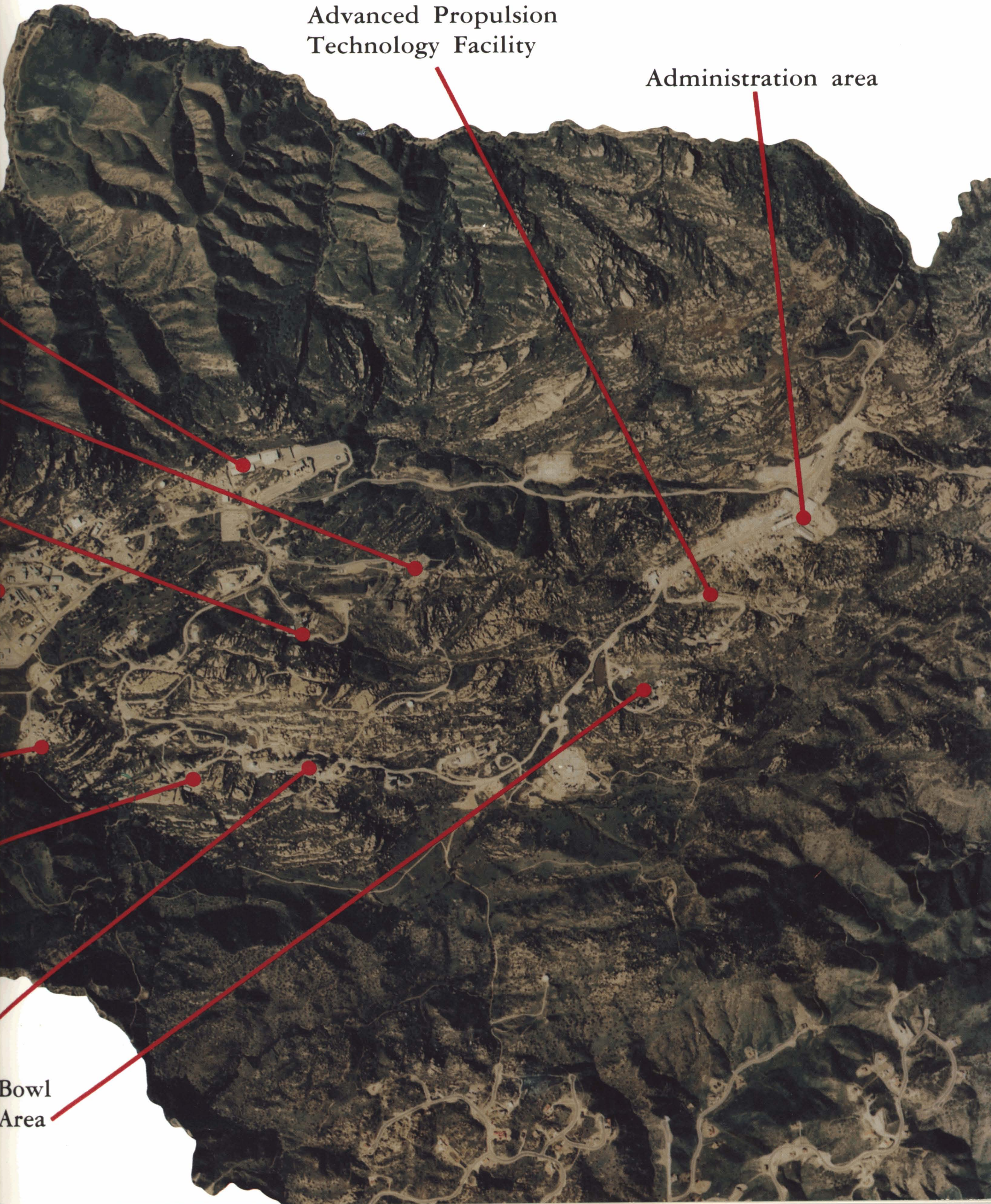
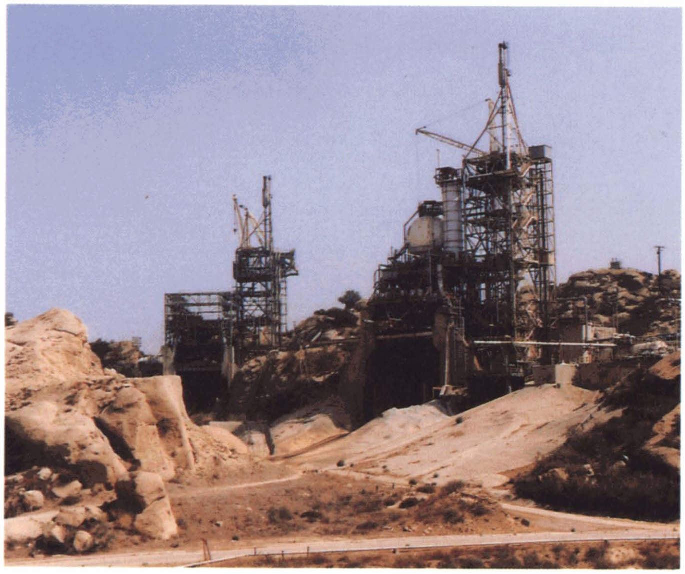

Advanced Propulsion
Technology Facility
Administration area
Bowl
Area

COCA



Coca was also built during the Apollo era, and was set up to test the Saturn second stage. In recent times, it has been reconfigured for high pressure Space Shuttle Main Engine (SSME) component development, including preburners, thrust chambers and turbomachinery. In 1978 Coca began testing of the complete SSME, which will continue into 1988. A concurrent testing program for the SSME is also conducted at the National Space Technology Laboratories in Mississippi.

A view of Coca's two test stands.

An SSME during a hot-fire test.

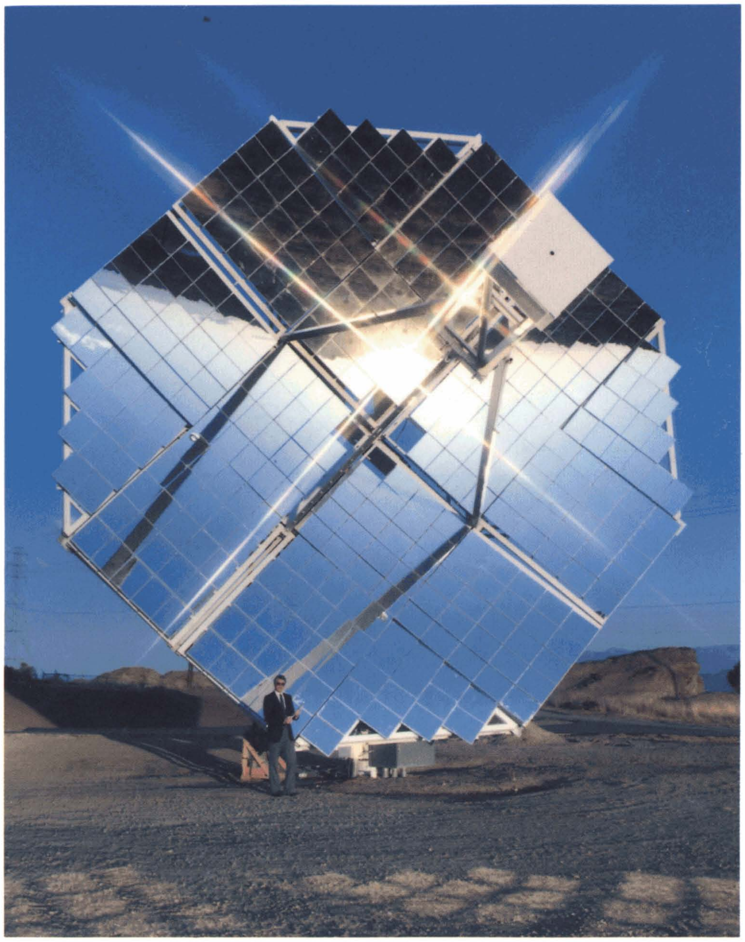
Intense action in the Coca Control Center during a test firing. Better than 5 million bytes of data are generated during each SSME test.

Solar Energy

The only test facility of its kind anywhere, Rocketdyne's Solar Dynamic Test Facility has been instrumental in the decision to use solar dynamic power generation in future space power applications. Rocketdyne engineers proved that the production of electrical power using a mirrored dish and a thermal storage unit was many times more efficient than photovoltaic methods. A key element was Rocketdyne's suggestion that salt be used as a storage medium; this in order to maintain a steady, even flow of energy to generating mechanisms, a technique that could be especially beneficial for orbiting spacecraft.

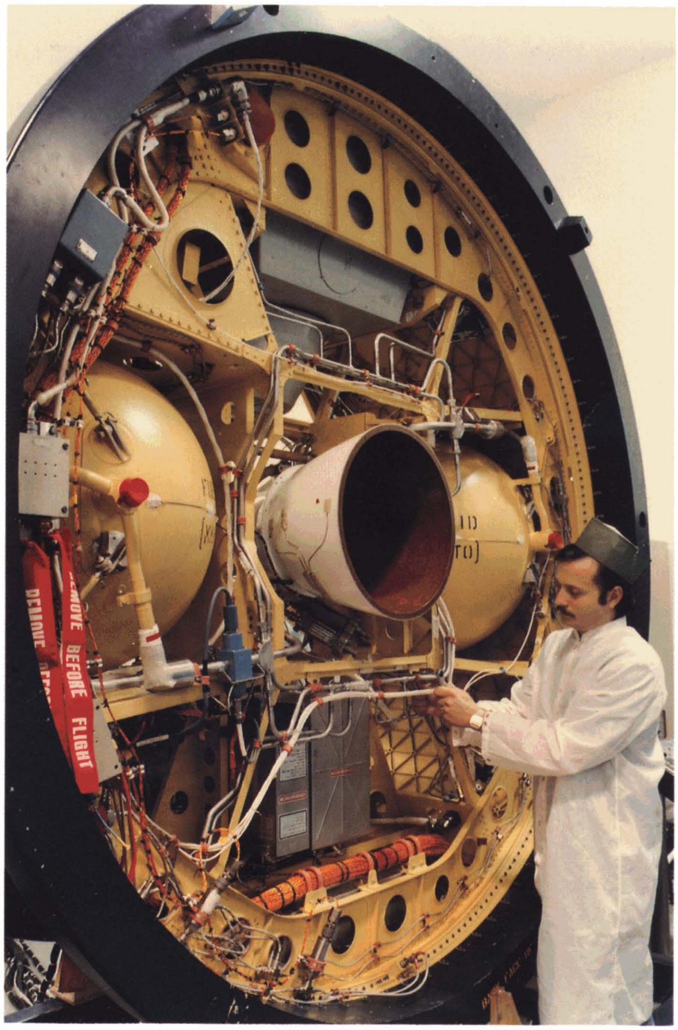
In addition, we have proved that solar dynamic means provide a very clean source of heat, with very precise energy applications. It was also discovered that the precise directional ability of the mirrored dish is amazingly effective in simulating laser action.

Rocketdyne's solar dish. Made up of individually focused mirrors, the dish directs solar heat at the thermal storage unit positioned at the ends of the supports.



DELTA

The Delta site, first constructed for Thor engine testing, then modified for Lance and J-2 testing, is now inactive as a test facility. The original control center, however, remains in use by manufacturing for propellant loading of Stage IV of the Peacekeeper. Since the propellants used in Stage IV are of a particularly volatile nature, the seclusion of Delta is of significant advantage.



Peacekeeper Stage IV during final assembly. The entire unit is then sent up to the Delta site for propellant loading.

In addition to the large engine test areas, STL IV (Space Technology Laboratory IV) and the Advanced Propulsion Testing Facility—or APTF—also provide key testing functions. STL IV specializes in small engine testing at simulated altitude conditions, with current programs being Peacekeeper (Stage IV), SABIR and the XLR-132. APTF has been set aside for a variety of research programs and investigations of the performance of a broad spectrum of small engine hardware. Included are injectors, turbopumps and numerous bearings and seals.

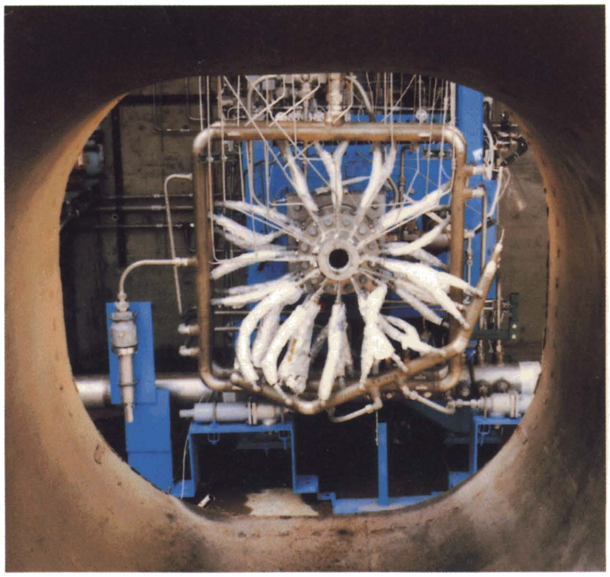
The Hill is also the scene of less spectacular action, albeit of genuine importance in its own right. Key among these additional efforts are ongoing testing and modifications of rocket engine components.

One such facility is at the CTL-V (Component Testing Laboratory-V) area, nearby the Coca area. Turbopumps can be tested here, using electrical drive systems that generate up to 22,500 horsepower — among the most powerful in the world.

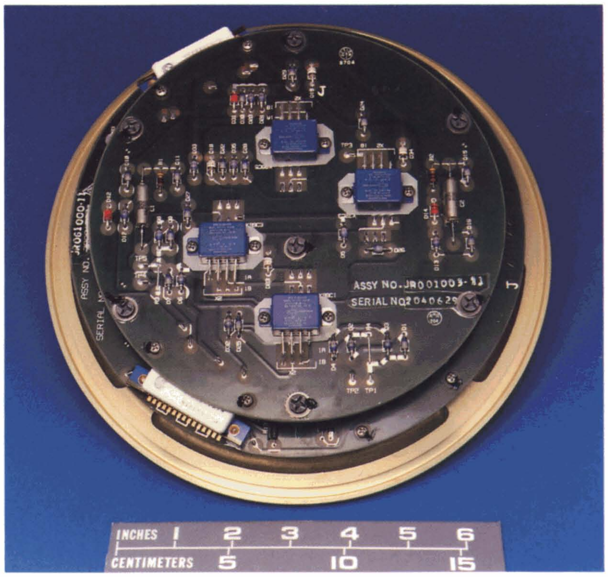
SSME bearings are tested at CTL-I in liquid oxygen to ensure compliance with performance specifications before they are attached to an engine, and propellant flowmeters are calibrated and checked for accuracy. At CTL-III, testing of large chemical lasers is conducted. There's also a test facility for hypergolic fabrication.

Laser experimentation is carried on at LETF (Laser Engineering Technology Facility) and at CTL-III.

Plus, there is significant work being done in electronic assembly and electrical harness.



The calorimeter thrust chamber, one of several research projects being conducted at APTF.



A component for an electronic controller, one of numerous custom devices that are designed and fabricated in the assembly facility.

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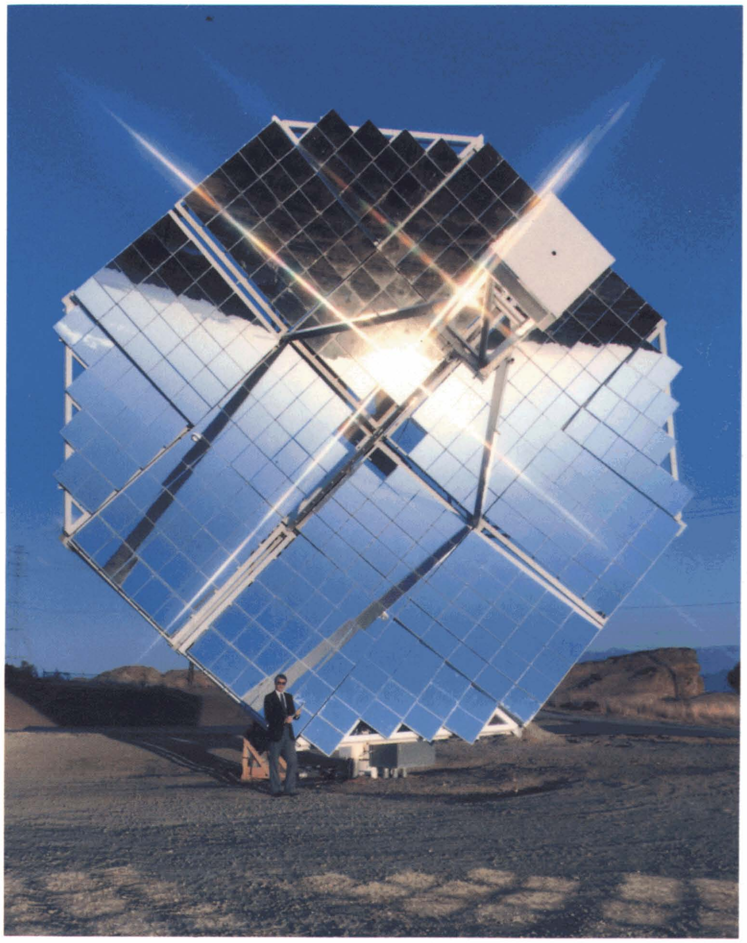
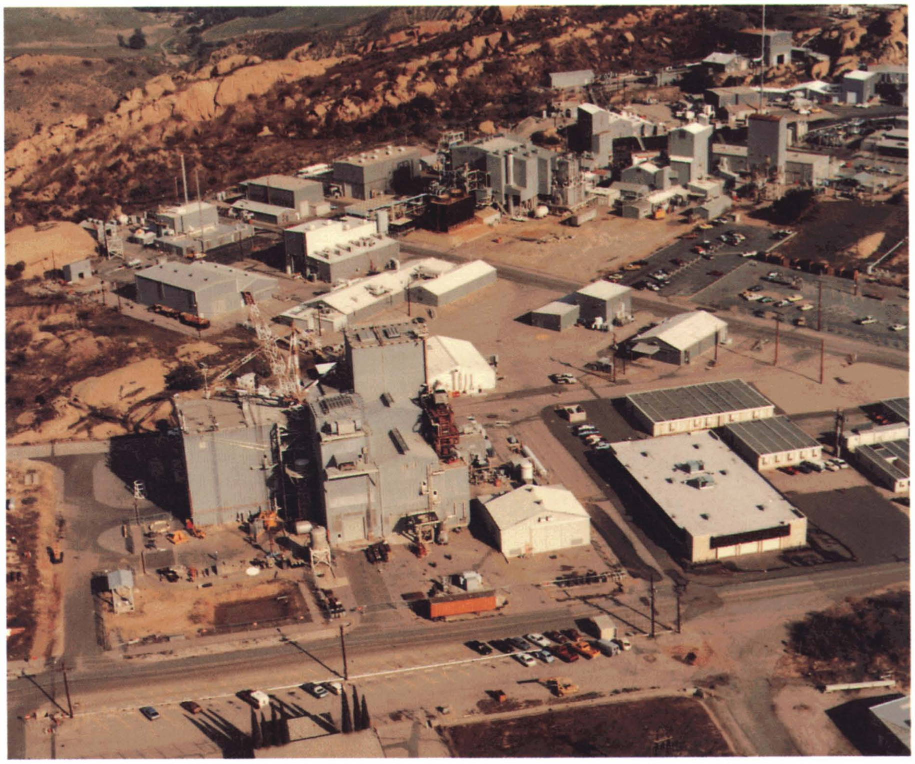


An aerial view of the ETEC area.



The Energy Technology Engineering Center, or ETEC, specializes in non-nuclear testing of components designed to transfer heat from a nuclear reactor using liquid metal instead of water or gases. As an independent government laboratory, owned by the U.S. Department of Energy, Rockwell has been the operating contractor since 1966.

In the early 1960s, Atomics International used the site to develop, assemble and ground test the SNAP (Systems for Nuclear Auxiliary Power) series of liquid metal compact nuclear reactors. The SNAP-10A, launched from Vandenberg Air Force Base in 1965, was the first and only U.S. demonstration of an operating reactor in earth orbit.

Following the SNAP program, ETEC became the principal development testing site for Liquid Metal Fast Breeder Reactor components.

On-site nuclear testing was later discontinued, along with the SNAP program, and now ETEC performs only nonradioactive testing of reactor components and heat transfer systems.

Essentially, ETEC is a development engineering and testing complex, rather than a basic or applied research laboratory, and provides a technology development linkage between basic research programs and commercialization or practical applications. As a "can-do" facility with an excellent track record for obtaining useful test data within budget and on schedule, ETEC has a reputation for practical results-oriented engineering.

The Future

Coca in the 1950s, with three test stands instead of the current two.

The prevailing constant in the Hill's four decades of Rocketdyne use has been change, directly reflecting Rocketdyne's own growth and maturation. New engineering innovations have always been introduced and proven first among the rocky crags and sparse sagebrush. As new, more powerful and more complex engines have moved off the drawing boards and taken shape as working powerplants, the Hill itself has changed accordingly. Test stands have been reconfigured periodically to meet new engine designs and performance standards, test supply sources modified to conform to new operational schemes, and test data collection adjusted for new information.

And now more changes are in store as the Nation's requirements for an ever more active Space presence are addressed. Rocketdyne is now deeply committed to the need for more and more powerful boosters and vehicles to lift massive payloads into Space in support of a wide range of exciting new American Space goals. With that commitment will necessarily be an energetic and ongoing program of testing, and the facilities on the Hill will evolve to meet those needs.

Yet the function and the drama of the Hill in action will not change. The dedication of the people who live and work there will continue undiminished. And the rumble reaching the Valley floor, giving notice of the work being done some two thousand feet above, will roll on unabated.

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