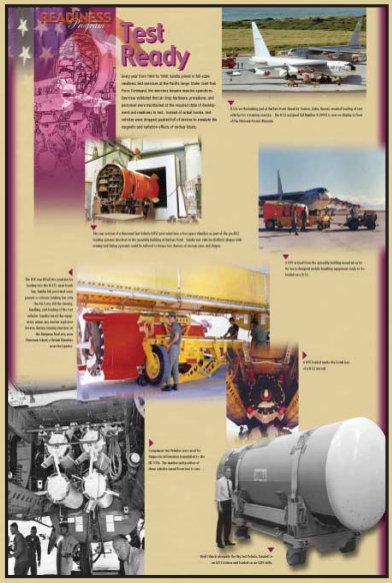
READINESS Program

This exhibit traces the events leading up to the U.S. Readiness Program and highlights Sandia's role in the effort to keep the U.S. prepared to advance nuclear research and testing.

To view a poster, click on any of the icons below. To magnify an area within a poster, use the magnifying tool on the Acrobat Reader tool bar and drag a box over the area.



READINESS Program

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Genesis of the Readiness Program

With the ratification of the Limited Test Ban Treaty (LTBT) in 1963, the United States, United Kingdom, and Soviet Union responded to worldwide concerns about radiation fallout. The LTBT suspended nuclear testing in the atmosphere, space, and in the seas, effectively confining testing underground. Congressional approval of the treaty was tied to the establishment of safeguards set forth by the Joint Chiefs of Staff that would maintain the readiness of the U.S. nuclear weapon research and development program. The third safeguard—the Readiness Program—provided for "The maintenance of the facilities and resources necessary to institute promptly nuclear tests in the atmosphere should they be deemed essential to our national security or should the treaty or any of its terms be abrogated by the Soviet Union."

This exhibit traces the events leading up to the Readiness Program and highlights Sandia's readiness role.

Race to the Moratorium

Understanding the push for readiness requires a familiarity with the sequence of events surrounding the U.S. and U.S.S.R. moratorium on nuclear testing from 1958 to 1961. Anticipating the upcoming moratorium, the U.S. launched Joint Task Force 7 (JTF-7) and rushed to complete weapon development, weapon effects, and safety tests in the atmosphere, at high altitudes, and underground. These included the Hardtack I atmospheric and high-altitude test series in the Pacific from May into August of 1958, Argus tests in the South Atlantic in August and September of 1958, and Hardtack II at the Nevada Test Site in September and October 1958. Major General Alvin Luedecke (U.S. Army) commanded JTF-7 and William Ogle of Los Alamos served as scientific deputy for this and other exercises. Don Shuster—later appointed Sandia's director of field test—commanded the 2,665-member scientific unit that was the center of the operational effort. The scientific task group, including 150 Sandians, was responsible for designing fuzing and firing systems, developing instrumentation, and providing technical support for the Pacific tests.

Beginning with Hardtack I, missiles carrying nuclear devices were launched from Johnston Island in the North Pacific. Johnston had been used during WWII as an aircraft and submarine stopover and refueling base; nuclear testing activities further covered the surface with airfield operation support structures. This photograph of Johnston Island (looking east) was taken in 1962.

In support of the Teak and Orange events, Sandia designed single- and two-stage Doorknob rockets that were launched from Johnston Island. The rockets measured nuclear radiation, blast, thermal radiation, and electromagnetic effects. Under the leadership of Morgan Kramm, John Eckhart, and Dick Eno, Sandia became a leader in small, unguided rocket design and testing—eventually conducting over 1,500 rocket launches at sites around the world.

Sandians provided, prepared, and armed the firing system for the nuclear devices carried by the Army's Redstone missiles launched from the Johnston Island area for the Operation Hardtack I Teak and Orange weapon effects tests. On July 31, 1958, Teak, the first high-altitude (252,000 feet) detonation [see inset], produced a spectacular fireball and colorful aurora that was visible from Honolulu 700 nautical miles away. The detonation created a magnetic disturbance in the atmosphere that affected radio transmissions. The less dramatic Orange shot followed on August 11 at an altitude of 141,000 feet.

During the Hardtack II test series in Nevada in September and October 1958, Sandia technicians suspended nuclear devices from tethered balloons as a substitute for more expensive towers; balloons became another Sandia specialty.

Over the long summer of 1958, Operation Hardtack I detonated thirty-five nuclear tests at Enewetak and Bikini in the Marshall Islands and at Johnston Island. The shots ranged in size from the zero-yield Quince test on August 6 on Enewetak to the 9.3 megaton-yield Popular on Bikini on July 12. Quince left this small crater at ground zero.

READINESS Program

JOINT TASK FORCE EIGHT

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Ready or Not?

In September 1961, the Soviet Union broke the test moratorium by resuming nuclear testing, conducting an astonishing 45 tests in two months. An October 30, 1961, shot yielded about 60 megatons, making it the largest single nuclear test ever. The U.S. was not prepared to resume atmospheric nuclear testing and scrambled to get its program back up and running. Joint Task Force 8 (JTF-8) under the command of Major General Alfred Dodd Starbird (U.S. Army) was formed to conduct the first U.S. post-moratorium test. In April 1962, the high-altitude Operation Dominic and Fishbowl tests began in the Pacific.

Don Shuster commanded Sandia's task unit JTF-8 with James Scott, John Eckhart, and Lee Hollingsworth in deputy leadership roles. Shuster, *center*, is shown here in April 1962 examining a map of the Dominic test area with Scott and Eckhart. Johnston Island was Operation Dominic's base and Barbers Point Naval Air Station, Oahu, Hawaii, served as the airdrop staging area.

In 1962, the Atomic Energy Commission acquired part of the Auxiliary Landing Field Bonham in Kauai, Hawaii, for launching diagnostic rockets. The site was used for Operation Dominic and renamed the Kauai Test Readiness Facility. Now called the Kauai Test Facility, it remains in use today.

The Dominic operations required extensive laboratory support—the purchasing division worked 60-75 hours a week during the operation, while the packaging and shipping division prepared and shipped 1,333,977 pounds of materiel within six weeks for the overseas operation.

Sandia field testers for Operation Dominic installed a Nike booster on a launcher at Kauai in May 1962.

The Thor, designed as an ICBM, had to be reconfigured to carry test payloads. Sandia designed the warhead hardware and modified the payload end of the rocket. After serious malfunctions took the Thor out of action for four months, Starbird asked Sandia to build an alternate carrier vehicle in time for the test series.

In June 1962, Bill Ogle, *left*, JTF-8 Scientific Deputy, two unidentified Army officers, and Major General Starbird met with John J. Miller, manager of Sandia's rocket test projects division, to review Dominic operations at Kauai.

For two months in late summer of 1962, Sandians worked around the clock to design, build, and successfully fire the new rocket—called Strypi. Strypi's name implied that in accepting the challenge Sandia had taken a "tiger by the tail." Although it never carried a nuclear warhead into space again, the Strypi became a workhorse in Sandia's rocket research program.

On hand for a Strypi XI launch at the Kauai Test Facility in the late 1980s were Bob Peurifoy, Dick Eno, Wayne Lathrop, Jack Canute, Drayton Boozer, Ron Bentley, Tom Hoban, Al Watts, Bill Barton, Carter Broyles, Randy Maydew, Venky Narayanamurti, and Pat Walters.

In November 1962, a Thor missile was launched for Operation Fishbowl's Kingfish high-altitude test in the Pacific. The streak on the right was formed by the missile carrying the warhead, and the streaks on the left are from Sandia and DoD diagnostic rockets.

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Aircraft Ready

Upon resumption of Soviet nuclear testing in 1961, President Kennedy noted, "The Soviet Union prepared to test while we were at the table negotiating with them. If they fooled us once, it is their fault, and if they fool us twice, it is our fault." This message loomed large in the minds of the American testing community after ratification of the LTBT in 1963. The readiness safeguard was established to provide peace of mind. In response to the safeguard mandate, the Air Force formed a special unit at Kirtland Air Force Base with aircraft ready to begin nuclear testing at any time. Sandia was involved in the readiness effort to modify three aircraft to serve as flying laboratories, design test vehicles to carry the devices and telemetry for nuclear tests, and participate in readiness practice missions, often in connection with scientific research projects.

In 1966, members of the Pacific Planning Board—a group of 150 scientists, government, and military representatives—met at Sandia Laboratory to review readiness exercises in the Pacific. Shown here are Robert Goeckermann, LRL, JTF-8 Scientific Deputy; Don Shuster, Sandia director of Special Projects; Lee Hollingsworth, Sandia director of Field Testing; and Major General John Stevenson (U. S. Air Force) JTF-8 Commander. Carter Broyles was also a member of the board. Other Sandia technical participants included Morgan Kramm, Albert Huters, Jr., Arthur Cole, Roland Millican, and Joseph Stiegler. William W. Parker, and Arnold Lamb represented Sandia's administrative support activities at the meeting.

In 1963, Sandia and its partner laboratories worked with the Air Force to install instrumentation in three modified Air Force 707 jets, renamed NC-135s, for use by Sandia, Los Alamos, and Lawrence Livermore laboratories. NC-135 aircraft offered the opportunity to perform operational diagnostics at optimum locations. The aircraft remained in service until 1976.

Sandia's NC-135 in flight, Tail Number 00370.

The mission commander was stationed at this console inside the NC-135. Technical personnel monitored specific systems, such as telemetry, and kept the mission commander informed. The console had a complete array of communications technology.

In 1967, 170 Sandians were assigned to the 971-member JTF-8 Operation Paddlewheel exercise. The technical crew for the laboratories' NC-135s at Hickham Air Force Base on Honolulu included, *back row:* Paul Seward, Albert Huters, Jr., Carl E. Smith, Robert Scharrer, W. Leroy Thomas, Herbert Sisson, Walter Norris, Marlin Frettem, Richard McKnight, David Ryerson, Robert E. Taylor, Sanford Markowitz, Edwin Oakes, Gorden Worthen, Lester Harris, James T. Wright, Ernest Niper, Robert W. Martin, William Bierly; *front row:* Rambert T. Rivera, Vaughn Nogle, Billy Stanton, Henry Ward, Jr., Jerome Truskowski, Andrew Sayers, Larry Gillette, Paul Stang, Roland Hewitt, Robert Hooker, Jr.

Arthur McMullen served as the Joint Labs Antenna Engineer and was responsible for the many antenna systems required for data acquisition. McMullen is shown here checking an antenna set-up at Barbers Point, Oahu. An NC-135 readiness aircraft is visible in the background.

In 1968 readiness aircraft were used in Material Test Vehicle (MTV) booster tests using a modified Strypi. The performance of the MTV and a re-entry vehicle was monitored by telemetry from Johnston Island and receiving stations on board the readiness aircraft. Aircraft also served as airborne platforms for the optical instrumentation shown here.

READINESS *Program*

Test Ready

Every year from 1964 to 1968, Sandia joined in full-scale readiness test exercises at the Pacific range. Under Joint Task Force Command, the exercises became massive operations. Exercises validated that air drop hardware, procedures, and personnel were maintained at the required state of development and readiness to test. Instead of actual bombs, test vehicles were dropped, packed full of devices to simulate the magnetic and radiation effects of nuclear blasts.

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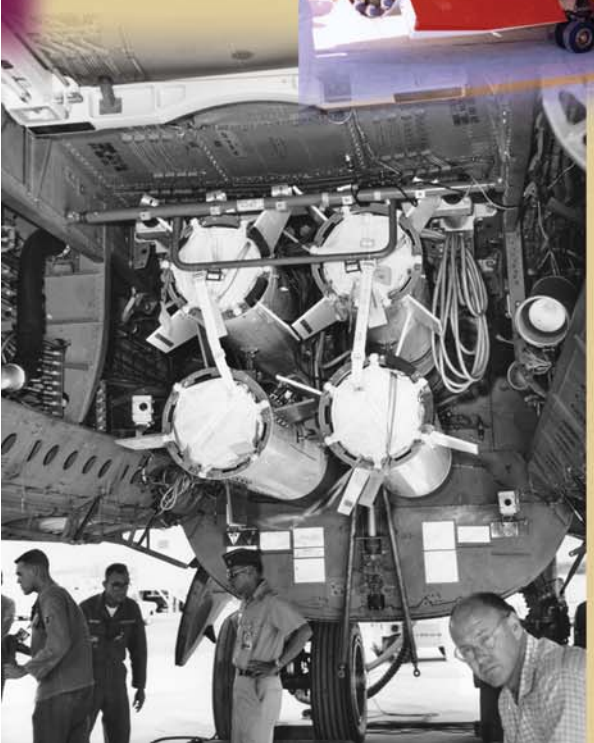
B-52s on the landing pad at Barbers Point Naval Air Station, Oahu, Hawaii, awaited loading of test vehicles for a training exercise. The B-52 assigned Tail Number 0-20013 is now on display in front of the National Atomic Museum.

The rear section of a Universal Test Vehicle (UTV) protruded into a free space chamber as part of the pre-B52 loading systems checkout in the assembly building at Barbers Point. Sandia test vehicles (ballistic shapes with arming and fuzing systems) could be tailored to house test devices of various sizes and shapes.

A UTV arrived from the assembly building mounted on its Air Force-designed mobile handling equipment ready to be loaded on a B-52.

The UTV was lifted into position for loading into the B-52's open bomb bay. Sandia lab personnel were present to witness loading, but only the Air Force did the moving, handling, and loading of the test vehicles. Sandia tested this equipment, minus any nuclear explosive devices, during training exercises at the Kingman Reef site, near Christmas Island, a British Mandate near the Equator.

A UTV loaded inside the bomb bay of a B-52 aircraft.



Companion Test Vehicles were used for diagnostic information transmitted to the NC-135s. The number and position of these vehicles varied from test to test.

Herb Filusch alongside the Big Test Vehicle, banded to an S212 bolster and loaded on an S289 dolly.

READINESS Program

Research Ready

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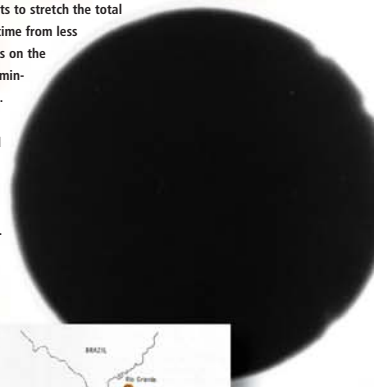
The NC-135 aircraft and crew participated with the rocket group in frequent scientific expeditions around the world. Sandians and scientists from many nations studied solar phenomena and their effects on the earth's atmosphere. The flights also gave the crew interesting and challenging experiences to help them maintain the required state of readiness. The research supported Sandia's work in aerospace nuclear safety, space vehicle re-entry, nuclear burst physics, and satellite detection of nuclear tests. Scientists considered this research especially useful because the aircraft could fly above much of the dust and atmospheric disturbances that hampered ground-based observatories. Rockets with instrument payloads were launched separately and simultaneously with the NC-135 flights to provide additional data.

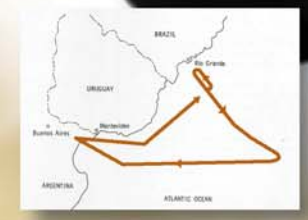
Twenty-seven Sandians journeyed half-way around the world in diagnostic aircraft to study the solar eclipse in the South Pacific on May 30, 1965. John Kuruzovich, Jose Llamas, John Barsic, and Lyle Porter operated a manual tracking infrared spectrograph—dubbed the *holy cow* because of its array of capabilities—for the expedition.

In early 1965, Sandians fired two Nike Tomahawk rockets from the Churchill Research Range, Manitoba, Canada, for Project Cariboo I, a joint Sandia and Los Alamos investigation of the aurora borealis (northern lights.)

In another eclipse study in the fall of 1966, 50 Sandia scientists used aircraft and rockets to study solar phenomenon during a total eclipse off the southeast coast of Brazil. The flying laboratory raced along the path of the moon's shadow at 600 mph allowing scientists to stretch the total eclipse viewing time from less than two minutes on the ground to three minutes, one second. The notches observed around the edge of the moon were due to overexposure from solar flares.



During stopovers at points around the globe, Sandians enjoyed interactions with the local residents. When the Sandia aircraft landed in Lima, Peru, after the 1966 eclipse study, John Kuruzovich visited a Sisters of Charity convent and ended up spending two days repairing the convent's vehicle. While Kuruzovich was occupied, Mert Robertson, scientific commander of the Sandia aircraft, explained the purpose of the eclipse study to students of the missionary school.



Route of the Sandia flying laboratory during the 1966 solar eclipse study.

In March 1967, Robert Martin, Sanford "Sandy" Markowitz, Raymond Caster, Mert Robertson, and Roland Hewitt examined a map while preparing for the first expedition to New Zealand; a second aircraft with Los Alamos experiments flew to Alaska. Similar missions followed in 1968 and 1970.

On the 1967 expedition, the crews conducted night flights to simultaneously gather data on the aurora borealis and on cosmic rays from two magnetically conjugate points. Scientists observed that with a two-second lag time the auroras appeared to be mirror images of each other in the northern and southern hemispheres. This view of the aurora was taken in Alaska.

Dave Mayhew, Bill Bierly, Paul Vandenberg, and Mert Robertson were at a scenic point during a stopover in American Samoa while in route for a spring 1968 cosmic ray and auroral study based in New Zealand.

READINESS *Program*

Flight Ready

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In conjunction with the other readiness activities, in 1964 the Joint Chiefs of Staff formed Joint Task Force Two (JTF-2) under the leadership of Major General George Brown (U.S. Air Force) to test and evaluate the low-altitude penetration capabilities of aircraft weapons systems and their defense. JTF-2 was headquartered at Sandia Base. At General Brown's request and with AEC approval, Sandia Laboratories supported JTF-2. Don Shuster led Sandia's effort, which was centered in John Eckhart's systems evaluation group. Tom Sellers supervised development of instrumentation pods and monitoring equipment; Jim DeMontmollin managed test planning; John J. Miller handled site engineering and maintenance.

The Tonopah Test Range crew laid out a zigzag course for the aircraft to follow over terrain ranging from flat to mountainous. Using an Army CH 3C helicopter in May 1965, test range maintenance crews delivered orange barrels to mark the flight path for JTF-2 flights.

By July 1965, crews of eight different aircraft types from the Air Force, Army, Navy, and Marines had flown 450 low-level sorties. Flight tests proved excellent training for aircraft pilots and crews bound for Vietnam.

A Navy A-6 aircraft completing a low-level test drop.

Sandia built a flight simulator by projecting film of test flights on a 160° screen. From the mock cockpit in the center, pilots reacted to situations presented on the screen. Sandia found that success depended less on which delivery system was used than on the training and skill of the delivery crew.

Readiness Program ends

The Readiness Program was severely curtailed in 1974. Funding for the program evaporated as political concerns made it evident that atmospheric nuclear testing would not resume. Finally, with the loss of Air Force support and President Ford's deletion of the word "promptly" from the third safeguard, the Readiness Program ended in 1975.

Events leading up to the 1963 Limited Test Ban Treaty and the establishment of the Readiness Program demonstrate how Sandia's staff and expertise were mobilized to support the nation's nuclear and non-nuclear weapon research and development programs in changing political circumstances. Sandia brought its unique capabilities to many aspects of the program, including test vehicle and weapon design, scientific research, rocketry, modifications to the NC-135 aircraft, and development of instrumentation for low-level testing. Sandia's role in the Readiness Program serves as a straightforward example of how the lab responds to urgent national priorities—an endeavor that continues today.

A Sandia-developed instrument pod was loaded on an A-4C aircraft for low-level testing in 1967. Although flight tests were moved from Tonopah to rugged terrain in the Ozarks in 1966 and to other locations in 1967 and 1968, Sandians continued to maintain and operate the instrumentation. Original task force plans called for continued testing into the 1970s, but Vietnam provided a more realistic testing ground.

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