SAND2018-1657R

SANDIA NATIONAL LABORATORIES
TONOPAH TEST RANGE, STATION 22
CONTRAVES TOWER
(Building 22-00)
Station 22
Tonopah Test Range
Nye County
Nevada

HAER No. NV-XXXX

PHOTOGRAPHS
WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
San Francisco, California 94107

HISTORIC AMERICAN ENGINEERING RECORD

SANDIA NATIONAL LABORATORIES, TONOPAH TEST RANGE
STATION 22 CONTRAVES TOWER
(BUILDING 22-00)

Location: Station 22, Sandia National Laboratories' Tonopah Test Range, Nye County, Nevada

Date of Construction: 1960

Engineers/Architects: Kenneth S. Clark and Philippe Register, Architect—Engineer

Builders: Reynolds Electrical and Engineering Company, Inc.

Present Owner: U.S. Department of Energy/National Nuclear Security Administration

Present Use: None. Building is unoccupied.

Significance: The Contraves Tower (Building 22-00) was built in 1960 as part of the initial expansion after the initial building at Tonopah Test Range (TTR). Located just west of the main road well to the south of the main Control Point (Area 3) at TTR, the tower was designed to hold a Contraves phototheodolite used in tracking and recording test units dropped from aircraft at the range. The tower was in steady use for the first decade of its existence, after which it was largely replaced by mobile Contraves units that could be placed at the stations as needed for particular tests.

The Contraves Tower (Building 22-00) is a contributing element to the Sandia National Laboratories Tonopah Test Range Historic District. Building 22-00 supported TTR's role as an outdoor laboratory and was built in 1960 as part of the range's initial expansion to support increasing test demands. The building provided and represents a key tracking and data capture facility at TTR during its period of significance. The period of significance for the historic district is 1956-1989; 22-00 is a contributing element for 1960-1970.

Part I. HISTORICAL INFORMATION

A. Physical History

1. **Date of erection:**
   1960

2. **Architect:**
   Kenneth S. Clark and Philippe Register, Architect—Engineer

3. **Original and subsequent owners, occupants, uses:**
   The Station 22 Contraves Tower (Building 22-00) was built and used in support of nuclear weapon design testing activities at SNL TTR. SNL, a government-owned, contractor-operated facility, is owned by the U.S. DOE/NNSA.

4. **Builder, contractor, suppliers:**
   Reynolds Electrical and Engineering Company, Inc. (REECo)

5. **Original plans and constructions:**
   In 1960, REECo built the Contraves Tower (Building 22-00) at Station 22 based on a design by Kenneth S. Clark and Philippe Register, Architect—Engineer of Santa Fe, New Mexico. The tower was designed to hold a Contraves phototheodolite and was a concrete pedestal surrounded by a steel outer skin; a metal staircase spiraled up the tower's south side. The phototheodolite was mounted on the top of the tower and covered with a protective dome.

6. **Alterations and additions:**
   The Station 22 Contraves Tower (Building 22-00) structure has had no alterations or additions. The cover of the protective dome has been removed, as has the Contraves.

Historical Context:
The Station 22 Contraves Tower (Building 22-00) was part of the second wave of construction that significantly expanded the facilities at TTR. The expansion included several Contraves towers—some to replace the existing Askania towers and some to expand the number of tracking stations available during testing. There were two new tower designs—one 20' in height, one 30'. Built in 1960, Building 22-00 was on of the 20' towers and was located at the new Station 22, well south of the Control Point in Area 3 (Figures 1, 2, and 5).

Early SNL History

SNL began as Z Division, the engineering group of Los Alamos National Laboratory (LANL).[1] LANL was established during World War II (WWII) as the scientific design entity within the Manhattan Engineer District (MED) tasked with the development of atomic weapons. LANL scientists successfully tested the first atomic device at Trinity Site near Alamogordo, New Mexico, on July 16, 1945. On August 6 and 9, 1945, the U.S. deployed the first two atomic bombs against Japan, ending WWII.[2]

In July 1945, around the time of the Trinity test, LANL director J. Robert Oppenheimer gathered up several engineering functions into Z Division. In September 1945, Z Division began moving to Sandia Base, a U.S. Army base just east of Kirtland Air Force Base (KAFB),[3] outside of Albuquerque, New Mexico. Oppenheimer moved Z Division from the main site to alleviate crowed conditions at LANL, to work more closely with the military, and to take advantage of the nearby KAFB airfield for testing.

Z Division originally designed, tested, and oversaw the production of all of the non-nuclear systems on a nuclear weapon. It also had responsibility for training the military in assembly and handling of the weapons, testing completed weapon designs at offsite testing facilities, and supporting full-scale nuclear tests.

In 1946, with passage of the Atomic Energy Act and President Truman's signature, Congress created the Atomic Energy Commission (AEC) to oversee the development and management of new nuclear weapons and atomic energy applications.

The AEC took over all MED activities and properties on January 1, 1947. Z Division continued to provide ordnance engineering for nuclear weapon designs.

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[1] Los Alamos National Laboratory (LANL) is referred to by its current name. Originally, LANL was identified as Los Alamos Scientific Laboratory. It became a national laboratory via legislation passed in 1979.

[2] The account of the Manhattan Project and SNL's early history is from Necah Stewart Furman, Sandia National Laboratories: the Postwar Decade (Albuquerque: New Mexico, 1990); Gregg Herken, The Winning Weapon: The Atomic Bomb in the Cold War, 1945-1950 (New York: Alfred Knopf, 1980); Leland Johnson, Sandia National Laboratories: A History of Exceptional Service in the National Interest (Albuquerque: Sandia National Laboratories, 1997); Charles R. Loeber, Building the Bombs: A History of the Nuclear Weapons Complex, Second Edition (Albuquerque: Sandia National Laboratories, 2005); Rebecca Ullrich, Michael Anne Sullivan, Cynthia Martin, and Dick Gerdes, Sandia in the Cold War and Post-Cold War Periods: A Statement of Historic Context for Sandia National Laboratories/New Mexico, SAND2010-4971P (Albuquerque: Sandia National Laboratories, 2010); and Peter Westwick, The National Labs: Science in an American System, 1947-1974 (Cambridge: Harvard University Press, 2003).

[3] Kirtland Air Force Base is referred to here by its current name. It was originally called the Albuquerque Army Air Base. It was renamed Kirtland Army Airfield in 1942 in honor of aviation pioneer Colonel Roy C. Kirtland. It, Sandia Army Base, and Manzano Army Base merged into Kirtland Air Force Base (KAFB) in 1971.

Plans included having Z Division function as the production and assembly site for the growing nuclear weapons complex. Z Division also participated in and supported all post-WWII nuclear tests.

On April 1, 1948, Z Division became Sandia Laboratory, a separate branch of LANL. The following year, on November 1, 1949, Sandia Corporation, a wholly owned subsidiary of Western Electric, took over management of the lab, which became a separate entity from LANL. The core mission of ordnance engineering for nuclear weapons, including testing and production of non-nuclear components remained the same.

As part of its design efforts, SNL conducted environmental tests on each component, weapon sub-system, and final weapon design. Over time, testing was done in off-the-shelf environmental test equipment in SNL/NM buildings, in large test facilities built to the south of the main SNL/NM Tech Area, and at remote sites with space and facilities for drop-testing components and prototypes.

Establishing Tonopah Test Range
SNL's early testing activities included ballistic studies of weapon shapes—dropping test devices from aircraft to determine how and where they fell. Drop tests were also used to test the operation of weapon subsystems in flight. In its first months as Z Division, the lab established a practice bombing range west of Los Lunas, New Mexico. By December 1945, the Z Division field test group was setting up equipment at the Los Lunas test range.

While arrangements were underway at the Los Lunas range, the MED received permission to let Z Division use the Salton Sea Test Base as well. The U.S. Navy established a test range at the Salton Sea in southern California during WWII.[4] In June 1946, the U.S. Navy's buildings at the site were transferred to the U.S. Army for use as a bombing range by Z Division.

Sitting approximately 200 feet below sea level and offering excellent testing weather for most of the year, the Salton Sea site allowed Z Division to test ballistic performance in dense, sea-level atmospheric conditions unavailable in New Mexico. It had a water impact area and, later, a land target. SNL used the site until 1960.

By the mid-1950s, the Salton Sea Test Base experienced tension between a growing number of weapon programs requiring testing and general population growth in the area. Increased population to the west blew in additional haze in the air, limiting visibility for instruments and cameras. The growing population in the

[4] This was the Naval Auxiliary Air Station at Salton Sea. During WWII, the MED also occasionally used the site as a low-altitude bombing range.

nearby Imperial Valley filled in previously open land, restricting opportunities to place tracking stations further out from the target points. Finally, bombing approaches became more complicated as commercial airways increased in the area.

The AEC and SNL launched a search for a new test site. A variety of sites were considered. Potential sites near Salton Sea were small and posed similar problems to the Sea itself. A temporary site was established in 1954 on the bed of Yucca Lake, within the AEC's Nevada Test Site, while scouting continued for an area that could accommodate low-altitude as well as high-altitude approaches. Multiple sites in Arizona, Virginia, Texas, and Colorado were reviewed and excluded.

An area known as Cactus Flats in the northwestern section of the Las Vegas Bombing and Gunnery Range (now Nellis Air Force Base) presented a series of dry lake beds stretching north-south in a long valley between the Cactus Range to the west and the Kawich Range to the east. Used as a practice bombing range during WWII, the site offered a set of potential impact points in the dry lake beds and good flying weather. The Air Force authorized AEC use of the property for SNL for five years beginning November 9, 1956. Approximately 35 miles southeast of Tonopah, Nevada, the site was named Tonopah Test Range.

In the fall of 1956, SNL selected Pork Lake, the northernmost in the string of lake beds, as the primary impact point for drop tests and began construction of facilities. SNL's Plant Engineering Department was responsible for design and the Reynolds Electrical & Engineering Company (REECo) undertook construction work. The AEC had an existing contract with REECo to provide maintenance for the Nevada Test Site further south on the Las Vegas Bombing and Gunnery Range and extended that to cover TTR construction. In 1958, a contract was placed with REECo for TTR operation and maintenance activities.

Planning for facilities and operations at the site included laying out the stations from which tests would be observed, photographed, and tracked. The stations were identified on maps of the range and revealed the expectation that flights would be tracked along the east and west sides of the dry lake beds, concentrating on the main target in the dry lake bed at the north end. Ultimately, additional targets and stations would be added toward the south, but the initial construction focus was on Pork Lake. In addition to lights and night-camera stations installed around the target area, construction in the first months included four instrument stations for tracking test units and data collection.

The stations at TTR are identified by specific coordinates and most house one or more pieces of tracking/recording equipment.[5] (Figure 5) The larger stations—including multiple facilities and a variety of instrumentation—were absorbed into and became identified as Areas. Thus, Station 3, which included an Askania phototheodolite tower in the early years, is almost never referred to as Station 3—it is Area 3 or the Control Point and includes the main control tower and many support facilities for operating the range. Buildings and structures are usually numbered based on their location (for example, Building 09-50 is an observation bunker in Area 9; Building 02-00 is at Station 2; and Building 22-00 is at Station 22).

The tracking and recording equipment used at the range is deployed at the stations to provide multiple views and recordings of a test. Radar units identify and track the test delivery aircraft as it approaches the range and throughout the test, offering spatial position information. Telemetry stations capture information transmitted from the delivery aircraft and (in later years) from the test unit itself. The Askania and Contraves phototheodolites, high-speed cameras, and telescopes capture test images and annotate the film with the time, azimuth, and elevation of the test item. Later analysis of the data from multiple phototheodolites allows calculation of precisely where the test unit was throughout the test. (Figure 6)

The first four stations established by the end of January 1957 and provided with Askania phototheodolite towers and instrumentation were Station 1, Station 2, Station 3 (at Area 3, the Control Point), and Station 4. Station 1, 2 miles northwest of the impact area, had an Askania phototheodolite on a tower, a tracking telescope, and a trailer-mounted M-33 radar. Station 2 was 3 miles south of the target and featured an Askania phototheodolite on a tower (Building 02-00) and a tracking telescope (Building 02-01). Three miles further south was Station 3, the Control Point, which had an Askania phototheodolite on a tower, a tracking telescope, and project offices, weather station, control consoles, darkroom facilities, and a generator building. Two miles south of Area 3 and on the southern end of the flight path, was Station 4, which had an Askania phototheodolite on a tower and an SCR-584 radar.

Testing began on February 4, 1957, with drop tests done both during the day and at night. By the summer, testing included rocket launches. Rocket testing was added to the site as part of the preparation for the Operation Hardtack series of nuclear test shots in the Pacific, scheduled for 1958. To support ground-launched tests, SNL created a rocket launch capability in Area 9 (including Station 9, but with additional facilities), northeast of the main target at TTR. The facilities

[5] In later years, stations had concrete pads to place mobile Contraves cinetheodolite units as they were needed for particular tests. The early years of testing did not enjoy such flexibility.

constructed by REECo during the summer of 1957 included two rocket launchers, an assembly building, a control bunker, and various camera stands.

Demand for both drop and rocket testing continued after the initial rounds for which the first facilities were built and the site extended its capabilities in response. Planned construction continued—Station 2 received Building 02-01, a tracking telescope and dome, for example. In addition, planning started for new facilities. The AEC approved an expansion and improvement program for the site in early 1959. The USAF also extended the permit for SNL's operations until March 31, 1969. On September 1, 1960, TTR was named Sandia's permanent test range and the Salton Sea Test Base range was closed.

The range expansion was swift and extensive. Additional tracking and data capture stations were added along the line of flight to the target, support facilities at the Control Point were expanded, the weather station at the Control Point was moved to the west side of the range, and a Control Tower was added. The target impact area on Pork Lake was supplemented with a concrete hard target.

In 1960, the Askania phototheodolites were replaced with Contraves phototheodolites. Three of the four Askania towers were removed, leaving the tower at Station 2 (Building 02-00), which received new instrumentation. New towers were built at additional stations for the new Contraves instruments, providing a larger ring of data capture opportunities along the flight path and the Pork Lake target.

TTR planned to add 8 towers—five 20' tall and three 30' tall (Figures 8 and 10). Later, additional targets were placed on the lakebeds further south in the valley, offering additional test configuration opportunities. The towers held protective domes that opened in the direction of the target. The Contraves was placed inside the dome (Figure 8). The new Contraves tower at Station 22 (Building 22-00) was part of and represents the early expansion of stations at the range. Station 22 is south of the main control point in Area 3 (Figures 4 and 5).

As originally manufactured, the Contraves required two individuals to operate each unit. SNL modified the design for operation with a single control stick. The Contraves phototheodolited used 35mm film, each numbered frame capturing a coded time record and the azimuth and elevation angles of the object being tracked. The Contraves' locations were known, so the photographic record from two or more of them allowed for the calculation of the location of an object at any specific time.

Beginning in 1969, TTR moved to introduce mobile Contraves units to its arsenal of tracking and data capture instrumentation. The first pad for a mobile unit was poured at Station 37 in 1969 and the first mobile Contraves cinetheodolite—a

Model C—was assembled at TTR in 1970. TTR purchased the Model F Contraves ca. 1980 and installed them in the mobile trailers after that. Over time, the mobile Contraves lifting mechanisms, trailers, and pads have been redesigned and renovated.

Station 22 has a mobile Contraves pad and the tower identified as Building 22-00 is no longer used in tracking and data collection (NV-XXXX-5). Its instrumentation has been removed (there is no longer a Contraves unit on top of the tower), as has the protective dome, although the base supporting the dome remains. The tower is not maintained as there is no expectation that it will be brought back into service (Figure 7).

Part II. ARCHITECTURAL INFORMATION

A. General Statement:

1. Architectural character:
Building 22-00 is a steel tower structure resting on a concrete foundation at Station 22 (NV-XXXX-1, NV-XXXX-2; Figure 7). It is a simple design with no occupied interior space. Its core is a poured reinforced concrete pedestal that tapers slightly to the top (Figure 3). The outside shell is steel. A steel spiral staircase with a metal handrail winds to the top on the exterior of the tower's south side (NV-XXXX-2; Figure 9). There is a steel platform extending halfway around the top (NV-XXXX-1). The tower top has mounts for the theodolite instrumentation, which is not extant (NV-XXXX-8, NV-XXXX-9). A small metal elevator tower rests on its own concrete pad on the side of the tower to raise equipment to the top (NV-XXXX-6, NV-XXXX-7).

2. Condition of fabric:
Poor.

B. Description of Exterior:

1. Overall dimensions:
The tower is 20' tall and 12' in diameter. A concrete pad extends around its south side and a metal spiral staircase with a metal handrail rises from the pad to the top; the center pole of the staircase is 4' from the tower's outer wall. A steel pedestrian access platform extends from the south half of the tower top and the staircase lands on it (NV-XXXX-1). On the top of the tower, the metal base for the original protective dome remains—it is a steel wall approximately 3' 6" tall. The protective dome is no longer in place and its base is open on top (NV-XXXX-9). The metal mounting pieces for the Contraves phototheodolite are on the tower top inside of the dome base. The Contraves has been removed.

2. Foundations:
The steel outer shell of the tower rests on concrete footings extending 3' 6" below ground. The 7' diameter inner concrete pedestal supporting the tower extends 6' below ground then widens to 10' in diameter for an additional 1', forming a broad footing for the tower. (Figure 3)

3. Walls:
The exterior of the steel outer shell of the tower is painted white. (Figure 7)

4. Structural system, framing:

The outer shell of the tower is steel. The pedestal on which the Contraves was mounted at the top of the tower rises from 7' below ground to the tower top 20' above grade. It is 7' in diameter at ground level, tapering to 4' 2" in diameter at the top. It is reinforced concrete.

5. **Porches, stoops, balconies, porticoes, bulkheads**:
A steel pedestrian platform with a handrail curves around the south half of the tower top (NV-XXXX-1). It extends approximately 4' beyond the edge of the tower. The spiral staircase opens to it and it allows access to the Contraves dome (NV-XXXX-2). The top side of the platform is finished with Diamond Plate hatched metal flooring (NV-XXXX-8).

6. **Stairways:**
There is one external spiral staircase rising from the concrete pad at the base to the metal flooring on top of the tower (NV-XXXX-1, NV-XXXX-11). The center post of the staircase is 4’ from the side of the tower and attached to it by metal braces. A metal handrail is attached on the outer edge of the stairs. The treads are flat metal and mounted to the center post on the inner edge and to a ribbon of metal on the outer edge (NV-XXXX-11, Figure 9).

7. **Chimneys:**
The building does not have a chimney.

8. **Openings:**
Doorways and doors:
There is one smooth, slightly curved (to match the curve of the tower’s outer wall) metal door on the tower’s south side (NV-XXXX-1, NV-XXXX-11). The lower edge of the door is above grade, creating a lip for a pedestrian to step over into the interior.

There is a hatch in the side of the base of the protective dome on top of the tower (NV-XXXX-8). The protective dome was manufactured by Houston Fearless (NV-XXXX-10). The hatch provided access to the Contraves’ equipment within the dome. The dome itself has been removed.

Windows and shutters:
There are no windows in Building 22-00.

9. **Roof:**
The tower is topped by a steel platform on which the base of the protective dome rests. A steel pedestrian platform also extends 4' from the south side of the tower.

C. Description of Interior:

1. Stairways:

Metal rungs form a ladder up the interior of the steel outer wall of the tower (NV-XXXX-13).

2. Flooring:

The steel outer wall of the tower is bolted to the concrete base, which forms the floor area between the outer wall and the concrete pedestal supporting the tower (NV-XXXX-12).

3. Wall and ceiling finish:

The interior wall of the tower's outer steel shell is painted white and is not otherwise finished. The concrete pedestal in the interior is smooth, but unpainted. (NV-XXXX-12)

The ceiling is the underside of the metal tower top. It is unfinished.

4. Openings:

Doorways and doors:

The tower has no interior doors.

Windows:

There are no interior windows in Building 22-00.

5. Decorative features and trim:

The Contraves Tower is utilitarian in design and displays no trim or other features that serve only a decorative purpose. However, the spiral staircase and the light fixture on the tower top reflect a deliberately pleasing aesthetic. (NV-XXXX-1, NV-XXXX-2)

6. Hardware:

The three metal flap hinges on the tower's door are left-hand reverse. The door latch is a flat metal hasp.

7. Mechanical Equipment:

Heating, air conditioning, ventilation:

The tower's interior is ventilated by a mechanical blower attached near the top on the exterior (NV-XXXX-5) and louvers near the ground (NV-XXXX-11, NV-XXXX-12).

Lighting:

The interior light is a single bulb in a metal fixture mounted to the wall inside of the door and controlled by a light switch to the left of the door (NV-XXXX-12).

The exterior light is mounted on a post extended from the top of the center post of the spiral staircase. It is a single bulb in a curved metal fixture. (NV-XXXX-2)

Plumbing:
The tower does not have a water supply.

8. **Original Furnishings:**
The tower does not have furnishings beyond the equipment to operate the Contraves and the Contraves itself. The Contraves is no longer in place.

9. **Description of Equipment:**
The Contraves phototheodolite was removed from the top of the tower at an earlier date. The mount for the protective dome equipment cover and the mount for the phototheodolite remain (NV-XXXX-9).

A small steel elevator tower rests on its own concrete pad on the west side of the tower to raise equipment to the top. Powered by a Vickers motor, a small platform holding a metal box rises to the top of the elevator tower, level with the pedestrian platform at the top of the Contraves Tower (NV-XXXX-3, NV-XXXX-6, Figure 7).

D. Site:

1. **Historic landscape design:**
There is no historic landscape design associated with the test facilities at TTR in general or Building 22-00 specifically. The area immediately around the tower and the mobile Contraves pad was cleared, although vegetation has pushed through (Figures 4 and 7). Beyond the cleared area, the landscape is native vegetation (NV-XXXX-3, NV-XXXX-5).

2. **Outbuildings:**
A small steel elevator tower rests on its own concrete pad on the northeast side of the tower to raise equipment to the top. (NV-XXXX-2, NV-XXXX-3, NV-XXXX-6)

There is also a mobile Contraves concrete pad to the southeast of the tower. The pad is a concrete rectangle with metal grooved plates on the north and south sides to hold the tires of the mobile tracking unit and an open rectangular section in the center that holds a triangular concrete frame with metal mounting hooks for the cinetheodolite base (NV-XXXX-5, Figure 11). A mobile Contraves tracking cinetheodolite unit is moved onto the pad during tests (NV-XXXX-2, NV-XXXX-14).

Part III. SOURCES OF INFORMATION

A. Architectural Drawings: Architectural drawings are held in the SNL Facilities Library, with copies at TTR.

"Concrete Target & Miscellaneous Construction, Tonopah Test Range, Contraves Camera Tower Plans & Details," NTS-AG-12/26, Sheet 12 of 26, 1959.

"Foundation, Contraves Installation," SK-07-09-86, Sheet 1 of 1, 1969.

B. Early Views:
Early photographs were located and used as figures in this report.

C. Interviews:
Although there were several discussions with current TTR staff regarding the Contraves towers, Station 22, and the various tracking and data collection activities related to testing at the range, no formal interviews were recorded.

D. Bibliography:

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Ullrich, Rebecca, Jayne Aaron, and Judy Berryman. *Historic Building Survey: Sandia National Laboratories' Tonopah Test Range, Nye County, Nevada. Volume II: Survey and Historic Resource Inventory Forms.* SAND2005-5109P. Albuquerque: Sandia National Laboratories, 2005.

Ullrich, Rebecca A., Michael Anne Sullivan, Cynthia Martin, and Dick Gerdes. *Sandia in the Cold War and Post-Cold War Periods: A Statement of Historic Context for Sandia National Laboratories/New Mexico.* SAND2010-4971P. Albuquerque: Sandia National Laboratories, 2010.

Westwick, Peter. *The National Labs: Science in an American System, 1947-1974.* Cambridge: Harvard University Press, 2003.

E. Likely Sources Not Yet Investigated:

The literature on the history of theodolites, phototheodolites, cinetheodolites, and the Askania and Contraves companies was not fully investigated for this report. More information is available on these topics.

F. Supplemental Material:

None.

Part IV. PROJECT INFORMATION

This report was prepared by Rebecca Ullrich of the Sandia National Laboratories[6] Corporate Archives and History Program.

In 2005, SNL completed a historic building survey and assessment of TTR and recommended that 59 buildings—including Building 22-00—be included in a historic district. In 2011, DOE/NNSA/SFO completed consultation with SHPO regarding the historic significance and eligibility of the Sandia National Laboratories Tonopah Test Range Historic District for the National Register of Historic Places. During consultation, SHPO recommended one additional building be added to the proposed historic district. DOE determined that sixty buildings located at SNL's Tonopah Test Range were eligible as a district based on the Secretary of the Interior's Criteria for Eligibility. Building 22-00 was one of the buildings identified as part of the district and is a contributing element to it.

Large- and medium-format photographs of the contributing elements within the district were taken by SNL photographers Jim Galli, Joseph M. Bonaguidi, and William Suderman. Jim Galli, Jerry Elliston, and Jerry McCorkle provided insight into the TTR station layout and Contraves operations. Myra O'Canna, SNL Corporate Archivist, provided research advice, access to relevant collections, and copies of historical photographs. Joe Bonaguidi, Joanna Eckstein, and Jessica Small of the SNL NEPA Program oversaw the project.

[6] Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC., a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

Figure 1 USGS 1:100,000 Topo Map.
USGS TOPO MAP MARKED TO INDICATE CONTRIBUTING ELEMENTS WITHIN THE SANDIA NATIONAL LABORATORIES TONOPAH TEST RANGE HISTORIC DISTRICT, INCLUDING STATION 22 AND BUILDING 22-00

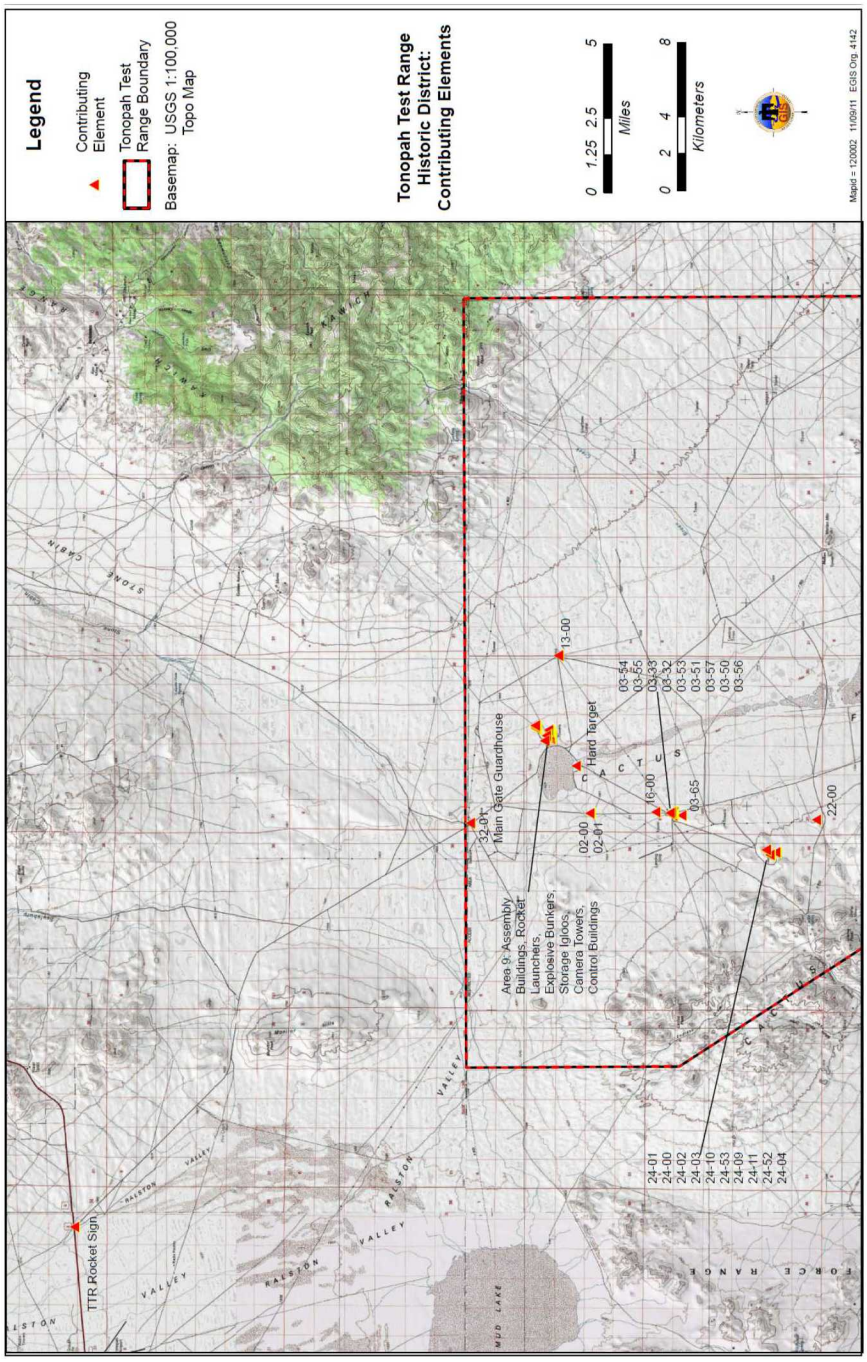


Figure 2 USGS 1:24,000 Topo Map.
USGS TOPO MAP MARKED TO INDICATE CONTRIBUTING ELEMENTS WITHIN THE SANDIA NATIONAL LABORATORIES TONOPAH TEST RANGE HISTORIC DISTRICT; NORTH PORTION OF TONOPAH TEST RANGE; INCLUDING STATION 22, WITH BUILDING 22-00

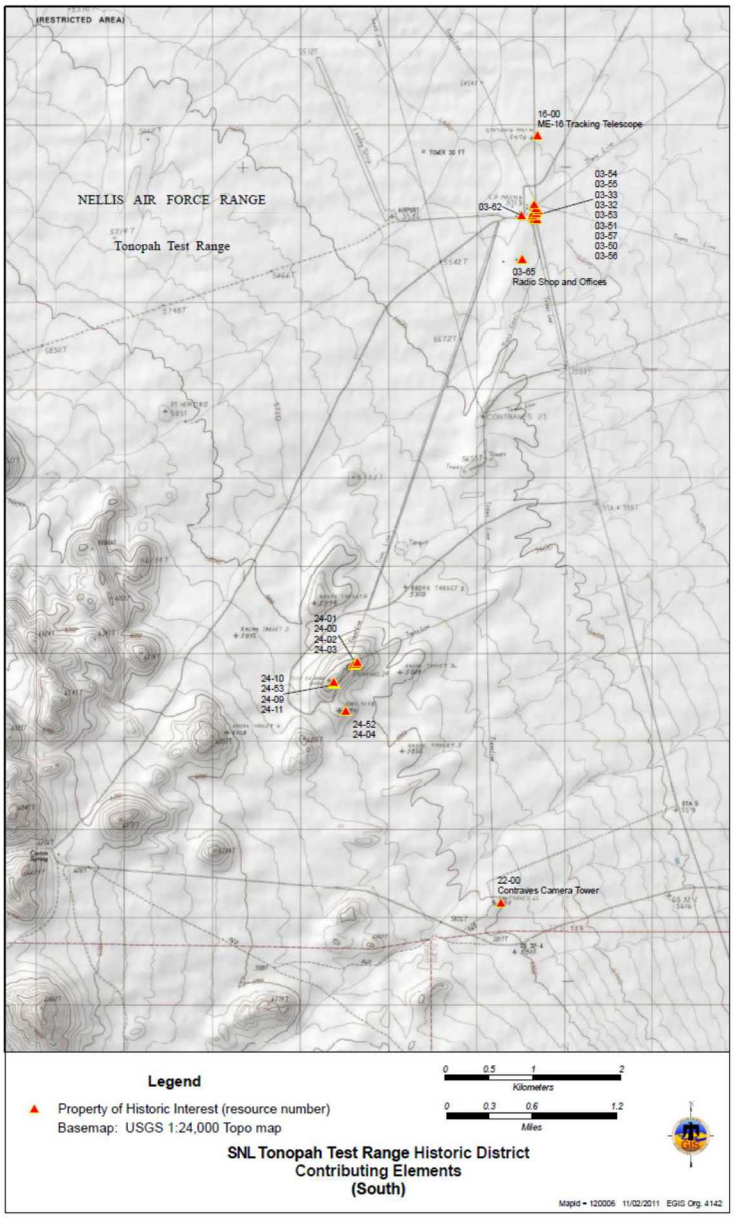


Figure 3 Kenneth S. Clark and Philippe Register, Architect—Engineer, "Concrete Target & Miscellaneous Construction, Tonopah Test Range, Contraves Camera Tower Plans & Details," NTS-AG-12/26, 1959.

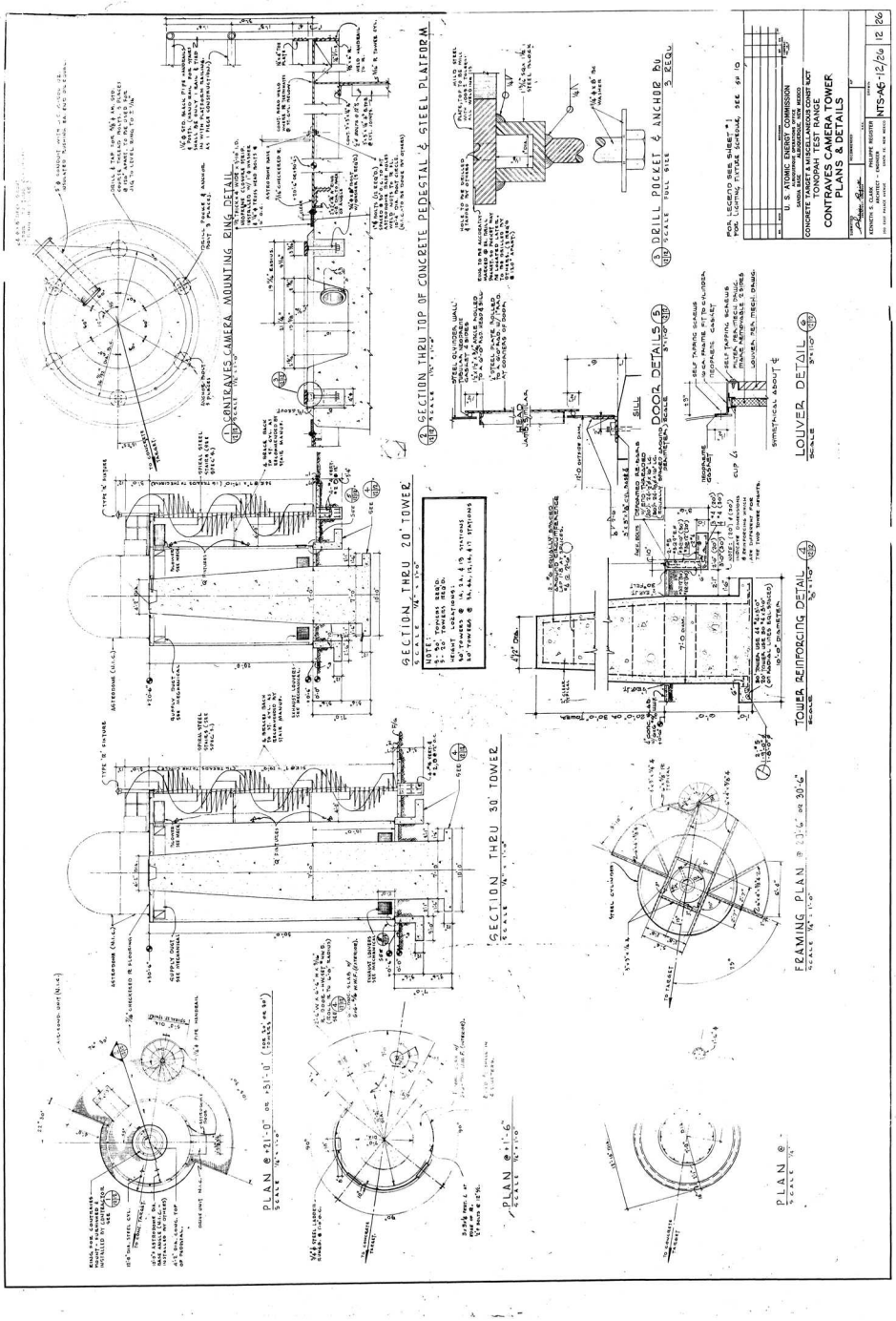


Figure 4 Photographer unknown. Ca. 1964
STATION 22, CONTRAVES TOWER, BUILDING 22-00; AERIAL VIEW OF STATION SHOWING CONTRAVES TOWER AND TWO MOVABLE SUPPORT SHEDS; CONCRETE PAD EXTENDING AROUND SOUTH HALF OF BUILDING IS CLEARLY VISIBLE

Figure 5 Sandia Corporation, *Tonopah Test Range,* brochure (Albuquerque, New Mexico: Sandia Corporation, 1966), 7-8.
RANGE LOCATION AND FACILITIES; LAYOUT OF STATIONS AT TONOPAH TEST RANGE IN 1966

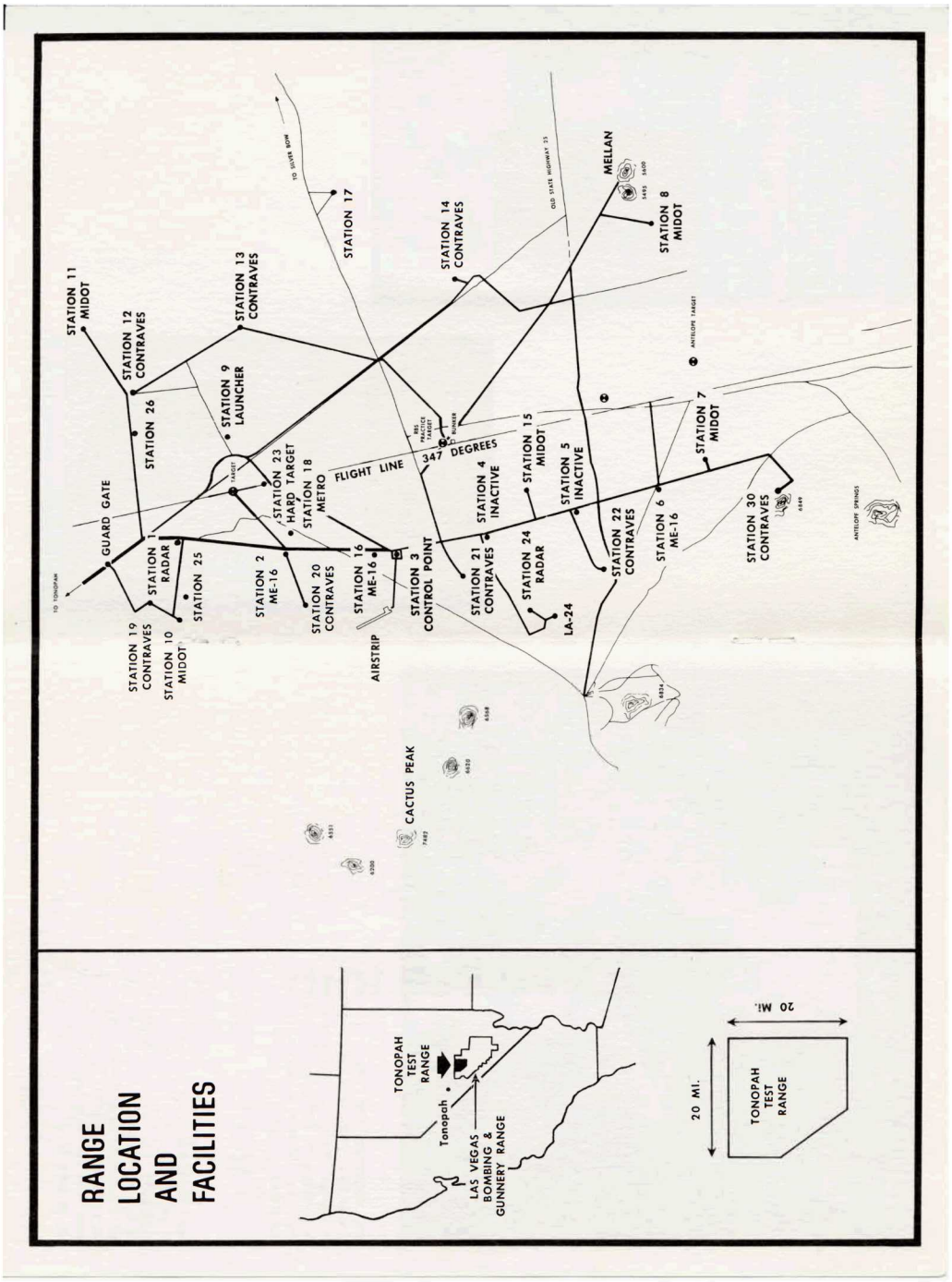


Figure 6 Tonopah Test Range, "Figure 1-1, Typical Tracking Range," *Field Test Series: Operation and Maintenance Instructions ME-16 Tracking Telescope* (Albuquerque, New Mexico: Sandia Laboratories, June 1973), p. 1-2.

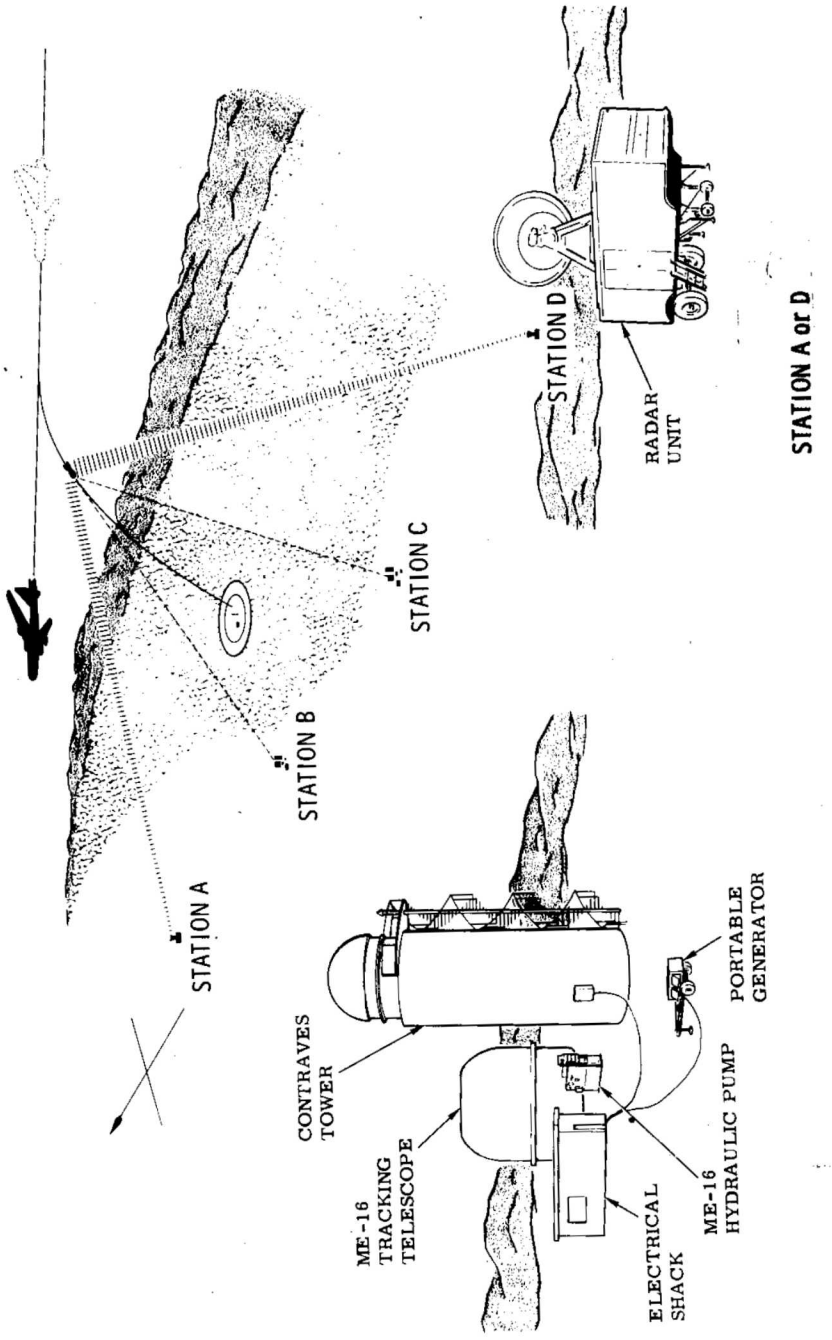


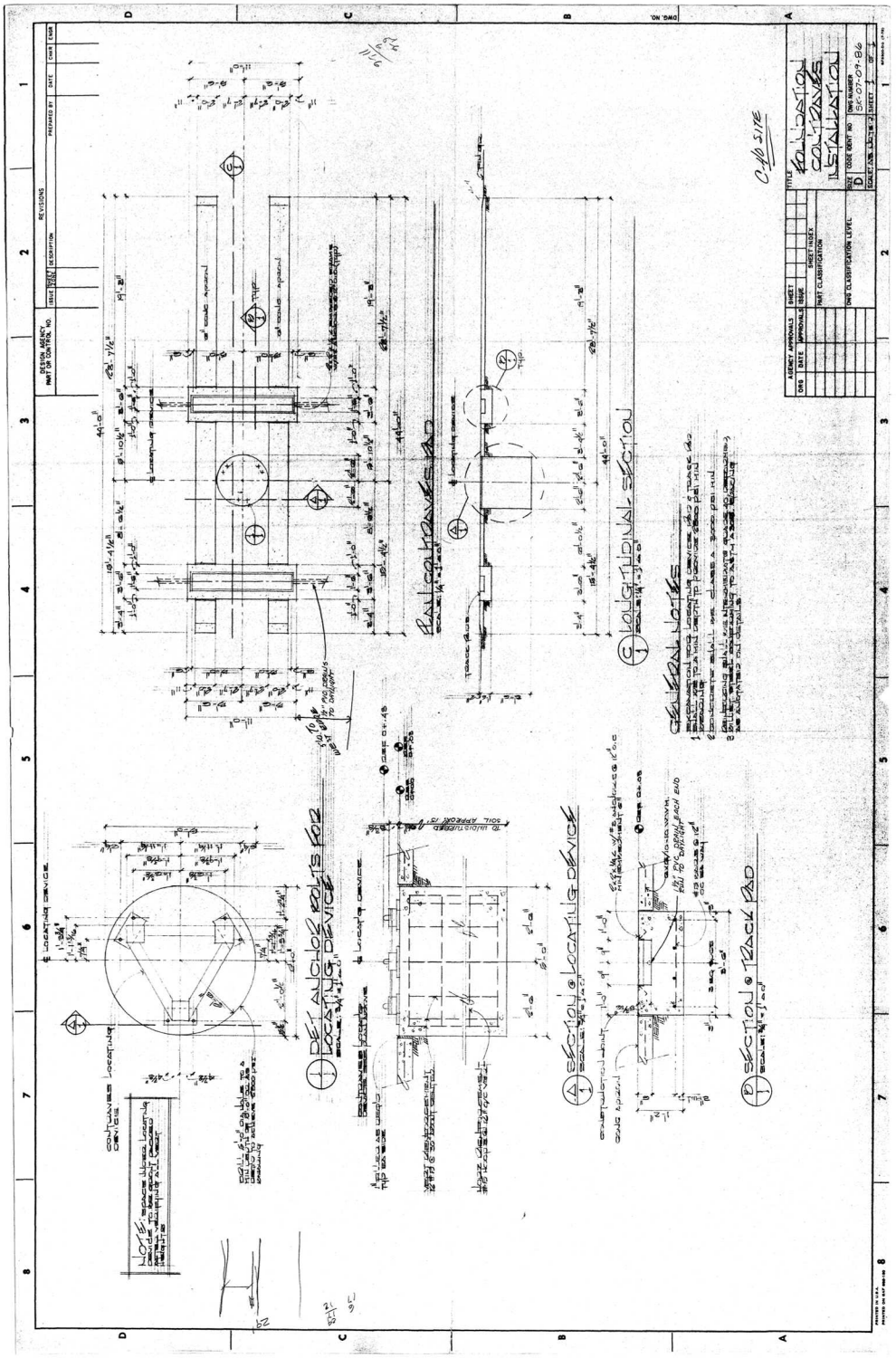
Figure 7 Clair Blackburn, Photographer. 2009.
STATION 22 CONTRAVES TOWER, BUILDING 22-00; EXTERIOR;
SMALL ELEVATOR TOWER ON PAD WITH GENERATOR;
CIRCULAR STAIRWAY; VIEW FROM WEST

Figure 8 Photographer unknown. Ca. 1960.
INSTALLATION OF CAMERA AT A NEW 20' CONTRAVES TOWER

Figure 9 Harley D. Moody, "Tonopah Test Range: Sandia Corporation Board of Directors Tour, September 14, 1960," booklet of photographs (Tonopah, Nevada: Tonopah Test Range, 1960), p. 23.
SPIRAL STAIRCASE ON A 30' CONTRAVES TOWER, 1960

Figure 10 Harley Moody, Photographer. 1960.
30' CONTRAVES TOWER WITH VISITORS ON TOP LEVEL; NEW CONSTRUCTION, 1960

Figure 11 "Foundation, Contraves Installation," SK-07-09-86, Sheet 1 of 1, 1969.



HISTORIC AMERICAN ENGINEERING RECORD

INDEX TO PHOTOGRAPHS

SANDIA NATIONAL LABORATORIES
TONOPAH TEST RANGE
FIXED CONTRAVES TOWER
(BUILDING 22-00)
Station 22
Tonopah Test Range
Nye County
Nevada

Jim Galli, Photographer; July 15, 2004.

NV-XXXX-1 BUILDING 22-00, FIXED CONTRAVES TOWER, EXTERIOR; SOUTH SIDE OF TOWER; CONCRETE PAD AT BASE OF METAL SPIRAL STAIRWAY WITH METAL HANDRAIL; PLATFORM ON TOP OF TOWER; SERVICE ELEVATOR ON WEST SIDE OF TOWER; VIEW FROM SOUTH

NV-XXXX-2 BUILDING 22-00, FIXED CONTRAVES TOWER, EXTERIOR; WEST SIDE WITH SERVICE ELEVATOR; MODERN MOBIL CONTRAVES (MC 8) IN RIGHT BACKGROUND; VIEW FROM WEST

NV-XXXX-3 BUILDING 22-00, FIXED CONTRAVES TOWER, EXTERIOR; NORTH SIDE OF TOWER WITH ELEVATOR STRUCTURE TO RIGHT (WEST); BASE OF PROTECTIVE DOME RISING FROM TOWER TOP; VIEW FROM NORTH

NV-XXXX-4 BUILDING 22-00, FIXED CONTRAVES TOWER, EXTERIOR; EAST SIDE OF TOWER; SPIRAL STAIRCASE WINDING AROUND CENTER POLE WITH LIGHT ATTACHED; VENTILATION UNITS ATTACHED TO TOWER; PLATFORM EXTENDING FROM SOUTH HALF OF TOWER TOP; BASE OF PROTECTIVE DOME RISING FROM TOWER TOP; VIEW FROM EAST

NV-XXXX-5 BUILDING 22-00, FIXED CONTRAVES TOWER, EXTERIOR; EAST SIDE OF TOWER; CONCRETE FOUNDTION OF TOWER AND POURED CONCRETE PAD FOR STAIRCASE; PLATFORM EXTENDING FROM SOUTH HALF OF TOWER TOP; BASE OF PROTECTIVE DOME RISING FROM TOWER TOP; THREE-POINT CONTRAVES MOUNT FOR MODERN MOBILE UNIT IN FOREGROUND; VIEW FROM EAST

NV-XXXX-6 BUILDING 22-00, FIXED CONTRAVES TOWER, EXTERIOR; UNDER SIDE OF PLATFORM EXTENDING FROM TOWER TOP IS VISIBLE; SERVICE ELEVATOR DETAIL; GENERATOR AND PULLEY HOOK-UP AT BASE; VIEW FROM NORTHEAST

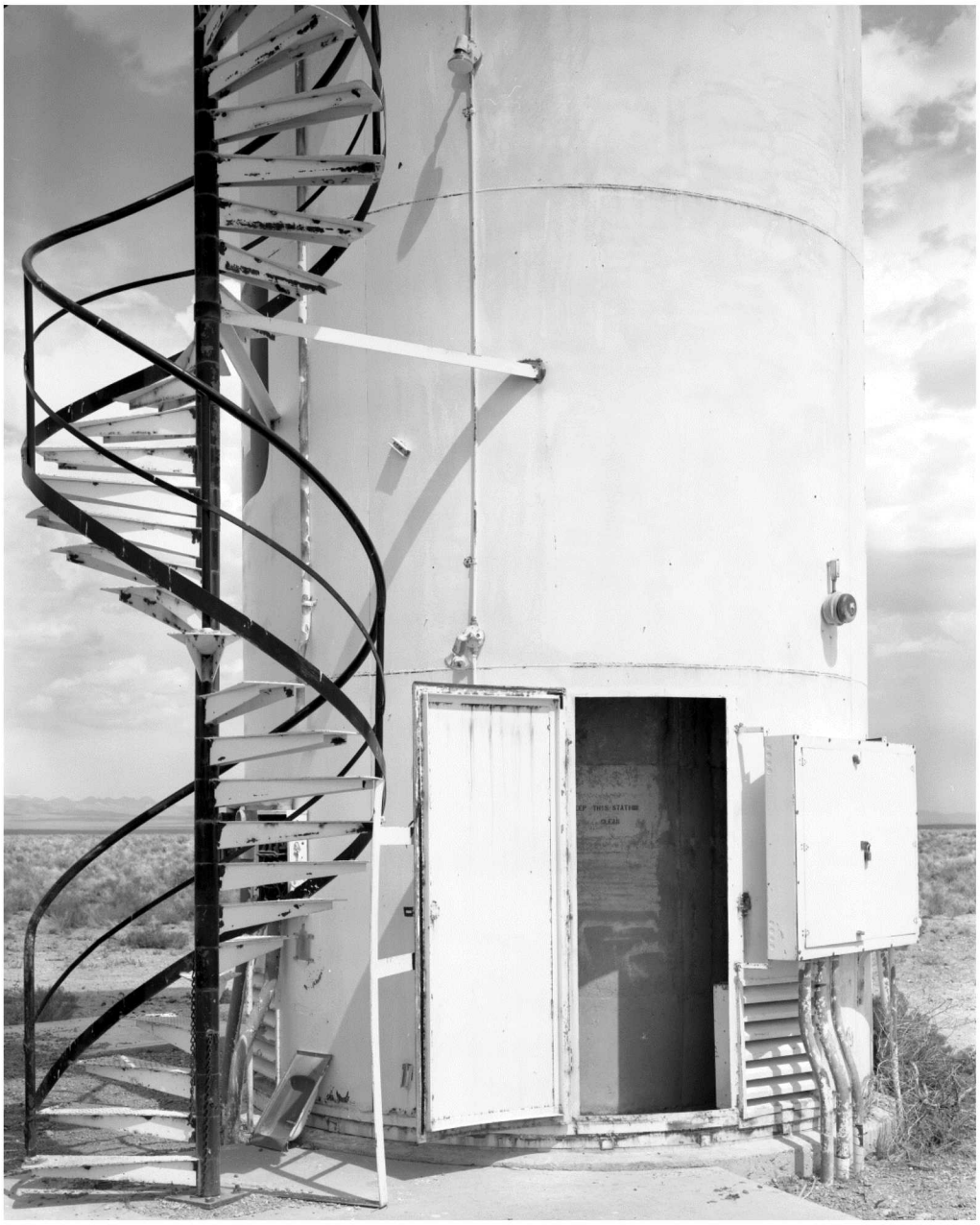
NV-XXXX-7 BUILDING 22-00, FIXED CONTRAVES TOWER, EXTERIOR; SOUTH SIDE OF SERVICE ELEVATOR; VIEW FROM SOUTHEAST

NV-XXXX-8 BUILDING 22-00, FIXED CONTRAVES TOWER, EXTERIOR; TOP OF TOWER; STEEL DECK WITH DIAMOND PLATE HATCHED METAL FLOORING AND HANDRAIL; BASE OF PROTECTIVE DOME THAT HOUSED CONTRAVES; HATCH ON BASE OF DOME PROVIDING ACCESS TO CONTRAVES AND EQUIPMENT; VIEW FROM EAST

NV-XXXX-9 BUILDING 22-00, FIXED CONTRAVES TOWER, EXTERIOR; TOP OF TOWER; INTERIOR OF CENTER SECTION WHERE CONTRAVES AND DOME FORMERLY MOUNTED; VIEW FROM WEST

NV-XXXX-10 BUILDING 22-00, FIXED CONTRAVES TOWER, EXTERIOR; TOP OF TOWER; BASE OF PROTECTIVE DOME; DETAIL OF SIGNS ON HATCH IN SIDE OF BASE OF PROTECTIVE DOME; VIEW FROM SOUTH

NV-XXXX-11 BUILDING 22-00, FIXED CONTRAVES TOWER, EXTERIOR; PEDESTRIAN DOOR AT BASE OF TOWER (SOUTH SIDE); STEEL DOOR OPENING TO CONCRETE COLUMN FORMING PEDESTAL FOR CONTRAVES; VIEW FROM SOUTHWEST



NV-XXXX-12 BUILDING 22-00, FIXED CONTRAVES TOWER, INTERIOR; ELECTRICAL BOXES MOUNTED ON STEEL EXTERIOR WALL; CONCRETE COLUMN THAT FORMS PEDESTAL FOR CONTRAVES ON RIGHT; VIEW FROM SOUTHEAST

NV-XXXX-13 BUILDING 22-00, FIXED CONTRAVES TOWER, INTERIOR; CONCRETE COLUMN FORMING PEDESTAL FOR CONTRAVES; STEEL OUTER WALL WITH METAL CLIMBING RUNGS MOUNTED ON INTERIOR; VIEW FROM SOUTH

NV-XXXX-14 BUILDING 22-00, FIXED CONTRAVES TOWER, EXTERIOR; MODERN MOBILE CONTRAVES NEXT TO OLDER FIXED CONTRAVES TOWER; VIEW FROM SOUTH