HAER No. NV-32-A

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Nevada Test Site, Pluto Facility, Disassembly Building
(Building No. 2201)
Area 26, Wahmonie Flat
Cane Spring Road
Mercury Vicinity
Nye County
Nevada

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

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

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HISTORIC AMERICAN ENGINEERING RECORD
NEVADA TEST SITE, PLUTO FACILITY, DISASSEMBLY BUILDING 2201
HAER NO. NV-32-A

Location: Cane Spring Road, Wahmonie Flat, Area 26, Nevada Test Site, Mercury Vicinity, Nye County, Nevada

USGS Skull Mountain 7.5' (1983)
UTM Coordinates Zone 11 E 574,540 N 4,074,620

Dates of Construction: 1960

Engineer: Burns and McDonnell Engineering Company, Kansas City, Missouri

Builder: J.A. Tiberti Construction Company, Las Vegas, Nevada

Present Owner: Department of Energy, Nevada Operations Office
P.O. Box 98518, Las Vegas, NV 89193-8518

Present Occupant: Not occupied

Present Use: Vacant; no public access; to be demolished

Significance: Building 2201 is significant for its role in the scientific experiments associated with the Pluto program at the Nevada Test Site in the development and testing of a nuclear reactor for a ramjet propulsion system, an important military goal involving the feasibility and applicability of nuclear-propelled low-altitude missiles in the national defense of the United States. It was one of three related facilities and it primarily served for disassembling the reactors after being tested so as to be able to study the components and improve on them.

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I. CONTEXTUAL INFORMATION

The Pluto Disassembly Building 2201 facility is in Area 26 of the Nevada Test Site (NTS) (Figure 1) administered originally by the Atomic Energy Commission (AEC) and later by the Department of Energy, Nevada Operations Office (DOE/NV). It is reached by traveling north from the town of Mercury along the Mercury Highway, over the Checkpoint Pass and into Frenchman Flat, turning west at the Cane Spring Road turnoff, passing Cane Spring and through Wahmonie Flat to a turnoff to the north for the historic mining town of Wahmonie and Building 2201. All roads are paved. The setting is at the eastern edge of Jackass Flats and the western edge of Wahmonie Flat, two open valleys at the northern extent of the Mohave Desert. The building is at an elevation of 4,400 ft (1,341 m) on an alluvial fan at the south base of Lookout Peak in the Mine Mountain range. Lookout Peak is at an elevation of 5,650 ft (1,722 m). Skull Mountain is across the valley to the south and reaches an elevation of almost 6,000 ft (1,829 m). The natural ground surface around the building is characterized by mostly sand and gravel with various size cobbles.

Surrounding vegetation is interspersed, typical of a desert setting, and includes creosote bush (*Larrea tridentata*), shadscale (*Atriplex conifertifolia*), Mormon tea (*Ephedra viridis*), blackbrush (*Coleogyne ramosissima*), bladder pod (*Salazaria mexicana*), buckwheat (*Eriogonum* spp.), ratany (*Krameria parvifolia*), bur-sage (*Ambrosia dumosa*), winterfat (*Ceratoides lanata*), Russian thistle (*Salsola kali*), cheat grass (*Bromus* spp.), rice grass (*Oryzopsis hymenoides*), and other unidentified grasses. In the area are kit fox, desert tortoise, western shovelnose snake, the sidewinder snake, speckled rattlesnake, gopher snake, coyote, bobcat, raven, red-tailed hawk, black-tailed jackrabbit, desert and Nuttall's cottontail, long-tailed pocket mouse, kangaroo rat, desert woodrat, white-tailed antelope squirrel, black-throated sparrow, horned lark, Say's phoebe, western kingbird, loggerhead shrike, chuckwalla, side-blotched lizard, and desert horned lizard. Other animals in the region include mountain lion, chukar, Gambel's quail, morning dove, golden eagle, and occasionally, bighorn sheep and antelope. The nearest natural perennial water source is Cane Spring about 7.7 km (4.8 miles) to the east; however, drilled wells were the sources of water supply for the modern NTS facilities and the springs were not relied upon for dependable and potable water.

The Pluto Disassembly Building 2201 facility was originally recorded during a cultural resources reconnaissance for the Reentry Body Impact Fuze Flights (RBIFF) project (Jones et al. 1996). It was considered a recent component of a much larger cultural resource, site 26NY9843. Other components of site 26NY9843 were a small and diffuse prehistoric lithic artifact scatter, consisting of a few flakes, and the abandoned historic mining town of Wahmonie dating to the late 1920s. The history of Wahmonie spans only a few years and is typical of the boom-and-bust cycle of the mining industry in the western region of the United States. Prospecting in the Wahmonie area began as early as 1905, but the infamous mining boom did not occur until more than twenty years later when in February of 1928 the mining camp of Wahmonie was organized (McLane 1995; Paher 1970:322). It soon grew to a small town with boarding houses, tent stores, and cafes. The Silver Dollar Saloon and the Northern Club were but two of the enterprises (Long 1950:103). Most of the miners lived in small tents. By March of 1928, 1,350 claims had been staked within five miles of the original strike and the population had grown to 500, and by June, 1,451 claims had been filed in the district and the population varied between 500 and 1,500 (McLane 1995). George Wingfield, a local mine owner and banker, became interested and purchased a portion of the original claim and incorporated the Wahmonie Mining Company. Soon, however, the strike was apparently not as rich as had first been thought and by early 1929 optimism faded and people began leaving Wahmonie. Prospecting in the Wahmonie district continued into the 1930s and 1940s, but few ore deposits were ever discovered. The Pluto Disassembly Building 2201 facility was constructed on a portion of the abandoned townsite.

The Pluto complex in Area 26 (originally Area 401) of the NTS consisted of three facilities and included the Control Building and Assembly Area, the Test Area, and Disassembly Building 2201 (Figures 2 and 3). The Pluto program was managed by the University of California Radiation Laboratory (UCRL), Livermore, California (now the Lawrence Livermore National Laboratory) with an objective to develop nuclear-propelled missiles for the Department of Defense. Although having a slightly different mission and being relatively smaller (Jones et al. 1996), Building 2201 is similar in construction to the Engine and the Reactor Maintenance and Disassembly buildings in Area 25 employed in the Rover program for the development of nuclear-propelled rockets for the space program (Beck et al. 1996; Drollinger et al. 1997, 2000). A notable feature of these massive multi-room structures is the reinforced concrete walls five to six feet thick surrounding the hot bays where nuclear reactors were disassembled after being tested. Disassembly Building 2201 has had limited use since the Pluto program ended in 1964. In 1998 and 1999 the control room of the building was used in a conventional rocket launch program, and at other times, it and the other Pluto facilities have been used in radiological training exercises. Building 2201 has been determined eligible to the National Register of Historic Places through consultation between DOE/NV and the Nevada State Historic Preservation Office and is currently slated to be demolished under the Environmental Management Deactivation and Decommissioning Program.

II. ARCHITECTURAL AND ENGINEERING INFORMATION

Construction of the testing facilities at the NTS in Area 26 for the Pluto project occurred in several phases, beginning with roads and water service in 1957 (AEC 1958:1) and shortly thereafter by the first phase of building construction in 1958 with the Control Building, the Hot Critical Test Facility (also known as the Hot Box), and the Assembly and Shop Building (AEC 1963:2). Burns and McDonnell Engineering Company of Kansas City, Missouri designed the original Pluto facilities and J.A. Tiberti Construction Company of Las Vegas, Nevada was the primary builder (AEC 1958:6). In 1960, new construction at the Pluto facilities included the Disassembly Building (Building 2201) and the Test Bunker, as well as 18,000 feet of pipe for the compressed air tank farm, an air heater and furnace, a railroad spur, and a compressor house. Construction in 1961 included another 33,000 feet of pipe, and in early 1962, 81,000 feet of pipe, an air heating system furnace, and a 4,000 pound air compressor. Diversified Builders, Inc. and Industrial Contractors, Inc. of Paramount, California were awarded the contract to expand and modify the Pluto facilities. Norman Engineering Company of Los Angeles was the architect-engineering firm for the new work (AEC 1962:158).

The Disassembly Building 2201 facility included, besides the main building (Photographs NV-32-1 and NV-32-A-1), a fenced compound surrounding the building, a guardhouse (Photograph NV-32-B-1), brock houses (Photographs NV-32-C-1 and NV-32-2), miscellaneous equipment (Photographs NV-32-3 and NV-32-4), a water tower (Photograph NV-32-D-1), and a test car wash stand (Photograph NV-32-E-1). The fenced compound encompasses 1.8 acre (0.7 hectares). The guardhouse is at the southeast corner of the compound near the main entrance gate. It is typical of the guardhouses found at the other facilities, consisting of a one-story wood frame structure, with a flat roof and deep overhangs, and measuring about 9 x 6.7 ft (2.8 x 2 m) and 8.5 ft (2.6 m) high. Walls consist of horizontal siding at the lower portions, with sliding wood sash windows all around. Two plywood sheds on skids, known as brock houses, stand at the eastern edge of the site. These are one-room, one-story structures. One of the brock houses was used to accommodate the water filtering system. Other features within the compound include a power substation at the southwest corner and pumping equipment at the northeast corner. The wash stand is a 50 ft (15 m) long corrugated metal structure, open on two ends, and straddles the railroad tracks by which the test cars were moved between facilities. It is about 550 ft (167 m) east of the Disassembly Building 2201 facility.

Building 2201 occupies the northwest portion of the compound. The building is 167 ft (50.9 m) in length and 143 ft (43.6 m) in width, with a floor space of 11,200 ft^2 (1,041 m^2). It is of the same general construction consisting mostly of reinforced concrete and masonry as the main buildings at the E-MAD and R-MAD facilities in nearby Area 25. Building 2201 is mostly one-story, with irregular massing and a flat roof, with the parts of the building requiring radiation shielding being constructed of solid, reinforced concrete. The building consists of a number of discrete parts (Figure 4): a Cold Assembly Bay (Room 101), Main Disassembly Bay (Room 102), Hot and Warm Cell (Room 104), Kilo-Curie Hot Cell (Room 106), Hot Storage and Packaging Room (Room 107), Control Room (Room 105), Operations Area (Room 108), Warm and Cold Storage Room (Room 109), a personnel area with toilets, showers, and the Radiation Safety Room (Rooms 112 and 115), a dark room, a Cold Storage Room (Room 116), and offices (Room 117). Railroad tracks for transporting the reactor enter the building at both the Main Disassembly Bay and Cold Assembly Bay and extend to the Test Bunker where the reactor was tested.

Main entry to the building is on the south elevation (Photograph NV-32-A-2). The western half of the building, enclosing the Warm and Cold Storage Room, is monolithic concrete. There are no openings in the west half of the elevation, but a metal vent penetrates the center portion of the wall near the top. The eastern half is of concrete masonry units. Openings include the main entry doors, which are two-leaf glazed metal doors accessed by a five-riser flight of stairs, and three aluminum horizontally-sashed projecting windows. Expanded metal lath now covers these windows. The east elevation also features reinforced concrete and masonry unit walls (Photographs NV-32-A-3 and NV-32-A-4). It is dominated by the tall, forward-projecting Hot Storage and Packaging Room mass. The south end is lower, with concrete masonry unit walls and two aluminum windows similar to those on the south elevation and are also covered by metal lath (see Photograph NV-32-A-1). A chain link enclosed ramp ascends to a glazed metal door accessing this storage room. Three large equipment doors are also present; the most notable of these is near the center of the elevation, accessing the Main Disassembly Bay. This door is a thick concrete assembly with steel pulleys mounted above. A plywood temporary structure, 16 ft (4.9 m) wide by 60 ft (18.3 m) long, abuts the north side of the Hot Storage and Packaging Room mass. Both the north and west elevations are monolithic windowless planes (Photographs NV-32-A-5 to NV-32-A-8). Two single-leaf glazed metal doors access the Cold Assembly Bay on the north elevation, while a pair of glazed metal doors access the mechanical equipment room (Room 103).

The building interior is of two levels, dominated by the Main Disassembly Bay (Photographs NV-32-A-9 to NV-32-A-12), three small hot bays, including the Hot and Warm Cell (Photograph NV-32-A-13), the Kilo-Curie Hot Cell (Photographs NV-32-A-14 and NV-32-A-15), and the Hot Storage and Packaging Room (Photograph NV-32-A-16), and the Cold Assembly Bay (Photographs NV-32-A-17 to NV-32-A-21) in the lower level. The hot bays have high ceilings and all feature painted concrete walls and ceilings. Floors in the Main Disassembly Bay are painted concrete, while those in the smaller hot bays are linoleum over a built-up platform. Major equipment in these spaces, mostly ceiling-mounted, includes one 15-ton crane, three 7 1/2-ton cranes, four 3,000-pound capacity manipulators, and two master-slave manipulators. Hot cell doors are thick hydraulic units made of concrete, with elaborate operating systems featuring internal piping systems, counterweights, and pulleys. The six viewing windows into the hot cells are made of a 4 ft (1.2 m) thick radiation-shielding glass. Equipment controls for remote handling are mounted around the perimeters of these windows. The lower level also contains a circulation equipment room (Photograph NV-32-A-22).

The main spaces in the upper level of the building are the Control and Operation Rooms (Photographs NV-32-A-23 and NV-32-A-24) next to the hot cells and Main Disassembly Bay, the Warm and Cold Storage Room (Photographs NV-32-A-25 to NV-32-A-27) in the southwest corner of the building, and the Cold Storage Room (Photograph NV-32-A-28) at the southeast corner of the building. The Cold Storage Room also contains extra offices. The control and operation areas (Rooms 105 and 108) are notable for the assortment of 1960s era computers, equipment, and viewing windows into the Main Disassembly Bay and hot cells (Photographs NV-32-A-29 to NV-32-A-33). An entrance hallway (Photographs NV-32-A-34 and NV-32-A-35), a janitorial room (Photograph NV-32-A-36), and toilet and wash rooms (Photographs NV-32-A-37) are also present. These areas feature vinyl asbestos tile floors, painted concrete or concrete masonry unit walls with vinyl base and a painted wainscot, and suspended acoustical ceilings.

A basement, featuring three rooms for equipment and storage (Photographs NV-32-A-38 to NV-32-A-40), extends beneath the southern part of the building and below the upper level. It is accessible by a ramp from the exterior at the southeast corner of the building.

III. HISTORICAL INFORMATION

The concept of nuclear propulsion for rockets and other aircraft was initially discussed in 1944 by personnel at both the Los Alamos Scientific Laboratory (LASL, now the Los Alamos National Laboratory) and the University of Chicago Metallurgical Laboratory (Bussard 1962:169; Bussard and DeLauer 1965:1). Following these discussions, the first serious study dealing with the concept of nuclear propulsion for rockets, aircraft, and missiles, according to Bussard (Bussard 1962:169; Bussard and DeLauer 1965:2), was produced in 1946 as a secret document by personnel at the Applied Physics Laboratory, John Hopkins University. This document summarized the contemporary information about nuclear propulsion and the principles and problems for developing such systems. What was made evident in the document was that little or nothing was known about specific properties of materials in order to build the systems. A second secret document was prepared in 1947 by the Aerophysics Laboratory, North American Aviation Corporation, focusing on nuclear ramjets and rockets of different sizes for military purposes (Bussard 1962:170; Bussard and DeLauer 1965:2).

In 1946, the U.S. Air Force established the Nuclear Energy for Propulsion of Aircraft (NEPA) project at the Oak Ridge National Laboratory, Tennessee for exploring the possibility of low-altitude nuclear aircraft (Bussard and DeLauer 1965:2; Larson 1950:2). Work on this project continued intermittently until 1949 (Bussard 1962:170). The Lexington Project, an ad hoc study group convening in 1948 at the Massachusetts Institute of Technology at the behest of the AEC, determined the least difficult system to develop was the low-altitude nuclear aircraft, followed by the nuclear ramjet for powering missiles, with the nuclear rocket being the most difficult. The NEPA project evolved into an expanded Aircraft Nuclear Propulsion (ANP) program when the U.S. Air Force joined with the AEC to develop the systems, focusing primarily on manned military aircraft (AEC 1956; see Larson 1950). In 1955 the U.S. Navy also became interested and requested a feasibility study for a nuclear-powered seaplane (AEC 1956). The first test linking a turbojet engine for aircraft to nuclear power was successfully carried out in 1956 during the Heat Transfer Reactor Experiments at the National Reactor Testing Station in Idaho (AEC 1960:76; Savage 1961:45). The ANP program was terminated in 1961 by President Kennedy (AEC 1962:155), with few results ever obtained (Bussard and DeLauer 1965:4). In contrast to the earlier beliefs, it was found that a nuclear-propelled low-altitude aircraft was the most difficult of the three systems to develop, due mostly to size constraints and safety considerations.

In the 1950s, an article by Bussard (1953), who was working at the Oak Ridge National Laboratory at the time, on the potentialities of a wide range of missions for nuclear rockets sufficiently influenced the U.S. Air Force to direct, through the AEC, the LASL and UCRL to study the feasibility of linking nuclear power with rockets (AEC 1962:71; Baker 1996:48-49; Bussard 1962:170; Bussard and DeLauer 1965:3; General Advisory Committee 1956:18-24; House 1963). The great appeal of nuclear propulsion, as opposed to chemical propulsion, was its smaller size and greater velocity to enable bigger payloads. Consequently, it was considered more efficient and preferable than chemical systems, particularly in the long and complex journeys for exploring the solar system (see Angelo and Buden 1985:ix; Schreiber 1961:25, 29). In 1955, the Condor committee of the U.S. Air Force Scientific Advisory Board recommended that work was to begin on a nuclear-propelled rocket (Baker 1996:55; House 1963). In 1957, a Rover reactor approach using uranium-loaded graphite fuel was selected as the method to be developed based on the studies by LASL and UCRL (AEC 1962:71). Construction and testing of reactors for rockets was assigned to LASL within the Rover program (AEC 1958; Schreiber 1958:70).

Also in 1957 the task of producing a nuclear reactor for a ramjet engine was assigned to UCRL within the Pluto program, and following U.S. Air Force studies, focused on low-altitude missile application. This type of application had the advantage of being virtually undetectable by radar, and additionally, did not subject service personnel to the radiation hazards as compared with the manned aircraft (see Merkle 1961:38). Ramjets are the simplest type of air-breathing engine (AEC 1963:174), having a continuous inlet of air at their forward end, and compresses or rams the air taken in during flight. As opposed to rockets, ramjets can only be operated in the atmosphere of the earth because of the need for air and was somewhat ideal for the intended applicability in low-altitude missiles. As the air is heated in the engine, it expands and is ejected at a higher velocity than when it entered. A nuclear reactor heating the air produces a propulsion system feasible for long-range use. It was considered that one pound of uranium could produce as much heat as about two million pounds of jet fuel, and thus, the nuclear ramjet missile would have almost unlimited range over the earth at a very low altitude and at high speed and have a much larger payload capability. In contrast, chemically-fueled ramjet engines have the drawback of requiring tremendous fuel consumption, and therefore, are only useful for a limited range. Furthermore, a heavy fuel load and complex combustion system imposed by chemical fuels also greatly limited the range of the missile.

Two nuclear reactors were tested at the NTS as part of the Pluto program. In 1961, Tory II-A, a small, low-power engineering test reactor, demonstrated the program's technical feasibility by successfully performing a series of power runs (AEC 1962:137, 1963:175). The primary objective of these tests was to demonstrate the applicability of linking nuclear power, that is, a nuclear reactor as the basis for propulsion, with a ramjet. Building 2201, constructed in 1960, was primarily designed to remotely adjust components and completely disassemble the Tory II-A nuclear reactor system for study and enable improvements in the components of the system to be made. After disassembly, fuel repackaging and decontamination activities were conducted in the smaller hot cells of the building. Following the successful test of Tory II-A, facilities were added and modified for the Tory II-C experiments. In the spring of 1964, Tory II-C, a full-scale, missile-sized reactor successfully demonstrated the feasibility of incorporating the ramjet engine for low-altitude supersonic flights (AEC 1965:126). The test on May 12 simulated a flight at 10,000 ft (3,048 m) altitude and at Mach 2.8 speed, while a second test on May 20 simulated a flight at sea level also at a speed of Mach 2.8. This reactor, having more power and capable of a higher temperature than the earlier one, was at the proper scale and configuration for actual flight. It was still only an intermediate stage, however, toward a more advanced flyable prototype (AEC 1964:129).

Eventually, it was determined no or little further advantage was to be gained in developing ballistic missiles powered by nuclear engines when compared with the chemically-propelled missiles already developed and operational, and therefore, effort and money for research and development could be spent more effectively elsewhere (Baker 1996:62). The Pluto program ended in 1964 when the Department of Defense decided against a flight test within the program, and consequently, all tests at that time planned for the future were cancelled (AEC 1965:126). Later budget restrictions and changes in national priorities in 1973 led to a termination of all space-oriented nuclear propulsion development efforts and the Rover program for nuclear rockets was phased out as well (AEC 1974:23; Koenig 1986:7). In summary, the significant technological advances made during the time of the Pluto and Rover programs proved the feasibility and applicability of nuclear-propelled vehicles in low-altitude and for outer space travel, and overall, the programs can be considered successful scientific achievements for the United States.

IV. SOURCES

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V. PROJECT INFORMATION

This manuscript has been prepared at the request of the Department of Energy, Nevada Operations Office in response to the management of cultural resources on the Nevada Test Site. It is based on previous investigations conducted by the Desert Research Institute, reported in Cultural Resources Reconnaissance Short Report No. SR102599-1, *An Historical Evaluation of Pluto Building 2201, Area 26, Nevada Test Site, Nye County, Nevada*, 2000 and Cultural Resources Reconnaissance Short Report No. SR121395-2, *A Class III Cultural Resources Reconnaissance of the Proposed Reentry Body Impact Fuze Flights (RBIFF), Area 26, Nevada Test Site, Nye County, Nevada*, 1996. Project Manager and Co-Principal Investigator for this latest effort in the documentation of the facility was Colleen M. Beck of the Desert Research Institute, Las Vegas, Nevada; Harold Drollinger of the Desert Research Institute, Las Vegas, was the second Principal Investigator; Nancy Goldenberg of Carey & Company, Inc. Architects, San Francisco, California was the historic architect; and the photographer was Richard Smith of Bechtel Nevada, Las Vegas.