ROCKET ENGINE TEST FACILITY – OBSERVATION BLOCKHOUSE HAER No. OH-124-E
(Rocket Propulsion Test Facility – Observation Blockhouse)
NASA Glenn Research Center
Cleveland
Cuyahoga County
Ohio

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

REDUCED COPIES OF MEASURED DRAWINGS

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Great Lakes Support Office
1709 Jackson Street
Omaha, Nebraska 68102

February 27, 2003

HISTORIC AMERICAN ENGINEERING RECORD

ROCKET ENGINE TEST FACILITY – GRC OBSERVATION BLOCKHOUSE
(Rocket Propulsion Test Facility – Blockhouse)

HAER No. OH-124-E

Location: NASA – Glenn Research Center
Cleveland
Cuyahoga County
Ohio
UTM: 17.427510.4584080
Quadrangle: Lakewood, Ohio 1:24,000

Date of Construction: 1955-57

Engineers: H. K. Ferguson Company

Present Owner: National Aeronautics and Space Administration – Glenn Research Center

Present Use: Vacant/Not in use.

Significance: The Rocket Engine Test Facility Complex is a National Historic Landmark, and the observation blockhouse is included in the description of the site on the National Historic Landmark nomination form. The blockhouse is located approximately 260' north of the Rocket Engine Test Cell in Building 202. The blockhouse was one of the original Rocket Engine Test Facility Buildings constructed from 1955-57. The significance of the blockhouse lies in its role of providing a safe place where observers could monitor rocket engine tests during the early period of testing at the facility, from 1957-72.

Project Information: This documentation was initiated on May 15, 2002, in accordance with a Memorandum of Agreement among the Federal Aviation Administration, National Aeronautics and Space Administration (NASA), The Ohio State Historic Preservation Officer, and the Advisory Council on Historic Preservation. The City of Cleveland plans to expand the Cleveland Hopkins International Airport. The NASA Glenn Research Center Rocket Engine Test Facility, located adjacent to the airport, must be removed before this expansion can be realized. To mitigate the removal of this registered National Historic Landmark, the National Park Service has stipulated that the Rocket Engine Test Facility be documented to Level I standards of the Historic American Engineering Record (HAER). This project was initiated to fulfill that requirement.

Historian: Robert C. Stewart Historical Technologies, West Suffield, Connecticut

Description:

The observation blockhouse covers a surface area of about 132 square feet. The concrete walls of this small one-story building are 6" thick, and a flat built-up roof covers the structure. Observers could enter the blockhouse through a steel door in the north elevation. A ladder next to the door led to the building's roof, where a closed-circuit television camera was installed in 1972. The south elevation has a deeply recessed thick glass window that measures approximately 4' wide and is divided into two sections by a vertical mullion. The window is about 18" high and allowed observers stationed inside the blockhouse to watch engine tests in Building 202.[1]

While photographic evidence suggests that a closed-circuit television system was installed in the test cell as early as 1957, observers in the blockhouse were needed to supplement electronic and video data.[2] The blockhouse was originally equipped with an intercom system, an emergency communications system, and a telephone system to allow two-way contact between observers and test engineers. The blockhouse also had a small instrument panel with several switches and a "panic button." This instrument panel was similar to that located in the Building 100 control room, and was positioned below the observation window. In case of emergency, the "panic button" could be activated to initiate automatic test shutdown through programmable logic control. The control panel and telephone system components are still in place in the observation blockhouse, but this equipment is no longer functional. Other than some moisture-related deterioration of equipment on the building's interior, the observation blockhouse appears to have changed very little since its active use was discontinued around 1972.

History and Function:

The observation blockhouse was built from 1955-57, during the original construction phase at the Rocket Engine Test Facility. A sheet of construction drawings for the building is dated June 29, 1955, and indicates that engineers of the H. K. Ferguson Company designed the structure.[3] During the early years of operation at the Rocket Engine Test Facility, technicians and engineers relied on the direct observation of engine firings to supplement instrument readings. One visual observation post was located in the observation room adjacent to the test cell. This post consisted of two mirrors arranged to form a periscope, through which the observer safely viewed the engine firing from a position that was not in direct line with the test engine. Another viewing point for rocket engine tests was the observation blockhouse, a plain, reinforced concrete bunker located approximately 260' north of Building 202. The actual line of sight distance from the test stand to the center of the blockhouse was 294'-7$^{3}/_{8}$".[4] The blockhouse protected observers from flying debris in case of catastrophic engine failure.

---

[1] Drawing CE-101540.

[2] NASA Photograph Number C-45021 (1957). Photo on file at NASA Plumbrook Research Center.

[3] Drawing CE-101540.

[4] Drawing CF-101580 – 7/3/86.

In 1972 the Rocket Engine Test Facility staff installed a closed-circuit television camera on top of the blockhouse.[5] They also installed further lighting in the test cell and surrounding area. These improvements enabled technicians and engineers in the Building 100 control room to observe rocket engine tests on closed-circuit television from a safe distance. This development reduced the need for observers in the blockhouse.[6] Increasingly sophisticated sensors, instrumentation, and computerized data reduction technology further diminished the need for direct observers, and the blockhouse became obsolete.

The observation blockhouse is currently not in use. Based on the deteriorated condition of the interior, it is clear that the building has not been used for many years. The Rocket Engine Test Facility ceased operations in 1995 and has been vacant since that time. Along with the entire Rocket Engine Test Facility complex, the observation blockhouse is scheduled for demolition to make way for expansion of the Cleveland Hopkins International Airport.

Conclusion:

The observation blockhouse dates to an earlier period in the history of technology, when test monitoring by a human observer provided useful data. During active testing, a rocket engine often exhibited transient phenomena that human observers could not detect. These events were instead recorded by sound monitoring equipment and high-speed cine-cameras operating at 200 frames per second. As closed-circuit television systems improved and faster methods of recording and analyzing data became available, the contributions of human observers in a blockhouse became less important, and this method of observation was discontinued.

[5] Interview with George Repas, 10/24/02.

[6] See HAER No. OH-124-D – GRC Building 100 – Rocket Operations Building.

Sources of Information/Bibliography

A. Engineering Drawings:

NASA Lewis Research Center – Cleveland, Ohio 44135
Rocket Engine Test Facility
Building No. 202
Pilot Plan Equipment Location
Drawing No. CF-101580 – 7/9/86

NASA Lewis Research Center – Cleveland, Ohio 44135
Rocket Engine Test Facility
Observation Post
Drawing No. CF-101540 – 6/29/55

B. Interviews:

Repas, George, Hardware Design Engineer
Interview by the author, 24 October 2002
West Suffield, Connecticut, Telephone interview, Hardlines Design Company, Columbus, Ohio

C. Secondary Sources:

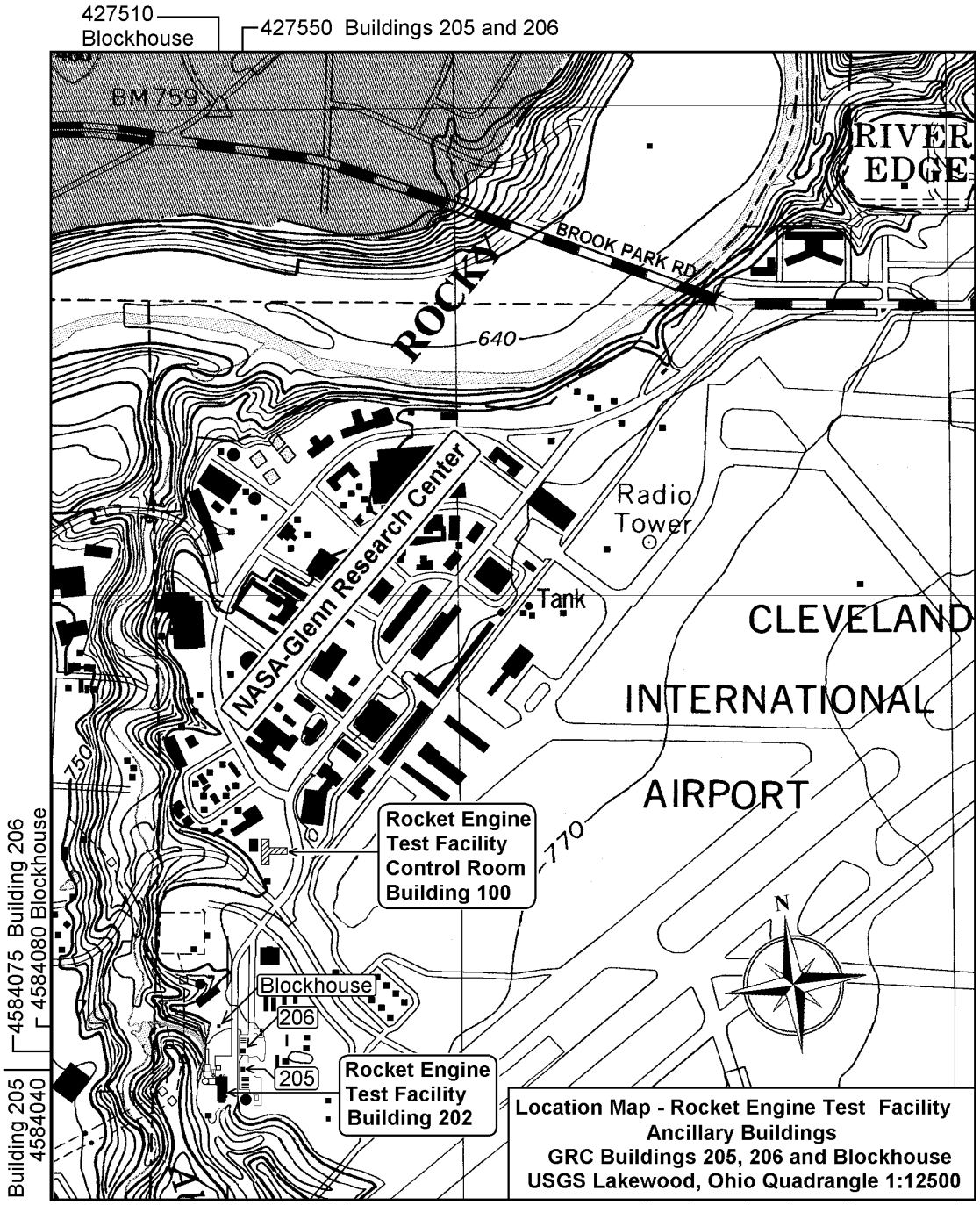
Butowsky, Harry. "Rocket Engine Test Facility, National Register of Historic Places Nomination." Washington, D.C.: United States Department of the Interior, National Park Service, 1984.

Dawson, Virginia P. "Rocket Propulsion Research at Lewis Research Center," 28th Joint Propulsion Conference AIAA/SAE/ASME/ASEE, July 6-8, 1992, AIAA-92-31230. NASA Contractor Report 189187.

National Aeronautics and Space Administration. "Historic Photographs of Rocket Engine Test Facility, 1955-1995." On file at NASA Plumbrook Research Center, Sandusky, Ohio.

Sloop, John. *Liquid Hydrogen as a Propulsion Fuel.* Washington, D.C.: NASA Special Publication No. 4404, 1978.

Thomas, Wayne. "Description of the Rocket Engine Test Facility." Cleveland: Lewis Research Center, 1984.


427510
Blockhouse
427550 Buildings 205 and 206
BM 759
RIVER
EDGE
BROOK PARK RD
ROCKY
640
NASA-Glenn Research Center
Radio
Tower
Tank
CLEVELAND
INTERNATIONAL
AIRPORT
750
770
Rocket Engine
Test Facility
Control Room
Building 100
Blockhouse
206
205
Rocket Engine
Test Facility
Building 202
N
4584075 Building 206
4584080 Blockhouse
Building 205
4584040
Location Map - Rocket Engine Test Facility
Ancillary Buildings
GRC Buildings 205, 206 and Blockhouse
USGS Lakewood, Ohio Quadrangle 1:12500

HISTORIC AMERICAN ENGINEERING RECORD

INDEX TO PHOTOGRAPHS

RETF OBSERVATION BLOCKHOUSE HAER No. OH-124-E
NASA Glenn Research Center
Cleveland
Cuyahoga County
Ohio

Jeff Bates, Hardlines Design Company, Field Photographer, May 2002
NASA Information Technology Center (ITC), Copywork Photographer, November 2002

OH-124-E-1 CONTEXT VIEW OF NORTHEAST CORNER OF OBSERVATION BLOCKHOUSE, WITH BUILDING 202 IN BACKGROUND. VIEW LOOKING SOUTH FROM HILL NORTH OF OBSERVATION BLOCKHOUSE.

OH-124-E-2 SITE CONTEXT OF OBSERVATION BLOCKHOUSE, LOOKING NORTHWEST FROM ACCESS ROAD.

OH-124-E-3 CONTEXT VIEW OF OBSERVATION BLOCKHOUSE, LOOKING NORTH AT SOUTH ELEVATION FROM HILLSIDE NORTH OF BUILDING 202.

OH-124-E-4 VIEW OF NORTHEAST CORNER OF OBSERVATION BLOCKHOUSE, LOOKING SOUTHWEST.

OH-124-E-5 VIEW OF SOUTHWEST CORNER OF OBSERVATION BLOCKHOUSE, LOOKING NORTHEAST.

OH-124-E-6 VIEW OF NORTH ELEVATION OF OBSERVATION BLOCKHOUSE, LOOKING SOUTH.

OH-124-E-7 INTERIOR VIEW OF OBSERVATION BLOCKHOUSE, LOOKING SOUTHEAST.

OH-124-E-8 HISTORIC PLAN, SECTION, AND DETAIL DRAWING OF OBSERVATION BLOCKHOUSE. NASA GRC DRAWING NO. CE-101540, JUNE 29, 1955 (ON FILE AT NASA GLENN RESEARCH CENTER).

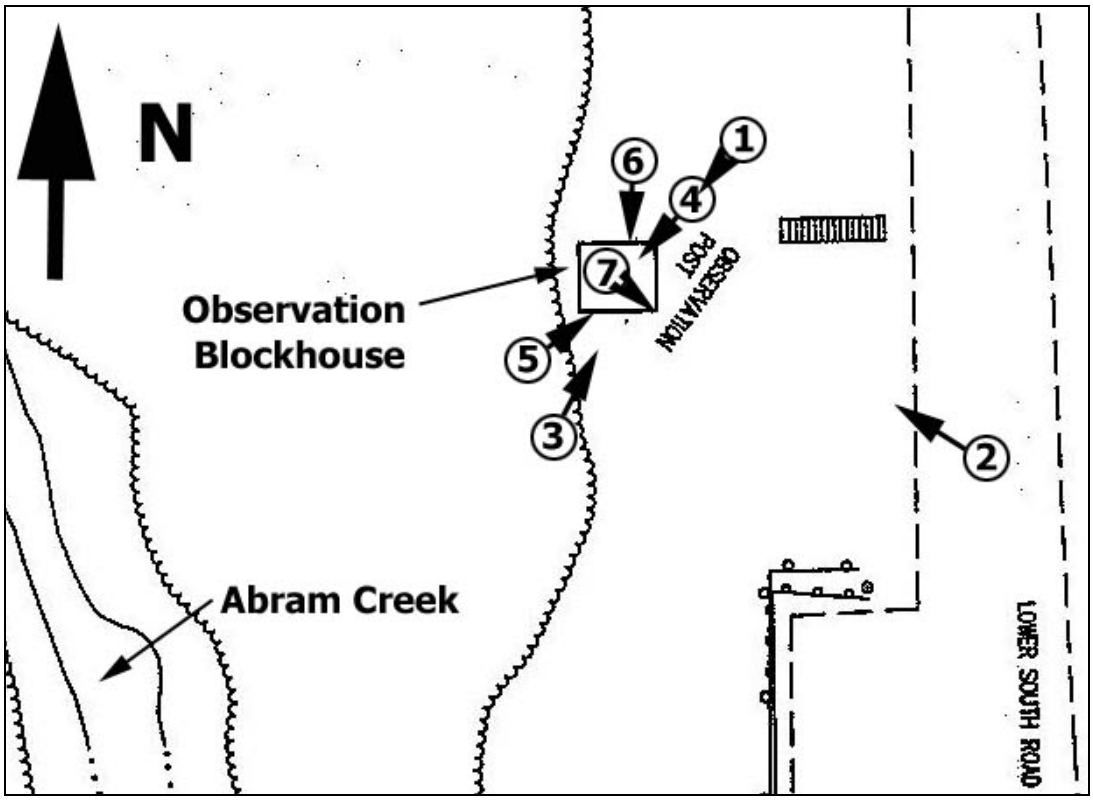
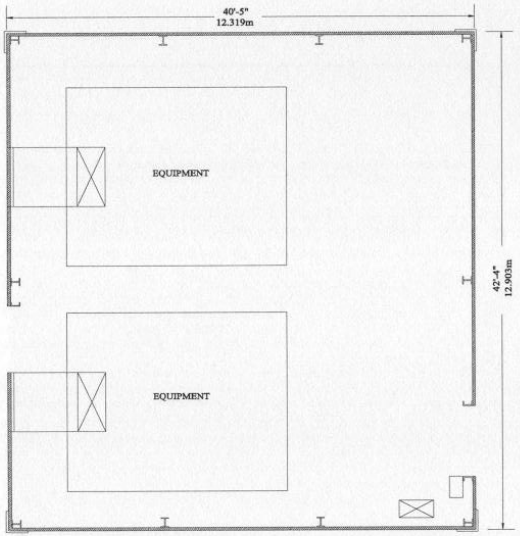


Photo Key for Observation Blockhouse

BUILDINGS 205, 206 AND OBSERVATION BLOCKHOUSE

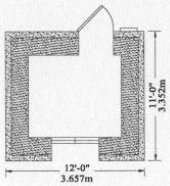


BUILDING 205 FLOOR PLAN

1/4" = 1'-0" 0 5' 10FT 1:48 0 3M NORTH

Building 205 is located approximately 170 feet northeast of the Rocket Engine Test Cell in Building 202. The structure covers a surface area of about 1,710 square feet. This building is lightly constructed, with a framing of pipe uprights that is welded to channel iron cross members. Light steel I-beams support the roof. The side of the building is sheathed with opaque fiberglass panels, while translucent fiberglass panels cover the roof.

The significance of Building 205 lies in its relationship to the reactant distribution system for the Rocket Engine Test Facility (RETF). Building 205 housed a compressor and an automated control system used to pressurize helium gas to 6,000 psi for distribution throughout the complex. Liquid oxygen boils at -183°C, which can make pumping and distribution of this substance difficult. Mechanical pumps available at the time for handling cryogenic fluids were not ideally designed for forcing liquid oxygen at high flow rates into test engines. To force liquid oxygen through the piping system and into test engines, the designer of RETF developed a pumping system powered by pressurized helium gas supplied by the compressor in Building 205. An inlet at the top of the main liquid oxygen outlet pipe was located below the liquid level. Control valves admitted pressurized helium at 4,000 psi that flowed at up to 3.5 pounds per second into the tank and forced liquid oxygen into the test rig.



OBSERVATION BLOCK-HOUSE FLOOR PLAN

1/4" = 1'-0" 0 5' 10FT 1:48 0 3M NORTH

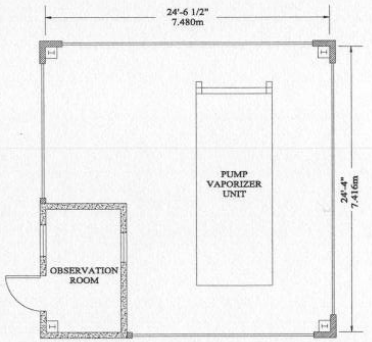
During the early years of operation at the Rocket Engine Test Facility (RETF), technicians and engineers relied on direct observation of engine firing tests to supplement instrument readings. One observation post was a large periscope in the terminal room of Building 202, which was adjacent to the test cell. A second viewing location was the Observation Blockhouse, which was a plain reinforced concrete bunker located approximately 260 feet north of the test cell. The blockhouse protected observers from flying debris in case of catastrophic engine failure during testing.

Built from 1955-1957, the Observation Blockhouse covers 132 square feet, and its reinforced concrete walls are 6" thick. Observers entered the bunker through a door in the north elevation. A ladder next to this door led to the roof. The south elevation has a deeply recessed thick glass window that measures approximately 4' wide and is divided into two sections by a vertical mullion. The window is about 18" high and allowed observers stationed inside the blockhouse to watch engine tests in Building 202. The blockhouse was equipped with an intercom system, emergency communications, and a telephone system to allow two - way contact with test stand engineers. The blockhouse also had a small switch panel with an "abort" button positioned below the observation window.

While there is photographic evidence that a closed-circuit television system was installed in the test cell as early as 1957, observers in the blockhouse were still needed to supplement electronic and video data. In 1972, however, RETF staff installed an additional closed-circuit television camera on top of the blockhouse. Additional lights installed in Building 202 enabled viewers in the RETF Building 100 control room to observe tests on a monitor. These modifications reduced the need to station observers in the blockhouse. As sensors, instrumentation, and computerized data reduction became more sophisticated, the information that could be provided by observers in a protected area was limited, and use of the blockhouse became increasingly rare.

Constructed in 1968, Building 206 was part of the gas distribution system for the Rocket Engine Test Facility (RETF). This building housed a liquid nitrogen vaporizer and a gaseous nitrogen compressor. This building covers 597 square feet and is sheathed in corrugated metal panels. Ventilation was an important consideration in the design of the building, so a vent was incorporated into the roof along the full length of the ridgeline. Louvered vents on the gable end of the building provided additional ventilation. A rolling shutter door about 16' wide on the building's gable end allowed access to the interior and machinery. An isolated control room featured a small window through which operators monitored the machinery bay. The control room had a switchboard of 12 explosion-proof switches for controlling motors and fans in the building. The building was also equipped with explosion-proof wiring, telephones, and lighting.

A nitrogen vaporizer essentially functions as a heat exchanger. Liquid nitrogen flowed through a network of pipes, the external surfaces of which were largely exposed. Fans drew ambient air over the exterior surface of this piping. The liquid nitrogen in the tubes then warmed and boiled to form gaseous nitrogen, which was then pressurized to 6,000 psi and piped throughout the RETF complex.



BUILDING 206 FLOOR PLAN

1/4" = 1'-0" 0 5' 10 FT 1:48 0 3M NORTH

DELINEATED BY: Hardlines Design Company, 2003

NASA ROCKET ENGINE TEST FACILITY
ROCKET ENGINE TEST FACILITY
CLEVELAND

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, LEWIS RESEARCH CENTER
CUYAHOGA COUNTY
OHIO

SHEET 12 of 12

HISTORIC AMERICAN ENGINEERING RECORD
OH-134-D

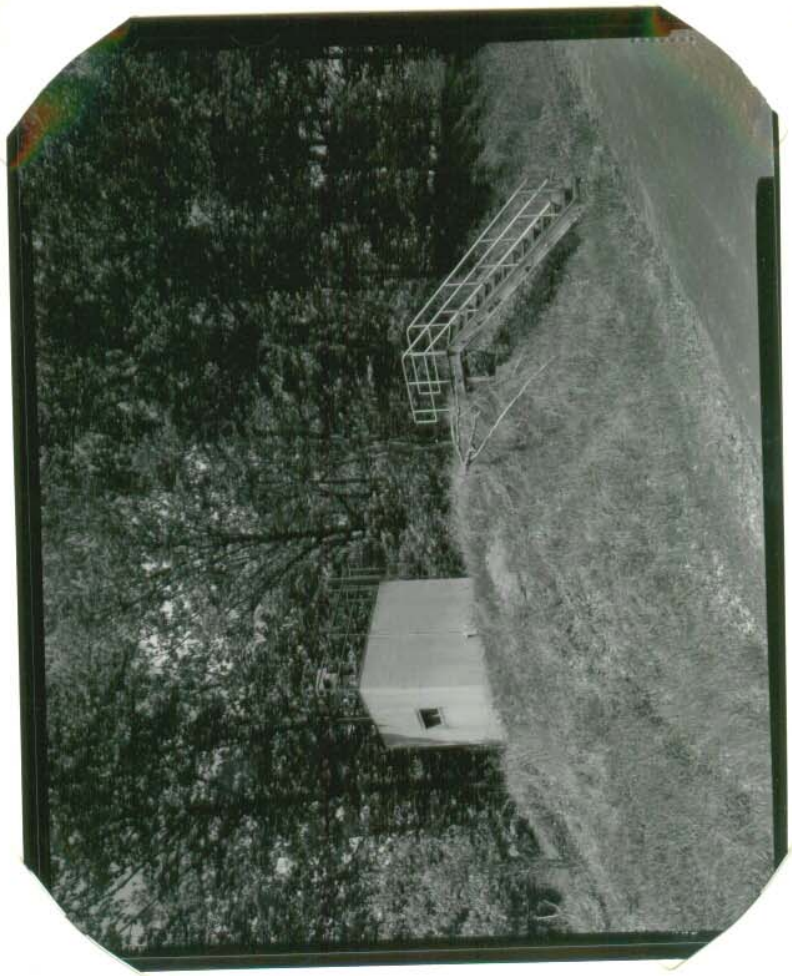
BY REPRODUCED, PLEASE CREDIT: HISTORIC AMERICAN ENGINEERING RECORD, NATIONAL PARK SERVICE, HARDLINES DESIGN COMPANY, FEBRUARY 27, 2003

HISTORIC AMERICAN ENGINEERING RECORD
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HAER No. OH-124-E-1

HISTORIC AMERICAN ENGINEERING RECORD
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HAER No. OH-124-E-2



HISTORIC AMERICAN ENGINEERING RECORD
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HAER No. OH-124-E-3

HISTORIC AMERICAN ENGINEERING RECORD
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HAER No. OH-124-E-4

HISTORIC AMERICAN ENGINEERING RECORD
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

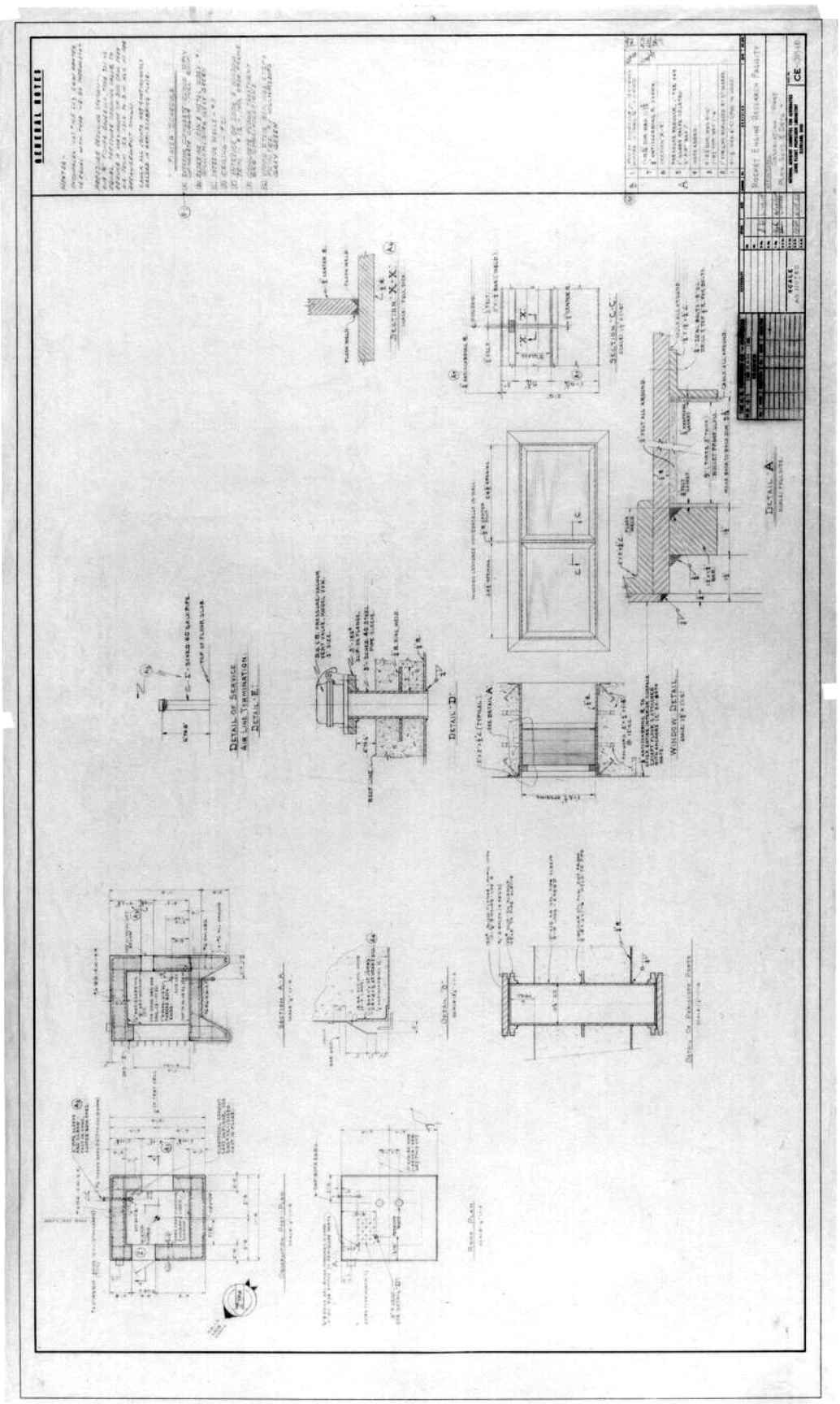
HAER No. OH-124-E-5

HISTORIC AMERICAN ENGINEERING RECORD
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HAER No. OH-124-E-6

HISTORIC AMERICAN ENGINEERING RECORD
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HAER No. OH-124-E-7


GENERAL NOTES
SECTION X-X
SECTION C-C
DETAIL A
DETAIL B
DETAIL D
WINDOW DETAIL
SECTION A-A
SECTION B-B
DETAIL OF SERVICE AIR LINE TERMINATION DETAIL E
ROOF PLAN
BASE PLAN
SCALE
CE