

CAPE CANAVERAL AIR FORCE STATION,
LAUNCH COMPLEX 39,

HAER NO.FL-8-11-S-4

SOLID ROCKET BOOSTER DISASSEMBLY & REFURBISHMENT COMPLEX
THRUST VECTOR CONTROL DESERVICING FACILITY

(Hangar AF Complex-TVC Building)

(John F. Kennedy Space Center)

Cape Canaveral

Brevard County

Florida

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD

National Park Service
Department of Interior
100 Alabama St., SW
Atlanta, Georgia 30303

HISTORIC AMERICAN ENGINEERING RECORD

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SOLID ROCKET BOOSTER DISASSEMBLY & REFURBISHMENT COMPLEX
THRUST VECTOR CONTROL (TVC) DESERVICING BUILDING
(Hangar AF Complex - TVC Deservicing Building)

HAER No. FL-8-11-S-4

Location: Cape Canaveral Air Force Station, Cape Canaveral,
Brevard County, Florida.

USGS Orsino, Florida, Quadrangle, Universal
Transverse Mercator Coordinates: E 540465.24 N
3151325.46 Zone 17, NAD 1983.

Date of Construction: 1985

Present Owner: National Aeronautics and Space Administration (NASA)

Present Use: Solid Rocket Booster Disassembly & Refurbishment

Significance: The Solid Rocket Booster (SRB) Disassembly & Refurbishment Complex contains the Thrust Vector Control (TVC) Deservicing Facility and eight other facilities that played an essential role in the reusability of the SRBs in the Space Shuttle Program (SSP). The complex is considered eligible for the NRHP as a historic district in the context of the SSP (1969-2011) under Criterion A for Space Exploration. The building has achieved exceptional significance within the past 50 years, so Criterion Consideration G also applies. The complex was originally designed or modified to process SRBs, from pre-launch manufacture and assembly to post-launch recovery, disassembly, cleaning, and refurbishment. The building and complex maintain a high level of physical integrity.

Report Prepared by: New South Associates, Stone Mountain, Georgia

Date: October 16, 2012

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4

Page 2

PART I. HISTORICAL INFORMATION

A. INTRODUCTION

The TVC Deservicing Facility (Building 66249) lies within the SRB Disassembly and Refurbishment Complex at which is located on Hangar Road in the Industrial Area of the Cape Canaveral Air Force Station (CCAFS). The complex's boundaries are defined as the edges of the concrete hardscape that surround Hangar AF. The complex contains nine significant facilities, including the Thrust Vector Control Deservicing Building (8BR2008). The remaining eight facilities are Hangar AF (8BR2001), the High Pressure Gas Building (8BR2002), the High Pressure Wash Building (8BR2003), the First Wash Building (8BR2004), the SRB Recovery Slip (8BR2005), the SRB Paint Building (8BR2006), the Robot Wash Building (8BR2007), and the Multi-Media Blast Facility (8BR2009).

The complex is a significant historic property for its association with the Space Transportation System (STS), commonly known as the "Space Shuttle." The STS was a unique breakthrough in the history of the U.S. Space Program, because it was based on a design that made most of its major components reusable. This model decreased program costs and helped make orbital space flight a routine endeavor. Along with the orbiter spacecraft, the SRBs were two of the Space Shuttle's primary reusable elements, while the external tank (ET) was not reused. The SRBs' reusability was made possible by a number of facilities at Kennedy Space Center (KSC) and CCAFS, including the SRB Disassembly and Refurbishment Complex. The complex is the first place the SRBs were brought after their recovery from sea and where they were disassembled, cleaned, and processed before they were moved to other KSC facilities for buildup and assembly.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4

Page 3

B. HISTORICAL CONTEXT

A full historical context for the SRB Disassembly and Refurbishment Complex, as well as a summary of the entire disassembly and refurbishment process, can be found in HAER NO. FL-8-11-S (Hangar AF Complex). A detailed explanation for the portions of that process that occurred in this resource is located in Section III of this document.

C. PHYSICAL HISTORY

1. Date of Construction:

1985

2. Architects/Engineers:

Burns and Roe Industrial Services Corporation (BRISC),
Cocoa Beach, Florida.¹

Burns and Roe was founded in 1932 by Ralph Roe and Allen E. Burns. The company built much of its early reputation in the 1930s and 1940s on the design and engineering of electric power plants. By the 1950s, the company expanded into national defense projects, including radar and missile installations. In 1963, Ralph Roe handed over control of the company to his son, Kenneth, who continued to broaden its work into nuclear power plants, desalination plants, and aerospace projects. The company was a major participant in the planning of NASA's Mercury and Apollo Programs, including Mercury's Ground Support System and

¹Burns and Roe Industrial Services Corporation, "Thrust Vector Control Deservicing Facility," Construction drawings, 1984. Kennedy Space Center, Florida.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4

Page 4

Apollo's Lunar Module Test Facility, Site Activation Program in Texas, and the White Sands Missile Range in New Mexico. Burns and Roe's connections to NASA led to continued design and engineering work in the 1980s, including construction drawings for the SRB Paint and the TVC Deservicing Buildings.²

3. Builder/Contractor/Supplier:

Unknown

4. Original Plans and Construction:

The TVC Deservicing Building retains its original appearance.

5. Alterations and Additions:

The TVC Deservicing Building has not undergone any substantial alterations or additions.

PART II. STRUCTURAL/DESIGN/EQUIPMENT INFORMATION

A. GENERAL STATEMENT:

1. Character:

The TVC Deservicing Building is metal workshop-type building with a double-bay servicing area and attached control and processing rooms.

² Burns and Roe, "History and Legacy," http://www.roe.com/about_legacy.htm, Accessed December 20, 2011.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4

Page 5

2. Condition of fabric:

The condition of the TVC Deservicing Building's fabric is excellent. The building was regularly maintained and does not exhibit any major signs of neglect or deterioration.

B. BUILDING DESCRIPTION:

The TVC Deservicing Building was completed in 1985 to house the removal and cleaning of the TVC system from the SRB aft skirts. Located on the north edge of the Hangar AF Complex, it is accessed by a concrete driveway and staging area. It is an industrial-type metal and concrete block building with a double-bay work area, storage/pump room, control area, and TVC process area. The rear (north) TVC process area was not included on the original construction drawings, so it was either a last minute addition or it was completed at an unknown date after 1984.

Exterior

Each of the building's four areas is clad in corrugated metal siding and has its own roof. The main work bay has a slightly-pitched gable roof and the other areas have shed roofs. The roofs are lined by metal gable trim and gutters. The original width and length of the building's footprint are 76'-0" (W) x 46'-0" (D) and the building's height is not indicated on the original construction drawings. It has a cast-in-place concrete slab floor throughout and a reinforced concrete foundation. The first 12' of the building's high-bay work area walls are built of concrete block, the upper portion is steel frame with corrugated metal siding. The work bay is accessed by two roll-up doors on the south façade. Three

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4

Page 6

flood lights are mounted on the south façade wall just under the eaves.

The one-story air compressor room portion of the building lies on the east side of the building, while the control area lies on the north side of the work bays. The control room, a long room that stretches the length of the building, is where operations in the work bay are observed. North of the control area is an addition that contains the TVC parts decontamination room, an office/staging area, and a break room with rest room. This addition was not included on the original 1984 construction drawings.

Interior

The TVC Skirt Stand

In the middle of the double-bay work area is the "skirt stand," a metal work platform device specifically designed to remove the TVC from the SRB aft skirts. The stand can service two skirts at one time, one on either side. The top level of the "skirt stand" has hinged extensions that lower down onto the curved top of the aft skirts. On the south side of the "skirt stand" upper level are its two TVC deservicing panels, which are used to flush the fuel from the units with alcohol and gaseous nitrogen. The TVC's auxiliary power units (APUs) are also flushed here with water, alcohol, and gaseous nitrogen. The two panels work in the same way, however, one is used to flush the "rock" side of the TVC and the other flushed the "tilt" side. On the lower level of the stand are another set of instrument panels that are used to give the APUs an additional flush of gaseous nitrogen and water.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4

Page 7

The bay work area surrounding the "skirt stand" resembles a typical hangar or mechanical work area. The unfinished interior is composed of the exposed concrete block and steel frame structural system of the building. It is lit by ceiling mounted flood lights and has a cast concrete floor. Tool storage areas, electrical conduits, gauges, and other equipment lines the perimeter of the room. There are viewing windows in the north wall that allow observation by staff in the control room. Overhead is a one-ton hoist that travels the length of the room on a track.

Through a pair of pedestrian doors on the east side of the bay area is the air compressor room. It has a cast concrete floor with exposed steel frame and corrugated metal walls and ceiling. It is lit by fluorescent fixtures suspended from the ceiling. The room contains an air compressor and other equipment used to operate the "skirt stand" in the bay.

Just north of the bay area is the building's control room. This room has a concrete block south wall with observation windows. The other walls are faced with drywall. There are storage lockers and shelves occupying much of the north wall. The ceiling is metal with an exposed structural frame. The room is lit with two rows of fluorescent fixtures suspended from the ceiling. An oxygen monitor ensures that no harmful vapors from the TVC fuel system contaminate the air in the building.

The final interior part of the building is the north wing, which houses the TVC decontamination room, an office/staging area, and a break room with restroom. This area has a combination of interior wall types, including exposed steel frame/corrugated metal, drywall, and metal

paneling. It has a metal ceiling with fluorescent light fixtures and a cast concrete floor. The TVC deservicing room contains an alcohol room with sink and a water sink and wash basin used to flush and bathe the TVC fuel service modules (FSMs) and other fuel components. It also contains two vacuum bake ovens used to dry these components.

PART III: OPERATIONS AND PROCESS

A. INTRODUCTION

The primary operations at the Hangar AF Complex involved separating all of the SRB segments, removing their electronic and mechanical components and protective TPS finishes, and preparing them for buildup and assembly at the ARF Manufacturing Building/L6-247. The buildings and structures at Hangar AF Complex processed the aft skirts, forward skirts, frustums, TVC systems, MPSS, ETA ring, and a variety of small metal parts contained in each of the segments. The boosters' four SRMs were separated and cleaned at Hangar AF Complex and then shipped to their manufacturer for full refurbishment. Typically, the number of people working at Hangar AF Complex during the Space Shuttle era was approximately 150 people. It typically took these workers from two to three weeks to fully process the SRB components from the time of their arrival.

B. Aft Skirt Processing and TVC Deservicing

The SRB aft skirts were demated in Hangar AF and then moved into the High Pressure Wash Building where the TVC components were hydrolased to remove the protective interior TPS foam that coated them. Additional interior foam was blasted off in the Robot Wash Building.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4

Page 9

The aft skirts were then transferred from the wash facilities to the TVC Deservicing Building on the northern edge of the complex. Once there, the skirts were positioned on either side of the aft skirt deservicing stand, a structure in the middle of the building's main processing bay. There the fuel was removed and the TVC components were disassembled, including the hydraulic reservoirs, APUs, hydraulic power units (HPUs), and related line replaceable units (LRUs).

The TVC fuel was removed with the use of the "skirt stand's" two deservicing panels on the south side of its upper level. The TVCs are connected to the panels with lines that flush the fuel from the units with alcohol and gaseous nitrogen. The gaseous nitrogen used in this process is stored in large tanks mounted on a truck parked in front of the building. The TVC's APUs are also flushed here with water, alcohol, and gaseous nitrogen. The two panels work in the same way, but one is used to flush the "rock" side of the TVC and the other flushed the "tilt" side. On the lower level of the stand is another set of instrument panels that are used to give the APUs an additional flush of gaseous nitrogen and water. For their protection, technicians at the TVC Deservicing Building complete this work while wearing a SCAPE outfit: Self Contained Atmospheric Protective Ensemble.

Once removed, the TVC system's fuel service modules, fuel isolation valves, and other fuel components were transferred to the TVC decontamination room in the rear (north) end of the building. There the components were rinsed with water and isopropyl alcohol in large sinks. They were then dried and placed in specially designed plastic bags. After a set amount of time, the bags were checked to verify if the component surfaces had continued

to release any fuel vapors. If so, they were washed again. Once fully washed, the components were baked in two vacuum ovens designed to open the pores of the metal to remove any fuel vapors trapped there. The ovens cycled for one-and-a-half hours at 200 degrees Fahrenheit until there were no gas vapors detected. All of the TVC fuel components were baked in the ovens.³

After the aft skirts completed the TPS blasting and TVC deservicing process, they received an inspection for necessary modifications or structural repairs. Crew members also installed new fasteners and sealed critical joints with sealant. The aft skirts then coated with alodine and hypalon paint to complete the process.

PART IV. SOURCES OF INFORMATION

A. ENGINEERING DRAWINGS AND PLANS

Burns and Roe Industrial Services Corporation. "Thrust Vector Control Deservicing Facility." Kennedy Space Center, Florida. Construction drawings, 1984.

B. EARLY VIEWS

Kennedy Space Center.

Photograph negative number 108-KSC-81PC-459. 1981. On file at Kennedy Space Center Archives.

Photograph negative number 116-KSC-383C-1256. 1983. On file at Kennedy Space Center Archives.

³ David Pappalardo, United Space Alliance TVC Technician, interview with author, October 11, 2011.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4

Page 11

C. INTERVIEWS

Pappalardo, David. United Space Alliance, TVC Technician.
Interview with author. October 11, 2011.

Price, David. United Space Alliance, Hangar AF Facility
Manager. September 27, 2011.

D. SECONDARY SOURCES

Burns and Roe. "History and Legacy."
http://www.roe.com/about_legacy.htm. Accessed December
20, 2011.

Deming, Joan, and Patricia Slovinac. *NASA-Wide Survey and
Evaluation of Historic Facilities in the Context of the
U.S. Space Shuttle Program: Roll-Up Report*. Submitted to
the National Aeronautics and Space Administration,
Environmental Management Branch. Sarasota, Florida:
Archaeological Consultants, Inc. February 2008, revised
July 2008.

National Aeronautics and Space Administration (NASA)
NASA Facts: Solid Rocket Boosters. Kennedy Space Center,
Florida. IS-2004-09-014-KSC, Revised 2006.

*NASA Facts: Solid Rocket Boosters and Post-Launch
Processing*. Kennedy Space Center, Florida. FS-2004-07-
012-KSC (Rev. 2006).

United Space Alliance

"Marine Operations, Revision J." (John F. Kennedy Space
Center, n.d.), MO-1.

"Structures Assembly Buildup Operations, Revision J"
(John F. Kennedy Space Center, n.d.).

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4

Page 12

E. LIKELY SOURCES NOT YET INVESTIGATED

Research was conducted at KSC using primary and secondary sources. Sources that were not investigated that may contain secondary information include NASA Headquarters and at the offices of the various architects and contractors that constructed the buildings of the Hangar AF Complex.

Additional oral history interviews with other engineers and technicians could also prove useful.

V. PROJECT INFORMATION

NASA determined that the SRB Disassembly & Refurbishment Complex was eligible to the NRHP as a historic district under Criterion A in the area of Space Exploration. The TVC Deservicing Building was considered a contributing resource to the historic district. This determination was made by NASA's "Shuttle Transition Historic Preservation Working Group" or HPWG, which looked at 335 facilities at thirteen NASA Centers.⁴ As a result of this work, seventy properties were identified as either listed, determined eligible, or were potentially eligible to the National Register. Out of twelve property types identified for NASA's SSP, the SRB Disassembly and Refurbishment Complex was identified as Type 2, which includes Resources Associated with Vehicle Processing Facilities.⁵ NASA completed this evaluation as the SSP was scheduled for termination in 2011.

⁴ Deming and Slovinac, *Evaluation of Historic Facilities, Space Shuttle Program*, 5.11.

⁵ Deming and Slovinac, *Evaluation of Historic Facilities, Space Shuttle Program*, 5.11.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4

Page 13

A Programmatic Agreement (PA) was developed to document the identified eligible resources and streamline the Section 106 consultation process. Per Section V.A of the PA between NASA, the Advisory Council on Historic Preservation (ACHP), and the Florida State Historic Preservation Officer (SHPO), dated May 2009, and the Statement of Work provided to New South Associates by KSC/InoMedic Health Applications (IHA), as part of the Task Order Contract, dated August 2011, the documentation package for the SRB Disassembly & Refurbishment Complex includes the following items: a written narrative; a series of photographs showing both exterior and interior views using large format negatives; and a selection of existing drawings, which were photographed with large format negatives. This HAER documentation fulfills the recordation requirements of the PA for the historic district.

New South Associates, under contract with IHA, a subcontractor to NASA, conducted the HAER documentation and historic research for this project in September and October 2011. Therefore, NASA is completing HAER documentation of the historic district and other KSC properties to record these as they appear and as they existed during the SSP. David Diener served as the project photographer. Julie Coco served as Principal Investigator, while David L. Price served as Project Historian.

In order to complete the project, New South Associates personnel were allowed full access to the facility, under the supervision of Barbara Naylor, KSC Historic Preservation Officer, and Nancy English, Cultural Resources Specialist. Photographs were taken of each building's interior, exterior, and context. David Price conducted a limited number of oral interviews and otherwise compiled the historic documentation required for the project. The following people were interviewed for this project: David

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4

Page 14

Price, Hangar AF Facility Manager, United Space Alliance;
Art Morales, George C. Marshall Space Flight Center, Office
of the Director Shuttle - ARES Transition Office; and Dave
Pappalardo, United Space Alliance, TVC Technician. Elaine
Liston, KSC Archivist, provided a wealth of information from
her office in the KSC Headquarters Building.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4



Source: USGS 7.5 Minute Topographic Quadrangle Map, Orsino, FL (1976)

Figure 1. USGS Map Showing the Location of the TVC Deservicing Building.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4



Source: ESRI Resource Data, Imagery Layer

Figure 2. Aerial Photograph Showing the Location of the TVC Deservicing Building.

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39,
SRB DISASSEMBLY & REFURBISHMENT COMPLEX,
THRUST VECTOR CONTROL DESERVICING BUILDING
(Hangar AF Complex-TVC Deservicing Building)
HAER NO. FL-8-11-S-4

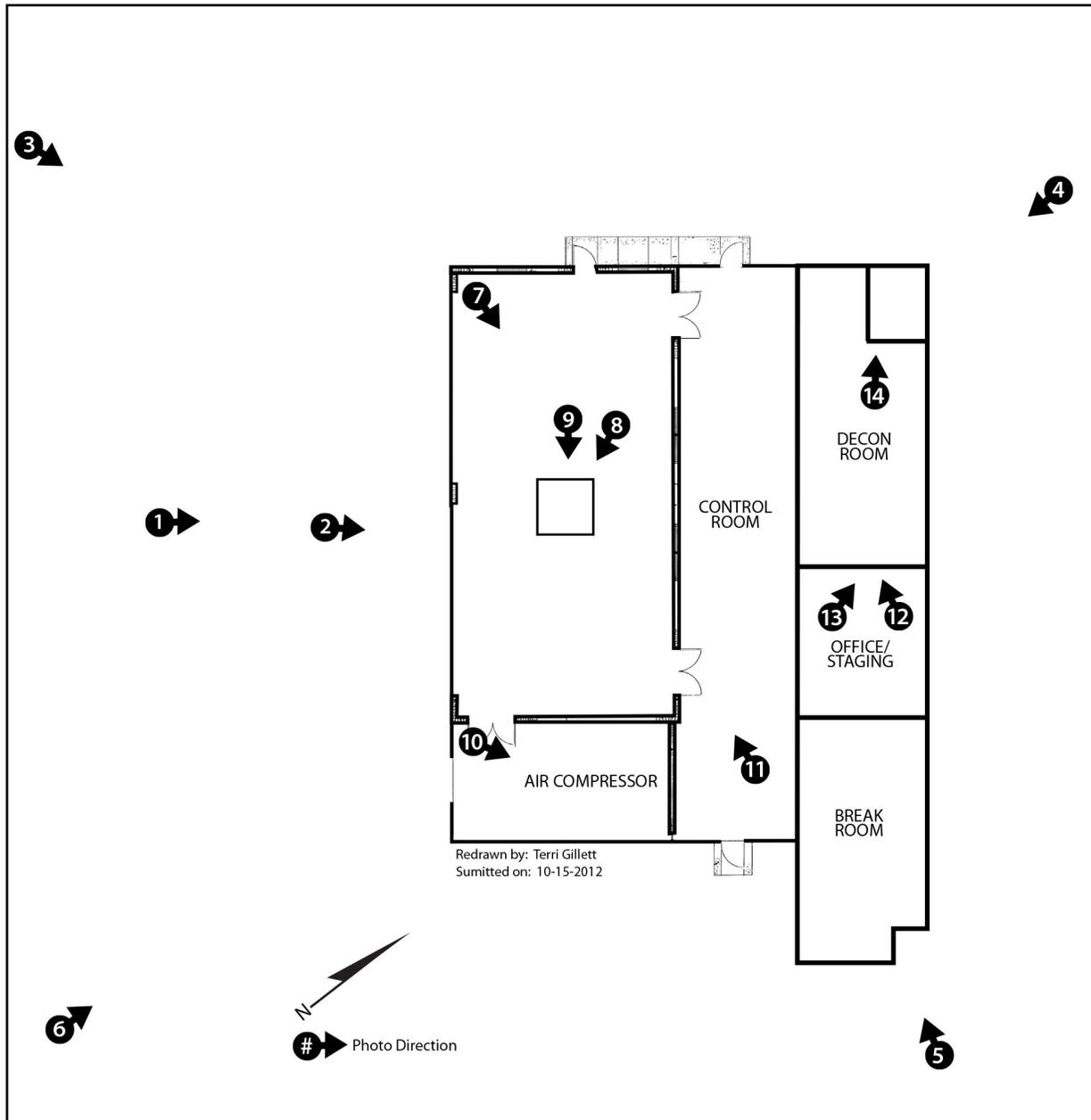


Figure 3. Photograph key for HAER NO. FL-8-11-S-4.