

EIGHT RESEARCH & DEVELOPMENT SITES: (A, C, D, E, F, I, J & K)

General: All of these R&D Sites have a versatility which allows them to be used for a great variety of programs. They all have a large number of instrument and control lines which tie them to control and instrument data recording buildings. The control and instrumentation system is so interconnected that all Sites can make use of the same control and instrumentation equipment. The Station's digital computer can also be utilized by these Sites, and a remote control TV system is available for each Site. All test areas have explosion-proof wiring, separate remote heating plants, burn-offs (to dispose of unwanted gases), shops, shop office space, restrooms, locker rooms, storage areas, and all except I, J, and F have rail sidings on which large quantities of propellants or gases are moved and connected to the Site's outside piping. The Sites also receive large portable truck high pressure gas and propellant trailers. Both cryogenic and non-cryogenics can be used. Each Site has a bank of high pressure gas storage cylinders and distribution system. Most of the test areas have their own high pressure hydraulic system. They are also connected to the Station service air system, and communications and warning systems. Their construction is permanent type, of steel and reinforced concrete.

"A" SITE:

The test building has a test area of 1,605 SF, a concrete instrumentation room of 240 SF, a concrete controls room of 240 SF, and a concrete electrical-mechanical room of 192 SF. The test area has two large steel bedplates and two 16-foot high, 3-ton capacity crane rails overhead. Four sets of railroad tracks lead up to the outside gas and liquid piping. It has an air-driven, 10,000 HP turbine for driving research test units. 200 PSI service air can be heated to 1,000° to drive the turbine. A nitrogen gas storage bank holds 49,000 SCF at 2400 PSI.

The Site Shop Building has 1,763 SF of shop area, 568 SF storage area, 140 SF of locker room, 102 SF of tool crib, and 139 SF of shop office area. There is a 13-foot crane rail through the shop area and it has a 12-foot x 12-foot door.

"C" SITE:

The test building has 2,093 SF of test area. One test area has a steel bedplate; another test area has a 2,500-gallon vacuum jacketed, stainless steel, liquid hydrogen tank. Test units can be driven by an air turbine which is located on the outside of the tank. A shaft through the bottom of the tank connects to test hardware. 125 - 200 PSI service air is heated by the Site air heater to drive the turbine.

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"C" SITE (Cont.)

The Site is equipped with its own vacuum pumps and can receive high pressure gas from rail cars as well as truck trailers. 13,000-gallon liquid hydrogen and liquid nitrogen trailers can connect to the Site's outside piping system.

The test building has 369 SF of storage area, a 242 SF vacuum pump room, a 740 SF instrument room, a 240 SF control room, a 224 SF mechanical room, and a 234 SF electrical room.

The Site Shop Building has a shop area of 1,722 SF, with a 13-foot high crane rail. There is a storage area of 580 SF, locker room of 224 SF, and shop office of 139 SF.

The Site has a high pressure gas storage bank (2400 PSI), for a total storage capacity of 29,200 SCF.

"D" SITE:

The test buildings have a test area of 1,511 SF, with two steel bedplates and two crane rails, 15-foot high, of 5-ton and 1½-ton capacities. There is an electronics shop and office area of 540 SF, electrical and mechanical room with 242 SF, control room with 242 SF, instrument room with 242 SF, 400-gallon LH<sub>2</sub> tank room, 30-gallon LO<sub>2</sub> tank room, and two rooms equipped to run gas generators - 399 SF.

The Site has a gas storage bank for high pressure gas (2400 PSI), 30,000 SCF; and gas rail cars can connect into the Site as well as truck dewars and gas trailers.

The Site Shop Building has a shop area of 1,763 SF with a 2-ton crane rail. There is 568 SF of storage area, a 240 SF locker room, 108 SF tool crib, and a 139 SF shop office.

"E" SITE:

This is a 7-story, metal covered tower which is 144 feet high. The first floor test area is 835 SF. The other 6 floors are 448 SF, and encircle a 14-foot diameter well on one side and a rectangular well, 6-foot x 12-foot, on the other side, that extend through the full height of the tower. There are sliding doors and removable front door spandrels at all of the levels, providing a full-length access to the 14-foot diameter well. An elevator provides access for personnel and there is an outside stairway. There is a 20-ton bridge crane with a 93-foot maximum hook height, and a 10-ton bridge crane with a 130-foot hook height.

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"E" SITE (Cont.)

The test area has a 472 SF instrument room area, 294 SF control room area, 231 SF electrical-mechanical room area, and a 442 SF equipment room area.

The Site Shop Building has a shop area of 803 SF and a tool crib area of 138 SF.

The Site can be supplied by railroad gas and liquid cars, as well as by truck trailers.

"F" SITE:

This test site building has three test areas; 1,919 SF, 1,239 SF, and a mezzanine with 1,102 SF. It is equipped to do a wide range of hydraulic testing using hydrogen and other cryogenic liquids, as well as non-cryogenic liquids. The Site has a high pressure, 1,000-gallon liquid hydrogen dewar.

The Shop area is 816 SF, the instrument room 394 SF, the control room 338 SF, and the electrical-mechanical room is 282 SF.

The Site has an outside gas storage area with a capacity of 79,000 SCF.

"I" SITE:

The Site test area is 855 SF, the instrument area is 185 SF, the control room area is 94 SF, and the mechanical equipment area is 92 SF. The test area has a 12-foot, one-ton capacity crane rail.

The Site is equipped with an air-driven turbine which is used to drive research test units of sizes up to 200 HP and speeds up to 20,000 RPM. Service air at 125 - 200 PSI is supplied to the Site from the Station's service air system.

A 2,400 PSI gas storage bank for 29,200 SCF gas is located at this Site.

The Shop Building has a 744 SF shop area, 334 SF storage area, and 132 SF equipment room.

The Boiler Building has a 148 SF safety wash room which is equipped with bath and shower equipment.

"J" SITE:

The test area of this Site is installed in a 38-foot diameter steel containment vessel. The floor area is 558 SF and is equipped with a 2-ton, 16-foot high crane rail. This hydraulics laboratory is equipped to test liquid fluorine and liquid oxygen under pressures up to 1,200 PSI.

A 254 SF control tank is located near the test area.

The Site Shop has a shop area of 1,712 SF with crane rails 13-foot high. The locker rooms are 343 SF, there is a 77 SF safety shower room, and there are two offices - 153 SF and 120 SF.

"K" SITE:

The test building was a renovated concrete power plant building built in the early 1940's. It has a test area which is a 25-foot diameter spherical tank with a 20-foot diameter access door. In this tank, hydrogen fuel tanks up to 18 feet in diameter can be tested. Vacuum conditions can be maintained, and the tank can also be actuated by hydraulic actuators. The Site has a large clean area to install insulation on tanks and assemble test items. There is also a 2,455 SF shop area, a 245 SF tool crib, 223 SF locker room, and 426 SF shop office. There is also a 180 SF control terminal room, and a 2,969 SF instrument terminal room.

The Site Control Building has an 826 SF control room, 166 SF instrument room, 215 SF mechanical equipment room, and 125 SF office.

The Site Boiler House is 1,047 SF, and it supplies steam to the Site heat exchanger which is used in research programs.

The Site's 2,400 PSI gas storage bottle racks hold 198,700 SCF, and its LN<sub>2</sub> dewar holds 7,000 gallons. Railroad and truck gas trailer and liquid dewars serve the Site.

CONTROL &  
DATA SYSTEMS: (B- and H- Buildings)

GENERAL: These buildings are made of reinforced concrete, and the control rooms for 10 research sites are located in these buildings (B-Building has control rooms for 4 research sites, and H-Building has control rooms for 6.) Over 13,000 electrical lines in instrument and control cables enter these buildings. Closed circuit television systems allow operators to view research tests at the test site. Data recording and control equipment are located here.

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CONTROL &  
DATA SYSTEMS (Cont.)

B- AND H-  
BUILDINGS

B-CONTROL BUILDING: This building has a gross square foot area of 11,508, and has 14 rooms which include: 5 control rooms, a terminal and instrument room, an acquisition data instrumentation and computer room, an instrument room, office, an equipment room, and a utility and observation room. (A 225 SF sheet metal building next to this building houses an emergency power generating unit.)

Low level and high level instrumentation signals are sent to patchboards and relays via land lines. Each of the larger test sites has a control room which contains numerous meters and recording devices. Patchboard inter-wiring permits any control room to use another's recording equipment.

Instrumentation currently installed includes:

1. Six 8-channel Brush recorders
2. Three 50-channel Oscillograph Recorders
3. One 100-channel Events Recorder
4. Forty-eight Differential DC Amplifiers

An XDS-9300 data computer displays research parameters of calculated data in engineering units. It is used on-line, or immediately after a test run to enable researchers to quickly analyze data to make decisions quickly for a next run. The computer also provides digital displays in engineering units to assist operating engineers to run the facility. The computer can check out site instrument systems to assure accuracy, and save on manpower and time. The computer has a 32,000-word memory, split into sectors of 16,000, 8,000, and 8,000. Auxiliary equipment for the computer includes:

- 4 Tape Transports
- 1 250,000-word Rapid Access Disc (RAD)
- 2 Mini-computers with 180,000-word RADs to interface with graphics and inputs
- 5 Cathode Ray Displays
- 1 Printer
- 1 Houston Plotter
- 1 Versatec Printer/Plotter

H-CONTROL BUILDING: This reinforced concrete building has a gross SF area of 12,258. It is divided into 15 rooms which include a data recording and computer room, data recording and equipment room, control rooms, electronic equipment shop, calibration room, and offices.

All the test sites in the central part of the Station can utilize the recording and processing equipment in H-Control Building. Overhead

CONTROL & DATA  
SYSTEMS (Cont.)

H-CONTROL  
BUILDING (Cont.)

lines from the sites terminate in patchboards and a switching matrix for routing to analog and digital recording equipment.

The following equipment is currently installed:

1. Two Central Record Trains (CRTs) to record prime digital data at sampling rates between 2,000 HZ and 31,000 HZ. Six hundred datachannels from a test site can be recorded in random sequence. Seven low-level input subsystems which digitize the Site data are slaved to the CRTs. Two of them may be placed within H-Control Building to digitize data from the smaller test sites. The subsystems can be moved from Site to Site, or merged to achieve a 600-channel capability. The individual seven subsystems have the following capability:
  - 1 - 400-channel
  - 5 - 200-channel
  - 1 - 100-channel
2. Two 8-channel Brush Recorders for playback of digital data from the 20 D/A Converters on the CRTs.
3. Three 14-Channel FM Recorders for 0-10 KHZ analog data.
4. Two 36-channel Oscillograph Recorders.
5. One Master Timing Generator.

- - OTHER STATION BUILDINGS & SERVICE AREAS - -

AIR COMPRESSOR  
BUILDING:  
(5131)

This is a concrete and brick building built over 30 years ago. (See "Service Air System", Page 4, of this report for list of equipment in the building.) The building has a gross square footage of 9,174 SF, and almost half of this area is used for storage.

GAS HANDLING

AREA: (5331,  
5332, 5333,  
& 5334)

This area has 4 buildings, two permanently installed dewars (one 28,000-gallon liquid nitrogen and one 18,000-gallon liquid hydrogen), and vaporizers to take liquid hydrogen or liquid nitrogen and convert it to high purity, high pressure gas (2,400 PSI or 5000 PSI).

Also, Helium railcars can be unloaded here and truck gas trailers pressurized with the stationary compressors. The 11-year old buildings are of metal construction.

The Helium Building (5331) is used for shop and office area, as well as to contain the helium compressors that can accept inlet pressures as low as 1/2 PSI and repressurize to 2,000 PSI, at 390 SCFH. The building gross floor area is 2,098 SF.

The Nitrogen Building (5332) has two vaporizers and a control room. Its gross floor area is 1,180 SF. The vaporizer can convert LN<sub>2</sub>, LOX, Liquid Methane, and Argon to 5,000 PSI at 178,000 SCFH.

The Hydrogen Building (5333) has two vaporizers and a control room. Its gross floor area is 1,000 SF. Vaporizers can convert LH<sub>2</sub> to 5,000 PSI at 140,000 SCFH.

The Storage Building (5334) is where gas cylinders are stored. Its gross floor area is 1,673 SF.

MAINTENANCE

SHOP: (7121)

The Station Maintenance Shop is over 30 years old. It has cement block walls and a wood roof, and has a gross SF area of 23,896.

It has a 4,183 SF Machine Shop; 4,300 SF Sheet Metal Shop; 4,340 SF Pipe and Welding Shop; (with four welding booths); 2,295 SF Instrument Shop; 1,542 SF Precleaning and Disassembly Area; 1,109 SF Clean Room; 464 SF Hydraulics Room; 1,344 SF Tool Crib Area; and nine Shop Offices.

The Shop is equipped with machine tools and related equipment, as well as facilities for fabrication, testing and installation of T.C.s, strain gages, and pressure probes. There are also facilities for build-up and checkout of control systems and valves.

There are high pressure gas bottle storage racks for 84,500 SCF.

The Class 10,000, Clean and White Room is fully equipped with eight stainless steel cleaning tanks with glass liners (2' x 2' x 3'), and exhaust hoods. The ultrasonic cleaning tank is 5' x 4' x 3' deep. Hot and cold water, as well as acetone, NASA-500, 2,400 PSI nitrogen are available in the room. There is also packaging

MAINTENANCE  
SHOP (Cont.)

equipment (sealers, plastic bags and tubing). The room has laundry facilities for white room uniforms, a laminar flow bench (Class 100 exhaust air across bench), an automatic gage cleaning console, and an Airquipt spacecraft brazing (induction) unit.

CARPENTER  
SHOP: (7122)

This Shop is over 30 years old and is of wood construction. Its gross square foot area is 4,269 SF, which includes a shop area, storage and office areas. The Shop is equipped with woodworking tools and machines, to do the Station's maintenance work.

LOCOMOTIVE  
SHOP: (7123)

The main part of this Shop is over 30 years old. A 1,680 SF addition was added in the last 10 years. It is brick construction with large doors, and two railroad tracks run almost the length of the building. The gross area is 5,810 SF.

A 13,000-gallon LN<sub>2</sub> dewar is located outside the building, as well as a bank of helium gas bottles (47,000 SCF) and a bank of Nitrogen bottles (50,000 SCF). All of these gases and liquids are piped into the building.

GARAGE:  
(7131)

The garage is of brick, concrete, and wood construction and has 6,386 gross SF of area. It has an automotive repair area; heavy equipment repair area; large, 334 SF, paint spray area; and storage rooms.

ENGINEERING  
BUILDING:  
(7141)

This is a modern, air-conditioned brick building with a gross SF area of 57,625. An Assembly Area that will hold 550 people, and a Cafeteria that will accommodate 150 to 200 people are a part of this building. The 4,322 SF Assembly Area can be divided into three separate areas. There is a 739 SF Library, and an IBM 1620 computer with disk and tape drives, punch, printer and all other associated equipment. The building has four Conference Rooms and 69 individual offices.

ADMINISTRATION  
BUILDING (7144)

This wooden building is over 30 years old and was built as a temporary structure during World War II. The building is 25,700 SF gross area. It has a Print Shop with Ozalid machine, Xerox copier, offset press, platemaker and all associated equipment.

Three large vaults are located in the building and these have a total area of 610 SF.

There are four Conference Rooms and 53 individual offices.

PLANT PROTEC-  
TION BUILDING:  
(7231)

This wooden building is over 30 years old and houses the Station plant protection equipment. It has an area of 4,931 SF gross. It has a 2,769 SF garage area with six bay areas. It has four office areas, a stockroom, tool room, and work shop area.

BIG ISLAND  
PUMPING  
STATION:  
(8131)

This building is located next to the City of Sandusky's water intake. It has an area of 3,756 gross SF. (For information on its pumping equipment, see 'Raw Water System', Page 3, item in this report.)

RYE BEACH  
PUMPING  
STATION:  
(8132)

This concrete pumping station is located on Lake Erie, about 6 miles from the Station. The equipment is listed under 'Raw Water System', Page 3, of this report. The building has an area of 6,424 gross SF.

PUMP STATION  
NO. 1: (8133)

The concrete and brick building has a gross SF area of 2,873 SF. The building is located next to the Station's 5,500,000 gallon reservoir. (See 'Raw Water System', Page 3 of this report, for data on pumps.)

OFFICE BUILDING:  
(7142)

This wood construction building is over 30 years old. It has eleven individual offices with a total gross SF of 2,456. It is presently being used by the Department of Interior under a Use Agreement.

CHEMICAL  
LABORATORY:  
(7143)

This is a tile block building that has been modernized within the last 8 years. It has a 1,003 SF Laboratory, two smaller Laboratories of 94 SF each, an 115 SF Office, and a 175 SF Stockroom.

GUARD HOUSE  
(TAYLOR ROAD):  
(7191)

This wood building is the guard house for the Station's Main Gate. It has a gross area of 200 SF.

MEDICAL SERVICES  
BUILDING AND  
COMMUNICATIONS  
CENTER: (7192)

This brick medical services building has a gross area of 4,703 SF. The medical services area includes an office, a diathermy room, and two examination rooms. There is also an 1,101 SF garage, and a 552 SF storage area; and on the second floor is the Station Communications Center, 417 SF, and a 213 SF dormitory.

PHOTO LAB &  
HEATING  
PLANT: (7193)

This brick building has a gross area of 1,972 SF. It houses the Administration Building (7144) boiler plant in a 230 SF boiler room; and the rest of the building is used for the Station Photo Lab, which has a studio, darkroom, dryer room, storage rooms, and an office.

DOMESTIC  
WATER PUMP  
HOUSE: (8231)

The 30-year old, wooden construction building is located next to the domestic water reservoir. The building has 336 SF of space. (See "Domestic Water System", Page 2 of this report, for data on the pumps.

SEWAGE PLANT  
BUILDINGS:  
(8331, 8332,  
& 8337)

The Station is located 1/2 mile from the Plum Brook Station proper, and has three main concrete and brick buildings, a sewage pumping station, sewage pump and chlorine building, and a sewage chemical building. It also has a chlorine contact tank, mixing chamber, settling tank, digesting tank, sludge beds, flocculator and final settling tank, diversion chamber and trickling filter.

Information on the Sewage System is detailed elsewhere (Page 3) in this report under "Sanitary Sewer".

POWER HOUSE  
NO. 1: (8531)

The Power House boilers are inactive. Only a small portion of the building is being used - 1,357 SF for the electrical switchgear room, and 4,521 SF for an electrical shop, electrical storage room, electrical equipment garage, and electrical shop office area. The building has an area of 21,437 SF (gross).

POWER HOUSE  
NO. 2: (8532)

The Power House boilers are inactive. It has a gross square footage of 21,437, and the building is being used for equipment storage.

SUBSTATION "A":  
(8561)

This brick and concrete building is located at the Station's main substation. It is the Station's electrical power control room. The building has 837 SF of floor space and besides the control room it has a battery room and storage room.

STORAGE IGLOOS:(9101 thru  
9199)

There are 99 storage igloos which are constructed of concrete covered with earth. There are no utilities connected to these structures but due to their construction the temperature does not go below 32°F. They have a natural ventilation system. Each unit has 1,789 gross SF area (26½ feet x 60½ feet, inside dimensions).

WAREHOUSES: (9201, 9202, 9203, 9204, 9205, 9206, 9207, 9208, 9209, 9210, 9211, 9212, 9213, 9214, 9215)

These buildings are located throughout the Station. Their total gross square footage is 85,690 SF. Building 9213 is a metal building, about 10 years old; the rest are over 30 years old and are constructed of various materials - metal, wood and block, or combinations of these. Building 9209 is used for Station Shipping & Receiving and also for a Stockroom. It has a gross square footage of 9,990 SF. Only two other storage buildings are heated (9210 and 9215), which have a gross square footage of 21,960 SF.

MAJOR  
EQUIPMENT:

Railroad Equipment: The Station has a railroad locomotive; 6 flat cars and two railroad cranes - 25 Ton and 40 Ton; 2 high pressure gas cars (550,000 pounds each) and 5 smaller cars with a total gas capacity of 2,030,000 SCF; 4 (34,000 gallon) liquid hydrogen dewar cars.

Truck Trailers: There are 37 high pressure gas tube trailers with a total SCF of 2,204,000.

There are 15, LN<sub>2</sub> Dewars with a total capacity of 55,300 gallons; 8, LH<sub>2</sub> Dewars with a total capacity of 73,900 gallons; and 2, LO<sub>2</sub> Dewars with a total capacity of 5,800 gallons.

Emergency Equipment: The Station has one ambulance and two fire trucks.

RADIO EQUIPMENT  
AND COMMUNICATIONS  
CENTER:

The Station has 12 base radio stations, 22 mobile units, and 22 portable units. All units can be set between 150 to 174 MHZ frequency by the installation of the proper crystals. They can also send and receive on 4 different frequencies.

The Station has a Communications Center which monitors all radio channels, abnormal conditions in test areas (a 100-panel annunciator is located at this center), and emergency telephone calls.