HISTORICAL NARRATIVE OF THE X-533 ELECTRICAL SWITCHYARD COMPLEX

Portsmouth Gaseous Diffusion Plant
Piketon, Ohio

This document is approved for public release per review by:

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PORTS Classification and Information Officer    Date
HISTORICAL NARRATIVE
for the
X-533 ELECTRICAL SWITCHYARD COMPLEX
at the Portsmouth Gaseous Diffusion Plant
Piketon, Ohio

February 2010

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managing the
Environmental Remediation Activities at the
Portsmouth Gaseous Diffusion Plant
under contract DE-AC24-05OH20192
for the
U.S. DEPARTMENT OF ENERGY
PREFACE

This narrative on the X-533 Electrical Switchyard Complex at the Portsmouth Gaseous Diffusion Plant (PORTS) has been prepared in accordance with requirements of the Action Memorandum for the Removal of the X-533 Switchyard Complex at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE/PPPO/03-0107&D1; LPP-0294/R6), under the Comprehensive Environmental Response, Compensation and Liability Act. The X-533 Action Memorandum includes information that meets the substantive requirements of the National Historic Preservation Act and implementing regulations at 36 CFR 800, prior to the decontamination and decommissioning of the X-533 Electrical Switchyard. The narrative on the X-533 Electrical Switchyard Complex is submitted to the Ohio Historic Preservation Office (OHPO) to provide documentation of the facility’s historical significance to the overall gaseous diffusion plant, how it supported the uranium enrichment operations at the site, and highlights the construction, use and physical features of the electrical switchyard that contributed to the historic property at PORTS. In addition to the descriptive narrative, maps, drawings and photographs of the X-533 Electrical Switchyard Complex are included in the documentation.
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<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEC</td>
<td>Atomic Energy Commission</td>
</tr>
<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
</tr>
<tr>
<td>EE/CA</td>
<td>Engineering Evaluation/Cost Analysis</td>
</tr>
<tr>
<td>GDP</td>
<td>gaseous diffusion plant</td>
</tr>
<tr>
<td>OHI</td>
<td>Ohio Historic Inventory</td>
</tr>
<tr>
<td>OHPO</td>
<td>Ohio Historic Preservation Office</td>
</tr>
<tr>
<td>OVEC</td>
<td>Ohio Valley Electric Corporation</td>
</tr>
<tr>
<td>PORTS</td>
<td>Portsmouth Gaseous Diffusion Plant</td>
</tr>
<tr>
<td>PPPO</td>
<td>Portsmouth/Paducah Project Office</td>
</tr>
<tr>
<td>USEC</td>
<td>United States Enrichment Corporation</td>
</tr>
</tbody>
</table>
1. BACKGROUND OF PORTSMOUTH GASEOUS DIFFUSION PLANT

The Portsmouth Gaseous Diffusion Plant (PORTS) was built between 1952 and 1956 by the Atomic Energy Commission (AEC), a predecessor of the U.S. Department of Energy (DOE), in a rural area of southern Ohio, east of the Scioto River on a 5.8-square mile site. The plant was the last of three gaseous diffusion plants built in the United States for enriching uranium for national defense purposes at the height of the Cold War.

In August 1952, the AEC selected a tract of land in the Ohio Valley near the Scioto River in Pike County for the site of the Portsmouth Gaseous Diffusion Plant (See Figure 1). Site selection was based on the availability of a vast expanse of relatively flat terrain – the original tract was 4,000 acres – as well as availability of large amounts of electrical power, a dependable source of water, local labor and suitable transportation routes.

In March 1956, the plant was completed six months ahead of schedule by construction contractor Peter Kiewit and Sons of Nebraska at a cost of $750 million, considerably less than the estimated $1.2 billion construction cost. Construction required 69 million man-hours, more than 68,000 drawings and as many as 22,500 construction workers at its peak in the summer of 1954. More than 1,200 acres were cleared and more than 4.5 million cubic yards of earth were moved.

In the 1960s, the Portsmouth plant’s mission changed from enriching uranium for nuclear weapons to one focused on producing enriched uranium for use in nuclear submarine reactors and commercial nuclear power plants. Production of highly enriched uranium was suspended in 1991. Until 2001, the Portsmouth plant and its sister plant in Paducah, Kentucky, worked in tandem to enrich uranium for use in nuclear power plants. The Paducah plant enriched uranium up to 2.75% Uranium-235 and then shipped it to Portsmouth for further enrichment to approximately 4% to 5%.

Enrichment operations ended at the Portsmouth plant in May 2001. Today, the Paducah Gaseous Diffusion Plant in Kentucky is currently the only operating uranium enrichment plant in the country.

1.1 SURROUNDING AREA OF PORTS

The terrain surrounding the PORTS facility, with the exception of the Scioto River floodplain, consists mainly of marginal farmland and densely forested hillsides. The Scioto River floodplain is extensively farmed. PORTS is situated on a 3,777-acre parcel of DOE owned land. Twelve hundred acres of DOE’s property are located within the facility’s Perimeter Road and comprise the centrally-developed portion of the facility (See Figure 2). Five hundred acres of the land within the Perimeter Road are fenced for controlled access. Approximately 190 buildings are located within PORTS, and there are numerous utility structures on the site. The DOE owned land outside the Perimeter Road is used for a variety of purposes, including a water treatment plant, holding ponds, sanitary and inert landfills, cemeteries, and open and forested buffer areas. The majority of the site improvements associated with the gaseous diffusion plant (GDP) are located within the fenced area. Within this area is the core gaseous diffusion plant including the three large process buildings and auxiliary facilities that are currently leased to the United States Enrichment Corporation (USEC). These areas are largely devoid of trees, with grass and paved areas dominating the open space. The remaining area within Perimeter Road has been cleared and is essentially level.
Figure 1. Portsmouth Gaseous Diffusion Plant (PORTS) Vicinity Map.
Figure 2. Aerial Photograph of the Portsmouth Gaseous Diffusion Plant Site.
1.2 ARCHITECTURAL SURVEY OF PORTS CONDUCTED TO INVENTORY SITE FACILITIES

A Phase I Architectural Survey was performed at the PORTS site in 1996-1997, in accordance with Sections 106 and 110 of the National Historic Preservation Act of 1966, as amended. The purpose was to compile an inventory of the standing buildings, structures and facilities on plant site and identify any historic properties at the site. The Architectural Survey report provided an inventory of all facilities and structures at the plant. Ohio Historic Inventory (OHI) forms were prepared to document each facility, identifying building/facility number, description, building construction and significance of the facility.

The PORTS facility is considered eligible for the National Register of Historic Places under Criterion A and Criteria Consideration G within the historic contexts of military and industry. The significance lies in its association with the massive expansion of the U.S. nuclear weapons program at the start of the Cold War.

An update of the draft Phase I Architectural Survey report was provided by DOE to the Ohio Historic Preservation Office (OHPO) in 2008. Several communications have transpired since the initial report submission and consultation between the two agencies continue to complete the documentation. The draft Phase I Architectural Survey report provides a recommended historic district boundary within the gaseous diffusion plant areas.

The X-533 Electrical Switchyard Complex is located within the historic district and is considered a contributing resource to the historic property of PORTS due to its construction during the initial construction phase of the gaseous diffusion plant and its overall significance in supporting the uranium enrichment process by providing large amounts of electrical power for the X-333 process building and support facilities.

1.3 DECISION TO DECONTAMINATE AND DECOMMISSION THE X-533 ELECTRICAL SWITCHYARD COMPLEX

Based on the outcome of a Real Property evaluation process, DOE determined the X-533 Electrical Switchyard Complex was excess to DOE’s PORTS mission. There was a threat of releasing hazardous substances into the environment from the X-533 Switchyard Complex due to its deteriorating condition. DOE determined in 2009 that disposition of the X-533 Switchyard Complex structures was appropriate, based on no future use of the switchyard and associated facilities. Additionally, the deteriorated condition of the X-533 Switchyard Complex and an assessment of the cost to upgrade/replace the switchyard and its associated structures as compared to disposition were factored into the decision-making process.

An Engineering Evaluation/Cost Analysis for the X-533 Switchyard Complex at the Portsmouth Gaseous Diffusion Plant, documenting the evaluation of alternatives for the non-time critical removal action of the switchyard was provided to the OHPO, consulting parties, the PORTS Site-Specific Advisory Board, and public for a 30-day public comment period between November 3, 2009 and December 4, 2009.

1.4 DESCRIPTION AND OPERATIONS OF THE X-533 SWITCHYARD COMPLEX

The X-533 Switchyard Complex is a high voltage switchyard that furnished electric power to the cascade in the X-333 Process Building. It was completed in 1956 and was upgraded during the plant improvement program conducted in the 1970s. While in active use (1954 until being de-energized in
November 2008), it received power from the Ohio Valley Electric Corporation (OVEC) grid at 345kV nominal and power was stepped down to 13.8 kV for distribution to the process building and area auxiliaries. The X-533 is located in the northern portion of PORTS in Quadrant IV at coordinates N12000, E9000. As presented in Figure 3 and Table 1, the X-533 Switchyard Complex is comprised of the following:

- The 770,000 ft² equipment switchyard area (X-533A)
- A two-story control room with two switchgear houses (X-533B)
- A general maintenance crew area for housing the yard maintenance equipment and performing minor maintenance activities (X-533C)
- An oil pumping/reclaiming station (X-533D)
- Two below-ground head houses for housing the fire water valves used to transition the fire water system from a wet to dry system for transformer fire suppression (X-533E and X-533F)
- A metal pole barn type structure for housing the sulfur hexafluoride (SF₆) reclamation cart, spare SF₆ cylinders, and an air monitoring station (X-533J)
- An outbound transformer cleaning slab

Ages, plant coordinates, sizes, and construction for the individual buildings of the X-533 Electrical Switchyard Complex are listed below:

<table>
<thead>
<tr>
<th>FACILITY</th>
<th>IDENTIFICATION</th>
<th>DATE BUILT</th>
<th>FACILITY COORDINATES</th>
<th>SQ FT</th>
<th>CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-533A Switchyard</td>
<td>1954</td>
<td>N 12200, E 9000</td>
<td>772,174</td>
<td>Limestone gravel bed</td>
<td></td>
</tr>
<tr>
<td>X-533B Switch House (Control House)</td>
<td>1955</td>
<td>N 11900, E 9000</td>
<td>148,874</td>
<td>Steel-framed, transite</td>
<td></td>
</tr>
<tr>
<td>X-533C Test &amp; Repair Facility</td>
<td>1955</td>
<td>N 12200, E 9500</td>
<td>1,200</td>
<td>Steel-framed, transite</td>
<td></td>
</tr>
<tr>
<td>X-533D Oil House</td>
<td>1955</td>
<td>N 12300, E 8600</td>
<td>500</td>
<td>Steel-framed, transite</td>
<td></td>
</tr>
<tr>
<td>X-533E Valve House</td>
<td>1955</td>
<td>N 12000, E 9600</td>
<td>500</td>
<td>Reinforced concrete</td>
<td></td>
</tr>
<tr>
<td>X-533F Valve House</td>
<td>1955</td>
<td>N 12200, E 8400</td>
<td>500</td>
<td>Reinforced concrete</td>
<td></td>
</tr>
<tr>
<td>X-533H (Renamed X-533J) Gas Reclaiming Cart Garage</td>
<td>1985</td>
<td>N 12300, E 9500</td>
<td>1,200</td>
<td>Metal sides, roof</td>
<td></td>
</tr>
</tbody>
</table>

Switchyard equipment includes power transformers, grounding transformers, synchronous condensers, oil circuit breakers, lightning arrestors, disconnect switches, potential transformers, coupling capacitors, line tuning units, and wave traps.

The X-533A Switchyard is an open yard enclosed by a perimeter fence on three sides, and the switch houses on the south. The bed of the switchyard contains 1 to 3 feet of 2 to 3 inch diameter limestone cobbles, underlain by clay soils: Above the soils and below the limestone are a series of north-south french drains, high-voltage electrical cables, and a grounding grid. The eastern half of the switchyard drains into Storm Sewer L, which flows into the X-230J6 Holding Pond before discharging to Little
Figure 3. Location of X-533 Switchyard Complex Within PORTS.
Beaver Creek via an unnamed tributary. The western half of the switchyard drains into Storm Sewer K, which flows into the X-230L North Holding Pond before discharging to Little Beaver Creek via an unnamed tributary.

Over the more than 53 years the X-533 switchyard was in service, there were various documented incidents, a few of which are mentioned below. These are not meant to be all inclusive. One of the more serious incidents occurred in July 1955 with an explosion in a synchronous condenser.

In 1956, a fire occurred at Transformer #308, and in 1963, a fire occurred at transformer #305 (I-120) at the X-533A.

An oil spill occurred at the United States Enrichment Corporation-leased and operated X-533 Switchyard on April 8, 1999, when the main tank of Transformer #309 ruptured and released oil. The transformer’s rated capacity was 9,800 gallons; at the time of the release, the transformer was estimated to have contained 9,500 gallons of mineral oil. Prior PCB analysis of the oil in Transformer #309 indicated a PCB content of <2 parts per million. Approximately 1,200 to 1,300 gallons of oil were later recovered from the transformer, leaving 8,200 to 8,300 gallons of mineral oil presumed released.

The released oil discharged from the switchyard drainage system into Storm Sewer L and then into the X-230J6 Northeast Holding Pond. The oil diversion equipment was successful in containing the oil within the oil containment basin for subsequent removal with on-site vacuum trucks. Approximately 23,000 gallons of oil/water were recovered and transported to treatment facilities. Oil was also collected through other recovery methods (e.g., absorbent cloth). Water samples taken every four hours during the 24-hour period following the spill indicated that the National Pollutant Discharge Elimination System daily discharge limitations for oil and grease (15 mg/L) and PCBs (“no detectable amount”) were not exceeded (Taimi 1999).

The X-533B switchgear houses received power from the switchyard transformers and fed that power to the underground distribution system. The X-533B Switch Gear Houses supplied power to the X-333 Process Building and to the X-633 Pump House via 13.8 kV feeder cables housed in concrete ducts.

The X-533B switchgear houses and the control house run parallel to the length of the switchyard and are located on the southern boundary line of the X-533 Switchyard Complex. The control house is located between the switchgear houses and is connected to each switchgear house operating deck by a walkway from the operating floor level of the control house. Underground cable tunnels also connect the switch houses with the control room.

The X-533B switchgear houses are one-story, rectangular structures, 67 feet wide by 424 feet long. Foundations for the building, equipment, and cable tunnels are reinforced concrete, and the floor slab is reinforced monolithic concrete placed on compacted fill. The superstructure is a structural steel frame with columns that support steel roof-beam members. The roof is a reinforced concrete slab covered with membrane waterproofing and a cement topping. The roof area of the switchgear house is a deck area which contains the 13.8 kV switchgear and the synchronous condensers. A parapet wall projects above the roof deck slab, and for personnel safety, there is a pipe railing on top of the parapet wall. The exterior walls are covered with a corrugated asbestos siding bolted to horizontal steel girt. Aluminum flashing covers the parapet wall and the top of the siding. The ground floor houses auxiliary equipment such as synchronous condenser controls and pumps, switchgear air compressors, low-voltage switchgear, heating and ventilating equipment, distribution transformers and panels, and lighting transformers and panels.
The X-533B control house is a two-story rectangular structure, 67 feet wide and 120 feet in length. The building and equipment foundations are reinforced concrete and the ground floor slab is a monolithic concrete slab placed on compacted fill. The second floor or operation floor is also reinforced concrete. The construction of the superstructure of this building is similar to that of the switch house; differences include the roof construction, which is built up with a gravel topping, and the exterior walls, which are covered with an aluminum siding bolted to horizontal steel girt.

The operating floor of the X-533B control house contains two groups of panels for control of 345 kV and 13.8 kV equipment, one recording and metering control panel, and two groups of 13.8 kV switchgear controls. An operator’s console, which is part of the communications system, is located in the approximate center of the operating floor, and a control panel for lighting and auxiliary power is located behind the recording and meter panel. The operator’s floor also contains kitchen, restroom, and shower facilities.

The control house ground floor houses carrier current equipment, batteries and chargers, supervisory cabinets, alarm relay cabinets, heaters, ventilating and air conditioning equipment, and synchronous condenser amplifying and field rheostat controls.

The X-533C test and prepare building is a general maintenance crew area for housing the yard maintenance equipment and performing minor maintenance activities.

The X-533D Oil House is approximately 500 square feet. Within this facility, oil from transformers and circuit breakers is drained, stored, filtered and refueled.

The X-533E and X-533F are two below ground head houses for housing the fire water valves used to transition the fire water system from a wet to dry system for transformer fire suppression.

The X-533H is a 1200 square foot metal garage for SF₆ storage and gas reclaiming cart Garage. The carts replenish circuit-breakers with SF₆ and are themselves recharged at the garage. Sulfur hexafluoride is used as an insulator in circuit breakers in the place of Askarel or mineral oil.

1.5 X-533 SWITCHYARD COMPLEX REMOVED FROM SERVICE

The uranium enrichment production and operations facilities at PORTS are leased by USEC. The lease between DOE and USEC is active through July 1, 2016, although some facilities may be returned to DOE on an earlier date. In addition to the leased facilities, USEC also leases many common areas including ditches, creeks, ponds, and other areas such as roads and rail spurs that are necessary for ingress, egress, and proper maintenance of facilities.

On November 1, 2008, while the X-533 Switchyard Complex was leased to USEC, it was de-energized and removed from service (DOE 2008). The X-533 Switchyard Complex was returned to DOE on July 29, 2009.
2. X-533 ELECTRICAL SWITCHYARD COMPLEX DESIGN

The X-533 Electrical Switchyard, is located in the northern portion of the Portsmouth Gaseous Diffusion Plant (within the Perimeter Road) and 200 feet north of the X-333 Process Building (See Figure 4). It provided power in the quantity and at the voltage required for the operation of the X-333 Process Buildings, attendant facilities, and for general purposes. The X-533 Switchyard complex was built between October 1953 and January 1956.

Electrical power was received at the X-533 substation over four 330-kV transmission lines of the Ohio Valley Electrical Corporation, two of the lines being extended from the Kyger Creek steam plant along the Ohio River in Gallipolis, Ohio, and the other two from the Pierce switching station and from the tie line to the X-530 Electrical Switchyard, another switchyard on plant site which is currently in operation.

The X-533 complex, including the switchyard, two switch houses, the control house and auxiliaries, were generally similar in design, appearance and arrangement to the X-530 electrical substation.

2.1 ARCHITECTURAL DESIGN

The switch houses at the X-533 Electrical Switchyard are each 458 feet long including an extension provided during the course of construction. The major portions of the buildings are 67 feet wide, while portions of both east and west units are 55 feet wide. The offset occurs in the south side of the structure facing the X-333 Process Building. The roof of each switch house supports four separate metal panel enclosures for switch gear and provides for two synchronous condensers mounted at the roof level. With the exception of fewer foundations for the synchronous condensers, the different locations of the fan rooms and the omission of the under-floor power tunnels, the architectural aspects of these switch houses are the same as the X-530 Electrical Switchyard. The substation control house is identical to the similar X-530 facility.

2.2 STRUCTURAL DESIGN

In general, the basic design of the X-530 and X-533 Substation buildings are the same. However, column spacing and the length and size of structural members for the switch houses vary as a result of differences in the amount and arrangement of equipment.

An underground power tunnel was provided only between the switch houses and the control house, power distribution lines from this substation being carried in underground ducts to the X-333 Process Building.

Foundations of the X-533 substation are generally similar to those of the X-530 facility still in operation. However, in the X-533 substation, the major portion of each switch house is supported on spread footings except for the section of the switch house housing the central 25,000 kva. synchronous condensers. This is supported on concrete piles drilled in place.
Figure 4. Aerial Photograph Showing Location of X-533 Electrical Switchyard Complex.
2.3 MECHANICAL DESIGN

The mechanical installations for the X-533 substation are similar in all respects to the X-530 substation.

2.4 ELECTRICAL DESIGN

The electrical design of the X-533 substation was predicated on receiving power over four 330-kV lines of the Ohio Valley Electric Corporation (OVEC) in accordance with mutual arrangements. Power requirements for the X-533 substation were estimated at 950 megawatts of 13.8-kV for the process area.

A single line diagram for the 330-kV and 13.8-kV systems was developed in conjunction with the Carbide and Carbon Chemicals Company for installation. The two substations, X-530 and X-533, were interconnected by a 330-kV line provided during the course of construction for interim power. The X-533 Switchyard was de-energized in November 2008.

2.5 X-533 ELECTRICAL SWITCHYARD

Switching arrangements on the 330-kV side were based on double buses and the “breaker and a half” scheme. Main buses consisted of aluminum tubing mounted on pedestal supported insulators. Eighteen oil circuit breakers rated at 330-kV, 1600 ampere, 25,000 mva. interrupting capacity, were installed for the lines, transformers, and bus sectionalizing. A total of fourteen power transformers, each rated 100 mva., were installed for reducing the power supply voltage from 330-kV to 13.8-kV. One of the fourteen transformers was a reserve for all the others. Each transformer was provided with equipment for changing taps under load and the high voltage neutral of each transformer was solidly grounded.

2.6 SWITCH HOUSES

Thirteen groups of outdoor-type, metal-enclosed, 13.8-kV switchgear with a combined total of 132 circuit breakers having 1,500-mva. interrupting capacity, were used for switching the process load feeders. The connections between the power transformers and respective 13.8-kV switch groups were made by means of 5,000 ampere bus duct of the isolated phase type. A reserve bus duct tie connected the reserve power transformer with all of the thirteen switch groups. The 13.8-kV system on each power transformer was grounded by means of a zig-zag grounding transformer.

Two 50-mva., 13.8-kV outdoor synchronous condensers were provided in the original design to supply power factor correction. Two more similar condensers were added to compensate for the 330-kV system voltage reduction required to reduce radio interference. Six 25-mva., 13.8-kV outdoor synchronous condensers were provided as a necessary condition for obtaining a firm contract from OVEC for the first 150 mw increment of power above the design level.

Each condenser was equipped with a wound-rotor induction motor and automatic control equipment for starting. One condenser was connected to each of ten secondary buses.

Power for the substation auxiliary equipment and lighting was supplied from two sets of 2300-volt and 440-volt, unit-type substations. Control power for all substation equipment was supplied from two 250-volt, station-type storage batteries.
2.7 CONTROL HOUSE

Control boards in the control house provided the necessary manual and automatic controls for breakers, power transformers, 13.8-kV switchgear, synchronous condensers, and auxiliaries. An automatic-recording annunciator system was provided to annunciate and record the occurrence of abnormal conditions of operation in major electrical equipment. In addition, circuit breaker operations, protective relay operations and many manual operations were also recorded. Remote control from the X-300 Plant Control Facility was also provided.
3. HISTORICAL CONSTRUCTION OF THE X-533 ELECTRICAL SWITCHYARD COMPLEX

The most expeditious and economical method of constructing the X-533 substation, including the switchyard, control house and switch houses, was considered to be by lump-sum subcontract, except for a portion of the architectural and structural components. Construction subcontracts were awarded for structural steel, roofing, siding, lathing and plastering, acoustical tile ceilings, asphalt tile flooring, glass and glazing, pneumatic dispatch system, equipment fire protection system and the electrical and mechanical components. Peter Kiewit Sons Company (the original construction contractor for the Portsmouth Gaseous Diffusion Plant), as contract administrator, expedited and coordinated the subcontract work. All construction not covered by subcontracts, as outlined above, was done by Peter Kiewit Sons Company with their own workforce. The construction subcontracts were:

- Construction subcontract CSC-171 to the Crawford Steel Construction Company, Inc., for the furnishing and erecting of the structural steel in connection with the control house and the two switch houses.

- Construction subcontract CSC-183 to Globe Automatic Sprinkler Company for furnishing and installing the equipment fire protection system.

- Construction subcontract CSC-184 to Brown and Kerr for furnishing and erecting the metal roof deck and built-up roofing for the control house, switch houses and test and repair shop.

- Construction subcontract CSC-188 to Charles S. Wood and Company for furnishing and installing all standard and special perforated-metal, acoustical tile ceilings and accessories in the control rooms of the control house.

- Construction subcontract CSC-190 to the Standard Asbestos Manufacturing and Insulation Company for furnishing and erecting aluminum panels, corrugated asbestos siding and roofing, interior and exterior louvers and related sheet metal items.

- Construction subcontract CSC-196 to Patterson-Emerson-Comstock Inc. for construction of the X-533 substation including architectural, structural, electrical and mechanical components.

- Construction subcontract CSC-213 to Portsmouth Glass Company for furnishing and installing all glass.

- Construction subcontract CSC-217 to the Thomas Moulding Floor Company, Inc. for furnishing and installing the asphalt tile flooring.

- Construction subcontract CSC-230 to the Standard Conveyor Company for furnishing and installing a pneumatic dispatch system between the X-533 substation and the X-333 process building.

- Construction subcontract CSC-232 to E.B. Carley Company, Inc. for the lathing, plastering and suspension system for acoustical tile ceilings.
3.1 X-533 SWITCHYARD CONSTRUCTION

3.1.1 X-533 Switchyard Foundation, Excavation and Backfill

The general site grading was done by Taylor Wheless Company prior to construction of the switchyard. Excavation for the switchyard footings and underground system was started November 9, 1953 and involved 20,000 cubic yards. Backfill was started on November 16, 1953 and amounted to 9,700 cubic yards. The excavation and backfill was completed November 16, 1954. Fine grading and placing of rock-fire fill and oiled stone was started in February 1955 and was completed in December 1955.

3.1.2 X-533 Switchyard Concrete

The first concrete was placed November 13, 1953. The whole job involved 60,400 square feet of forms, 5,850 cubic yards of concrete and 189 tons of reinforcing steel. The switchyard foundations were completed June 25, 1954 and all concrete work was completed on August 21, 1954.

3.1.3 X-533 Switchyard Structural Steel and Miscellaneous Iron

The structural steel and miscellaneous iron, excluding the high voltage switching structure, was erected during the period May 10, 1954 to August 21, 1954.

3.1.4 Painting and Glazing

The painting and glazing work was completed during the period August 9, 1954 to December 3, 1955.

3.1.5 Interior Fire Protection System

Excavation for the valve house was started December 21, 1953 and the structure was completed on December 1, 1954. There were 591 cubic yards of excavation, 116 cubic yards of backfill, 9000 square feet of forms, 145 cubic yards of concrete and 10 tons of reinforcing steel used. The fire protection piping and accessories were installed starting February 8, 1954 and the entire system was completed on January 25, 1956.

3.1.6 Interior Electric Lighting System

The installation of the interior electric lighting system was completed between August 9, 1954 and November 25, 1955 and consisted of over 30,000 feet of wiring and 100 lighting fixtures.

3.1.7 Electrical Conduit

The installation of approximately 57,000 lineal feet of conduit was completed between November 23, 1953 and November 26, 1955.
3.1.8 Oil Storage System

Excavation for the oil pump house was started February 15, 1954 and the structure was completed on November 24, 1954. The oil tanks and yard piping were completed between August 13, 1954 and November 25, 1955. Approximately 12,150 lineal feet of piping was installed.

3.1.9 Substation Maintenance Building

The substation maintenance building was completed between March 29, 1954 and December 2, 1954.

3.1.10 Grounding

The switchyard grounding system was started on November 23, 1953 and all grounding was completed December 1, 1955. Approximately 90,000 lineal feet of grounding conductors and 400 ground rods were installed.

3.1.11 Power and Control Cable

Installation of power and control cable was started on November 1, 1954. Approximately 516,700 lineal feet of cable was installed by the completion date of November 18, 1955.

3.1.12 Bus Duct

The erection of the bus duct supports was started May 24, 1954. Approximately 3,300 lineal feet of bus duct were installed and the completion date was November 18, 1955.

3.1.13 Underground Electric Facilities

Excavation was started on October 26, 1953 and the first duct run was poured on October 27, 1953. The last manhole was completed on March 18, 1954 and all duct runs were completed by September 11, 1954. There were 14,130 cubic yards of excavation and backfill, 32,450 square feet of forms, 2,215 cubic yards of concrete, and 30 tons of reinforcing steel used.

3.1.14 Instrument Transformers

Installation of potential transformers, current transformers, etc. was started May 27, 1954 and was essentially completed August 5, 1955 with only minor installations to be made after that date.

3.1.15 Oil Circuit Breakers

The installation of 18 oil circuit breakers was accomplished between September 20, 1954 and August 26, 1955.

3.1.16 Power Transformers

Installation of base plates was started on August 9, 1954. The transformers were assembled and installed as they were delivered to the job site. A total of 14 were installed and the project was completed January 25, 1956.
3.1.17 Other Protective Equipment

Installation involved various equipment including 21 lightning arrestors, 14 grounding transformers, 14 grounding resistors, etc. The installation of this equipment was started on August 2, 1954 and completed November 4, 1955.

3.1.18 High Voltage Switch Structure

The assembly of the towers was started May 17, 1954 and 765 tons of steel were erected. The installation, including conductors, switches, etc. was completed June 10, 1955.

3.2 CONSTRUCTION OF X-533B SWITCH AND CONTROL HOUSES

3.2.1 Foundation, Excavation and Backfill

The general site grading was done by Taylor Wheless Company prior to construction of this facility. Structural excavation was started on the east synchronous condenser foundation on October 6, 1953 and the column footings were started the following day. Subsequently, excavation for the cable pan tunnels, control house, switch houses and extensions was performed with completion of all excavation and backfill being July 28, 1954. Yardages involved were 9,000 cubic yards of excavation and 5,600 cubic yards of backfill.

3.2.2 Concrete

The first concrete was placed in the east synchronous condenser pan on October 12, 1953. Concrete mud slabs were used extensively throughout the area. The floor slab for the east cable pan tunnel was poured October 23, 1953, and the west tunnel slab was poured on December 4, 1953. The ground and main floor slabs were poured between April 7, 1954 and July 23, 1954. Concrete for the extensions was completed October 29, 1954 at which time essentially all concrete work was complete with only miscellaneous items to be completed. Quantities involved were 138,000 square feet of forms, 9,600 cubic yard of concrete and 501 tons of reinforcing steel.

3.2.3 Structural Steel and Miscellaneous Iron

The structural steel erection was started on December 7, 1953 and completed on July 9, 1954. Approximately 775 tons of steel were erected. Both bolted and riveted connections were used. The miscellaneous iron, consisting of embedded items, handrails, pipe hangers, etc., was installed between December 7, 1954 and April 28, 1955.

3.2.4 Roofing

The installation of the roof on the control house, east and west switch house stair wells and the test and repair shop was done between April 30, 1954 and August 16, 1954. Approximately 10,586 square feet of ribbed steel deck panels were erected between April 30, 1954 and August 6, 1954. Built-up roofing was placed between July 1, 1954 and August 16, 1954. Approximately 1,000 board feet of wood nailers were installed by July 1, 1954. The sheet metal work, including such items as copings, scuppers, gravel stops, gutters, etc., and amounting to approximately 1,000 pounds was installed between July 1, 1954 and August 16, 1954. Cement asbestos roofing was installed on the oil pump house between July 29, 1954 and August 6, 1954.
3.2.5 Siding

Installation of 390 squares of corrugated asbestos cement siding and 125 squares of insulated aluminum panel siding was started on May 3, 1954. The insulated aluminum panel siding on the control house was erected between May 5, 1954 and September 23, 1954. The corrugated asbestos cement siding was erected on the east switch house between May 17, 1954 and October 1, 1954 and on the west switch house between June 3, 1954 and October 1, 1954.

3.2.6 Walls and Ceilings

Erection of 18,600 square feet of block walls was started on May 17, 1954 and was essentially complete on July 16, 1954. Lathing and plastering was completed during the period between September 27, 1954 and October 20, 1954. Installation of the metal tile ceiling was started October 14, 1954 and completed on November 11, 1954, with the project encompassing 6,700 square feet. All work in connection with walls and ceilings was completed on December 4, 1954.

3.2.7 Special Flooring

The special asphalt tile flooring was installed in the control house between April 18, 1955 and June 10, 1955. Approximately 12,200 pieces of asphalt tile were laid.

3.2.8 Millwork and Miscellaneous Carpentry

Millwork and miscellaneous carpentry work was accomplished between September 20, 1954 and October 2, 1954.

3.2.9 Doors and Sash; Painting and Glazing

Doors and sash work was accomplished between September 20, 1954 and June 17, 1955. Painting and glazing was completed between September 20, 1954 and December 1, 1955.

3.2.10 Miscellaneous Building Equipment

Installation of metal lockers, dark room equipment, kitchen equipment, etc., was accomplished between August 2, 1954 and June 17, 1955.

3.2.11 Interior Fire Alarm System

Installation of conduit was started November 15, 1954. The 2,100 lineal feet of conduit was installed by November 1955.

3.2.12 Interior Electric Lighting System

Installation of the interior electric lighting system was started August 9, 1954 and the entire system was complete on November 25, 1955. Approximately 28,000 feet of conduit, 120,000 feet of wire and 850 lighting fixtures were installed.

3.2.13 Plumbing and Drainage

Excavation for underground lines was started November 2, 1953 and the first drain pipe was installed November 4, 1954. Quantities involved were 500 cubic yards of excavation and backfill, 2,200
lineal feet of cast iron pipe and 2,000 lineal feet of steel and copper pipe. The underground work was completed November 6, 1954. The above grade installation was completed between June 28, 1954 and April 1, 1955, with all work completed on June 17, 1955.

3.2.14 Heating and Ventilating

Installation of the first duct work was started on May 3, 1954. Subsequently, the steam lines, filters, unit heater, air condition unit, etc., were installed and all work was complete April 23, 1955.

3.2.15 Insulation

Insulation of piping, valves, fitting and duct work was accomplished during the period between July 26, 1954 and October 28, 1955.

3.2.16 Interior Recirculating Water System

Installation was started October 11, 1954, and the system was complete including piping, switches, floats, thermometers, etc., on April 9, 1955.

3.2.17 Cable Trays and Pans

The installation of cable trays, cable pans, hangers, etc., was accomplished during the period between May 17, 1954, and November 20, 1954.

3.2.18 Main Control Boards

Installation of the main control boards took place between August 9, 1954 and August 5, 1955.

3.2.19 Main Feeder Switchgear

Installation of the main feeder switchgear was started August 2, 1954 with the setting of the first base plates. Subsequently, the switchgear, pothead compartments, and air piping were installed and work was completed November 18, 1955.

3.2.20 Synchronous Condensers

Installation of the synchronous condensers was started August 9, 1954 and completed November 18, 1955.

3.2.21 Auxiliary Station Equipment

Installation of the auxiliary station equipment was accomplished between August 2, 1954 and February 25, 1955, and included space heaters, substations, control centers and cubicles, storage batteries, etc.

3.2.22 General

The construction of this facility followed a normal construction sequence and standard engineering and construction methods were used. There were no major material or equipment substitutions.
3.3 TURNOVER OF X-533 SWITCHYARD COMPLEX TO OPERATING CONTRACTOR

Construction of the X-533 Electrical Switchyard Complex was essentially complete on January 27, 1956 with only minor items to be completed after that date. The construction contractor, Peter Kiewit and Sons, turned over the completed facility to the Operating Contractor for the gaseous diffusion plant, Goodyear Atomic Corporation.

**Dates of Turnover to Operating Contractor Goodyear Atomic Corporation**

<table>
<thead>
<tr>
<th>Item</th>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>Control House (initial)</td>
<td>2/1/55</td>
</tr>
<tr>
<td>Control House (final)</td>
<td>7/20/55</td>
</tr>
<tr>
<td>Substation Electrical (OCBs, initial)</td>
<td>3/30/55</td>
</tr>
<tr>
<td>Transformers, Panels, Buses, Switches, etc. (final)</td>
<td>1/27/56</td>
</tr>
<tr>
<td>Test and Repair Shop</td>
<td>4/29/55</td>
</tr>
<tr>
<td>West Switch House (initial)</td>
<td>7/20/55</td>
</tr>
<tr>
<td>West Switch House (final)</td>
<td>10/29/55</td>
</tr>
<tr>
<td>East Switch House (initial)</td>
<td>10/6/55</td>
</tr>
<tr>
<td>East Switch House (final)</td>
<td>11/25/55</td>
</tr>
<tr>
<td>Insulated Oil System</td>
<td>10/24/55</td>
</tr>
<tr>
<td>Switchyard fence, rock-fire (initial) fill, drainage, etc.</td>
<td>9/27/55</td>
</tr>
<tr>
<td>Switchyard fence, rock-fire (final) fill, drainage, etc.</td>
<td>12/13/55</td>
</tr>
<tr>
<td>Transformer No. 301 and Equipment Fire Protection System</td>
<td>1/27/56</td>
</tr>
<tr>
<td>Balance of Facility</td>
<td>2/3/56</td>
</tr>
</tbody>
</table>

Subsequent operators of the X-533 Switchyard Complex after Goodyear Atomic Corporation were Martin Marietta, Lockheed Martin Utility Services and the United States Enrichment Corporation.
4. X-533 ELECTRICAL SWITCHYARD DEMOLITION MITIGATION MEASURES

The Department of Energy (DOE) identified four mitigation measures in the X-533 Electrical Switchyard Complex Engineering Evaluation/Cost Analysis (EE/CA) Appendix B, Section B-3, to mitigate the adverse effect that would occur to the X-533 Switchyard Complex resulting from its demolition. Additional mitigation measures were added in the comment responsiveness summary of the X-533 Electrical Switchyard Action Memorandum to respond specifically to additional comments from the Ohio Historic Preservation Office (OHPO) to the X-533 EE/CA. Photographs, drawings and other materials will be archived by DOE in the DOE official records repository at PORTS until such time as DOE and consulting parties can determine a permanent archive location.

Mitigation measures include the following:

4.1 PROVIDE ORIGINAL OHI FORMS

DOE will provide original Ohio Historic Inventory (OHI) Forms No. PIK-164-12 and PIK-165-12 documenting the structures associated with the X-533 Electrical Switchyard Complex to be demolished at the PORTS site in both hard copy and electronic format. Original OHI forms have previously been submitted to the OHPO. The DOE Portsmouth/Paducah Project Office retains a copy of the forms in its files.

4.2 TAKE COLOR AND/OR BLACK AND WHITE DIGITAL PHOTOGRAPHS

DOE will take no fewer than fifty (50) color and/or black and white digital photographs in a minimum 5” x 7” format, appropriately labeled, documenting the design and current conditions and landscape surrounding the X-533 Electrical Switchyard Complex. Photographs are being taken prior to facility demolition, and will continue to be taken during demolition if conditions are suitable, and after demolition. The photographs will be provided in hard copy and electronic format to the OHPO and copies will be retained in the DOE files. Photographs taken during and after demolition of the X-533 Electrical Switchyard Complex will be provided to the OHPO as a supplement to this documentation. See Appendix A for current photographs.

4.3 TAKE ADDITIONAL PHOTOGRAPHS WITH IPIX® CAMERA

DOE will take additional photographs using an IPIX® 360-degree digital camera and/or videography from various locations within and around the X-533 Electrical Switchyard Complex to obtain a sense of proportion of the facility and its structures as well as its layout, site and situation within its surrounding landscape at PORTS. The photographs are being taken prior to facility demolition, and will continue to be taken during demolition if conditions are suitable, and after demolition. The photographs will be provided in electronic format to OHPO, and copies shall be retained in the DOE files. See the enclosed computer disk for current IPIX® digital photographs.
4.4 REVIEW HISTORIC PHOTOGRAPHS

DOE will review its historic photographic archives at PORTS to compile historic black and white and/or color film photographs of the X-533 Switchyard Complex. Copies of the photographs are being provided in hard copy and electronic format to OHPO and copies are retained in the DOE files. See Appendix A for hard copies. Due to the quality of reproduction of the hard copies, reference the electronic copies of the historical photographs provided on the enclosed computer disk.

4.5 PROVIDE DESCRIPTION OR NARRATIVE OF PHOTOGRAPHS

The photographs or groups of photographs compiled for mitigation purposes include a description or narrative of the activities performed by the equipment, feature, or system shown in the photograph.

4.6 PROVIDE HISTORIC STRUCTURAL AND ARCHITECTURAL DRAWINGS

DOE will review its archive material of historic structural and architectural drawings documenting the details and layout of the X-533 Electrical Switchyard Complex and the drawings will be provided to the OHPO in hard copy prior to demolition. Copies of any such drawings will be retained in the DOE files. If drawings are not available, DOE will prepare basic plan view drawings, to scale, of the X-533 Switchyard Complex emphasizing the spatial organization of interior components and the functional relationship of the facility to the overall plant. See Appendix B for copies of the X-533 Switchyard drawings.

4.7 PROVIDE BRIEF WRITTEN NARRATIVE

Prior to demolition, DOE will prepare a brief narrative explaining the functional relationship of the X-533 Electrical Switchyard Complex to the overall processes at PORTS, submit the written narrative to OHPO with the photographic and other documentation described, and retain a copy in the DOE files. Submission of this narrative document to the OHPO satisfies the brief narrative mitigation measure.

4.8 SALVAGE UNCONTAMINATED ITEMS

Prior to facility demolition, DOE will salvage selected uncontaminated items from the X-533 Electrical Switchyard Complex for future preservation consideration. Salvaged items will be stored in a manner and at a location or locations that will enable their retrieval for future display. Certain items may be set aside by DOE at PORTS or other off-site locations, or title provided by DOE to others for their management at suitable storage facilities pending future display.

On October 14, 2009, the U.S. Department of Energy met with a representative from the OHPO and consulting parties to discuss the proposed demolition actions at the X-533 Electrical Switchyard Complex. Mitigation actions were also discussed among the parties and attendees participated in a walking tour of the X-533 switchyard complex to identify any potential salvageable items for future preservation consideration. The following items were tagged to be surveyed and, if uncontaminated, will be segregated by DOE prior to demolition of the structure. These items will be stored in a manner and at a location or locations that will enable their retrieval for future display. See Appendix C for photographs of salvaged items from the X-533 Switchyard Complex.
• Tag No. NHPA 001 – Pneumatic message system from X-533 Control Room
• Tag No. NHPA 002 – Red telephone from X-533 Control Room
• Tag No. NHPA 003 – Wooden control panel in former dark room, X-533 Control House
• Tag No. NHPA 004 – Section of control panel from X-533 Control House
• Tag No. NHPA 005 – Sight saver box from X-533 Control Room
• Tag No. NHPA 006 – Red Fire Alarm Box from X-533 Control House
• Tag No. NHPA 007 – Small wooden box electrical test kit from X-533 Control Room
• Tag No. NHPA 010 – Old grey metal desk with Cold War Patriots bumper sticker from X-533 Control Room

The Department of Energy will continue to consult with the OHPO, consulting parties and the public to identify any further mitigation actions that may be necessary to comprehensively preserve the history of the PORTS site in words, diagrams, photographs and other methods for documentation of the site’s mission and roles during the Cold War era, prior to demolition of the major facilities.

4.9 OTHER EQUIPMENT

Appendix D provides a listing and photographs of additional equipment that were contained in the X-533 Switchyard Complex.
5. REFERENCES


Action Memorandum for the Removal of the X-533 Switchyard Complex at the Portsmouth Gaseous Diffusion Plant, Piketon, Ohio (DOE/PPPO/03-0107&D1; LPP-0294/R6).


APPENDIX A

PHOTOGRAPHS OF THE X-533 SWITCHYARD COMPLEX

(Historical and Current Photographs)
APPENDIX B

DRAWINGS OF THE X-533 SWITCHYARD COMPLEX
APPENDIX C

PHOTOGRAPHS OF SALVAGED ITEMS FROM THE X-533 SWITCHYARD COMPLEX
APPENDIX D

X-533 EQUIPMENT LIST
RECORD COPY DISTRIBUTION

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