COLUMBIA BASIN PROJECT, GRAND COULEE
POWERPLANT COMPLEX
Grand Coulee
Grant County
Washington

HAER No. WA-139-B

HAER
WASH
13-GRACO,
1B-

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ADDENDUM TO:
COLUMBIA BASIN PROJECT, GRAND COULEE DAM
POWERPLANT COMPLEX
Grand Coulee
Grant County
Washington

HAER WA-139-B
HAER WASH,13-GRACO,1B-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
PACIFIC WEST REGIONAL OFFICE
National Park Service
U.S. Department of the Interior
333 Bush Street
San Francisco, CA 94104

HISTORIC AMERICAN ENGINEERING RECORD

COLUMBIA BASIN PROJECT, GRAND COULEE DAM POWERPLANT COMPLEX

HAER No. WA-139-B

Location: Grand Coulee
Grant and Okanogan Counties
Washington

The Left Powerplant of Grand Coulee Power Plant is located at latitude: 47.9560, longitude: -118.9866. The Right Powerplant is located at latitude: 47.9573, longitude: -118.9771. Third Powerplant is located at latitude: 47.9596, longitude: -118.9752. The latitude and longitude coordinates were converted from the UTMs via Montana State University and Yellowstone National Park RCN Utilities and Tools web site on November 18, 2013.

Dates of Construction: 1934-81

Engineers/ Architects: Bureau of Reclamation, Marcel Breuer and Associates, Kenneth Brooks

Original Owner: Bureau of Reclamation

Original Use: Powerplants

Present Owner: U.S. Bureau of Reclamation

Present Use: Powerplants

Significance: Grand Coulee has three powerplants. The first, the Left Powerplant, is on the west bank of the Columbia River, just downstream from the dam. It is mirrored on the east end of the dam by the Right Powerplant. After several decades, the Third Powerplant was added, necessitating alterations to the east end of the dam to create a new forebay. The three plants make an important contribution to a power grid that provides electricity to the Pacific Northwest and beyond. Construction of the Left Powerplant was justified to create jobs in the 1930s, while work on the Right Powerplant began ahead of schedule to meet the power needs of strategically important aluminum plants during World War II. The design of the Third Powerplant, which was started in the late 1960s, is particularly noteworthy

because its architect was Marcel Breuer, an internationally prominent Modernist.

Project Information:

This documentation study was initiated by the U.S. Bureau of Reclamation's Pacific Northwest Regional Office in Boise, Idaho. Joseph Pratt was the contracting officer; Derek Beery, Mike Flowers, Sean Hess, Pei-Lin Yu, and Lynne MacDonald served as contracting officer representatives. Hess, Roise and Company, a historical consulting firm based in Minneapolis, Minnesota, was the prime contractor for the project, with photography and delineation completed by subcontractor Clayton Fraser of FraserDesign, Loveland, Colorado. Charlene Roise, principal of Hess Roise, was the project manager and historian, with research assistance from staff historian Elizabeth Gales and staff researcher Penny Petersen. CH2M HILL's Boise office provided editorial and other assistance, under the supervision of Mark Bransom, as a subcontractor to Hess Roise.

NOTE: Previous HAER documentation referenced only Grant County. The Grand Coulee Powerplant Complex is in both Grant and Okanogan Counties.

Grand Coulee has three powerplants. The first, the Left Powerplant, is on the west bank of the Columbia River, just downstream from the dam. The Right Powerplant mirrors it on the east end of the dam. The Third Powerplant was added several decades later, necessitating alterations to the east end of the dam to create a new forebay. (See ILLUSTRATION 1: Grand Coulee Dam Complex Features, and ILLUSTRATION 2: Grand Coulee Dam Plan.)

The following description is based primarily on information provided in Reclamation drawings of historical conditions. A detailed history of the construction and evolution of the powerplants is provided in "Columbia Basin Project, Grand Coulee Dam and Franklin D. Roosevelt Lake," HAER No. WA-139-A.

Left Powerplant

The Left Powerplant was the first to be constructed. Its foundation was included in a major construction contract awarded to the dam in 1934. The first units went into operation in 1941. It now has nine major generators, each rated at 125 megawatts (MW), and three station service generators rated at 10 MW. Penstocks 18′ in diameter direct water to the Francis-type runners—measuring 16′-8″ in diameter—of the main unit turbines. The service unit turbines have smaller Francis-type runners rated at 14,000 horsepower.

Located at the base of the dam near the river's west bank, the Left Powerplant is composed of two main sections: a control bay 86′-8″ in length and a 678′-0″ x 102′-0″ powerhouse. Together, the sections total 764′-8″ in length. The powerhouse comprises an 86′-8″ service bay adjacent to the control bay, eight 65′-0″ turbine-generator bays to the east, and a ninth turbine-generator bay measuring 71′-4″ at the building's east end. Transverse expansion joints are located between the bays, most of which are further subdivided into 21′-8″ structural units. The exception is the ninth bay, where the easternmost subsection is 28′-0″.[1]

The steel superstructure supports 18″-thick concrete walls. The long north (downstream) side features a series of ten glass-block windows. The wall above and beside the windows is ornamented with vertical grooves formed by 2″ x 6″ lagging when the concrete was placed. The rest of the wall is articulated by regularly spaced, horizontal V-grooves.[2]

The control bay's 86′-8″-long north facade is set back about 56′ from the north facade of the main powerhouse to the east. The area in front of the control bay is mostly occupied at the entry level (elevation 1012.5) by a 44′ 8″-deep concrete terrace, which extends to a parking lot to the north. A standard-gauge track was embedded in the terrace 32′-0″ in front of the control bay and passed into the service bay through a large door in the west wall of the powerhouse; most of the tracks were removed in 1950 and only remnants remain at the entrance to the building (see

[1] Bureau of Reclamation, "Left Power House-General Longitudinal Section," Drawing 222-D-1972, October 14, 1937; Bureau of Reclamation, "Left Power House Plan-Floor el. 979.0," Drawing 222-D-1975, October 14, 1937.
[2] Bureau of Reclamation, "Architectural Elevations-Left Power Plant," Drawing 222-D-4963, November 22, 1939.

Photograph WA-139-B-62). North of the terrace, a ramp descends on a 10-percent slope to a 43′-8″-wide draft tube gate bridge along the north facade of the powerhouse at elevation 993.0.[3]

A concrete ledge just below the powerhouse windows supports the upper beam of a 20-ton gantry crane on the draft tube gate bridge. The crane's north leg rides on a rail in a 12″-wide concrete parapet that doubles as a railing for the bridge. The bridge is partially cantilevered, but is also supported by a lower level of the control station. The total depth from the front of the bridge to the back of the control station is 176′-0″.[4]

A Warren truss with a vertical strut between each panel supports the flat roof. A concrete parapet rings the roof, topping out at elevation 1079.75. Each transformer, located directly behind the powerhouse, required two transmission towers, a lighting arrester, and a disconnecting switch mounted on the powerhouse roof. The steel-frame transmission towers carried lines from the transformer yard to a switchyard on the bluff on the west bank. The transmission line towers were removed in the 1970s when the Third Powerplant was erected. The transformers—originally 25,000 kilovolt-amperes (kVa)—were later upgraded to 36,000 kVa.[5]

Below the transformers sat an oil circuit breaker gallery (elevation 991.0), a general protective equipment gallery (elevation 979.75), a unit auxiliary gallery (elevation 968.0), and a unit air compressor (elevation 951.0). The bus gallery was directly south of the oil circuit breaker gallery. Below the bus gallery was a cable gallery (elevation 979.75) and a conduit gallery (elevation 968.0). North of the turbine-generator units were a heat exchanger gallery (about elevation 979), a pipe gallery (about elevation 968.0), a governor gallery (about elevation 951.0), and another pipe gallery (elevation 934.0).

The largest space on the interior of the powerhouse is the main generator room, where nine 108 MW turbine-generator units (subsequently upgraded to 125 MW) were installed. The generator floor (at elevation 991.0) is overlooked by a balcony that is reached from the entryway in the control bay. A walkway at this level extends above the south side of the generator room. The large windows on the north facade fill the room with natural light, illuminating the room's terrazzo floor (elevation 991.00). The south facade, which faces the dam, has several louvers rather than windows. Near the room's ceiling, two 350-ton cranes run on steel tracks imbedded in concrete beams at elevation 1,049.50.[6]

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[3] Bureau of Reclamation, "Left Power House-Equipment Arrangement at el. 1012.5," Drawing 222-D-1999, October 14, 1937; Bureau of Reclamation, "Left Power House-Longitudinal Section thru Downstream Galleries," Drawing 222-D-1981, October 14, 1937.
[4] Bureau of Reclamation, "Left Power House-Temporary Installation Shasta Generating Units," Drawing 222-D-8632, June 19, 1942; Bureau of Reclamation, "Left Power House-Transverse Section-Control Bay," Drawing 222-D-1987, October 14, 1937.
[5] Bureau of Reclamation, "Left Power House-Temporary Installation Shasta Generating Units," Drawing 222-D-8632, June 19, 1942.
[6] Bureau of Reclamation, "Left Power House-Longitudinal Section thru CL Units," Drawing 222-D-1982, October 14, 1937; Bureau of Reclamation, "Left Power House-Temporary Installation Shasta Generating Units," Drawing 222-D-8632, June 19, 1942; Bureau of Reclamation, "Architectural Elevations-Left Power Plant," Drawing 222-D-

The turbine-generator units were originally labeled L-1 through L-9; later, they were renamed G-1 through G-9. Initial plans called for installing only three of the main turbine-generator units (G-1 through G-3, with the units numbered from west to east) and two (Nos. 2 and 3) of the three station service units. Political changes and the onset of World War II brought a push to accelerate the installation. Because of the lead time required to fabricate the units, two were temporarily borrowed from Shasta Dam, but these were later removed and replaced with full-size units.[7]

While the units are equally spaced longitudinally, they are off-center transversely, with centerlines 52′-0″ from the south exterior wall and 32′-0″ from the north exterior wall. Steel railings encircle the pits holding the generators. Only the top of the housing, containing a light indicating if the unit is running, rises above the main floor of the generator room. Stairways between every-other unit descend to a floor at elevation 979.00, where the CO_2 gallery (for fire suppression) is to the south and the generator gallery is to the north, adjacent to the cable gallery beneath the transformers. The stairway continues down another level to the base of the generator housing at elevation 968.00, with the pipe gallery to the north and the auxiliary gallery to the south, by the conduit gallery. The next level (elevation 951.00) holds the turbine gallery to the north and the governor gallery and unit control boards to the south. Two additional floors are below the governor gallery: the pump gallery (elevation 934.0.) and the unwatering gallery (elevation 921.0).[8]

Each unit in the turbine gallery (elevation 951.0) is surrounded by thick, concrete walls, octagonal in form. The east and west sides of the octagon have openings with steps down to the turbine casing. The turbine shaft is centered in this space, linking the generator to the turbine. Outside of the octagonal walls, each bay has an actuator, hydraulic board, and electrical board to the north, edging the governor gallery. Along the east wall of each bay are cubicles with the main and pilot exciters. The even-numbered unit bays hold stairways; the others have access hatches. Both have pipe shafts. Beyond thick walls to the south are unit air compressors and receivers. The service bay at this level includes neutral breakers; an actuator; a generator cubicle; hydraulic, unit auxiliary, exciter, and D.C. boards; and sump pumps. Flowmeters, recorders, and a sump pump cubicle are arrayed along the bay's north wall. Along the south wall and extending east into the Unit 1 bay is a row of 12 service station transformers, grouped in threes. A ramp through the west wall leads down to a room in the adjacent control station level (elevation 949.0) that holds four air compressors; three receivers; a motor control cubicle; CO_2 cylinders; and a hot water heating tank and pump. An adit, with a pair of rails embedded in its floor, extends from the room's south wall to the headgates (station 6+87.67). A small room in the northwest corner holds three oil purifier pumps, a sink and bench, a centrifuge, and an oven. The room has a door to the

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4963, November 22, 1939; Bureau of Reclamation, "Left Power House-Temporary Installation Shasta Generating Units," Drawing 222-D-8632, June 19, 1942.

[7] Bureau of Reclamation, "Left Power House-General Longitudinal Section, Drawing," 222-D-1972, October 14, 1937; Bureau of Reclamation, "Left Power House Plan-Floor el. 979.0," Drawing 222-D-1975, October 14, 1937.

[8] Bureau of Reclamation, "Left Power House-Temporary Installation Shasta Generating Units," Drawing 222-D-8632, June 19, 1942.

main floor of the multistory oil storage room, which stretches along the building's west wall and holds six transit oil tanks and three smaller lubricant oil tanks.[9]

Penstocks for both the main and service station units enter at elevation 938.0. Passageways (elevation 934.0) lead from the pipe gallery along the north wall of the powerhouse to a manhole in each unit. The passageway in Unit 1 connects with a narrow gallery in the service station bay that holds draft tube unwatering valves and draft tube manholes for each of the service units. West of the service units, a corridor leads to the elevator lobby, the lowest level reached by the passenger and freight elevators. Several stairways go to lower levels.[10]

Just to the north of the service bay at elevation 968.0 is a two-story machine shop. West of the station service units, beneath elevation 921.0, is an unwatering sump and, to the north, a drainage sump. The sump floors are at elevation 886.5. Another drainage sump is to the west in the control bay at elevation 910.0.[11]

The control bay rises six stories (from elevation 1012.50 to elevation 1096.00) from the main level of the powerhouse. The first level holds an entry vestibule, which leads to a lobby. On the lobby's north wall, just east of the vestibule, are doors for the passenger elevator and freight elevator. A stairway is across from the elevators. At the west end of the lobby is a door for a reception room. Restrooms, storage rooms, and a first-aid room edge an adit running south from the lobby to a gallery and elevators in the dam.[12]

The upper floors also have elevator lobbies. The motor generator room, battery room, and laboratory dominate the second floor (elevation 1,025.50), the cable spreading room is on the third floor (elevation 1,038.50), and the terminal board room is on the fourth floor (elevation 1051.50). The main control room occupies a two-story space at the top of the building (elevation 1064.50). A partial sixth floor (elevation 1077.50) contains machinery for the elevator, a fan room, and a file room. In addition to the uses mentioned, most of the floors also hold toilet rooms, storage rooms, and offices. Cable ducts for the Left and Right powerplants—as well as lighting cable ducts—rise vertically through the structure.[13]

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[9] Bureau of Reclamation, "Left Power House Equipment Arrangement at El. 952.0," Drawing 222-D-2003, October 14, 1937.
[10] Bureau of Reclamation, "Left Power House Equipment Arrangement at El. 938.0," Drawing 222-D-2004, October 14, 1937.
[11] Bureau of Reclamation, "Left Power House-Transverse Sections-Service Bay," Drawing 222-D-1986, October 14, 1937; Bureau of Reclamation, "Left Power House-Longitudinal Section thru Downstream Galleries," Drawing 222-D-1981, October 14, 1937.
[12] Bureau of Reclamation, "Left Power House-Transverse Section-Control Bay," Drawing 222-D-1987, October 14, 1937; Bureau of Reclamation, "Key Drawing above El. 1012.50," Drawing 222-D-4165, 1939; "Left Power House-Equipment Arrangement at el. 1012.5," Drawing 222-D-1999, October 14, 1937.
[13] Bureau of Reclamation, "Left Power House-Transverse Section-Control Bay," Drawing 222-D-1987, October 14, 1937; Bureau of Reclamation, "Key Drawing above El. 1012.50," Drawing 222-D-4165, 1939; Bureau of Reclamation, "Left Power House Equipment Arrangement at El. 991.0," Drawing 222-D-2000, October 14, 1937.

Below this section is the intermediate structure, which is partly an extension of the functions housed in the powerplant. The first level down, holding a bus gallery and adjacent transformer room at about elevation 991, is taller than the two stories beneath it (elevation 979.00 and elevation 968.00). These floors have a cable gallery and auxiliary conduit gallery, respectively, among other functions. Air compressors and oil storage are on the next level. At the very bottom is a sump (elevation 910.00).[14]

Right Powerplant

Construction of the base of the Right Powerplant was begun in the late 1930s. The final unit went on the line in 1950. Although the plant has no station service units, it is otherwise equipped much like the Left Powerplant with nine 125 MW generators. Originally, its units were labeled R-1 through R-9. They are now designated G-10 through G-18.

The design of the Right Powerplant is, for the most part, a mirror image of the Left Powerplant. Notes in architectural plans for the Right Powerplant indicate that "all concrete forming shall conform with forming of Left Power House. All exterior architectural details shall conform with the details of the Left Power House." Exterior details, including horizontal V-grooves and vertical bands above and flanking the glass-block windows, match the Left Powerplant.[15]

The entryway to the control bay is at elevation 1012.50. The double metal door is flanked by paired metal casements with five lights, stacked horizontally. The windows and doorway are protected by a thin, horizontal, 4′ concrete canopy. Just to the west, the only opening in the powerhouse's west facade is a vertical lift door. Two entries, which feature doors and a canopy like the north facade, are on the east facade of the control station. One is at the level of the main lobby (elevation 1012.50). The other opens to a pedestrian walkway (elevation 1025.50) above the control cable tunnel to the Right Switchyard. This entryway is at the bottom of the northernmost of three (four) vertical bands of windows.[16]

Like the front facade, the rear (south) facade is also similar to that of the Left Powerplant. The wall behind Units G-10 to G-18 is edged by a lower, flat-roofed transformer bus gallery. A louver is at the east end of each unit bay and three small rectangular bus openings are to the west, near the roofline at elevation 1039.75. Metal person doors are by Units 10, 14, and 18. A tall opening, large enough to accommodate vehicles, provides access to the service bay; its original accordion-fold door has been replaced by a vertical-lift door. To the east, adjacent to the control station, is a windowless projection. The base of the control station is apparently at elevation 1028.50; the top of its parapet is at elevation 1096.00. A louver is centered near the top of the

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[14] Bureau of Reclamation, "Intermediate Structure-Control Bay-L-General and Concrete Reinforcement-Key Secs. below 1012," Drawing 222-D-3406, November 21, 1938.
[15] Bureau of Reclamation, "Right Powerhouse, Architectural Elevations," Drawing 222-D-7918, November 27, 1941; Bureau of Reclamation, "Hydraulic Model Studies-1:60 Scale-Plan and Elevations of Right and Left Powerhouses," Drawing 222-D-0877, August 14, 1942.
[16] Bureau of Reclamation, "Right Powerhouse, Architectural Elevations," Drawing 222-D-7918, November 27, 1941.

control station's upstream facade. Three louvers are centered near the top of the powerhouse's upstream facade by Units 11, 14, and 17. There are no other openings on these facades. Two vertical stacks of window openings like those on the control station's east facade appear on its west facade.[17]

A concrete balcony is cantilevered 9′-0″ out from the west facade at elevation 1063.92, outside the main control room. A solid concrete railing is topped by a metal railing. Metal columns support the balcony's lightweight concrete and steel canopy (elevation 1074.00). Several pairs of doors provide access to the balcony. One of the doors is aligned with one of the two rows of windows that are vertically aligned; a window to the south of the door tops the second row. Like the windows on the two floors below, this metal-frame window has three awning lights stacked horizontally.[18]

The generating room holds eight identical bays (G-11 through G-18), each 65′-0″ long, and a 71′-6″-long west bay (G10). The underlying structural unit is 21′-8″ long; three of these form the typical 65′-0″ bay. The centerline of the generating units of both powerplants is 335′-0″ from the axis of the dam. The Right Powerplant service station and erection bay is also similar (86′-8″ long) but the control bay is smaller in all dimensions (65′-0″ long, 102′-0″ deep), making the Right Powerplant 743′-2″ long in contrast to the 764′-10″ length of the Left Powerplant. The Right Powerplant is 84′-0″ in depth.[19]

A vestibule leads from the exterior terrace at elevation 1012.50 into the control bay reception room. A pair of offices flanks the vestibule; elevators are on the far side of each office, in the building's northeast and northwest corners. Another vestibule provides access to the reception room from the east. Leading south from the reception room is a hallway labeled in early plans as the "drinking fountain corridor," which leads to an audit to the eastern elevator in the dam. Mens' and womens' lounges, a first aid room, a janitor's closet, and storage areas edge the corridor. At the west end of the reception room, past a stairway in the south wall, is a pair of doors opening into the service bay.[20]

An entry from the east side at elevation 1025.50 leads into another lobby and reception room. At the south end of this floor are a motor generator room, battery room, and battery service room. Upper floors of the control bay hold offices, storage rooms, toilets, and other basic functions. A

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[17] Bureau of Reclamation, "Right Powerhouse, Architectural Elevations," Drawing 222-D-7918, November 27, 1941.
[18] Bureau of Reclamation, "Right Powerhouse, Architectural Elevations," Drawing 222-D-7918, November 27, 1941.
[19] Bureau of Reclamation, "Grand Coulee Dam and Appurtenant Works-Supersedes 222-D-1714," Drawing 222-D-2047, October 4, 1937, with Third Plant Revisions, February 27, 1941, January 20, 1949; Bureau of Reclamation, "Right Powerhouse, Architectural Elevations," Drawing 222-D-7918, November 27, 1941.
[20] Bureau of Reclamation, "Hydraulic Model Studies-1:60 Scale-Plan and Elevations of Right and Left Powerhouses," Drawing 222-D-8077, August 14, 1942.

unit substation is at elevation 1038.50 and a cable spreading room at elevation 1051.50. Cable shafts extend vertically through the building. The main control room is at elevation 1064.50.[21]

Beneath the terrace at elevation 979.00 is an oil storage room with four tanks—two large and two smaller—and a CO_2 room with a double row of small tanks. To the northwest, stairs lead down to a room at elevation 925.25 that contains an oil purifier, two oil pumps, and a pressure tank. Above this, at elevation 991, is a partial floor with a locker room, shower room, toilet, and storage.[22]

A 37.5 kVa lighting transformer, lighting distribution cabinet, and air intake are in the section projecting from the southeast corner of the service bay. An opening leads from the service bay into this room, which is dominated by a square trench in its center. A fan room is below at elevation 991.00.[23]

A transfer track comes into the unloading floor of the service bay through a garage door in the south wall. A transformer oil service pit is on one side of the track; an air and water service pit is on the other.[24]

The unloading floor is essentially a balcony overlooking the generating floor. A cantilevered balcony continues at this elevation along the south side of the powerhouse, while a stairway descends from the south end of the balcony to the lower level (elevation 991.00). A rotor assembly hatch is in the middle of the rotor assembly space. A governor hatch is northeast of the next unit to the west. The centerline of the units is 52′-0″ south of the north facade and 31′-6″ from the south facade.[25]

Three 43,000-kVa transformers are located behind each unit, beyond the transformer bus gallery that projects from the south facade of the powerhouse. A firewall is between the group of transformers for each unit. A spare transformer is stored to the east of one of the firewalls. Pipe hangar rails and transformer rails for each transformer stretch from the facade to the edge of the transformer deck (elevation 1012.00). A railing and lights run along this edge, adjacent to a sidewalk on the deck. An embedded rail on the edge of the deck, paired with a parallel rail 10′ to the south attached to the dam, serves as a transformer transfer track. The area between the rails is depressed, dropping to elevation 1009. A metal cabinet, 11.5″ wide, 14″ long, and 72″ high, is north of the sidewalk by each transformer; each cabinet holds a nitrogen bottle.[26]

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[21] Bureau of Reclamation, Drawing 222-D-13044; Bureau of Reclamation, Drawing 222-D-13170; Bureau of Reclamation, Drawing 222-D-8076.
[22] Bureau of Reclamation, Drawing 222-D-8078; Bureau of Reclamation, Drawing 222-D-8079.
[23] Bureau of Reclamation, "Hydraulic Model Studies-1:60 Scale-Plan and Elevations of Right and Left Powerhouses," Drawing 222-D-8077, August 14, 1942; Bureau of Reclamation, Drawing 222-D-8078.
[24] Bureau of Reclamation, "Hydraulic Model Studies-1:60 Scale-Plan and Elevations of Right and Left Powerhouses," Drawing 222-D-8077, August 14, 1942.
[25] Bureau of Reclamation, "Hydraulic Model Studies-1:60 Scale-Plan and Elevations of Right and Left Powerhouses," Drawing 222-D-8077, August 14, 1942.
[26] Bureau of Reclamation, "Hydraulic Model Studies-1:60 Scale-Plan and Elevations of Right and Left Powerhouses," Drawing 222-D-8077, August 14, 1942.

At the southeast corner of the powerhouse, a ramp descends from elevation 991.00 to elevation 979.00, ending at the east end of the cable gallery. The gallery's long axis is bisected by a continuous line of cable trays. Directly to the north is the governor gallery. To the northeast, the service bay holds 6.9 V switchgear and an auxiliary power unit substation with 750 kVa 7200/480V transformers. Most of the bay is occupied by a pump and compressor room. The CO_2 gallery runs along the north side of the powerhouse. It is connected to the southern galleries by transverse galleries between concrete walls surrounding the turbine-generator units. Platforms in the units at elevation 980.25 have stairs leading down to the east.[27]

At elevation 968.0, a conduit gallery runs along the south wall, curving around the southeast corner to a conduit room at the building's east end. The upstream pipe gallery is just north of the conduit gallery; the downstream pipe gallery edges the north wall. In between, the turbine-generator units are encased in octagonal concrete walls, with stairs leading up through the east wall accessed by a transverse gallery between the pipe galleries, and with air ducts in the northeast and northwest walls.[28]

The turbine gallery is to the south and the governor gallery is to the north of the turbine-generator units at elevation 951.00. Along the south wall of the governor gallery are arrayed the governor, unit control board, auxiliary power unit substation, lubrication panel, and hydraulic panel. A pipe trench and pressure tank is just to the north. Connected to the rear of the substation is a 500 kVa 7200/480V transformer and a disconnect switch. A heater and fan are west of the transformer. A heating cabinet is attached to the north side of the octagonal walls surrounding the turbine. Openings on the east and west sides of the walls are served by stairs that descend to the turbine housing. The east opening is approached by a transverse gallery between the governor and turbine galleries. An opening in the concrete wall between the units provides direct access to the west stair. The west elevator is essentially the only part of the control bay that descends to this level.[29]

Third Powerplant

A hiatus of more than two decades existed between the completion of the Right and Left powerplants and the construction of the Third Powerplant. Reclamation opened a construction office for the project in 1967, and the first unit went on the line in 1975. The powerplant was officially dedicated in 1981. To make room for the new plant, the east end of Grand Coulee Dam was reworked to create a forebay. The plant contains six generators, acquired in two phases, with the potential to extend the powerhouse and add six more. After Reclamation obtained the first three generators—rated at 600 MW—technological improvements made it possible to procure 700 MW generators, so the next three met this specification. The first three Francis-type turbines were rated at 820,000 horsepower and the second three at 960,000 horsepower. Water is provided by penstocks 40′ in diameter.

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[27] Bureau of Reclamation, Drawing 222-D-8078; Bureau of Reclamation, Drawing 222-D-8079.
[28] Bureau of Reclamation, Drawing 222-D-8080.
[29] Bureau of Reclamation, Drawing 222-D-8081.

Situated at elevation 1311.67, the top of the forebay dam is mostly occupied by a road, which extends onto a cantilever on the dam's upstream side. A cantilever on the other side supports the top station of an inclined elevator to the powerplant. The elevator's hoistway, which incorporates an emergency stair, is made of precast concrete panels that are self-supported for part of its length. At the elevator's mid-station (elevation 1081.50), a crossover bridge for visitors, connecting the elevator to a gallery in the powerhouse, is above the transformers for Unit Bay 20. Made of precast concrete panels, the bridge continues through the powerhouse to an observation balcony cantilevered from the powerhouse's west side. In the powerhouse, the underside of the bridge is plastered. The elevator's lower station lobby (elevation 983.12) has two terrazzo-faced benches. A long, U-shaped, visitors' access ramp, another terrazzo-faced bench and lined with a photomural, leads to the powerplant's lower level (elevation 968.12).[30]

The Third Powerplant measures 126′-0″ wide by 1,099′-9″. The elevation is 1097.29 at the top of the building and 1,012.50 at grade. Precast reinforced-concrete panels trimmed with horizontal lines serve as both the structure and the walls. The long facades are articulated by 18 V-shaped forms. These forms are paired to create nine bays 119′-0″ wide. The turbine erection bay on the south end is wider, augmented by a 29′-9″-wide section that trims the edge of the facade. Units G-19 through G-24 occupy the six bays to the north. The two north bays are paired to facilitate generator erection and there is a 29′-9″ extension as on the south end, stretching this bay to 266′-9″.[31]

On the west facade, air supply structures are incorporated into niches in the concrete forms. Return air vestibules flank doorways between each bay, with horizontal louvers facing the interior and vertical louvers on the building's exterior. Eighteen exhaust fans formed from precast single T-beams are imbedded at regular intervals in the concrete roof. The beams are sheathed with urethane foam with roof coating.[32]

On the interior, two 275-ton cranes and two 80-ton cranes are on rails spaced 105′-8″ center to center. A maintenance platform is on the upstream side, just beneath the cranes; the operator's cab is in the same location on the downstream side, suspended from the beam of the crane. A massive 2,000-ton gantry crane rolls on rails set 92′-4″ apart, center to center.[33]

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[30] "Third Powerplant-General Arrangement-Part Plan and Misc. Sections," Drawing 1222-D-345, February 18, 1969; "Third Powerplant-Architectural-Transverse Section-Power Plant, Mid Station, and Dam," Drawing 1222-D-1403, September 19, 1969.

[31] "Third Powerplant-General Arrangement Transverse Sections Unit Bays 22, 23, 24," Drawing 1222-D-348, September 16, 1974; "Third Powerplant, General Arrangement-Longitudinal Sections thru Galleries," Drawing 1222-D-324, October 1, 1971.

[32] "Third Powerplant-General Arrangement Unit Bays 21, 22, 23, Various Elevations 29, 32, 35, 38, 40, 4," Drawing 1222-D-3261, August 14, 1969; "Third Powerplant-General Arrangement Transverse Sections Unit Bays 22, 23, 24," Drawing 1222-D-348, September 16, 1974; Third Powerplant-General Arrangement Longitudinal Section through CL Units," Drawing 1222-D-323, August 14, 1969; "Third Powerplant, General Arrangement Transverse Sections Unit Bays 19 and 21," Drawing 1222-D-344, August 14, 1969.

[33] "Third Powerplant-General Arrangement Transverse Sections Unit Bays 22, 23, 24," Drawing 1222-D-348, September 16, 1974.

Units 19, 20, and 21 are centered longitudinally within a bay, but not transversely; their centerlines are 65′-6″ from the south end of the 119′-0″ bay and 53′-6″ from the north end. Removable handrails edge the perimeter of the generator air housing for Units 22, 23, and 24. Metal platforms are below the generators, connected by stairs. The centerline for the scrollcase distributors is at elevation 946.00. Spiral case drains empty into an unwatering tunnel beneath the draft tube, as does the draft tube drain. The end of the metal draft tube liners disgorge into concrete draft tubes at a diagonal, beginning at elevation 886.87. The draft tubes project about 48′ beyond the gates between elevation 901.25 and elevation 863.9.[34]

A 40′-0″-wide transformer yard runs along the east side of the powerhouse, paralleled by a broad, asphalt-surfaced access roadway to the east. A chilling drain runs down the middle of the road. Penstock access vaults covered with steel plates are on the west side of the road; turbine air vents appear on the east side. Three single-phase, 525 kV, 276,000 kVa transformers are associated with each turbine-generator unit; spare transformers are stored on the upstream end. Cable potheads, lightening arresters, and fire protection towers are associated with each group of transformers. Below the transformer yard are EHV cable galleries; an isolated phase bus gallery with heat exchangers and surge protective equipment; a miscellaneous equipment gallery; and a pipe gallery. A monorail for a 7-ton hoist is attached to the ceiling of a pipe gallery; a strainer and raw water supply connection is directly beneath it.[35]

Tracks for a 70-ton gantry crane edge the 30′-0″-wide roadway on the draft tube gate bridge along the downstream side of the powerhouse. The crane raises and lowers the gates between imbedded guides in draft tube gate slots, which are covered with steel grating. Gate seats in each draft tube secure the gate in place. Gate storage slots are incorporated into a projecting bay on the face of the downstream wall. Steel plates cover the slots.[36]

A series of galleries are stacked below the roadway. The floor of the service gallery is at elevation 990.00. The electrical gallery, which holds cable trays, unit control boards, and air-conditioning units, is at elevation 968.12. A control cable gallery at this level provides an underground connection to the Right Powerplant. Below the electrical gallery is the mechanical equipment gallery (elevation 943.12), which holds pumps and control equipment and water chillers by Units 21 and 22. Passageways from this gallery lead to man doors providing access into the scrollcases. Under the mechanical equipment gallery is the pipe gallery (elevation

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[34] "Third Powerplant-General Arrangement Longitudinal Section through CL Units," Drawing 1222-D-323, August 14, 1969.
[35] "Third Powerplant-General Arrangement Transverse Sections Unit Bays 22, 23, 24," Drawing 1222-D-348, September 16, 1974; "Third Powerplant, General Arrangement Transverse Sections Unit Bays 19 and 21," Drawing 1222-D-344, August 14, 1969; "Third Powerplant-General Arrangement Unit Bays 21, 22, 23, Various Elevations 29, 32, 35, 38, 40, 41," Drawing 1222-D-326, August 14, 1969.
[36] "Third Powerplant-General Arrangement Transverse Sections Unit Bays 22, 23, 24," Drawing 1222-D-348, September 16, 1974; "Third Powerplant-General Arrangement Unit Bays 21, 22, 23, Various Elevations 29, 32, 35, 38, 40, 41," Drawing 1222-D-326, August 14, 1969.

919.37). Passageways from this gallery extend to steps, which provide access to doors by the turbine. An unwatering gallery (elevation 904.37) is beneath the pipe gallery.[37]

[37] "Third Powerplant-General Arrangement Transverse Sections Unit Bays 22, 23, 24," Drawing 1222-D-348, September 16, 1974.

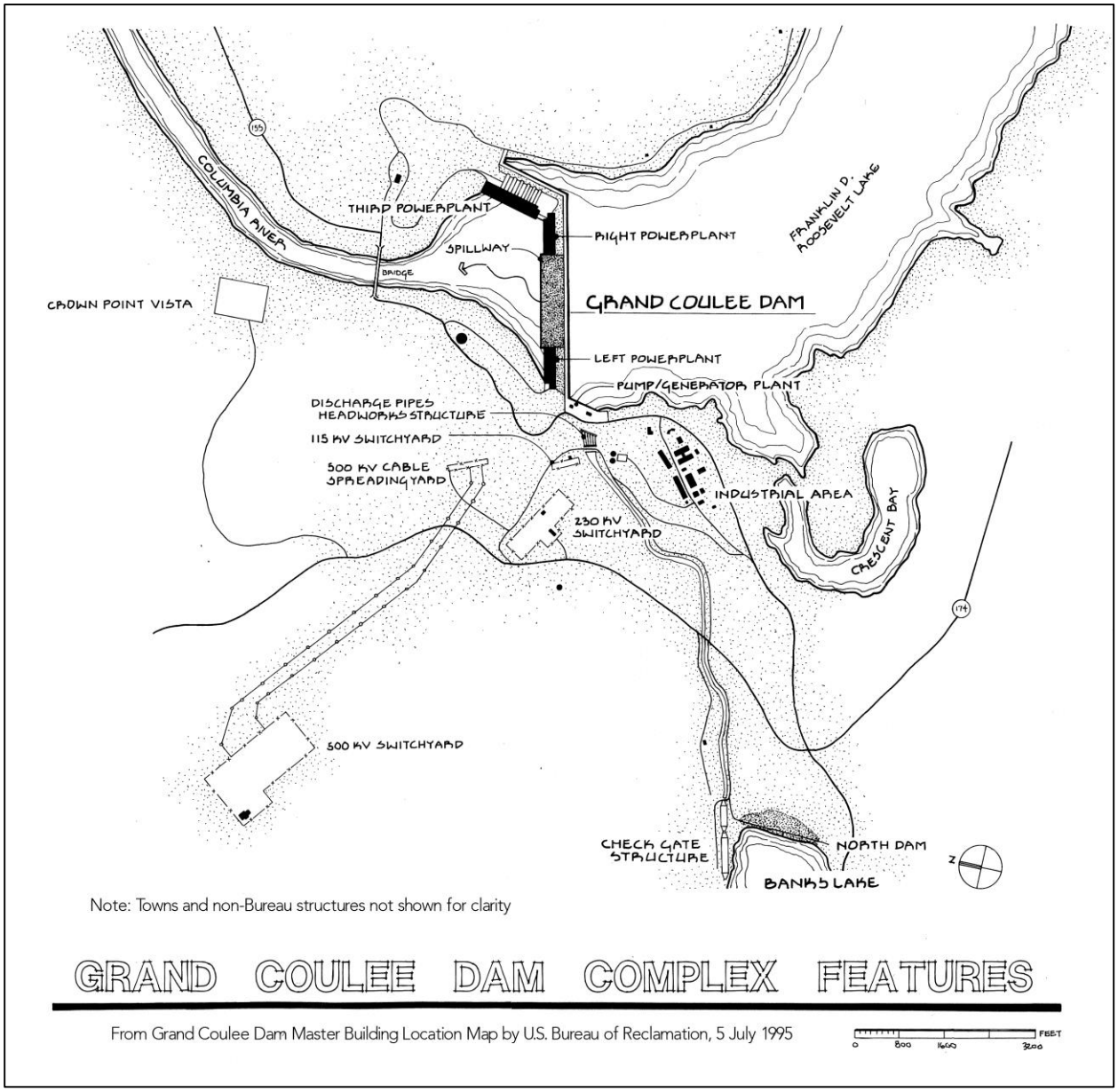

ILLUSTRATION 1: Grand Coulee Dam Complex Features

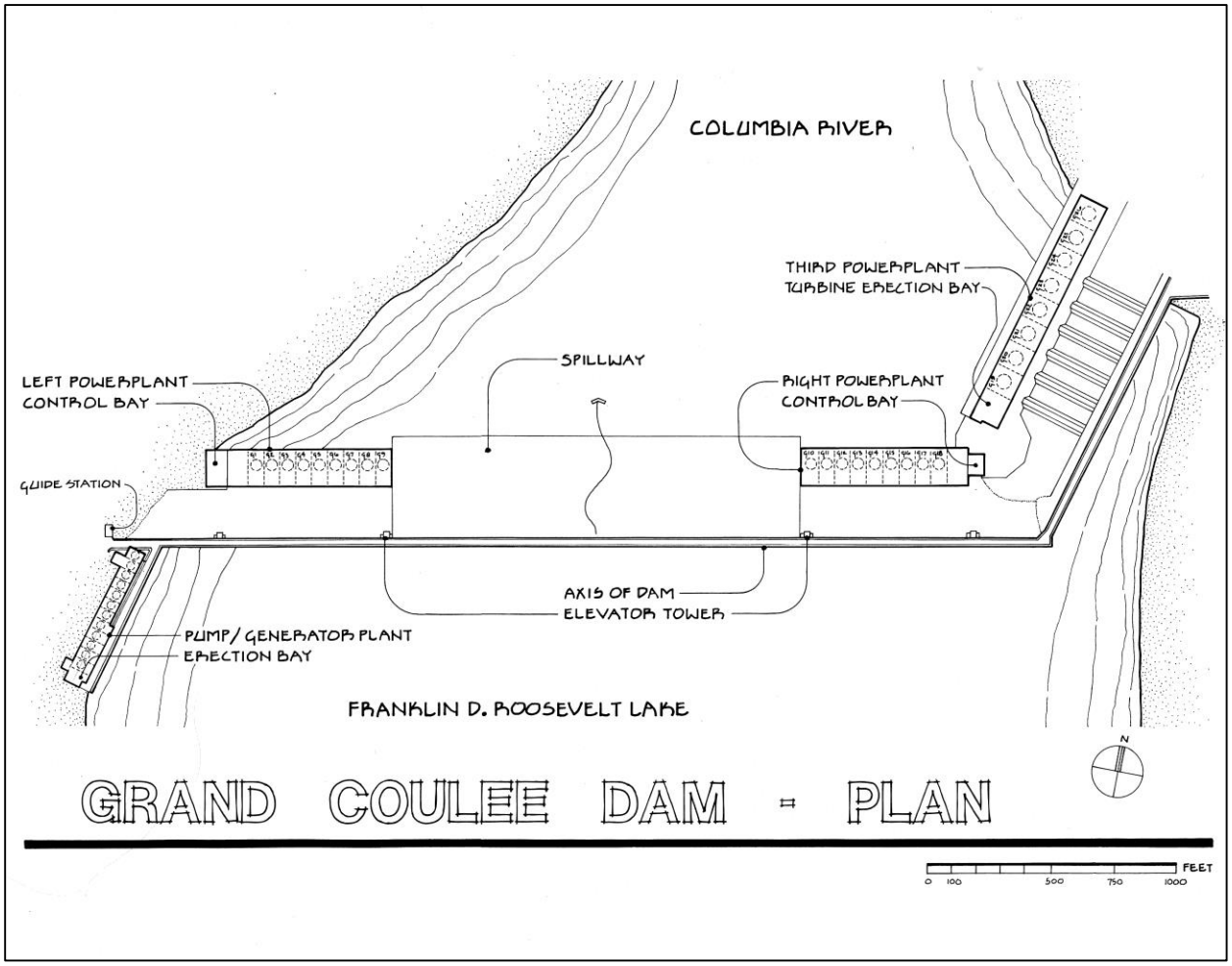

ILLUSTRATION 2: Grand Coulee Dam Plan