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The Grand Coulee Dam, and the Columbia Basin Reclamation Project

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Purposes of the Project

The development of the Columbia Basin Reclamation Project in central Washington is the culmination of several decades of investigations, planning, and promotion. The objects of the enterprise are to irrigate, within the next 25 to 50 years, a million and a quarter acres of dry-farms, abandoned land, and desert, to develop electrical energy for use on the project and elsewhere, and to regulate the flow of the upper Columbia for the benefit of future downstream power plants. Flood control for the protection of property is a minor consideration; but regulation of the winter flow is potentially important to navigation in the lower Columbia, where the low water of winter can be increased two feet in depth by the releasing of stored water.

The Columbia River Basin

The Columbia River is of very great economic importance to the Pacific Northwest. It drains an area of 259,000 square miles -- an area greater than that of Minnesota, Iowa, Illinois, and Wisconsin combined -- four times the area of the New England States. The drainage basin includes nearly all of Idaho, the greater parts of Oregon and Washington, small areas in Wyoming, Utah and Nevada, and large areas in Montana and British Columbia.

Without irrigation from the Columbia and its tributaries, but few people could live in the Pacific Northwest; and, as a consequence, the Middle West and the East would pay much higher prices for western products, and would have a more restricted market for middle-west foodstuffs and eastern manufactured goods.

The Columbia is second in flow to the Mississippi alone, among the rivers of North America, and greater than any other in potential power.

Watersheds above the Dam

Seventy-four thousand one hundred square miles of the Columbia Basin lie above the site of the Grand Coulee Dam, 39,000 square miles of it in Canada. Sixty per cent of the water passing the dam comes out of Canada.

The most important contribution of is the main stem of the Columbia. It rises in Lake Columbia, between the Canadian Rockies and the Selkirks, flows northwesterly 195 miles, and thence southerly 270 miles to the international border. It brings down about 38 per cent of the water that passes the dam.

The most important tributary to the upper Columbia is the Kootenai River which rises in the Canadian Rockies 75 miles north of Lake Columbia, source of the Columbia River. It flows south 180 miles into Montana, passing within a few miles of Lake Columbia. After making a 167-mile loop through northwestern Montana and northern Idaho, the Kootenai returns into Canada, and joins the Columbia 30 miles north of the border. Nearly 28 per cent of the flow at the dam, an average of 25,300,000 acre-feet a year, comes from the Kootenai.

Third largest of the streams above the dam ~~is~~ is Clark's Fork. Its source is on the western slope of the Rocky Mountains near Butte, and not far from the sources of the Missouri River and the Snake, large downstream tributary of the Columbia. Most of the drainage of western Montana is collected by the Clark's Fork in its 360-mile course northwesterly

to Lake Pend Oreille in north Idaho. Thence, the river runs northwesterly through Idaho and northeastern Washington to a junction with the Columbia half a mile north of the Canadian border.

The Clark's Fork furnishes about 24 per cent of the flow at the dam, the Spokane, draining a part of the western slope of the Bitterroot Mts., seven per cent, and the Kettle, Colville, and San Poil rivers half as much.

Flow
Run-off
Etc.

The average annual run-off of the Columbia at the dam site during the past 25 years was 80 million acre-feet, and the average flow 110,000 second-feet, ranging from a minimum of 17,000 second-feet to a maximum of 492,000.

Since much of the flow, particularly that from the Columbia and Kootenai Rivers, comes from glaciers and ice fields high in the Selkirks and Canadian Rockies, the peak is reached in June or early in July, and the flow always continues high throughout the summer. Fortunate consequences are that surplus water will provide both water for irrigation and power for pumping it, and that all firm or primary power will be available for industrial, domestic, and municipal uses.

Geology of the Grand Coulee Region

At least a superficial understanding of the general geological features of central Washington is necessary if one is to understand the power potentialities of the Columbia, and the scheme for expanding a little the limited agricultural resources of the arid west, where, in a third of the country, the government holds more than half the land, and irrigation can never cover more than a thirteenth of the nation's farm land.

Millions of years ago, great fissures opened in the earth's surface, first in an arm of the sea, and later in low land, lying between the Rocky Mountain system and the Cascades; and floods of highly fluid lava poured out on many successive occasions, separated by thousands, and perhaps by millions of years. Thus was formed the Columbia Lava Plateau, covering parts of Washington, Oregon, Idaho, Utah, Nevada, and California.

Columbia Lava Plateau

Such flows of lava forced the prehistoric Columbia out of its short course to the southwest, and compelled it to cut, to the west and south, a new channel which was completed before the close of the last ice age, and is now occupied by the river. The Big Bend of the Columbia follows, generally, the contact of the lava plateau with the Okanogan Highlands on the north and the Cascades on the west; and, at the dam site, is a canyon 1600 feet deep, 3000 feet wide at the bottom and a mile wide at the top. No doubt great seasonal

The Big Bend

floods from the ice cap, vastly greater than the floods of this day, are largely responsible for the depth and width of the canyon.

Mountain building forces that forced up the Okanogan Highlands and the Cascades lifted the northerly and westerly margins of the lava plateau, causing its surface to slope away to the south and east from the Columbia canyon wall. They also lifted the northwesterly portion, known as the Waterville Plateau, about 800 feet above the interior of the Big Bend country, the southeastern boundary of the Waterville Plateau being marked by the Coulee Monocline.

Two or more advances of the Cordilleran Ice Cap into the Pacific Northwest produced profound changes in the Columbia Basin. The Spokane Ice Lobe appears to have closed for a long time the Spokane River and the Columbia above its junction with the Spokane, while the Okanogan Lobe at the same time occupied the Okanogan valley, closed the Columbia from the vicinity of the dam site westward to some point above Chelan, and covered the northwestern part of the Waterville Plateau. The San Poil valley and the Columbia from the dam site eastward to the Spokane River remained open.

During that period of thousands of years, tremendous floods of glacial water, overflowing the divide a few miles south of the river canyon, along a hundred-mile front, swept

away the soil and cut rugged channels in the lava plateau, to carry the floods away southwesterly to the lower Columbia and its tributaries. The most westerly of these relief channels, and by far the greatest in size, is the Grand Coulee.

The Grand Coulee

Water backing up in Rattlesnake Canyon, near the site of the dam, spilled over into the basin of a small stream which flowed southwesterly across the Waterville Plateau. Pouring over the Coulee Monocline, which drops 800 feet in a mile to the Hartline Basin, the glacial torrent formed great rapids and then a stupendous waterfall, which by headward erosion cut through the Waterville Plateau the upper Grand Coulee, 800 feet deep, 25 miles long, and one and a half to five miles wide. It intersects the Columbia River canyon 600 feet above the bottom of the gorge.

After spilling over the Coulee Monocline, the outflow filled the Hartline Basin and overflowed its southern margin at several places, forming rapids and waterfalls which produced the lower Grand Coulee, the Dry Coulee, and the Spring Coulee, all opening into the Quincy Basin.

The Lower Coulee

In the broken rock of the Coulee Monocline, the lower Grand Coulee was cut to elevations far below the bewildering network of channels that lie east of it, by a waterfall that originated in rapids near the site of Soup Lake. The west wall of the lower coulee, an edge of the Waterville Plateau, is 800 to 1000 feet above the lakes on the coulee floor, and the east wall, on the Hartline Basin,

is about half as high. Islands in the lakes are remnants of the Coulee Monocline, and show its sloping strata.

The 17-mile box-canyon of the lower Grand Coulee terminates at its northerly end in the Dry Falls, 400 feet high and with a brink five miles long.

After the retreat of the Spokane front of the Okanogan lobe of the Ice Cap, the Glacial Columbia resumed, for a time, its course through the canyon which the Columbia now occupies. Later, the canyon was closed again by the Okanogan Lobe, the Wisconsin Ice Front extending as far south as the Dry Falls, along the west side of the upper coulee, the entrance to which was closed. During this period the channel on the east side of Steamboat Rock was probably formed or enlarged, and the Dry Falls advanced three miles further north, to their present site.

Glacial torrents, flowing out of the upper coulee, spread out over the Hartline Basin, and laid down, over an area of 50 square miles, deep deposits of gravel, sand, and silt. This basin was finally almost completely drained by the Dry Falls, which advanced to within about 6 miles of the outlet of the upper coulee.

Lake Quincy

Below the outlet of the lower coulee, the turbid run-off from the Ice Cap spread over the Quincy Basin, forming Lake Quincy, and covering an area of 850 square miles with detritus from the Ice Cap. Through three outlets to the west, one now traversed by the highway east of the Vantage bridge, the lake overflowed into the Columbia River canyon, and to the south it found one outlet around the Frenchman Hills and another past the Saddle Mts. through the Drumheller and Othello Channels.

These outlets ultimately drained the lake, and exposed hundreds of thousands of acres of land that are to be irrigated from the Grand Coulee Dam.

Millions of acres of land west of the Missouri River, and millions more west of the Rocky Mts. were formerly characterized in the geographies as desert. Large areas were used for grazing, but people native to humid climates believed they would never raise cultivated crops. In the 70's, settlers in the Palouse country raised crops in the flats and ran stock on the bunch-grass hills, which they believed to be otherwise useless. Then someone learned that wheat would grow on the hills too, and dry-farming developed.

In the 80's, farmers pushed further out into the range country of central Washington; and as late as 1900, homesteaders were still settling on the sage-covered lands in the Big Bend. Some still remain, dry-farming the rim of the area to be irrigated, but thousands of families, after a brief success, followed by years of drought, long ago moved away.

The Columbia Basin Reclamation Project will reclaim thousands of abandoned farms, and thousands of acres of desert, and will some day save thousands of acres of dry-farm wheat land from the fate of the Great Plains dust bowl.

Irrigation of the Big Bend Country

It was but natural that engineers and early settlers should think of bringing the abundant water of the Columbia or one of its tributaries to land that sparse streams and deep wells had proved to be rich, and, if irrigated, highly productive.

A scheme that had much early serious attention contemplated carrying water entirely by gravity from Albany Falls, on the Clark's Fork in northern Idaho, across the country to the southwest, through canals, inverted siphons, and tunnels, to irrigate the lower part of the area now to be served. Another scheme proposed a dam, a power house, and a pumping plant on the Columbia River near the mouth of the Grand Coulee, and the use of the Grand Coulee as the route to the irrigable lands. Technological developments of the last quarter century have made that plan feasible, and in 1932 it was approved by the Army Engineers as a consequence of a comprehensive study of the Columbia Basin.

The enterprise involves building, in an isolated, 1600-foot canyon, a dam of unprecedented size to raise the river above it about 335 feet; and, as the project develops, the construction of the biggest power plant in the world, a pumping plant to raise irrigating water an additional 280 feet at the rate of 500 tons a second, a reservoir 27 miles long in the upper Grand Coulee, hundreds of miles of main and lateral canals, numerous auxiliary power and pumping plants

on the project lands, and a variety of structures and control works.

The Columbia River falls ~~1310~~ 1290 feet in its 750-mile course from the Canadian border to the sea. According to plans of the Army Engineers, ten dams will someday utilize 92 per cent of this head. Two of the dams are already completed, one at Bonneville, at the head of tidewater, and one at Rock Island. Uppermost and most important of the ten will be the Grand Coulee Dam. It will utilize 27 per cent of the total head; and will regulate the flow of the river for the benefit of power plants at other dams, doubling the firm power capacities of such plants above the junction of the Columbia with the Snake River, and increasing by 50 per cent the firm power capacities of others.

Pages from the Columbia

The Grand Coulee Dam

The Grand Coulee Dam is of the gravity type, and extends straight across the river canyon. Its maximum height from lowest bedrock will be 550 feet, and its maximum length 4300 feet. The base is 500 feet wide at the bottom of the canyon, and about 3000 feet long.

The downstream face has a uniform slope of 0.8 to 1; and, in the 1650-foot spillway section, it terminates in a so-called bucket, designed to dissipate the energy of water falling over the dam, and thus prevent serious erosion of the river bed downstream. The bucket is 90 feet wide, and 80 feet deep. Its crest is at Elevation 900, about 33 feet below average low-water level and nearly 80 feet below the high-water average.

Control of river flow and of storage will be accomplished by means of 11 drum gates at the crest of the spillway, each 135 feet long and 28 feet high, and 60 outlet tunnels through the dam. The tunnels are 8-1/2 feet in diameter, and are arranged in 3 sets of 10 pairs, one set at approximately low-water level, one set 100 feet higher, and one set 200 feet above low water. The estimated capacity of the spillway is a million second feet, and that of the outlet tunnels 253,000 second feet. The turbines, fully loaded, will pass 81,000 second feet.

Trash racks protect the entrances to the outlet works, and two gate valves are installed near the upstream end of each tunnel. Air ports and control valves will admit

air to the tunnels when valves are closed, to prevent the creation of vacuuo in the tunnels, and consequent damage to linings and valves. Entrances to the tunnels are lined with heavy, ribbed, semi-steel castings, flared to reduce or eliminate cavitation.

At vertical intervals of 80 feet, galleries extend from end to end of the dam. These, with a number of adits extending from them toward the face of the dam, are provided for use in inspecting, cooling, and grouting the dam. One cross-channel gallery follows closely the bedrock. From it, holes will be drilled for final bedrock grouting, when the dam is nearly completed; and, later, 80-foot open uplift relief holes will be put down.

Storage, Reservoir

Above the Coulee Dam, a storage reservoir 151 miles long will extend to the Canadian border. It will average about 4,000 feet in width; and will extend about 30 miles up the Spokane River and about 8 miles up the Kettle and San Poil Rivers.

The storage capacity will be about 10 million acre-feet, of which a little more than 5 million will be useful for regulating purposes with an 80-foot drawdown. No stored water will be needed for irrigation or for pumping irrigating water, since the season of high water coincides with the growing season; hence the entire useful storage capacity of the reservoir will be available for the benefit of future downstream power plants.

The flood line will be at elevation 1290 to 1292, but all land below elevation 1310, an area of 128 square miles, will be acquired by the government. It has been surveyed and evaluated for the government by local appraisers. With very rare exceptions, owners have accepted the prices offered. Chiefly grazing and cut-over timber land are involved. Two small towns, and several small settlements, including a little orchard land, are included. Several miles of railroad and of primary and other highways will be relocated.

Kettle Falls, a 30-foot irregular cataract, will be flooded; and the long highway bridge at that location will be replaced with another which will accommodate both the

railroad and highway.

Clearing of the reservoir area of buoyant and combustible materials is in progress as a W.P.A. project, the Bureau of Reclamation furnishing all material and equipment. Merchantable logs are sold to commercial sawmills.

The Power Plants

Flanking the spillway section on each side is a power house and abutment section. The foundation for the east power house has been completed, but no further work will be done on it until the west power house is developed. It is a reinforced concrete building 765 feet long and 85 feet wide, now under construction.

When completed, the power plant is to contain 18 generating sets, each consisting of a 108,000 kva generator, driven by a 150,000 h.p. turbine, nine in each power house. In the west power house, there will be also three station service units, each a 12,500 kva generator driven by a 14,000 h.p. turbine.

The three large and two small generators are under construction at the Westinghouse plant in Pittsburgh. The Newport News Shipbuilding and Drydock Co. is building the three large turbines, and the Pelton Water Wheel Co. the two small machines. The three large generators are to cost $2,611,000, installed, and the two small machines $193,480. The low bid on the three large turbines (to be installed by the Bureau) was $1,477,200, and that on the two small wheels $108,498. Installations are to be complete early in 1942. Governors will cost $87,090.

The large generators will run 120 r.p.m., and will generate 13,800 volts, 3 phase, at 60 cycles. Rotors will be

10 feet high and ~~25~~ 31 feet in diameter; and the stator and frame ~~24~~ 22 feet high and 45 feet in diameter. One generator will weigh about a thousand tons. Turbine scroll cases will be 58 feet in diameter with 15½-foot draft-tube throats. Each will weigh about 750 tons.

The Pumping Plant

The pumping plant will be located on a wing dam, approximately 150 feet high and about 600 feet long, located behind the west end of the dam. It is designed to include, ultimately, 12 centrifugal pumps, each with a capacity of 1600 second-feet against a head of 295 feet. Two pumps will be spare units.

Each pump will be driven by a 65,000 h.p. synchronous motor. Two motors will take their power supply directly from one generator, and the two pumps will be started by controlling generator and motor field excitation as a turbine is started. It will be possible to adjust pump speeds to pumping heads by controlling turbine speeds.

The base of the pumping plant is now under construction, but pumping equipment and the building will not be added until the irrigation phase of the project is undertaken.

The output of each pump will be delivered by means of a 12-foot steel pipe, through one of 12 tunnels already driven diagonally upward through the canyon wall, to be carried thence by an open canal to the upper of the two earth-fill dams which will form a 27-mile balancing reservoir in the upper Grand Coulee.

Balancing Reservoir and Canals

The construction of two earth-fill dams in the upper Grand Coulee is justified chiefly by the fact that 27 miles of main canal would be more expensive, but the balancing reservoir so formed will be useful in adjusting the demand for water, and the supply in the irrigation system. Off-peak power can be used for pumping; and in the distant future, when other power sites on the river are fully developed, water stored in the balancing reservoir will start the season's irrigating if a late spring should cause a low run-off in April.

Not all of the floor of the upper Coulee will be flooded, but most of the construction railroad and 8 or 10 miles of the highway will be covered. No water will flow through the lower coulee.

A main canal, 12 miles long, will pass east of the Dry Falls; and from it a canal, ultimately to be 100 miles long, will supply the west side, and a 150-mile canal will supply the east side of the project with water. The west canal will cross the lower coulee, between Soap and Lenore Lakes, by inverted siphon or viaduct.

Project Lands

The land to be irrigated extends from the vicinity of Soap Lake, 50 miles south of the dam, to Pasco, about 80 miles further south, at the junction of the Snake and Columbia Rivers. The greatest width of the area, east and west, is sixty miles. Elevations range from about 1300 in the north to 400 in the south. The soil resembles others of glacial origin.

The climate is temperate, but of low humidity, precipitation varying from 5 to 16 or 17 inches, very little falling during the growing season. The mean annual temperature is about 50 degrees, and the average during the growing season about 62. Summer days are hot, but the nights are reasonably cool.

The average frost-free period over a number of years was 159 days. Temperate zone crops can be grown, but they must be of varieties to be consumed locally or to stand high shipping costs. Forage crops will occupy large areas. Staples like wheat and corn can not be grown profitably on small tracts of irrigated land. The climate is not suited to cotton, and marketing conditions will not favor tobacco. Diversified farming will be practiced.

Almost all of the land to be irrigated was patented years ago and is now held by individuals and corporations. It includes desert, abandoned dry farms, and dry-farm wheat land.

No land on the project is open to homestead entry. Settlers will be obliged to buy from private owners, but they will be protected from land speculators by the "Anti-Speculation Act", of May 27, 1937.

The Anti-Speculation Act

The principal objects of the Anti-Speculation Act are to insure prospective settlers that they will be able to buy land at its actual unirrigated value without the addition of any speculative increment, and to provide homes for many families by preventing the holding of large acreages. This is accomplished without depriving the landowner of any of his legal rights, by the simple expedient of introducing suitable conditions into the contracts under which the government undertakes to build, maintain, and operate irrigation works for the benefit of the landowners. The plan has already been followed successfully on the Kittitas and Owyhee Projects.

Briefly, the principal provisions of the Anti-Speculation Act are:

(a) that contracts for the repayment of that part of the cost of the project allocated by the Secretary of the Interior to irrigation, and contracts for other purposes, be entered into by the government and the landowners as members of irrigation districts;

(b) that landowners agree to limit their holdings to 40 acres for an individual or 80 acres for a man and wife;

(c) that landowners agree to sell lands held in excess of these minima at the government-appraised price; and

(d) that lands to be served with water be impartially appraised by the government to determine their present-day market values without reference to the proposed irrigation works;

(e) that in the event "excess" lands are sold at higher prices, or are retained, no water shall be delivered to either the land so sold or to non-excess or excess lands retained;

(f) that water may be obtained for lands which were purchased at prices above the government appraisal, unless they were "excess" lands so purchased, upon payment to the government of a portion of the excess price, varying from 50 to 100 per cent with the delay in payment, this money to be applied as credit against the last construction payments to be charged against the land; and

(g) that the State of Washington by appropriate legislation shall authorize, adopt, ratify, and consent to all the provisions of the act which come within the jurisdiction of the State.

Conditions under which water can be obtained for any tract of land run with the land as part of any title to it. Records of government appraisals will be accessible free to prospective land buyers at appropriate time and places. The State of Washington has complied with the provisions of the act, and landowners are active in carrying out the preliminary steps of their obligations.

Surveying land
Appraising land

In order that the Secretary of the Interior may be enabled to discharge his duties under the act, an enormous surveying and appraising project is in progress by the Bureau of Reclamation on the project lands.

It involves, first, the retracement of original contract surveys, made 30 to 75 years ago, in an area of two and a half million acres (3780 sections). Lost corners are relocated according to the practices of the General Land Office, and all section and quarter-section corners are marked with concrete and metal monuments. About two million acres have been covered.

Level parties determine the elevations of all monuments, and they are used as benchmarks by topographers who take contours at two-foot intervals on all land likely to be irrigable. Topographic work has been completed on nearly a million and a half acres of land.

Soil technologists are sampling and classifying the soil on each 40-acre tract; and appraisers, taking into account any improvements on the land, are fixing the values at which each parcel of land is to be sold.

Actual development of the irrigation phase of the project must depend upon the progress made by landowners in organizing their districts and contracting with the government, and on appropriations by Congress.

Active work on the project began in the late summer of 1933 with diamond drilling, the digging of test pits, and preliminary surveying on the dam site. In December, a contract for the removal of 2 million yards of overburden was let to David M. Ryan, and a slide the following spring added a million yards to that job. Power shovels, heavy dump trucks, and tractor-drawn scrapers were used.

A contract for a low dam and power plant was let July 15, 1934 to the Mason-Walsh-Atkinson-Kier Co., and work on that contract was started on October 1. On account of technical problems involved, and because the Bonneville power project had been recently initiated, the contract was altered June 5, 1935 to cover, instead of a complete low dam, the base of the high dam originally planned as the basic feature of a combined irrigation and power project. The base of the dam was completed March 21, 1938 (due April 2, 1939).

Completion of the dam, the west power house, and the base of the pumping plant is covered by a contract let February 7, 1938 to the Consolidated Builders, Inc., a firm composed of the M.W.A.K. Co., the Six Companies, builders of the Boulder Dam, and the General Construction Co., builder of the Owyhee Dam.

Under provisions in the construction contract, the government took over from the M.W.A.K. Company, at the termination of its work, the town Mason City for $25,000, the 29.5-mile 110,000-volt transmission line for $25,000, and, for $100,000 the entire installation of construction equipment, including crushing, screening, washing, conveying, concrete mixing, and other installed facilities, but excluding shovels, drag-lines, tractors, trucks, and other mobile equipment. All of the property taken over from the M.W.A.K. Company, except 59 houses in Mason City, was transferred to Consolidated Builders, Inc. at a price specified in its contract.

Numerous additional contracts covered a 30-mile railroad to the site, details of the government construction camp, construction materials, and dam and power plant equipment. The government furnishes all material and equipment in the permanent installation.

If funds are available at the necessary rate, the dam, the west power house, the base of the pumping plant, two station-service generating units, and three main generating units will be complete in 1942.

No part of the irrigation phase of the project will be undertaken until landowners contract with the government for its construction, and until Congress then makes necessary appropriations for financing it.

Auxiliary Construction and Towns

Gravel roads and temporary living quarters served the pioneer crews, but with the letting of the U.S.B.R. contract, more substantial facilities became necessary. Highways leading to the dam were realigned, regraded, widened, and hard-surfaced by County Commissioners and the State Highway Department; 32 miles of standard gauge railroad were built from Odair to the mouth of the Coulee by the Government; a 29.5-mile 110,000-volt transmission line was constructed by the contractor in 42 days; a 950-foot cantilever highway bridge was built across the Columbia by the Government, and a heavy timber Howe truss bridge by the contractor; telegraph and telephone lines were run in by the public utility companies; and two towns were built below the dam site.

Mason City, on the right bank, is the contractor's town. Since it is to be dismantled when the dam is finished, its houses and public facilities are of a less substantial character than those in Coulee Dam, the Government town on the opposite side of the river; but houses are comfortable, streets are oiled, and efficient water, street lighting, and sewer systems were provided. There are 290 houses in Mason City, all but a dozen of them of three standard types, containing one, two, or three rooms, bath, and kitchen or kitchenette. There are, also, 60 cabin-type dormitories with accommodations for 1360 men, 2 dormitories for women, a hospital, a hotel, two school houses, a gymnasium, two churches, a laundry, stores,

recreation hall, office and shop buildings, warehouses, storage yards, a large mess hall, a motion picture theatre, a garage, and a service station.

Coulee Dam is a permanent town to house operating and headquarters employees of the Columbia Basin Project, composed of 77 permanent residences of six standard types, 3 large dormitories, administration building, school house, post office, garages, fire station, shops, warehouse, and service station. Fifty-seven 5-room, court-type residences, and 7 temporary dormitories are to be removed after the dam is completed.

The two towns cooperate in ~~operating~~ their school systems. High school and primary grade pupils attend school in Mason City, others in Coulee Dam.

Private towns and villages, that sprang up in the vicinity of the dam, have a combined population of nearly 10,000.

Excavation

Among the major tasks included in the building of the Coulee Dam was the excavation of overburden from the dam site.

While the canyon was blockaded downstream during the last ice age, glacial water deposited fine rock flour, side streams brought in sand and gravel, and icebergs dropped boulders to fill the canyon, principally with sand and rock flour, to depths of several hundred feet.

Much of the material was carried out into the Quincy Basin when the cutting of the upper coulee was completed, and later much of it was carried down the river, but much still remains.

At the dam site, the river flows in a rock canyon 3,000 feet wide at the bottom, in an 800-foot bed between sand and clay slopes and terraces against the canyon walls. Twenty to 70 feet of hard clay, interspersed with boulders, sand, and gravel, covered the bedrock beneath the river channel at the dam site.

In order to lay bare the 350-acre site of the dam and to provide forebays and tailbays for the power houses, about 15 million yards of overburden were removed. Material, dug by large electric shovels, was hauled in 8- to 12-yard trucks and 12- to 20-yard tractor-drawn buggies to grizzlies over feeder pits, where boulders over 15 inches in size were pushed off, to be hauled away later by trucks, and other material was broken up and forced through the grizzlies by bulldozers.

Feeders under several grizzlies delivered material by belt conveyors to the surge feeder on the 60-inch main conveyor system, which was made up of several sections, each driven by a 200-horsepower motor, and long or short depending upon the grade.

More than 13 million yards of overburden were carried a mile away to Rattlesnake Canyon, and dumped at elevations 500 to 600 feet above the excavated area. Several million yards of overburden from the east side were carried by belts 2000 feet across the river, and thence on the main conveyor to Rattlesnake Canyon. After excavation on the west side was finished, the conveyor system was moved to the east side of the river.

Overburden was moved at the rate of about a million yards a month -- as much as 50,839 yards in one 21-hour day. Common excavation under the M.W.A.K. contract exceeded 17 million yards, and to date it has run over 20 million, not including, in either case, the moving of sand and gravel.

a
Frozen Earth
Dam

A frozen-clay dam was a unique and spectacular feature of excavation operations at the Coulee Dam. Threatened with serious delay and great expense by a moving mass of plastic clay which, in spite of ordinary efforts to hold it, poured into one of the deep gorges in the bedrock, engineers of the Bureau conceived and carried out the idea of freezing the toe of the clay slope.

The gorge in question was a hundred feet wide just upstream from the dam site, extended about 120 feet below adjacent bedrock, and opened into a deep pit in the dam site. A thick deposit of clay overlying it and extending further upstream, was not stable on a 3 to 1 slope, and it continued to flow into the pit over a concrete dam and a heavy timber crib built by the contractor at the bottom of the gorge.

Work in the area was abandoned during the high water season of 1935, and the entire sort excavation was flooded. Sloughing recurred as soon as unwatering was started late in the summer, and the freezing venture was then undertaken. The water level in the pit was maintained at elevation 360 to stabilize the material while the ice dam was formed.

Although meager information was available in connection with freezing of wet ground in shaft sinking, design data to suit local conditions could not be found. On the basis of a compressive strength of 200 pounds per square inch, a weight of

90 pounds per cubic foot, 75 per cent liquid pressure, and a cylindrical formula, a thickness of 10 feet on a radius of 105 feet was indicated. The long radius was chosen in order to give the frozen section vertical support on the timber crib, to avoid uplift, and to minimize the risk of slipping at the haunches. The arch thickness decided upon was 30 feet, the height was 40 feet, and the span 100.

Considering the time available and the probable rate of freezing, refrigeration pipes were spaced 30 inches each way. The water content in the mixture was 32 per cent of the dry weight of the clay, and heat conductivity and the rate of freezing exceeded expectations.

Freezing points consisted of 3-inch black iron pipe in two sections of 21 to 24 feet, driven one after another with a 800-lb. drop hammer. In addition to 8 rows of pipes evenly spaced, about 25 extra pipes were driven at each end of the arch to increase its strength and to make slipping on the rock abutments unlikely. There was a total of 377 points, of 45 feet average length. Lower ends were closed with standard pipe caps, which were found to produce less misalignment than pointed caps.

A tee and other standard fittings at the top of each 3-inch pipe supported within it a 1-1/2-inch pipe extending within 6 inches of the bottom, and facilitated hose connections

between the inner pipe in one freezing point with the exterior pipe of the next one. Groups of sixteen points were connected in series between 3-inch supply and return headers.

Forward movements of the upper portion of the freezing clay, and internal adjustments of the freezing material as it expanded caused the breaking of a few 3-inch pipes at the couplings between upper and lower sections. Ten were cut out of the line without serious delay in the freezing.

A drainage well, sunk 55 feet to the bottom of the supporting grit, 30 feet upstream from the dam, collected about 25 gallons of water per minute, reduced the water content of the clay bank, and diminished the pressure on the ice dam.

Two ammonia compressors of a combined ice capacity of 80 tons were used to chill the salt brine circulated through the system at the rate of 170 gallons per minute. Twenty tons of salt and 2200 pounds of ammonia were used.

The driving of freezing points was started August 14, 1936; the freezing of the first section completed was started August 25 and of the remainder September 3; and dewatering began September 18. The ice dam was dismantled in April 1937, after concrete had been built up to a higher level; and the clay bank promptly moved forward against it.

(Engineering News-Record, Feb. 11, 1937,
Reclamation Era, Jan. 1937)

The diversion of the Columbia River was the most precarious phase of construction work at the dam. The river has been known to reach a summer peak of 493,000 second-feet (elev. 961.5), and the flow actually averaged 445,000 second-feet (elev. 973) in ten years of the 38-year period for which records were available. The flood of 1894 is believed to have been 725,000 second-feet. Plans for the diversion of the river were based on a maximum assumed flow of 350,000 second-feet, and on assumed water levels of 1000 above the dam and 990 below it. The maximum flow in the years 1936 to 1937, inclusive, while the cofferdams were in use, did not exceed 400,000 second-feet.

At the dam site, the river channel was about 800 feet wide. Beneath it was a bed of hard clay, 20 to 70 feet thick, and on each side embankments of clay, sand, and gravel. Along the west side of the river there was built in 90 days, in the winter of 1934-35, the world's largest cofferdam. Its total length was about 5,000 feet, and it inclosed an area of 66 acres, in which excavations were made for the west third of the dam and for a forebay and tailbay for the west power house.

The greater part of the cofferdam consisted of cells of 15-inch interlocking steel piles, but wings at the ends consisted of an outer single line of steel piles and an

inner timber wall joined to it with tie rods, the intervening 37-foot space being filled with gravel. (Sections B and I, slide No. 421). Cells consisted of straight diaphragms spaced 36 feet or 40 feet apart and joined by curved outer faces. Where supporting berms could not be maintained in the tailbay (Section H), the cells were 36 x 90 feet in plan, elsewhere they were 40 x 90 feet in area. (Sections C and H). Two clusters of larger cells (Sections D and G) were constructed about 800 feet apart, to be joined later to a completed section of the dam (Block 40) and to cross-river cofferdams, for the purpose of diverting the river and making the riverbed accessible for excavation.

Sheet piling was driven by 80 steam hammers handled by long-arm cranes and derricks, and by special gantries made to span the row of cells and carry 4 hammers each. An average of 35 blows of 13,000 foot-pounds were required per inch of penetration, and it was found to be impractical to drive the steel piles through the "young shale" overburden to bedrock. "Refusal" was fixed at about 50 blows per inch.

The first steel pile was driven on January 1, 1935, and by April 10th 18,000 tons, 127 miles, of piling had been driven to complete the west cofferdam. All of the steel had been trucked in 38 miles, 12 to 15 trucks being in operation 24 hours a day.

While the west cofferdam was under construction, excavation was carried on actively within the area inclosed by it; and as soon as the cofferdam was completed, a heavily timbered excavation was sunk to bedrock just inside it. Within the deep excavation, there was built to elev. 1000 a complete 50-foot section of the dam, Block 40. It was joined, by concrete upstream and by means of a heavy timber crib downstream, with the two large cell-clusters of the cofferdam.

A 1300-foot section of the west end of the base of the dam, terminating in Block 40, was built within the west cofferdam. Blocks 32, 34, 36, and 38, each 50 feet wide, were built up only to elev. 910, even with the bottom of the river channel, and the three intervening blocks were raised to elev. 950. The resulting 350-foot low gap was designed as the diversion channel for the river; but in order to prevent reverse currents and erosion in the tailbay, several blocks in the power house section, aggregating 225 feet in width, were also left at elev. 950. The four deep gaps carried the flow up to about 85,000 second-feet, but the summer peak flowed about 18 feet deep over the high blocks and through the low gaps in the power house section.

Considerable excavation on the east side of the river was done inside of a low timber cofferdam, but the final excavation there and all of the excavating under the river channel were done in an area enclosed by Block 40, parts of

the west cofferdam above and below it, and two cross-river cofferdams.

From soundings taken at 2-foot intervals over the sites of the cross-river cofferdams, cribs to fit the river bottom were built inside the west cofferdam; and subsequently they were floated into position after the diversion channel through the west cofferdam had been opened. The down-stream cribs were 90 feet long and 64 feet wide, U-shaped, with 32-foot channels through them. After being sunk in their proper positions by having their compartments filled with gravel, stop-logs closed the channels and stilled the water to expedite the completion of the cross-river cofferdams.

Water was admitted to the west cofferdam early in Nov. 1936, the cribs of the down-stream cofferdam were all in place on Dec. 9, stoplogs were placed within 30 hours, and by Dec. 12 the river was flowing through the diversion channel. The up-stream cofferdam was substantially complete and dewatering was begun on Jan. 8, 1937. By Jan. 9, 80 million gallons of water had been removed, and excavation was underway.

In the system of cofferdams, 18,800 tons of sheet piling and 2,822 tons of miscellaneous steel, and 18,500,000 board feet of timbers were used. Excavation for the cofferdams totalled 1,326,735 yards, and fills 1,502,000 yards. The contractor's reported cost for the diversion of the river was nearly six million dollars.

Bedrock

The dam site is a granite spur of the Okanogan Highlands, once buried in the Columbia Lava Plateau and later exposed and eroded deeply when the Columbia cut out its canyon. The rock is coarsely crystalline except where fine-grain, much-jointed grey granite was intruded.

Early investigations of the dam site included the drilling of fourteen diamond-drill holes in 1921, and two in 1930. Subsequent examinations brought the total of diamond drilling to about 33,000 feet, holes extending to depths as great as 880 feet. In all cases, only dense granite was penetrated. After bedrock was exposed, a number of 36-inch Calyx holes were drilled to depths of 29 to 58 feet in the areas showing greatest jointing. The bedrock was found to be satisfactory, and was prepared for foundation by removing 6 to 10 feet of weathered and loose rock.

Bedrock Grouting

Grouting of crevices in bedrock under a dam is done primarily for the purpose of preventing or reducing seepage of water under the dam, and of preventing the development of up-lift pressure. Incidentally, it may reduce or prevent slight settlement as the load increases.

Bedrock grouting at Grand Coulee is done in three stages. Shallow grouting, carried out before any concrete is placed, produces a general solidification of the upper layers of rock so that deeper penetration and more effective sealing may be secured with the higher pressures used in deeper grouting. Intermediate grouting is done after 25 feet or more of concrete has been placed; and final grouting, to produce the main cut-off or grout curtain, will be done from a gallery near the upstream face, after the dam is built up 200 feet or more.

While general values are specified for depths and spacing of grout holes and for grouting pressures, actual requirements are determined by the Contracting Officer on the basis of information gained from excavations, drilling, water tests, and other investigations.

The quantity of grout "accepted" by grout holes varied over a wide range. In a "sheeted zone", much jointed and containing horizontal crevices of considerable size, two holes about 25 feet deep each took over 3,000 barrels of cement,

and a number of other holes in their vicinity took from 1,000 to 2,000 barrels. Pressures up to 400 pounds were applied, and some uplift of surface bedrock was noted.

Low pressure grouting was done through holes 20 to 50 feet deep (usually 30 feet), and at pressures of 50 to 200 pounds per square inch. So-called "B" holes were arranged generally in 5 rows 30 feet apart, extending from end to end of the dam site along the upstream boundary, the holes being spaced 20 feet apart in each row and staggered with respect to the holes in adjacent rows.

A single row of intermediate holes was drilled under the dam at an angle of about 32 degrees, through the curved fillet connecting the upstream face of the dam with bedrock, to a vertical depth of 75 feet; and was grouted at pressures up to 300 pounds after at least 50 feet of concrete had been placed within a distance of 100 feet.

The final cut-off curtain will be created by grouting at pressures up to 1,000 pounds a series of holes 150 to 200 feet deep, to be drilled from a gallery which follows the bedrock closely from end to end of the dam. The first holes to be drilled and grouted will be spaced some distance apart. Then, repeatedly, holes spaced intermediately will be drilled and grouted until operations indicate that an effective cut-off has been effected.

After the cut-off grouting has been completed within a distance of 600 feet, uplift pressure relief holes will be drilled at intervals of 10 feet along the lowermost gallery to a depth of 50 feet, and will remain open to admit any seepage water from bedrock to the drainage system within the dam. Porous concrete tile, set vertically about 13 feet from the upstream face of the dam, and spaced at 10-foot intervals, will intercept any seepage through the face of the dam.

45

Placing Concrete

Placing concrete in the Grand Coulee Dam involved, originally, distributing it over an area 500 feet wide and more than 3,000 feet long. The plan evolved for doing that for the construction of the base of the dam, provided two high steel trestles, one with its deck at elev. 1024 and its center line 93 feet from the upstream face of the dam, and one with its deck at elevation 950, and its center line 312.5 feet from the upstream face. Decks were 32 feet wide, and each carried three standard-gauge railroad tracks. The dam is to be completed from a 3600-foot 4-track trestle, 140 feet from the upstream face, with its deck at elevation 1180. Practically all of the two original trestles, except their decks, is buried in the dam. The deck and parts of the vertical members of the third trestle will be salvaged. About 20,000 25,000 tons of steel were used in the three trestles.

Concrete is handled in 4-yard bottom-dumping buckets, hauled on flatcars by 10-ton Diesel-electric locomotives which are operated by the hook-tenders from any one of six stations along a runway from which they couple crane hooks and buckets. When a car leaves the mixing plant, it carries four loaded buckets and space for an empty bucket which it will pick up from the first crane served.

Two types of cranes are used. One type consists of Wiley Whirleys mounted on traveling towers spanning the railroad tracks. They are suited especially to the handling of forms,

equipment, and supplies. Except under special circumstances, they will handle only about half as much concrete as the double-cantilever cranes. Of the latter, there are seven, four from the first contractor's equipment, overhauled and increased in working span from 250 to 300 feet by C.E.I., and three new and larger cranes with a working span of 330 feet.

The Whirley cranes have 110-foot booms, and have a reach of 115 feet from the center-line of the trestle. Capacities range from 11 tons with a flat boom to 40 tons at 75 degrees. Frequently two such cranes have been used together to handle heavy sections of penstock and heavy cast linings for outlet tunnels. The larger double cantilever cranes lift 22 tons on a 100-foot arm, lower buckets at 575 feet per minute and hoist empties at 750 feet per minute. They handle 100 to 150 buckets an hour to points 100 feet below the trestle deck. They have 440 volt a.c. motors driving 250 volt d.c. generators and motors with Ward-Leonard controls. Main hoist motors are rated at 150 h.p. Two 50 h.p. motors can move the crane along the trestle 100 feet per minute.

Concrete is placed in movable forms 5 feet deep and generally 50 feet square. They are set each time with reference to points located with transits and levels, the dam being, in effect, made up of a group of columns composed of 5-foot lifts. Columns are interlocked along up- and down-stream joints by vertical keys and keyways 3 feet wide and 6 inches deep, and

along cross-stream joints by horizontal keys about three and a half feet wide, vertically, and 16 inches deep. Cross-stream joints are staggered in adjacent 60-foot blocks.

The average content of a 5-foot lift, 60 feet square, is 463 cubic yards, and it is placed in about 4 hours in layers about 18 inches deep. Vibrators compact and distribute the concrete.

Curing must begin within 3 hours after concrete is placed, and exposed surfaces must then be kept wet at least 14 days. After a period of 72 hours or more, the surface of a lift is cleaned by a blast of air, sand, and water, exposing uncoated surfaces of gravel and sand particles to reaction with cement in a coat of sand-cement grout which is brushed on just before the next lift is placed. This insures strong water-tight bonds between lifts.

After sandblasting, the surface is cleaned off with jets of air and water, the blasting sand and the water being carried away through a hole opening into a drainage system from a depression at the center of the block. Surplus water is removed with sponges or air jets before grout is spread.

Supported on the insides of the forms are pipes and outlets through which grout is injected into spaces between columns after cooling is completed. On the surface of each lift, 1-inch thin-wall steel tubing is spaced 5'-9", and joined by means of compression couplings with tubes in adjoining columns. About 2,000 miles of such tubing will be used in the entire cooling system.

Artificial Cooling

This dam, like Boulder and like other concrete dams under construction by the Bureau, is being cooled, shrunk, and grouted during construction, in order to prevent the development, years hence, of cracks due to natural slow cooling and shrinking. In time, the interior of any massive dam will reach, and thereafter will vary but little, if any, from a temperature close to the mean annual temperature of the air and water in its locality.

Concrete is placed in dams at various temperatures above that finally to be reached. The reaction of water with cement liberates heat. Concrete is a relatively poor conductor; and, unless measures are taken to prevent it, maximum temperatures in mass concrete may be reached months or years after placing, and xxx slow cooling and consequent shrinking will produce cracks years after construction is completed.

Temperatures in the interior of the xx Coulee Dam reach 100 to 130 degrees F. The temperature will finally be about 50 degrees. Shrinkage in the 4300-foot length of the dam will aggregate about 8 inches. Shrinkage cracks are produced artificially in the Coulee Dam during construction. They are made to occur at predetermined locations, and they are closed with grout.

Cooling

This is accomplished by placing, on the surface of each 5-foot lift, 1-inch thin-wall steel tubing, spaced

5 feet 9 inches horizontally and joined to tubing in adjacent blocks by compression couplings. Cold river water is circulated through the cooling pipes, final cooling to 45 degrees F. being done in the winter. Into the thin cracks (3/32" ± in 50 feet) that open up between the blocks, grout of cement and water is pumped through a special system of grout piping embedded in the concrete. Copper grout-strips prevent the escape of grout into galleries or elsewhere. Future expansion will put the concrete under compression.

Internal temperatures are determined by means of resistance thermometers buried in the concrete, and connected with terminals in the inspection galleries. By means of Wheatstone bridges, readings are taken directly in degrees.

Concrete specified ranges from that used in mass construction, containing aggregate up to 6 inches in size, a minimum of one barrel of cement per yard, and water to produce a maximum water-cement ratio of ~~one by volume~~ 0.69 bbl, by weight, to concrete suitable for heavily reinforced structures, containing aggregate of three-fourths inch maximum size, about one and a half barrels of cement per yard, and water to give a six-tenths water-cement ratio, by ~~volume~~ weight. Minimum compression strengths acceptable are 2800 pounds for mass concrete and 3000 pounds for the structural grade. Strengths actually run 3600 to 5000 pounds. Slumps range from 2-1/2 to 4-1/2 inches.

Concrete mixing

Originally, a complete concrete mixing plant was operated on each side of the river at elevation 1084, and construction of the base of the dam was carried on from both sides of the river. At that time, sand and gravel were carried to the west mixing plant by a 36-inch belt conveyor over a suspension bridge 3400 feet long. Cement for the east mixing plant crossed the river over the same bridge through an 11-inch pipe.

After the base of the dam was completed by the W.P.A.K. Company, the mixing plants were dismantled, overhauled, and reconstructed together on the east side of the river at elevation 1139 by the Consolidated Builders, Inc.

Each mixing plant includes, at the top, a bin for sand, four bins for gravel, and two bins for cement; below them, a weigh-bin and scale for each concrete component, including water; and on the next lower floor a swiveled chute and four four-yard mixers, arranged about a conical delivery chute, centered above a railroad track over which concrete is delivered.

The mixing and moving of concrete is controlled by a dispatcher who receives his orders from the contractor's field office. By means of corresponding switches, he turns on lights on the batchers' signal boards on the weighing floors to indicate the kind and the number of batches of concrete required. With occasional exceptions, when grout or structural concrete are required, the lamp boards are set for mass concrete.

Destinations of special mixes are indicated to train operators by notes placed within their reach. Mass concrete is "peddled" from crane to crane until loads are disposed of, every effort being made to avoid any delay in placing concrete.

On the weighing floor, there is provided for each concrete component, including water, a weigh-bin suspended on a scale mechanism provided with 5 beams, which makes it possible to weigh out any one of five different mixes without shifting weights on the scale beams. By means of an air valve on his control board, the batcher selects the set of scale beams to make the mix he requires. By the movement of a second air valve, the air-operated gates over the weigh-bins are caused to open. Mercoid switches on the scale beams close the gates when the scales are balanced.

Weigh-bins cannot be dumped until the mixer operator has a mixer ready to receive a batch, shows the proper signal light on the batcher's board, and releases the lock on the air valve by means of which the batcher dumps the weigh-bins.

By means of time-controlled switches, cobbles and coarse gravel are dumped in the first 5 seconds of the 17-second mixer-charging period. Between the 4th and 12th second, sand, cement, and fine and intermediate gravel run simultaneously; and throughout the 17-second period, water flows into the mixer#. During the charging period, controls on the mixer and the swivel chute are locked electrically.

A graphic record, in front of the batcher, shows the actions of weigh-bins and mixers. As bins are loaded, a pen swinging to the right records the weight of each component. Dumping is recorded as pens swing left. Mixer operations are recorded in curves which show concrete consistency as well as loading and dumping. A plastic batch is concentrated further forward in a mixer than a stiff mix. This difference in the position of the center of gravity of the loaded mixer is recorded by means of heavy springs, a system of levers, and some solenoids connected with the air cylinders which dump the mixer. By comparing slump tests with the curves drawn by the mechanism, the curves can be interpreted as indications of consistency.

The mixer operator controls the swivel chute by means of which the mixers are loaded, and the starting, stopping, and dumping of the mixers. Timing devices prevent the dumping of the mixers within two minutes after charging, and the moving of the swivel chute or the dumping of the mixer during the 17-second charging period. No mixer can be dumped until a trainman signals that he is ready, and in so doing unlocks dumping controls.

Specifications provide, among other things, that the concrete shall be a "homogeneous mass of uniform consistency such that the difference in the sand-cement or water-cement ratios between any two portions of any batch

shall not exceed 10 per cent." As originally built and operated, a 5-minute mixing period was necessary; but as a result of experimental work of the contractor and the Bureau, the original nine blades in each 4-yard mixer were replaced by three simple blades, a definite order and period for loading concrete components into the mixers was fixed, and the mixing time was reduced to two minutes.

Limiting temperatures specified for concrete are a maximum of 85 degrees and minima of 40 degrees in moderate and 50 degrees in freezing weather.

Aggregate

Aggregate

Aggregate is obtained by the contractor from a sand and gravel pit furnished by the government. Electric shovels, equipped with 7-yard dippers, move the material from the face to an 18-inch grizzly over a feeder bin. Oversize is rejected, to be hauled by trucks to the primary crusher, and undersize material is carried away by a 60-inch conveyor belt system which consists of a stationary conveyor, extended from time to time as the pit developes, and a "pendulum" conveyor which feeds it. The pendulum conveyor is carried on a steel truss, one end of which is pivoted on a carriage astride the stationery conveyor, and the other carried on tractor treads which support the feed hopper and grizzly. The pendulum conveyor swings through a half circle, enabling the shovels to cut a 350-foot swath through the pit parallel to the stationary conveyor.

A large jaw crusher in the gravel pit breaks down to a maximum of 10 inches all coarse material delivered by the belt system as well as boulders delivered to it by truck. A secondary crushing plant, containing two cylindrical trommels and two gyratory crushers, reduces all material to a maximum size of 6 inches.

Four large vibrating screens take out cobbles (6" to 3") and coarse gravel (3" to 1-1/2"); and eight screens separate the intermediate (1-1/2" to 3/4") and fine gravel (3/4" to 3/16") from the sand and wash water, which go to Dorr thickeners. They feed material under 100 mesh and wash water to two large clarifiers, and sand to hydraulic classifiers.

Sand is washed in three sizes -- 5/16" to 20-mesh, 20- to 48-mesh, and 48- to 100-mesh, and the three sizes are blended to a fineness modulus of 2.5 to 3.0. About half the output of the pit goes to waste as surplus sand. The pit turns out 60,000 to 70,000 tons per day, and the screening and washing plant produces about 16,000 yards of finished material.

Aggregate is moved from the processing plant to stock-piles near the dam over 48-inch conveyor belts, running 450 feet per minute, at the rate of 2,000 to 2,700 tons per hour. The movement is down grade, and it is consequently possible to use here the longest single conveyor belt in the world -- 4,968 feet between pulley axes -- eight 10-ton sections vulcanized on the job into one endless band.

Near the dam, sand and gravel are stored in two rows of piles parallel to the tripper belt. Belt systems carry aggregate from tunnels under these stock piles up inclines to small bins at the top of the mixing plant.

Cement

Cement is furnished by the government and may be of the standard, modified, or low-heat varieties, which differ chiefly in volume change and heat of hydration, which are progressively less in the three kinds of cement, in the order named. In modified cement, and to a greater extent in low-heat cement, the percentage of tricalcium silicate is limited. The compounds of lime with alumina and with iron and alumina are also limited. Fineness is specified in terms of surface exposed, and must average 1800 or more square centimeters per gram and be not less than 1600 in any one sample.

The greater part of the cement has been produced in five of the six plants in Washington, but shipments have been made from one plant in Montana and three in California, also. The cement moves in bulk in boxcars assigned to the service. Deliveries have occasionally exceeded a hundred cars a day, and have averaged above 50 cars a day over long periods.

Cars are unloaded by means of Fuller-Kinyon portable pumps with remote control, each brand being delivered through a system of pipes to an assigned silo. Different brands are blended, in approximately the ratio in which they are furnished, before the cement is pumped to the mixing plants 6,500 feet away. A Fluxo system operates through a 14-inch pipe and a Fuller-Kinyon pump through an 8-inch pipe.

5-58abc

Concrete Records

Notable records have been made in concrete mixing on this job. M.R.A.K. once made 9,290 yards in the east mixing plant in 24 hours, and produced 15,844 yards in one day in the two plants. Available forms in which to place concrete limited that record. C.B.I. mixed and placed 20,684 yards on May 25, 1939, at an average rate of one yard in 4.18 seconds, a record unsurpassed anywhere. The average daily output in the fall of 1939 was about 16,000 yards requiring about 71 carloads of cement and the equivalent of 650 carloads of aggregate. M.R.A.K. placed a little over 4-1/2 million yards of concrete in the base of the dam and power house, and C.B.I. has placed more than 5 million yards. The total is to be about 11 million.

Diversion;
Installation
of equipment.

While the contractor is now occupied almost entirely in processing aggregate, and mixing and placing concrete, the handling of the river is still a matter of importance, as is also the installation of trashracks, valves, and gates.

The original four diversion slots having been left open to the level of the river bed, it was necessary to close them at both ends before they could be built up after numerous other higher gaps had been left elsewhere in the spillway section of the base. M.P.A.K. built four arched timber gates about 54 feet square, loaded one end of each with concrete, and closed the gaps two at a time.

During seasons of high water, the river flows through numerous 50-foot gaps left low in the spillway section. As the water falls, the gaps are closed one after another, at the upper end, with 70-ton steel gates. Being above the downstream water-level, the gaps drain, and after cleaning are built up. The twenty 8-1/2-foot outlet tunnels at elevation 934 carry the fall and winter flow, and the entire spillway section can be built up without interruption by diversion activities.

Liners and valves for the uppermost set of 20 outlet tunnels, and eleven drum gates, 135 feet long and 38 feet high,

are the principal pieces of equipment yet to be installed by U.S.I.

Western Pipe and Steel Co. is installing, in tunnels in the dam, 18 penstocks aggregating a mile in length. From steel plates, planed and curved in Chicago, 20-foot sections were made up in a plant 2 miles from the dam. They are moved into place by means of flatcars, trucks, a barge, a floating crane, and special facilities arranged in the tunnels. This job is consuming 5.7 acres (8,000 tons) of steel plate, 23 tons of welding rod, and 11-1/2 miles of X-ray film for the testing of welded seams, of which there will be 9 miles.

Installation of turbines and generators will begin in 1940, and, in case Congress makes the necessary appropriations, the dam, the base for the pumping plant, and west power house, with three large and two small generating sets will be complete in 1942.

Finances; 59
USBR Projects

Ordinarily, reclamation projects are financed out of a revolving fund created by the sale of western land and western natural resources; and the fund is reimbursed by the beneficiaries over a period of years, without interest. This may be regarded as a subsidy, or as reinvesting, in the west, funds realized from the sale of land or from western wasting assets. As a subsidy, it has a precedent in the generous government support of highways, railroads, canals, ship operations, rivers and harbors improvements, and a variety of other activities which return neither interest nor capital.

Changed conditions in the west have made necessary the development of large, multi-purpose projects, such as Boulder Dam, which deprives the turbulent Colorado River of its destructive power and supplies water and power to southern California, and the Central Valley Project, which will conserve the spring flood waters of the Sacramento and San Joaquin Rivers, prevent flood damage and salt-water encroachment in the low lands, furnish power, and save irrigated districts now vanishing for want of water.

The revolving fund administered by the Bureau of Reclamation is far too small to finance such huge projects, and private enterprise was long ago found inadequate to carry out even the remaining larger reclamation works, notwithstanding that it had irrigated 20 million acres in the west, so further development of the arid west is dependent upon Congressional appropriations to be ~~fr~~ refunded.

Obviously, the precise total cost of the project cannot be determined because the greater part of the necessary expenditures remain to be made over a period of 25 to 50 years. The estimated cost of the dam is $119,000,000, and of the power plant $67,000,000. It is probable that the total required financing will not exceed $260,000,000, for income from the sale of power and from repayments by landowners will finance the later development of the power plant and the greater part of the $208,000,000 irrigation system.

The costs of the dam and power plant, and the cost of that part of the irrigation system not assessed against the landowners are to be repaid with interest. In the end, the project will cost the government nothing, for the income from power sales will be far greater than the interest lost on the money advanced for the construction of a part of the project.

Cost of Water Rights
and Operation

Until the project is much further advanced, it will not be possible to determine exactly the per-acre cost of the irrigation works chargeable to landowners, nor the annual operation and maintenance cost.

At present, it is estimated that after water is available the landowner will pay $2.60 per acre per year for operation and maintenance of irrigation works, including one dollar per acre per year for surplus power used in pumping. During the first four years after water is available, it is anticipated that no collections will be made on the construction account.

The construction charge is expected to be $85 to $100 per acre. On that basis, the settler would probably pay $2.60 per acre per year for operation and maintenance and nothing on account of construction during the first 4 years, then about $4.60 per acre per year for construction, and operation and maintenance for 4 years, and finally about $5.10 per acre per year for 32 years. Thereafter, only the charge for operation and maintenance would be paid.

The estimated annual output of firm power, available at a uniform rate throughout the year, will be ~~8,200,000~~ 8,100,000,000 k.w. hrs. Of the seasonal output of 4,200,000,000 k.w. hrs., generated largely during the summer, about 2-1/4 billion will ultimately be required for pumping irrigating water from the storage reservoir to the balancing reservoir in the Grand Coulee.

Financial estimates have been based on sales of firm power at 2-1/4 mills at the power plant, and on a charge of one dollar per acre per year for power for pumping.

The Market for Power

The area within which power can be distributed economically from Coulee Dam includes all of Washington, the northern part of Oregon, northern Idaho, and western Montana.

Between 1920 and 1930, power requirements in that territory increased at an average rate of 9.8 per cent per year, compounded annually. Following a reduction of growth from 1930 to 1933, the rate of increase in demand since 1934 has exceeded the 1920-1930 rate.

Assuming that the demand will continue at a rate falling from 8 per cent to 4 per cent in the next 30 years, and allotting half of it to the Grand Coulee plant, the output of the plant would be absorbed in 15 years; and at 2-1/4 mills per kilowatt hour, the cost of the dam and power plant would be liquidated in 50 years, with a surplus of $144,500,000 to apply on the irrigation system. Thereafter, the annual surplus would be $15,000,000.

When automobiles were first built, about 1900, businessmen of long experience were convinced that they would never come into general use. About 1912 most manufacturers of automobiles were of the opinion that the motor car market was saturated, and that no future expansion of the industry was possible. The annual production of automobiles now runs into millions; and the United States, with 15 per cent of the population, has 70 per cent of automobiles in the world.

People in general were not able to forecast the growth of markets for automobiles, telephones, airplanes, radios, wrist watches, and hundreds of other things unknown a few years or a

few decades ago, nor do they now realize the tremendous numbers of such things that would be required to supply all people, or even those in America, to the extent of the average use of them. Neither do they realize that America enjoys more of services and goods than does the rest of the world chiefly because energy from coal, oil, and waterpower is abundant and cheap in America. So long as there is an unsatisfied or a growing demand for services or manufactured goods, there will be a demand for additional supplies of power.

The average central station output per capita in the United States rose from 33 kilowatts in 1900 to about 102 in 1910, and to about 550 in 1930. It is still growing. The consumption of electrical energy per capita, in both domestic uses and manufacturing activities, ranges from a small fraction of the average in some cases to many times the average in others. There is no means of knowing the limit to which the per capita use of electricity will go, but it is known that with the nation's waterpower fully developed the minimum use could not reach the present average use.

A large part of the output of the power plant at Coulee Dam will be used by the population of the area to be irrigated; and great quantities will be used in metallurgical operations which will provide industry with magnesium, tungsten, manganese, and other metals.

The Need for More Land

Our agricultural lands are shrinking. Natural forces and wasteful methods of farming are destroying each year more land than the Bureau of Reclamation has irrigated in the 36 years of its existence. Large areas throughout the country yield only a meager living for the occupants, and repeated droughts have driven 100,000 farm families off of semi-arid lands of the Great Plains. Sub-marginal lands are serious contributors to crop surpluses and crop deficits, and the National Resources Committee proposes to take out of cultivation 75,345,000 acres of land on which economical farming has been proved to be impossible, 40,464,000 acres in 17 western states. Only 10,000,000 acres of land economically irrigable remains in the far-west states, and 50 to 100 years will be required to reclaim it.

Soil erosion, according to the Department of Agriculture, has impoverished or ruined 200,000,000 acres of once productive farm lands; and 10,000,000 acres of useful farm land is actively affected by erosion.

We import from countries of low buying power great quantities of agricultural products -- in 1935 the equivalent of the output of 72,461,119 American acres -- of butter and cheese, or of corn, or of sugar, or of tobacco alone, enough to use more land than is to be reclaimed by the Columbia Basin Project in the next 40 or 50 years.

The natural growth of population, and the need of farm homes for the growing younger generation of farmers, as well as for farm families from impoverished lands, will absorb irrigated land more rapidly than it can be developed.

Surplus Crops

The troublesome surplus crops are corn, hogs, wheat, cotton and tobacco, all products of humid-region farms. We have such surpluses, not because we could not consume them, but because many of our people cannot buy them.

Only one of them, wheat, is produced in any quantity in the far-west states. The irrigated lands produce sixth-tenths of one per cent of the country's wheat crop, only a third of the wheat consumed by their occupants. Most of the wheat produced in the far-west is grown on dry-farms, much of it on sub-marginal dust-bowl land. Such lands shrink and the western market for middle-west foodstuffs grows with the growth of irrigation.

Cotton is grown in some parts of the southwestern states, but only one-half of one per cent of the country's cotton acreage is on Federal Irrigation Projects. The cotton production of the west falls far short of the cotton consumption of the west, which produces some long-staple cotton, of which there is no surplus.

The west is only a consumer, not a producer of tobacco. It buys annually $81,000,000 worth of tobacco and tobacco products; and pays to the government each year $35,000,000 in tobacco taxes--enough to pay for the Coulee Dam, the storage reservoir, and the west power plant in 6 years.

In the ten-year period from 1926 to 1935, middle-west hog growers and pork packers had an average annual income of $123,000,000 from the western states. Washington buys from the

middle-west each year, for slaughter, 300,000 hogs; California buys a million. The growth of the western states will increase the market for middle-west pork.

Of corn, Minnesota produces 4 times as much, Illinois 8 times as much, and Iowa 12 times as much as the eleven western states combined. In recent years, Argentine corn has been imported not only to the Pacific Coast but into Kansas City, on the edge of the corn belt.

The eleven western states buy great quantities of the middle-west surplus crops, and must always do so -- more as the western population increases for the west can never be agriculturally self sufficient. It has already one-tenth of the population and only one-twentieth of the arable land.

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Standard Form No. 20
Approved by the President
Nov. 19, 1926
(Rev. USBR Nov. 15, 1949)

STANDARD GOVERNMENT FORM OF INVITATION FOR BIDS
(CONSTRUCTION CONTRACT)

DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

Specifications No. R1-CB-70
Coulee Dam, Washington, July 31, 1950

SEALED BIDS, in single, subject to the conditions contained herein, will be received at Coulee Dam, Washington, until 11 a.m., Pacific Standard Time, August 31, 1950, and then publicly opened, for furnishing labor and materials and performing all work for removing construction railroad and miscellaneous structures, Coulee Dam Division, Columbia Basin Project, Washington. The work is situated between Grand Coulee Dam and Odair, Washington.

The principal items of work and the estimated quantities involved are as follows:

30.7 track miles - Removing track and disposing of track materials;
Lump sum - Moving stockpiled materials from Electric City yard;
Lump sum - Removing bridges and trestles along railroad;
Lump sum - Razing engine house, coal bunker and motor-car house;
Lump sum - Moving pumphouse, sand house, oil house and office;
Lump sum - Moving service pump and two steel storage tanks;
Lump sum - Removing bridges along Secondary State Highway 2-F;
Lump sum - Removing signs and posts along Secondary State Highway 2-F.

This invitation for bids does not cover the purchase of materials which are to be furnished by the Government. Materials to be furnished by the contractor and those furnished by the Government are described in the specifications which will be a part of the contract.

The work shall be commenced within ten (10) calendar days after date of receipt of notice to proceed and shall be completed within two hundred (200) calendar days from the date of receipt of such notice.

Liquidated damages for delay will be one hundred dollars ($100) per day for each calendar day's delay.

Partial payments will be made monthly. (See Article 16 of the contract.)

Article on patents will be made a part of the contract.

Bid bond.--Guarantee will be required with each bid in an amount not less than 10 per cent of the amount of the bid. Attention is called to Paragraph 8 of Instructions to Bidders (U. S. Standard Form No. 22) which

reads in part: "Where security is required to insure the execution of contract and bond for performance of the service, no bid will be considered unless it is so guaranteed."

Performance bond.--A performance bond will be required in the sum of one-half of the total amount payable by the terms of the contract.

Payment bond.--If the total amount payable by terms of the contract exceeds $2,000 the payment bond shall be in the sum of one-half of the total amount payable by the terms of the contract.

All prospective bidders are hereby notified that, before any bid submitted in response to this invitation is considered for award, the Government may require the bidder to submit a statement of facts in detail as to the previous experience of the bidder in performing similar or comparable work and of the business and technical organization and financial resources and plant of the bidder available and to be used in performing the contemplated work. The Government expressly reserves the right to reject any bid on which the facts as to business and technical organization, plant, financial, and other resources, or business experience, compared with the work bid upon, justify such rejection.

The right is reserved, as the interest of the Government may require to reject any and all bids, to waive any informality in bids received, and to accept or reject any schedule of any bid, unless such bid is qualified by specific limitation.

Bids must be submitted upon the standard Government form of bid (Standard Form No. 21), and the successful bidder will be required to execute the standard Government form of contract for construction (Standard Form No. 23).

Envelopes containing bids must be sealed, marked, and addressed as follows:

SPECIFICATIONS NO. R1-CB-70
BID FOR REMOVING CONSTRUCTION
RAILROAD AND MISCELLANEOUS STRUCTURES
TO BE OPENED AT 11 A.M.
PACIFIC STANDARD TIME,
AUGUST 31, 1950

BUREAU OF RECLAMATION
COULEE DAM, WASHINGTON

(Sgd.) H. T. NELSON, Regional Director

Notes: See Standard Governement instructions to bidders and copies of the standard Government forms of contract, bid bond, performance bond, and payment bond, which may be obtained upon application.

Copies of the standard forms and of the specifications may be obtained from the following offices of the Bureau of Reclamation: H. T. Nelson, Regional Director, Box 937, Boise, Idaho; F. A. Banks, District Manager, Coulee Dam, Washington. No charge for copies of the specifications and drawings furnished for bidding purposes; for all others $0.25 per copy, not returnable.

Prospective bidders desiring to visit the site of the work should communicate with the District Manager.


AUG
1950

964

Specifications No. R1-CB-70

UNITED STATES

DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

REGION I

- - - -

Schedule, Specifications, and Drawings

- - - -

REMOVING CONSTRUCTION RAILROAD AND MISCELLANEOUS STRUCTURES

- - - -

COULEE DAM DIVISION

COLUMBIA BASIN PROJECT, WASHINGTON

Bids will be received at the office of the Bureau of Reclamation, Coulee Dam, Washington, until 11 a.m., Pacific Standard Time, August 31, 1950.

(Price $0.25)

CONTENTS

REMOVING CONSTRUCTION RAILROAD

AND

MISCELLANEOUS STRUCTURES

COULEE DAM DIVISION
COLUMBIA BASIN PROJECT, WASHINGTON

- - -

Bids will be considered on the following schedule, but no bid will be considered for only part of the schedule.

SCHEDULE

Item No.	Work or material	Quantity and price	Amount
1.	Removing track and disposing of track materials	30.7 track miles at_____ _____ (words) _____(\$_____)per track mile	$_____
2.	Moving stockpiled materials from Electric City yard	For the lump sum of_____ _____ (words) _____ dollars	_____
3.	Removing bridges and trestles along railroad	For the lump sum of_____ _____ (words) _____ dollars	_____
4.	Razing engine house, coal bunker and motor-car house	For the lump sum of_____ _____ (words) _____ dollars	_____

SCHEDULE (Continued)

Item No.	Work or material	Quantity and price	Amount
5.	Moving pump house, sand house, oil house, and office	For the lump sum of_____ (words) _____ dollars	$_____
6.	Moving service pump, and two steel storage tanks	For the lump sum of_____ (words) _____ dollars	_____
7.	Removing bridges along Secondary State Highway 2-F	For the lump sum of_____ (words) _____ dollars	_____
8.	Removing signs, and posts along Secondary State Highway 2-F	For the lump sum of_____ (words) _____ dollars	_____
		TOTAL FOR SCHEDULE	$_____

GUARANTY

It is hereby guaranteed that in the event award is made to the undersigned, all articles, materials, and supplies used will conform to the article "Domestic preference" of the contract, except as noted below:

_____

_____

_____

_____

The cost of the articles, materials, and supplies listed above will be_____ per cent of the total cost of all of the articles, materials, and supplies used.

SPECIFICATIONS
GENERAL CONDITIONS

1. Bonds. The contractor shall furnish bonds as follows:

(a) Performance bond.—The performance bond shall be furnished in accordance with the following table:

Amount of contract	Performance bond
Up to $ 1,000,000	Not less than 50 percent of contract
$ 1,000,000 to $ 5,000,000	Not less than 40 percent of contract
$ 5,000,000 to $10,000,000	Not less than 30 percent of contract
$10,000,000 to $25,000,000	Not less than 20 percent of contract
$25,000,000 and over	$ 5,000,000

Bonds in amounts of $1,000 or less will be made in multiples of $100; in amounts exceeding $1,000 but not exceeding $5,000, in multiples of $500; in amounts exceeding $5,000, in multiples of $1,000: Provided, That the amount of the bond shall be fixed by the contracting officer at the lowest sum that fulfills all conditions of the contract.

(b) Payment bond.--If the amount of the contract exceeds $2,000, the contractor shall furnish to the United States, in addition to the bond required under (a) hereof, a payment bond with a surety or sureties satisfactory to the officer awarding the contract, for the protection of all persons supplying labor and material in the prosecution of the work provided for in the contract, for the use of each such person. Whenever the total amount payable by the terms of the contract shall be not more than $1,000,000, the payment bond shall be in the sum of one-half of the total amount payable by the terms of the contract. Whenever the total amount payable by the terms of the contract shall be more than $1,000,000 and not more than $5,000,000, the payment bond shall be in the sum of 40 percent of the total amount payable by the terms of the contract. Whenever the total amount payable by the terms of the contract shall be more than $5,000,000, the payment bond shall be in the sum of $2,500,000.

2. Climatic conditions. The contracting officer may order the contractor to suspend any work that may be subject to damage by climatic conditions.

3. Rights-of-way. The Government will provide the right-of-way or the site for permanent works or installations, the site for borrow pits, channels, spoil banks, and ditches, and right-of-way for access thereto over routes established by the contracting officer. The contractor will be permitted to use such land for construction purposes, but any additional right-of-way or land desired by the contractor for construction purposes shall be provided by the contractor without expense to the Government.

4. Quantities and unit prices. The quantities noted in the schedule are approximations for comparing bids, and no claim shall be made against the Government for excess or deficiency therein, actual or relative. Payment at the prices agreed upon will be in full for the completed work and will cover materials, supplies, labor, tools, machinery, and all other expenditures incident to satisfactory compliance with the contract, unless otherwise specifically provided.

5. Staking out work. The work to be done will be staked out for the contractor who shall, without cost to the Government, provide such material and give such assistance as may be required by the contracting officer.

6. Bench marks and survey stakes. Bench marks and survey stakes shall be preserved by the contractor, and in case of their destruction or removal by him or his employees, they will be replaced by the contracting officer at the contractor's expense, and his sureties shall be liable therefor.

7. Data to be furnished by contractor. The contracting officer, through his authorized agents, shall have access to all pay rolls, records of personnel, invoices of materials, and any and all other data relevant to the performance of the contract or necessary to determine its cost, and the contractor shall furnish at the end of each month an itemized statement in a form satisfactory to the contracting officer of the cost of all work under the contract.

8. Sanitation. The contracting officer may establish sanitary and police rules and regulations for all forces employed under this contract, and if the contractor fails to enforce these rules the contracting officer may enforce them at the expense of the contractor.

9. Extras. The contractor shall, when ordered in writing by the contracting officer, perform extra work and furnish extra material, not required by the specifications or included in the schedule, but forming an inseparable part of the work contracted for. Extra work and material will ordinarily be paid for at the lump-sum or unit price stated in the order. Whenever, in the judgment of the contracting officer, it is impracticable, because of the nature of the work or for any other reason to otherwise fix the price in the order, the extra work and material shall be paid for at the actual necessary cost as determined by the contracting officer, plus an allowance, not to exceed 10 percent of such

actual necessary cost of the extra work and materials, for superintendence, general expense, and profit. The actual necessary cost will include all reasonable expenditures for material, labor (including compensation insurance and social security taxes), and supplies furnished by the contractor, and a reasonable allowance for the use of his plant and equipment, where required, but will in no case include any allowance for office expenses, general superintendence, or other general expenses.

10. Cleaning up. Upon completion of the work the contractor shall remove from the vicinity of the work all plant, buildings, rubbish, unused materials, concrete forms, and other like material, belonging to him or used under his direction during construction, and in the event of his failure to do so the same may be removed by the Government at the expense of the contractor, and his surety or sureties shall be liable therefor.

11. Patents and/or copyrights. The contractor shall hold and save the Government, its officers, agents, servants, and employees, harmless from liability of any nature or kind, including costs and expenses, for or on account of any copyrighted or uncopyrighted composition, secret process, patented or unpatented invention, article, or appliance manufactured or used in the performance of this contract, including their use by the Government, unless otherwise specifically stipulated in this contract. Any patented invention the use of which by these specifications is required, or permitted in the alternative to be used, and which the United States has the right to use, royalty free, shall be available to the contractor without the payment of royalty.

12. Protests. If the contractor considers any work demanded of him to be outside of the requirements of the contract, or considers any record or ruling of the contracting officer or of the inspectors to be unfair, he shall immediately upon such work being demanded or such record or ruling being made, ask, in writing, for written instructions or decision, whereupon he shall proceed without delay to perform the work or to conform to the record or ruling, and, within twenty (20) calendar days after date of receipt of the written instructions or decision (unless the contracting officer shall grant a further period of time prior to commencement of the work affected) he shall file a written protest with the contracting officer, stating clearly and in detail the basis of his protest. Except for such protests as are made of record in the manner herein specified and within the time limit stated, the records, rulings, instructions, or decisions of the contracting officer shall be final and conclusive. Instructions and/or decisions of the contracting officer contained in letters transmitting drawings to the contractor shall be considered as written instructions or decisions subject to protest as herein provided.

13. Accident prevention. The contractor shall, at all times, exercise rea sonable precautions for the safety of employees in the performance of this contract, and shall comply with all applicable provisions of Federal, State, and municipal safety laws and building and construction codes. The contractor shall also comply with the provisions of the Safety Handbook of the Bureau of Reclamation (Volume XII of the Bureau Manual) as approved by the Commissioner and in effect on the date of award of contract, so far as applicable, as determined by the contracting officer and unless such instructions are incompatible with Federal, State, or municipal laws or regulations. Monthly reports of all lost-time accidents shall be promptly submitted giving such data as may be prescribed by the contracting officer. Nothing in this paragraph shall be construed to permit the enforcement of any laws, codes, or regulations herein specified by any except the contracting officer.

14. Suspension of work. The Government may at any time suspend the whole or any portion of the work under this contract but this right to suspend the work shall not be construed as denying the contractor actual, reasonable, and necessary expenses due to delays, caused by such suspension, it being understood that expenses will not be allowed for such suspensions when ordered by the Government on account of weather conditions or on account of the failure of Congress to make the necessary appropriations for expenditures under this contract.

SPECIAL CONDITIONS

15. The requirement. It is required that there be completed, in accordance with these specifications and the drawings listed in paragraph 17 hereof, the removal of 30.7 miles of standard-gage railroad track, stock-piled track materials, bridges, buildings, and miscellaneous structures. The work is situated between Grand Coulee Dam and Odair, Washington, as shown on the Location Map.

16. Description of the work. The principal components of the work to be done under these specifications include the following:

(a) The removal and disposal of approximately 30.7 track miles of standard-gage railroad track with appurtenances.

(b) The moving of stockpiled track materials from Electric City yard.

(c) The moving of a service pump and two steel storage tanks.

(d) The razing of three buildings.

(e) The moving of four buildings.

(f) The removal and disposal of 13 timber railroad bridges and three timber highway bridges.

(g) Removal and disposal of signs and posts along existing Secondary State Highway 2-F, which highway is to be abandoned.

17. Drawings. The following drawings are made a part of these specifications:

1.	222-D-1901	Location Map
2.	222-117-11511	USBR Construction Railroad--Location Map
3.	222-117-11512	Grand Coulee Dam--Vicinity Map
4.	222-117-11513	USBR Construction Railroad--Siding and Yard Details

The contractor will be furnished such additional copies of the specifications and drawings as may be required for carrying out the work. Contact prints of the original drawings from which the attached reproductions were made will be furnished to the contractor for construction purposes upon request.

18. Rates of wages. Pursuant to the provisions of the Davis-Bacon Act, as amended (49 Stat. 1011; U.S.C. ti. 40, sec 276(a)), the Secretary of Labor has determined that the following rates of wages are the prevailing rates of wages for the classifications specified in the locality of the work covered by these specifications, and said rates of wages shall be the

minimum rates per hour to be paid for the work covered by these specifications:

Classification	Rate per hour
Air tool operator (jackhammermen, vibrator)	$1.70
Electricians	2.33
Electricians' apprentices:	
1st 6 months 40% of journeymen's rate	
2nd 6 months 45% of journeymen's rate	
3rd 6 months 50% of journeymen's rate	
4th 6 months 55% of journeymen's rate	
5th 6 months 60% of journeymen's rate	
6th 6 months 65% of journeymen's rate	
7th 6 months 75% of journeymen's rate	
8th 6 months 90% of journeymen's rate	
Laborers:	
General laborers	1.60
Power equipment operators:	
Bulldozer, tractor, carry-all (including tandem)	2.15
Compressors, one only (portable)	1.75
Derrick and pile drivers	2.35
Firemen	1.80
Heavy duty mechanic or welder	2.15
Hoist, one drum (heavy construction)	1.90
Hoist, two or more drums (heavy)	2.10
Oilers, mechanic helpers	1.70
Power shovels and shovel-rigged machines (cranes, clamshells, etc.)	2.35
Power shovels, 4 yds. and over (factory rating)	2.70
Wheel-type tractor	1.75
Truck drivers:	
Flat bed trucks	1.65
Service and supply trucks	1.65
Dump trucks:	
Including 6 yds.	1.70
Over 6 yds. and including 8 yds.	1.80
Over 8 yds. and including 12 yds.	1.90
Over 12 yds. and including 20 yds.	2.00
Over 20 yds.	2.15

The wage rates contained in this decision are straight hourly wage rates. In some areas, management and labor organizations in the construction industry have collectively bargained for health and welfare fund contributions. Such contributions are not included in wage rates determined by the Secretary of Labor for construction projects.

Apprentices employed pursuant to this determination of wage rates must be registered in a bona fide apprenticeship program registered with a State apprenticeship agency recognized by the Federal Committee on Apprenticeship, U. S. Department of Labor; or if no such recognized agency exists in a State, it shall mean a program registered with the Federal Committee on Apprenticeship, Bureau of Apprenticeship, U. S. Department of Labor.

Any class of laborers and mechanics not listed above, which will be employed on this contract, shall be classified or reclassified conformably to the foregoing schedule. In the event the interested parties cannot agree on the proper classification or reclassification of a particular class of laborers and mechanics to be used, the question, accompanied by the recommendation of the contracting officer, shall be referred to the Secretary of Labor for final determination. While the wage rates shown are the minimum rates required by these specifications to be paid during the life of the contract, it is the responsibility of bidders to inform themselves as to local labor conditions such as the length of workday and workweek, overtime compensation, health and welfare contributions, labor supply, and prospective changes or adjustments of wage rates. No increase in the contract price will be allowed or authorized on account of the payment of wage rates in excess of those listed herein.

19. Labor statistics. It is requested that the bidder agree to comply with the provision of the following clause:

> "The contractor will report monthly, and will cause all subcontractors to report in like manner, within 5 days after the close of each calendar month, on forms to be furnished by the Department of Labor, the number of persons on their respective pay rolls, the aggregate amount of such pay rolls, the man hours worked, and the total expenditures for materials. He shall furnish to the Department of Labor the names and addresses of all subcontractors on the work at the earliest date practicable. The foregoing is applicable only to work at the site of the construction project."

20. Discrimination against employees or applicants for employment prohibited. The contractor shall not discriminate against any employee or applicant for employment because of race, creed, color, or national origin and shall require an identical provision to be included in all subcontracts.

21. Payments and funds. Special provisions relating to payments and funds are as follows:

(a) Section 12 of the Reclamation Project Act of 1939 provides as follows: "When appropriations have been made for the commencement or continuation of construction or operation and maintenance of any project, the Secretary may, in connection with such construction or operation and maintenance, enter into contracts for miscellaneous services, for materials and supplies, as well as for construction, which may cover such periods of time as the Secretary may consider necessary but in which the liability of the United States shall be contingent upon appropriations being made therefor" (43 U.S.C. 388).

(b) Under the contract to be entered into under these specifications, the liability of the United States is contingent on the necessary appropriations and reservation of funds therefor.

(c) When funds become available for payment for contractor's earnings, including percentages to be retained and payable when due (holdbacks), the Government will notify the contractor of the sum that has been reserved and is available for that purpose.

(d) If at any time it becomes apparent to the contracting officer that the balance of this reservation is in excess of the estimated amount required to meet all payments due and to become due the contractor because of work performed or to be performed until June 30, 1951, the right is reserved to reduce said reservation by the amount of such excess. The contractor will be advised of any reduction so made.

(e) If the rate of progress of the work is such that it becomes apparent to the contracting officer that the balance of the reservation is less than the estimated amount required to meet all payments due and to become due because of work performed until June 30, 1951, the Government may reserve additional funds for payments under this contract if there be funds available for such purpose. The contractor will be advised of any additional reservation so made.

(f) It is expected that Congress will make appropriations applicable to work under this contract, but as to this it must be distinctly understood and agreed that the Government is in no case to be made liable for damages in connection with this contract on account of delays in payments on same due to a lack of available funds. Should it become apparent to the contracting officer that available funds will be exhausted before additional funds are appropriated, the contracting officer will give 30 days' written notice to the contractor that work may be suspended by the contractor, but if the contractor so elects, he may continue work under the conditions and restrictions of the specifications, after the time set by such notice, so long as there are funds for inspection and superintendence, concerning which he will be advised, with the understanding, however, that no payment will be made for such work until sufficient additional funds have been provided by the Congress. When funds again become available, the contractor will be notified in writing as to the

amount thereof reserved for payments under this contract. The amount so reserved shall be subject to decrease or increase in a manner similar to that provided in subparagraphs (d) and (e) hereof. Should work be thus suspended, additional time for completion will be allowed equal to the period during which the work is necessarily so suspended as determined by the dates specified in the above-mentioned notices.

(g) So long as funds are available, payments will be made in accordance with the provisions of the contract. Unless otherwise authorized in writing by the contracting officer, the items of work for which payment will be made shall be limited to those listed and enumerated in the contract. The unit or lump-sum price or prices stated in the contract will be used in determining the amount to be paid and shall constitute full and final compensation for all work.

(h) The procedure above described in this paragraph shall be repeated as often as necessary on account of exhaustion of available funds and the necessity of awaiting the appropriation of additional funds by Congress.

(i) Should Congress fail to provide additional funds during its regular session as expected, the contract may be terminated and considered to be completed at the option of the contractor, without prejudice to him, at any time not later than 30 days after payments are discontinued, or, if payments have been previously discontinued, not later than 30 days after passage of the Act which would ordinarily carry an appropriation for continuing the work or after the adjournment of Congress without passing such Act.

22. Commencement, prosecution, and completion of work. The contractor shall begin work within ten (10) calendar days after date of receipt of notice to proceed and shall complete all of the work within two hundred (200) calendar days from the date of receipt of such notice: Provided, That the period allowed for completion of the work shall be reduced by one (1) calendar day for each calendar day of delay in excess of ten (10) calendar days, or any extension thereof, in returning properly executed contract, performance and payment bonds as required in U.S. Standard Form No. 21 (Rev. 4/6/50).

A commitment has been made to the Washington State Highway Department that the railroad crossing of Secondary State Highway 10-B, West of Grand Coulee, will be removed by October 15, 1950, in order to accommodate the surfacing program for that highway. The work shall be prosecuted in such a manner that all materials are removed from the right-of-way for this crossing by the date specified above unless other arrangements are made by the contractor with the State Highway Department. In the event notice to proceed is not issued prior to October 3, 1950, the contractor will not be required to perform this work and the track crossing will be removed by others.

Removal of bridges and signs from the existing Secondary State Highway 2-F will not be permitted until the relocated Highway 2-F is open

for public travel. If the relocated Highway 2-F is not open for public travel within 170 calendar days from receipt by the contractor of notice to proceed, the contractor will not be required to remove the bridges and signs.

Capacity of the contractor's equipment, sequence of operations, method of operations, forces employed shall, at all times during continuance of the contract, be subject to approval of the contracting officer and shall be such as to insure completion of the work within the specified period of time.

23. Liquidated damages. The contractor shall pay to the Government, as fixed, agreed, and liquidated damages, the sum of one hundred dollars ($100) per day for each calendar day's delay.

24. Operation of Railroad. Operation of the railroad will be permitted only for removal of materials under these specifications. Hauling of freight will not be permitted.

25. Materials and equipment. The contractor will be required to furnish all labor, materials and supplies, and all equipment except as provided in paragraph 26, necessary for completing the work.

26. Construction equipment available for the contractor's use. Various items of government-owned construction equipment, as listed below are available for the contractor's use only on work to be performed under these specifications. The Government will assume no responsibility for the condition of the equipment, or for the capacity of the items of construction equipment or for their adaptability to the work to be performed. Prospective bidders shall inspect the equipment. The contractor shall submit a written request to the contracting officer for the equipment within 20 days after the date of notice to proceed, and the items of equipment will be turned over to the contractor for his use by written order from the contracting officer. Upon receipt of such written order from the contracting officer, the contractor shall immediately accept the equipment and assume its operation and maintenance. The contractor may at any time during the continuation of the contract return any equipment to the Government subject to the provisions of this paragraph: Provided, That any equipment so returned will not again be made available for use by the contractor. The contractor shall furnish the necessary operators and maintenance personnel who are satisfactory to the contracting officer. Fuel, lubricants, and other operational supplies shall be furnished by the contractor, and the cost of all maintenance shall be borne by the contractor. The Government shall have the right to make such inspections of the equipment as to its use, maintenance, storage, and protection facilities afforded by the contractor as the contracting officer may deem necessary, and may demand the immediate return of such equipment to the Government for failure to comply with the requirements of this paragraph as determined by the contracting officer. The contractor shall not remove any of the equipment from the site of the work without the written approval of the contracting officer. The equipment made available to the contractor by the Government shall remain the property

of the Government, and upon completion of the work under this contract all Government-owned equipment remaining in possession of the contractor shall be returned to the Government at the Odair terminal in the same condition as received, reasonable wear and tear excepted. No charge will be made to the contractor for the use of the items of construction equipment listed in this paragraph. On all work to be done under extra work orders, the contractor shall use Government-owned construction equipment, where available and suitable as determined by the contracting officer, and no payment will be made for rental or for maintenance of Government-owned equipment. Payment for work done under extra work orders will exclude any charge with regard to rental or for maintenance of Government-owned equipment. The contractor hereby releases and agrees to indemnify and hold harmless the United States, its officers, agents, and employees on account of all damage or claims for damage by whomsoever made, and of any nature whatsoever arising out of or in any manner connected with the Government's furnishing of the equipment as provided in this paragraph. The contractor shall perform any and all repairs and shall make all replacements as may be required at his own expense to keep the equipment in first-class operating condition, as determined by the contracting officer.

Inventory of equipment available for contractor's use:

(1) 1 - Locomotive, G. E. Diesel-electric, 65 ton, 400 hp, USBR No. 4620.5.

(2) 1 - Crane, locomotive, Industrial Brown Hoist Model 7, 30-ton cap. with a 50-ft. boom, USBR No. 1976.1.

(3) 1 - Motor car, USBR No. 1220.1

(4) 1 - Flat car, USBR No. 1210.1

(5) 1 - Flat car, USBR No. 1210.2

(6) 1 - Flat car, USBR No. 1210.4

(7) 1 - Push car, USBR No. 1215.2

27. Camp sites. The contractor will be permitted to use for construction plant and storage purposes such land that is the property of the Government, as is designated by the contracting officer: Provided, That such use shall not interfere with any part of the work or of the work of other contractors or of the Government in the vicinity. If private land is used by the contractor for residential camp, construction plant, or other construction purposes, the contractor shall make all necessary arrangements with the owner and shall pay all rentals or other costs connected therewith. The location, construction, maintenance, operation, and removal of the contractor's construction plant and storage facilities shall be subject to approval of the contracting officer.

28. Fire protection. All burning shall be subject to the regulations and precautions prescribed by the State Fire Marshal and no fire or other burning operation shall be left unguarded or unattended at any time. The contractor shall at all times take special precaution to prevent fire from spreading to the area outside of the limits of the work sites and shall be liable for any damage inside or outside the work sites caused by his burning operations. The contractor shall have available at all time suitable materials and supplies for use in preventing and suppressing fires.

29. Roads, interference with other work, and safety of the public. Access to the work from existing roads shall be provided by the contractor. No payment will be made to the contractor by the Government for any work done in constructing, improving, repairing, or maintaining any road or structure thereon for use in the performance of the work under these specifications. The Government assumes no responsibility for the condition or maintenance of any road or structure thereon that may be used by the contractor in performing the work under these specifications or in traveling to and from the site of the work. Roads subject to interference by the work shall be kept open or suitable detours shall be provided by the contractor. During the period of time covered by this contract, the Government and others may be engaged in other construction work in the vicinity of the work covered by these specifications. The contractor shall arrange and prosecute the work under these specifications so as not to interfere with other work or with existing improvements. The contractor shall not obstruct traffic unnecessarily and shall cause as little inconvenience as possible to occupants of abutting property and to the general public. The contractor shall provide, erect, and maintain all necessary barricades; suitable and sufficient red lights, danger signals, and signs; and shall take all necessary precautions for the protection of the work and the safety of the public. Roads closed to traffic shall be protected by effective barricades on which shall be placed acceptable warning and detour signs. All barricades and obstructions shall be illuminated at night, and all lights shall be kept burning from sunset until sunrise. The cost of all work required by this paragraph shall be included in the prices bid in the schedule for the various items of the work.

30. Transmission, telegraph, and telephone lines. The contractor shall make all necessary or required provisions and shall perform all work required by his operations under the contract and incident to any interference with the transmission, telegraph, and/or telephone lines, with their operation, or with the maintenance of traffic or service thereon, all in a manner satisfactory to the owners or operators thereof and to the contracting officer. The cost of providing and maintaining all necessary or required watchmen, signals, guards, and temporary structures; of making any necessary repairs, replacements, or similar operations; of furnishing indemnity or other bonds, if required; and of all or any other costs required by this paragraph shall be paid by the contractor and shall be included in the prices bid in the schedule for other items of work.

31. Investigation of the site. Bidders shall visit the site of the work and by their own investigations, shall satisfy themselves as to the existing conditions affecting the work to be done under these specifications. Bidders and the contractor shall assume all responsibility for deductions and conclusions as to the difficulties in performing the work.

TRACK AND TRACK MATERIALS

32. Removal of Railroad. (a) Removal.--The contractor shall remove all track and track materials from the construction railroad to be removed under this contract. Removal of track materials shall include removal of spare rails located along the construction railroad for emergency use, spare rail stands, road crossings, sign posts, appurtenant railroad equipment, and 4 cattle guards. The cattle guards are located 2 each near stations 63+61 and 161+00. Materials to be salvaged shall be removed without damage. All component parts of the track except frogs, switches and switch stands, shall be completely disassembled. Metal parts to be salvaged shall be reasonably free of dirt and foreign matter. After the track materials have been removed from within the town of Grand Coulee, the roadbed shall be graded so as to leave it neat and sightly. After cattle guards have been removed, fences similar to those attached to the cattle guards shall be built across the right-of-way.

(b) Measurement and payment.--Measurement for payment for removing track and disposing of track materials will be made along the center line of track in place, through switches and cross-overs, to the center lines of intersecting tracks, and to the nearest one-hundredth of a mile. Payment for removing track and disposing of track materials will be made at the unit price per track mile bid therefor in the schedule, which price shall include all cost of removing materials, including spare rails, cattle guards and appurtenant materials; of burning, cleaning, separating, handling, stockpiling, and loading materials as required by these specifications; of grading road bed; of repair and maintenance of road crossings; of constructing fences; and of all other work connected with removal and disposal of track materials from the existing railroad.

33. Track materials to be salvaged. (a) Track materials to be loaded on cars at Odair.--The materials listed below are to be delivered ready for shipment on railroad cars at Odair, Washington. The Northern Pacific Railroad Company has agreed to furnish the railroad cars that will be required, but all arangements for procurement, loading, and use of these cars shall be made by the contractor. Any demurrage or other expense connected with use of the cars shall be paid by the contractor. Cars shall be loaded so that each kind and class of material will be separate, and in a manner that will be acceptable to the railroad. Ties, other than those to be stockpiled as provided in subparagraph 33 (c), may be used to side-board cars on which track fastenings are to be loaded: Provided That such side-boarding and loading is acceptable to the railroad. Transportation of loaded cars from Odair will be at the expense of others.

Material	Quantities
	All available up to the following:
90-pound rail	365,716 lin. feet
72-pound rail	1,316 lin. feet
No. 11 Frogs, 90-lb., with 16½-ft. spring rail	6
No. 9 Frogs, 90-lb., with 15-ft. spring rail	4
Split Switches, compromise, 16½-ft., 90-lb.	17
High Banner Switch Stands	8
Low Banner Switch Stands	9
Switch Stand connecting Rods	17
Guard rails, 90-lb., compromise	18 sets
Guard Rail Clamps	1
Guard Rail Base Plates	20 sets
Angle Bars, 90-lb., common	12,130 pairs
Angle Bars, 72-lb., common	72 pairs
Tie Plates, 90-lb.	27,564
Bolts, track, for 90-lb. Rail	720

(b) Materials to be stockpiled at Coulee Dam, Washington.--The requirements for track materials listed under subparagraph (a) above shall have first consideration. Insofar as possible, the materials listed below are to be placed in stockpiles at the Salvage Yard located north of the Coulee Dam Industrial Area as shown on Drawings No. 3 (222-117-11512).

Material	Quantities All available up to the following:
90-lb. rail	6,930 lin. feet
No. 9 Switches, 90-lb. complete with Switch-stands	3
Tie Plates for 90-lb. rail	3,250
Spikes	7,000

(c) Bonneville ties.--All ties from the Bonneville Spur as shown on the drawing shall be salvaged and stockpiled on the right-of-way at one end of the spur.

(d) Materials to be stockpiled at Odair Yard.--All remaining metal track materials, other than track bolts and spikes, not listed under (a) or (b) above, shall be stockpiled at Odair Yard. Component parts and accessories shall be stockpiled separately. Stockpiles of track fittings shall be placed on wooden platforms provided by the contractor. Ties obtained from track removal may be used for these platforms.

34. Track materials not to be salvaged. All materials not to be salvaged shall become the property of the contractor and shall be removed from Government property, or may be disposed of as follows:

(1) Track bolts and spikes may be left on the right-of-way in the reservoir area below elevation 1570.

(2) Combustible materials not to be salvaged, such as ties (all ties except as provided in paragraph 33), piling, sign posts, bridge timbers, cattle guards, and other wooden pieces may be burned. All material burned shall be completely consumed. Any charred pieces remaining shall be reburned until completely consumed, or shall be removed from Government property. Burning shall be subject to approval of the contracting officer and in accordance with paragraph 28.

35. Repair of highway crossings. After the railroad crossing at U. S. Highway No. 2 near Coulee City has been removed, the highway shall be repaired and resurfaced. Replacement of subgrade and shoulders shall be performed so as to make the patched area the same as adjacent subgrade and shoulders, and the surface course shall be the same as the surface course on the highway. The new surface material shall be placed so as to make a smooth continuous road surface across the railroad right-of-way. Highway 2-F crossings from which track has been removed, shall be filled, graded, and maintained in a good, safe condition approved by

the contracting officer until the new Highway 2-F is open to public travel. Other road crossings shall be filled and graded to form a serviceable roadway. Ballast material from the railroad right-of-way may be used for repair of highway crossings.

36. Moving stockpiled materials from Electric City Yard. All railroad materials, including metal parts and ties, stockpiled along the north side of the main line track between approximate stations 1415+00 and 1425+00 in the Electric City Yard shall be moved by the contractor. The stockpiled materials contained in the yard at time of advertisement for bids will be augmented by the addition of the rails, angle bars, tie plates, and switch materials from approximately 0.25 mile of an existing spur track located east of the North Coulee Dam. This additional material from the spur track will be stockpiled in the above described area by others in time to avoid delay in removal of stockpiled material. Disposition of the stockpiled material shall be made as provided in paragraphs 33 and 34. The contractor shall give the contracting officer ten (10) days' notice in writing before removal of stockpiled material is commenced. Payment for moving and disposing of materials as described above will be made at the lump sum price bid in the schedule for moving stockpiled materials from Electric City Yard, which price shall include all cost of moving, loading, separating, stockpiling, and removing or destroying all materials described in this paragraph.

REMOVING MISCELLANEOUS STRUCTURES AND MATERIALS

37. Removal and disposition. (a) Removal.--The contractor shall remove structures and materials as listed in the following paragraphs, including concrete floors and concrete footings for buildings, but not the engine pit. All service lines to tanks and buildings such as air, water, sewer, oil and electrical conduits shall be cut and plugged or capped so as to be water tight. The plug or cap on water lines shall be not less than 3 feet underground, and on others not less than 1 foot underground. All holes including the engine pit shall be filled with earth or gravel obtained from the adjacent area.

(b) Disposal.--The pump house, sand house, oil house, and office and the oil pump and storage tanks shall be moved without dismemberment. Other materials removed shall become the property of the contractor and shall be removed from Government property, or may be disposed of as follows:

(1) Concrete from floor and footings of buildings razed or moved may be hauled to the disposal site near the sawmill south of the Industrial Area.

(2) Other non-combustible material may be deposited in the Brett Canyon Yard.

(3) Combustible material may be burned as provided in paragraph 34.

38. Railroad bridges, buildings, and tanks. (a) Removing bridges and trestles along railroad.--The contractor shall remove all combustible materials in bridges and trestles along the railroad. All wood piling shall be cut off within 6 inches of the ground surface, or water surface, at time of cutting. Some of the bridge bents rest on timber mud sills, timber mats, or sleepers, which may be buried or partly buried, and the contractor will be required to remove all such sills, mats, sleepers, or other buried or partly buried combustible material.

Railroad Bridges and Trestles

Railroad station	Number spans	Approximate length in feet
125+25	2	31
420+00	8	71
463+86	4	61
520+00	5	76
740+20	4	61
801+47	2	31
978+50	2	31
1044+50	7	106
1089+00	8	76
1175+00	2	31
1225+00	2	31
1286+00	2	31
1325+00	2	31

Payment for removing bridges and trestles along railroad will be made at the lump sum price bid therefor in the schedule, which price shall include all cost of removal and disposition.

(b) Razing engine house, coal bunker, and motor-car house.--The contractor shall remove the buildings listed below:

Engine house - - - - - Approximately 43 x 72 feet, 35 feet high
Coal bunker - - - - - Approximately 16 x 46 feet, 13 feet high
Motor-car house - - - Approximately 14 x 20 feet, 12 feet high

Payment for razing engine house, coal bunker, and motor-car house, will be made at the lump sum price bid therefor in the schedule, which price shall include all cost of removal, disposition, and filling of holes.

(c) Moving pump house, sand house, oil house, and office.--The contractor shall lift structures listed below from their foundations, transport them to the Brett Pit Yard, and place each structure in an upright position on timber blocking at sites designated by the contracting officer. The structures shall be handled carefully and the entire moving operation shall be conducted so as to insure no physical damage to the structures.

Pump house - - - - - - - - - Approximately 12 x 16 feet, 10 feet high

Sand house - - - - - - - - - Approximately 10 x 12 feet, 10 feet high

Oil house - - - - - - - - - Approximately 10 x 12 feet, 10 feet high

Office - - - - - - - - - - - Approximately 14 x 20 feet, 12 feet high

Payment for moving pump house, sand house, oil house, and office will be made at the lump sum price bid therefor in the schedule, which price shall include all cost of moving the buildings, removing and disposing of footings and floors, and filling of holes.

(d) Moving service pump and two steel storage tanks.--The contractor shall move the service pump, excavate and remove the 1,000-gallon storage tank buried in the rear of the motor-car house, and the 10,000-gallon storage tank buried beneath the concrete floor of the pump house, and deliver them to the Government salvage yard. No piping will be required to be salvaged. The tanks shall be cleaned of adhering dirt. Any damage caused by the contractor to the pump or tanks shall be repaired by and at the expense of the contractor. Payment for moving service pump and two steel storage tanks will be made at the lump sum price bid therefor in the schedule, which price shall include all cost of disconnecting, moving, and cleaning tanks, and of filling holes.

39. Bridges, signs, and posts along Secondary State Highway 2-F. (a) Bridges.--The contractor shall remove all combustible material from 3 timber bridges on Secondary State Highway 2-F as shown on the drawing. Piles shall be cut, and sills or sleepers shall be removed as required for railroad bridges in paragraph 38.

(b) Signs and posts.--The contractor shall remove all highway signs, advertising signs, and all guard and guide posts along Secondary State Highway 2-F within 300 feet of the highway. All posts shall be pulled.

(c) Payment.--Payment for removing bridges along Secondary State Highway 2-F will be made at the lump sum price bid therefor in the schedule, which price shall include all cost of removal and disposal of

the materials. Payment for removing signs and posts along Secondary State Highway 2-F will be made at the lump sum price bid therefor in the schedule, which price shall include all cost of removal and disposal of the materials. The contractor shall be entitled to no additional compensation because either item of this work is not required, due to a delay in opening the relocated State Highway 2-F, and the application of provisions in paragraph 22.

- - -

DRAWING NO. 1

GPO-8-580

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

COLUMBIA BASIN PROJECT—WASHINGTON

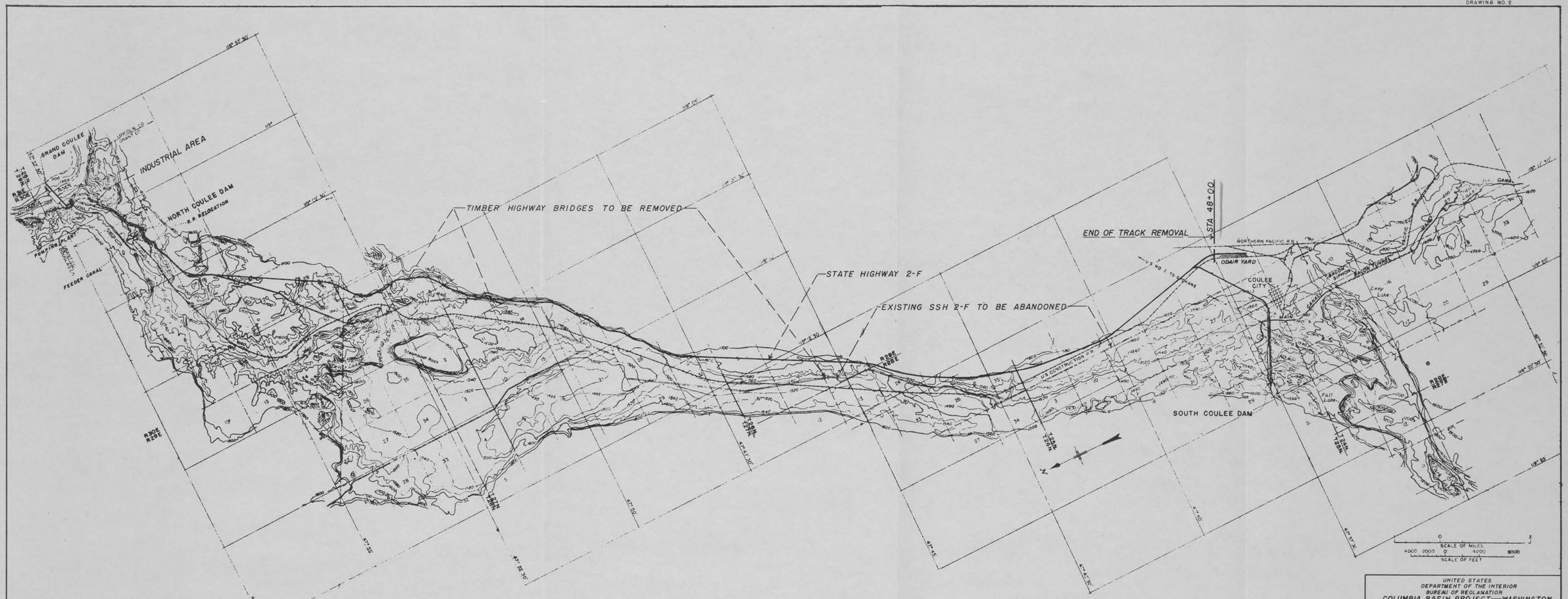
GRAND COULEE DAM
LOCATION MAP

REVISED 8-12-48
REV. 6-23-48

DRAWN: C.O.G. SUBMITTED: K.B. Keener
TRACED: B.F.W. RECOMMENDED: J.L. Savage
CHECKED: W.F.M. J.J.H. APPROVED: R.F. Walter
CHIEF ENGINEER

29425 DENVER, COLORADO - AUG. 10, 1948 222-D-1901

DRAWING NO. 2



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA BASIN PROJECT — WASHINGTON

USBR CONSTRUCTION RAILROAD
LOCATION MAP

DRAWN M.E.O.	SUBMITTED D.P. Johnson	
TRACED	RECOMMENDED A.P. Mickel	
CHECKED J.S.S.	APPROVED Bert A. Hall	
	COULEE DAM, WASH. JULY 19, 1950	222-117-11511

GPO-S-FSO

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA BASIN PROJECT WASHINGTON

GRAND COULEE DAM

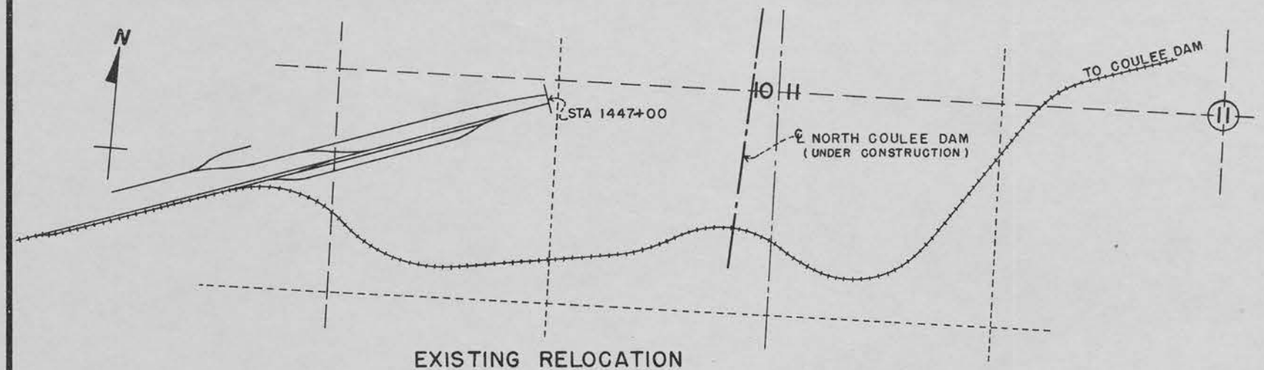
VICINITY MAP

DRAWN M.E.Q.	SUBMITTED Chas. D. Johnson
TRACED	RECOMMENDED S.P. Clarke
CHECKED J.S.E.	APPROVED Burt G. Hall

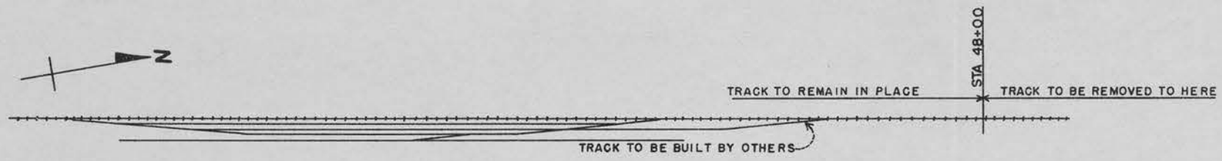
COULEE DAM WASH. JULY 19, 1950 | 222-117-11512

DRAWING NO. 3

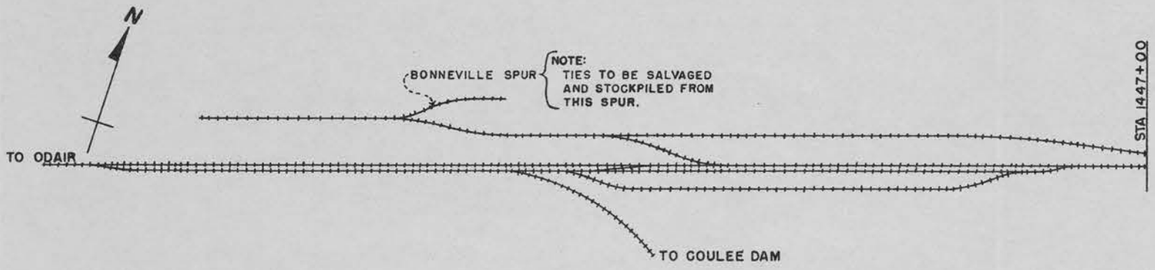
GPO-S-F60



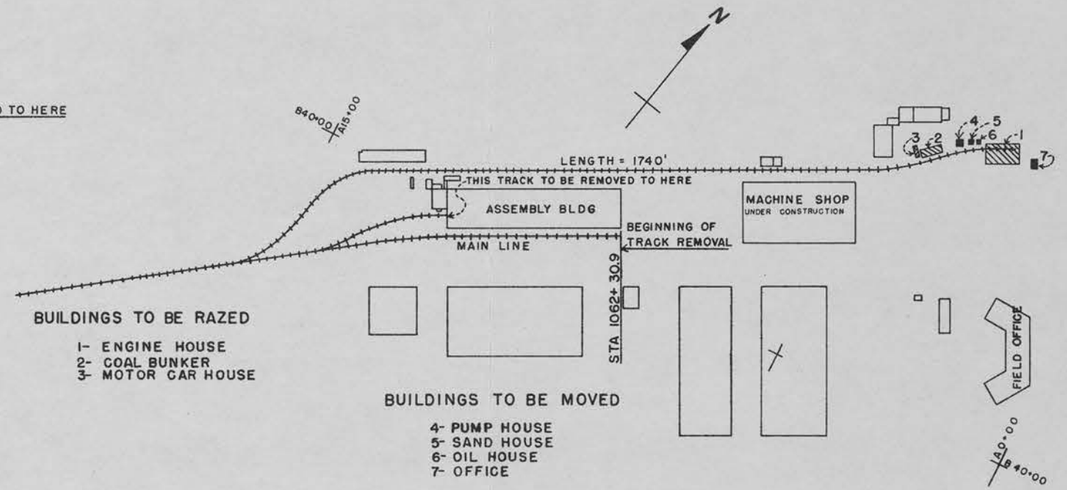
EXISTING RELOCATION
VICINITY ELECTRIC CITY SWITCHYARD
SCALE 1"/400'



ODAIR TERMINAL TRANSFER YARD
SCALE 1" 200'



ELECTRIC CITY SWITCHYARD
SCALE 1" 200'



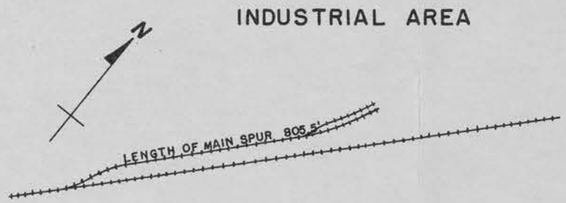
BUILDINGS TO BE RAZED

1- ENGINE HOUSE
2- COAL BUNKER
3- MOTOR CAR HOUSE

BUILDINGS TO BE MOVED

4- PUMP HOUSE
5- SAND HOUSE
6- OIL HOUSE
7- OFFICE

INDUSTRIAL AREA



CEMENT SILO SIDING

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLUMBIA BASIN PROJECT—WASHINGTON

USBR CONSTRUCTION RAILROAD
SIDING & YARD DETAILS

DRAWN MEO	SUBMITTED D. D. Johnson	
TRACED MEO	RECOMMENDED A. J. Nielsen	
CHECKED JSS	APPROVED Bert A. Hall	
	COULEE DAM, WASH. JULY 18, 1950	222-117-11513

GPO-6-F80