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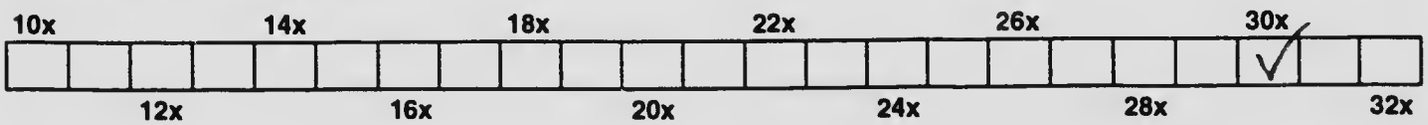

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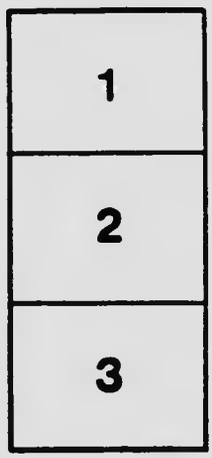

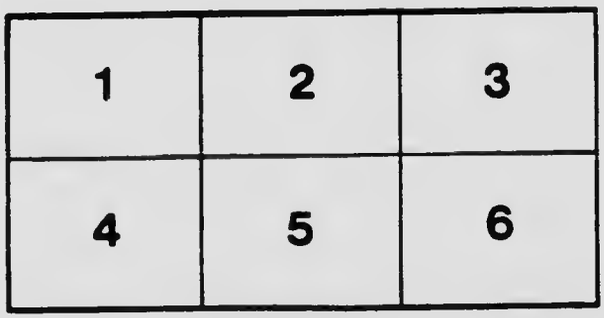


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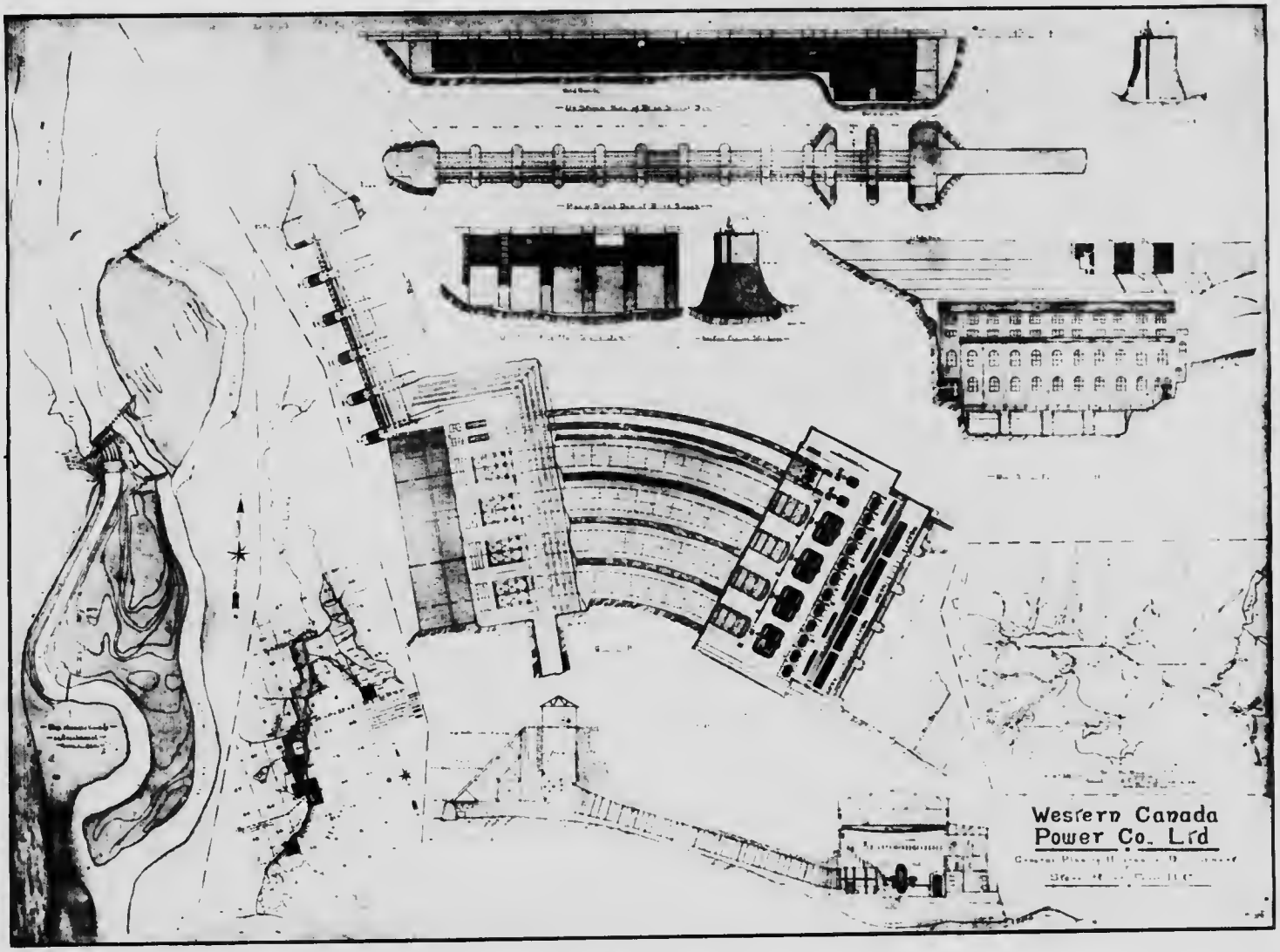

KEY MAP OF WORKS

DESCRIPTION

—OF—

THE HYDRO ELECTRIC DEVELOPMENT OF WESTERN CANADA POWER COMPANY, LIMITED

STAVE FALLS, B. C.

For several years the Stave Lake Power Company was engaged in the preliminary work and development of a hydro electric power plant at Stave Falls.

They had built an excellent wagon road from Ruskin to the works, for hauling supplies; they had erected a construction camp, together with a sawmill, and had partially completed the construction of the main dam at Stave River.

On June 30th, 1909, the property of the Stave Lake Power Company was transferred to the Western Canada Power Company, Limited, who immediately made preparation for the construction of a hydro-electric plant on a much larger scale than that which was planned by its predecessors.

The work of preparing the plans and letting contracts for the machinery occupied the winter of 1909-1910, and the work on the ground has been pushed with activity since the spring of this year.

The power development is located at the Stave River Falls, about six miles north from the junction of the Stave and Fraser Rivers, at Ruskin, B. C., and seven miles south of Stave Lake.

The mountains forming the water shed are granite; they rise high above the timber line, and are covered with snow and small glaciers.

The upper river is a large glacier-fed stream, and several smaller streams empty into the lake, some coming direct from the glaciers on the high mountains on the west side of the lake.

The lake is nine miles long and about one mile or more wide. The east and west shores are precipitous. At the head and foot of the lake there are large areas of low-lying land, which are flooded during high water.

From the foot of the lake to the Stave Falls the river is seven miles long. About two miles of this are rapids, with a total fall of eleven feet, the rest is navigable at all stages of the river and has practically no fall.

At the falls and the rapids, in the immediate vicinity of Stave Falls, the river drops eighty feet and then continues on its course over a series of rapids for a distance of four miles, finally debouching through a narrow granite gorge into a tide-water basin, where it joins the Fraser River.

The total fall from the low water level of the lake to tide-water is about two hundred and five feet, and this can be increased to two hundred and thirty-five feet by the construction of a fifty-five foot dam at Stave Falls.

The dam will form a lake extending from Stave Falls to the upper end of Stave Lake, a distance of sixteen miles, and having an area of approximately eighteen square miles.

This lake will be large enough to store the flood waters so that the total mean flow of the river can be made available for the generation of power.

The storage so obtained would be about 14,000,000,000 cubic feet, which is equivalent to a flow of 2,000 cubic feet per second for eighty-one days. Careful calculations made from the daily guage records show that with this storage a mean flow of 3,000 cubic feet per second can be utilized for generating power.

POWER AVAILABLE

With a fifty-five foot dam at Stave Falls, a maximum head of 120 feet can be obtained. This will be reduced to 100 feet at low stage of the lake and the average head will be 110 feet.

With an average head of 110 feet, a flow of 3,000 cubic feet per second will produce 28,000 electrical horsepower continuously, and under usual operating conditions a peak load of 44,000 to 48,000 horsepower can be provided for.

The Company also owns a water right near the mouth of the river, where, by the construction of a dam not more than 120 feet high in a narrow, rocky gorge, the same water can be used again and an equal amount of power developed.

The Company is therefore in a position to carry out hydro-electric developments on the Stave River within thirty-five miles of the City of Vancouver up to a capacity of 100,000 horsepower as rapidly as the market demands the power.

THE STAVE FALLS DEVELOPMENT

The complete development of Stave Falls comprises:

1. A dam, fifty-five feet high and 150 feet long, across the main channel of the river, known as the sluice dam.
2. An auxiliary dam varying in height from 40 feet to 20 feet and 640 feet long on the crest, known as the blind slough dam.
3. The forebay and intake works.
4. The power house, designed for four 13,000 h.p. turbines, and four 7,500 k.w. generators, with step-up transformers for a 60,000 volt transmission.

A portion of this work only is being undertaken at present, though all the parts are laid out for increasing the plant to the full development when the market requires it.

THE PRESENT UNDERTAKING

The present undertaking comprises the completion of the dams to a sufficient height to obtain a working head of 100 feet, and the construction of the power house for two units, each consisting of a 13,000 H.P. turbine, and a 7,500 K.W. generator, with the necessary complement of transformers and switchboards.

The work includes:

1. The completion of the sluice dam.
2. The construction of the blind slough dam.
3. The excavation of the forebay and the construction of the intake
4. The construction of the penstocks for two 13,000 H.P. turbines two exciter turbines.
5. The clearing of the tailrace and excavation of the powerhou down to elevation 100 feet.
6. The construction of the power house building of sufficient size for its.
7. The installation of two 13,000 H.P. turbines, and two 500 K.W. nes.
8. The installation of two 7,500 K.W. generators and two exciters.
9. The installation of six, 60,000-volt, 3,000 K.V.A., step-up trans
10. The installation of the switchboards for two units and two transmi lines.
11. The construction of about 35 miles of double transmission line from power house to Vancouver.
12. The construction of a receiving station near Vancouver, large enou six, step-down transformers, of a total capacity of 24,000 H.P.
13. The installation of four 3,000 K.V.A., step-down transformers (16,000 total acity)
14. The installation of switchboard equipment, necessary for the control of th ming lines, six transformers and a sufficient number of outgoing feeders.
15. The erection of distributing lines as called for by contracts for the sale of p

GENERAL VIEW SHOWING SLUICE DAM AND FLUME FOR PROVISIONAL POWER PLANT

THE SLUICE DAM

The dam across the main stream is built upon solid granite foundations. It consists of five concrete piers 35 feet high, eight feet wide, and 32 feet apart, and one abutment pier.

The piers are 56 feet wide at base and 32 feet at top, and are anchored to the foundation rock by a number of two inch bolts. The upstream face of the piers are protected by one-half-inch steel plates, against the battering of the heavy logs brought down by floods.

The sluice ways between the piers are designed to be closed by stoplogs which can be taken out to allow passage of flood waters. These stoplogs are 24 inches wide and are made from timber cut on the Company's land.

The guides or "checks" into which these stoplogs fit are made of steel built in the concrete piers. The logs, which are very heavy, are raised and lowered by means of a winch, operated by a 35 H.P. motor. This winch is so arranged that it can push the stoplogs down or lift them up with a force of 35 to 40 tons.

During the high flood in Nov[illegible]t, the sluice ways in the dam were found to be of ample capacity for the flood discharge. The water ra[illegible]hem about twenty feet deep, whereas the total available depth of water way is thirty-five feet.

THE BLIND SLOUGH DAM

The blind slough is an old river channel covered with timber, beginning above and ending below Stave Falls, and lying a short distance to the East of the sluice dam. Either the whole or a portion of the river originally flowed through this channel, and was diverted by the construction of beaver dams a long time ago. The channel is narrow, but straight, and of even grade. It is large enough to carry the whole river which it will discharge into the existing main channel a little way below the falls. A narrow ditch has been dug through this channel to form a lead to the flood waters which will scour out all the silt and make a wide channel for flood discharge during the coming freshets.

The site for the dam is excellent; the surface has been stripped and shows solid granite foundations clear across.

The dam when built to the full height (elevation 230 feet) will be 640 feet long. It will consist of eleven concrete piers and two abutments. Three of the piers will be 40 feet high, the rest will be only 20 feet. The arrangement for closing the spaces between piers with stop logs will be the same as in the sluice dam.

Th[illegible]vill be ultimately eleven sluice ways 22 feet wide and 20 feet deep for the discharge of flood water, whereas in the slu[illegible]dam there are only five sluice ways. With this large capacity for discharge and the good channel below the dam, all flood water and logs can eventually be run through the Blind Slough Dam, leaving the forebay and intake works of the power house clear of heavy currents, logs and driftwood.

For the present development, it will only be necessary to build three 20-foot piers and a light wall, not more than five feet high and about 240 feet long.

FOREBAY AND INTAKE WORKS

The forebay and intake works are being constructed as an extension of the sluice dam. The foundations are on solid granite. The intake dam is designed for four main penstocks, two exciter penstocks with screens and all necessary sluice gates.

The work is being constructed of concrete, re-inforced where necessary with steel. Large blocks of granite will be bedded in the concrete wherever possible in order to save cement.

The screen will be supported by heavy steel beams designed to be strong enough to support the whole pressure of the water, in case they should become blocked with driftwood and trash.

The main sluice gates will close an opening 20 feet square. They are being built by the Escher Wyss Co., and are known as the radial gate. This is a balanced gate which works on a pivot and is raised and lowered by a chain operated by an electric motor. The gates have to withstand a very great pressure and will weigh 35 tons each.

The forebay and intake works will ultimately be built to elevation 235 feet, but for the present the work will be stopped off at elevation 215 feet.

PENSTOCKS

The penstocks for the main turbines will be 14 feet 6 inches in diameter and 150 ft. long. They are designed to withstand sudden shock caused by water ram, and will be stiffened by external angle rings. They will be laid in channels cut in the solid rock, and will be bedded in concrete after being rivetted up. As an additional precaution against water ram, relief pipes three feet in diameter will be erected close to the junction of the penstocks with the turbines.

The penstocks for the exciter turbines will be 48 inches in diameter.

The steel plates for the penstocks were purchased from Scotland through Messrs. Evans, Coleman & Evans, and will be manufactured in Vancouver and New Westminster.

POWER HOUSE BUILDING

The building for the four units will be 150 feet long and 100 feet wide. For the two first units the building will be 100 feet long only.

The building will be divided into ~~three~~ ten bays; ~~the first 35 feet wide, will contain the~~ turbines; the main bay, ~~50~~ 70 feet wide will contain the turbine generators, low tension switches and transformers; and the third bay will contain the 60,000 volt switches, bus bars and lightning arresters.

A 60 ton electric travelling crane will be installed in the main bay to handle the generators and transformers, and a 30 ton crane will be placed over the turbines.

The building will be a concrete steel structure, fireproof throughout. All foundations will be on solid granite.

The west end of the building will be closed by a temporary structure of galvanized iron, which can be removed when the building is extended.

DOWN STREAM SIDE, SLUICE DAM

THE TURBINES

The order for the turbines has been placed with the Escher Wyss Co. of Zurich, Switzerland.

Two main turbines are to be supplied, each capable of developing 13,000 h.p. on the shaft, under a head of 110 feet, when running at a speed of 225 revolutions per minute.

These turbines are of the double Horizontal Francis type with central discharge. They weigh about 165 tons each.

The governors will be of the Escher Wyss pattern, and the high pressure oil system which is required for their operation will be supplied from pumps driven by independent water wheels and will be in duplicate.

Two turbines will be furnished for driving the exciters, each of which will deliver 500 h.p. on the shaft when running at a speed of 500 revolutions per minute.

The Escher Wyss Co. have promised delivery of the first turbine November, 1910, and the second, one month later.

THE GENERATORS

The contract for the two generators and exciters has been let to the Canadian General Electric Company, and the machinery will be built at Peterboro, Ont. Delivery is promised on the same dates as the turbines.

The generators will be of the three phase, horizontal two bearing type, coupled direct to the turbine shafts. The rotating parts will weigh 65 tons, and the whole machine will weigh over 160 tons.

Each generator is rated at 7,500 k.w. or 10,000 h. p. but it will be capable of running continuously at 9,375 k.w or 12,500 h.p. at a power factor of 85 per cent without the temperature of the machine rising more than 55 degrees centigrade above the surrounding atmosphere. The normal voltage is 4,000, cycles 60. They are guaranteed to run without damage at a speed of 75 per cent. in excess of the normal.

The two exciters are rated at 250 k.w. each, and will be direct coupled to the exciter turbines.

THE STEP-UP TRANSFORMERS

The contract for the step-up transformers has been let also to the Canadian General Electric Company, and they will be built at Peterboro, Ont.

There will be six 3,000 k.w. transformers of the water-cooled, oil insulated type, and they will be wound to step-up from 4,000 volts to 60,000 volts.

They will weigh complete 24 tons each.

THE SWITCHBOARDS

The contract for the switchboards has been placed with the Canadian Westinghouse Company and the switchboards are being built at their works at Hamilton, Ont.

The switchboard layout is being made as simple as possible, as experience has proved that most switchboards contain far too much costly apparatus which tends to complicate operations and militates against continuous service. There will be six 4,000 volt main switches and four 60,000 volt oil switches only. This will be the equipment for two generators, two banks of transformers, and two transmission lines. Aluminium cell lightning arresters will be used to protect the station apparatus.

All high tension wiring will be enclosed in fireproof cells built up of concrete slabs.

THE TRANSMISSION LINE

For the transmission line, which will be 35 miles long, steel towers will be used. The towers will carry six No. O B & S gauge copper cables and will be spaced 660 feet apart. The height of the lowest wire from the ground will be 40 feet, and a sag of about 12 feet will be allowed, thus bringing the lowest part of the wire 28 feet above ground. The towers will be delivered within two months.

The insulators will be of the suspension type as used by the Hydro-Electric Commission in Ontario.

The copper wire was purchased from the Dominion Wire Manufacturing Company and The Wire & Cable Company of Montreal and has already been delivered.

THE RECEIVING STATION

The receiving station will be a reinforced concrete structure about 50 feet wide and 80 feet long, and will contain space for six 3,000 k. w. transformers and the necessary switches and apparatus for two 60,000 volt incoming lines and about 10 outgoing 12,000 volt lines.

The contract for the construction of this building will be let within the next month.

UP STREAM S.DE, SLUICE DAM

THE STEP-DOWN TRANSFORMERS

The contract for the step-down transformers has been let to the Canadian General Electric Company.

There will be four transformers of the same size and type as the step-up transformers, but wound for different voltages, viz., from 60,000 volt on the high tension side to 13,000 on the low.

RECEIVING STATION SWITCHBOARDS

These are being built by the Canadian Westinghouse Company. The general layout will be similar to that of the power house, excepting that the low tension voltage will be 13,000 and there will be 8 or 10 feeder switches.

DISTRIBUTION SYSTEM

From the receiving station the power will be delivered over wooden pole lines to a number of small sub-stations located in various convenient centers of distribution in Vancouver City, North Vancouver, South Vancouver, New Westminster, Burnaby, Port Moody and Coquitlam, and from these substations the power will be distributed over the adjacent districts on three phase 2,000 volt alternating current circuits.

The municipalities of Mission and Maple Ridge will be supplied in a similar manner from sub-stations connected direct to the power house instead to the receiving station.

CONSTRUCTION PLANT

The Company has installed a very complete and interesting construction plant and is building a railway 6 miles long from Ruskin to the Works for the transportation of all the heavy machinery and materials to be used in the building of the power house.

The contract for the railway was let to Messrs. Grant, Smith & Co. on June 6th, 1910, and it is expected that trains will be running by 15th September.

The railway is built with a maximum grade of six per cent. and laid with 40 lb. steel. The transportation will be carried out by a forty ton Shay locomotive which the Company has recently purchased.

The excavation of the Tail Race channel involving 60,000 cubic yards of loose boulders and sand and some 20,000 cubic yards of rock will be carried out by Messrs. Grant, Smith & Co., who will do the work with a 75-ton steam shovel which will be brought in as soon as the railway is completed.

All power and compressed air required for the construction of the work is supplied from a provisional power plant which was installed by the Company in the Spring of this year near the Falls. This plant consists of a 650 h.p. turbine driving a 450 k.w. three phase 2,000 volt generator together with a 150 h.p. motor driving a 1,000 cubic foot Ingersoll Rand Air Compressor.

The whole of this machinery was supplied by the Allis, Chalmers Bullock, Limited, of Montreal.

The steel penstock was built by Messrs. Ross and Howard of Vancouver, and the flume was built by the Company from lumber cut in its sawmill.

The Company has installed 5 cable ways for the handling of the rock, concrete, and a great part of the structural materials. Four of these cableways were constructed by the Company in its shops on the works. They are operated by winches driven by 30 h.p. electric motors. These are ordinary steam winches converted into electric drive in the Company's shops.

These four cableways are capable of handling loads up to three tons, and the spans are from 350 to 500 feet in length.

The fifth cableway has a 2¼-in. cable and is designed for a six ton load which spans the center of the power house and will be used not only for the taking out of rock and the placing of concrete but for the erection of the steel and some of the machinery.

This cableway is driven by a steam winch which is operating on compressed air.

In the sawmill a steam engine has been replaced by a 50 h.p. motor and a top saw has been recently added in order to handle the heavy logs which are being cut on the Company's land and this top saw is operated by an independent 30 h.p. motor.

The machine shop has a small but complete equipment of up-to-date tools, most of which are of Canadian make, and all of which, with the exception of the small steam hammer are driven by electric motors.

Over 400 men are employed by the Company for the work at Stave Falls, the railway and line construction.

The machinery will be delivered before the end of the year and the Company expect to deliver power in the spring of 1911.

The first installation will have a capacity of 25,000 horse power, and so many enquiries for power are already being received, that the Company expect that it will not be long before the whole installation of four 12,500 h.p. units will be required.

PROVISIONAL POWER PLANT