ELECTRIC TRACTION

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Power From Glaciers

White River Power Plant of the Puget Sound Traction Light & Power Company Furnishes Service to One Hundred Thirty-two Cities From Its Five Hundred Fifty-one Miles of High Tension Transmission Lines—New Unit Will Supply Current for Electrification of Milwaukee Railway

Glaciers, past and present, play a great part in the electrification of industry and transportation in the Puget Sound region, for glaciers are not only the unfailing source of a large part of the developed power in that region, but an ancient glacier in some fargone time moulded and modeled natural topography and left in its wake a specially designed site for one of the most remarkable hydro-electric developments to be found anywhere in the world. This is the Lake Tapps or White River development, the generating station of which is located on the level of the lower valley between Seattle and Tacoma.

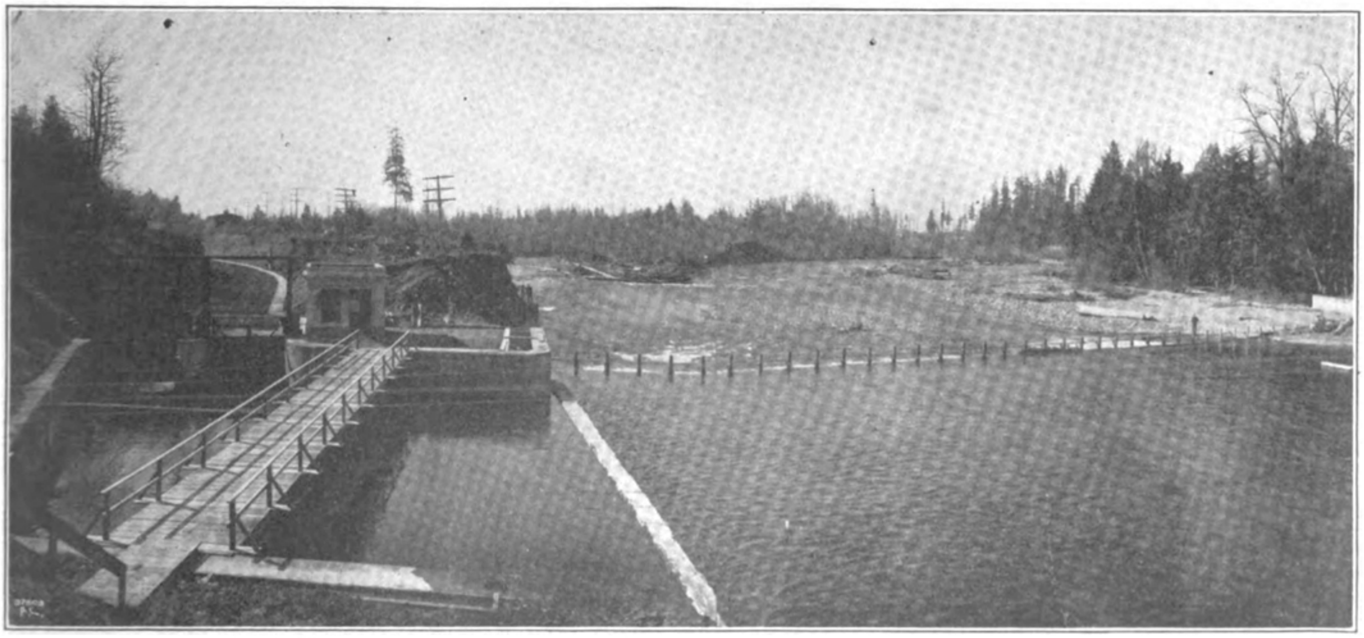


Fig. 1. Point of Diversion on White River Above Buckley, Wash.

It is here the water is taken from the river and started through the system of canals, settling basins and reservoir to the penstocks which lead directly into the power house.

White River furnishes the water. White River heads in the largest and most extensive glaciers to be found in United States, the White River glaciers, found on the slopes of Mt. Rainier. Along the course of the upper river the White receives the waters of many smaller streams whose sources are fed, too, by the snows of this majestic mountain dome.

From a point above Buckley to a point near Auburn the White flows in a general northwesterly direction, and then it curves sharply and flows almost south through the old channel of the Stuck into the Puyallup, partially enclosing a triangular plateau from 500 to 700 ft. in altitude. This plateau marks the point at which the ancient glacier aforesaid at one time pushed its

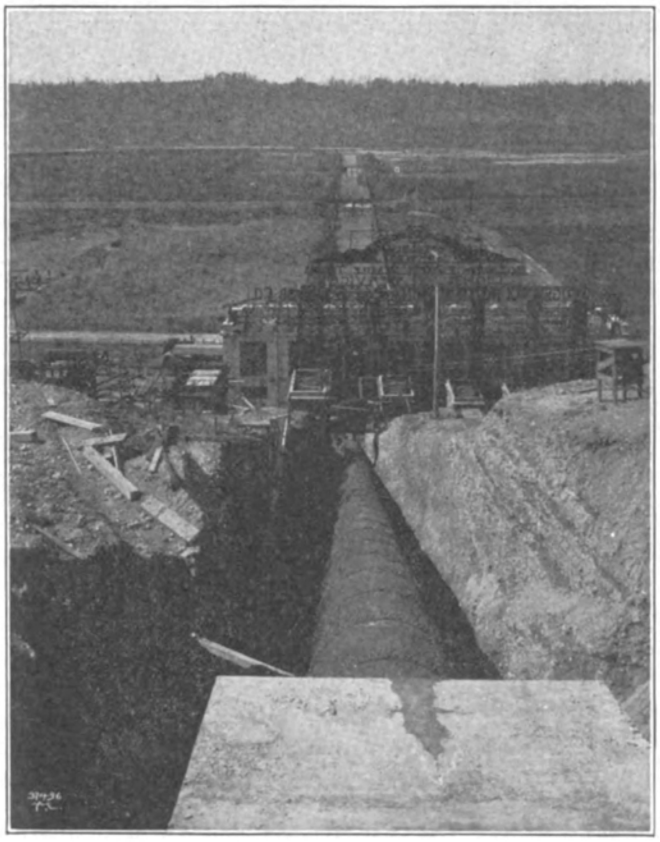


Fig. 2. Looking Down the Third Penstock with Power House and Tail Race in the Background

way out from the mountains into the basin of Puget Sound, or rather marks the point at which it rested its huge labors and expired. The moraine of that glacier is the plateau enclosed by the sharp curve of the White River.

This ancient moraine was cut by channels and indented with natural depressions which in turn became a series of connected lakes. The largest of these was Lake Tapps, lying nearest to the northern end or apex of the triangular plateau. It is the key to the development, for here it was possible to store the water and also to reach it with comparatively short penstocks and conduct it to the level of the lower valley under a head of 465 ft. The point of diversion is some 18 miles up White River from the apex of the triangle. The elevation of the stream at this point is approximately 700 ft. and the surface of the storage reservoir—Lake Tapps—is 500 ft.

At the diversion point a crib dam blocks the water, which is controlled by a pair of heavy steel gates and led for a half mile through a timber flume into the first settling basin where it deposits the heavier silt. This basin can be flushed and drained to prevent choking. An open canal carries the flow from this point through several smaller lakes to Lake Tapps. All of these lakes and channels are now one continuous body of water giving storage to 2,250,000,000 cu. ft., equivalent under a net head of 440 ft. to 18,000,000 kw. hrs.

The site of this storage basin and all of the plateau was originally heavily forested. Here and there were openings where farmers had established themselves. Along the river bottom for 28 miles on each side, between the upper intake and the lowes tail race discharge, were numerous farmers and ranchers, and the riparian rights of all were affected. The site was crisscrossed and intersected by highways. These 56 miles of riparian rights had to be acquired and settlements made for the roads destroyed. The litigation and settlements occupied ten years of preliminary work. It was not until November, 1911, that the initial development of two units was placed in commercial operation. The then rated output was 36,000 h. p., since increased by rewinding to 40,000 h. p.

The White River plant is the property of the Puget Sound Traction, Light & Power Company, and is one of five separate developments made in the Puget Sound basin. These are all interconnected and with the auxiliary steam plants give the company a total of more than 160,000 h. p. The company operates street rail-

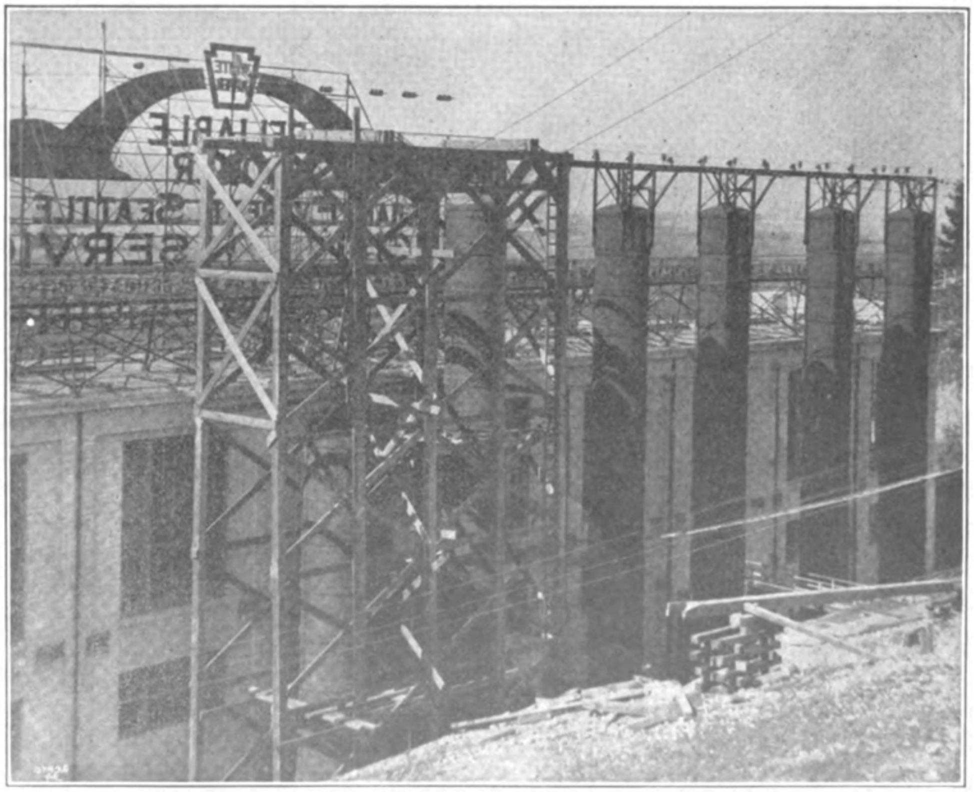
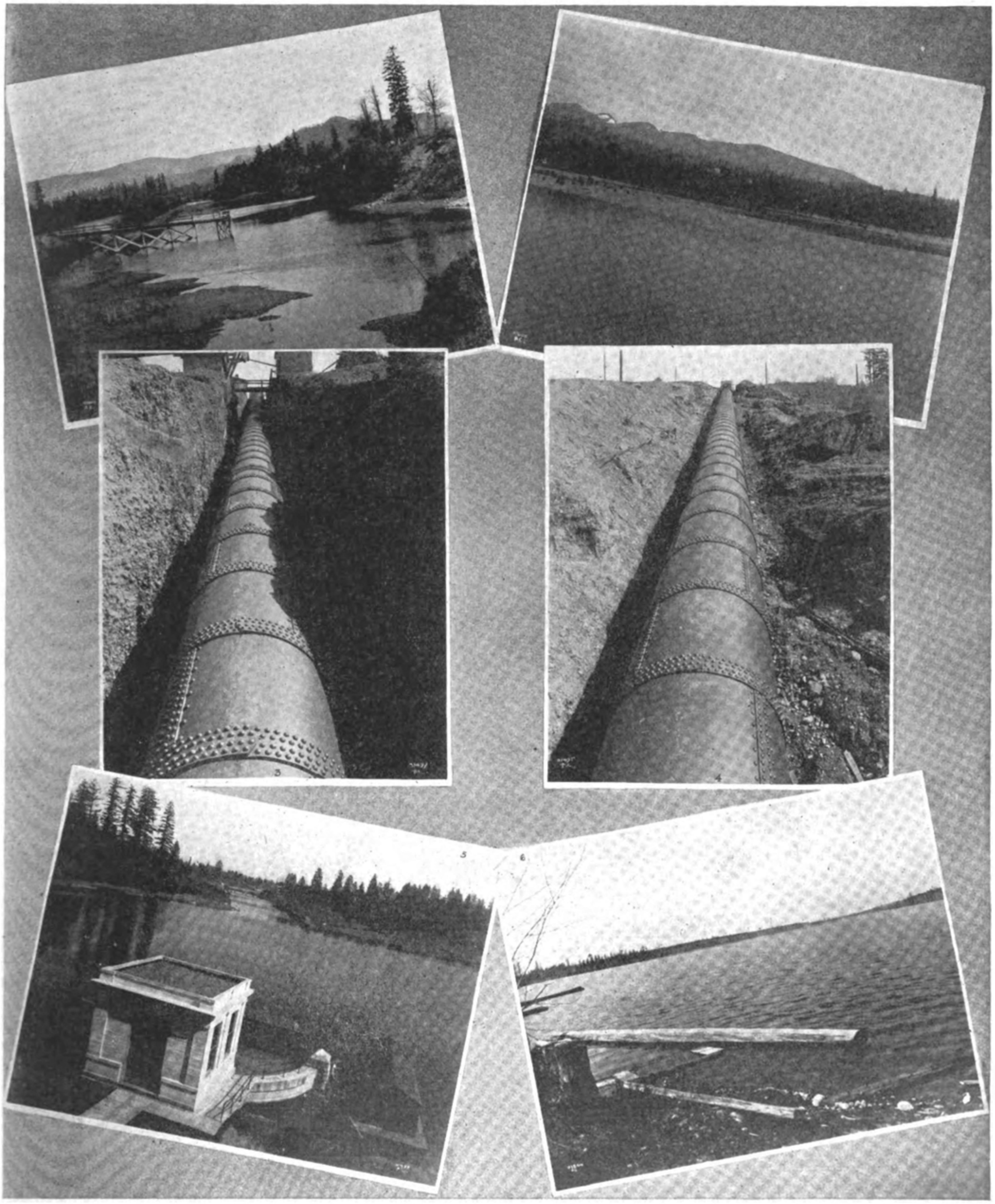


Fig. 3. Air Cushions that Control Water Pressure in the Penstocks

They are connected at the bottom with the lowest point of the penstock, a pair for each penstock. They are closed at the top and the water entering under high pressure from the bottom compresses the air which acts as an elastic cushion to maintain a constant and unvarying pressure.



1. Here is a picturesque bit of the canal leading from the point of diversion to the upper lake or settling basin. At the time this view was taken the water was high in Lake Tapps, the lower and largest of the storage basins, consequently there was not much water running through the canal. One of the two gates was only partly open at the time. 2. The source of the power is the glaciers of Mt. Rainier, the most extensive of which are known as the White glaciers. This view shows faintly outlined in the distance, the dome of Rainier, the most majestic in America. It was taken from the upper lake in the storage system of the White river development. 3. This is the third and newest penstock, eight feet in diameter at the top and six and one-half feet at the bottom. It takes the water from a circular, concrete lined forebay 3,000 feet west of the first forebay shown in view No. 6. This view is looking upward from the center. 4. The same penstock looking upward from the lowest point. 5. The intake and first forebay. The lake is at the farther end of the canal in the middle distance. In the bottom of this canal is a sunken closed flume weighted down with rocks. No earth slide can block the canal and stop the flow of water from the main storage basin to the deep forebay and intake in the foreground. The water is fifty feet deep at this intake. 6. This is a part of Lake Tapps. This lake was formed in a large depression in the glacial moraine, which made the development of this power project possible. The surface of this lake is some 460 feet above the level of the valley in which the power plant is located.

ways, power and light plants in Seattle, Tacoma, Everett and Bellingham, as well as three interurban lines, furnishing service to some 132 cities, towns and villages along the routes of its 551 miles of high tension transmission lines from Olympia on the south to Bellingham on the north.

The water in the White River development is taken from a forebay in Lake Tapps through a concrete lined tunnel 12 ft. in diameter and 3000 ft. long. At the west end of this tunnel is a second forebay, circular, 30 ft. in diameter and 75 ft. deep. This serves as an equalizing reservoir. At this point it enters the penstocks, which are 8 ft. in diameter at the top and 6½ ft. at the bottom, where they enter the power house. At this time the three penstocks serving the three units have a carrying capacity of 1500 cu. ft. per second, which is about one-half of the ultimate flow. They develop 65,000 h. p., so the complete development will be about 130,000 h. p.

The power variation at this plant is sometimes severe on account of the excessive and rapid changes in the power requirements of the Puget Sound Traction, Light & Power Company's freight trains operating on lines furnished with current from this power station. Hydraulic equipment capable of controlling these changes was therefore necessary if the plant was to utilize all of the energy brought to it by the mountain streams. The equipment for this purpose is shown in the accompanying illustrations.

The equalizing reservoir, the vent-pipes at the point where the penstocks first bend downward, and the air cushions at the bottom, are three devices used to take up changes in pressure. The air cushions are in pairs on each side of each penstock. They are 7 ft. in diameter, 75 ft. high, closed at the top, and are filled with compressed air which by its elasticity gives an almost perfect control of pressure variations.

The third unit of the White River plant was installed during last spring to take care of the electrification of the Chicago, Milwaukee & St. Paul Railway and to provide a larger power surplus for Seattle and Tacoma industries. The current will be taken on the high tension lines at 65,000 volts and carried to Snoqualmie where it is to be stepped up to 100,000 volts and delivered under the Milwaukee Railway contract to the high tension side of the transformers. Leaving this it becomes direct current, 3000 volts, and is ready for the motors of the Milwaukee electric locomotives.

S. L. Shuffleton, of Stone & Webster, engineer in charge, spent more than ten years on the initial development, so long and tedious was the preliminary work and litigation connected with this giant task.

The president recently announced that a school for foreign service to train young men for the work of carrying American trade to foreign lands would be established at Georgetown University.

SKIP-STOP PROVES A SAFETY MEASURE

Definite proof from carefully kept records by the Detroit United Railway is here presented to show that the skip-stop is an accident-preventing measure rather than a means of increasing accidents as has been claimed. This is probably the first careful analysis of the skip-stop from the anti-accident standpoint. The data has been compiled by Robert B. Rifenberick, consulting engineer under the direction of Mr. E. J. Burdick, assistant general manager of the Detroit United Railway.

The basis of the analysis is the record of the monthly accident reports of the claim department which tabulates accidents under the following sub-heads:

1—Collisions of cars.

2—Derailments.

3—Running into open switch points.

4—Running over street and steam railroad crossings.

5—Passengers hurt in boarding and alighting.

6—Passengers hurt otherwise.

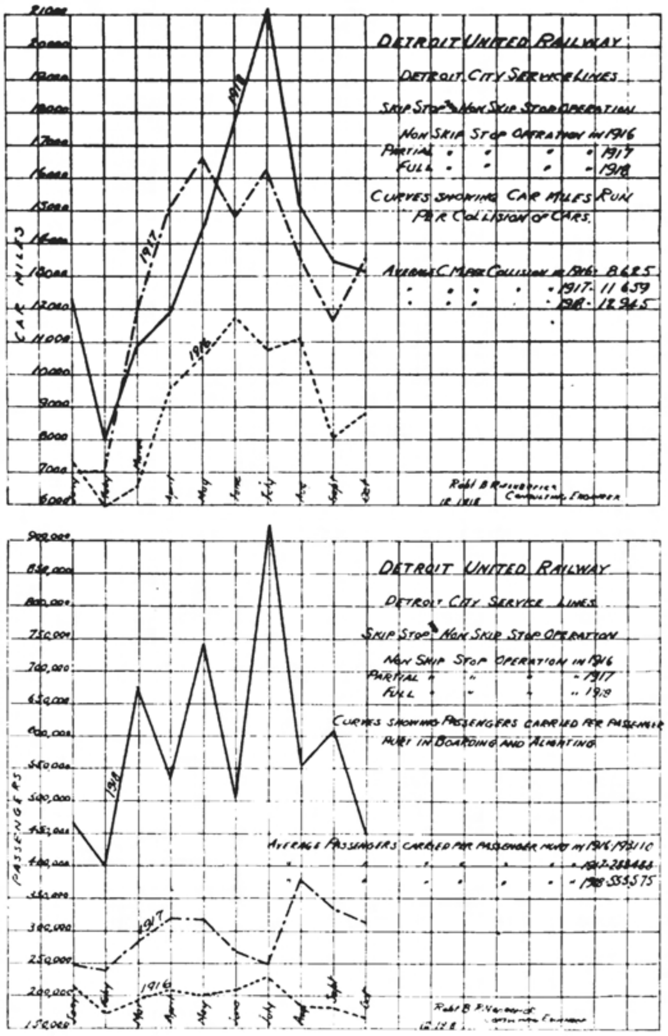


Fig. 1. Diagram Showing Reduction in the Hazard of Collisions and Boarding and Alighting with Skip-Stop Operation

7—Vehicles struck (including animals and excepting autos).

8—Automobiles struck.