



Seattle Electric Company

A description of the
system of generation
and distribution.

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partment of Electri-
cal Engineering of the
Seattle Electric Co.

The
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INTRODUCTION

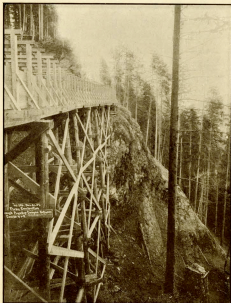
IN presenting this pamphlet the Seattle Electric Company has sought to embody features of technical interest in connection with the generation and distribution of its power. The attempt has been made to present the following matter in as concise a manner as possible and the officers of the Seattle Electric Company will be pleased to supplement the information contained in these pages upon specific inquiry.

The Seattle Electric Company takes this opportunity to express the wish that the deliberations of the technical bodies to whom this small work is dedicated will be attended with the highest measure of success.

SEATTLE, WASHINGTON, 1909.

Generation and Distribution

The Seattle Electric Company operates the street railway system of Seattle, has an Edison three-wire lighting system extending over the business district, and does a general A. C. lighting and two-phase power business throughout the entire city. It sells power to the Puget Sound Electric Railway for the operation



VIEW OF FLUME IN PUYALLUP CANON.

of the street railway system of Tacoma and of its interurban system between Seattle, Tacoma and the intermediate towns, and also to the Seattle-Everett Interurban Railway.

The larger part of the power demand is supplied by a hydroelectric development of 14,000 K. W. on the Puyallup river, at the base of Mt. Rainier, about 45 miles from Seattle. This plant is relayed by a Curtis steam turbine plant of 11,000 K. W. at Georgetown in the suburbs of Seattle, and a 3,200 K. W. reciprocating engine plant at Post and Columbia Streets.

The Puyallup Plant

The water power plant at Electron has an effective head of 875 feet and is typical of the high-head developments of the Pacific Northwest. The flow is diverted from the upper Puyallup river into a 6'x8' wooden flume line and carried eleven miles along the valley, with a drop of seven feet to the mile, to a reservoir site directly above the power house. The present development is of 14,000 K. W. rated capacity, and consists of four General Electric 3,500 K. W., 2,200 volt, three-phase revolving field generators, each direct connected to Pelton impulse water wheels of 7,500 maximum H. P. rating. Each unit is controlled by an oil-operated Lombard governor.

Power is stepped up to 55,000 volts for transmission, in three banks of transformers, each consisting of three General Electric 2,333 K. W. 2200/55000 volt transformers in delta.

There are duplicate transmission lines running from Electron twenty-two miles to a switching station at Bluffs, on the line of the Puget Sound Electric Railway. From Bluffs lines run nine miles West to Tacoma and twenty-five miles North to Seattle. There is also a



FLUME NEAR HEADWORKS.

55,000 volt line between Seattle and Tacoma along the line of the interurban railway, so that the entire high-tension transmission system is in duplicate. The main transmission line from Electron to Seattle is of 4/0 semi-hard drawn stranded cable, spaced seventy-two inches between wires and transposed one-third of a turn every four miles. The minimum height of poles is forty-five feet; the standard spacing between poles being 125 feet on tangents and ninety to 100 feet on curves.

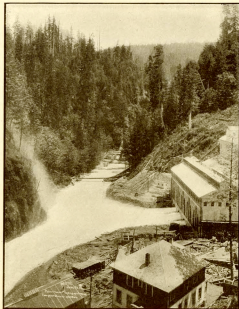
The Georgetown Turbine Plant

This is a Curtis steam-turbine plant of 11,000 K. W. capacity, completed in 1907 and used in conjunction with the reciprocating engine plant at Post Street as an auxiliary to the Electron supply.

There are two 13,800 volt, three-phase units, one of 8,000 K. W. and one of 3,000 K. W. capacity, supplied by fourteen 500 H. P. Sterling water-tube boilers. Steam is supplied at 180 pounds pressure and 100 degrees superheat. California crude oil is used as fuel. The power station building is of reinforced concrete con-



GENERAL VIEW OF ELECTRON POWER-HOUSE, PENSTOCKS, ETC.



VIEW OF ELECTRON POWER-HOUSE, SHOWING TAIL RACE, ETC.

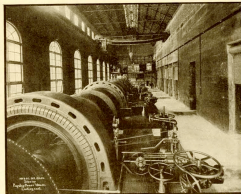
struction, so designed that additional units may be added from time to time as desired.

The Post Street Reciprocating Engine Plant

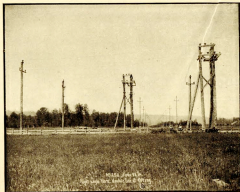
The Post Street Plant is especially valuable as a relay to the Edison lighting system, which serves the

large retail stores and offices and requires every assurance of continuous service.

The generating equipment consists of two 1,600 K. W. Westinghouse 2,200 volt two-phase alternators of the revolving field type, each direct connected to a pair of vertical, tandem compound McIntosh-Seymour engines of 2,500 H. P. capacity. This plant also supplies a steam heating system extending throughout the hotel and business district. It is the practice to carry sufficient load on the engines at all times so that the exhaust will supply the steam heat demand. This keeps the engines in condition to be instantly put on the load in case of emergency and in addition, supplies a considerable amount of power at very low cost.



INTERIOR VIEW OF ELECTRON POWER HOUSE.



RIGHT-ANGLE TURN OF ELECTRON SIXTY-THOUSAND VOLT
TRANSMISSION LINE.

The S. E. Co. Distributing System

The general scheme of the system of distribution is clearly shown in the attached diagram. The three-phase power at 55,000 volts is transmitted from the Puyallup Plant to a receiving station of 10,000 K. W. transformer capacity, located in the manufacturing district on Massachusetts Street near First Avenue South.

It is reduced for distribution to the down-town Post Street and Union Street Stations, to 2,200 volts, two-phase in a bank of two 2,000 K. W. Scott connected transformers.

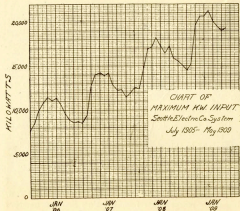
A bank of three 2,000 K. W. Transformers in delta is used to reduce the high tension power to 13,800 volts, three-phase, at which voltage it is distributed over an

extensive system of 13,800 volt tie lines to six substations throughout the outlying residence and manufacturing districts. The 2,200 volt, two-phase system is connected in parallel with the two 1,600 K. W. generators at Post Street and the Georgetown turbine plant feeds directly into the 13,000 volt, three-phase system. The two systems are tied together by a 2,200 volt, two-phase line running from Post Street to four 1,000 K. W. 2,200V/13,800V transformers in James Street Station in two banks.

Direct current is supplied the business district over an underground Edison 250 volt, three-wire system. There are in this service five 500 K. W. Westinghouse rotary converters at Post Street and two General Electric 500 K. W. motor-generator sets in a new Edison Sub-station on Union Street in the northern part of the district. All of this equipment receives 2,200 volt, two-phase power either from the Post Street generators or over the tie lines from Massachusetts Street or James Street.

The residence sections of the City are supplied with alternating current at 117 volts over a 117V/2,200V distributing system. There is also a 2,200 volt, two-phase power system and a 500 volt D. C. power system extending along the water front and throughout the wholesale and manufacturing districts.

The railway system is supplied in the down-town section by 2,500 K. W. in rotary converter capacity at Post Street. The outlying sub-stations are equipped with General Electric motor-generator sets consisting of 13,800 volt, three-phase synchronous motors, direct connected to 600 volt D. C. generators, except in the case of four 300 K. W. machines driven by 2,200 volt, two-phase motors. The railway system has a total motor-generator capacity of 12,700 K. W.



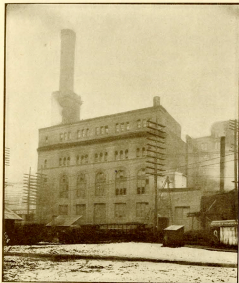
Above is shown a chart of the maximum load by months on the Seattle Electric Company system for the past four years. These loads show an average yearly increase of about 25% for each month over the corresponding month of the previous year.

Below is listed the power apparatus in each of the Company's stations:

New Post Street Station

- 2—1600 KW. Westinghouse 2,200 volt, two-phase engine driven alternators.
- 5— 500 KW. Westinghouse 500 volt, three-phase rotary converters for railway service.
- 5— 500 KW. Westinghouse 250 volt, three-wire, two-phase rotary converters for Edison lighting service.
- 1—1360 K. W. 250 volt storage battery on Edison lighting service.

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EXTERIOR OF POST STREET POWER HOUSE, SEATTLE.

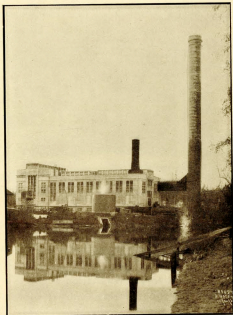
- 1— 35 KW. Battery booster.
- 1— 35 KW. Steam driven exciter.

Georgetown Station

- 1—8000 KW. 13,800V, three-phase Curtis Vertical Steam Turbine.
- 1—3000 KW. 13,800V, three-phase Curtis Vertical Steam Turbine.

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- 2— 500 KW. General Electric synchronous motor-generator, sets 13,200 volts three-phase A. C., 600 volts D. C.
- 2— 500 KW. G. E. Oil-insulated, water-cooled transformers 13,200 volts three-phase to 2,200 volts two-phase for lighting and two-phase power.



EXTERIOR OF TURBINE PLANT, GEORGETOWN.

- 2— 100 KW. G. E. transformers, 13,200 volts three-phase, 2,200 volts two-phase used for station lighting and power.
- 1— 30 KW. G. E. tub transformer for arc lighting.

Massachusetts Street Sub-Station

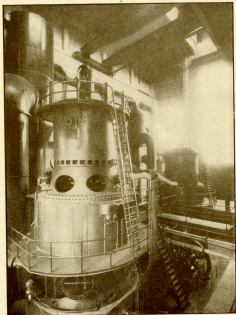
- 2—2000 KW. Oil-insulated, water-cooled step-down transformers, G. E. 50,000/2,200V, for local lighting and power and transmission over the 2,200V two-phase system.
- 3—2000 KW. Oil-insulated, water-cooled step-down transformers, 50,000/13,800 volts for 13,800 volt distributing system.
- 1—2000 KW. Oil-insulated, water-cooled G. E. step-down transformer, 50,000/13,800 volts, or 2,200 volts, used as reserve unit.

James Street Station

- 3— 500 KW. G. E. synchronous motor-generator sets, 13,200 volts three-phase A. C., 600 volts D. C.
- 1—1000 KW. G. E. synchronous motor-generator set, 13,200 volts three-phase A. C., 600 volts D. C.
- 4—1000 KW. G. E. air blast transformers in two banks, 13,200 volts three-phase to 2,200 volts two-phase, used for local A. C. lighting and transmission to Post St. over 2,200 volt tie line.
- 3— 150 KW. G. E. 600 volt Edison bipolar generators, used as motors to drive James Street cable.

Fremont Sub-Station

- 1—1000 KW. G. E. synchronous motor-generator set, 13,200 volts three-phase A. C., 600 volts D. C.



INTERIOR

- 1— 500 KW. G. E. synchronous motor-generator set, 13,200 volts three-phase A. C., 600 volts D. C.
- 1— 300 KW. G. E. synchronous motor-generator set, 2,200 volts two-phase A. C., 600 volts D. C.

- 1— 300 KW. G. E. induction motor-generator set, 2,200 volts two-phase A. C., 600 volts D. C.
- 2—1000 KW. G. E. air blast transformers, Scott connected, 13,800 volts three-phase to 2,200 volts two-phase.
- 1—1000 KW. Spare air blast transformer, 13,800 volts three-phase to 2,200 volts two-phase, for railway motor-generator sets, two-phase power and A. C. lighting.
- 2— 30 KW. G. E. tub transformers for arc lighting

North Seattle Sub-Station

- 2—1000 KW. G. E. synchronous motor-generator sets, 13,200 volts three-phase A. C., 600 volts D. C.

West Seattle Sub-Station

- 2— 300 KW. G. E. induction motor-generator sets, 2,200 volts, two-phase A. C., 600 volts D. C.
- 2— 500 KW. Air blast G. E. transformers, 13,800 volts, three-phase to 2,200 volts, two phase.

A-Y-P Sub-Station

- 2—100 KW. G. E. synchronous motor-generator sets, 13,200 volts three-phase A. C., 600 volts D. C.
- 4—1000 KW. G. E. transformers in two banks, 13,800 volts, three-phase to 2,200 volts, two-phase. Used for Fair lighting, power, etc.

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