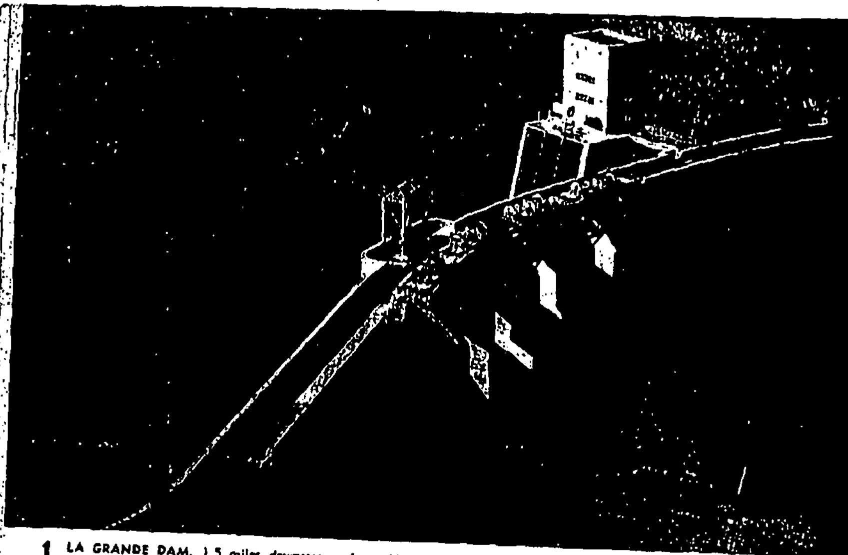

1 LA GRANDE DAM, 1.5 miles *downstream from Alder* is essentially a diversion for La Grande tunnel. Height, 215 ft; *crest length, 500 ft; base thickness, 165 ft. Assuming 25-ft* operating range, dam forms 1060-acre-ft regulating *reservoir.*

2 ALDER DAM and powerhouse form largest single unit in Nisqually No. 2 development. The dam, a variable-radius concrete structure, 330 ft high, 1500 ft long, 120 ft thick at *base, forms* a storage reservoir of 210,000 acre-ft capacity

Redeveloping Old Hydro Project Ups Output From 150 to 500 Million Kwhr

When Tacoma, Wash. needed more power it redeveloped its site on Nisqually River by installing 90,000-kw more capacity in two plants and adding water storage that more than tripled kwhr generation. Units connect direct to stepup transformers

▶ DURING THE 54 YEARS that Tacoma, Wash. has operated its electric power system, the capacity has grown to 238,000 kw. Of this amount, 204,000 kw are in four hydroelectric plants, and 34,000 kw in two steam plants, the latter being held in cold emergency reserve. Latest additions *are the* 40,000-kw La Grande and 50,000-kw Alder *plants, which* are jointly known as Nisqually No. 2 power development. The *last* generator was placed in operation May 5, 1947.

Tacoma's Hydro System. Before con*sidering this* project, here's a general picture of the city's hydro system and how it ties into the Northwest power network. Tacoma *is fortunately* located in regard to hydroelectric power. *All four of its* plants have been devel*oped within* a *radius* of 35 miles from the center of load, which is one reason *why the city enjoys the lowest power* rates in the U. S.

This system ties into the Northwestern power pool that includes eleven of the largest private, municipal and federal government utilities *in the* five Northwestern states of Washington, Oregon, Idaho, Montana and Utah. When the generating equipment on order for this pool is installed it will have a capacity of nearly 5,000,000 kw. Surplus energy of one system is made available for sale to the others, thus reducing the use of high-cost power from fuel-burning plants.

At various times, because of insufficient hydroelectric capacity, the city has purchased power for part of its *load, which has had a continuous* growth, averaging 10% per year. Cost *of power bought from other utilities is* higher than that produced by the city's own plants. Purchase is economical up to a *given point, however,* because of the savings in investment and operating costs.

Because of continued demands for low-cost power, engineering recommendations made in 1938 favored expansion of the city's hydroelectric capacity. Studies of several sites culminated *in the selection and development* of what is now known as Nisqually No. 2 power development. Contracts were let for the construction of this project in April and June 1942, but because of the war the first generator did *not go* into service until late in 1945; construc*tion was completed* in April 1947. This addition makes the capacity practic*ally sufficient* to supply the city's load of 900 *million kwhr per year.*

The site of the new development is that of the old 24,000-kw La Grande plant built in 1912, 30 miles southeast of Tacoma. This plant has four 6000-kw *horizontal-shaft units driven by* 8000-hp francis turbines operating under a 415-ft head. Redeveloping this site changes La Grande from a stream-flow to a storage plant and increases its output, including that of the Alder units, from 150 kwhr to 500 million kwhr per year.

Alder Dam. As shown in Fig. 3A. old La Grande development included a low diversion *dam* and intake about two miles up river from the power plant. The *dam diverted water into a* 2-mile tunnel and pipeline leading to a regulating reservoir. From *this reservoir* four penstocks, led to an equal number of main generating units in the power plant and one *penstock* served the two service units, Fig. 3C.

In the new development, Fig. 3A and B, Alder Dam floods out the old La Grande diversion dam and forms a reservoir of 210,000 acre-ft storage capacity, of which 158,300 are usable on 86-ft drawdown. Maximum normal reservoir elevation is 1200 ft with extreme design flood level at 1207.

This dam, *the largest single unit* in the project, is a variable-radius structure containing 420,000 cu yd of concrete. It is 330 ft high, 1500 ft long, 120 ft thick at its base, and 15 ft thick at *the top.* Here there is an 11-ft road and walkway. *An overflow* spillway with four tainter gates, each 32 ft long by 23 ft high, provides flood protection. Rated 75,000 cfs, the spillway has a capacity equal to three times maximum recorded flood.

Alder powerhouse, immediately downstream from the dam, Fig. 2, *3B* and 4, has two Pelton 34,500-hp francis, vertical-shaft turbines designed for a *178- to 273-ft head range.* Each connects to the upstream face of the dam, at center-line elevation 985, by a 10-ft-diameter steel penstock. A 6.5-ft river outlet pipe with its upstream center line at elevation 972.5 also *passes* through the dam near its base, Fig. 4. Discharge from this pipe is controlled by a regulating valve below the downstream face of the powerhouse. Penstocks and outlet pipe are *protected by emergency* bulkhead gates and trash racks at the dam's upstream face and each turbine's scroll case connects to its penstock by a 10-ft butterfly valve.

La Grande Dam. Downstream 1.5 miles from *Alder, La Grande Dam,* Fig. 1 and *3A,* is *essentially a diversion* for La Grande tunnel. It forms a regulating reservoir of 1060 acre-ft *capacity,* assuming 25-ft operating range. This dam, 215 ft high with *500-ft crest length* is 164 ft thick at its base, 12 ft at its crest and contains 85,000 cu yd of concrete. Of gravity design, the dam curves slightly at its top to converge the water *flowing* over the spillway so it won't slop over the training walls. Located *in the dam's* center portion, the spillway is controlled by four tainter gates also of *75,000-cfs capacity.*

A 14.5-ft concrete-lined tunnel, 6500 ft long, leads from *above* the dam to the new powerhouse that forms an extension to the old one, Fig. 3A and B. Trash *racks* operated with traveling hoists protect the *tunnel's entrance, and* caterpillar gates regulate water flow into it.

Near the lower end of the tunnel a steel-lined 14.5-ft surge shaft rises 280 *ft vertically* to a plate-steel *differential* surge tank, 40 ft in diameter and 113.5 *ft high.* This *tank* is sunk for half its height into the bluff's top, 400 ft above