SURFACE WATER REGISTRATION CHECKLIST

(received after July 18, 1990)

CHECK BASIN MAP JC NAME Lower Williamson # 2C UNADJUDICATED AREA ? YES

RECEIPT # 95631-95632-95633 S W R NUMBER 385

CHECK ENCLOSURES WEX PRELIMINARY DATA BASE ENTRY DWR

ACKNOWLEDGEMENT LETTER WEX ENTER ON STREAM INDEX _____

CHECK QUADRANGLE MAP _____ CHECK GLO PLATS _____

WATERMASTER CHECKLIST _____ PUBLIC NOTICE PUBLICATION 7-28

FORM REVIEW

_____ blanks filled in
_____ signed
_____ date received stamped

MAP REVIEW

✓ source and trib
✓ diversion point location
✓ conveyances (pipes, ditch, etc.)
✓ place of use
✓ scale
✓ township, range, section
✓ north arrow
✓ CWRE stamp
✓ disclaimer
✓ date survey was performed
✓ P.O.B. of survey
✓ dimensions and capacity of diversion system
✓ "beneficial use" type title
✓ "permanent-quality" paper

WATER RIGHT RECORD CHECK _____ FIELD INSPECTION _____

FINAL FILE REVIEW _____ FINAL DATA BASE ENTRY _____

ENTER ON PLAT CARDS _____

C:\WP51\SWR\CHCKLIST.1

7-30-92

SWR #	POWER CLAIM #
384/385	PC 25
386	PC 116
387	PC 122
388	PC 24
389	PC 117

THE NORTHWEST

PGE's Willamette water rights cause worries

■ The electric utility's assertion of century-old claims has cities which drink from the river concerned about their future supply

The Associated Press

EUGENE — Portland General Electric Co. is legally asserting century-old rights to Willamette River water, a move that worries cities and utilities along the waterway.

PGE's claim threatens to override community water claims that were filed many years after PGE first began drawing water from the river in the late 1800s.

Officials at the Eugene Water & Electric Board and at the city of Corvallis are among those concerned that, in times of low water, municipalities might be forced to pay PGE for their drinking water.

"They could tell us, 'We'll let you use it, but you've got to reimburse us,' " said Kimber Johnson, manager of water planning for EWEB, which draws Eugene's drinking water supply from the McKenzie River, a Willamette tributary.

Under Oregon law, water rights extend not only to the main river, but to all upstream tributaries, Johnson said.

"The way the law reads, they could call for that water any time they wanted," he said.

Corvallis Public Works Director Rolland Baxter expressed concerns similar to Johnson's.

"If, through the courts or through legislation, PGE is able to establish their water rights, it could dramatically increase the cost of using Willamette River water," Baxter said. "The word going around is, they would offer to sell us the water back."

Such fears are exaggerated, PGE spokeswoman Roxanne Bailey said.

"We're not in the business of selling water," Bailey said.

But Bailey acknowledged that, as population in the Willamette Valley grows, water in the Willamette could become a scarce and precious commodity. If PGE were forced to cut back power production, it might require upstream water users to start paying, she said.

"If we have to go elsewhere for power and purchase it at a higher price, there's a possibility of charging for water," Bailey said.

PGE filed papers with the state last fall claiming priority rights to 11,700 cubic feet per second of water to operate the Sullivan hydropower plant near Oregon City. The water flows through turbines near Willamette Falls, then is returned to the river.

At certain times of the year, 11,700 cfs represents all the water in the river, said Bob Hall, PGE governmental affairs representative.

If the river flow falls below that number, PGE might be entitled to call for restrictions on upriver use of the water.

Hall said PGE filed the claim only because it was required to do so by the 1987 Legislature. The Legislature said anyone or any corporation with water rights established before 1909 had to register their claim by last December or risk losing their rights.

The idea was to straighten out a complex network of water rights extending back before the turn of the century.

PGE's claim rests on the principle that water users are granted access to public waterways based on a first come, first-served basis.

However, water priorities can change through the adjudication process, said Lorna Stickel, chairwoman of the state Water Resources Commission, which issues water rights.

"It has the potential to reorganize or reprioritize how water might be called upon in the Willamette," Stickel said. Some uses, such as municipal drinking water supplies, could be granted a higher priority.

"Whether or not a hydropower plant has the ability to make a call on water like that I think is a big question," Stickel said.

PGE's claims do appear to be valid, however, she said, adding that such cities as Eugene and Corvallis "are right to be concerned about it."

Child-care a problem at night

■ For growing ranks of parents who work odd hours a safe, affordable service is hard to find

FORUM

OPINION & COMMENTARY

PGE water claims raise alarm

Water districts fear old rights may curtail their use of rivers

By ERIC GORANSON

Metropolitan Portland and Willamette Valley residents sometime in the future could wind up paying their water bills — along with their electric bills — to Portland General Electric Co.

That's the fear of dozens of water suppliers, stemming from PGE, Smurfit Newsprint Corp. and others reaffirming late last year their water rights on the Willamette, Sandy, Little Sandy and Clackamas rivers.

Their claims are among 3,900 water-rights applications pending before the Oregon Water Resources Department as water threatens to surpass the spotted owl and salmon as a political football.

Had the applicants not refiled, they face the loss of water rights that predate 1909 and are senior to the claims by most municipal water suppliers.

If PGE's claims are endorsed by the Oregon Water Resources Department, as expected, it would be treated presumptively as vested rights. PGE and the others would have the state enforce these rights against the holders of junior upstream rights.

The endorsements also could remove the Willamette River from any further appropriation during low flows.

There are only about 1,600 cubic-feet-per-second of water left to appropriate on a year-round basis in the Willamette near Wilsonville, said the Water Resources Department. But this does not include PGE's and other pre-1909 claims at Willamette Falls.

The Willamette is one of the major sources being studied to fill future municipal needs of Portland's 720,000 customers and other suppliers.

PGE officials say that water suppliers and customers need not worry.

"We're not about to be a water seller, selling water for premium prices," said Roxanne Bailey, a PGE spokeswoman.

The Portland company needs water for its Willamette Falls hydropower plant. It's a nonconsumptive use, but any drop in revenues from not having water to make electricity will have to be made up by the cities and customers benefiting from PGE's power cutback.

The utility says it won't turn off the tap for water users but probably would charge suppliers for any water the utility have to forgo to meet municipal needs.

End-water users would pay their customary purveyors; they, in turn, would pay PGE. But the next step, some water suppliers fear, would be for PGE to become a regulated water supplier in their place.

The water suppliers have united and introduced Senate Bill 1062, which would subordinate PGE's rights to those of the public.

Among those requesting the bill are water districts in Sandy, Estacada, Gladstone, Lake Oswego, Milwaukie, Molalla, Oregon City, Tualatin and the Damascus, Clairmont, Clackamas, Mount Scott, Oak Lodge, South Fork, Tigard and Tualatin Valley.

Portland is not included.

"We don't think PGE ought to get all the river water," said Dennis Klingbile, superintendent of the Damascus Water District, which uses only well water. "The way things are going, we may wind up using surface water, and PGE shouldn't have all the water just because its rights predate 1909."

The PGE claim is the biggest. On the Willamette its rights total 11,700 cfs, thus affecting almost all water users on the river's main stem plus its tributaries above Willamette Falls.

These tributaries include the Molalla, Tualatin, Yamhill, Santiam, Marys and McKenzie rivers.

Cities affected include Eugene, Corvallis, Cottage Grove, Creswell, Salem, Stayton, Albany, Philomath, Independence, Junction City, Newberg, Molalla, Monmouth and Forest Grove, plus the Tualatin Valley and Clairmont water districts.

Affected by PGE's filing for 4,600 cfs on the Clackamas River are West Linn, Estacada, Oregon City and Clairmont Water District. Affected by the Sandy River system filings for 1,600 cfs are Sandy, Portland and Hoodland corridor.

Another bill, HB2110, in effect would give water combatants and the state breathing time to work out a settlement and avoid litigation.

Both PGE and water suppliers hope the House bill will head off a repeat of the current 16-year litigation over water rights on the Klamath River.

Suppliers also want Congress to change Army Corps of Engineers policies regarding stored water behind dams that feed the Willamette. Almost all of the 1.9 million acre-feet of water is allocated for navigation, irrigation, hydro and flood-control uses.

To use that water, irrigators pay $1.50 an acre-foot, municipalities from $300 to in excess of $1,500 an acre-foot. Talks to change the allocations and charges have taken place in Washington, D.C.

Not everyone opposes the idea of having PGE as a water purveyor. One Portland Water Bureau official said it "might not be a bad idea." He said getting water from the utility might be cheaper than tapping sources such as the Cascade reservoirs.

The efficiency of a private company providing water probably would be greater than Portland or a regional water authority. Having PGE meter readers record water and power uses on the same visit would save time and labor. The Oregon Public Utility Commission could control water rates as it does phone and power rates.

Having a utility sell power and water is not unique. The Eugene Water & Electric Board does both.

What will happen is as uncertain as the weather that supplies our water. Whether the disputing sides can settle without litigation rests with the Legislature. We need both power and water. Hopefully the lawmakers can broker a peaceful compromise.

Eric Goranson is a staff writer in The Oregonian's East Metro bureau.

RICHARD MILLHOLLAND/Los Angeles Times

High court demands judges, not lobbyists

By ANTHONY LEWIS

In the weeks since Justice Byron White's decision to retire from the Supreme Court, the press has run various stories about whom President Clinton may appoint in his place.

The speculation has proved little about the choice, but it has done one depressing thing: shown how narrowly politicized some people want the process of selection to be.

LEWIS

One story mentions a possible nominee and then says that some interest group is likely to object to him or her. Why? Because the person has strayed, however slightly, from the party line of that group.

An example to hand is Judge Ruth Bader Ginsburg of the U.S. Court of Appeals for the District of Columbia. When her name was mentioned as a Supreme Court possibility, she was said to have angered some women's groups by what she said about the 1973 abortion decision, Roe vs. Wade, in a recent speech.

Judge Ginsburg gave the James Madison Lecture at New York University Law School in March. She used the occasion to explore how appellate judges can best do their work and how they should function as one of the three branches of government in our constitutional system.

She emphasized, first, the need for collegiality — for mutual respect — on a court of many judges. "One must be sensitive," she said, "to the sensibilities and mind-sets of one's colleagues."

Kurds working toward self-reliance may set example

Oregon

WATER
RESOURCES
DEPARTMENT

March 22, 1993

JULIE KEIL C/0
PORTLAND GENERAL ELECTRIC COMPANY
121 SW SALMON STREET
PORTLAND OR 97204

Dear MS KEIL,

This will acknowledge that your Surface Water Registration Statement in the name of PORTLAND GENERAL ELECTRIC COMPANY, SIMPSON PAPER COMPANY, SMURFIT NEWSPRINT CORPORATION has been received by our office. The fees in the amount of $14,641.50, 2875.00, 2950.00 have been received and our receipt #95631, 95632, 95633 were given to you. Your registration statement has been numbered SWR-385.

Our office will review your form and map in the near future. If necessary we will schedule a meeting with you that will include a site inspection. If there are problems with your form we are usually able to take care of them during our visit. We will be able to answer any questions you might have about the adjudication process at that time.

Please feel free to contact this office if you have any questions.

Sincerely,

Don Knauer
Adjudication Specialist

Enclosure

M:\WP51\SWR\CLAIMANT\SWR-0385.001

3850 Portland Rd NE
Salem, OR 97310
(503) 378-3739
FAX (503) 378-8130

Attorney wary of PGE's water rights

By MIKE LUCAS
Of The Pioneer

Portland General Electric is getting ready to file for "considerable" water rights on the Molalla River, an act which City Attorney Tom Rastetter warns could require the city to curtail use in the future.

Rastetter told the Molalla City Council on Nov. 18 about PGE's intentions and explained that it might affect the city during low river flows.

But according to Roxanne Bailey, a PGE spokesperson, the company at this time has no intention of curtailing municipal water use.

"Just because we're filing for them doesn't mean we're going to change our practice," she said.

Bailey explained that to comply with state law, PGE is refiling for waters rights on the Willamette River the power company obtained prior to 1909.

"State Law requires that anyone who has water rights dated prior to 1909 that they haven't used has to refile for them," said Jack Dunn, Molalla public works director. "They have water rights on the Willamette River that date way back -- and Molalla is a tributary."

PGE's action could also affect other cities which are above the Willamette Falls, including Estacada, Canby, Wilsonville and Salem.

State law requires PGE to reapply for water rights within the year or risk losing them, Bailey said.

"We would be happy to discuss this the city, but right now we intend to file for those water rights to protect them," she said.

In the meantime, City Council, at Rastetter's request, asked the city attorney to prepare to defend Molalla's water rights if need be.

"Mainly, Tom will monitor what's going on between the Department of Water Resources,

See *WATER RIGHTS*, Page 3.

Molalla, OR
(Clackamas Co.)
Pioneer
(Cir. W. 2,500)

NOV 2 5 1992

WATER RIGHTS

Continued from Page 1.

PGE and the various municipalities," Dunn said, adding that Rastetter also provides legal services for the South Fork Water Board and Estacada, a city which relies on the Clackamas River -- another tributary of the Willamette -- as its water source.

Molalla currently has rights to 3 cubic feet of water per second from the Molalla River, but averages 1.75 cfs a day. PGE's rights would entitle the company to draw 8,000-10,000 cfs from the Willamette River, Dunn said.

The city's water rights on the Molalla River date to 1954, but since PGE's rights are older, the company would have priority over Molalla when the river was low.

To better protect Molalla, Dunn hopes the city can transfer water rights on Trout Creek -- which date back to 1914 -- to the Molalla River. It will be four years before that can happen, however, Dunn said.

"As I understand it, PGE has no intention of curtailing municipal water use," Dunn said. "If they do, they'll be cutting their throats, pure and simple."

"I guess what worries me is that although they say won't use that much water, PGE would be legally entitled to it if they wanted it," Rastetter said."

3-24-92

Summit - Simpson - PGE

Julie A. Keil

PROJECT MANAGER
HYDRO LICENSING

PGE

Portland General Electric
121 SW Salmon Street
Portland, Oregon 97204
503/464-8864
Fax: 503/464-2605

FOR M -

DWIGHT - NOTICE TO ODF&W ABOUT
FISH LADDER @ WILLAMETTE FALLS

NEED WILL DO A COVER LETTER

Simpson

CONTACT: JUNE

Jeanne M. Verville
Corporate Attorney

Simpson

Duane Pearson
General Manager,
Real Estate

Simpson

Carol Hyams Guthrie
Assistant Director of Energy

Simpson Paper Comp

GAIL L. ACHTERMAN
(503) 294-9123

STOEL RIVES BOLEY
JONES & GREY
ATTORNEYS AT LAW

900 SW FIFTH AVENUE
PORTLAND, OREGON 97204-1268
TELECOPIER (503) 220-2480

WILLIAM H. HOLMES
(503) 294-9207

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JONES & GREY
ATTORNEYS AT LAW

900 SW FIFTH AVENUE
PORTLAND, OREGON 97204-1268
TELECOPIER (503) 220-2480

Simpson

RICHARD M. GLICK

DAVIS WRIGHT TREMAINE
LAWYERS
2300 FIRST INTERSTATE TOWER • 1300 S.W. FIFTH AVENUE • PORTLAND, OR 97201
(503) 241-2300 • FAX: (503) 778-5299 • TELEX: 185224
ANCHORAGE • BELLEVUE • LOS ANGELES
RICHLAND • SEATTLE • WASHINGTON, D.C.

DOX

M E M O R A N D U M

July 29, 1992

TO: Carol Hyams Guthrie
Jeanne Verville
Rod Schmall
Gary Hackett
Gail Achterman
Gary Margason

FROM: Julie Keil JK

RE: Meeting with Water Resources Department regarding Willamette Falls

Due to an unexpected scheduling conflict with personnel from the Water Resources Department, the meeting originally scheduled for August 18 must be rescheduled. August 24th appears to be the only date that is available that fits within the time frame we discussed at our last meeting. The meeting would be still be held on site at 9:00 am and would include a site tour. Please call either me (464-8864) or Marty May (464-7578) if this date is absolutely not possible.

c: Reed Marbut, Water Resources Department

-PGE-

Portland General Electric Company

July 22, 1992

Mr. Reed Marbut
Oregon State Water Resource Dept.
3850 Portland Road NE
Salem, Oregon 97310

Subject: Willamette Falls Water Rights

Dear Mr. Marbut,

This letter is sent to confirm a meetinc
between you and Gail Achterman regard:
Willamette Falls pre-1909 water rights
Tuesday, August 18, 1992, 9AM, in
"evergreen" conference room adjacent to
side. The meeting will include a walking
both sides of the river. Representativ
Electric Co., Smurfit Newsprint Co., and
in attendance.

If you have any questions please call me a
Keil at (503) 464-8864.

Dan 7/24
Dan working on
changing this to
8/24 or 8/25
Reed

Sincerely,

Gary Hackett
Branch Manager, Hydro Support

c. Julie Keil, PGE
Gary Margason, PGE
Gail Achterman, Stoel Rives Boley Jones & Grey
Carol Hyams Guthrie, Simpson Paper Co., San Francisco
Jeanne Verville, Simpson Paper Co., Seattle
Rod Schmall, Smurfit Newsprint Co.
Jerry Newville, Smurfit Newsprint Co.

SIMPSON PAPER

INTEROFFICE MEMORANDUM

Oregon Water Resources Department
Adjudication Section

TO: SWR Files

FROM: Don Knauer

DATE: February 25, 1992

SUBJECT: Simpson Paper - Willamette River- SWR claim

On this day Reed Marbut, Tom Paul, Rick Craiger and I, all from the WRD, met with two engineers from HDR Engineering, Lawrence Magura and Robert King. We met to talk about Simpson Papers possible claim to a vested water right at the Willamette Falls at Oregon City.

Reed explained the adjudication process and the registration statement program. There were questions and answers on this subject. I gave the engineers copies of the SWR form, instructions and mapping requirements. We talked about the requirements and how best to get the information to us. We suggested working closely together at the start of the Simpson research and claim preparation. Rick Craiger talked about power claims. There was discussion about vested water rights vs power claims. We suggested Simpson pursue the claim to a vested right. They said the diversion point was used by the Army Corp of Engineers and we talked about the possibility of federal reserved water rights. We suggested they contact the Corp and PGE to coordinate the claim process.

HDR

Lawrence M. Magura, PE

HDR Engineering, Inc.
Suite 300
Kruse Way Plaza
4500 S.W. Kruse Way
Lake Oswego, OR 97035-2564
(503) 635-9760
Fax: (503) 635-9764

HDR

Robert D. King, PE

HDR Engineering, Inc.
Suite 200, Building C
11225 S.E. Sixth Street
Bellevue, WA 98004-6441
(206) 453-1523
Fax: (206) 453-7107

(C:\W\S\SIMPSON.01)

-SIMPSON PAPER-

PGE

MEMORANDUM

TO: Oregon Water Utilities Council

FROM: Tualatin Valley Water District, Canby Utility Board, City of Gladstone, City of Lake Oswego, Clairmont Water District

DATE: November 9, 1991

RE: Pre-1909 Water Rights

The above municipal entities have filed applications for appropriation from the Willamette River above Willamette Falls at Oregon City/West Linn. The Water Resources Commission (WRC) is scheduled to hear the Canby Utility Board application on January 22, 1993. It is anticipated that the other municipalities above will follow thereafter although the Water Resources Department (WRD) has not set a schedule. Various objections have been received to Canby's application from Water Watch and others. We anticipate similar objections to the others.

In the process of preparing for Canby's hearing, Jack Hammond discovered that PGE is prepared to file an application with the Water Resources Department to establish a pre-1909 water right for 8,000 to 10,000 cfs at Willamette Falls. PGE's claims stem from their allegations that they have owned land on each side of the river since 1880 and, as a riparian owner, generated power from that period to the present as well as continuous lease of land and water for hydroelectric and process water uses to two pulp mills (Simpson and Smurfit) since 1887. They also anticipate a filing by

DON - 11/12
FYI & Read and save for possible future conversation w/ Reed
Dick

the Corps of Engineers for navigation purposes and ODF&W for fish passage.

As you know, in 1909 the legislature adopted our present system of prior appropriation (first in time, first in right) to the permit/certification process. ORS 539.010(1) allows any person or entity (including successors or assigns) to prove a pre-1909 vested right thereby having priority over a post-1909 appropriation, if they can show continuous use from the claim date. Abandonment for a continuous period of two years will cause loss of the right. OAR 690-28-005 et seq. provides the administrative process. PGE and others seeking pre-1909 rights have until December 31, 1992, to file these applications.

OAR 690-28-029 provides that upon receipt of a registration statement by WRD, the Department shall review and identify new or conflicting uses of water and those that may impacted by enforcement of the claim. If two or more persons are impacted by the registration then an informational public hearing may be scheduled to determine the extent of the problem. The Director shall than prepare a proposed order of registration for each registration detailing, among other things, the tentative priority date of the claimed use of water. Upon completion of the review the Director shall mail a copy of the proposed order to the registrant and if no hearing is requested the order will become final. Upon entry of the final order the registrant is prima facie entitled to appropriate the water to the extent and in the manner disclosed in the recorded registration. Thereafter, the

registration will be regulated as any other pending final adjudication of the river under ORS Chapter 539. The adjudication process is generally described:

ORS 539.030 provides the Water Resources Director shall give a notice to claimants to use of waters of the stream as to anticipated investigation of the stream.

ORS 539.040 and 539.070 provide for an administrative case hearing process to take testimony and regarding the rights of the various claimants. See OAR 690-28-060.

ORS 539.090. Upon completion of the taking of the testimony by the Water Resources Director, the parties shall be given a further opportunity to inspect evidence in anticipation of contesting claims of others.

ORS 539.100 and 539.110 provide for an administrative contested case hearing to determine claims. OAR 690-28-075.

ORS 539.130 provides that the Water Resources Director shall then make findings of fact and an order of determination establishing the rights to waters of the stream. That order shall be certified by the Director and filed with the clerk of the Circuit Court for subsequent Circuit Court review if requested by any aggrieved party. OAR 690-28-080.

Based upon the Robison study, Water Availability in Oregon Rivers and Streams: Volume II, it is clear PGE's claim will greatly exceed water available for appropriation. If allowed, PGE would jump ahead of all others having subsequent appropriation

dates and the Water Master would be in the position of regulating all users in favor of PGE.

Under OAR 690-28-040 each claim for registration statement shall be compared to all information submitted for consistency regarding settlement of the area and general development of projects. In stream flow requirements shall be based on hydrological estimates or gauging data that can be obtained for the particular stream reach. The Department is required to prepare an estimate of natural flows that would be available in the stream reach and the water availability estimate shall account for current usage. The Director is given power to require additional documentation of in stream flow requirements if the claim is greater than the estimated average natural flow or level for the stream reach. If the physical conditions of the waterway have changed the Department has the power to consult with other appropriate agencies or experts to determine natural flows necessary to maintain the primary purpose or purposes of the reservation.

Obviously, this has tremendous implications for <u>all</u> users of the entire Willamette River Basin:

(1) Water Resources could be obligated to assure sufficient water remains in the river to Willamette Falls to satisfy this nonconsumptive use.

(2) Established permits/certificates of municipal users may be displaced by the application and regulated (June to September), throwing a wrench in planning, design and construction

of facilities to meet current and future needs of individual municipalities as well as regional needs.

(3) Water Resources may adopt a position, and we anticipate Water Watch and other like groups may seek such a ruling, that all pending future applications be held in abeyance pending adjudication of PGE's claim or any other pre-1909 claim. We anticipate adjudicating PGE's claim alone could take many years.

Conclusion

We will monitor the situation and ask for a meeting with the Water Resources Director, Martha Pagel. Legislative action or administrative rule making may be necessary in the very near future to flesh out this process procedurally and substantively as well as to increase the priority of municipal rights in terms of appropriation, Water Resource Department imposed reserve capacity for anticipated growth by municipalities and preference in Water Resources' regulation during low flow periods.

Portland General Electric Company

INVOICE DATE	INVOICE NO.	VOUCHER	GROSS	DISCOUNT	NET
12/29/92	WILL FALLS	93863	14,641.50	.00	14,641.50
		TOTALS ▶	14,641.50	.00	14,641.50

RECEIVED
DEC 30 1992
WATER RESOURCES DEPT.
SALEM, OREGON

PLEASE DETACH BEFORE DEPOSITING.

STATE OF OREGON
WATER RESOURCES DEPARTMENT
3850 PORTLAND ROAD NE
SALEM, OR 97310
378-8455/378-8130 (FAX)

RECEIPT # 95631

RECEIVED OVER THE COUNTER

RECEIVED FROM: PGE
BY:

APPLICATION	
PERMIT	
TRANSFER	

CASH: ☐ CHECK: # ☒ 66-153 OTHER: (IDENTIFY) ☐ _____ TOTAL REC'D $ 14641.50

01-00-0 WRD MISC CASH ACCT

842.010	ADJUDICATIONS		$ 14641.50
831.087	PUBLICATIONS/MAPS		$
830.650	PARKING FEES Name/month		$
_____	OTHER: (IDENTIFY)		$

REDUCTION OF EXPENSE CASH ACCT. $

COST CENTER AND OBJECT CLASS VOUCHER #

03-00-0 WRD OPERATING ACCT

MISCELLANEOUS:

840.001	COPY FEES		$
850.200	RESEARCH FEES		$
880.109	MISC REVENUE: (IDENTIFY)		$
520.000	OTHER (P-6): (IDENTIFY)		$

WATER RIGHTS:

		EXAM FEE		RECORD FEE
842.001	SURFACE WATER	$	842.002	$
842.003	GROUND WATER	$	842.004	$
842.005	TRANSFER	$	842.006	$

WELL CONSTRUCTION

		EXAM FEE		LICENSE FEE
842.022	WELL DRILL CONSTRUCTOR	$	842.023	$
842.016	WELL DRILL OPERATOR	$	842.019	$
	LANDOWNER'S PERMIT		842.024	$

06-00-0 WELL CONST START FEE

842.013	WELL CONST START FEE	$	CARD #	
	MONITORING WELLS	$	CARD #	

45-00-0 LOTTERY PROCEEDS

864.000	LOTTERY PROCEEDS	$

07-00-0 HYDRO ACTIVITY LIC NUMBER

842.011	POWER LICENSE FEE(FW/WRD)		$
842.115	HYDRO LICENSE FEE(FW/WRD)		$
_____	HYDRO APPLICATION		$

RECEIPT # 95631 DATED: 12/30/92 BY: C. Engel

Distribution—White Copy-Customer, Yellow Copy-Fiscal, Blue Copy-File, Buff Copy-Fiscal

Portland General Electric Company

INVOICE DATE	INVOICE NO.	VOUCHER	GROSS	DISCOUNT	NET
12/29/92	SIMPSON PROCESS	93868	2,875.00	.00	2,875.00
		TOTALS ▶	2,875.00	.00	2,875.00

RECEIVED
DEC 30 1992
WATER RESOURCES DEPT.
SALEM, OREGON

PLEASE DETACH BEFORE DEPOSITING.

STATE OF OREGON
WATER RESOURCES DEPARTMENT
3850 PORTLAND ROAD NE
SALEM, OR 97310
378-8455/378-8130 (FAX)

RECEIPT # **95632**

RECEIVED
OVER THE COUNTER

RECEIVED FROM: PGE
BY:

APPLICATION	
PERMIT	
TRANSFER	

CASH: ☐ CHECK: # ☒ 66158 OTHER: (IDENTIFY) ☐

TOTAL REC'D $ 2875.00

01-00-0 WRD MISC CASH ACCT

842.010	ADJUDICATIONS		$ 2875.00
831.087	PUBLICATIONS/MAPS		$
830.650	PARKING FEES Name/month		$
_____	OTHER: (IDENTIFY)		$

REDUCTION OF EXPENSE CASH ACCT. $

COST CENTER AND OBJECT CLASS VOUCHER #

03-00-0 WRD OPERATING ACCT

MISCELLANEOUS:

840.001	COPY FEES		$
850.200	RESEARCH FEES		$
880.109	MISC REVENUE: (IDENTIFY)		$
520.000	OTHER (P-6): (IDENTIFY)		$

WATER RIGHTS:

		EXAM FEE		RECORD FEE
842.001	SURFACE WATER	$	842.002	$
842.003	GROUND WATER	$	842.004	$
842.005	TRANSFER	$	842.006	$

WELL CONSTRUCTION

		EXAM FEE		LICENSE FEE
842.022	WELL DRILL CONSTRUCTOR	$	842.023	$
842.016	WELL DRILL OPERATOR	$	842.019	$
	LANDOWNER'S PERMIT		842.024	$

06-00-0 WELL CONST START FEE

842.013	WELL CONST START FEE	$	CARD #	
	MONITORING WELLS	$	CARD #	

45-00-0 LOTTERY PROCEEDS

864.000	LOTTERY PROCEEDS	$

07-00-0 HYDRO ACTIVITY

		LIC NUMBER	
842.011	POWER LICENSE FEE(FW/WRD)		$
842.115	HYDRO LICENSE FEE(FW/WRD)		$
_____	HYDRO APPLICATION		$

RECEIPT # **95632** DATED: 12/30/92 BY: C. Engel

Distribution—White Copy-Customer, Yellow Copy-Fiscal, Blue Copy-File, Buff Copy-Fiscal

Portland General Electric Company

INVOICE DATE	INVOICE NO.	VOUCHER	GROSS	DISCOUNT	NET
12/29/92	SMURFIT PROCESS	93869	2,950.00	.00	2,950.00
		TOTALS ▶	2,950.00	.00	2,950.00

RECEIVED
DEC 30 1992
WATER RESOURCES DEPT.
SALEM, OREGON

PLEASE DETACH BEFORE DEPOSITING.

STATE OF OREGON
WATER RESOURCES DEPARTMENT
3850 PORTLAND ROAD NE
SALEM, OR 97310
378-8455/378-8130 (FAX)

RECEIPT # 95633

RECEIVED OVER THE COUNTER

RECEIVED FROM: PGE
BY:

APPLICATION	
PERMIT	
TRANSFER	

CASH: ☐ CHECK: # ☒ 66-153 ☐ OTHER: (IDENTIFY) _____ TOTAL REC'D $2950.00

01-00-0 WRD MISC CASH ACCT

842.010	ADJUDICATIONS		$2950.00
831.087	PUBLICATIONS/MAPS		$
830.650	PARKING FEES Name/month		$
_____	OTHER: (IDENTIFY)		$

REDUCTION OF EXPENSE CASH ACCT. $

COST CENTER AND OBJECT CLASS VOUCHER #

03-00-0 WRD OPERATING ACCT

MISCELLANEOUS:

840.001	COPY FEES		$
850.200	RESEARCH FEES		$
880.109	MISC REVENUE: (IDENTIFY)		$
520.000	OTHER (P-6): (IDENTIFY)		$

WATER RIGHTS:

		EXAM FEE		RECORD FEE
842.001	SURFACE WATER	$	842.002	$
842.003	GROUND WATER	$	842.004	$
842.005	TRANSFER	$	842.006	$

WELL CONSTRUCTION

		EXAM FEE		LICENSE FEE
842.022	WELL DRILL CONSTRUCTOR	$	842.023	$
842.016	WELL DRILL OPERATOR	$	842.019	$
	LANDOWNER'S PERMIT		842.024	$

06-00-0 WELL CONST START FEE

842.013	WELL CONST START FEE	$	CARD #	
	MONITORING WELLS	$	CARD #	

45-00-0 LOTTERY PROCEEDS

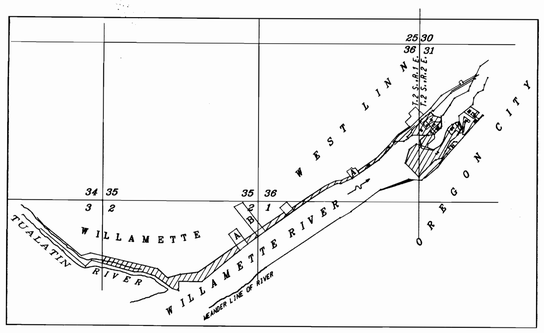
864.000	LOTTERY PROCEEDS	$

07-00-0 HYDRO ACTIVITY LIC NUMBER

842.011	POWER LICENSE FEE(FW/WRD)		$
842.115	HYDRO LICENSE FEE(FW/WRD)		$
_____	HYDRO APPLICATION		$

RECEIPT # 95633 DATED: 12/30/92 BY: C. Engel

Distribution—White Copy-Customer, Yellow Copy-Fiscal, Blue Copy-File, Buff Copy-Fiscal



25 30
36 31

N.624.624
E.1.455.331

PGE SULLIVAN HYDROELECTRIC POWER PLANT
12-1600 HP UNITS AND 1-1200 HP UNIT
13-9 FOOT DIAMETER PENSTOCKS

SECTION 36
T.2 S., R.1 E. W.M.
T.2 S., R.2 E. W.M.
SECTION 31

M.C.

U. S. GOVERNMENT CANAL

WEST LINN PAPER PROCESS WATER AND LOCKAGE DIVERSION
N.621.816
E.1.455.051

LOG POND
(ABANDONED)
BULKHEAD

EXISTING POINT OF DIVERSION FOR PGE SULLIVAN PLANT AND PROPOSED POINT OF DIVERSION FOR BLUE HERON PAPER CO. WATER RIGHTS TRANSFERRED TO PGE
SEE DETAIL 1, SHEET 2
N.622.012
E.1.455.376

LOG HAUL
P.G.E. HEADWALL

FOREBAY

FOREBAY

WEST LINN PAPER COMPANY
GRINDER ROOM 2

PORTLAND GENERAL ELECTRIC CO.
T.W. SULLIVAN HYDROELECTRIC PLANT

ENTRANCE NO.1

CONVEYOR-SUSPENSION BRIDGE ABANDONED

FOOT BRIDGE

ISLAND

FISHLADDER

GRINDER ROOM 1

TAILRACE

LIGHT TRAFFIC
(PGE. & ODF# EASEMENT)

WEST LINN PAPER COMPANY

R I V E R

TAILRACE

BLUE HERON PAPER COMPANY

BLUE HERON HYDROELECTRIC POWER PLANT
(SEE DETAIL 2, SHEET 2).

BLUE HERON PAPER COMPANY

FISH LADDER DIVERSION
N.621.755
E.1.455.860

FISHLADDER EXIT

DAM

ROCK

FISHLADDER

ENTRANCE NO.2

EXISTING POINT FOR DIVERSION OF BLUE HERON PAPER COMPANY WATER RIGHT
(SEE DETAIL 2, SHEET 2).

M O O R E

W I L L A M E T T E

R I V E R

FISH LADDER EXIT

BLUE HERON PROCESS WATER DIVERSION
N.621.926
E.1.456.498

SPILLWAY

FOREBAY

BLUE HERON PAPER COMPANY

TAILRACE

DAM

FOREBAY MILL RESERVE

BLUE HERON PAPER COMPANY

ROCK

ENTRANCE NO.3/4

ROCK

FORBAY

DAM

ROCK

BLUE HERON PROCESS WATER DIVERSION
N.621.732
E.1.456.812

A B E R N E T H Y I S L A N D

(S U B M E R G E D)

SUBMERGED

OREGON CITY CLAIM LINE
N. LINE McKINLEY D.L.C.

DAVID McLAUGHLIN PROPERTY LINE

EXIST. S. LINE POWELL PROPERTY

100 0 100 200 300 400 500
SCALE: 1 INCH = 100 FEET

REFERENCE DRAWINGS:

FERC WILLAMETTE FALLS LICENSE DRAWINGS
- EXHIBIT F SHEET 2
- EXHIBIT F SHEET 4
- EXHIBIT F SHEET 5
- EXHIBIT F SHEET 6
- EXHIBIT F SHEET 7
- EXHIBIT F SHEET 8
- EXHIBIT F SHEET 9
- EXHIBIT F SHEET 12

C-20444 PRE 1909 VESTED WATER RIGHTS FINAL PROOF SURVEY
SHEET 1 AND SHEET 2

NOTE:

THE PURPOSE OF THIS MAP IS TO SHOW THE EXISTING DIVERSION POINT FROM THE BLUE HERON POWERHOUSE (COORD. N.621.926, E.1.456.498) TO THE PROPOSED DIVERSION POINT FOR THE PORTLAND GENERAL ELECTRIC CO. T.W. SULLIVAN POWER PLANT (COORD. N.622.012, E. 1.455.376)

COORDINATE BASED ON OREGON COORDINATE SYSTEM OF 1927, NORTH ZONE.

CERTIFIED WATER RIGHTS EXAMINER
#60433
JEFFREY L. DANIELSON
JUNE 11, 1999
STATE OF OREGON
RENEWAL DATE: 12/31/05

REV	DATE	DESCRIPTION	BY	CHK	ENGR	SUPV	MGR
0	7-27 2004	ISSUED FOR INFORMATION	YCW		JCD		

REVISIONS

PGE PORTLAND GENERAL ELECTRIC CO.
PORTLAND , OREGON

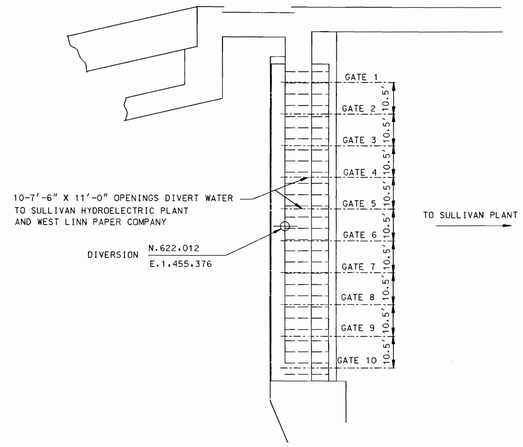
T.W. SULLIVAN PROJECT

BLUE HERON PAPER COMPANY WATER RIGHTS TRANSFER TO P.G.E.

SECTION 31, T.2 S., R.2 E., W.M.
CLACKAMAS COUNTY, STATE OF OREGON

APPROVALS	SCALE AS SHOWN
DESIGNER	DRAWN BY WM. Y. C. WONG
DESIGN ENGR JEFF L. DANIELSON	CHECKED BY
ENGR SUPV	DATE 7-27-2004
ENGR MANAGER	C-35614 SHEET 1 OF 2 REV 0

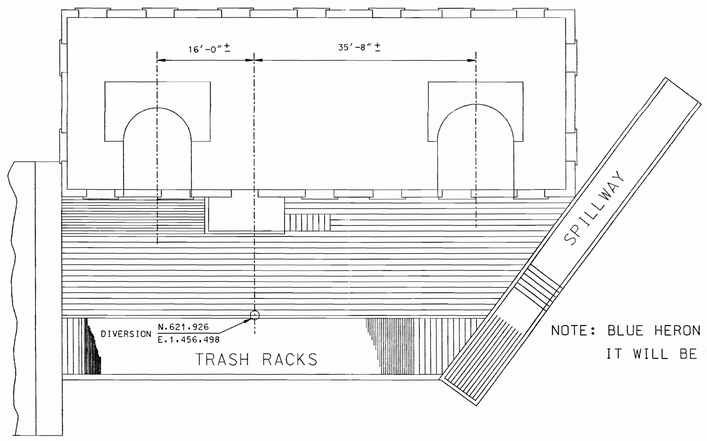
42 X 30



PGE SULLIVAN HYDROELECTRIC POWER PLANT INTAKE

DETAIL 1

SCALE: 1"=20'



BLUE HERON HYDROELECTRIC POWER PLANT

DETAIL 2

SCALE: 1"=10'

NOTE: BLUE HERON HYDROELECTRIC POWER PLANT HAS BEEN SHUT DOWN.
IT WILL BE DECOMMISSIONED IN 2005

NOTE:

SEE SHEET 1 OF 2

CERTIFIED WATER RIGHTS EXAMINER
640433
JEFFREY L. DANIELSON
EXPIRES: 11/30/05
STATE OF OREGON

RENEWAL DATE: 12/31/05

REV	DATE	DESCRIPTION	BY	CHK	ENGR	SUPV	MGR
0	7-27 2004	ISSUED FOR INFORMATION	YCW		JLD		

REVISIONS

PGE PORTLAND GENERAL ELECTRIC CO.
PORTLAND , OREGON

T.W. SULLIVAN PROJECT

BLUE HERON PAPER COMPANY WATER RIGHTS
TRANSFER TO P.G.E.
SECTION 31, T.2 S., R.2 E., W.M.
CLACKAMAS COUNTY, STATE OF OREGON

APPROVALS	SCALE AS SHOWN
DESIGNER	DRAWN BY WM. Y. C. WONG
DESIGN ENGR JEFF L. DANIELSON	CHECKED BY
ENGR SUPV	DATE 7-27-2004
ENGR MANAGER	C-35614 SHEET 2 OF 2 REV 0

42 X 30

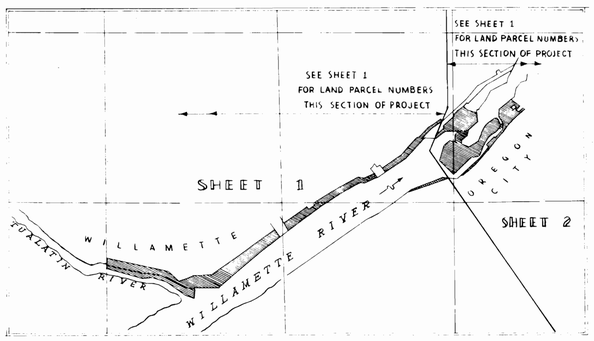
Portland General Electric Company

Willamette Falls

Water Rights
Registration Statement
pursuant to
ORS 539.240

SWR-385


RECEIVED
AUG - 7 1992
WATER RESOURCES DEPT.
SALEM, OREGON
SECTION CORNER
COORDINATE - 624,624
1,455,331
25 30
36 31
GATE #1
GATE #2
GATE #3
GATE #4
GATE #5
GATE #6
GATE #7
GATE #8
GATE #9
GATE #10
10.5'
TO SULLIVAN PLANT FOREBAY
10-7'-6"x11'-0" OPENINGS DIVERT WATER TO SULLIVAN HYDROELECTRIC PLANT AND SIMPSON PAPER PLANT.
NW 1/4, S31, T2S, R2E
COORDINATE - 622,012
1,455,376
FLOW OF WATER TO FOREBAY
PGE HEADGATES
DETAIL 1
SULLIVAN HYDROELECTRIC POWER PLANT, PGE
12-1600 HP UNITS AND 1-1200 HP UNIT
13-9' DIAMETER PENSTOCKS
NW 1/4, S31, T2S, R2E
SIMPSON DIVERSION
PROCESS WATER COORDINATES - 622,364
1,456,706
COORDINATE - 621,944
1,455,730
2-1145 HP UNITS
972 HP UNIT
1430 HP UNIT
PENSTOCKS (TYP)
4-1800 HP UNITS
TRASHRACKS
WALKWAY
DETAIL 2
GRINDER ROOM NO. 3
1" = 40'
WALKWAY
NO. 9
NO. 10
NO. 11
NO. 12
NO. 13
NO. 14
NO. 15
NO. 16
24'-0"
TURBINE
PENSTOCKS (TYP)
TRASH RACKS
WALKWAY
11'-0 x 12'-0 OPENING (TYP)
1430 HP UNIT (TYP)
COORDINATE - 621,944
1,455,730
DETAIL 3
GRINDER ROOM NO. 2
1" = 30'
U. S. GOVERNMENT CANAL
SIMPSON PAPER MILLS
GRINDER ROOM 2
SEE DETAIL 3
CONVEYOR
FOOT BRIDGE
TAILRACE
FISHLADDER
COORDINATE - 622,012
1,455,376
PGE SULLIVAN PLANT DIVERSION
(SEE DETAIL 1)
COORDINATE - 621,944
1,455,730
GRINDER ROOM 3 - SEE DETAIL 2
SIMPSON MILL DIVERSIONS
SEE DETAILS 2 & 3
RIVER
DAM
FISHLADDER
WILLAMETTE
SMURFIT DIVERSION
HYDROELECTRIC POWER PLANT, SEE DETAIL 4
2-1100 HP UNITS
7'-3"x10'-3" INLET - NO. 1
8'-6"x12'-6" INLET - NO. 2
SW 1/4, S31, T2S, R2E
DIVERSION
COORDINATE - 621,926
1,456,498
SMURFIT PAPER MILLS
DAM
SPILLWAY
FOREBAY
SMURFIT DIVERSION
PROCESS WATER COORDINATES - 622,162
SW 1/4, S31, T2S, R2E
1,457,153
16'-0"±
35'-8"±
TURBINE
PENSTOCK
NO. 1
NO. 2
1100 HP UNIT
7'-3x10'-3 INLET
1100 HP UNIT
8'-6x12'-6 INLET
TRASH RACKS
COORDINATE - 621,926
1,456,498
DETAIL 4
SMURFIT POWER PLANT
1" = 16'
WILLAMETTE
FALLS
DAM
T2S, R1E
T2S, R2E
THE PURPOSE OF THIS MAP IS TO IDENTIFY THE LOCATION OF WATER RIGHTS. IT IS NOT INTENDED TO PROVIDE INFORMATION RELATIVE TO THE LOCATION OF PROPERTY OWNERSHIP BOUNDARY LINES.
WILLAMETTE FALLS PROJECT
VICINITY MAP
1" = 100'
SECTION 31, T.2S, R2E
PRELIMIN
REV
DATE
DESCRIPTION
REVISION
PORTLAND GENERAL
PORTLAND, O
WILLAMETTE FALLS PRO
WATER RIGHTS MAP
APPROVALS
DESIGNER
DESIGN ENGR
ENGR SUPV
ENGR MANAGER
DATE



SEE SHEET 1 FOR LAND PARCEL NUMBERS THIS SECTION OF PROJECT

MAGNETIC VARIATION
TRUE NORTH

U. S. GOVERNMENT CANAL
M.C.
N. 47° 02' E. 503.45'
S. 45° 42' 05" W. 71.04'
S. 45° 17' 05" W. 381.8'
N. 46° 32' E. 459'
N. 55° 02' E. 412.18'
N. 41° 48' 30" E. 351.33'
N. 83° 55' 15" W.
S. 42° 30' W. 660'
S. 32° W. 146.32'
W. 291.72'
S. 58° 45' W. 101.64'
S. 54° W. 23'
S. 13° 40' E.
S. 44° 14' 40" W. 202.40'
S. 13° 54' 05" W. 100.00'
S. 46° 15' 20" W. 293.14'
S. 44° 42' 55" E. 9.50'
S. 40° 47' 13" W. 28.31'
S. 44° 17' 55" E. 4.10'
S. 50° 00' 28" W. 362.38'
S. 44° 45' 02" W. 118.32'
S. 49° 41' 05" W. 189.10'
S. 45° 43' 35" W. 104.84'
N. 45° 09' 29" W. 26.62'
N. 44° 50' 35" W. 564.5'
N. 58° 58' 05" 751.0'
S. 58° 58' 05" W. 967.62'
N. 58° 58' 05" E. 511.93'
N. 27° E. 757.68'
N. 30° 18' 05" E. 75.33'
N. 37° 01' 55" W. 75.33'
N. 58° 58' 05" E. 61'
S. 37° 01' 55" E. 100'
105.39'
132.5'
N. 27° E. 165'
S. 62° 30' W. 536.58'
S. 31° W. 215.22'
S. 35° W. 331.36'
S. 55° W. 79.2'
N. 65° E. 191.4'
N. 14° E. 178.2'
N. 37° 47' E. 224.4'
N. 10° E. 224.4'
N. 50° E. 495.35'
S. 56° 44' E. 318.37'
S. 36° 21' 30" W. 50'
N. 50° E. 247'
S. 71° 15' E. 132'
N. 17° E. 670.82'
N. 45° W. 646.1'
N. 0° 01' E. 2063.08' to M.C.
S. 76° W. 211.2'
S. 25° W. 396'
S. 16° 45' W. 389.82'
S. 43° 30' W. 348.08' ±
S. 40° 30' W. 521.4'
N. 39° E. 326.7'
S. 89° 35' W.
N. 36° E.
N. 46° E. 816.51'
1060' ±
S. 46° W. 798.6'
N. 70° E. 996.6'
S. 84° E. 343.2'
N. 85° E. 92.4'
117.48'
50' ±
100' ±
S. 76° W. 209.88'
S. 47° W. 188.48'
S. 26° 45' W. 41.36'
S. 62° W. 165'
N. 65° W. 254.4'
N. 30° E.
N. 39° E. 217.8'
N. 58° E. 264'
S. 73° E. 473.22'
S. 16° 45' W. 210.6'
100' ±
160' ±
600' ±
108.65' ±
N. 9° 44' W.
EST. S. LINE POWELL PROPERTY
S. 65° 36' 30" E.
DAVID McLAUGHLIN PROPERTY LINE
OREGON CITY CLAIM LINE
N. LINE McKINLEY D.L.C.

ABERNETHY ISLAND
(SUBMERGED)

MOORE ISLAND

CROWN ZELLERBACH CORPORATION
FOREBAY
TAILRACE
DAM
LADDER
LOG POND
BULKHEAD
DGE HEADWALL
100' FUEL CONVEYOR
SUSPENSION BRIDGE
BLOCK FLUME
PORTLAND GENERAL ELECTRIC CO.
T.W. SULLIVAN HYDROELECTRIC PLANT
SUBMERGED
PUBLISHERS PAPER COMPANY
PUBLISHERS POWERHOUSE
SPILLWAY
MILL
PUBLISHERS PAPER CO. BARKER & CHIP MILL
FOREBAY RESERVE
PUBLISHERS PAPER COMPANY

WILLAMETTE RIVER

100 0 100 200 300 400 500 FEET
SCALE

PROJECT PROPERTY

I CERTIFY THAT I SUPERVISED THE PREPARATION OF THE EXHIBIT DRAWINGS AND THAT THEY ACCURATELY SHOW THE PROJECT LANDS AND ACCESS TO THE RESERVOIRS AND THE RECREATIONAL AREAS AS OBTAINED FROM THE RECORDS AND PROJECT DRAWINGS IN THE PORTLAND GENERAL ELECTRIC FILES.

REGISTERED PROFESSIONAL ENGINEER
4608
OREGON
May 13, 1960
SAMUEL R. CHRISTENSEN

S. R. Christensen
S. R. CHRISTENSEN
GENERAL DESIGN SUPERVISOR

FPC FORM 80 DRAWING SHEET 2 of 2

PROJECT NO. 2233 - OREGON
PORTLAND GENERAL ELECTRIC COMPANY
WILLAMETTE FALLS DEVELOPMENT
PROJECT AREA
SCALE : 1" = 100'-0"

ATTACHMENT A

SUMMARY TABLES:
DATES OF FIRST USES, USES, AND WATER DEVELOPMENT INFORMATION

ATTACHMENT A

SUMMARY TABLES: DATES OF FIRST USE, USES, AND WATER DEVELOPMENT INFORMATION

Table 1

PORTLAND GENERAL ELECTRIC

Hydroelectric Use at Sullivan Station and Station "A"

Date of First Use	Quantity	Date on Which Development Was Initiated	Party That Initiated Development
June 3, 1889[1]	8,842 CFS used in 1911 in[2] fulfillment of plan for the development of hydroelectric power at Willamette Falls.	1889[3]	Willamette Falls Electric Company[4]

[1] Electric power was first generated at Willamette Falls at Station "A" on June 3, 1889. See Robley at 21 (attached to Affidavit of Julie A. Keil ("Keil Affidavit")).

[2] Water was first used at Station "A" at Willamette Falls on June 3, 1889. As the demand for electricity increased, more water was applied to generate hydroelectric power at Station "A" and its successor, Station "B" (now the Sullivan Station). PGE's predecessors in title actively encouraged manufacturers to establish themselves at Willamette Falls as part of PGE's plan for development. See Good Roads and Cyclist at 3; F.G. Sykes at flyleaf (both attached to Keil Affidavit.) By 1909, PGE's predecessors in title had appropriated an estimated 7,350 CFS for maximum peak hydroelectric generation. Water was fully devoted to this beneficial use by 1911, when 8,042 CFS was appropriated for maximum peak hydroelectric generation.

[3] Willamette Falls Electric Company began to build Station "A" a short time after the company was incorporated on November 8, 1888. See Robley at 20.

[4] Willamette Falls Electric Company is one of PGE's predecessors in title, and PGE owns all of the property and water rights at Willamette Falls formerly held by Willamette Falls Electric Company.

ATTACHMENT A

SUMMARY TABLES: DATES OF FIRST USE, USES, AND WATER DEVELOPMENT INFORMATION

Table 2

SIMPSON PAPER (OREGON) COMPANY

Hydroelectric Use at Evergreen Mill (West Linn)

Date of First Use	Quantity	Date on Which Development Was Initiated	Party That Initiated Development
1889[1]	8360 CFS used[2] in 1909 by Willamette Pulp & Paper Co. for its hydropower needs.	1889[3]	Willamette Falls Electric Company[4]

[1] Hydropower was first generated by Willamette Pulp & Paper Co. in October 1889.

[2] As the demand for pulp production increased, more water was applied to generate hydroelectric power at the Paper Mill. In 1909, Simpson's predecessors appropriated 8360 CFS for hydroelectric generation.

[3] Pursuant to a lease signed in 1889 with PGE's predecessor in title, the Willamette Pulp & Paper Co. built a mill and installed machinery. Diversion works built in that year included a wooden rock-filled crib bulkhead from the intake to the water wheels of the new mill, as well as a dam across the main channel of the river. After flooding destroyed these works in February 1890, Willamette Pulp & Paper Co. rebuilt them in 1891-92. See Robley at 25-26 (attached to Keil Affidavit).

[4] PGE's predecessor in interest.

ATTACHMENT A

SUMMARY TABLES: DATES OF FIRST USE, USES, AND WATER DEVELOPMENT INFORMATION

Table 3

SIMPSON PAPER (OREGON) COMPANY

Industrial Process Water Use at the Evergreen Mill (West Linn)

Date of First Use	Quantity	Date on Which Development Was Initiated	Party That Initiated Development
1889[1]	64.2 CFS of river[2] water was used in 1909 for industrial process.	1889[3]	Willamette Falls Electric Company[4]

[1] Industrial process water was first used by Willamette Pulp & Paper Co. in October 1889.

[2] As the demand for pulp production increased, more water was applied to produce pulp. In 1909, Simpson's predecessors appropriated 64.2 CFS of river water for industrial process.

[3] Pursuant to an 1889 lease between Willamette Pulp & Paper Co. and Willamette Falls Electric Company.

[4] PGE's predecessor in title.

ATTACHMENT A

SUMMARY TABLES: DATES OF FIRST USE, USES, AND WATER DEVELOPMENT INFORMATION

Table 4

SMURFIT NEWSPRINT CORPORATION

Hydroelectric Use at Smurfit Newsprint Corporation's Oregon City Mill

Date of First Use	Quantity	Date on Which Development Was Initiated	Party That Initiated Development
1909[1]	3115 CFS was used[2] in 1916 in fulfillment of a plan for the development of hydropower at Willamette Falls.	1889[3]	Willamette Falls Electric Company

[1] Hydropower via PGE's water right was first generated at Hawley Pulp & Paper Co. in 1909.

[2] PGE's predecessor first used hydropower at Willamette Falls on June 3, 1889. As the demand for pulp production increased, more water was provided to both paper mills to create hydropower. Water was fully devoted to this beneficial use by 1916, when 3115 CFS was provided to Hawley Pulp & Paper in fulfillment of its pre-1909 planned expansion.

[3] Development was initiated pursuant to a plan devised by PGE's predecessor, Willamette Falls Electric Company.

ATTACHMENT A

SUMMARY TABLES: DATES OF FIRST USE, USES, AND WATER DEVELOPMENT INFORMATION

Table 5

SMURFIT NEWSPRINT CORPORATION

Industrial Process Water Use at Smurfit Newsprint Corporation's Oregon City Mill

Date of First Use	Quantity	Date on Which Development Was Initiated	Party That Initiated Development
1909[1]	29.4 CFS was used in 1917 in fulfillment of a plan for the development of the pulp and paper mills. 50.9 CFS was used from 1929 onward after Hawley Pulp & Paper transferred a small amount of its pre-1909 hydro water right for process use.	1889[2]	Willamette Falls Electric Company

[1] Industrial process water was first used by Hawley Pulp & Paper Co. in early 1909.

[2] Development was initiated pursuant to a plan devised by PGE's predecessor in title.

ATTACHMENT B

NARRATIVE DESCRIPTION OF THE DEVELOPMENT OF WATER AT WILLAMETTE FALLS

Initial Development at Willamette Falls

On November 8, 1888, Willamette Falls Electric Company (one of the corporate predecessors of the modern Portland General Electric Company) was incorporated for the purpose of developing electrical power from the falls of the Willamette River. The new company soon began building Station A, erecting a wooden power house and rock-filled wooden bulkheads on the east side of the Willamette River at the falls. Station A first transmitted electric power to Portland on June 3, 1889.

Also in 1889, Willamette Falls Electric Company entered into the first of many leases authorizing the construction and operation of pulp and paper mill facilities on the land surrounding the falls. These leases authorized the diversion of water for use in mill processes and for the production of hydroelectric or direct mechanical power for mill operations.

In March 1889, Willamette Pulp and Paper Company, a predecessor of Simpson Paper (Oregon) Company ("Simpson"), began building a paper mill on the west bank of the falls at the site of today's Evergreen Mill. Diversion works built in that year included a wooden rockfilled crib bulkhead from the intake to the water wheels of the new mill, as well as a dam across the main channel of the river.

As part of a plan of industrial development at the falls, Willamette Falls Electric Company publicly invited businesses to lease land from it and to take advantage of the available hydropower at the falls. Over the years, the corporate successors of Willamette Falls Electric Company leased additional real property and associated water rights to pulp and paper companies. These leases authorized the diversion of water from the Willamette River for hydroelectric purposes and for industrial processes associated with pulp and paper mill operations.

Development of Hydroelectric Power at Portland General Electric Company's Sullivan Station (Station B)

Portland General Electric Company ("PGE Co."), a corporate predecessor of the modern company with the same name, was incorporated on August 5, 1892 to take advantage of the potential for large-scale industrial development at Willamette Falls. The new company quickly acquired Station A and the other assets of Willamette Falls Electric Company, as well as

the locks and other property of Willamette Transportation and Locks Company. PGE Co.'s goal was to build a modern generating station with a capacity far greater than Station A.

Construction of Station B, which would later become known as the Sullivan Station, began in the summer of 1893. The first four sections of Station B and foundations for seven additional sections and the bulkhead immediately above were built in the fall and winter of 1893-94. Because bedrock was located more than 40 feet below low water, the foundations for the new station proved extremely difficult to lay. Even so, the first four sections (including the pumping section) were finished by March 4, 1895, when water was first diverted into the forebay pond.

In 1897, PGE Co. completed the superstructure for seven additional sections of Station B. At about this time, PGE Co. transferred much of Station A's equipment to Station B and stopped using Station A to generate power. PGE Co. then leased Station A to Willamette Pulp and Paper Company, which used it as a cut-up and pulp grinding mill. Station A was later leased to Hawley Pulp and Paper Company, which also used it for pulp grinding purposes.

Throughout the 1890s and the early 1900s, PGE Co. added to and improved the generating equipment in Station B. Construction of Sections 12 and 13 was begun in 1899 and completed in 1903. In 1904, in conjunction with its hydroelectric opeartions, PGE Co. installed a fish ladder to provide for fish passage at Willamette Falls.

By 1905, Station B's rated generating capacity was 5,730 kw, its maximum peak generation was 8,293 kw, and its annual generation was 41,513,350 kwh. Hydroelectric development continued through 1911, when annual generation peaked at 50,962,979 kwh. The maximum hourly load in that year was 9650 kw, which would have required the diversion of 8,042 CFS of water. Since 1911, Portland General Electric Company and its predecessors have used Station B continuously to generate electricity.

Hydropower Development at Simpson's Evergreen Mill

A total of 32 turbine units were installed at the Evergreen Mill as the facility developed in phases over the years. Most of this development occurred at the West Linn site, on the west bank of the Willamette River, but one important component, Mill H, was built on the east bank of the river at Oregon City.

Development of hydropower at the Evergreen Mill site began with the construction of Mill A in 1889. Initial hydropower installation in Mill A consisted of five twin 36-inch diameter New American turbine units, manufactured by the

Dayton Globe Iron Works Company, Dayton, Ohio. These five units were installed in Grinder Room No. 1, with a horizontal shaft configuration that facilitated direct connection to pocket grinders used for producing wood pulp. All subsequent installations followed this basic arrangement.

Additional turbine units were added to Grinder Room No. 1 in 1891, 1893, 1895, and 1896. Several different manufacturers supplied these early units.

The second phase of hydropower development at the Evergreen Mill site consisted of the construction of Mill H on the Oregon City (east) side of the falls, beginning in 1902. Mill H contained seven turbine units, five dedicated to wood grinding to produce pulp and two smaller units to provide rotary power for various pumps and driver shafts in the mill. The mill was built and operated for many years by Simpson's predecessor, Crown-Willamette Paper Company, until 1944, at which time it was sold to Hawley Pulp and Paper Company of Oregon City, a predecessor of Smurfit Newsprint Corporation ("Smurfit").

The third phase of hydropower development at the Evergreen Mill occurred immediately after Mill H was completed. This phase consisted of a major expansion of plant capacity on the West Linn side of the river, with the construction of Grinder Room No. 2 at Mill A, which opened in 1905. Grinder Room No. 2 was equipped with turbine units #9 to 16. These units were all twin 37 ½-inch diameter Type "O" horizontal shaft Francis-type units manufactured by the S. Morgan Smith Company in 1905. These units were all directly connected to pocket grinders used to grind wood for pulp production. Individual units were gradually shut down over the years as they wore out beyond the point where they could be economically maintained in service.

The last operable unit, #11 was still in service when wood grinding operations at the Evergreen Mill were ended in 1990. Unit #11 operated briefly in 1991 and 1992 for electrical power generation. Simpson intends to rehabilitate the existing hydropower units that are presently installed at the Evergreen Mill. At the direction of the Federal Energy Regulatory Commission ("FERC"), Simpson conducted a reconnaissance-level study in 1991 to assess the feasibility and options available for rehabilitation of the existing hydropower facilities. The study concluded that rehabilitation was feasible. In order to more fully assess the feasibility of rehabilitating the hydropower units, Simpson plans to conduct additional, more detailed analyses prior to 1995.

The fourth phase of hydropower development at the Evergreen Mill consisted of the installation of turbines for the generation of mill electrical power. A separate Generator Room was constructed for this purpose at the location that

would eventually be known as Grinder Room No. 3. Two turbine-generator units (units #17 and #18) were installed at this location in 1907. These units were twin 37 ½-inch diameter Type "O" turbines, manufactured by the S. Morgan Smith Company of York, Pennsylvania. These two Type "O" turbines were identical to the units installed in Grinder Room No. 2, except that they were equipped with a somewhat smaller cylinder control gate. These units are still in a serviceable condition at the present time. Unit #17 operated for about 30 days during the early fall of 1992 and could have operated longer if severe drought conditions had not sharply reduced water availability.

History of Process Water Usage at Simpson's Evergreen Mill

The Evergreen Mill was constructed on the west bank of the Willamette River in 1889 by the newly formed Willamette Pulp and Paper Company. Pulp Mill A was completed on October 1, 1889, and the first groundwood pulp was produced on October 7, 1889. Logs were hauled mechanically from a forebay basin at the head of the Willamette Falls on the river into the pulp mill. Mechanical saws, debarkers, and splitters reduced the logs to wood blocks. The blocks were fed manually into pocket grinders that were powered by hydraulic turbines. The wood grinding process required large volumes of process water. Water was used to cool the grinder units, to lubricate the rotating components of the grinders, and to produce a pulp-water slurry that was fluid enough so that it could be piped to other locations in the mill. The first hydropower equipment installed in Mill A consisted of five water-powered grinder lines.

Capacity of the first grinding units installed in Mill A was listed as 20 tons of pulp per day in the 1892-93 issue of Lockwood's Director of the Paper and Stationary Trades, published in New York, NY. Capacity gradually increased during the 1890s as additional grinder lines were brought into service. Process water use increased significantly when Mill B, a sulfite pulp mill (the first of this type on the West Coast), was opened at the site in 1890. The sulfite process chemically transformed wood chips into pulp fiber. Mill C, which contained the first paper-making machine at the site (Machine No. 1), also opened in 1890.

The mill's pulp and paper-making capacity gradually increased during its first two decades of operation. In 1892 and 1893, industry trade directories reported that Willamette Pulp and Paper Company's sulfite pulp production capacity was 10 tons per day and groundwood pulp capacity was 23 tons per day. The mill was closed briefly at the beginning of the Depression of 1893-1897, but had restarted by August 1893 and remained in operation throughout the rest of the depression.

By 1899-1900, industry trade directories reported that the Evergreen Mill production capacity had increased to 15 tons of sulfite pulp and 80 tons of groundwood pulp per day. By 1906, sulfite pulp production had increased to 30 tons per day, while groundwood pulp production capacity had grown to 150 tons per day, as Grinder Room No. 2 came on line. Rated pulp production capacity continued to increase as plant efficiency improved from 50 tons to 200 tons per day respectively, in 1907-1908.

Newsprint sold in the United States and abroad long remained Willamette Pulp and Paper Company's major product. It was made from a combination of groundwood sulfite pulp. Surplus pulp production was shipped to the Stockton, California mill to be made into paper until 1892, when the No. 2 paper machine was installed in Mill C. The No. 7 paper machine (the third paper machine installed at the mill) went into production in 1893. No. 3 and No. 4 paper machines followed in 1896 and 1898, respectively. A new mill, Mill D, opened in 1905. Paper machines No. 5 and No. 6 went into operation in this mill in 1906 and 1908. With these additional paper-making machines, newsprint production capacity as reported in the trade directories also increased. A production capacity of 160 tons of newsprint per day was reported in 1909.

Another firm, Crown Paper Company, also began operations at Willamette Falls in 1889. Construction of Crown's first paper mill was started in November 1889, immediately to the north of the Willamette Pulp and Paper's mill. In 1895, Crown Mill had a production capacity of 20 tons of paper daily, 7 tons of groundwood pulp, and 15 tons of sulfite pulp. In 1902, Crown announced plans to construct a new mill on the east side of the Willamette River. This facility eventually became known as Mill H when it opened in 1903. In 1903-1904, Crown had increased its groundwood pulp production capacity to 10 tons per day as the new mill started to come on line. The company executed a hydropower lease from PGE for Mill H in 1904 that included 400,000 gallons per hour for process water needs.

A wave of consolidation swept the West Coast paper industry after 1900. Crown merged in 1905 with the Columbia Paper Company of Camas, Washington and became the Crown-Columbia Pulp and Paper Company. Daily production capacity for the new company reached 30 tons of paper, 24 tons of groundwood pulp, and 18 tons of sulphite pulp. Crown-Columbia and Willamette Pulp and Paper Company merged in 1914 to form the Crown-Willamette Pulp and Paper Company. This merger consolidated the operations of the adjacent West Linn plans and the Oregon City extension (Mill H). Production capacity of the new company continued to grow over the years as operations stabilized and more efficient production methods were adopted. In 1944, Crown-Willamette sold the Mill H facility to Hawley Pulp and Paper Company of Oregon City, thereby consolidating

its Evergreen Mill operations on the West Linn site. The mill has operated continuously since 1909.

History of Process Water Usage at Smurfit's Mill in Oregon City

On January 4, 1908, PGE sold Willard Hawley power at Station A and gave him the use of a 250-foot strip of property extending south along the crest of the dam and west of the lower river. Hawley could construct a pipeline to move pulp from Station A onto the Portland Flouring Mill's property, which Hawley was in the process of acquiring for his paper-making unit. PGE leased Station A as a pulp mill to Hawley Pulp & Paper on December 31, 1908. The lease provided 50,000 gallons of river water for processing pulp. Pulp was first ground at the mill on January 6, 1909.

Construction of Mill H began in 1902. The mill was built and operated for many years by Simpson Paper Company's predecessor Crown-Willamette Paper Company, until 1944 when it was sold to Hawley Pulp & Paper Company. Hawley and its successors have operated the mill since then.

Mill D contains #2 and #3 paper machines and is the original site of the Brick Mill built in 1864. In 1910, Hawley Pulp & Paper purchased the mill site. The mill used water as a part of its paper-making operations.

Mill C was originally called the sulphite mill in the early 1900s. Smurfit's Oregon City mill has operated continuously since 1909. Based on information in Hawley's files, manufacturing water was supplied to the mill from the Oregon City Water Works Pen Stock.

History of Hydropower Development at Smurfit's Mill in Oregon City

Hydropower development at the site occurred over several years by various companies. A total of 33 turbine units were identified and operated at the Smurfit Mill complex as the facility developed over the years.

Mill A was built on the site of the Old Station A, where PGE's predecessors first generated power. The water rights used at Mill A were obtained from leases from PGE and its predecessors. Initial hydropower installation in Mill A consisted of five units, manufactured by the Platt Iron Works Company, Dayton, Ohio. Three units were installed and connected to grinders used for producing wood pulp. The other two units were used for supplying power to station equipment. Between 1908 and 1919 seven additional waterwheels were installed.

Mill H contained 7 turbine units, 5 dedicated to wood grinding to produce pulp and 2 smaller units to provide rotary

power for various pumps and drive shafts in the mill. The mill was built and operated for many years by Simpson Paper Company's predecessor, Crown-Willamette Paper Company, until 1944, at which time it was sold to Hawley Pulp and Paper Company.

The hydroelectric power generation station was originally constructed in 1916 pursuant to Hawley Pulp & Paper Co.'s pre-1909 expansion plan. The first turbine was installed in 1916 and was a twin 36-inch unit. In 1924 Hawley added a second unit to the station. This second unit was a twin 28.5-inch unit. The hydro station has operated continuously over the years. The station was rebuilt in 1978 using the same waterwheels.

ATTACHMENT C

AFFIDAVIT OF JULIE A. KEIL
PROJECT MANAGER HYDRO LICENSING
PORTLAND GENERAL ELECTRIC COMPANY

STATE OF OREGON)
) ss.
COUNTY OF MULTNOMAH)

I, Julie A. Keil, being duly sworn, depose and say:

1. I am the Project Manager Hydro Licensing of Portland General Electric Company ("PGE"). I have personal knowledge of the matters set forth in this affidavit.

2. The attachments to this affidavit have been copied or compiled from records made by PGE as a regular practice in the ordinary course of its regularly conducted business activities.

3. "Attachment C-1" is a true and correct copy of an advertisement from the May 1896 issue of Good Roads and Cyclist concerning PGE's predecessors plan for industrial development at Willamette Falls.

4. "Attachment C-2" consists of a true and correct copy of F.G. Sykes, Generating and Distributing System of the Portland General Electric Company (a paper read before the Electrical Transmission Section of the Pacific Coast Engineering Congress held at the "American Inn," under the auspices of the Lewis & Clark Centennial Exposition, Portland, Oregon, June 29-30, 1905).

5. "Attachment C-3" consists of true and correct copies of selected pages from Portland Electric Power Company with Its Predecessor and Subsidiary Companies (December 16, 1860 - December 31, 1935), which was compiled in 1935 by R.R. Robley, Superintendent of Operation, Portland General Electric Company.

6. "Attachment C-4" consists of a true and correct copy of Chapter I of Arthur H. Greisser, History of Portland General Electric Company 1889-1981 (1982).

7. "Attachment C-5" consists of a true and correct copy of a map dated June 13, 1892 showing factories and business establishments in the vicinity of Willamette Falls.

8. "Attachment C-6" consists of photographs showing Station "A" as it appeared in the 1890s and the Sullivan

Station (Station B) as it appeared during and shortly after its construction in the 1890s.

9. "Attachment C-7" is a chart showing water usage at Sullivan Station from 1905 (the first year for which generation records are available) through 1911, when the development of the Sullivan Station (Station B) had been completed. Water usage from 1889 through 1911 was determined by calculating the amount of water required to generate the known maximum peak generation for that year.

10. PGE currently diverts 6850 CFS of water from the Willamette River for hydroelectric uses at the Sullivan Station.

11. PGE is the corporate successor of Willamette Falls Electric Company and Portland General Electric Co. and holds the rights of those companies and their successors in and to the water registered in the Registration Statement to which this affidavit is attached.

12. In addition to 430 CFS withdrawn for fish passage purposes by order of the Water Resources Department dated June 28, 1965, 650 CFS is used by PGE, Simpson Paper (Oregon) Company, and Smurfit Newsprint Corporation for fish passage purposes. As noted in the letter attached as "Attachment C-8," the Oregon Department of Fish & Wildlife concurs in a filing to protect this water right.

Julie A. Keil

Subscribed and sworn to before me this 29 day of December, 1992.

William A May
Notary Public for Oregon
My Commission Expires: 3/16/96

OFFICIAL SEAL
WILLIAM A. MAY
NOTARY PUBLIC - OREGON
COMMISSION NO.013718
MY COMMISSION EXPIRES MAR. 16, 1996

Rec'd 5

Good Roads and Cyclist.

Organ of the
Oregon Road Club
and
League of American Wheelmen

VOL. I MAY, 1896 NO. 1

PORTLAND'S DISGRACE

ATTACHMENT C-1

We ought to be willing to make considerable distance to avoid making an up grade in the direction of heaviest traffic steeper than five per cent. Grades up to ten and twelve feet in one hundred are not uncommon in mountain districts, but they are bad for any but light traffic. Keep your long-grade lines below five per cent, if possible; or, if they must be steeper, break the line occasionally with a short distance of easier grade. In mountain districts not devoted to mining, lumbering or other heavy products, steep grades are not so objectionable because the traffic is generally light. In locating in the mountains a cheap road, choose a minimum grade and do not spend money or distance to reduce grades below it. It sometimes occurs that a valley road miles long has one or two bad hills in its way. This is the [illegible] while the amount appropriated for this year, 1896, is $60,000. [illegible] to build a good road through a marsh, and expensive to maintain.

As this paper is on location, grade is the most important subject to consider, as affecting the hauling power of teams. The office of road inquiry for the department of agriculture gives the following items for the United States:

Average length of travel, 12.1 miles; average weight of load, 2,002 tons; cost per ton, $3.02; cost per ton per mile, 25 cents.

The report gives many other interesting items, but I consider many of them erroneous, or at least not applicable to Willamette valley conditions, but these give some idea of what it is worth to reduce your load one-half by a steep grade.

Your visit demonstrates the earnest feeling of the people, their deep

ATTACHMENT C-2

Generating and Distributing System

OF THE

Portland General Electric Company

BY

F. G. SYKES, E. E.

A paper read before the Electrical Transmission Section of the Pacific Coast Engineering Congress held at the "American Inn," under the auspices of the Lewis & Clark Centennial Exposition, Portland, Oregon, June 29th and 30th, 1905

COMPLIMENTS OF THE

Portland General Electric Company

Seventh and Alder Streets, Portland, Oregon

E 301 SV

O MANUFACTURERS

Electric Power for Manufacturing Purposes

If you contemplate establishing any business requiring **power**, in **Portland** or its suburbs, it will be to your advantage to talk with us, before placing your orders for machinery.

The economies effected by the use of **electric** power are: Lesser cost of operation, smaller amount of space required, and noteworthy saving in machinery and initial cost of installation of plant.

Modern methods of manufacturing demand prompt and efficient service for the elaborate and expensive machinery in which the owner's money is invested, and **intensified production** is imperative, that the capital invested may be turned over as many times as possible during the year.

The ease of control of Electric Power affords direct connection, making the period of operation of the machine or tool, and its speed, entirely subject to the will of the operator.

Our current is on the line twenty-four hours every day in the year, and thus overtime and additional **power** service is readily secured, and the increase in current consumption tends to **reduce** rather than increase the price per unit of power.

We are furnishing 20 000 horsepower to manufacturing establishments at Oregon City, and more than 15,000 horsepower is used in Portland for lighting, for manufactuing and for operating the street railways.

It is a significant fact that the immense increase in the use of Electric Power in Portland and its suburbs can be traced directly to the economic and other advantages afforded manufacturers by this company and were the determining factors that led to its adoption.

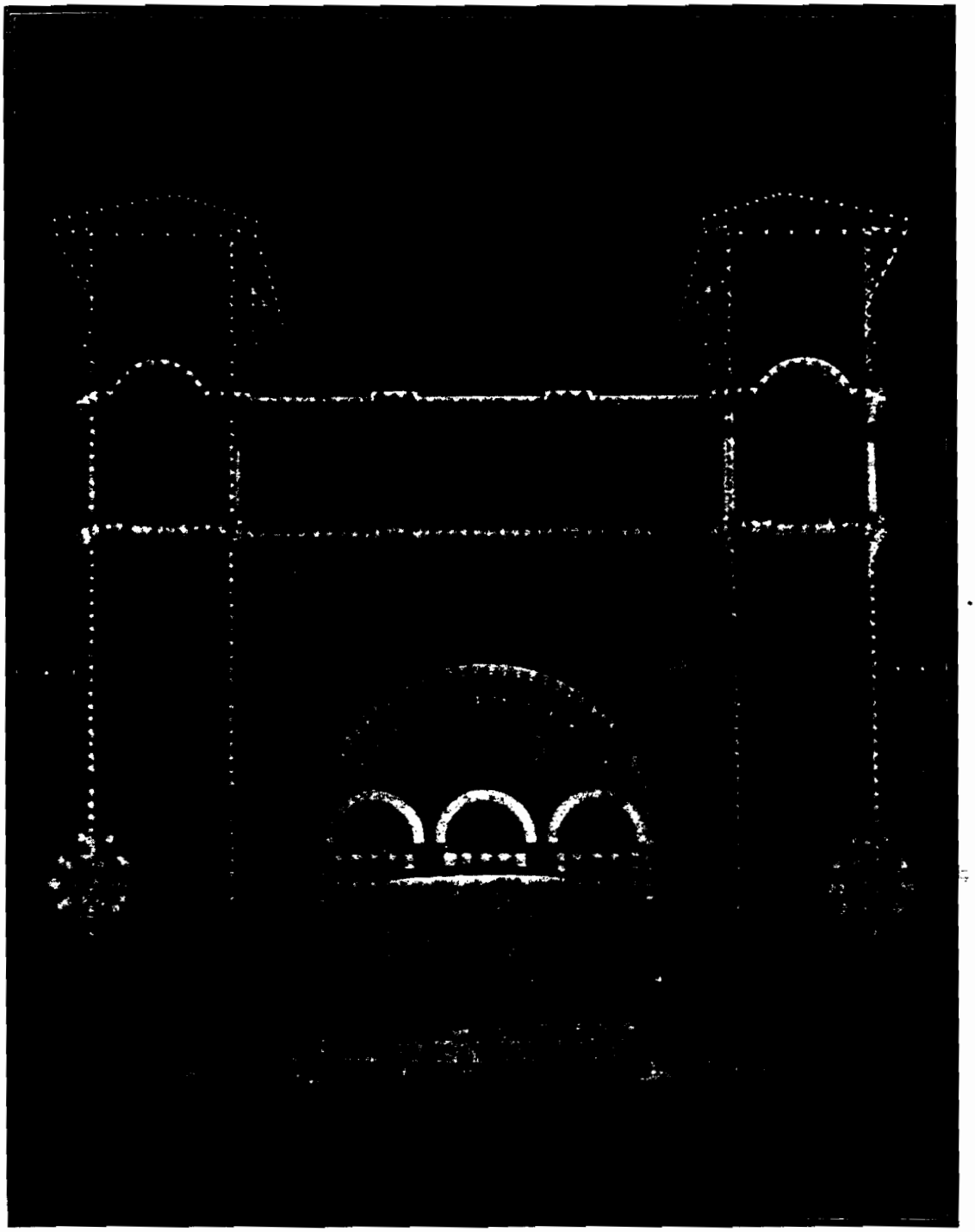
Substantial saving in the cost of producing power in Portland, in comparison with other cities in the country, enables us to make the lowest rates and to furnish unequalled service.

Manufacturers are invited to consult us in regard to the use of Electric Power. Our expert is in a position to advise as to the best sizes and arrangement of motors.

The Portland General Electric Company

Seventh and Alder Streets, Portland, Or.

An Electrical Display of Surpassing Beauty



MAIN ENTRANCE EUROPEAN BUILDING, LEWIS AND CLARK EXPOSITION

The entire complement of light and power used throughout the buildings and grounds of the Fair is furnished by the Portland General Electric Company

Generating and Distributing System of the Portland General Electric Company

WHEN the Pacific Coast Steamship Company's steamer "State of California" arrived in Portland on her maiden voyage in the summer of 1879, it gave to Portlanders their first view of an electric arc lamp, for, bolted by a framework to the underside of the deck which formed the ceiling of its engine room, it carried a small one-light Brush arc dynamo that was driven by a small simple engine of a vertical type placed immediately beneath it. The single arc lamp which it operated was used in lighting the main saloon of the steamer, and so great was the interest evidenced in this then-marvelous light that the steamer was thronged by hundreds if not thousands. Then to further satisfy public curiosity on the succeeding trip, a next year the Oregon Railway and Navigation Company's steamer "Columbia" reached Portland and created renewed interst in the infant art of illumination by being equipped, not only with an arc lighting dynamo—one lamp being placed in the main saloon, and the other in the engine room—but also with an incandescent lighting plant, which was remarkable in being the first marine incandescent lighting equipment ever installed on any vessel. This plant has been described in these columns heretofore*—and consisted of four long-field core dynamos of the type known as the "Z" pattern, the capacity of each of which was sixty sixteen-candle-power lamps, but as only three of these dynamos were used for lighting service, the fourth being utilized as an exciter

THE FALLS OF THE WILLAMETTE, AT OREGON CITY, OR.

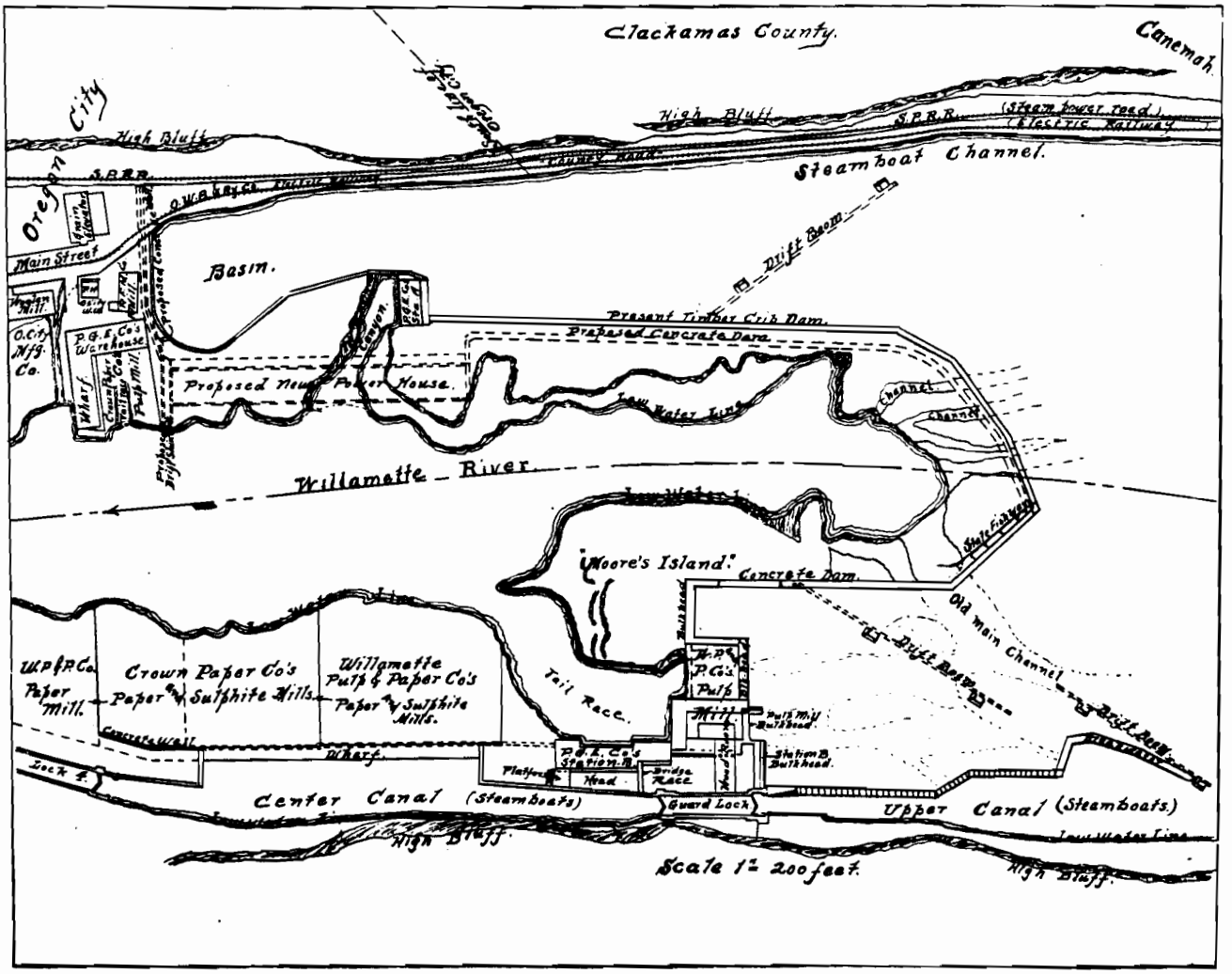
circuit of bare copper wire was run over Flanders' Dock to the intersection of First and F streets—now Flanders Street—where in front of the old Clarendon Hotel the Brush lamp from the main saloon o the steamer was suspended for three nights in exhibition of its remarkable abilities as a means of out-of-doors illumination.

Thenceforth the electric lighting development of Portland was at first slow, but, nevertheless, steady. During the ensuing year a small arc dynamo, also of the Brush type, was installed in Weidler's saw mill, then constituting the extreme northerly limit of the city. Two or three lamps therefrom were placed about the mill yards, and a single circuit of bare copper wire was run up town to the corner of First and Oak streets, where a lamp was hung under the awning in front of Matt Keith's, then the best known oyster house in Portland. Within the for the remaining three, the total output of the plant was 180 lights. Through this historic installation Portland saw its first indandescent electric lamps. Shortly thereafter two other incandescent lighting dynamos of similar make and capacity and one ten-light, 2000-candle-power, twenty-ampere Weston arc lighting dynamo were installed in Ainsworth Dock, this plant being operated by high speed steam engines, William H. Meeker being the engineer and electrician. This was Portland's first combined arc and incandescent lighting station; its service was confined to Ainsworth Dock, but it is possibly worthy of note that at that time an amateur telegraph line extended through a dozen different stations from the corner of Fourth and Montgomery streets down to Ainsworth Dock, embracing a line length of perhaps four

*THE JOURNAL, Volume I, page 22, July, 1895.

miles, and that over a portion of this line to a room occupied by the writer on the northwest corner of Front and Salmon streets, current for the operation of an eight-candle power Edison Incandescent lamp was transmitted from the Edison machines at Ainsworth Dock. This was undoubtedly the first instance of the use of the incandescent electric lamp operated from an electric lighting plant in a residence of Portland.

As an outgrowth of the installation at Weidler's Mill, which was instituted in 1882, the central station idea originated. Shortly prior to that time the Portland dynamos the second floor. This plant continued in operation until 1886, when the machines were moved to Weidler' Mill as a part of the electric plant of the United States Electric Lighting Company, organized in 1885 to operate under the Weidler franchise. Geo. W. Weilder, J. C. Ainsworth and Mr. Morey were the prime movers in this undertaking. On March 18, 1885, the first contract for city lighting was taken, and at Weidler's Mill a brick building was erected for central station purposes in which the engines were placed over the boilers, the dynamos occupying the second floor. In 1887 this plant

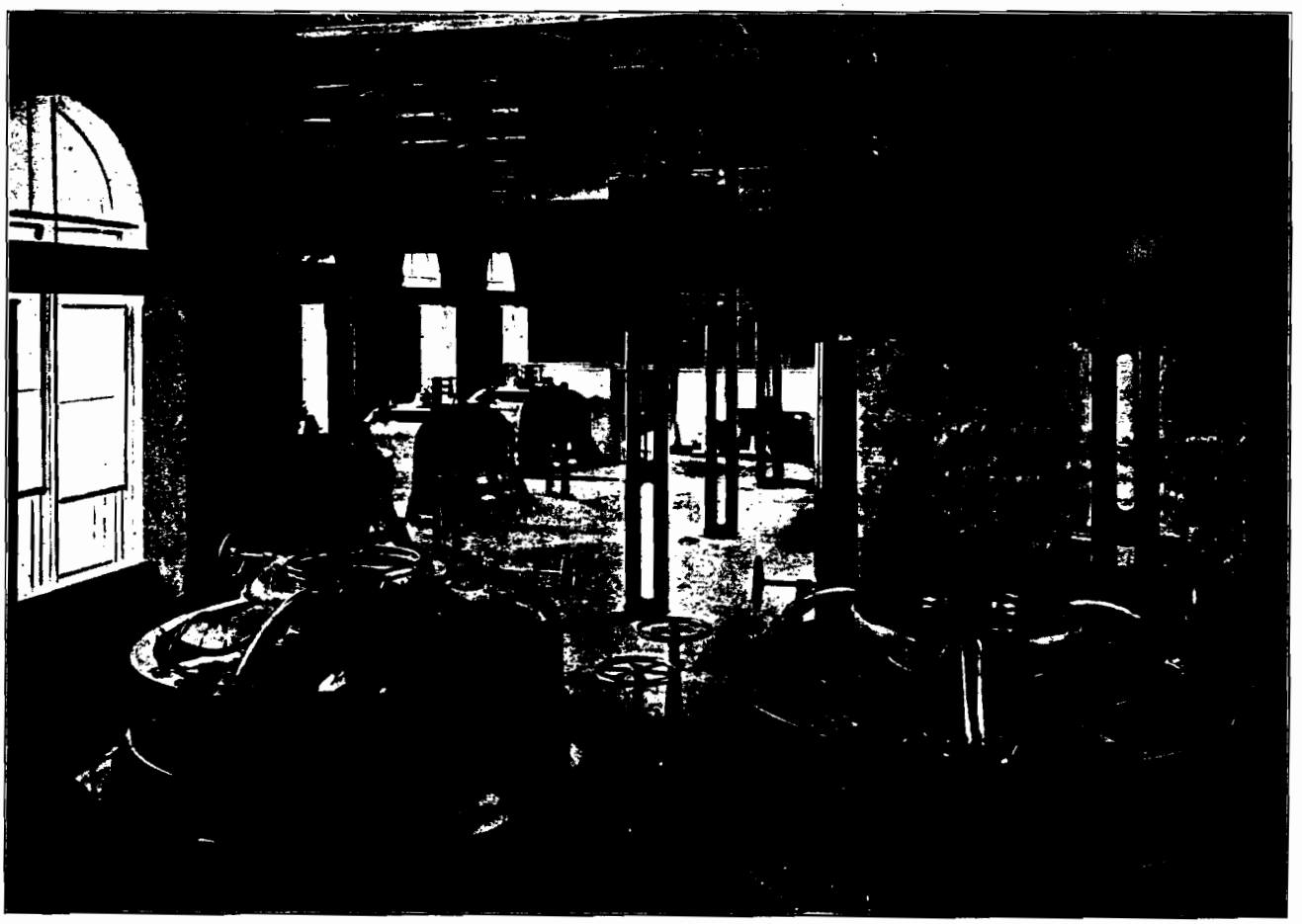


MAP SHOWING THE POWER DEVELOPMENT OF THE FALLS OF THE WILLAMETTE RIVER, AT OREGON CITY, OR.

Hydraulic Elevator Works, owned principally by the Ainsworth estate, and of which P. F. Morey was superintendent, had erected a large steam-driven, high-pressure pumping plant on the river side at the foot of Ash Street, and in this pumping plant there were installed three, 20-light, United States arc dynamos, each driven by an independent Westinghouse high-speed engine. Commercial arc lighting service was delivered from this plant, which occupied the four stories, basement and sub-basement of a small ell on a rear corner of the Starr Building. The heavy pumping machinery was placed in the sub-basement below the river level, the boilers occupied the basement, the engines the first floor, and the was enlarged by the addition of five 750-light, 1000-volt, Westinghouse alternators with Westinghouse engines to accompany them. This plant constituted the first alternating equipment of Portland, and it is noteworthy further in that it was sold to the United States Electric Lighting Company by H. W. Goode, then representing the Westinghouse Electric Company, and as such marks his entry into the electric lighting business of Portland. The Weidler plant was operated about five years, during which time it was increased by the installation of four sixty-five-light Brush arc dynamos, and two Thomson-Houston fifty lighters. In the meantime the Weston arc dynamos had been impressed into service for incan-

descent street lighting, five 110-volt incandescent lamps being placed in series across the 550-volt circuit. Upon the advent of the Westinghouse machines, however, this primitive installation was abandoned for the then more modern series system consisting of fifty-volt lamps each shunted by a reactance coil. In the Weston series incandescent system each lamp was supplemented by a second one which was cut into service on the burning out of the first lamp.

By this time the possibilities of electricity for lighting purposes had become firmly impressed upon Mr. Morey, who from the outset believed in the eventual practicability of developing electrical power from the falls of the Willamette River, at Oregon City, and transmitting it for industrial uses to Portland, and these ideas culminated on November 8, 1888, by the incorporation of the Willamette Falls Electric Company, which was organized for the water power development stated. Station A was then built at the Basin on the east side of the river at the Falls, and into it were moved all the equipment that had been in operation at Weidler's Mill, with the exception of the original five Westinghouse alternators. Early in 1890 six 4000-volt, 1500-light, Westinghouse alternators were installed therein after seemingly endless difficulty in inducing the Westinghouse Electric Company to build generators of such an "excessively" high protential. These machines were the first ones produced from the Westinghouse shops having coil-wound armatures, all previous armatures being provided with the so called pan-cake windings. As the outgrowth of the Willamette Falls Electric Company, the organization of the Portland General Electric Company was effected in August, 1892, and in October of the same year Mr. Goode become identified with it as general manager, being elected to the first vice-presidency in 1900, and to the presidency in the spring of 1902. Mr. Morey, on account of ill-health, retired from business early in 1902, and died early in July, 1904.



THE ORIGINAL, OR 1893-'94, SECTION OF STATION B, AT OREGON CITY, OR.

The actual development of water power from the Falls of the Willamette dates from 1854 when Dr. John McLaughlin, agent of the Hudson Bay Company, erected a grist mill on Abernathy's Island, now about the site of Station A. This was followed in 1863-64 by the erection of the La Rocque Grist Mill on the site now occupied by the Portland Flouring Mills, which, indeed, was built at the outgrowth of the La Rocque Mills. Prior to this, however, and in order to facillitate the landing of steamboats of the upper river of Oregon City, the people's Transportation Company had built the Basin, which was used not only as a steamboat landing but as a canal and forebay. Up to the time of the building of the Basin, freight from the upper river for Oregon City was landed

at Canemah and transported thence to Oregon City by a mule tramway built in 1860 by D. P. Thompson, one of the pioneers of Portland. The Oregon City Woolen Mills were built in 1865 and in the early '70s the People's Transportation Company, appreciating the necessity for open navigation between the upper and lower rivers, began the construction of the Willamette locks, which were completed on January 1, 1875, the first river steamer to traverse them being the "Maria Wilkins." From the People's Transportation Company the ownership of the locks passed successively through the Oregon Steam Navigation Company, the Oregon Railway and Navigation Company, the Willamette Transportation and Locks Company and the Portland General Electric Company—the latter concern consisting of the consolidation of the Willamette Transportation and Lock Company and the Willamette Falls Electric Company. This ownership carries with it that of the entire water rights of the falls.

These locks are of interest not only from the fact that they are indespensible to river navigation, but also because of the further fact that many of the manufacturing enterprises there located are driven by water power taken from their canal. They are forty feet wide between the pitch lines, but being rock-faced will pass a steamer of a width of thirty-seven feet. The upper canal has a length of 1500 feet above the guard lock, after which follows the center canal having a length of about 1200 feet. Four lip locks are provided, each being 210 feet long, forty feet wide, and designed to give a ten-foot lift. The gates are timber-faced and the locks will pass during the low water season boats having a draught of three and one-half feet, with a seven-foot draught during high water and five feet being the average. It is of further interest to note that the amount of water consumed in the operation of the locks themselves is equivalent to the continual use of slightly less than ninety horsepower.

According to the survey of United States engineers made in 1890, the Willamette River, at Oregon City, has a minimum flow of 15,000 cubic feet per second, but this rating is far in excess of the conservative figures which are relied upon by the hydraulic engineers of the Portland General Electric Company in the development of power. The latter figures, which are probably ultra conservative, show that the maximum flow during the wet season is approximately 350,000 cubic feet per second, and that the average flow is probably one-sixth of that, with a minimum flow of from 6000 to 7000 cubic feet per second. These figures are from readings taken one-half a mile above the Falls. The head fluctuates from a maximum varying from forty to forty-two feet at the time of minimum flow to a minimum head of twenty feet at the time of maximum flow. In round figures these represent a capacity of 25,000 horsepower at minimum flow.

THE SECOND, OR 1896-'97, SECTION OF STATION B, AT OREGON CITY, OR.

In point of reality the present hydraulic development at Oregon City is as follows:

Total east side development	5750 horsepower
Total west side development	26,850 horsepower
Total development	32,600 horsepower

The arrangement of these various properties are shown by the map given on page 300, which illustrates the contour of the Falls and the means that have been adopted for their present and prospective power development. All industries occupy not only the premises but their water rights as lessees of the Portland General Electric Company. The pulp and paper mills have been in operation on the sites indicated, since 1889, and they are operated exclusively by hydraulic power in-so-far as it is possible for hydraulic power to satisfy the requirements. In the Willamette Mills, for instance, steam boilers to the extent of about 4000 horsepower are installed, and from them about 2500 horsepower in steam is used in making sulphite, the balance going to steam engines for operating the paper machines. In the Crown Mills about 900 horsepower in steam is used for cooking sulphite pulp and drying paper, while a steam engine of 100 horsepower capacity assists the water wheels. The new mills of the Willamette Company, and which are now under construction, will be driven by three 800 horsepower electric motors in the beater mill, and it is the intention to gradually substitute electric power for water power in the paper mills as may be possible.

Probably the most difficult piece of construction work ever undertaken in the building of foundations on the Pacific Coast was encountered with those of Station B, which is located at a point that was beset with such difficulties in the way of securing foundations that no lessee could under any circumstance be induced to occupy the site. As the result the Portland General Electric Company was confronted with the alternative of occuping this site itself or leaving it vacant forever. It chose the former course, and the execution of its plan necessitated going to a depth of thirty-six feet below low water for bed-rock. Station B is located on a site which originally consisted in at least one-half its area in pot-holes filled with loose rock, to circumvent which the site was inclosed in a coffer dam that was three hundred feet long, twenty feet wide and forty-four feet high in its deepest part. This dam was of crib formation, sheathed with pine and filled with clay and gravel, and in pumping it out great difficulty was experienced from the wood-shavings which had accumulated there for years, clogging the foot valves of the pumps, which were of the centrifugal type, steam driven. No trouble was experienced after the mill refuse had been cleared away, and the dam was found to be

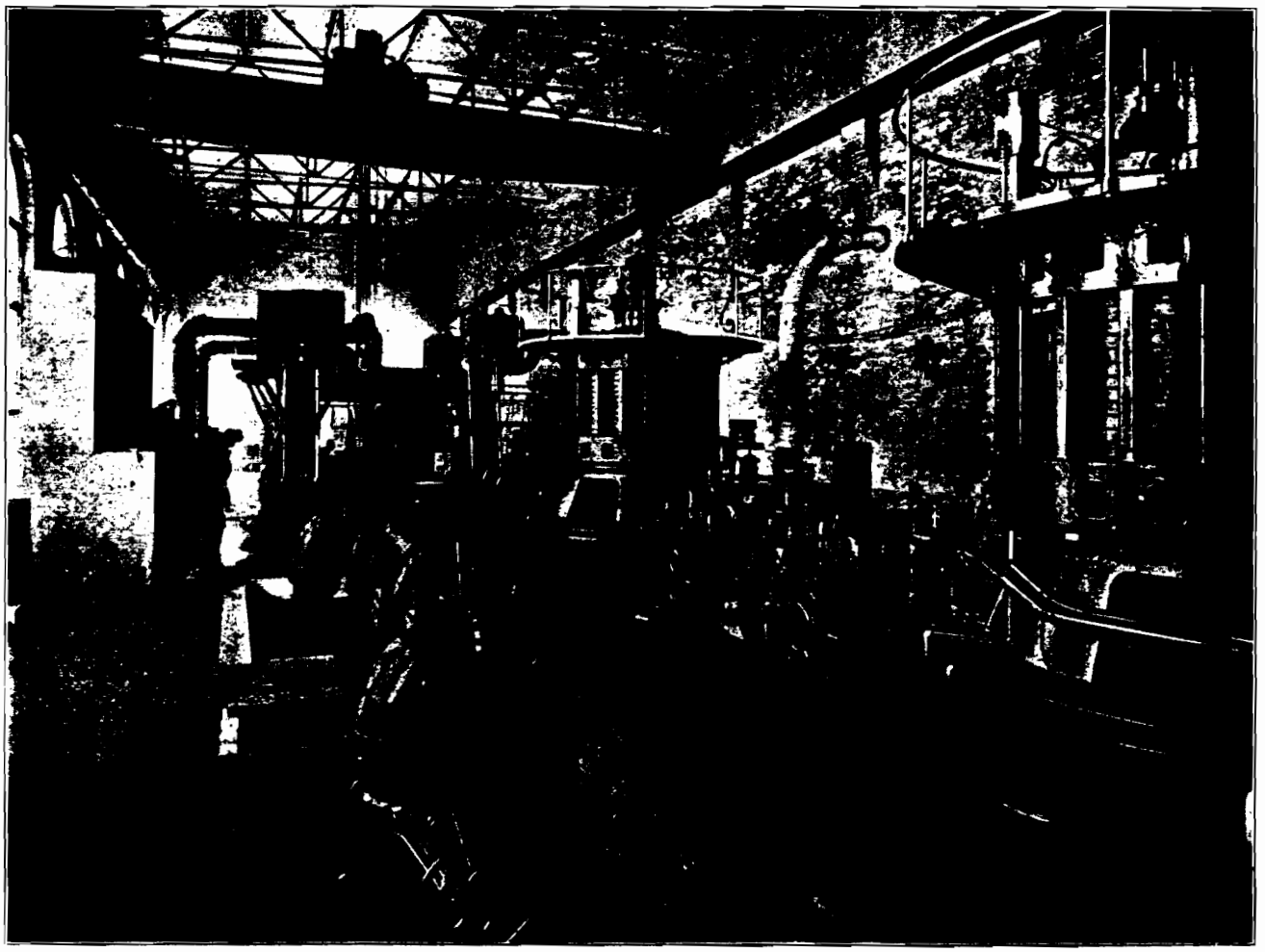
ANOTHER VIEW OF THE SECOND SECTION OF STATION B, WITH A PORTION OF THE ORIGINAL SECTION IN THE BACKGROUND

perfectly stable. An idea of the extent of concrete work executed in Station B may be conveyed from the statement that above 20,000 barrels of Portland cement were used in its construction.

The physical conditions confronting the hydraulic design of an electric power house to be operated under a maximum head of nominally forty feet down to a minimum head of twenty feet will be promptly recognized as exceedingly severe, and those conditions were satisfied through the installation of two sets of water wheels to each generating unit, one set being twice the capacity of the other. Normally the smaller wheel, which is designed to operate under heads varying from thirty to forty feet, carries the load, but in times of high water in the lower river the larger wheel, which operates at heads varying from twenty to thirty feet, carries the load. These turbines are of the Victor type, regulated by Replogle governors. In addition to them Station B carries two McCormick turbines, each driving by direct connection through horizontal shafting a 550-kilowatt generator. These latter turbines are designed to carry full load under head of twenty feet, and they give their greatest efficiency during the period of low water. On the other hand they are never operated under a head of less than twenty feet.

The principal improvement contemplated in the way of the future development of power at Oregon City will consist in the substitution of a concrete dam for the present timber crib dam containing the Basin on the east side of the river. The course of this proposed dam is indicated by dotted lines on the accompanying map, and its southerly end will consist of a power house approximately 700 feet in length by about eighty feet in width, which will be equipped for the development of 40,000 horsepower in 3000-horsepower units.

It is the purpose of this article to discuss the principal historical and extraordinary features of the system under consideration, rather than to detail the apparatus which its stations contain. In line with this policy it is pertinent to state that Station A is now abandoned as an electrical plant, all machinery being moved therefrom, but its wheels remaining for the operation of the East Side mill of the Willamette Pulp and Paper Company. Station B on the west side of the river is interesting mainly from the standpoints of its hydraulic features and types of generators. The two 250-kilowatt, 500-volt, direct-current dynamos of the vertical shaft type, while originally intended for use as exciters, are now delivering power for electric railway service; its three-phase gener-



STATION E OF THE PORTLAND GENERAL ELECTRIC COMPANY, SHOWING TWO 1500-KILOWATT CURTIS STEAM TURBINES IN THE FOREGROUND

ators are excited from direct current machines driven by belting from fly-wheels placed on the shafts of the McCormick turbines. Its newer three-phase generators deliver current at 10,000 volts in star connection, while the old 6000-volt generators have been rewound, and although some of them are at present delivering 6000 volts to line, the connections have all been changed over for the delivery of 10,000 volts. The station is operated under signal instruction from the substation at Portland, and it delivers power thereto only by the most simple and direct means.

The additional generating plant of the company consists of two steam-driven stations located in North Portland, the equipment of which, together with that contained in the Oregon City plants, is listed in the table of engineering data which is appended hereto. Station E is a remarkable plant in many ways. The use of sawdust under conditions which exist enable it to produce power with an exceeding economy of fuel. Its concrete stack alone constitutes a remarkable engineering achievement. The station itself is of the best possible building construction and its generating equipment, consisting of two 1400-horsepower compound marine type engines, with their respective generators, and its two 1500-kilowatt steam turbines, are of surpassing interest. Station C, which adjoins, is an older type of station presenting no unusual features.

The bulk of the output of the various stations is delivered to Substation A, located on the northeast corner of Seventh and Alder Streets, adjoining the main offices of the company. The contents of this substation are also detailed in the table of engineering data, but particular interest therein centers in the three frequency-changing sets which it contains, one of them having a capacity of 1000 kilowatts and the others being rated at 500 kilowatts each. Locally these frequency changers are termed motor-generators, for they are of that type, consisting of a synchronous motor direct-coupled to a three-phase generator, the motor taking three-phase, thirty-three-cycle current at nominally 10,000 volts, and the generator delivering three-phase, sixty-cycle current at 2300 volts. The use of thirty-three cycles dates from the time when Station B was built in 1893, and the selection of this frequency was adopted as a medium that would best fit the various conditions imposed by a mixed load, consisting of incandescent and arc lighting and power service, together with the operation of rotaries for railway duty. The subsequent determination of a periodicity of sixty cycles per second as standard in lighting and power works made the installation of frequency changers a necessity, but the synchronizing of these frequency changers, considering their build, developed a problem the solution of which became a matter of exceeding nicety.

INTERIOR OF STATION E, PORTLAND, AS SEEN FROM THE END CONTAINING THE MARINE TYPE ENGINE UNITS

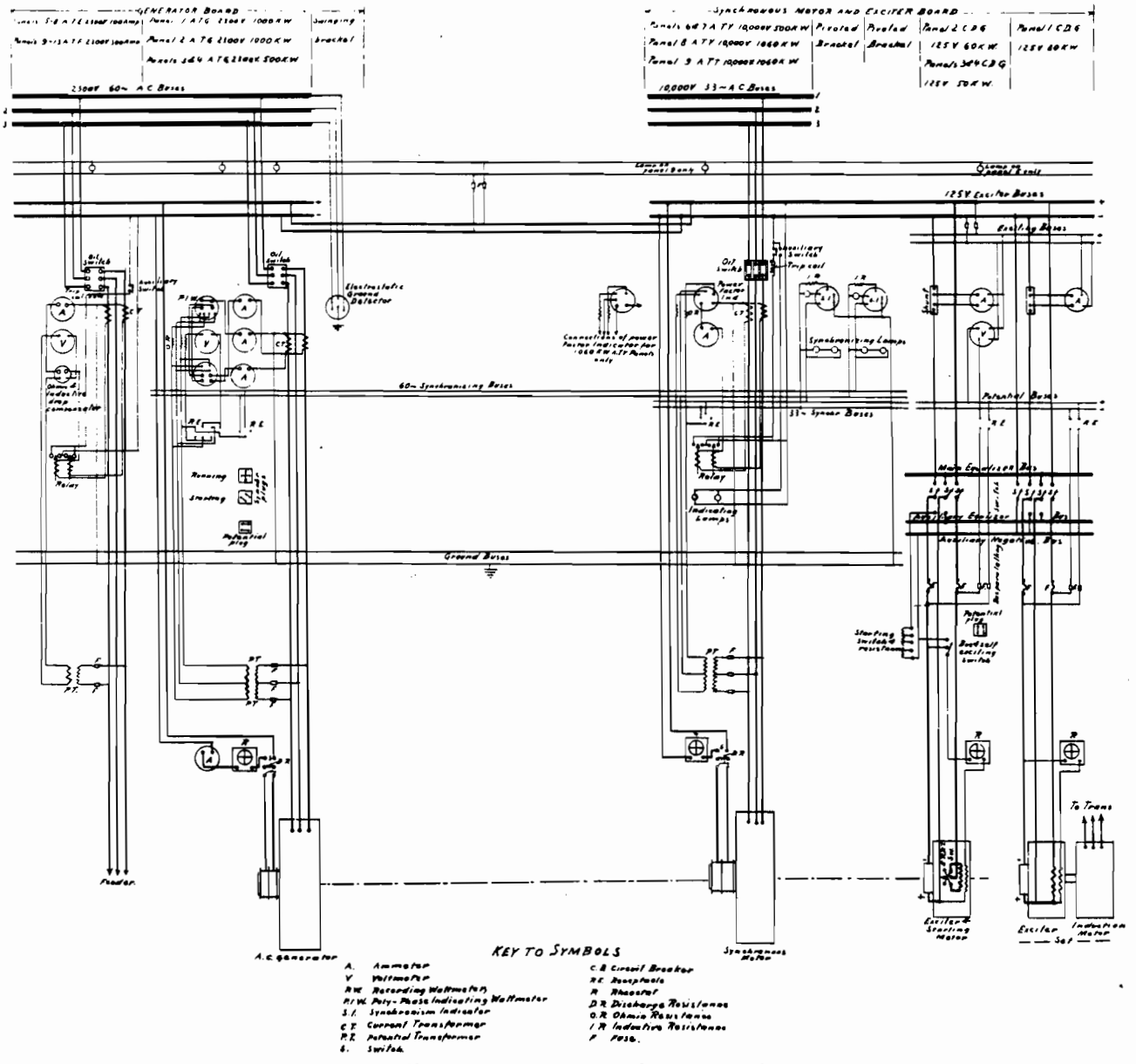
While it would be a simple matter to synchronize both sides under normal conditions in the design of machines built specially therefor, the fact that the ratio of the number of poles on the motor to those on the generator is as ten to eighteen involves serious complications. Overhung from the main bearing of each unit is a direct-current machine, provided for the dual use of starting motor and exciter, its potential being at 110 volts. The starting current for these machines is taken from the motor-generator set, consisting of a sixty-kilowatt, 220-volt, three-phase induction motor, taking current from a three-phase, started independently of the exciting busses, and so that these busses may give any starting combination without interfering with the exciter busses. Arrangements are further made for installing a Tirrell regulator on these busses should it be found desirable. In other respects the remaining panels of the board are of ordinary arrangements, with the exception of the synchroscope, which contains two dials, one for each frequency. In starting up the set a special switch that is provided on the overhung direct-current exciter is closed so as to convert it into a differential motor. The small sixty-kilowatt motor-generator set is then placed in oper-

AN INTERIOR VIEW OF SUBSTATION A, AT PORTLAND, SHOWING RESPECTIVELY TRANSFORMERS, ROTARY CONVERTERS AND FREQUENCY CHANGING SETS

100-kilowatt, thirty-three-cycle transformer, the primaries of which are cut in on the 10,000-volt mains. This induction motor drives by direct connection a sixty-kilowatt, 110-volt, direct-current generator. The switchboard equipment consists of high-tension panels, equipped with hand-operated "K" switches that have automatic trips on the 10,000-volt side. Similar switches are installed on the generator side, but they are non-automatic. The motor board carries principally power factor indicators and ammeters. The direct-current panel carries five busses, as shown on the accompanying diagram, these being the positive and negative exciter busses, the general arrangement being such that each machine may be ation, when, as soon as it has come up to speed the motor-starter, as the small direct-current machine on the shaft of the frequency changer is termed, is thrown on to the starting busses with suitable resistance inserted with its mains. This resistance is cut out as the speed rises, and when the machine is up to speed the fields of the synchronous motor are thrown under excitation, as are also those of the generator. The speed of the combined set is, of course, controlled by the rheostat of the starting motor, and in synchronizing it will be found that the needle of its motor synchroscope will make five revolutions to nine revolutions of the needle of the syncroscope connected to the generator. Synchronism is indicated when both needles reach the nodal points simul-taneously.

The rotaries in this station are started inductively with fields open and with a very low applied voltage. Ordinarily the direct current brushes are arranged from the commutators and the rotary is brought up to speed with its generator at the steam plant, for each rotary has its own generator and circuit.

With these introductory observations the reader will become possessed of a better understanding of the general conditions existing in the system of the Portland General Electric Company, preparatory to the specific details which follows.—THE EDITOR.



WIRING DIAGRAM OF THE 1000-KILOWATT FREQUENCY CHANGING SET

GENERATING AND DISTRIBUTING SYSTEM OF THE PORTLAND GENERAL ELECTRIC COMPANY.*

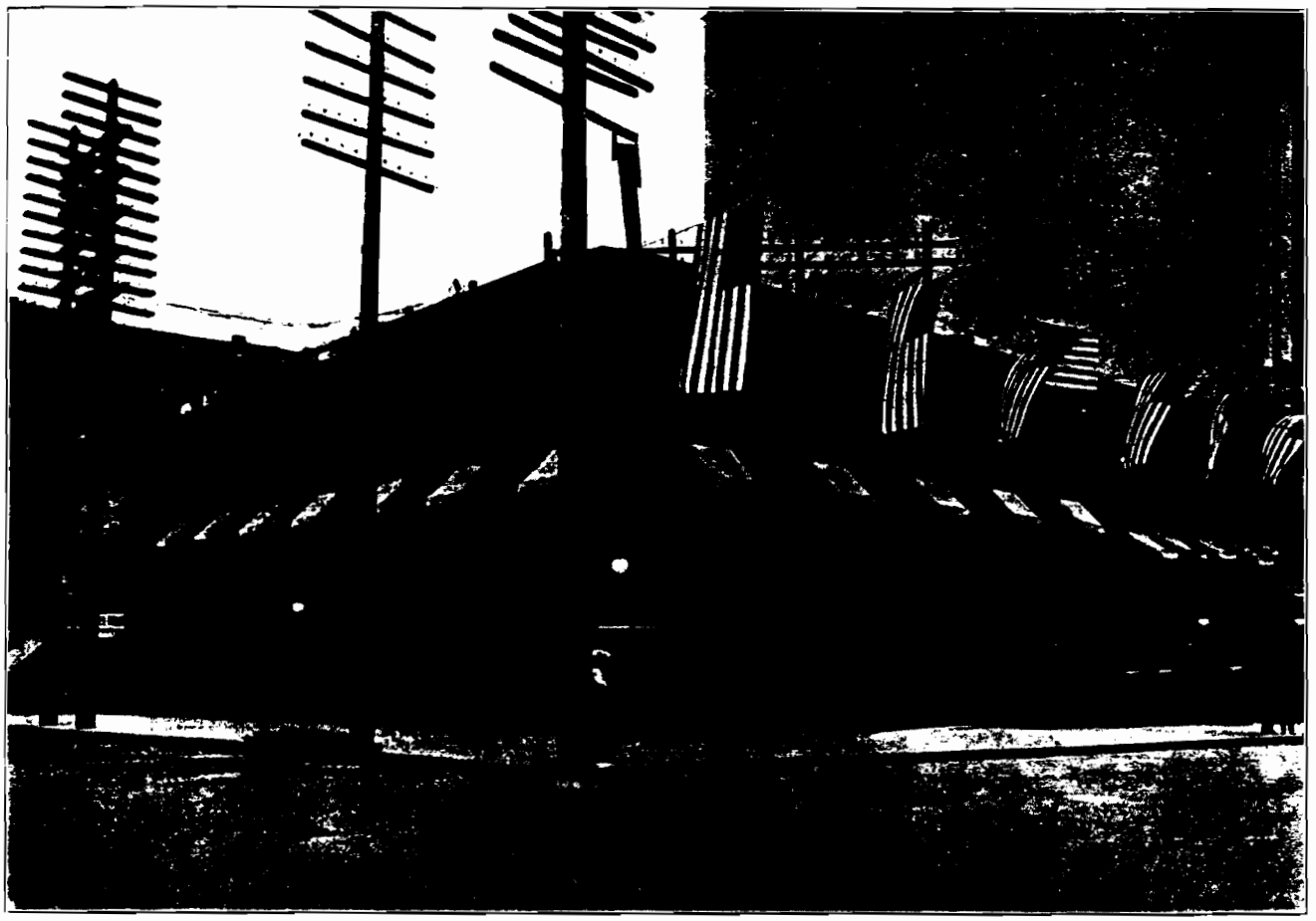
BY F. G. SYKES.

As it is probable that most of my listeners will find opportunity to visit the various stations and sub-stations of the Portland General Electric Company before the close of this congress, it is not the purpose here to enter into a lengthy description of the details of its stations, but rather to confine this paper to a general description of its generating and distributing system, leaving further investigation to the individual members themselves, should they so desire.

The Portland General Electric Company's system is in some respects different from other similar systems, and it may be well to glance for a moment at the conditions which prompted the adoption of such a system.

About 1889, the Willamette Falls Electric Co. built a wooden station on the east side of the Willamette River at Oregon City, close by the Willamette Falls, and installed six Westinghouse eight-kilowatt 125-cycle 4000-volt, and two Thomson-Houston 120-kilowatt 125-cycle 2000-volt arc circuit generators, which were run by Victor turbines. The voltage of the Thomson-Houston machines was stepped up from 2000 to 4000 volts by means of transformers, and the power was transmitted to Portland on the east side of the river, while the power from the

Westinghouse generators was transmitted at an initial potential of 4000 volts to Portland on the west side of the river. In order to furnish this power at Portland, a distance of fifteen miles, to be used for incandescent lighting, eight single-phase circuits were run, or one circuit for each generator, one of these circuits being on the east side of the Willamette River and seven on the west side. Eleven 100-lamp 2000 candle power, Excelsior arc machines were also installed in the station at Oregon City, and three arc circuits were completed between Portland and Oregon City on the east side and eight on the west side, a circuit being provided for each arc machine. Sub-stations were provided in Portland, both on the east and west sides of the Willamette River, to accommodate transformers for reducing the received voltage from 3000 to 1000, which was the voltage used for distribution in Portland on the west side, and from 3000 to 2000 volts for distribution on the east side of the Willamette. I believe that this system inaugurated the first long distance transmission in this country, and that the Westinghouse generators were the highest voltage machines that had been built at that time.



SUBSTATION A AND GENERAL OFFICES OF THE PORTLAND GENERAL ELECTRIC COMPANY, AT PORTLAND, OR.

In 1894 the electric railway system in Portland was built, and it was necessary to furnish power for its operation. Four sections of the present Station B were built on the west side of the Willamette Falls at Oregon City and two 400-kilowatt rotary converters were located in the basement under the present office, at Seventh and Alder streets, Portland. In order to obtain three-phase circuits to operate the rotary converters and more copper to take care of the increased load, the arc machines were brought to Portland, direct connected to motors and arranged to operate at 500 volts, direct current, from the rotary converters. The arc circuits between Oregon City and Portland were arranged in groups of three wires each, to operate the three-phase circuits, a separate circuit being provided for each machine, practically as they are today, thus making each machine at Oregon City each three-phase circuit, and each rotary converter at Portland one seperate unit.

When Station B was built it was decided to change the frequency from 125 to 33 cycles in order that arc and incandescent lamps might be operated from the same frequency as that used in operating the rotary converters. Sixty cycle rotary converters at that time were not successful, and it was hoped that low frequency arc lamps would be developed, hence the compromise frequency adopted.

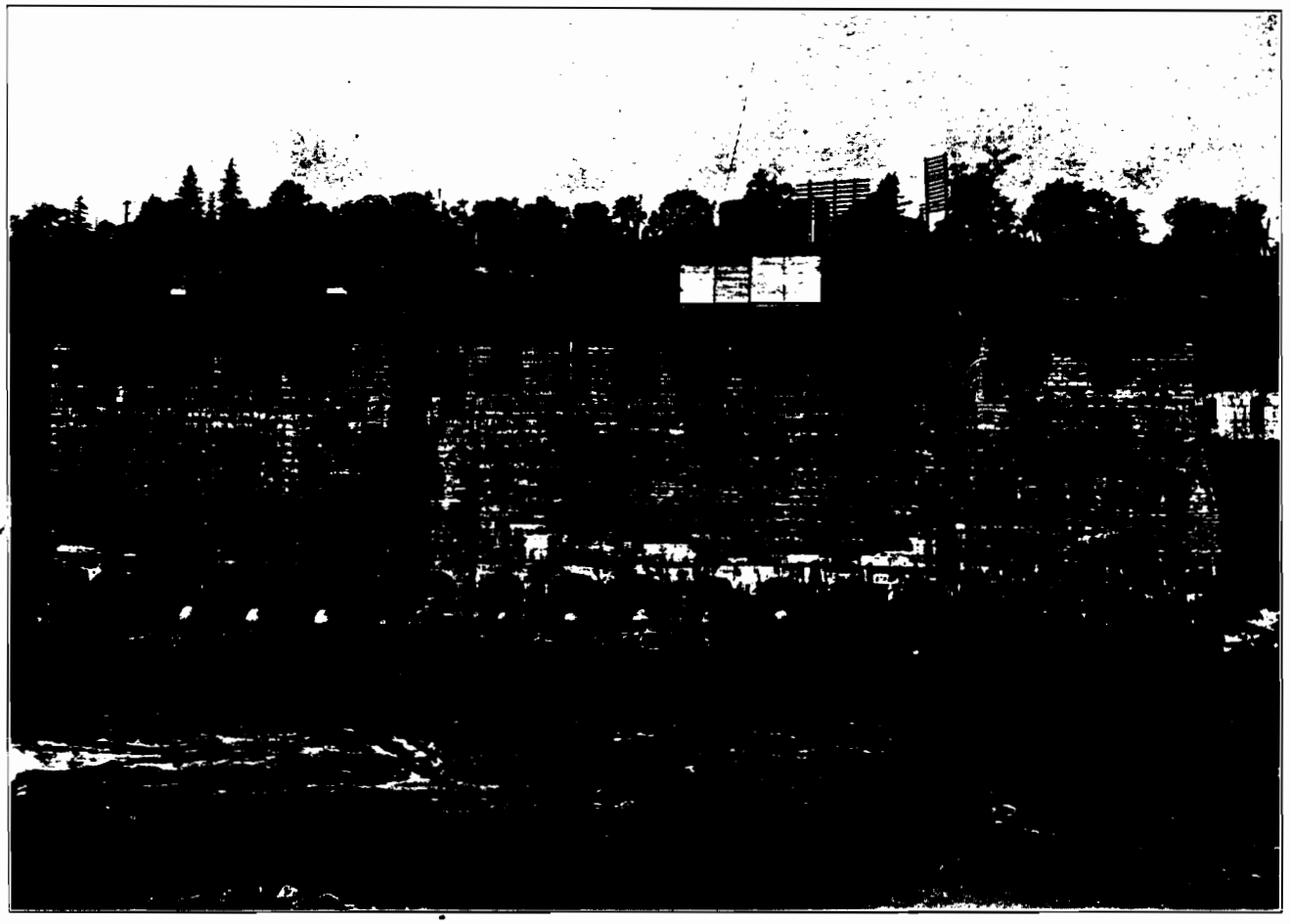
With this brief history regarding the reasons for developing the transmission line as it was and is at present, and for adopting a frequency of thirty-three cycles, I will proceed with a short description of the generating and distributing system.

The Portland General Electric Company furnishes

power for lighting the cities of Portland, Oregon City, St. Johns and suburbs, and for operating the railways of the Portland Consolidated Railway Company and the Oregon Water Power & Railway Company, and also for operating the Portland Flouring Mills and for other manufacturing purposes near at hand. The generated current is three-phase thirty-three-cycles, 10,000 volts, and can be furnished either from the water power plant at Oregon City, known as Station B, or from the steam station, located in Portland, known as Station E. This power is led to the sub-station in Portland, known as Sub-station H and located at the corner of Seventh and Alder streets, where part of it is changed by means of static transformers from 10,000 to 2300 volts, to be used for lighting purposes. It is distributed throughout the city of Portland at this voltage, and at a frequency of thirty-three-cycles, over single-phase circuits. The rest of the current for lighting purposes is transformed by means of motor-generator frequency changing sets from three-phase thirty-three-cycles 10,000 volts to three-phase sixty-cycle 2300-volt current, which in turn is distributed throughout the city by means of single-phase circuits.

The street arc lighting is accomplished at the present time by Thurston-Houston direct current open arcs furnished with current from the original Excelsior arc machines, which are operated by means of individual "D62" Thomson-Houston motors, direct driven from the 500-volt direct current railway machines.

Power is furnished to the railway system from Oregon City, and is conducted by means of individual transmission circuits to five 400-kilowatt rotary converters, and one 1000-kilowatt rotary converter, located at Sub-station A. This power is furnished to the Portland Consolidated Railway Company at a pressure of 550 volts at the bus-bars, the railway company providing the necessary feeders, etc., for distributing it to its trolley wires. The power or flour mill circuit at the present time is operated at about 6000 volts, over a three-phase thirty-three-cycle circuit. It is intended, however, to change this in the near future, to operate at 10,000 volts.



STATION B OF THE PORTLAND GENERAL ELECTRIC COMPANY, AT OREGON CITY, OR.

The various stations operated at present by the Portland General Electric Company are designated and located as follows:

Station B, located on the west bank of the Willamette Falls, at Oregon City.

Station C, formerly known as the Union Power House, located at the corner of Sherlock avenue and Twenty-first street, Portland.

Station D, which is located at the corner of Mill and Chapman streets, Portland.

Station E, which is the new steam plant, located close beside Station C.

Sub-station A, which is the distributing transmission station, and is located at the corner of Seventh and Alder streets.

I will now take up a description of each of these stations in turn.

The first five sections of Station B, with the foundations for seven additional sections and the bulkhead immediately above were built in the fall and winter of 1893-4; the seven additional sections were completed and foundations for the last two sections were built during the fall and winter of 1896-7, the last two sections being completed early in 1903. This building is of concrete construction and consists of a series of pier walls, vertical and horizontal arches, connected and reinforced by the use of iron rods built in the concrete, and arranged to form separate chambers or independent sections below the generator room for the draft tubes flume and water-wheel rooms. The first set of arches above the foundations forms the floors of the flume and wheel rooms, and the second set of like arches forms the roof over the flume and wheel rooms, and the floor of the generator room, which is of cement.

The generator room is 246 feet long, 206 feet of which is thirty-eight feet wide and forty feet is sixty-four feet wide. Its concrete walls are seventeen inches thick and twenty feet high from floor to roof truss plates, and are strengthened with pilasters every sixteen feet; the room is well lighted and ventilated by twenty-six windows six feet two inches by thirteen feet three inches. The roof is of timber truss, plank sheathed construction, covered with composition felt gravel roofing, and having wire tower of like construction near central part.

Station B is equipped with a twelve-ton electric traveling crane, and two twelve-ton handpower traveling cranes. The electric power crane can be used throughout the entire length of the building except in the end offsets, which are served by the handpower cranes. The switchboard and electric controlling apparatus is located in the central portion of the building below the wire tower. The racks to prevent debris getting to the wheels are set at inclination of one and one-half inches per foot to facilitate cleaning, and are supported by a steel frame of "I" and channel beams securely tied together and built into the concrete walls of the station. The forebay or headrace is open and extends along in front of and up to the concrete wall of the station.

The tail race is a natural arm of the river extending to and into which the station is built. The penstocks are of wrought steel, having cast iron heads and covers, and are connected to the open forebay by short steel cylindrical feed pipes extending through the concrete wall of the power station. Each unit is an independent and equipped with a supply gate operated by handpower through gearing. The supply gate is provided with large balanced iron wickets, so that it may be closed and the water shut off from the penstock without difficulty, even though the wheel gates could not be closed nor the wheels shut down through accident to their particular gate gearing or from other cause.

The original overflow dam is a timber crib plank deck, rock filled dam, fitted and secured to bedrock with iron anchor bolts, and has an upstream slope of two horizontal to one vertical, and a down-stream slope of one horizontal to one vertical. The slopes converge to an apex formed of heavy timber, rounded off. The height of the dam varies from three to twenty feet, and its greatest width of base is thirty feet.

The original dam structure, located on the west side of the river and extending to the center of the falls, was built in 1889 and was still in good condition after having passed, without serious injury, through the greatest floods known, when it was replaced last year by a solid concrete dam, made necessary by new works constructed at the falls. The present length of overflow dam is 2460 feet.

The power station proper, with its bulkhead and open forebay or headrace, occupies about 54,000 square feet. The storage area directly above and in front of the wheels, considering the open forebay only, is 27,500 square feet, and it has a depth of twenty feet at low water.

The water supply of the Willamette River above the falls is furnished and maintained by the watershed immediately tributary to itself and tributaries, among the most important of which are its coast and middle forks, the McKenzie, Calapooia, Santiam, Pudding, Mololla, Long Tom, Mary's, Luckiamute, La Creole, Yamhill and Tualatin Rivers, with their numerous forks and smaller branches, having their sources in the Calapooia Mountains at the extreme headwaters of the Willamette itself, and the Cascade and Coast Range Mountains, respectively; the whole system draining an area estimated at, approximately, 10,000 square miles.

The water conditions at this station are somewhat peculiar, owing to the fact that the normal head varies at different periods of the year from approximately forty feet to approximately twenty feet. During the months of May and June, the snows melting from the mountains at the headwaters of the Columbia and Snake Rivers, makes the former back into the Willamette. While the height of the river above the falls does not vary greatly, that below the falls, during these seasons of the year, is very much increased, thus cutting off the head. For this reason it was necessary to install two separate turbines, one forty-two inches in diameter and the other sixty inches in diameter, as noted below. During the months of July, August, September and part of October, the head is very high but the quantity of water is at its lowest stage. Throughout the rest of the year there is no lack of either water or head.

The water wheels are the regular American "Mixed Flow" turbine type, set above the tail water, and using draft tubes of twenty-one feet vertical distance between the wheels and the surface of the tail race at low water, in the sections equipped with vertical settings, and twenty-seven feet vertical distance between the center of the wheel shaft and the surface of the tail race, at low water, in the sections equipped with horizontal settings.

The main water-wheel equipment consists of ten Victor cylinder gate wheels forty-two inches in diameter, and ten increased capacity Victor cylinder gate wheels sixty inches in diameter, each set on vertical shafts. One wheel of each of the above diameters is installed in each section as one setting and is arranged to drive a single generator at a fixed speed, 200 r. p. m. at all heads varying from twenty to forty feet. These units are arranged so that they can be operated separately or all together for driving the generator, as may be required to get the best results and the most economical use of the water. The generator is direct connected to the forty-two inch wheel shafts and of which is placed in its own vertical shaft, the two wheels, however, being located in one section and arranged to be used, at the present time for furnishing power to the electric railroads around Oregon City.

The latest additions to the station are two horizontal sets, each consisting of two new McCormick cyclinder gate wheels fifty-one inches in diameter, direct connected on the same shaft to a 540-kilowatt general electric generator.

All the vertical wheel shafts mentioned above are provided with ring thrust and oil pressure piston bearings, except the sixty-inch wheel shafts, which have only the ring thrust bearings. These bearings are placed in cases,

STATION E OF THE PORTLAND GENERAL ELECTRIC COMPANY, AT PORTLAND, OR.

the sixty-inch wheel is connected to the forty-two-inch shaft and generator by means of an endless horizontally running double leather belt forty-six inches wide. The tension on this belt is controlled by a belt tightener that is arranged to move on its track by pinion and rack gearing, and the tightener shaft is supported on an ample step and runs in trunnion self-adjusting bearings, all of which are provided with self-lubricating oil baths.

In addition to the above equipment, there are installed two standard Victor cylinder gate wheels, each 15 inches in diameter and set on horizontal shafts. These sets are used in the pump section for driving the oil and water circulating pumps. There are also provided two Victor cylinder gate wheels forty-two inches in diameter, each supported from the flume heads on cast iron columns, and are arranged to carry the weight of the generator, armature or field, as the case may be, and of the pulleys and shafts. No part of these weights come upon the water wheel steps, as the shafts are separated by the coupling above the water wheel and the connection is made with a heavy pin drive or jaw, as the case may be, the faces of the separate halves of the coupling being one-quarter of an inch apart.

The generators installed in this station are of the following types and capacities:

Seven 450-kilowatt, three-phase 10,000-volt, revolving armature, thirty-three-cycle generators.

Three 500-kilowatt three-phase 10,000-volt, revolving field, thirty-three-cycle generators.

Two 540-kilowatt three-phase 10,000-volt, revolving field, thirty-three-cycle generators.

One section contains:

Two 200-kilowatt, vertical, 500-volt direct connected generators, used either as exciters or street railway generators.

The 540-kilowatt generators are horizontal and the remainder are vertical. To each of the two horizontal generators is belted an eighty-five-kilowatt 125-volt exciter. All of the generators are of general electric make.

The switchboard at Station B consists of general electric apparatus: Form K, 10,000-volt, single-phase oil switches, mounted in concrete compartments, and hand-operated from the control panel. Cambric insulating cables connect the generators with the switchboard. The feeder circuits run from the switchboard up into a wire tower located on the roof of the station, and pass out directly across the canal to the pole line leading to Portland.

The apparatus located in Station D, which is part of the old cable power house formerly belonging to the Portland Railway Company, consists principally of a 325-kilowatt 550-volt direct current railway generator, belted to a small engine. This station has been practically shut down, as power furnished by it is only used at times of extreme heavy load.

As Stations C and E are together, I will describe them as one station. These stations are located in adjoining buildings, on property owned by the company, situated at the intersection of Nicolai street and Front street, the ground area being 320 feet by 200 feet. There is, in addition, a detached strip forty feet wide extending into the Willamette River as far as the harbor line.

Station E is a brick structure with a steel truss roof covered with tar and gravel roofing. The engine room if forty-six feet by 160 feet in size, and is separated from the boiler room by a twenty-four-inch curtain wall. The boiler room is sixty-one feet by 148 feet, with an ell at one end thirty-six feet by seventy-one feet. The curtain wall is provided with fireproof doors, and there are also fireproof doors in the wall between Stations C and E. Station C is composed of a boiler room 100 feet by forty feet, an da nengine room 100 feet by 120 feet, all being in a frame structure with galvanized iron siding, wooden truss roof and tar and gravel covering; the engine room is separated from the boiler room by a twelve-inch curtain wall of brick.

The stack of Station E is 230 feet high, of concrete steel construction, and is twelve feet inside diameter. Each battery of boilers in Station C is equipped with an individual steel stack about sixty feet high by three feet in diameter. Station E is equipped with five batteries of Cahall water tube boilers, manufactured by the Aultman Taylor Co., each battery having a rating of 1040 boiler horsepower, and is built to operate at 175 pounds pressure. Three of these batteries are equipped with Foster superheaters, built to superheat the steam to 175° Fah.

Station C has fourteen 100-horsepower horizontal tubular boilers and four 125-horsepower horizontal boilers, which operate at 100 pounds pressure.

In Station E one end of the boiler room has been reserved for a pump pit, in which are installed three Worthington horizontal centrifugal turbine pumps, driven by vertical engines, and which are used for pumping the condenser cooling water from the river through the condensers. Two lines of thirty-three-inch cast iron pipe are run to the river for this purpose, one being for the suction and the other for the discharge. In addition to these pumps three Blake outside-pack plunger pumps are provided for feeding the boilers. The suctions of these pumps can be taken either from the discharge of the circulating water as it comes from the condenser, or directly from the river. Arrangements have been made so that in case either of these two sources of supply should fail, the water can be forced into the boilers from the city main. The plant is also provided with three Goubert feedwater heaters.

All of the steam piping was furnished by M. W. Kellogg & Co., and installed partly by the Willamette Iron & Steel Co. and partly by the Portland General Electric Company. The high-pressure steam piping, which is made extra heavy, is of lap welded mild open-hearth steel, with Vanstone joints. All low-pressure piping, except the free exhaust from the engines outside of the relief valves and the free exhaust from the feedwater heater are of standard weight wrought iron pipe, the free exhaust above mentioned being riveted sheet iron pipe. The piping is arranged so that any part of the plant can be isolated when desired.

The boilers at Station E are arranged so that they can either burn oil or sawdust, and are provided with Dutch ovens, there being two ovens under each boiler, or four ovens per battery. Each oven is provided with two Morrissey oil burners, and the steam and oil piping, so arranged, by means of unions that the burners can be quickly and easily disconnected when it is desired to use sawdust. An underground storage tank is provided outside of the station, of sufficient capacity to hold two and one-half carloads of oil. This oil is pumped to the burners by means of a pressure pump, built by the Portland Machinery Company.

The main fuel used in the station, however, is sawdust obtained from the Eastern and Western Lumber Co. and the North Pacific Lumber Co. which are located close to the station. This sawdust is transported to the station by team and dumped into a hopper. From this hopper it is carried to the fuel house by means of a conveyer. There other conveyers take the sawdust and carry it to the boilers at either Station C or E as desired, where it is fed into the top of the Dutch ovens. A remarkably hot fire is thus furnished at a low cost.

The generating aquipment of Station E consists of:

Two 1400-horsepower marine type vertical compound engines, built by the Willamette Iron & Steel Works, of Portland. Each of these engines is direct connected to a

1000-kilowatt thirty-three-cycle three-phase general electric alternator.

One Ideal engine exciter of eighty-five-kilowatt capacity.

One motor-generator exciter of sixty-kilowatt capacity.

Two Curtis steam turbines, each rated at 1500-kilowatt, but good for 2000-kilowatt continuously.

The condenser system of Station E consists of two Worthington surface condensers, each having 2300 square feet cooling surface, and two Worthington surface condensers having 7800 square feet cooling surface, the latter being used for the Curtis turbines. These condensers are provided with air coolers and hot wells, and with the necessary dry vacuum and hot well pumps. The turbines are also provided with two outside packed plunger pumps for forcing the water into the step bearing at a pressure of 450 pounds per square inch. An accumulator is also used in connection with these pumps.

The oiling system for the engines consists of White Star oil filter, and for the turbines of two tanks, one placed near the roof and the other in the basement, the oil being pumped into the tank near the roof by means of small plunger pumps and allowed to run through the turbine bearings by gravity.

The piping arrangement is such that water from the condenser hot well can be used for the end step bearings of the turbines, the surplus water not used for these being fed through the heaters back to the boilers.

The generating equipment of Station C consists of:

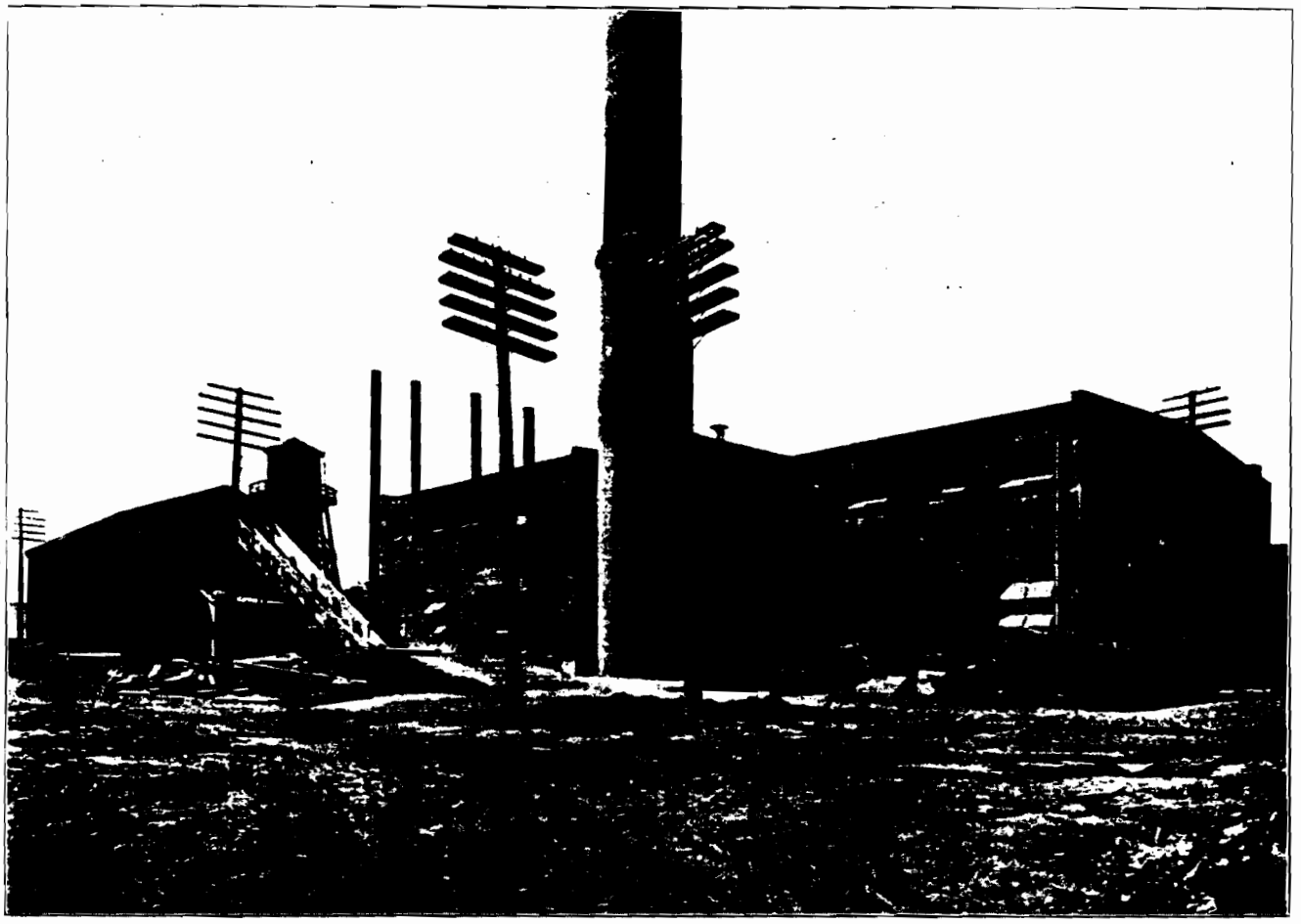
One double wheelock engine of 1600 horsepower capacity, at 100 pounds pressure, connected with rope drive to one 800-kilowatt 550-volt generator.

One Allis cross-compound engine of 1000 horsepower capacity, connected by rope drive to one 750-kilowatt 10,000-volt thirty-three-cycle alternator.

One 400-kilowatt and one 200-kilowatt general electric street railway generator sets, built to furnish 550 volts, and each direct connected to Fulton engines.

In Station C the Wheelock engine and the vertical railway sets operate non-condensing, while the cross-compound Allis engine, running the 750-kilowatt machine, is provided with a jet condenser.

The switchboard in Station E is composed of general electric apparatus, bus-bars, oil switch mechanism, lightning-arresters, potential transformers, etc., all placed in concrete compartments, and controlled by panels, placed at a suitable distance in front of these compartments. The remote control is used on all high-tension switches. All generators are connnected to the switchboards by



REAR VIEW OF STATIONS C AND E OF THE PORTLAND GENERAL ELECTRIC COMPANY, AT PORTLAND, OR.

means of cambric insulated cobles, drawn into ducts under the floor. The feeder wires leave the building through pipes and run out underground.

The switchboard equipment of Station C is composed of:

Panels to control direct current 500-volt machines and 750-kilowatt alternator.

Skeleton board at 2300 volts, which controls the current supplied to the Lewis & Clark Centennial Exposition.

The lighting of the station is so arranged that the light can be furnished either from the 500-volt direct current railway current or the sixty-cycle alternating current. Station E is equipped with a twenty-ton hand operated traveling crane, with a hoist arranged to operate electrically.

The maximum horsepower of the engines and boilers and the kilowatt capacity of the generators at Station E is as follows:

Boilers, 10,400 engine horsepower; engines, 2900 horsepower; turbines, 4326 horsepower; generators, 5145 kilowatts.

The capacity of Station C is as follows:

Boilers, 3200 engine horsepower; engines, 3440 horsepower; generators, 2150 kilowatts.

The one 400-wattmeter vertical set with Fulton engine and the 200-kilowatt similar set are supplied with steam from the boilers located at Station E.

The sub-station, together with the office, is built upon a plot of land located at the corner of Seventh and Alder streets, 100 feet by 100 feet. The building is a one-story brick structure, divided into two parts. The part next to Seventh street is sixty feet by 100 feet, and contains the rotary converters and motor generator sets; that next to Sixth street contains the arc machines in the basement, with the general offices located above. The substation is provided with a twenty-ton hand-operated traveling crane.

The rotary converter equipment of the substation consists of:

Five 400-kilowatt 550-volt and one 1000 kilowatt 550-volt rotary converters, all made by the General Electric Company. An additional 1000-kilowatt rotary converter is now on order, and is expected to be installed during the coming month. These rotaries are each provided with three suitable air-blast transformers, stepping down from 10,000 volts to 375 volts, and each has an alternating current panel and corresponding direct current panel at the switchboard.

The motor generator or frequency changing equipment of the sub-station consists of two 500-kilowatt and one 1000-kilowatt 10,000-volt thirty-three-cycle synchronous motors, direct connected to 2300-volt sixty-cycle generators, each provided with a 125-volt fifty-kilowatt, and sixty-kilowatt in the case of the 1000-kilowatt motor-generator set, combined starter and exciter, mounted on the end of the same shaft.

The switchboard equipment of these machines consists of the motor generator and exciter panels necessary for their control. The thirty-three-cycle lighting equipment of the sub-station consists of six 375-kilowatt 10,000 to 2200-volt thirty-three cycle single-phase transformers, each furnished with its own distributing panel.

The arc light equipment of the sub-station at the present time consists of eight motor generator arc sets, each made up of a 100-light Excelsior arc machine, direct connected to a D-62 motor.

DISTRIBUTING SYSTEM.

The wires of the distributing system are all placed overhead, throughout the city, on poles varying in length from sixty feet in the business area to forty and forty-five feet throughout the residence districts. There are a few lines of fifty-foot poles running into the residence districts, and all the high-tension circuits are carried out from the sub-station on seventy-foot poles.

The crossarms are made of 4x6 inch fir, and are of varying lengths. On the newly constructed or reconstructed lines, they are six feet for four pin, and eight and one-half feet for six pin, with pins spaced fifteen inches apart, and thirty inches between pole pins. On old lines the arms are five feet for four pin, seven feet for six pin, and with pins spaced twelve inches apart, and twenty-four inches between pole pins. On one or two heavy load from the sub-station, the arms are eight pin, nine feet long, with pins spaced twelve inches apart and twenty-six inches between pole pins.

The pins are of three-quarter-inch iron, twelve inches in length, with thread of lead, moulded on one end to receive the insulator. A deep groove, double petticoat glass insulator is used throughout, with the exception of the high-tension lines.

For the residence and business lighting the city is divided into areas, each being fed by a separate 2300-volt feeder which is distributed to pole transformers at various points, and stepped down to 117 and 234-volts on the three-wire system, at which voltage it is distributed to customers.

The lighting is accomplished on one phase of the three-phase system, and all houses whose installations consists of twelve lights or over are required to be arranged to use a three-wire wattmeter.

The tranformer units vary in size from one to thirty-kilowatts, the larger sizes being used throughout the down-town and heavy load districts, while the smaller sizes are used throughout the residence districts. The total transformer capacity connected to the distributing system is about 4600 kilowatts.

The high-tension line between Oregon City and Portland, about fifteen miles in length, is constructed for the most part on forty-five and fifty-foot poles, placed partly on a private right of way, but mostly on the county road. Through the city of Portland it is run on sixty and seventy-foot poles.

The cross arms throughout are a special four-pin arm 4x6 inches by nine feet long, with pins spaced twenty-four inches apart and forty-eight inches between pole pins. The insulators used

throughout are a special triple petticoat glass insulator, made by the Locke Insulator Manufacturing Company, having a diameter of six inches and height of five inches, and are placed on three-quarter-inch iron pins, with a length above the cross arm of seven inches. A private telephone line and 500 volt call-bell system is carried on a separate arm, placed five feet below the lowest high-tension cross arm.

As stated earlier in this paper, each rotary converter is at the present time an independent unit. The lighting side of the transmission line has recently been rebuilt, the separate wires being twisted together, and there are now simply three conductors, all of the lighting generators being run in multiple.

The high-tension line between Sub-station A and Station E, is two miles in length, and is constructed for one-third the distance upon seventy-foot poles, and for the remaining distance upon sixty-foot poles. It consists of two 10,000-volt circuits, the wires of which are strung on two cross arms and spaced thirty inches apart. The insulators are the same as those mentioned above as being in use on the high-tension Oregon City line.

Most of the power installations at the present time are of 500-volt direct current connected to the railway system, but as rapidly as possible it is intended to change these motors for those using three-phase sixty-cycle alternating current, a third wire being run out into the suburbs where necessary for this purpose. Where the amount of power used is extensive, as in the manufacturing district, a power feeder will be run. The motors at the present time connected to the system amount to approximately 5400 horsepower.

Considerable work has been laid out for the future, and orders have already been placed for a 1000-kilowatt motor-generator set, in addition to the 1000-kilowatt rotary converter already mentioned as being on order. Arrangements are also made for the installation at Station B and Sub-Station A of bus-bars, including General Electric type "H" switches, marble panels, bus-bar compartments, etc. The railway side of the Oregon City transmission line will also be rebuilt.

A VIEW OF THE BOILER ROOM OF STATION E OF THE PORTLAND GENERAL ELECTRIC COMPANY

A contract has been signed between the Oregon Water Power and Railway Co. and the Portland General Electric Company whereby the latter is to take part of the power generated at the new Cazadero powerhouse, beginning on September first, 1906. In order to accomplish this it will be necessary to build another sub-station to be located near the Golf Club, and a duplicate 10,000-volt feeder will be run from this sub-station to Sub-station A. It is intended to have all stations, including that at Cazadero, run in multiple, the power generated being 10,000-

volt, thirty-three-cycle, three-phase, it being changed to direct current for railway purposes by means of rotary converters, to sixty-cycle alternating current for lighting and power purposes, and to suitable current for use in direct current series arc lamps, by means of either rectifiers or synchronous motor brush arc sets.

ENGINEERING DATA OF THE SYSTEM OF THE PORTLAND GENERAL ELECTRIC COMPANY.

STATION A.

Location—
Oregon City, East Side.

Building—
Wooden, erected 1889.

Hydraulic equipment—
Three thousand horsepower in Victor turbines.

Electrical equipment—
Six 80-kilowatt, 4000-volt, 125-cycle, single-phase Westinghouse.

Alternators—
Two 120-kilowatt, 200-volt, 125-cycle, single-phase, Thomson-Houston alternators.
Eleven 100-lamp, 2000-candle-power, Excelsior arc-light dynamos.

This plant was abandoned as an electric station in 1903 and is now used as a pulp mill of the Crown Paper Company.

STATION B.

Location—
Oregon City, West Side.

Building—
Concrete, with timber truss roof; 5 sections built in 1893–94; 7 sections built in 1896–97; 2 final sections built in 1903. Size, 246 feet long, 206 feet of which is 30 feet wide and 40 feet being 64 feet wide.

Hydraulic Equipment—
Ten 42-inch Victor, cylinder-gate, vertical-shaft turbines, each carrying a 3-phase generator.
Ten 60-inch Victor increased capacity, vertical-shaft turbines, belted to its 42-inch mate.
Two 42-inch Victor, cylinder-gate, vertical shaft turbines, each carrying a direct-current generator.
Two 51-inch McCormick, cylinder-gate, horizontal-shaft turbines, each driving a three-phase generator.
Two 15-inch Victor, cylinder-gate, horizontal-shaft turbines for driving circulating pumps.

Governors: Replogle.

Electrical Equipment—
Seven 450-kilowatt, 3-phase, 10,000-volt, revolving armature, 33-cycle, vertical-shaft, General Electric generators.
Three 500-kilowatt, 3-phase, 10,000-volt, revolving-field, 33-cycle, vertical-shaft, General Electric generators.
Two 540-kilowatt, 3-phase, 10,000-volt, revolving-field, 33-cycle, horizontal-shaft, General Electric generators.
Two 200-kilowatt, 500-volt, vertical-shaft, direct-current, General Electric generators, used either as exciters or railway generators.
Two 85-kilowatt, 125-volt, direct-current, General Electric generators, each belt-driven from a McCormick turbine and used as an exciter.
Switchboards: Standard General Electric types, with hand-operated, Form "K," 10,000-volt, single-pole oil switches.
Station Lighting: From Substation A, at Portland, by 60-cycle, 2300-volt, current reduced to 120 volts.

TRANSMISSION LINE.

Length: Approximately 15 miles.
Voltage: 10,000 3-phase.
Poles: Various; length, 45′ and 50′ in the country and 60′ and 70′ in Portland.
Cross Arms: Special 4-pin arms, 4″x 6″x9′, with pins spaced 24″ and 48″ between pole pins.
Insulators: Locke special triple-petticoat glass; diameter 6″, height 5″.
Pins: ¾″ iron, 7″ above cross-arms.
Circuits: Five power lines, each consisting of 2 No. 4 wires; 1 lighting line, consisting of 6 No. 4 wires in 1 leg and 3 No. 1 wires in 2 legs; 1 flour mill circuit to Albina, running down the east side of the river.

STATION C.

Location—
Corner Sherlock Avenue and Twenty-first Street, Portland.

Building—
Corrugated iron with wooden truss roof. Size, 100′x40′; engine room 100′x120′.

Boilers—
Fourteen 100 horsepower horizontal tubular; 4, 125 horsepower horizontal tubular. Pressure, 100 pounds per square inch. Fuel, sawmill refuse fired through Dutch ovens.

Generating Equipment—
One 16,000 horsepower double Wheelock engine, non-condensing, operating by rope drive 1, 800-kilowatt, 550-volt, General Electric railway generator.
One 1000 horsepower Allis, cross-compound, condensing engine, operating by rope drive 1, 750-kilowatt, 10,000-volt, 33-cycle, General Electric generator.
Two Fulton compound marine-type engines, direct connected, respectively, to a 400-kilowatt and a 200-kilowatt General Electric 550-volt railway generator.

Switchboards—
Panels for the respective generators and skeleton board for controlling the 2300-volt current supplied to the Lewis & Clark Centennial Exposition

STATION D.

Location—
Site of cable powerhouse of old Portland Railway Company, corner of Mill and Chapman streets, Portland.

Equipment—
A small steam plant driving a 325-kilowatt, 550-volt, direct-current, General Electric railway generator.
This plant is seldom used.

STATION E.

Location—
Sherlock Avenue and Twenty-first Street, Portland.

Building—
Brick, with steel truss roof. Boiler room, 148′x61′, with ell 36′x71′. Engine room, 160′x46′. Stack, concrete-steel, 230′ high, 12′ inside diameter.

Boilers—
Five batteries of Cahall water-tube boilers, each rated at 1040 horsepower. Pressure, 175 pounds per square inch, superheated to 175° Fahrenheit. Fuel, sawmill refuse fired through Dutch ovens supplemented by Morrissey oil burners.

Generating Equipment—
Two 1400-horsepower, marine type, compound condensing engines, built by the Willamette Iron and Steel Company, each direct connected to a 1000-kilowatt, 10,000-volt, 33-cycle, 125 revolutions per minute, three-phase. General Electric revolving field generator.
One Ideal, 85-kilowatt, 125-volt engine exciter.
One 60-kilowatt, motor generator exciter set.
Two 1500-kilowatt 33-cycle, 10,000-volt, 990 revolutions per minute, Curtis steam turbines, each capable of delivering 2000 kilowatts continuously.
Switchboards, Standard General Electric types.

SUBSTATION A.

Location—
Northeast corner of Seventh and Alder streets, Portland. Size, 100′x100′.

Transformers—
Fifteen 150-kilowatt, 33-cycle, General Electric air-blast transformers in five groups, reducing from 10,000 volts three-phase △ to 375 volts three-phase for the 400-kilowatt rotaries.
Three 350-kilowatt General Electric air-blast transformers, reducing as above for the 1000-kilowatt rotary.

Six 375-kilowatt, 33-cycle, General Electric air-blast transformers, reducing from 10,000 volts three-phase to 2200 volts single-phase for lighting.

One 100-kilowatt, 33-cycle, three-phase, General Electric transformer, reducing from 10,000 volts three-phase to 220 volts three-phase for the motor-generator set used in starting frequency changers.

Electrical Machinery—

Five 400-kilowatt General Electric rotary converters, delivering 550 volts in railway current.

One 1000-kilowatt General Electric rotary converter, delivering 550 volts in railway current.

Two-500-kilowatt motor-generator sets, used as frequency changers, and each consisting of a three-phase, 33-cycle, 10,000-volt synchronous motor, driving by direct connection a 60 cycle, 2300-volt, three-phase generator.

One 1000-kilowatt ditto.

Eleven 60-kilowatt motor-generator sets, each consisting of a D62, 500-volt, T. H. motor, direct driving a 100-light, 2000-candle-power, 9.6-ampere, Excelsior arc-lighting dynamo. (These will shortly be replaced by Magnetite lamps operated through mercury arc rectifiers.)

ATTACHMENT C-3

PORTLAND ELECTRIC POWER COMPANY
WITH ITS
PREDECESSOR AND SUBSIDIARY COMPANIES

December 16, 1860 - December 31, 1935

Compiled by R. R. Robley
Superintendent of Operation - Portland General Electric Company
Electric Building - Portland, Oregon

1935

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III

WILLAMETTE FALLS ELECTRIC COMPANY AND PORTLAND GENERAL ELECTRIC COMPANY 1889 - 1907

Through the efforts of Mr. Morey and Mr. Eastham, long-believers in the possibilities of the use of water power at the Oregon City Falls to supply electric service for the City of Portland and surrounding territory, the Willamette Falls Electric Company was incorporated on November 8, 1888, by D. P. Thompson, E. L. Eastham, P. F. Morey, R. H. Thompson, L. L. Hawkins and W. K. Smith with a capital stock of $1,000,000. Mr. E. L. Eastham was elected president. The company within a short time began the erection of a "dynamo house" and rock-filled wooden bulkheads on the east side of the river and a transmission line from Oregon City to Portland. New electric equipment was ordered, the first order being for four No. 8 Brush arc light dynamos from the California Electric Light Company. Mr. Morey, with his consulting engineer, Mr. W. C. Cheney, was fully convinced that generation of electricity at a voltage higher than then utilized was not impossible and so insisted that new alternating current generators, soon to be purchased, should be built to generate at 4000 volts. Considerable difficulty was experienced in finding a manufacturer to undertake the job of designing and manufacturing equipment to operate at such a high voltage, but the Westinghouse Electric and Manufacturing Company finally agreed to build the machines with the express condition that that company was not to be held responsible for and would not undertake to guarantee satisfactory operation of such generators. Orders were placed for six 80-kw. (1600-light) No. 2, 4000-volt, single-phase, 125-cycle alternators, the first of which according to Westinghouse Company records was shipped via Kalama, Washington, April 30, 1890. Shipment of the remaining machines was two on May 17, 1890

(11)

and one each on October 30, 1890, February 8, 1891 and October 10, 1891.

At the meeting of the board of directors held November 27, 1888, it was voted to accept the proposition made by the United States Electric Lighting and Power Company to transfer all its assets to the new company. At the same meeting the board voted to purchase from E. L. Eastham 5,100 shares of stock of Willamette Transportation and Locks Company (18) thus giving the new company a voice in the control of the canal and locks.

The water wheel installation at the new power plant, later designated as Station "A", consisted at first of two 35-inch Victor Register gate vertical wheels bevel-geared to a horizontal line shaft from which the generators installed on an upper floor were belted. Later five more similar wheels were added, one however being a 30-inch wheel and another a 45-inch. Upon completion of the station building, part of the equipment was moved from the Weidler mill and installed for use at the new location, the first unit being put into service on the evening of June 3, 1889, to light one of the arc circuits in Portland. Concerning this achievement, the "Oregonian" the next day carried the following news item:

> "The Willamette Falls Electric Company started up one of their Brush arc dynamos last evening, and the electricity was sent from Oregon City for lighting one of their 10:00 o'clock circuits in this city. It worked magnificently and conclusively demonstrated the fact that our city can be lighted successfully from the falls. The result was a pleasing surprise to the company, the percentage of loss of electricity by transmission being much less than their most sanguine expectations. The work of removing the machinery from the station here to the falls will be carried on as expeditiously as possible. Another large dynamo will be moved up today."

As far as can be ascertained, this is the first instance of long distance transmission of electric energy in the United States.

The Brush dynamo was probably of 65-light capacity, each arc light using 10 amperes at 50 volts. The rating of the machine may therefore be taken at 32.5-kw. capacity.

The "Oregonian" of June 11, 1889, gives information concerning the starting of another machine at Oregon City in an item reading as follows:

> "Another dynamo was set running in the new station of the Willamette Falls Electric Company yesterday and another arc circuit in this city was run last night by electricity from the falls. The company has about 300 incandescent lights on its commercial circuit, now run by the United States machine wired to run by the A. C. machine. The difference in these machines is that instead of the lights being run, as now, in series of five, by the new style as many lamps can be run from one wire as desired."

The reporter was somewhat mixed in his use of electric language, so it is impossible to know just what information he was attempting to give other than that another dynamo had been started at the falls.

While the date of the first transmission of direct current from the falls to Portland is a matter of definite record, it is most unfortunate that a corresponding date for the first transmission of alternating current between the same two points has not been established, though with the delivery and installation of the first of the six new 4000-volt Westinghouse dynamos in the summer of 1890 there is no reasonable doubt but that energy from these machines was being transmitted to Portland for commercial use in the late summer or early fall of that year. Consequently, it seems that

September, 1890 may be safely taken as the date of first long distance transmission of alternating current for commercial purposes in the United States.(30)

Following this initial long distance transmission of electric energy from the plant of the Willamette Falls Electric Company, there is authentic record of transmission of alternating current by the Telluride Mining Company in Southwestern Colorado, where in June, 1891, single-phase, 133-cycle energy was transmitted at a generated voltage of 3000 volts from the hydro plant to the mills of the company(29) and by the San Antonio Light and Power Company, Pomona, California where transformed energy was transmitted in 1892 at 11,000 volts over two lines, one fourteen and the other twenty-eight miles in length.(29)

There is question as to what equipment was installed at Station "A". Mr. Cheney is of the opinion that there were moved to the station from the Weidler Mill:

4 - 65-light Brush arc machines,

2 - 50-light Thompson-Houston arc machines,

4 - 100-light Excelsior arc machines, and

1 - 125-light Stanley arc machine,

in addition to any 1000-volt alternators which he thinks may have been moved but which probably were not moved.(30)

All of this equipment, with the exception of the Excelsior machines, was replaced as new equipment was purchased, the total installation at the station with estimated capacity at the time the station was dismantled, being:

6 - 80-kw., 4000-volt Westinghouse alternators	480 kw.
2 - 120-kw., 2000-volt Thomson-Houston alternators	240 "
1 - 75-kw., (est.) 500-volt D. C. generator for Portland-Oregon City railway	75 "
11 - 100-light Excelsior arc machines - each using 10-amp. at 50 volts	550 "
Total capacity	1,345 "

Late in March, 1890, the company purchased two lots at the foot of Montgomery Street in Portland as a site for the first Portland substation, a building already on the lots being remodeled to provide for general offices as well as for substation purposes, and in September of that year, the board of directors ordered that their next meeting be held at this location. It was at this substation that O. B. Coldwell had his first experience in electric matters and began his career in May, 1892, in his chosen field of endeavor. Energy was received from Oregon City at 4000 volts and stepped down to 1100 volts for distribution on the west side of the river. A combined office and substation for East Portland was established on Union Avenue near Morrison Street where energy was received at 4000 volts and stepped down to 2000 volts for distribution on the east side.

The first superintendent of Station "A" was probably Mr. Otto F. Olson who had entered the employ of the company as steam engineer at the Weidler Mill plant in Portland. Mr. F. C. Miller, Sr., a millwright formerly employed by the Paper Company, was in charge of the installation of the machinery.

All electrical equipment had been removed from the Weidler Mill plant by the middle of 1891, such equipment that was not taken to Station "A" being stored at the Montgomery Street substation.

The Willamette Falls Electric Company was not the first company to operate an electric plant at the Willamette Falls. Mr. E. L. Eastham became

much interested in the electrical developments in the San Francisco bay region and in the winter of 1887 it was arranged by Mr. Eastham and Mr. T. L. Charman of Oregon City that the latter should go to San Francisco and make a study of the industry, having in mind the establishment of such an industry at the Oregon City Falls. Mr. Charman returned home in May, 1888, and the Oregon City Electric Company was incorporated on July 20th of that year by M. A. Stratton, T. L. Charman, E. L. Eastham and F. O. McCown, with a capital stock of $20,000, to supply electric lighting, telephone, telegraph and gas service in the vicinity of the Willamette Falls. A 450-light Edison dynamo was purchased and installed in an excelsior and shoddy mill on the east bank of the river run by a 200-hp. wheel,(19) and lighting for stores, residences and city streets was begun in November, 1888.

In February, 1890, occurred one of the worst floods on record in the Willamette Valley. The Station "A" bulkheads were washed out and the plant put out of commission according to Mr. Sullivan for a period of probably three months, the load in the meantime being carried by the equipment then still remaining in the Weidler Mill plant with the help of some smaller plants that had been installed in East Portland. The plant of the Oregon City Electric Company was carried away, the machinery, however, being saved and taken to Station "A" for storage. The bulkhead built by the Peoples Transportation Company from the upper river to the basin with all the basin bulkheads was washed away and a steamboat, the "Three Sisters", was left high and dry on the east bank rocks.

In March, 1889, Mr. T. W. Sullivan arrived in Oregon City to construct a mill and install the machinery for the Willamette Pulp and Paper Company. In this year he built a wooden rockfilled crib bulkhead from the intake to the water wheels of the new mill located on the west side of the

falls extending up river a short distance, then east, with a dam across the main channel of the river. He had planned to stay in Oregon for not more than a year, but following the havoc created by the flood, he was importuned by Mr. Morey and Mr. Eastham to remain and take charge of repairs. He agreed to stay and at once set about to rebuild what had been washed out. He rebuilt the bulkheads to put the electric light plant in operation including bulkheads around the basin. The long bulkhead from the upper river to the basin was not rebuilt. During 1891 and 1892 he completed the building of the dam across the entire river from the paper mill bulkhead and dam near the middle of the channel to the bulkhead of Station "A" on the east side. All this construction was rockfilled wood crib built to withstand a repetition of the disastrous flood of 1890 and located at a point well above the crest of the falls so that at a later date a concrete dam could be built to take its place. Such a concrete dam was built on the west side in 1904 and completed on the east side up to within 250 feet of the Station "A" bulkhead in 1908, this distance being left uncompleted pending further hydro development by the Hawley Paper Company. In 1931 the concrete work was carried along another 100 feet, bringing it up to the hydro plant of the Hawley Company. When the concrete dam was built in 1904, the location on the west side did not follow that of the bulkhead built earlier for the Paper Company, but was built about 250 feet to the east to provide a greater intake to the wheels. In 1920 approximately 200 feet of the lower end of the dam on this same side was removed and a new section built still further to the east to provide for intake to a new mill being built by the Paper Company. The total spillway length of the dam at elevation 52 feet, the elevation of the concrete dam, is approximately 2100 feet.

The drainage area of the Willamette above the falls is about 10,000 square miles and the available storage above the dam about 6,000 acre feet. The average minimum flow of the river is 3,300 sec. ft. and the maximum recorded 470,000 sec. ft.

Mr. Sullivan has been at the head of all construction work undertaken by the Company at the falls and is still active in Company work, not only at Oregon City, but at any of the several other properties of the Company where his services may be required. He bears the title of Hydraulic Engineer and is a recognized authority in this branch of engineering.

Mr. Eastham, first president of the Willamette Falls Electric Company, died January 18, 1891, and Mr. Morey was elected president at the directors' meeting of February 26, 1891. (18)

The Willamette Falls Electric Company, as has been stated, voted on November 27, 1888, to take over the assets of the United States Electric Lighting and Power Company. The property of the Oregon City Electric Company was purchased June 20, 1891. (18) At the stockholders' meeting of the Willamette Transportation and Locks Company held August 11, 1890, a resolution was adopted by the board of directors offering to transfer the property to the Willamette Falls Electric Company. (16) It would seem, however, that this transfer was not consummated since the stockholders at their meeting of August 6, 1892 voted to sell all assets to a new corporation then being formed, the Portland General Electric Company.

In 1888 a novel plan was experimented with in Portland for lighting the city streets at night. A mast approximately 200 feet high was erected on 3rd Street between Lincoln and College Streets and six or eight arc lamps were installed on arms at the top of the mast, the idea being that with such installations scattered over town, a general illumination

simulating daylight could be secured. The lamps were fed from a small generator in the Smith and Watson Iron Works. The plan did not prove a success and was soon abandoned.(6)

Another attempt to establish competition in Portland with the Oregon City Company according to R. M. Townsend, was made by John F. Cordray who, about 1891, built a steam plant of about 250-light capacity on the property at 3rd and Yamhill Streets later occupied by the Powers Furniture Company. The plant was built primarily to supply lighting for the amusement houses operated by Mr. Cordray though a few customers were served along 3rd Street. The plant operated for a short time only and was then dismantled.

It soon became quite evident that the company could not keep pace with the development of the new industry with the meager facilities at hand and with no feasible program of expansion in its powerhouse arrangement. The result of this condition was the incorporation of Portland General Electric Company on August 5, 1892, by P. F. Morey, Frederick V. Holman and Charles H. Caufield with a capital of $4,250,000,(21) to engage in a general light and power business. The stockholders of the new corporation on August 22, 1892, elected eleven directors and then instructed these directors to purchase all the property of the Willamette Transportation and Locks Company and of the Willamette Falls Electric Company. The board of directors met August 26th following the stockholders' meeting and organized by electing P. F. Morey, president, and Howard C. Levis, vice president. Charles H. Caufield was appointed secretary. (Mr. Caufield died in Oregon City, December, 1934.) H. W. Goode was elected a director at this meeting, and at the following meeting held September 21st his appointment as general manager was ratified.

The need of a better arranged and more commodious powerhouse became more and more apparent, so the Company planned a new station, later known as Station "B", to be built on the east bank of the river between the ship canal and the river. The building was to be of concrete with space to extend it to final dimensions of approximately 50 by 250 feet, the layout being such that the construction job could be done in sections as business requirements might demand. The first step decided upon was to build four sections, three for three alternating current generating units, including space for the auxiliary oil and water pumping equipment, and one for two 500-volt direct current generators to be used for railway service and for excitation for the three alternators. Three-phase equipment had been developed by this time so orders were placed with the General Electric Company for three 450-kw., 33-1/3-cycle, 6000-volt revolving armature alternating current generators and two 500-volt direct current generators. Since the operating head at the new location might vary from 10 feet to 40 feet over the period of a year, it was deemed necessary that two different types of water wheels be installed with each alternator to insure full water wheel capacity at any and all heads. Each section for alternators was therefore designed for two wheels, one 42 inches in diameter with the alternator to be mounted on the upper end of the shaft of this wheel operating at 200 revolutions per minute to carry the load at high head periods and the other 60 inches in diameter to carry the load at low head periods. The two wheels were to be connected together by means of a leather belt 46 inches wide. Each of the two 500-volt generators was to be driven by a single 45-inch diameter wheel. All wheels except the small ones used for the pumps were to be of the vertical improved cylinder gate Victor type. Plans were made for construction to start at an early date.

The frequency of the current of a generator expressed in cycles is dependent on definite characteristics of the machine. While the frequency of the new machines at Station "B" and of all other machines of similar frequency installed subsequent thereto is 33-1/3 cycles, as a matter of brevity, this frequency as hereinafter used will be referred to as 33 cycles.

On October 5, 1892, the board of directors voted to buy the property of the Albina Light and Water Company, a company incorporated on December 28, 1889 by H. C. Campbell, George W. Bates and C. F. Swigert with a capital of $50,000. Just what equipment the plant contained is not known as no records of the plant are available except that there is reference to an Albina plant at Railroad and Loring Streets with two Edison bi-polar generators installed. On the graphic chart of constituent plants to be found further along, it appears that the East Portland Light and Power Company, incorporated November 20, 1890, by H. A. Hogue, C. P. Hogue and D. H. Jones with a capital of $50,000 had been absorbed or taken over by the Albina Company. Mr. J. R. Thompson, later the superintendent of Portland General Electric Company, says the Hogue plant was located at the foot of East Main Street in the Hogue saw mill, but there is no record of its installed capacity.

The directors of the Company, realizing that there was danger of a shortage of power before the new station at the falls could be completed, at their meeting held February 20, 1901, voted a loan of $20,000 to the Union Power Company to put their plant, which had been damaged by fire five or six years previously, back into operating condition. This Company was incorporated April 9, 1891, by I. B. Hammond, P. F. Morey, C. F. Swigert, Geo. B. Markle, D. F. Sherman and H. C. Campbell with a capital of $150,000.

The plant equipment consisted of five 175-kw., 500-volt Edison bi-polar generators, each machine rope driven from a line shaft in turn driven by a 300-hp. Buckeye engine, probably later replaced by a 1250-hp. cross compound Allis engine. The boiler plant consisted of 10 boilers with furnaces fitted for sawdust of slabwood fuel. An ex-sailor, Adolph Helgesson, one of the oldest living employes of the Portland Electric Power Company in terms of seniority, spliced ropes in this plant and, incidentally, in other mills and factories in the city and it is from him that most of the detailed information given above concerning this plant has been secured. The plant burned again, probably some time in 1902, and was not rebuilt. The property of the Company was transferred to Portland General Electric Company in 1905 and the corporation dissolved. The plant was located about one-half mile north of the present site of Station "E".

The Oregonian of February 2, 1893, reporting doings of the City Council held the day before, stated that the Portland General Electric Company submitted a proposition to purchase "machinery, material and pole line now in use in connection with the city east side electric light plant" - the plant being located at Powell and Milwaukie Streets. The machinery consisted of three Edison arc light dynamos and two Reynolds Corliss engines with shafting and belts. The Company agreed to light all arc lights being lighted from that station for not more than $9.72 per month the same as charged on the west side and "to guarantee that we will never ask the city more than $9.72 per month each for any arc lamps it may require." The matter was referred to the judiciary committee. The same paper a month later stated that the ordinance authorizing the sale was passed 12 to 4, the mayor casting one of the dissenting votes.

Construction of the new powerhouse at Oregon City was begun in the summer of 1893 and carried on to completion of the first four sections, including the pumping section, as rapidly as the difficult construction would permit. The site chosen for the building was at the bottom of high rocky cliffs bordering the west side of the river with bedrock for building foundations from 30 to 50 feet below ordinary water level. Almost two years were taken in this building which, however, included all foundation structure for seven more similar sections, and it was not until March 4, 1895, that water was first turned into the forebay pond. Considerable trouble was experienced with some of the water wheel apparatus, especially with the belt and belt tightening equipment, so the 60-inch wheels were disconnected from the 42-inch and the first unit put in commission in this manner about the middle of September. The belt tightening equipment was rebuilt and the first two units put in commission with both wheels on December 1st and 12th, 1895, and the third on January 1st, 1896.

The electric equipment for the first three sections had been received from the General Electric Company and was in the Portland railway yards awaiting transfer to Oregon City when a considerable part of the equipment, including the three generators, was destroyed by fire on September 23, 1894.(22) This necessitated replacement of the damaged equipment by the General Electric Company which happily was delivered in time not to delay the opening date of the plant. The Portland General Electric Company purchased the damaged equipment from the insurance companies for a nominal price and repaired what could be repaired, with the result that the Company at a comparatively small expense was able to obtain three new generators for the next step in its expansion program.

With the development of three-phase generators came the development of three-phase rotary converters designed especially for delivering 500 volts for street and interurban railways. As the electric railway was fast gaining in popularity, this necessitated additional substation room in Portland and so with the building of Station "B", the Company purchased a quarter block at 7th and Alder Streets in Portland and erected thereon a combined office and substation building, the first building being erected on the east half of the lot to allow for future building on the west half.

The general offices of the Company were maintained at Montgomery Street Substation for about a year and were then moved to the Ainsworth Building. After a time at this place they were moved to an upstairs location in the Worcester Building, later moved to a street level location in the same building where they remained until the flood of 1894 forced another move, this time to the Oregonian Building. By this time the new substation building was nearing completion and in November of 1894 they were again moved, this time to the upper floor of the new substation where, it was hoped, they had found a permanent home.

The art of synchronizing two alternators to run in parallel had not yet been perfected, so each arc machine and each alternating current generator at Oregon City required a transmission circuit of its own between the two towns, the transmission line on the west side of the river at one time carrying between 30 and 35 separate wires. Consequently, the installation of three 3-phase generators at Station "B", each requiring a 3-wire circuit into Portland presented transmiasion line difficulties hard to solve. Upon the completion of Station "B" it was planned to dismantle Station "A" which further complicated matters because of the arc machines at Station "A" in use for lighting the streets of Portland. The solution of the problem was

to purchase two 400-kw. rotaries to be installed in the basement of the new Portland substation, later called Substation "a". The Excelsior arc machines were then to be moved from Station "A" to Substation "a", each to be direct connected to a type D-62, bi-polar, 500-volt motor. Eight such machines were eventually set up in the new substation (11) and continued to operate until the street lighting was changed to the magnetite arc system beginning early in 1906. Several banks of air cooled transformers for commercial lighting were also installed in this station. By thus moving the arc machines to Portland, use of a sufficient number of wires was released on the pole line so that there were plenty available to make up the three 3-wire circuits required for the three new generators.

Mr. Goode in November, 1895, was elected a member of the executive committee and in October of the following year he was appointed assistant secretary. It was a year earlier or in 1894 that Franklin T. Griffith first became identified with the Company as attorney for the Company at Oregon City.

The superstructure for the seven additional sections of Station "B", the foundations for which were built at the time the first four sections were built, was completed in 1897 and a pair of 42 and 60-inch wheels installed in each section similar to the wheels in the first three sections. One new 450-kw., 33-cycle generator was purchased which with the three generators that had been repaired after the fire were installed in Sections Nos. 7, 9, 10 and 11. Two sets of bevel gears and horizontal shafting each with two alternators known as "Twins" (so-called because they were rigidly connected together by means of one end of each shaft being inserted in the bore of a single driving pulley) were moved from Station "A" to Station "B", one set being set up in Section No. 6 and the other in Section No. 8. These

two sets operated in this fashion until about 1899 when three new 500-kw. revolving field generators were installed in Sections Nos. 5, 6 and 8. The building program at this time also included the west and north foundation walls for Sections Nos. 12 and 13, the only remaining sections to complete the program. A three-phase line was built on the east side to run a 600-hp. synchronous motor installed by the Portland Flouring Mill near the present site of the Swan Island Airport. The motor was started inductively without load from Station "B", the mill load being applied by a friction clutch after the motor had come to full speed. This load was ordinarily carried by generators Nos. 7 and 9.

Sections Nos. 12 and 13 were completed in 1903, the wheels in these sections being 51-inch double-runner McCormick horizontal wheels with General Electric Company generators, 540-kw., 3-phase, running at 143 revolutions per minute.

Mr. Otto F. Olson, as plant superintendent, and Mr. F. C. Miller, Sr., as millwright were both transferred, holding their respective positions, to Station "B" from Station "A". Mr. Olson resigned as superintendent February 14, 1908, but remained with the Company in other employment until his death in November, 1918. He was succeeded as superintendent by F. C. Miller, Jr.

Mr. John Harisberger, now manager, Division of Power Supply of Puget Sound Power and Light Company, was employed at Station "B" in connection with the installation of the first three-phase generating equipment, leaving the employ of the Company in 1898.

With increased generating capacity installed at Station "B", a new building was erected at the 7th and Alder Street Substation location in Portland to cover the remaining 50 x 100-foot ground area, machinery to be

located on the ground floor with repair shops and ventilating and cooling fans in the basement. The building was surmounted by the so-called Tower, the entering and leaving point for all lines serving or served by the station. The two 400-kw. rotaries were moved up from the basement of the first building and three more of the same type were soon purchased and installed, and at a still later date, probably in 1904 and 1905, two 1000-kw. rotaries were purchased and installed. Remaining in the old substation were the commercial lighting transformers and the street lighting machines, the substations at Montgomery and Water Streets and at East Morrison and Union Avenue being completely abandoned and the equipment moved out.

After the two sets of alternators had been removed from Station "A" to Station "B" and the Excelsior arc machines moved to Portland, all remaining equipment except the water wheels was removed from Station "A" and the plant abandoned as a generating station, probably in 1897. The station as it then stood was leased for a time to the Willamette Pulp and Paper Company and used as a cut-up and pulp grinding mill. Later it was leased to Hawley Pulp and Paper Company which took out the original vertical wheels and installed horizontal wheels instead. The plant is still in use by the Hawley Company for pulp grinding purposes.

The electric light and power business by this time had increased to such an extent and had become of so much importance in the everyday life of the community that it was deemed unwise to depend altogether for this service on one plant and that one 14 miles away. In 1901 a steam plant was built at Front and Nicolai Streets in Portland on property adjacent to what is now Station "E". The plant, Station "C", was built near the saw mill of the Eastern and Western Lumber Company in order that cheap fuel in the form of saw mill waste could be available. The building was of mill construction

covered with galvanized iron. The boiler plant consisted of fourteen 100-hp- and four 125-hp. horizontal tubular boilers operating at 100 lbs. pressure.(11) Just what electric equipment was at first installed in Station "C", it is impossible to say, but probabilities are that the two "Twin" sets of single-phase, 125-cycle alternators taken from Station "A" to Station "B" and then in 1899 taken out of Station "B" were the first units in the new steam plant. A 1600-horsepower double Wheelock engine was moved from the old Weidler Mill and connected by rope-drive to a line shaft to which the separate machines were belted. Some time later, probably in 1903, two direct connected Fulton engine railway sets were purchased from the Sutro Railway Company in San Francisco, one of 200-kw. and the other of 400-kw. capacity and installed in the station. One or two or maybe more Excelsior arc machines were belted to the fly wheels of these engine sets.

A 1250-hp. cross-compound Allis engine was moved from the Union Powerhouse, and connected by rope-drive to a 750-kw., 3-phase, 33-cycle, 6000-volt generator, bought new from the General Electric Company and installed during the winter of 1901-1902.

In 1905 an 800-kw., 500-volt General Electric generator bought new the year before for Station "E", as will be explained later, was moved into Station "C", the Wheelock engine being belted to this unit and the operation of all 125-cycle machines discontinued.

Synchronizing equipment by this time having been perfected so that alternating current generators could be switched together to feed over the same transmission line, necessary equipment was installed at Station "B" and at Substation "a" to permit of such operation. This allowed two or more generators at Station "B" to be connected to the same line to Portland, but at the same time to carry the increased load lines of greater carrying

capacity than had been theretofore built would be required. The whole transmission system was then simplified by bunching all the wires in the whole line to make on the west side two 3-phase lines, the separate conductors of each line being made up of five or six No. 4 wires. This was a great forward step in the method of operation of electrical equipment and did much to simplify the connections between generators, transmission lines and receiving apparatus. Common buses were established at each station and substation and each separate machine or line was connected to it and controlled by means of its individual oil switch.

The 3-phase generators at Station "B" were Delta connected normally operating at 6000 volts. A higher voltage was deemed advisable so they were all changed to "Y" connection and the voltage boosted accordingly, the normal voltage thereafter on the 33-cycle system being considered 10,000 volts.

Mr. Morey resigned as president of the Company in 1902 due to ill health and Mr. H. W. Goode, who had been elected first vice president in October the year before was, on April 12, 1902, elected to succeed him. Mr. Morey died in July, 1904.

The Lewis and Clark Centennial Exposition having become an assured event, it was necessary for the Company to prepare to carry the extra load that would be imposed upon it. The result was the building of Station "E" adjacent to Station "C" with an installation of the most up-to-date steam equipment available. The boiler room is 61 feet by 148 feet with an ell at one end 36 by 71 feet.(11) The boiler installation was ten Cahall water tube boilers manufactured by the Aultman Taylor Company operating at 175 lbs. pressure. Furnaces were built to burn either sawmill refuse, ("hog fuel"), or fuel oil. The stack is of reinforced concrete construction 230 feet high

and 12 feet inside diameter. Four oil storage tanks were built with a total capacity of 6263 barrels. Steam driven pumps for circulating water were first installed in a sub basement of the boiler room, but these later were discarded and motor driven pumps were installed in a new pump house built at the river bank.

The generator room is 46 by 160 feet, separated from the boiler room by a 24-inch curtain wall. All construction of the building is brick. The generating equipment consisted of:

2 - 1000-kw., 33-cycle, 3-phase, 10,000-volt General Electric Company generators each direct connected to a 1400-hp. Marine type vertical compound engine made by the Willamette Iron and Steel Works of Portland. These were put into operation late in 1904 or early in 1905.

2 - 1500-kw., 33-cycle, 3-phase, 10,000-volt Curtis vertical steam turbine units made by General Electric Company. These two units were designed to carry 2000-kw. continuously and were started in May, 1905.

The original order for generators for the engine sets was for one alternating current generator and one 800-kw., 500-volt direct-connected generator. The direct-current generator was never installed with the engine, but was moved to Station "C" as noted a few pages back and a 1000-kw. alternator ordered in its place for the engine.

Two 10,000-volt transmission lines were built on one pole line from Station "E" to Substation "a" - a distance of 2 miles.

All equipment at the new station operated without serious difficulty during the period of the fair, the turbine units operating for hours at a time at their full maximum overload capacity. It was at this station that the writer began his service with the Company in December, 1904, finding himself employed in general construction work incident to such a building program alongside Chas. P. Osborne whose employment dated from August, 1902.

Another young employe also beginning a long term of service with the Company was A. C. McMicken, a clerk in the stores department with employment dating from September, 1902.

Mr. Edward Hippely was chief engineer of the new steam plant during its construction and until about 1907 when he resigned to engage in private business. He died in January, 1928. Mr. B. W. Slocum, a marine engineer, was his successor at Station "E". Another engineer at Station "E", prominent with the Company, was Charles Cooper, first employed as engineer at Station "F" of the City and Suburban Street Railway Company in 1892. Due to ill health Mr. Cooper was transferred from active duty to the office at Station "L" in September, 1926. He died November 15, 1934.

As 33-cycle current had been considered preferable to 125-cycle current when Station "B" was built, new development of the industry had progressed to such a point that at this time 60-cycle current seemed to be the best adapted to commercial use in general and the trend over the whole country definitely turned toward this frequency as a standard. So the next step was the installation of 33-cycle to 60-cycle synchronous frequency changer sets, two 500-kw. General Electric sets and two 1000-kw. sets being installed in Substation "a" in 1905, one 1000-kw. set in 1906 and another in 1907. Each set consisted of a 10,000-volt, 33-cycle synchronous motor direct connected to a 2300-volt, 3-phase, 60-cycle generator.

With the advent of electric lighting for general use, it was not unusual in the early days for owners of office buildings to install small steam driven generators to serve their own buildings to be operated from boilers already installed for heating purposes. In some cases this no doubt enabled owners to electrify their offices at a time when it was impossible to obtain similar service from any other source. In other cases it may have

been done under the belief that such a method would prove cheaper than to buy from the distributing company. Whatever the reason may have been for such installations, the Company took over several of them to operate, in some cases including the heating of the building. The earliest record of such a building being so taken over is the Concord Building to which the Company agreed in 1901 to supply light, heat and elevator service for five years at $185.00 per month. Similar equipment in the Abington, Dekum, Chamber of Commerce, Exposition, Marquam and Macleay Buildings was at some time or other operated by the Electric Company under the general heading of "Isolated Plants." The latest record of such operation is in 1908 with a generating record of 367 kw.-hr. for that year.

Up to the beginning of 1905 station reports consisted of ammeter and voltmeter readings, the time of starting and stopping machines, etc. By this time, however, all generator switchboards had been equipped with integrating watt-hour meters and for 1905 there is available the first record of yearly generation:

Station "B"	41,513,350	kw.-hr.
" "C"	3,851,892	" "
" "D"	85,234	" "
" "E"	4,806,538	" "
Isolated Plants	21,506	" "
Total -	50,278,520	" "

Station "B" as has been noted was the powerhouse at Oregon City and Station "C" the new steam plant in North Portland. Station "D" was the powerhouse belonging to the company operating the cable railway line and will be discussed later on.

The year 1905 also provides the first tabulation of station capacities, the figures for that year being:

Station "B" -	7 units	450 kw. each		
	3 "	500 " "		
	2 "	540 " "	Total	5,730 kw.
Station "C" -	1 unit	800 kw.		
	1 "	750 "		
	1 "	400 "		
	1 "	200 "	"	2,150 kw.
Station "D" -	1 unit	325 kw.	"	325 kw.
Station "E" -	2 units	1000 kw. each		
	2 "	1500 " "	"	5,000 kw.
				13,205 kw.
Station "D" out of commission by Dec. 31				325
Effective capacity, Dec. 31, 1905 -				12,880 kw.

It is in order to mention at this point that Mr. Goode was elected president of the Lewis and Clark Exposition and carried on with such a degree of success that a good percentage of the subscriptions to the exposition was repaid to the subscribers, a result distinctly unusual in the history of similar undertakings.

The next step of advance in the art was the introduction of the magnetite street arc lamp with mercury arc rectifier transforming equipment to take the place of the old type carbon arcs fed by Excelsior arc machines. Ten single tube rectifier sets with the new type of lamps were purchased for Sub "a" and installed on the second floor in space formerly occupied by the general offices, the offices having previously been moved probably in 1905 to what is now 615 S. W. Broadway Street. These were put into commission probably late in 1906 and the Excelsior machines done away with. The single tube sets did not give satisfaction so were gradually worked over for double

motors at the Willamette River and the Columbia Slough draw bridges. One of the 400-kw. rotaries was taken from Substation "a" and installed at this new substation. Three 375-kw., 33-cycle transformers for incandescent lighting and one mercury rectifier street lighting unit were also installed. In 1908 property was purchased for a permanent location for this station and the equipment was moved to the present site of Northern Substation at Lombard and Macrum Streets. The building was erected principally from used brick and steel beams salvaged from the old Cable Company powerhouse on Chapman Street. In 1909 an 11,000-volt, 60-cycle line was extended to this station from Substation "d" and at the same time the 33-cycle line from Substation "d" was looped into the station, thus providing for two tie lines between the two substations and an 11,000-volt, 33-cycle feeder line from Substation "c" to the railway bridges. A second 400-kw. rotary was later installed in this station, probably brought from Station "B" in 1910 after two new 600-volt generators had been installed at that plant.

Early in 1907 after the Cazadero power plant, Station "G", had been put into commission, need was felt for a 600-volt source of supply at that end of the interurban railway line, so another small rotary was taken from Substation "a" and installed at that place. At the same time the 280-ampere-hour Gould storage battery installed at Piedmont Barns by the City and Suburban Railway Company was taken to Station "G" and installed as a standby source of 600-volt supply. The life of the battery at that place was short and after its failure was not replaced.

At Station "B" the need of 600-volt equipment was also very much needed so two more of the small Substation "a" rotaries were taken out and installed at that point. At the same time, 1907, one of the 500-kw. frequency changers was also moved to Station "B" to supply 60-cycle current for the district served from that station.

The other 400-kw. rotary at Substation "a" was taken in 1906 to another new substation which had been built at Lents Junction to supply service to the railway lines serving the Lents and Mt. Scott districts.

Additional 600-volt railway capacity was needed at Station "H", Salem, so the 325-kw. motor generator set installed by the City and Suburban Railway Company at Piedmont was taken to Salem and put into commission in January, 1908.

On November 1, 1907, the Oregon Electric Railway Company entered into agreement with Portland General Electric Company for the purchase of electric energy for the operation of trains over its interurban railroad then being built between Portland and Salem. Energy for this source was to be supplied from Station "B" over a 33,000-volt, 33-cycle line built from Station "B" over county roads and private right-of-way and connecting near Tualatin to the transmission line built along the railway right-of-way from Multnomah Station to Waconda, the southern terminal of the transmission line. As one of the considerations of this agreement, the Electric Company was granted the privilege of extending this transmission line at its own cost from Waconda upon the right-of-way of the Railway Company to Salem, thence to the steam plant of the Electric Company and to transmit energy over the entire line from Station "B" for its use at the Salem steam plant. The Electric Company had in the meantime built a reinforced concrete transformer house on the bluff across the canal from Station "B" at Oregon City and also a new concrete substation at Salem. The Railway Company in 1907 purchased and installed three 750-kw., 11,000-volt to 33,000-volt, single-phase step-up transformers at Station "B" and the Electric Company purchased and installed three similar step-down transformers at the Salem steam plant. With an adequate supply of energy thus being assured from the Portland

With the Steam Station "L" being scheduled for completion early in 1911, there was no need to rush the new work and before it had been carried on to any great extent, it was abandoned in favor of a new project undertaken by another company building a dam about three miles below Station "G". The story of this development will follow a little later on.

The plan earlier adopted of designating generating stations by capital letters, as Station "A", and substations by small letters, as Substation "a", led to confusion as the number of stations and substations increased, so the use of letters to designate substations was discontinued and the substations instead named according to the locality in which located. Substation "a" was changed to Alder Substation, Substation "b" to Sellwood Substation, Substation "c" (St. Johns) to Northern Substation, Substation "d" to Knott Substation, Substation "e" to Jefferson Substation, and Substation "f" to Piedmont Substation.

The generating capacity of the system at the end of 1910 was:

Steam			Hydro		
Station C	-	1,750 kw.	Station B	-	6,730 kw.
E	-	5,000 kw.	G	-	14,250 kw.
F	-	1,300 kw.	J	-	250 kw.
H	-	1,000 kw.			21,230 kw.
I	-	920 kw.			12,370
K	-	400 kw.			
L	-	2,000 kw.			
		12,370 kw.			

Grand Total - 33,600 kw.

Generated for this year was:

Steam	-	17,995,688 kw.-hr.
Hydro	-	102,708,027 kw.-hr.
Total	-	120,703,715 kw.-hr.

Maximum hour 31,111 kw.

system covering the major portion of the town and a 300-kw., 3-phase transformer to serve this community was cut in on the transmission line on the railway right-of-way on April 2, 1915.

In addition to the increase in generating capacity brought about by the building of new plants, new generators were purchased and installed in plants already built, and on the other hand some generating equipment was retired at some of the smaller plants. The largest unit installed in an existing plant was a 7500-kw., 5500-volt, 33-cycle General Electric Company turbo generator installed at Station "E" in April, 1913. An auto transformer with voltage ratio of 2:1 was permanently installed with the generator to give a bus voltage of 11,000 volts. This was the last 33-cycle generator that the company ever purchased. A 500-kw., 60-cycle, 11,000-volt generator was purchased from the Allis-Chalmers Manufacturing Company and installed on the 60-inch water wheel in Section No. 11 at Station "B" in December, 1911. Generating equipment removed consisted of three generators at Station "F" totaling 1300 kw., and three at Station "C" totaling 1750 kw. Steam Station "I" at Vancouver with a capacity of 920 kw. was completely destroyed by fire June 4, 1911. The 1000-kw. rotary at Station "F" was moved probably to Jefferson Substation when the 2000-kw., 600-volt steam driven generator was cut in at Station "L".

The net generating capacity of the system at the end of the period was:

Steam	-	22,400 kw.
Hydro	-	42,880 kw.
Total	-	65,280 kw.

In 1912, to satisfy the National Board of Fire Underwriters, the Company was required to provide two wire metallic circuits clear of all

APPENDIX

Under this general heading is included information having to do with the interest and welfare of employes through their various societies and organization together with other items that are of general interest but not necessarily a part of company utility business.

power activities at the falls under control of a single company whose primary business was to supply electric service to the public. Plans for the construction of a modern generating station with a capacity far in excess of that of the old Willamette Falls Electric Company plant were immediately gotten under way and Right No. 10 was set up as owned by the company to cover water required by the new station (Station "B"). The right calls for water to produce 12,000 electric horsepower (approximately 9,000 kilowatts). All water power rights granted subsequently were made subject to the prior right to this water for use by the company.

From January 25, 1895 to April 10, 1928 an additional ten rights were granted, seven to Crown Willamette Paper Company and three to Hawley Pulp and Paper Company. These rights are the so-called high water rights, the right to use water under any right being conditional upon the full use of water under any prior right.

Right No.	Granted To	Date
11	Crown Paper Company	1895-1904
12	Willamette Pulp and Paper Co.	1904
13	Crown Paper Company	1908
14	Willamette Pulp and Paper Co.	1904
15	Willamette Pulp and Paper Co.	1907
16	Crown-Columbia Pulp and Paper Co. (These 6 rights were subsequently acquired by Crown-Willamette Paper Company)	1908
17	Hawley Pulp and Paper Company	1908
18	" " " " "	1916
19	" " " " "	1919-1924
22	Crown Willamette Paper Company	1920-'25-'28

No water rights involved Right No. 20 while Right No. 21 is an option that has not yet been exercised.

III

THE FIRST TRANSMISSION OF ALTERNATING CURRENT FROM STATION "A", OREGON CITY, TO PORTLAND

In an attempt to establish a definite date, or even an approximate date, on which alternating current was first transmitted from Oregon City to Portland, old time employes of Portland Electric Power Company and of Willamette Falls Electric Company have been personally interviewed and letters written to other individuals and manufacturing companies who, it was anticipated, might have information bearing on the matter.

It is a matter of newspaper record that direct current was transmitted for the first time on the evening of June 3, 1889 when an arc circuit was lighted in Portland by a dynamo that had been moved from the Weidler Mill in Portland and installed in Station "A" at the Willamette Falls in Oregon City. Unfortunately no similar record has been found for the first transmission of alternating current. 6/3/1889

Mr. W. C. Cheney, electrical engineer with the Willamette Falls Electric Company, is of the opinion that the first transmission of alternating current out of Station "A" was in late February, 1890 when he believes, the plant was put back into commission following the flood which occurred earlier in that month. It is his remembrance that at least one 1000-volt Westinghouse alternator had been moved from Weidler's Mill to Oregon City and connected with four one to one ratio 1000-volt transformers in multiple-series to step voltage up to 4000 volts for transmission to Portland where it was stepped down by a similar bank of transformers mounted on poles. This procedure was easily possible if all equipment had been available, but the question comes up: Where did the transformers come from? Mr. Cheney says in his letter of April 21, 1936, they were

CHAPTER I

THE PIONEER PERIOD IN THE WILLAMETTE FALLS AREA

The origins of the Portland General Electric Company are intimately entwined with the pioneer period of Oregon City and Willamette Falls. Improvements in river transportation and an expanding use of water power in the area's mills and factories led to the creation of predecessor companies. Land acquisitions around the falls, including Abernethy and Moore's Islands, perfected riparian water rights, ultimately producing significant direct water power income for the Company and a major resource for hydroelectric generation.

In pioneer days, the Willamette River was the only "highway" above and below the falls at Oregon City. Because of steep basalt rock cliffs rising at river-edge on each side of the falls area, goods and passengers were transported over it with considerable difficulty. In 1852 a shore road was blasted out on the easterly side at a cost of $20,000 that was funded by popular subscription in Oregon City.[1]

Later, a horse-powered railway was built on the portage road, extending from a deep-water boat anchorage at Canemah to a warehouse and dock at the foot of Eighth Street in Oregon City. A further facilitation of river navigation was the blasting of a channel on the east side of Abernethy Island. This channel generally followed the course of a mill race that had been excavated in 1832 by Dr. John McLoughlin, Chief Factor of the Hudson's Bay Company, to serve his projected sawmill.

In the early 1850s, regular river traffic consisted of two steamboats running constantly on the lower river to Portland and the Columbia, and nine boats plying the upper river to bring a variety of farm products to the falls for portage downriver. Increasing demand for boats encouraged the construction of a dry dock where Publishers' Paper Company's hydro generating plant now stands, at the east end of the falls. The dry dock was built into a natural depression in the rock river bed, which was then surrounded with a wooden crib dam and provided with a gate at the entrance.

In May 1851, the first experimental side-wheeler steamer was built at the Canemah dry dock. It was the ***Hoosier,*** made from a ship's long boat and equipped with a pile driver engine and boiler. Other boats constructed in the dry dock, later in 1851, ran as far as Corvallis, carrying 1,000-bushel loads of wheat. The ***James Clinton,*** built early in 1856, reached Eugene on March 12 that same year, transporting grain formerly carried downstream in flatboats paddled by Indians. In 1850 river boats had begun regular service runs from Oregon City to Astoria at an initial fare of $50 for the 25-hour, 120-mile trip. Later, more powerful steamers were able to make the trip upriver in 10 hours, with competition reducing the passenger fare to $22 for the faster trip. In the period from 1850 to 1890, rate wars were commonplace.

Early river steamers were fueled with cordwood or heavy slab where available; hence, a major problem on longer trips was the need to refuel. Although steamboat men paid up to $5 a cord, farmers along the route were not always willing (or able) to have a wood supply on a dock ready for loading. Besides, wood was bulky and reduced freight-carrying capacity. The temptation for two boats headed in the same direction to race under forced draft, with black smoke billowing from the stacks and sparks flying, was exciting for the passengers but hard on the fuel supply. Even under normal operation, sparks were a threat to the fields and forests bordering the river routes.

In December 1861, a great flood on the Willamette River carried away most of the improvements on both sides of the falls — including all the mills. Abernethy Island was swept clean of trees and soil. At the crest of the flood, a steamer, ***The St. Clair,*** was navigated over the falls, landing safely with whistle blowing in the lower river where it was to be delivered as a condition of a prior sale.

1

6 Arthur H. Greisser, History of Portland General Electric Company 1889-1981 (1982).

A need for a deeper boat basin and other improved facilities for river-borne commerce was apparent after the flood. The first step in that direction was the incorporation, on October 27, 1862, of the People's Transportation Company, with a later capitalization of $2 million. Its purpose was to provide transport for passengers and freight on the waters of the Willamette and Columbia Rivers and tributaries.

The company built a wood crib, rock-filled dam along with the east side of Abernethy Island, extending upstream from the basin wall to a point above the head of the falls. This formed a sort of canal to the basin which boats could navigate in low-water periods. They also built a warehouse on the north end of the basin created by the wood crib dams on the north and west sides. River navigation was thereby greatly assisted and the company prospered until the Oregon Steam Navigation Company entered the Willamette River service. Rates were then reduced. Eventually, a negotiated compromise gave the People's Transportation Company a 10-year relief period from competition by the Oregon Steam Navigation Company. Although business was good, no profits were forthcoming until 1865, when a 10 percent dividend was declared. The consequent surplus covered the purchase of three more steamboats.

Plans for a railroad running from Portland to California were conceived in 1863 as a line that would pass on the east side of Willamette Falls. Surveys started that year on a route from Marysville, California were carried north to Jacksonville, where an argument erupted among the promotors as to the best route to Portland. As the argument dragged on, funds ran out.[2]

In 1864 another company was formed. It continued the survey to Portland, reaching that city on October 1 that year. In January 1870 a railroad was constructed on the surveyed route from Portland to Oregon City. Later extended to Salem, the line developed into a direct competitor of the Peoples' Transportation Company (P.T. Co.) Therefore, the P.T. Co. sold a portion of its assets — including nine steamboats — to Ben Holladay, who controlled the railroad. The price paid was $200,000. The P.T. Co. was then reorganized and reincorporated by Ben Holladay and others, on September 5, 1871, as the Willamette Transportation Company. However, it soon met with financial reverses and was absorbed by its competitor, the Oregon Steam Navigation Company.

The initial operation of PGE's predecessor companies as a "utility", consisted of managing the canal and locks at the west side of the falls. The Willamette Falls Canal and Locks Company was incorporated September 16, 1868 to build a canal and locks and to engage in general river transportation activities. However, as progress on construction of the locks went slowly and costs soared, in 1870 the Oregon Legislature granted a subsidy of $200,000 and set a date for completion of the work — January 1, 1873 — as a condition of the subsidy. On New Year's Day 1873, the first boat to navigate the locks was the steamer ***Maria Wilkins.***

The legislature had specified that toll charges were not to exceed 50 cents per ton for freight and 10 cents per person; the State should receive 10 percent of net profit (there was none); and, after 10 years, the State could purchase the property. PGE's predecessor companies operated the locks continuously until their sale on July 8, 1913, together with 11,184 acres of land; to the U.S. Government for $375,000 — payment of which was not received until March 1915.[3] A water right to operate the locks was then granted the U.S. Government by Portland Railway, Light & Power Company. That right (No. 5 in priority), was estimated by T. W. Sullivan, Hydraulic Engineer for the Company, to be the equivalent of "100 horsepower in water power value".

After the Willamette Falls Canal and Locks Company came under the domination of the Oregon Steam Navigation Company, the former entity was reorganized as the Willamette Transportation and Locks Company and was incorporated December 29, 1875 with $1 million in capital stock. The following year, the Willamette Transportation and Locks Company purchased the east-side canal, boat basin and certain lands from the Oregon Steam Navigation Company, thereby acquiring practically complete control of the water power potential at the falls. Four small water rights and plant sites with titles dating in the 1860s were not acquired. The largest of these were owned by Oregon City Manufacturing Company for their woolen mill, and by George Larocque for his flouring mill, which later became the Portland Flouring Mills Company. Ultimately, Publishers Paper Company purchased all four prior water rights and properties.

The unexploited power potential at the falls was recognized by Henry Villard, a railroad genius who was sent to Oregon in 1874 by Jay Gould of the Union Pacific Railroad (then building west from Salt Lake). Acting upon his insight, Villard engaged P. Miescher, a Swiss civil engineer, to make a power study of the falls area. Miescher's report, dated May 2, 1884, covered numerous plans for the development of power and for power transmission to mills in the Oregon City area. The plans included a large canal about 5,000 feet long, through Main Street in Oregon City to Abernethy Creek, which would develop 5,200 hp continuously to supply projected mill operations on the lands abutting the Willamette River. On the west side, Miescher envisioned a tunnel in the rock cliff 40 feet wide, 20 feet high and 400 feet long, to carry water around the locks to develop an additional 4,000 hp. He estimated that a total of 12,500 hp could be produced by turbines at the falls year around. Transmission of the turbine power to mill sites "one or more miles distant" below the falls was proposed "by means of endless wire ropes running over large pulleys". Electric transmission of power was not considered economically feasible by Miescher.

The Paper Industry

On January 3, 1867, the first paper mill in the Pacific Northwest started operation at the Oregon City side of Willamette Falls. The company was headed by W. W. Buck of Ohio and two Oregon City associates. Substantial stone and brick mill buildings were provided with two water wheels for power. Operating only a few months, the venture proved unsuccessful. A sheriff's foreclosure on a bank's note forced sale of the mill, the mill site, and equipment, for $14,000.

In the fall of 1867 Buck and his son formed a partnership with Henry L. Pittock, publisher of *The Oregonian*, establishing a paper mill at Park Place on the Clackamas River at the site of Buck's sawmill, which was to be torn down. Four water wheels were installed to operate the mill, which started producing paper on August 30, 1868. Using principally rags and straw, the mill continued in operation for 17 years, producing newsprint, manila wrapping and carpet paper. When Pittock became interested in a projected much larger paper mill on the Columbia River at "LaCamas" (now Camas, Washington), the Park Place mill was closed down. The paper machine and plant superintendent moved to Camas.

A syndicate of Oregon City and Portland businessmen with E. L. Eastham as president, secured the stock of the Willamette Transportation and Locks Company in 1886, embarking on a campaign to convince milling and manufacturing plants to locate at the falls. Initially, 10 years free water power and land lease was offered, under agreements extending an additional 40 years. The first large company to be attracted was the Willamette Pulp and Paper Company of San Francisco, which entered into an agreement on September 7, 1887 to lease 1,000 hp for a 50-year period. However, when the time came to consummate a lease, the quantity of power was increased to 2,000 hp with an option for 600 hp additional. This was the first in a long succession of direct water power leases at Willamette Falls.* Construction of a ground-wood pulp mill was started in the fall of 1888, with T. W. Sullivan as hydraulic engineer in charge after March 1889.

Under subsequent leases, dated April 17, June 19, and August 1, 1889, land areas were increased and water power requirements were modified for the Willamette Pulp and Paper Company, to the extent of 2,400 hp of "low" water power, with a priority over ultimate requirements for electric generation by PGE in its Stations A and B.

Shortly after securing a location for the Willamette Pulp and Paper Company mill, Eastham persuaded the Crown Paper Company of San Francisco to begin a mill site and 200 hp of low water power for a 30-year period beginning January 1, 1887. The agreement also granted a 10-year free right to the use of lands and power.

*See chapter entitled "Riparian Water Rights and Sale of Direct Water Power".

Electric Power Developments At Willamette Falls

After convincing two paper mills to locate at the falls, E. L. Eastham conceived a plan for developing hydroelectric power and transmitting it to Portland, where some electric lighting had been installed. He and his associates formed the Willamette Falls Electric Company, incorporated November 8, 1888, with Eastham as president. Within a short time, a "dynamo house" (later named Station A) and rock-filled, wooden bulkheads were constructed on the east side of the falls, and the plant was equipped with four "No. 8" "Brush" arc light dynamos ordered from the California Electric Light Company. Two water turbines were geared to a line shaft for belt connection to the direct current generators. A transmission line to Portland was erected and, on June 3, 1889, the first generating unit was connected to an arc light circuit in the city. On June 10, 1889, a second unit was connected. *This accomplishment was the first instance of long-distance transmission of electrical energy for commercial purposes in the United States.*

The Willamette Falls Electric Company was not the first to use the falls for electric generation. The Oregon City Electric Company was incorporated on July 20, 1888 by a group including Eastham, to supply electric lighting and other utility services in the area. A 450-light capacity Edison dynamo operated by a 200-hp water turbine was installed in an excelsior and shoddy mill on the east bank of the river. Thus, lighting services in stores, residences, and on Oregon City streets began in November 1888. However, the plant had a relatively short life, because the great flood of February 1890 wrecked the building. Only the machinery was salvaged. The flood carried away all of the bulkheads built by the Peoples Transportation Company, from the upper river, down to and including those forming the basin at the south end of the Main Street.

The basin bulkheads were rebuilt by T. W. Sullivan who, having completed his work on the Willamette Pulp and Paper Company plant, had been hired by Messrs. Morey and Eastham. The electric light plant (Station A) was thus soon able to resume operations. Sullivan was named Hydraulic Engineer for the Willamette Falls Electric Company and its successors, remaining on the PGE payroll until his death in June 1940.

As for the Willamette Falls Electric Company, its P. F. Morey and his consulting engineer, W. C. Cheney, were convinced that higher voltage generation was both necessary and feasible. Accordingly, six 4,000-V, 80 kW generators (single-phase, 125 cycles) were ordered from the Westinghouse Electric and Manufacturing Company — the only manufacturer willing to design and build such equipment. Westinghouse insisted, however, that it be absolved of any responsibility for unsatisfactory or unsuccessful operation.

In the summer of 1890 the six generators were installed. They are believed to have begun transmission of their alternating current output to Portland in September 1890. This was another "first" — *the first instance of long distance transmission of alternating current for commercial purposes in the United States.*

As the art of synchronizing two or more alternators to run in parallel had not yet been perfected, each arc light machine and alternating-current generator required its own transmission circuit. Consequently, the transmission line running to Portland along the west side of the river ultimately carried 36 separate wires. The line was rebuilt in September 1894. The *Journal of Electricity*, in December 1895, reported that the line: ". . . contains a conglomeration of circuits that makes it noteworthy. It consists of 50-foot poles, having a diameter of 12 inches at the top and varying in diameter from 20 inches to 24 inches at the butt, the poles being placed 100 feet apart. The poles erected in the country division contain three six-pin crossarms and three eight-pin crossarms . . . on these are run the following circuits: seven 4000-V incandescent circuits; six arc circuits; two three-phase circuits of No. 1 wire; one six-conductor telephone cable; one galvanized wire linemen's call-bell circuit; one copper signal circuit."

By July 1891, the Willamette Falls Electric Company generating plant had grown to a total capacity of 1,345 kW, including a 75-kW, 500-V, direct-current generator for the Portland-Oregon City electric interurban railway, which was then under construction.

On November 27, 1888, the board of directors of the Willamette Falls Electric Company (WFE) voted to acquire all the assets of the United States Electric Light and Power Company of Portland, which had been incorporated on March 17, 1884.* The directors also voted to purchase 5,100 of E. L. Eastham's shares of Willamette Transportation and Locks Company stock to give WFE a voice in the control of the canal and locks. Property of the Oregon City Electric Company was purchased June 20, 1891; Eastham had died January 18, 1891. On February 26, 1891, P. E. Morey was elected to succeed him as president.

Portland General Electric Company Incorporation

Growth of the electric industry developed rapidly in 1892, so more capital was needed to keep pace with demand. Accordingly, the Portland General Electric Company (a predecessor of the present PGE) was incorporated on August 5, 1892 with a capital of $4,250,000, to engage in a general light and power business. On August 26, a board of 11 directors elected P. F. Morey as president and Howard C. Levis as vice president and appointed Charles H. Caulfield secretary. H. W. Goode, elected director at that meeting, was later appointed general manager.

On September 1, 1892, PGE acquired the assets, liabilities and surplus of the Willamette Falls Electric Company, which had a book value of $562,191. At the same time, assets of the Willamette Falls Transportation & Locks Company, with a book value of $1,427,038, was also purchased by PGE. PGE preferred stock was issued in exchange for the outstanding securities of the purchased companies. PGE common stock, consisting of 20,000 shares with a par value of $100, and 795 shares of preferred stock with par value of $100 was issued to the Northwest General Electric Company of St. Paul, Minnesota. According to the minutes of PGE at the time, the securities were issued in payment for "certain territorial rights" in connection with the purchase and sale of General Electric Company equipment and appliances.

An early summary of manufacturing activities at Willamette Falls appeared in the December 14, 1889 issue of the publication, *West Shore*. It stated: "Oregon City has experienced greater growth during the past year than during any previous similar period of its history. The city at the falls of the Willamette has always been cited as the most favorable location in Oregon for extensive and varied manufacturing enterprises. Portland, by virtue of its being at the head of deep water navigation, grew to be the commercial entrepot of the northwest. The conditions of markets and means of transportation were such that manufacturing advantages, however great, had small weight in the building up of cities in this country. It required a certain stage of development of the natural resources to make those benefits appreciated. That stage of development (at Oregon City) has been reached. The matchless water power of Oregon City has drawn there, during the past twelve months, more capital for investment in factories than any other city in the state has obtained".

As for the water power potential at the falls, the article said: "The volume of water varies considerably at different seasons of the year, but at its lowest stage the power it furnishes is practically unlimited. The ease with which it is controlled is a consideration; the expense of utilizing a power in every way adequate to drive heavy machinery often being so great that the investment is hazardous. At either side of Willamette Falls there are factory sites where the simplest arrangements for securing and governing the water supply are entirely successful. But with all the favoring conditions that exist there the *power capacity of the falls is so vast that it is not likely to ever all be employed* . . . The Willamette Transportation & Locks Company (W.T.& L. Co.) as now organized controls the water power privileges and the liberal policy of granting free sites and free power for a term of years to those who will invest money in manufactories is bearing gratifying results."

"Besides the pulp and paper mills and electric power plants the improvements last year at Oregon City include the establishment of a flouring mill with a daily output of 125 barrels, a cement mill of a capacity of 100 barrels a day, a furniture factory, an excelsior factory, a shoddy mill, an ice factory, a soap factory, two brick yards, a box factory, scroll and moulding works, a hose factory, a sash, door and blind factory and two saw mills near

* See chapter entitled "Electric Light on the Portland Scene".

the city. These represent, in the aggregate, a vast amount of capital and surely warrant the expectations of those best acquainted with the growth and possibilities of the falls city for very rapid advancement."

E. L. Eastham's acumen in the promotion of industry for the Willamette Falls area was demonstrated by the installations of water-driven turbines, tabulated by T. W. Sullivan on April 20, 1892. The two paper mills had an installed capacity of 4,620 hp in 19 turbines; an excelsior mill, 182 hp; the Portland Cement Company, 73 hp; the Oregon City Water Works, 133 hp; Smith & Lovett's "ice factory and cold storage depot", unrecorded hp; and the Willamette Falls Electric Company, 1,877 hp in seven turbines. In addition, both the Oregon City Manufacturing Company's woolen mill and "soap factory" and the Portland Flouring Mills Company continued their operation of water-driven turbines under rights acquired in the 1860's. Other industry shown on a map of Oregon City in 1892 included Bestow's Sash, Door and Fence Factory, Oregon City Brewery, Electrical Iron & Steel Works, Oregon City Sash and Door Factory, and Oregon City Iron Works.

In May 1893, an electric interurban railway line was constructed by the East Side Railway Company (another early corporate predecessor of PGE), from Portland to Oregon City, with relatively frequent, quiet, non-polluting and — for those days — fast, service. The electric interurban was particularly convenient in that period of dirt roads and no automobiles. Sunday and holiday excursion rates were 35 cents for the round trip to the public park at Canemah, constructed by the East Side Railway Company. The Park afforded free picnic facilities, a baseball diamond, a large covered dance hall and pavilion, a bandstand, and children's playground equipment.

The interurban line also brought many fishermen to the popular river areas above and below the falls. It spurred early development of homesites in the Sellwood, Milwaukie, Jennings Lodge and Gladstone areas and provided a route for log and freight hauling from the Oregon City area to Portland. Later (in 1915), an electrified connecting railroad between Oregon City and Mt. Angel was built by the subsidiary, Willamette Valley Southern Railroad Company, enlarging the log marketing possibilities on the east side of the valley.

Early in its history, the Portland General Electric Company planned a new hydro turbine generating plant on the west side of the falls, adjacent to the ship canal and locks. It was later named "Station B", ultimately becoming the Sullivan Plant in honor of its original designer. Its design was unique in that two turbines of different head ratings were installed for each 450-kW, alternating-current generator. The turbine for low-head conditions was larger in physical dimensions, slower in speed, and connected to the generator by a wide leather belt. Under high-head conditions, tension of the belt was reduced so it could "slip", allowing the higher speed turbine to drive the generator. The station was designed for an ultimate capacity of 12,000 hp and a projected initial installation of 6,000 hp. Foundations were to be provided for 11 generating sections and a "pump" turbine section.

Construction of the Station B powerhouse was started in the summer of 1893. It required almost two years of effort, due to difficulties encountered in placing concrete in the 30-to-50 foot depth to bedrock in the old river channel that the structure bridged. The first two generating units were put into commercial service on December 1 and 12, 1895 and the third on January 1, 1896. Two 500-V, direct-current generators were installed in a fourth turbine section to furnish service for electric railways and to provide excitation for the alternating-current generators.

In 1897, an additional four 750-kW generating units, identical with the original three, were installed — as well as "alternators" moved from Station A for installation in the No. 6 and 8 sections of the powerhouse. In 1899, the latter were replaced with new 500-kW revolving-field-type generators, and a third 500-kW unit was added in the No. 5 section.

The 1899, construction program included the foundation walls for projected generating sections No. 12 and 13, completed in 1903 with the installation of two horizontal turbines, each with a 540-kW generator. This brought

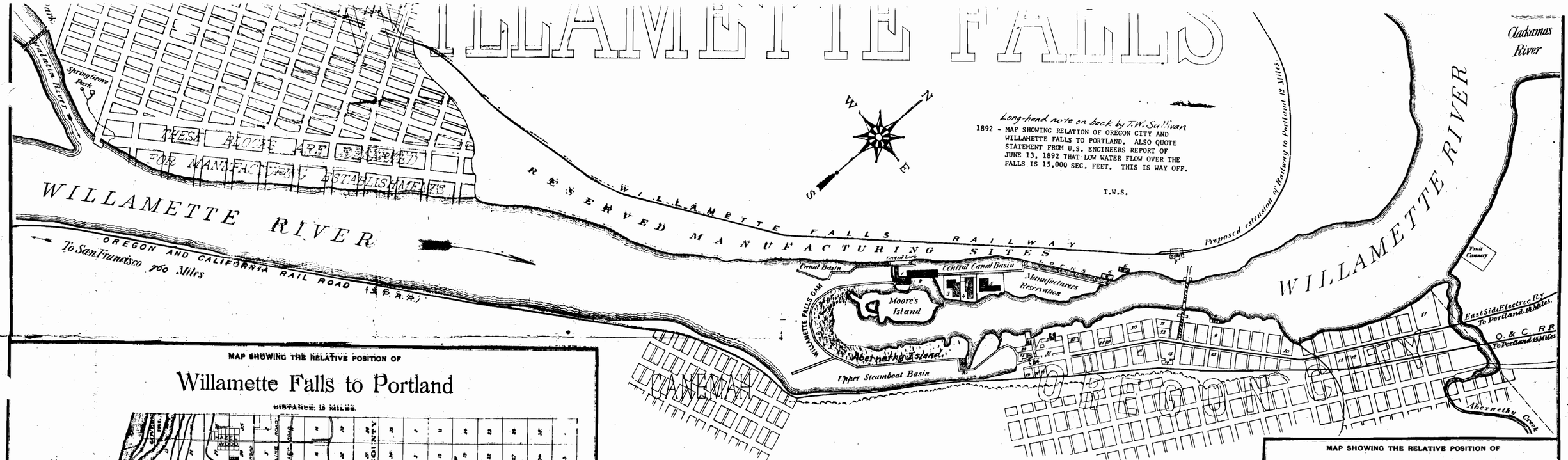
the generating capacity of the station up to 5,730 kW. Until 1907, when the Cazadero (Faraday) plant was placed in service, Station B was by far the largest electric generating plant in the State of Oregon.

Station A was abandoned as a generating station circa 1897; some electrical equipment (Excelsior arc machines) was moved for use in a Portland steam plant, and the two alternators were temporarily installed in Station B. The station structures and turbines were leased for a time to the Willamette Pulp and Paper Company, for use in a cut-up and pulp grinding mill. In 1908, the site and equipment was leased to Hawley Pulp and Paper Company which used it in their "Mill A" pulp grinding operations, as did Hawley's successor, Publishers' Paper Company, until July 16, 1961 when pulp grinding by water power was finally abandoned.

In 1893, one phase of the PGE program to increase industrial activity in the Willamette Falls area included the construction of a three-mile electric railroad on the west side of the river. The line was called Willamette Falls Railway. Initially, it extended upriver, from a station near the West Linn hotel,to the townsite of Willamette Falls near the mouth of the Tualatin River where about 1,600 acres were platted for a "manufacturing city". According to *The Journal of Electricity* of December 1895: "Situated as it is . . . but a short distance above the falls, it is within easy reach of Portland, the commercial center of the Pacific Northwest, and it will in all probability soon become the Lynn of that portion of the country. At present the city of Willamette Falls contains about 800 inhabitants, many of whom find employment in the Capen shoe factory, its solitary industry, and which is operated by electric power".

The Electrical World, of May 6, 1893 reported that the railroad right-of-way was being graded and six carloads of 56-pound rails were on hand. That same publication reported that the East Side Electric Railway from Portland had reached Oregon City with a 25-cent fare in effect.

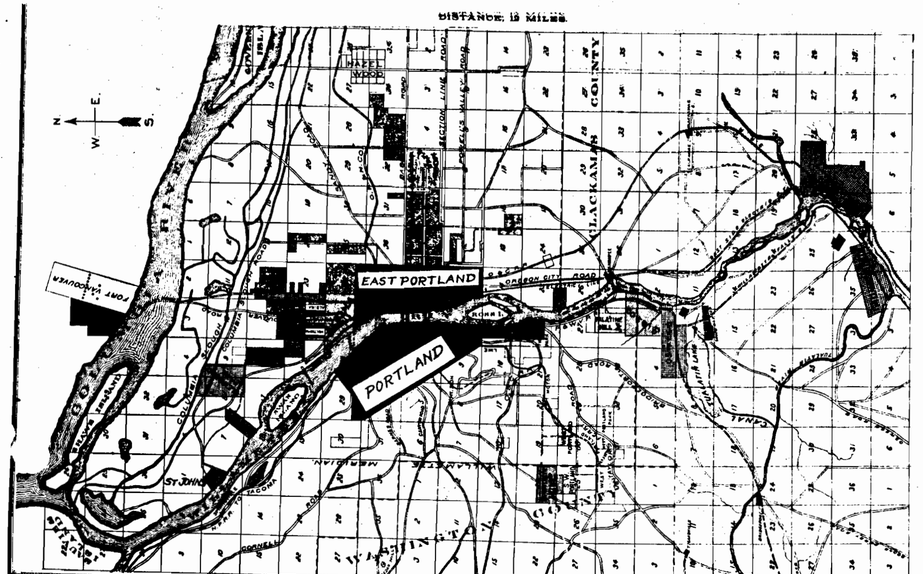
As industry did not develop at the city of Willamette Falls, the railroad was extended northerly to the Willamette River near Sucker Creek, and was used extensively to haul logs downriver from the Tualatin. In November 1912, the railroad was sold by Portland Railway, Light and Power Company, to the Portland, Eugene and Eastern Railway Company.



MAP SHOWING THE RELATIVE POSITION OF

Willamette Falls to Portland

DISTANCE 12 MILES.



FACTORIES AND BUSINESS ESTABLISHMENTS

—LOCATED AT—

WILLAMETTE FALLS AND IN OREGON CITY.

1. Willamette Pulp & Paper Co., Pulp Mill.
2. Portland General Electric Co., Power Station B.
3. Willamette Pulp & Paper Co., Chemical Pulp Mill.
4. Willamette Pulp & Paper Co., Paper Mill.
5. Crown Paper Co., Paper Mill.
6. Willamette Falls Excelsior Co., Excelsior Mill.
7. Willamette Falls Railway Station.
8. Oregon City Transportation Co., Wharf and Warehouse.
9. Clackamas County Court House.
10. Bestow's Sash, Door and Fence Factory.
11. Broughton's Saw Mill.
12. Oregon City Sash and Door Factory.
13. Oregon City Brewery.
14. Oregon & California Railroad, Depot and Warehouse.
15. Oregon City "Courier."
16. Commercial Bank.
17. Cement Works.
18. Electrical Iron & Steel Works.
19. Portland Flouring Mills Co., Grain Elevator.
20. Portland General Electric Co., Power Station A.
21. Portland General Electric Co., Wharf and Warehouse.
22. Smith & Lovett's Ice Factory and Cold Storage Depot.
23. Portland Flouring Mills Co., Flour Mill—Roller Process.
24. Oregon City Water Works, Pumping Station.
25. Oregon City Manufacturing Co., 18 Set Woolen Mill.
26. Oregon City Manufacturing Co., Soap Factory.
27. Portland Flouring Mills Co., Brick Flour Mill.
28. Livermore's Hotel.
29. U. S. Land Office.
30. Oregon City Iron Works.
31. Oregon City "Enterprise."
32. Oregon City Bank.

THE WATER POWER

—AT—

WILLAMETTE FALLS, OREGON.

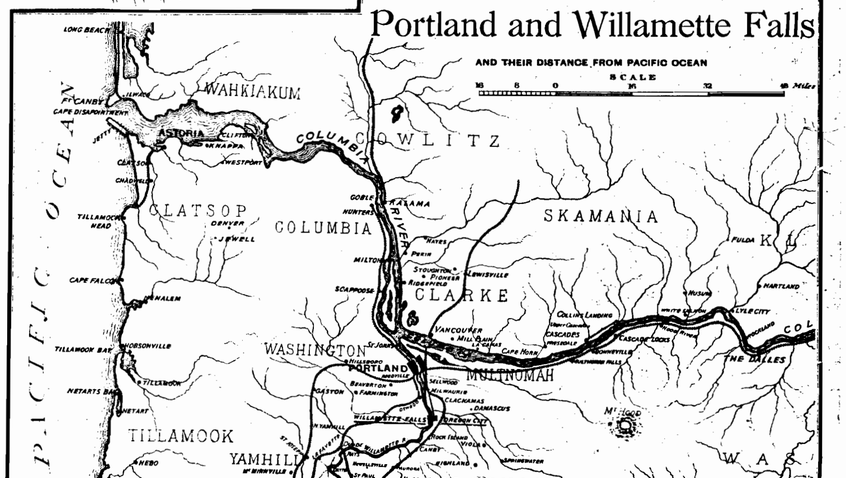
The engineers of the Department of the Columbia, Major T. H. Handbury, Captain T. W. Symons and Lieutenant H. Taylor, in their report to Brigadier-General Thomas L. Casey, chief of engineers of the United States army, dated June 13th, 1892, state that at the lowest stage of water the discharge over the falls is 15,000 cubic feet per second. The height of the falls, or the head, is 42 feet. There is therefore at the lowest stage of water **71,591** horse-power.

MAP SHOWING THE RELATIVE POSITION OF

Portland and Willamette Falls

AND THEIR DISTANCE FROM PACIFIC OCEAN

SCALE



PORTLAND GENERAL ELECTRIC

#5

DEC 11 1975

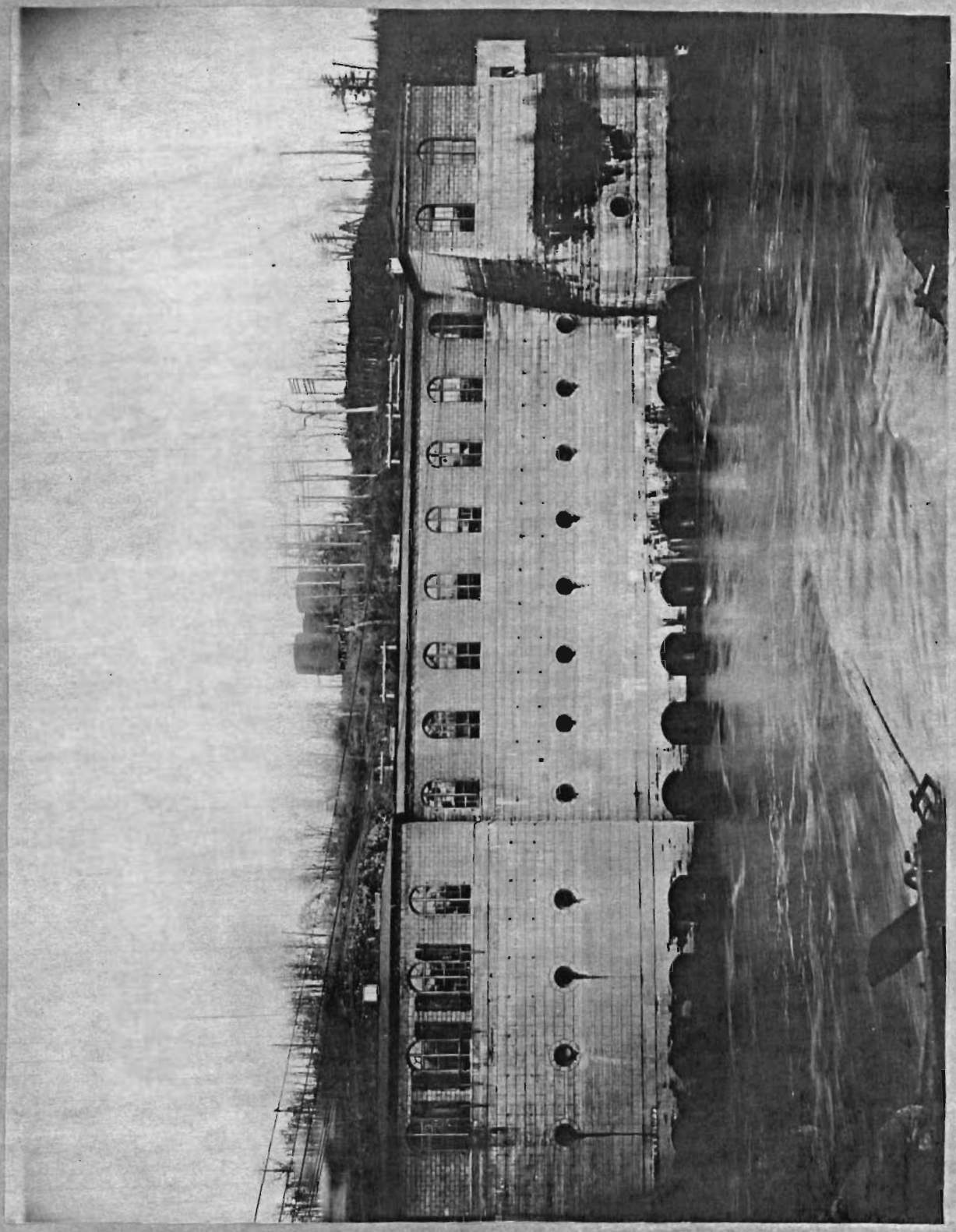
FIRST — "Remote" power plant getting power from falls at Oregon City generated DEC 1 1889 electricity which was sent 12 miles to Portland, a national record distance.

STATION A after 1890 flood.
Steamer "Three Sisters" grounded.
East side of river.

This is Portland General Electric company's original long-distance transmission line from a plant on the Willamette river near Oregon City to Portland, Oregon. The energy from six new 4,000-volt Westinghouse dynamos went on the line to Portland in the late summer or early fall of 1889. While the date for the first transmission of direct current is a matter of definite record, it is unfortunate that a corresponding date for the first transmission of alternating current has not been established. However it did occur subsequently over these same lines.

64 X 53
1st plant

Station "B" - Exterior.



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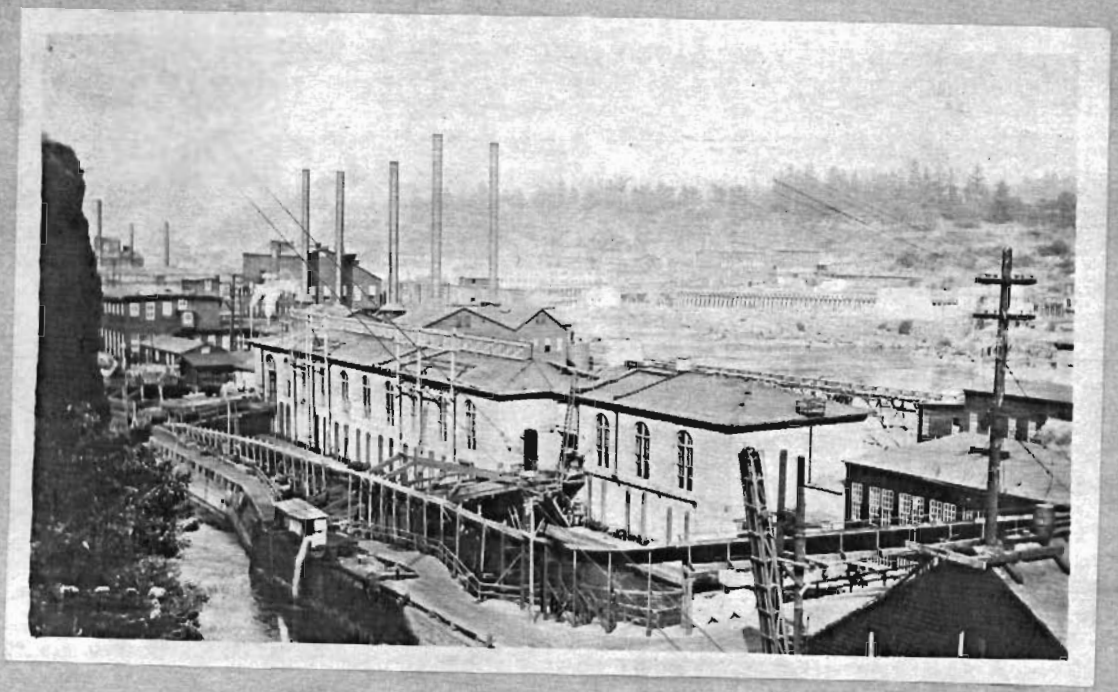
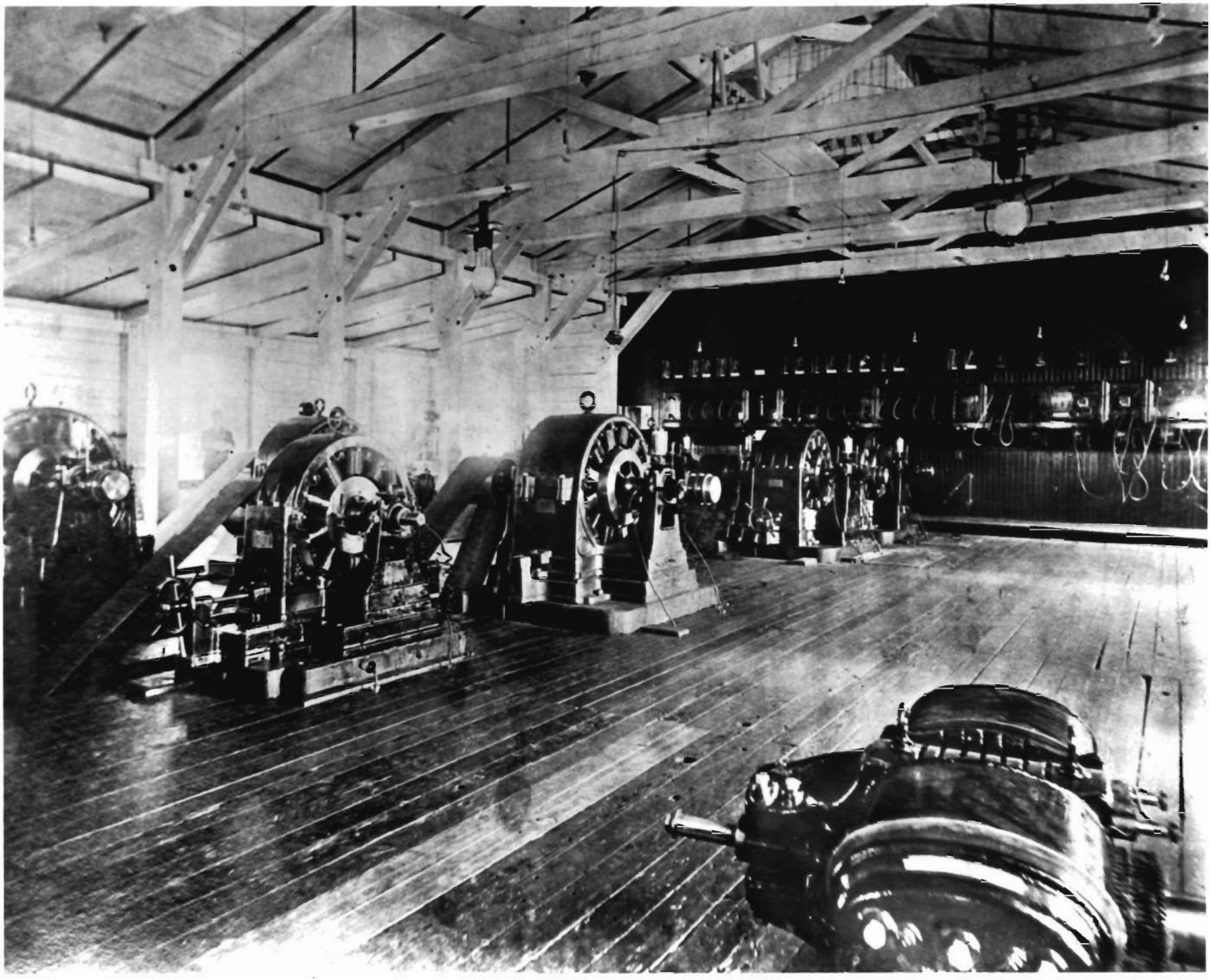
2-1

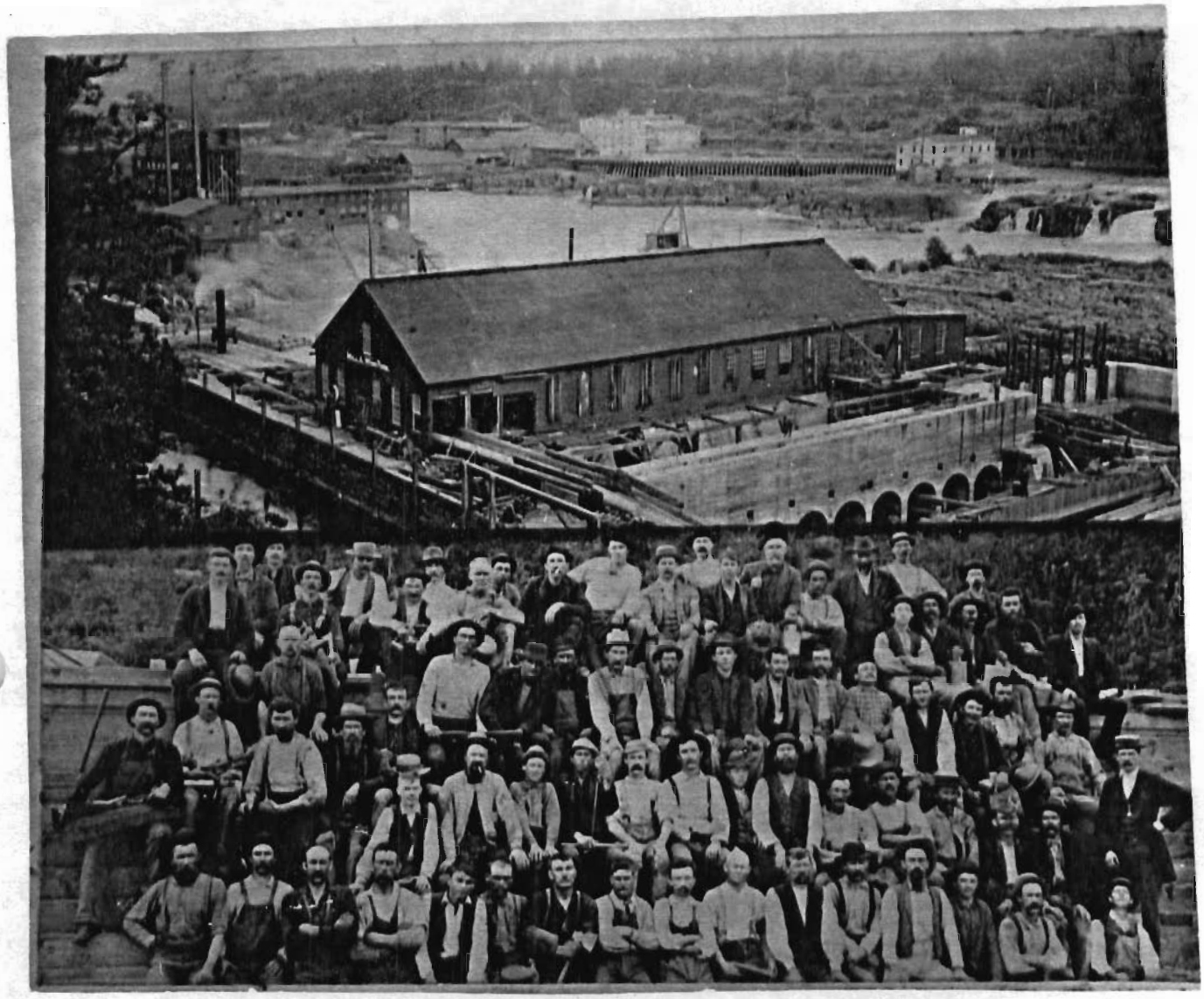
Station "B" - Oregon City.



E 301-B 554

2-2





ATTACHMENT C-7

Year	Peak Generation (kw)	CFS
1905[1]	8,293	6,910
1906	9,630	8,025
1907	8,500	7,083
1908	9,310	7,758
1909	8,820	7,350
1910	9,180	7,650
1911	9,650	8,042

[1] This is the first year for which records of actual power generation are available. The rated capacity of PGE's facilities at Willamette Falls was 1,350 kw from 1894 through 1897, 3,150 kw from 1898 through 1899, 4,650 kw from 1900 through 1902, and 5730 kw from 1903 through 1910.

Attachment C-8

Oregon

DEPARTMENT OF
FISH AND
WILDLIFE

December 21, 1992

Julie A. Keil, Licensing Manager
Portland General Electric Company
121 SW Salmon Street
Portland, Oregon 97204

Subject: Water Right for Fish Ladder at Willamette Falls, FERC # 2233

Dear Julie:

The Oregon Department of Fish and Wildlife (ODFW) and Portland General Electric (PGE) have discussed the need to file for a water right through the Oregon Water Resources Department (WRD) for the water necessary to operate the fish ladder at Willamette Falls. ODFW supports PGE's filing of the application to protect water used for adult fish passage at Willamette Falls from future appropriation.

The filing will be accomplished through PGE's surface water registration statement for the water rights at Willamette Falls for pre-1909 water rights. Filings for pre-1909 water rights must be made by December 31, 1992, in accordance with Oregon statutes (ORS 539.240).

Through data collected in the Willamette Falls Study, ODFW has determined a maximum flow of 1080 cfs is required to adequately achieve fish passage at Willamette Falls. ODFW recommends that 1080 cfs be appropriated for use in the fish ladder at Willamette Falls and that the water right be based on this flow level.

ODFW greatly appreciates PGE's cooperation and willingness to apply for this water right. If there are any question or concerns, please call at 229-6967 extension 441.

Sincerely,

Stephanie Burchfield

Stephanie Burchfield
Water Resources Program Manager
Habitat Conservation Division

2501 SW First Avenue
PO Box 59
Portland, OR 97207
(503) 229-5400

c: Clayton Hawkes, NMFS
Marv Yoshinaka, USFWS
Rick Craiger, WRD
Reed Marbut, WRD
Audrey Simmons, Water Watch
Peter Paquet, NW Power Planning Council

ATTACHMENT D

AFFIDAVIT OF LAWRENCE MAGURA
ENGINEERING CONSULTANT FOR SIMPSON PAPER COMPANY

STATE OF OREGON)
) ss.
COUNTY OF CLACKAMAS)

I, Lawrence Magura, being first duly sworn, depose and say:

1. I am a registered engineer in the State of Oregon employed by HDR Engineering Inc. ("HDR"). HDR has been engaged by Simpson Paper Company ("Simpson") to assist in preparation of surface water registration statements for its Evergreen Mill in West Linn, Oregon. I have personal knowledge of the matters set forth in this affidavit.

2. Pursuant to an "Amendment to and Restatement of Lease Agreement" dated November 30, 1990 between Portland General Electric Company and Simpson Paper (Oregon) Company (the "Lease"), Simpson leases from Portland General Electric Company ("PGE") certain land and water rights. Simpson has leased such water rights from PGE and its predecessors in title under various instruments as described on "Attachment D-1" since 1888.

3. "Attachment D-2" is a table showing the total quantity of water diverted by Simpson from the Willamette River for industrial processes during the years 1889-1992, expressed in cubic feet per second.

4. "Attachment D-3" is a table showing the total quantity of water diverted by Simpson from the Willamette River for hydropower purposes during the years 1889-1992, expressed in cubic feet per second.

5. The water quantities described in Attachment D-2 include filtered water and raw water for fire systems and process uses. Water usage from 1889 through 1909 is estimated based on the equipment in place each year and its recorded capacities. The estimated capacity of each piece of equipment is based on engineering records found in the Evergreen Mill.

6. Pursuant to the Lease, Simpson currently diverts 54.5 CFS of water for use in industrial processes at Simpson's paper mills.

7. Pursuant to the Lease, Simpson currently diverts 3,356 CFS of water for use in its hydropower facilities.

Lawrence Magura

Lawrence Magura
Engineering Consultant for
Simpson Paper Company

SUBSCRIBED and SWORN to before me this 28th day of December, 1992.

Linda Dexter

NOTARY PUBLIC FOR OREGON
My Commission Expires: 8-8-94

ATTACHMENT D-1

Summary of Leases Between Simpson and Its Predecessors and PGE and Its Predecessors

1. Lease from Willamette Transportation and Locks Company to Willamette Pulp & Paper Company dated September 7, 1888.

2. Lease from Willamette Transportation and Locks Company to Willamette Pulp & Paper Company dated September 7, 1888.

3. Lease/option from Willamette Transportation and Locks Company to Willamette Pulp & Paper Company dated April 27, 1889.

4. Lease from Willamette Transportation and Locks Company to Willamette Pulp & Paper Company dated June 19, 1889.

5. Lease from Willamette Transportation to Willamette Pulp dated August 1, 1889.

6. Lease from PGE to Willamette Pulp dated December 18, 1893.

7. Lease from PGE to Willamette Pulp dated December 20, 1893.

8. Lease from PGE to Willamette Pulp dated May 27, 1904.

9. Supplementary agreement from PGE to Willamette Pulp dated May 27, 1904.

10. Lease from PGE to Willamette Pulp dated May 31, 1904.

11. Lease from PGE to Willamette Pulp dated April 18, 1907.

12. Lease from Willamette Transportation to Crown Paper Company dated November 2, 1889.

13. Lease from PGE to Crown Paper dated January 25, 1895.

14. Lease from PGE to Crown Paper Company dated May 25, 1904.

15. Lease from PGE to Crown-Columbia Pulp & Paper dated March 12, 1908.

16. Lease from PGE to Crown-Columbia Paper dated May 13, 1908.

17. Lease from Portland Railway Light & Power Company to Crown-Willamette Paper Company dated January 31, 1917.

18. Lease from Portland Railway to Crown-Willamette Paper dated June 10, 1920.

19. Lease from Portland Railway to Crown-Willamette Paper dated June 11, 1920.

20. Lease from PGE to Crown-Willamette Paper dated October 28, 1925.

21. Lease from PGE to Crown-Willamette Paper Company dated September 1, 1932.

22. Lease from PGE to Crown-Willamette Paper Company dated June 26, 1934.

23. Lease option agreement between PGE and Crown-Zellerbach dated May 6, 1946.

24. Lease from PGE to Crown-Zellerbach dated May 1, 1946.

25. Agreement from PGE and Crown-Zellerbach (entitled Amendment to Lease between PGE and Willamette Paper dated May 27, 1904) dated February 1, 1950.

26. Supplemental agreement between PGE and Crown-Zellerbach dated February 1, 1950.

27. Lease agreement from PGE to Crown-Zellerbach dated November 12, 1971.

28. Lease from PGE and Simpson Paper Company dated November 30, 1990.

ATTACHMENT D-2

Summary of Simpson Paper Company – Evergreen Mill Process Water Use
in cubic feet per second (CFS)

Year	Peak Annual Flow	Year	Peak Annual Flow	Year	Peak Annual Flow
1889	14.3	1924	80.3	1959	77.4
1890	35.5	1925	80.3	1960	77.4
1891	37.9	1926	80.3	1961	77.4
1892	39.5	1927	80.3	1962	77.4
1893	41.1	1928	80.4	1963	77.4
1894	42.4	1929	80.4	1964	76.6
1895	42.4	1930	80.4	1965	76.6
1896	44.7	1931	80.4	1966	76.6
1897	44.7	1932	80.4	1967	76.6
1898	47.4	1933	76.9	1968	76.6
1899	47.4	1934	76.9	1969	70.6
1900	47.6	1935	95.2	1970	74.0
1901	47.6	1936	95.2	1971	74.0
1902	49.3	1937	98.1	1972	74.0
1903	49.3	1938	98.1	1973	74.0
1904	49.3	1939	98.1	1974	74.0
1905	52.9	1940	98.1	1975	74.0
1906	52.9	1941	98.1	1976	74.0
1907	52.9	1942	98.1	1977	74.9
1908	55.0	1943	98.1	1978	74.1
1909	54.2	1944	98.1	1979	74.1
1910	55.0	1945	97.1	1980	71.8
1911	64.7	1946	97.1	1981	71.8
1912	64.7	1947	98.8	1982	71.8
1913	64.7	1948	98.8	1983	71.8
1914	64.7	1949	98.8	1984	71.8
1915	64.7	1950	98.8	1985	71.8
1916	64.7	1951	94.6	1986	71.8
1917	64.7	1952	94.6	1987	71.8
1918	64.7	1953	94.6	1988	71.8
1919	64.7	1954	74.5	1989	71.8
1920	70.4	1955	77.4	1990	73.7
1921	80.3	1956	77.4	1991	54.5
1922	80.3	1957	77.4	1992	54.5
1923	80.3	1958	77.4		

ATTACHMENT D-3

Summary of Simpson Hydropower Capacity at Willamette Falls
in cubic feet per second (cfs), for the years 1888 – 1992

Year	Flow	Year	Flow	Year	Flow	Year	Flow	Year	Flow
1888	0	1911	8427	1934	14502	1957	8830	1980	6173
1889	805	1912	8427	1935	14502	1958	8830	1981	6173
1890	805	1913	8427	1936	14502	1959	8830	1982	6173
1891	958	958	8924	1937	14502	1960	8830	1983	6173
1892	958	1915	8924	1938	14502	1961	8830	1984	6173
1893	1038	1916	8924	1939	14502	1962	8830	1985	5516
1894	1038	1917	8924	1940	14502	1963	8830	1986	3857
1895	1827	1918	8924	1941	14502	1964	8830	1987	3356
1896	1827	1919	8924	1942	14502	1965	8830	1988	3356
1897	1827	1920	13912	1943	14502	1966	7676	1989	3356
1898	1827	1921	13912	1944	14502	1967	7676	1990	2855
1899	1827	1922	13912	1945	13017	1968	7676	1991	1541
1900	1827	1923	13912	1946	13017	1969	7676	1992	1021
1901	1827	1924	13912	1947	8830	1970	7676		
1902	3312	1925	13912	1948	8830	1971	7676		
1903	3312	1926	13912	1949	8830	1972	7676		
1904	3312	1927	13912	1950	8830	1973	7175		
1905	7320	1928	14569	1951	8830	1974	7175		
1906	7320	1929	14569	1952	8830	1975	7175		
1907	8360	1930	14569	1953	8830	1976	7175		
1908	8360	1931	14569	1954	8830	1977	7175		
1909	8360	1932	14569	1955	8830	1978	6674		
1910	8360	1933	14569	1956	8830	1979	6674		

ATTACHMENT E

AFFIDAVIT OF LAWRENCE MAGURA
ENGINEERING CONSULTANT FOR SMURFIT NEWSPRINT CORPORATION

STATE OF OREGON)
) ss.
COUNTY OF CLACKAMAS)

I, Lawrence Magura, being first duly sworn, depose and say:

1. I am a registered engineer in the State of Oregon employed by HDR Engineering Inc. ("HDR"). HDR has been engaged by Smurfit Newsprint Corporation ("Smurfit") to assist in preparation of surface water registration statements for its mill in Oregon City, Oregon. I have personal knowledge of the matters set forth in this affidavit.

2. Pursuant to the Leases described on "Attachment E-1" (the "Leases"), Smurfit leases from Portland General Electric Company ("PGE") certain land and water rights. Smurfit and its predecessors have leased such water rights from PGE and its predecessors in title under various instruments since 1908.

3. "Attachment E-2" is a table showing the total quantity of water diverted by Smurfit from the Willamette River for hydroelectric purposes during the years 1889-1992, expressed in cubic feet per second.

4. "Attachment E-3" is a table showing the total quantity of water diverted by Smurfit from the Willamette River for industrial process during the years 1889-1992, expressed in cubic feet per second.

5. Pursuant to the Leases, Smurfit currently diverts 898 cfs for the purpose of generating hydroelectric power for use at Smurfit's paper mills.

6. Pursuant to the Leases, Smurfit currently diverts 55.7 cfs for the purpose of industrial process use.

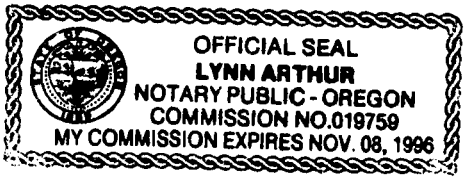
Lawrence Magura

Lawrence Magura
Engineering Consultant for
Smurfit Newsprint Corporation

SUBSCRIBED and SWORN to before me this 29th day of December, 1992.

Lynn Arthur

NOTARY PUBLIC FOR OREGON
My Commission Expires: _____



ATTACHMENT E-1

Summary of Leases Between Smurfit and Its Predecessors and PGE and Its Predecessors

1. Lease from Portland Railway Light and Power Company to Hawley Pulp and Paper Company dated December 31, 1908.

2. Lease from Portland Railway Light and Power Company to Hawley Pulp and Paper Company dated December 30, 1916.

3. Lease from Portland Railway Light and Power Company to Hawley Pulp and Paper Company dated November 1, 1919.

4. Supplementary electrical agreement between Portland Railway Light and Power Company to Hawley Pulp and Paper Company dated December 13, 1916.

5. Lease from Portland Electric Power Company to Hawley Pulp and Paper Company dated August 1, 1924.

6. Supplementary agreement of Portland Electric Power Company with Hawley Pulp and Paper Company dated August 1, 1924.

7. Any rights assigned from Crown-Zellerbach Company to Hawley Pulp and Paper Company by assignment dated June 30, 1944. The assignment granted certain rights in leases described as follows:

a. The lease from Portland General Electric Company to Crown Paper Company dated May 25, 1904.

b. Lease from Portland General Electric Company to Crown-Columbia Pulp and Paper Company dated March 12, 1908.

c. Lease from Portland General Electric Company to Crown-Columbia Pulp and Paper Company dated March 13, 1908.

d. Lease from Portland Railway Light and Power Company to Crown-Willamette Paper Company dated June 10, 1920.

8. Agreement between Portland General Electric Company and Hawley Pulp and Paper Company dated March 10, 1933.

9. Agreement between Portland General Electric Company and Hawley Pulp and Paper Company dated May 10, 1943.

SUMMARY OF WATER USED FOR SMURFIT LEASED HYDROPOWER

YEAR	CFS	YEAR	CFS	YEAR	CFS
1909	710	1937	3561	1965	898
1910	710	1938	3561	1966	898
1911	850	1939	3561	1967	898
1912	850	1940	3561	1968	898
1913	850	1941	3561	1969	898
1914	850	1942	3561	1970	898
1915	850	1943	3561	1971	898
1916	3115	1944	3853	1972	898
1917	3115	1945	3853	1973	898
1918	3115	1946	3853	1974	898
1919	3115	1947	3853	1975	898
1920	3115	1948	3853	1976	898
1921	3115	1949	3853	1977	898
1922	3115	1950	3853	1978	898
1923	3115	1951	3853	1979	898
1924	3561	1952	3853	1980	898
1925	3561	1953	3853	1981	898
1926	3561	1954	3853	1982	898
1927	3561	1955	3853	1983	898
1928	3561	1956	3853	1984	898
1929	3561	1957	3853	1985	898
1930	3561	1958	3561	1986	898
1931	3561	1959	3561	1987	898
1932	3561	1960	3561	1988	898
1933	3561	1961	3561	1989	898
1934	3561	1962	3561	1990	898
1935	3561	1963	898	1991	898
1936	3561	1964	898	1992	898

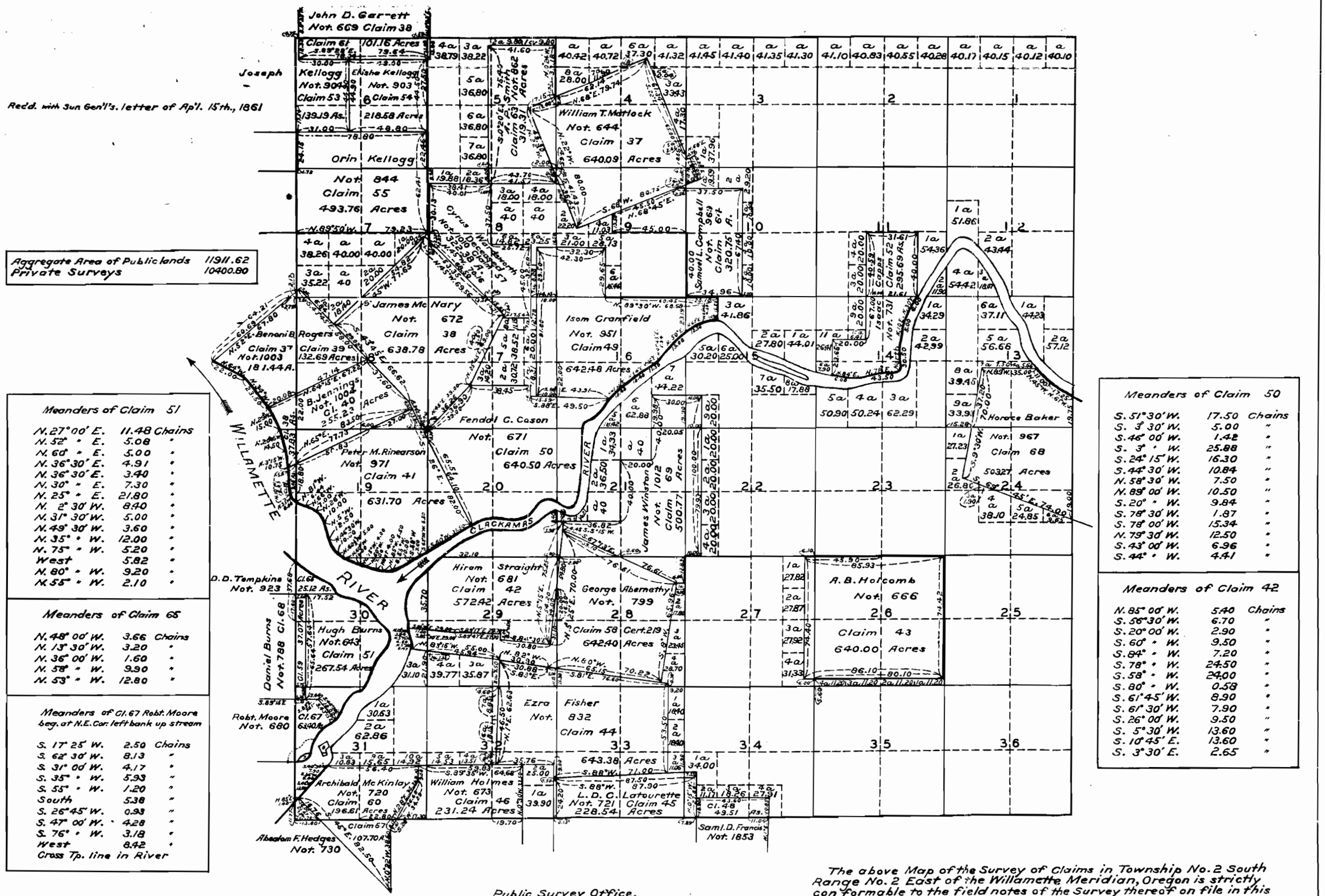
SUMMARY OF LEASE PROCESS WATER USAGE AT THE SMURFIT MILL

Year	Peak Annual Flow (CFS)	Year	Peak Annual Flow (CFS)
1909	7.9	1950	40.7
1910	8.4	1951	41.8
1911	9.6	1952	40.7
1912	9.8	1953	40.7
1913	13.1	1954	40.7
1914	13.6	1955	40.7
1915	13.7	1956	40.7
1916	16.2	1957	43.9
1917	27.9	1958	48.9
1918	28.6	1959	53.7
1919	35.8	1960	44.7
1920	33.7	1961	44.7
1921	31.9	1962	44.7
1922	33.1	1963	44.7
1923	32.6	1964	44.7
1924	33.1	1965	54.3
1925	37.0	1966	54.3
1926	37.1	1967	54.8
1927	37.4	1968	68.7
1928	43.9	1969	71.5
1929	49.8	1970	58.0
1930	41.7	1971	56.7
1931	43.5	1972	57.4
1932	43.5	1973	58.7
1933	44.4	1974	60.1
1934	43.5	1975	44.4
1935	43.5	1976	63.8
1936	43.5	1977	66.2
1937	50.1	1978	63.5
1938	50.1	1979	70.1
1939	50.1	1980	55.7
1940	38.8	1981	55.7
1941	38.8	1982	55.7
1942	38.8	1983	55.7
1943	38.8	1984	55.7
1944	38.8	1985	55.7
1945	42.1	1986	55.7
1946	42.1	1987	55.7
1947	42.1	1988	55.7
1948	38.8	1989	55.7
1949	42.1	1990	55.7
		1991	55.7
		1992	55.7

ATTACHMENT F

GOVERNMENT LAND OFFICE SURVEY MAPS (TRUE COPIES)

TOWNSHIP Nº 2 SOUTH RANGE Nº 2 EAST WILLAMETTE MERIDIAN OREGON



Meanders of Claim 51

N. 27° 00' E.	11.48	Chains
N. 52° " E.	5.08	"
N. 60° " E.	5.00	"
N. 36° 30' E.	4.91	"
N. 36° 30' E.	3.40	"
N. 30° " E.	7.30	"
N. 25° " E.	21.80	"
N. 2° 30' W.	8.40	"
N. 31° 30' W.	5.00	"
N. 49° 30' W.	3.60	"
N. 35° " W.	12.00	"
N. 75° " W.	5.20	"
West	5.82	"
N. 80° " W.	9.20	"
N. 55° " W.	2.10	"

Meanders of Claim 65

N. 48° 00' W.	3.66	Chains
N. 13° 30' W.	3.20	"
N. 36° 00' W.	1.60	"
N. 58° " W.	9.90	"
N. 53° " W.	12.80	"

Meanders of Cl. 67 Robt. Moore beg. at N.E. Cor. left bank up stream

S. 17° 25' W.	2.50	Chains
S. 62° 30' W.	8.13	"
S. 31° 00' W.	4.17	"
S. 35° " W.	5.93	"
S. 55° " W.	1.20	"
South	5.38	"
S. 26° 45' W.	0.93	"
S. 47° 00' W.	4.28	"
S. 76° " W.	3.18	"
West	8.42	"

Cross Tp. line in River

Meanders of Claim 50

S. 51° 30' W.	17.50	Chains
S. 3° 30' W.	5.00	"
S. 46° 00' W.	1.42	"
S. 3° " W.	25.88	"
S. 24° 15' W.	16.30	"
S. 44° 30' W.	10.84	"
N. 58° 30' W.	7.50	"
N. 89° 00' W.	10.50	"
S. 20° " W.	9.84	"
S. 78° 30' W.	1.87	"
S. 78° 00' W.	15.34	"
N. 79° 30' W.	12.50	"
S. 43° 00' W.	6.96	"
S. 44° " W.	4.41	"

Meanders of Claim 42

N. 85° 00' W.	5.40	Chains
S. 56° 30' W.	6.70	"
S. 20° 00' W.	2.90	"
S. 60° " W.	9.50	"
S. 84° " W.	7.20	"
S. 78° " W.	24.50	"
S. 58° " W.	24.00	"
S. 80° " W.	0.58	"
S. 61° 45' W.	8.90	"
S. 67° 30' W.	7.90	"
S. 26° 00' W.	9.50	"
S. 5° 30' W.	13.60	"
S. 10° 45' E.	13.60	"
S. 3° 30' E.	2.65	"

Public Survey Office,
Portland, Oregon, December 1, 1931.
I hereby certify this to be a correct copy of the original plat on file in this office.

Joseph A. Jaeong
Office Cadastral Engineer.

The above Map of the Survey of Claims in Township No. 2 South Range No. 2 East of the Willamette Meridian, Oregon is strictly conformable to the field notes of the Survey thereof on file in this Office, which have been examined and approved.

Surveyor General's Office,
Eugene City April 13th., 1861.

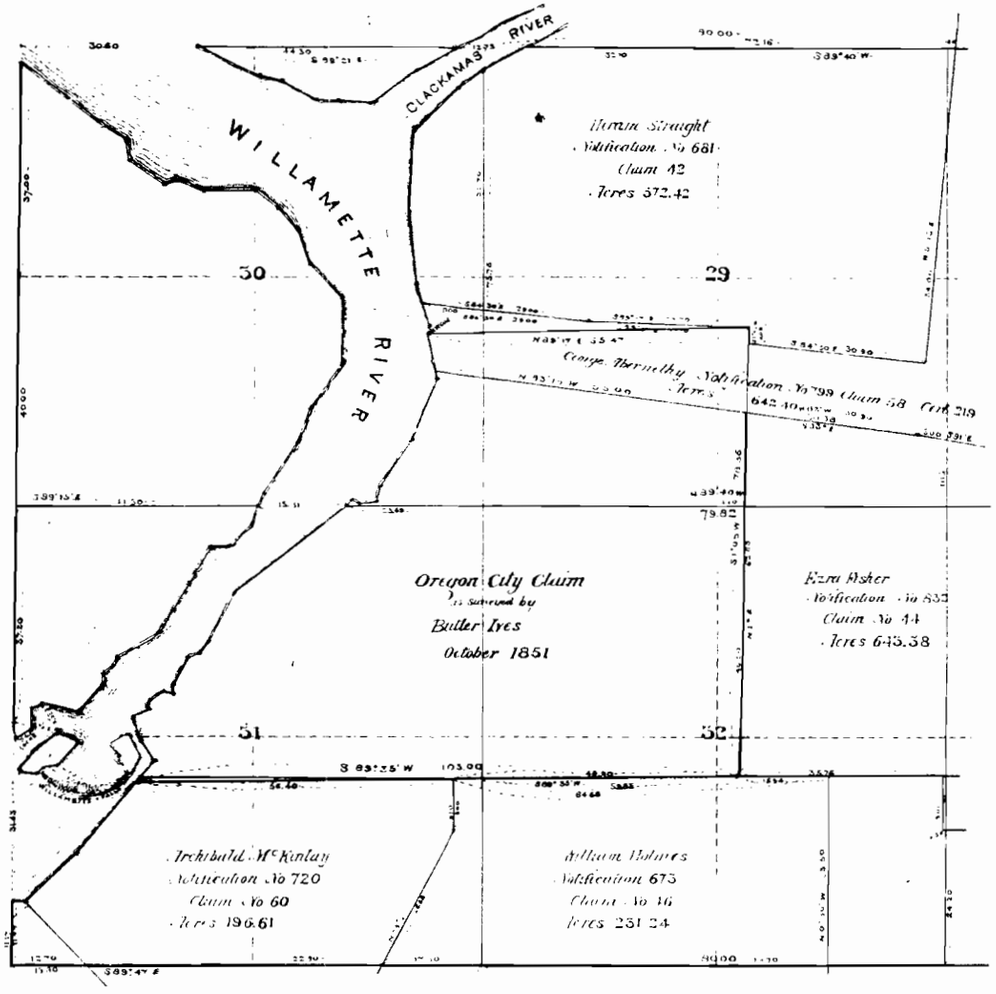
(Signed)
W. W. Chapman
Surveyor Gen. of Oregon.

Copy. E.C.T.

Fraction of Township No 2 South Range No 2 East Willamette Meridian Oregon

D. L. C.

1885



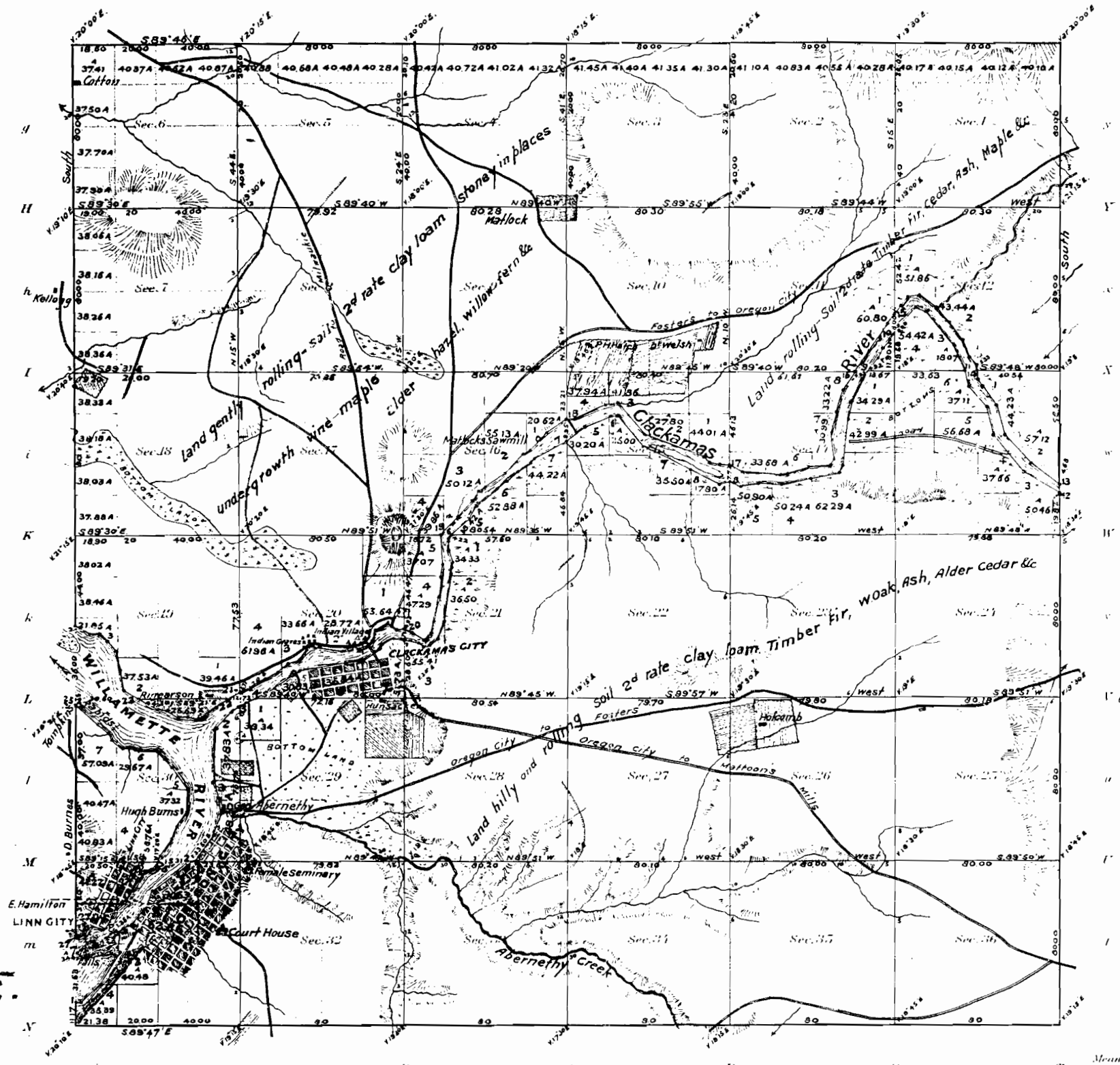
SCALE 20 CHAINS to an INCH

The above Map of a Fraction of Township No 2 South of Range No 2 East Willamette Meridian Oregon is strictly conformable to the field notes of the survey thereof on file in this Office which have been examined and approved

Surveyor Generals Office
Portland Oregon November 17th 1890

W. Vowell Byars
Surv Gen'l for Oregon

Township N? 2 South Range N? 2 East Willamette Meri. an.



See R. 1 E.

Areas in Acres	
Public Land	
Indian Reservation	
Indian Allotments	
Mineral Claims	
Water Surface	
Total Area	

Scale 40 Chains to an inch

Mean Magnetic Declination

Surveys Designated	By Whom Surveyed	Contract No.	Contract Date	Amount of Surveys Mls.	chs.	lks.	When Surveyed	When charged in the Surr Gen'l Acct
Township Lines	Joseph Hunt	13	March 25th 1852	12	1	38	May 10th 1852	2nd Quarter 1852
Subdivisions	Joseph Hunt	17	May 13th 1852	80	19	67	June 30th 1852	2nd Quarter 1852
				1	30	92		3d Quarter 1852

I certify this to be a correct copy of the Original Plat on file in this Office.
U.S. Surveyor Generals Office
Portland, Oregon, Jan. 12, 1915
Edward A. Worth
Surveyor General

(2)

The above map of Township No. 2 South Range No. 2 East of the Willamette Meridian Territory of Oregon is strictly conformable to the field notes of the survey thereof on file in this office, which have been examined and approved

Surveyor General's Office.
Oregon City June 30th 1852

(signed) Jn. B. Preston
Surv. Gen.

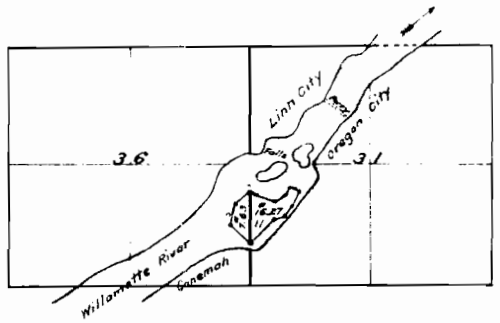
Special Plat

of the Survey of

a Rocky Island in the Willamette River

lying in Sec. 31, T. 2 S. R. 2 E. and Sec. 36, T. 2 S. R. 1 E. Will. Mer. Oregon.

File in T. 2 S., R. 2 E.



Meanders of Island, commencing at Meander Post on Town line, on South Side of Island, thence

N. 45° W.	9.80	Chains	
N. 17° E.	7.27	"	
N. 50½° E.	4.58	"	Intersect M.P. on line bet. Secs 31 and 36
S. 71½° E.	2.00	"	
S. 73° E.	7.17	"	
N. 58° E.	4.00	"	
N. 30° E.	3.30	"	
East	1.50	"	
S. 61° E.	2.00	"	
S. 26°45' W.	5.77	"	
S. 25° W.	4.10	"	
S. 76° W.	3.20	"	
S. 16° W.	12.10	"	to place of beginning.

[Scale 40 chs. to an inch]

The above Special plat of the Survey of a rocky Island in the Willamette River lying in Section 31, T. 2 S. R. 2 E. and Sec. 36, Town. 2 S. R. 1 East Will. Mer. Oregon, is strictly conformable to the field notes of the Survey thereof on file in this Office, which have been examined and approved.

Surveyor General's Office
Eugene City, Sep. 9, 1865

(Signed) E. L. Applegate
Surveyor General, of Oregon

I certify this to be a correct copy of the Original Special Plat on file in this Office.

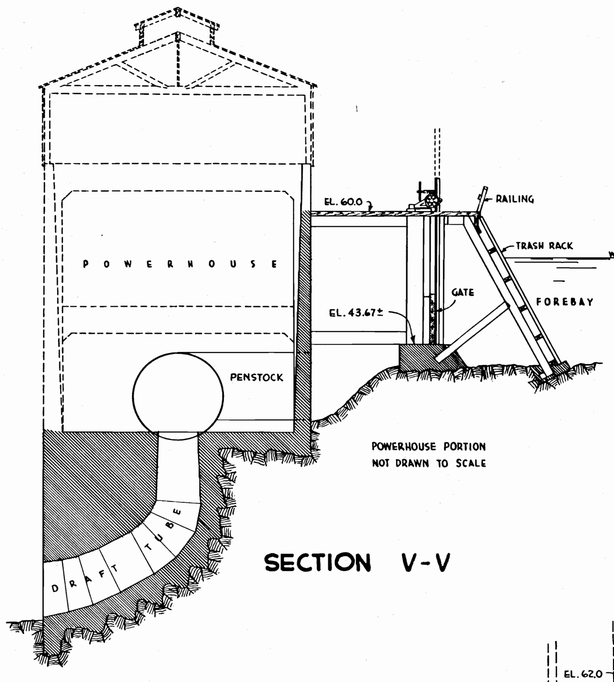
U. S. Surveyor General's Office
Portland, Oregon, Jan. 12, 1915

Edward H. Worth
Surveyor General

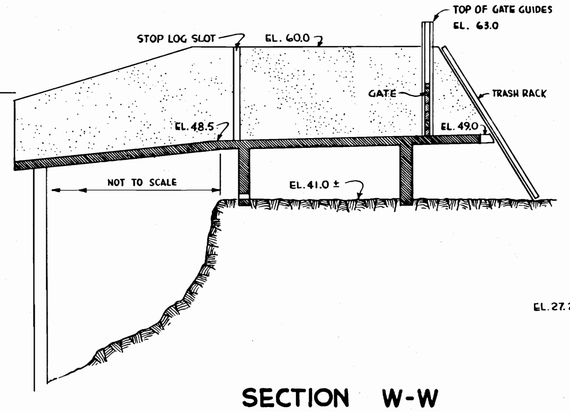
Copy E.G.T.

Willamette Falls

WR Map C-20444, 2 Shts
Exhibit L Sht 1
Exhibit L Sht 2
Exhibit L Sht 3



SECTION V-V



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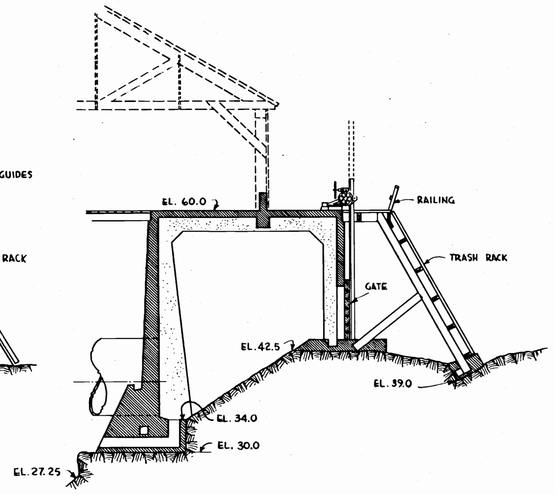

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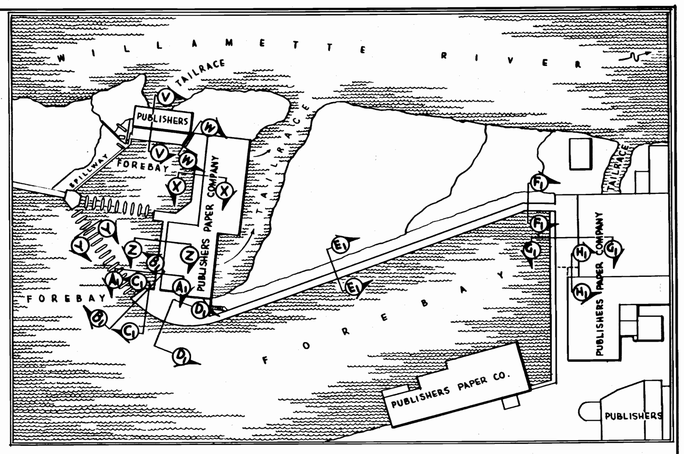
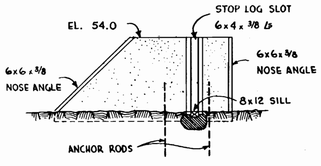
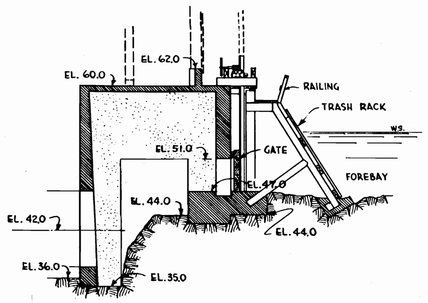
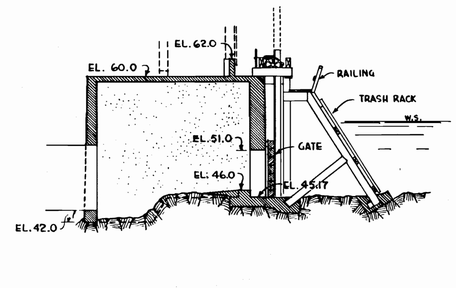




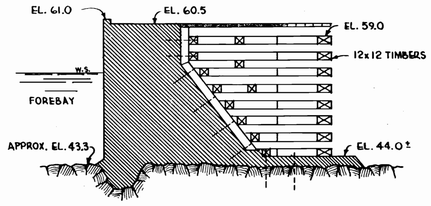
SECTION Y-Y



SECTION Z-Z



SECTION A_1-A_1



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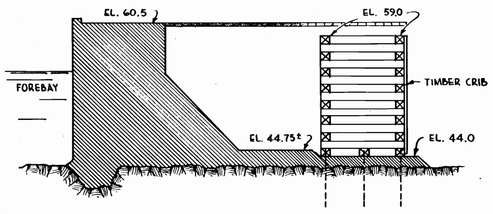

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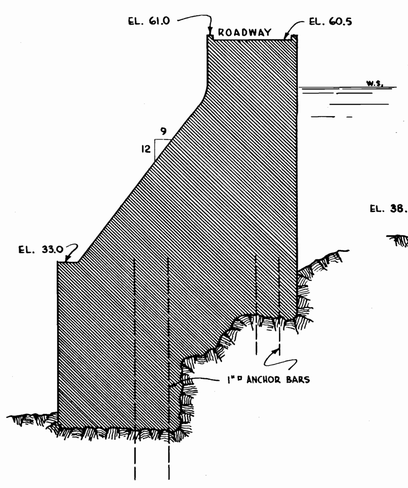

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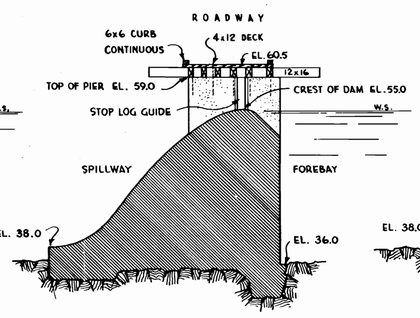

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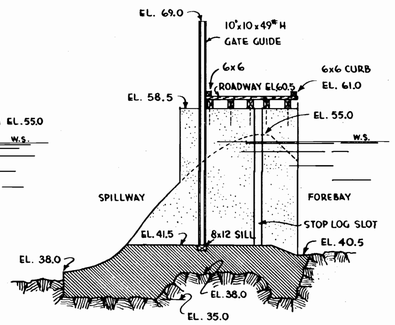
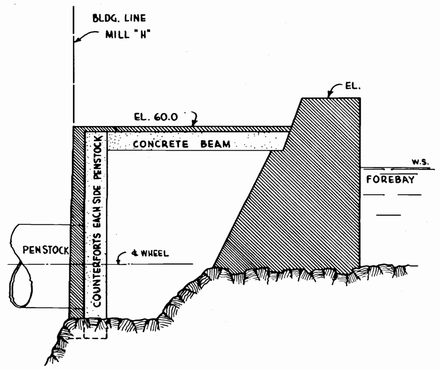


SECTION F_1-F_1



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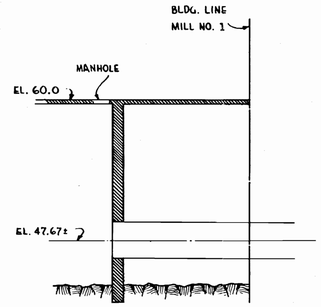


SECTION H_1-H_1

THIS DRAWING IS A PART OF
THE APPLICATION FOR LICENSE
MADE BY THE UNDERSIGNED THE
28th DAY OF JUNE, 1957.

PORTLAND GENERAL ELECTRIC COMPANY

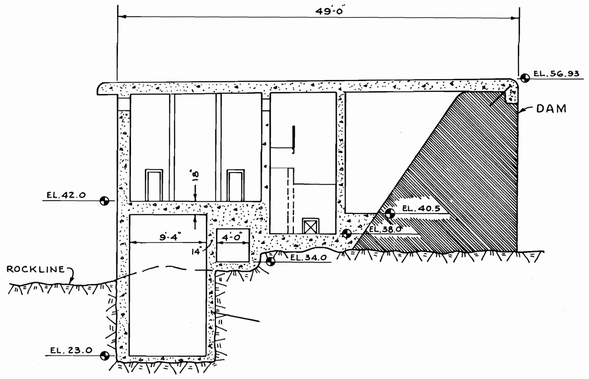
By: Waldemar Nelson
Vice President

EXHIBIT "L"
SHEET 3

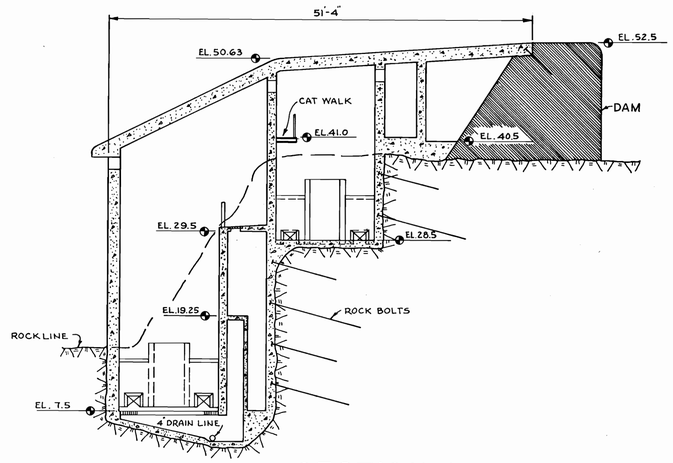
10 0 10 20 30 40 FEET
SCALE

PROJECT PROPERTY

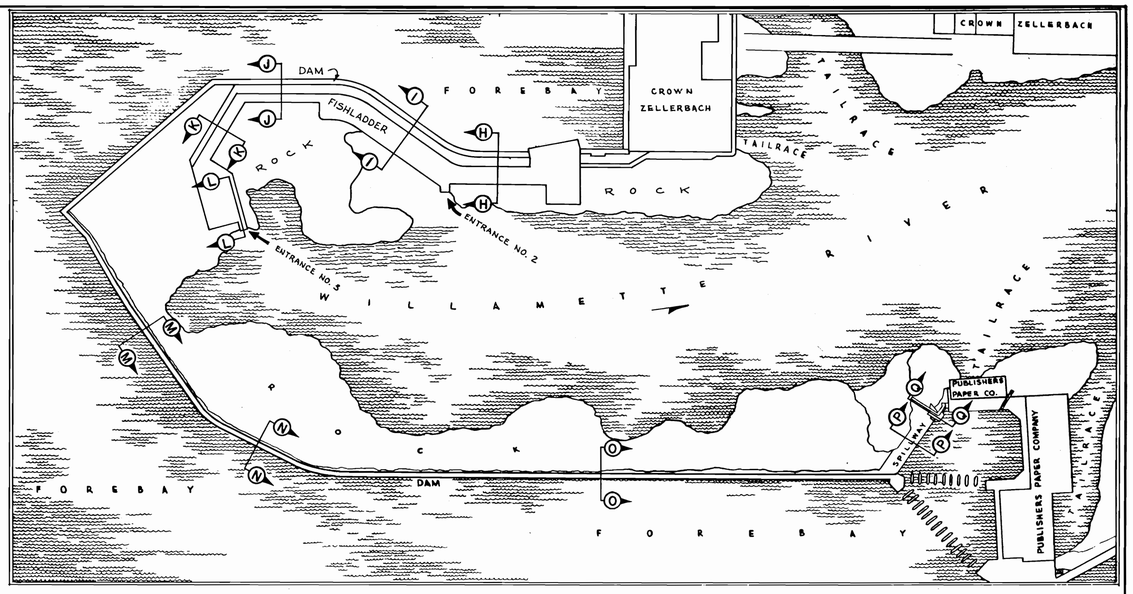
PROJECT NO. 38 - OREGON
PORTLAND GENERAL ELECTRIC COMPANY
WILLAMETTE FALLS DEVELOPMENT
GENERAL PLANS, SECTIONS
RIGHT SIDE OF RIVER
SCALE : 1" = 8'-0"

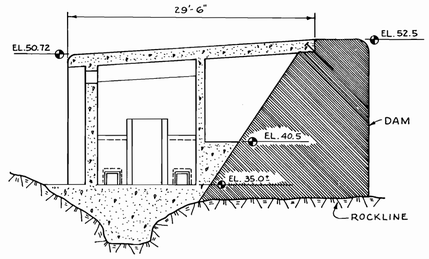


SECTION H-H

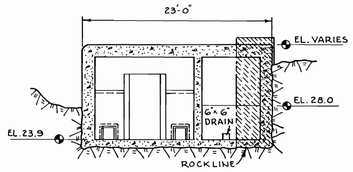


SECTION I-I





SECTION J-J



SECTION K-K

THIS DRAWING IS PART OF THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THE 28 DAY OF JUNE, 1957.

PORTLAND GENERAL ELECTRIC COMPANY

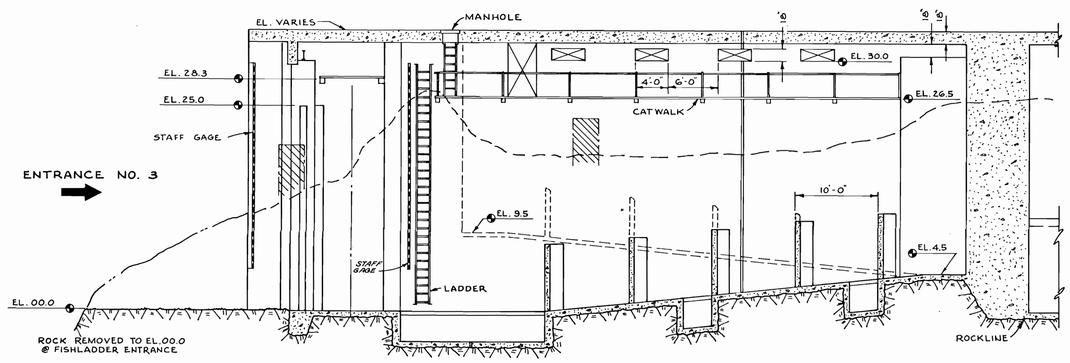
BY Waldemar Nelson
VICE PRESIDENT

THIS DRAWING HAS BEEN REVISED TO SHOW THE NEW FISH LADDER CONSTRUCTED IN ACCORDANCE WITH ARTICLE 20 OF THE LICENSE.

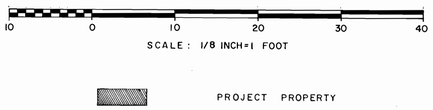
PORTLAND GENERAL ELECTRIC COMPANY

BY N. H. Phillips
VICE PRESIDENT

MARCH 22 1972



SECTION L-L

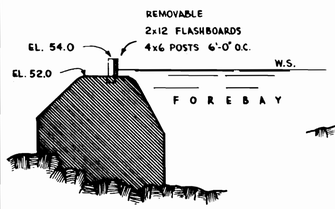


I CERTIFY THAT I SUPERVISED THE PREPARATION OF THE EXHIBIT DRAWINGS, AND THAT THEY ACCURATELY SHOW THE PRINCIPAL STRUCTURES AND APPURTENANT WORKS AS OBTAINED FROM THE RECORDS OF DESIGN AND CONSTRUCTION DRAWINGS IN THE PORTLAND GENERAL ELECTRIC COMPANY FILES.

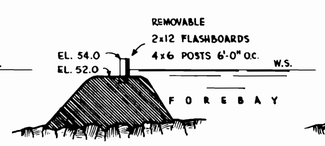
N. W. PETTIJOHN
MARCH 20, 1972

PETTIJOHN ENGINEERING CO., INC. WAS RETAINED BY THE LICENSEE TO PREPARE THE EXHIBIT MAPS REFERRED TO ABOVE.

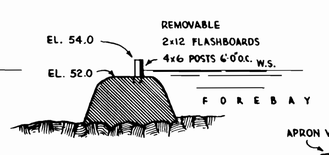
REGISTERED PROFESSIONAL ENGINEER OREGON N. W. PETTIJOHN



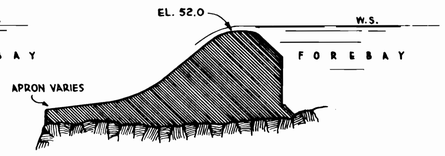
SECTION M-M



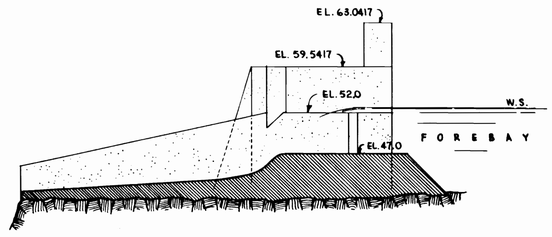
SECTION N-N



SECTION O-O



SECTION P-P



SECTION Q-Q

EXHIBIT "L" (REVISED) SHEET 2

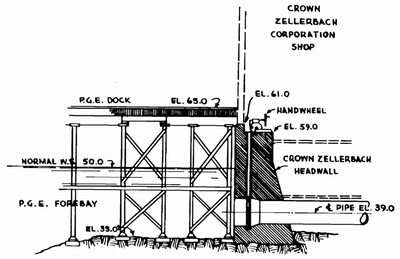
PROJECT NO. 2233 - OREGON

PORTLAND GENERAL ELECTRIC COMPANY

WILLAMETTE FALLS DEVELOPMENT

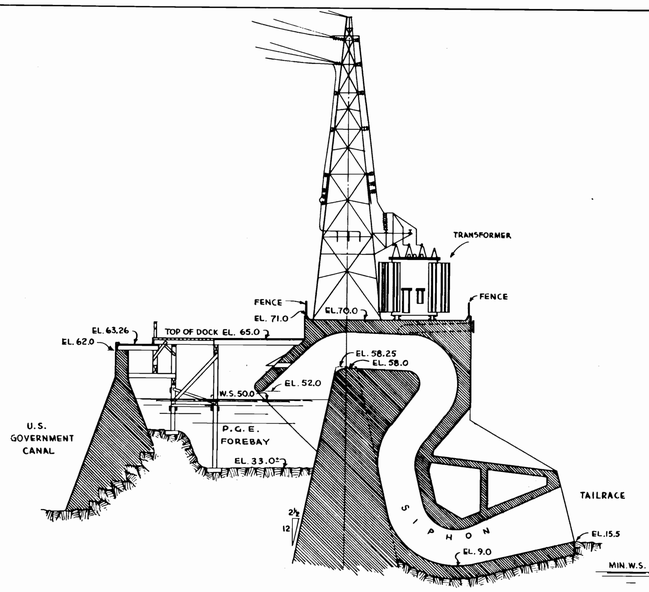
GENERAL PLANS, SECTIONS

CENTER OF RIVER

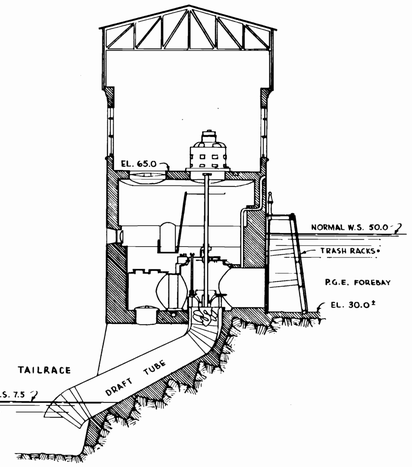


ORIGINALLY TWO GATES WERE LOCATED IN HEADWALL. ONE HAS BEEN PLUGGED, REMAINING ONE SUPPLIES WATER FOR FIRE PROTECTION AND MANUFACTURING WATER FOR CROWN ZELLERBACH CORPORATION.

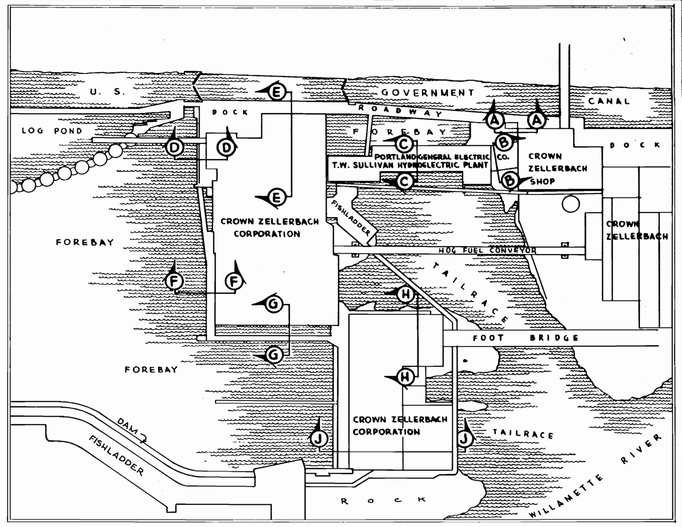
SECTION A-A



SECTION B-B



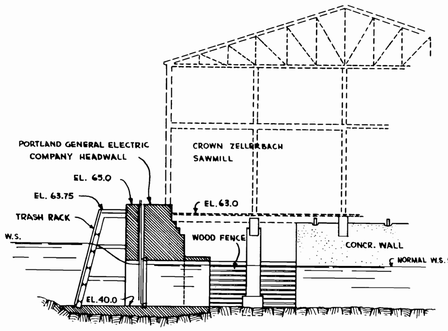
SECTION C-C



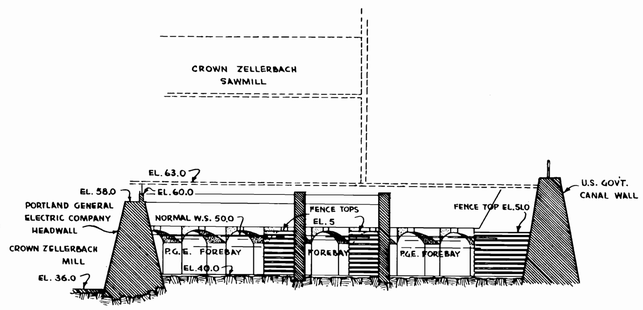
THIS DRAWING IS PART OF THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THE 28 DAY OF JUNE, 1957.

PORTLAND GENERAL ELECTRIC COMPANY

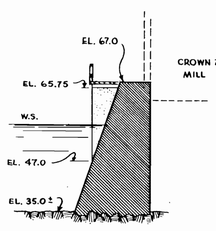
BY Waldemar Lister
VICE PRESIDENT



SECTION D-D



SECTION E-E



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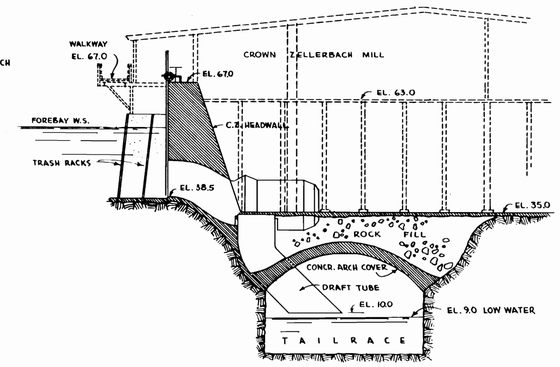


SECTION G-G

THIS DRAWING HAS BEEN REVISED TO SHOW THE NEW FISH LADDER CONSTRUCTION IN ACCORDANCE WITH ARTICLE 20 OF THE LICENSE.

PORTLAND GENERAL ELECTRIC COMPANY

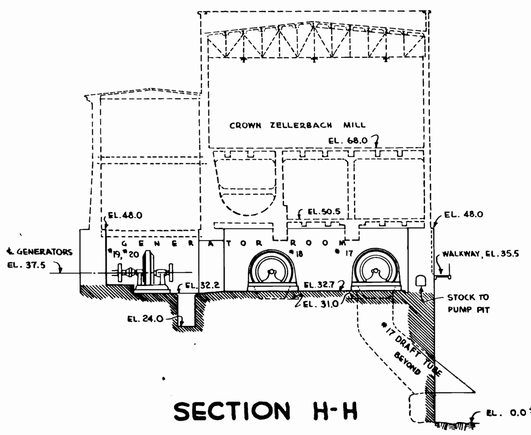
BY H H Phillips
VICE PRESIDENT
MARCH 27, 1972

I CERTIFY THAT I SUPERVISED THE PREPARATION OF THE EXHIBIT DRAWINGS, AND THAT THEY ACCURATELY SHOW THE PRINCIPAL STRUCTURES AND APPURTENANT WORKS AS OBTAINED FROM THE RECORDS OF DESIGN AND CONSTRUCTION DRAWINGS IN THE PORTLAND GENERAL ELECTRIC COMPANY FILES.

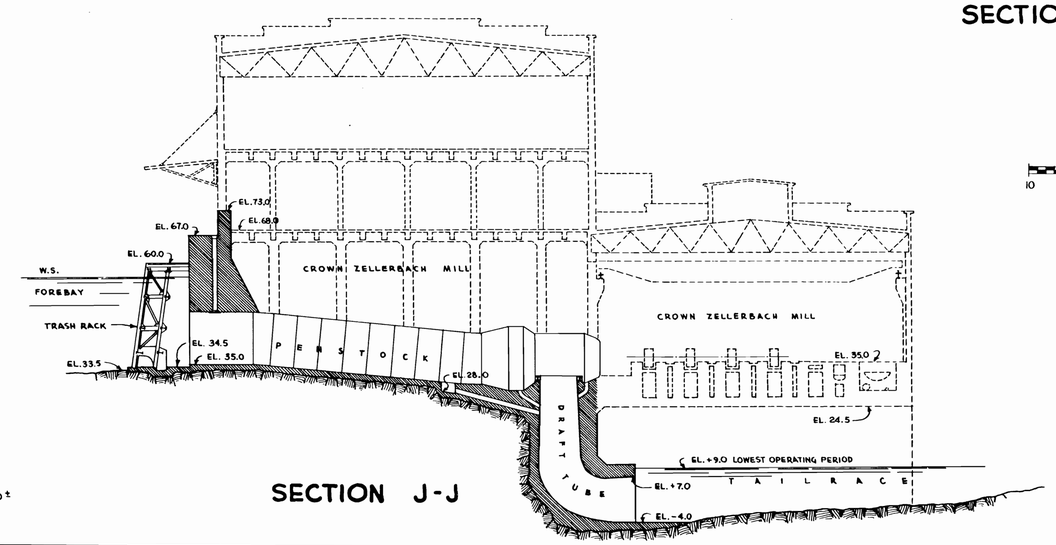
N. W. PETTIJOHN
MARCH 20, 1972

PETTIJOHN ENGINEERING CO., INC. WAS RETAINED BY THE LICENSEE TO PREPARE THE EXHIBIT MAPS REFERRED TO ABOVE.

REGISTERED PROFESSIONAL ENGINEER 2111 OREGON MAR. 5, 1918 N. W. PETTIJOHN



SECTION H-H



SECTION J-J

PROJECT PROPERTY

10 0 10 20 30 40 50 60 70 80 90 FEET

SCALE: 1/16 INCH = 1 FOOT

EXHIBIT "L" (REVISED) SHEET 1

PROJECT NO. 2233 - OREGON

PORTLAND GENERAL ELECTRIC COMPANY

WILLAMETTE FALLS DEVELOPMENT

GENERAL PLANS, SECTIONS

LEFT SIDE OF RIVER

SECTION CORNER
COORDINATE-N 624624
E1,455,331

25 | 30
36 | 31

PGE SULLIVAN HYDROELECTRIC POWERPLANT
12-1600 HP UNITS AND 1-1200 HP UNITS
3-9 FOOT DIAMETER PENSTOCKS

U. S. GOVERNMENT CANAL

SIMPSON PROCESS WATER
AND LOCKAGE DIVERSION
COORD. N621,816
E1,455,031

REFERENCE POINT FOR
PGE SULLIVAN AND SIMPSON
DIVERSION - SEE DETAIL
1, SHT 2.. COORD. N622,012
E1,455,376

GRINDER ROOM 2

REFERENCE POINT FOR
SIMPSON DIVERSION
SEE DETAIL 2, SHT 2. COORD. N 621,944
E 1,455,730

GRINDER ROOM 3

TAILRACE

FISH LADDER DIVERSION N621,755
E1,455,860

DAM 7

FISH LADDER

WILLAMETTE FALLS

DAM

T.2 S., R.1 E.
T.2 S., R.2 E.

SIMPSON

PAPER COMPANY

LOCKS

WILLAMETTE RIVER

SMURFIT HYDROELECTRIC POWERPLANT
(SEE DETAIL 3, SHT 2).

SMURFIT NEWSPRINT CORP.

REFERENCE POINT FOR
DIVERSION, SEE DETAIL 3, SHT 2.
COORD. N 621,926
E1,456,498

SPILLWAY

SMURFIT PROCESS WATER
DIVERSION COORD. N621,732
E1,456,812

WILLAMETTE FALLS PROJECT

100 0 100 200 300 400
SCALE - 1" = 100'

Oregon Water Rights Division
#153
Harold J. Cruger
12-30-92
STATE OF OREGON

THIS FINAL PROOF SURVEY WAS PERFORMED
DURING THE PERIOD OCTOBER-DECEMBER, 1992.

REFERENCE DRAWINGS

FERC WILLAMETTE FALLS LICENSE DRAWINGS
EXHIBIT L, SHT 1
EXHIBIT L, SHT 2
EXHIBIT L, SHT 3
EXHIBIT L, SHT 3A OF 9
EXHIBIT L, SHT 4 OF 9
EXHIBIT L, SHT 5 OF 9
EXHIBIT L, SHT 6 OF 9
EXHIBIT L, SHT 9 OF 9

THE PURPOSE OF THIS MAP IS TO IDENTIFY THE LOCATION OF WATER RIGHTS. IT IS NOT INTENDED TO PROVIDE INFORMATION RELATIVE TO THE LOCATION OF PROPERTY OWNERSHIP BOUNDARY LINES.

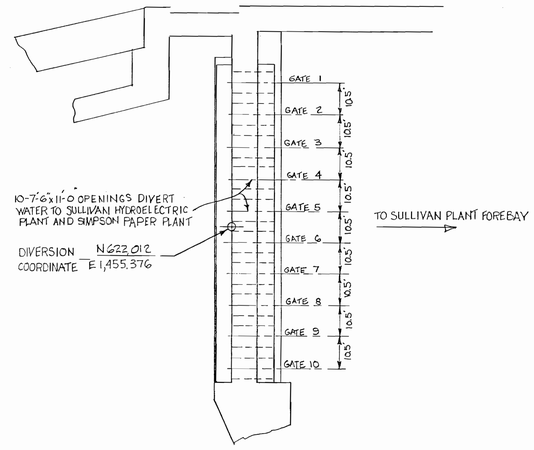
REV'T DATE	DESCRIPTION	BY	CHK	ENGR	SUPV	MGR

REVISIONS

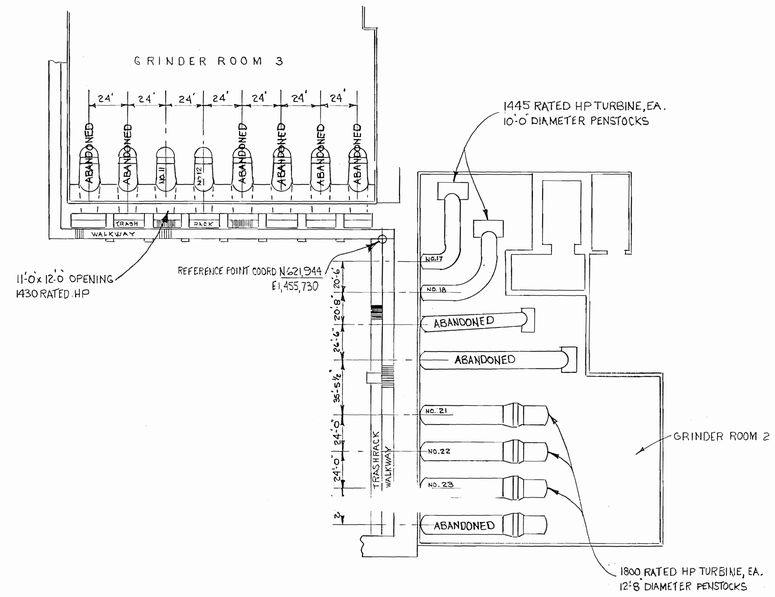
PORTLAND GENERAL ELECTRIC CO.
PORTLAND, OREGON

WILLAMETTE FALLS PROJECT
PRE 1909 VESTED WATER RIGHTS
FINAL PROOF SURVEY

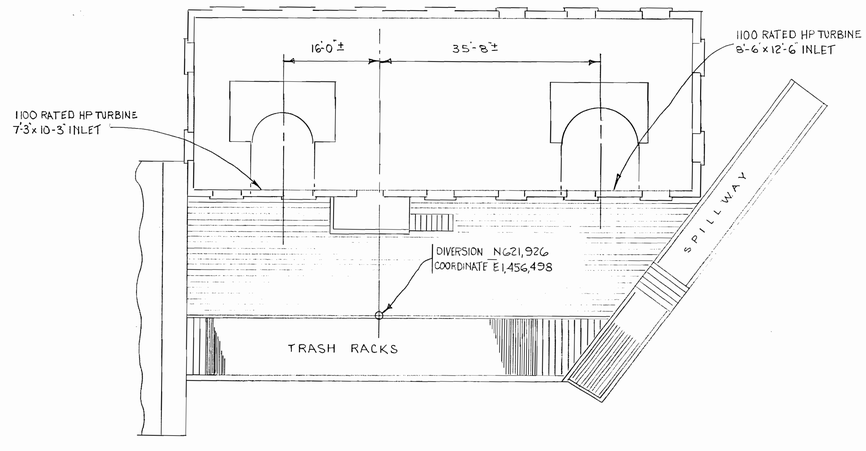
APPROVALS	SCALE 1"=100'
DESIGNER	DRAWN BY HJC
ENGR	CHECKED BY
ENGR SUPV	DATE 12/28/92
ENGR MANAGER	C-20444, SHT 1/2 REV



PGE SULLIVAN HYDROELECTRIC POWERPLANT INTAKE
DETAIL 1
1"=20'



SIMPSON GRINDER ROOMS 2 AND 3
DETAIL 2
1"=40'



SMURFIT HYDROELECTRIC POWERPLANT
DETAIL 3
1"=10'

Certified Water Right Examiner #159
Harold S. George
Dec 17, 1992
STATE OF OREGON

THIS FINAL PROOF SURVEY WAS PERFORMED DURING THE PERIOD OCTOBER-DECEMBER, 1992.

THE PURPOSE OF THIS MAP IS TO IDENTIFY THE LOCATION OF WATER RIGHTS. IT IS NOT INTENDED TO PROVIDE INFORMATION RELATIVE TO THE LOCATION OF PROPERTY OWNERSHIP BOUNDARY LINES.

REV	DATE	DESCRIPTION	BY	CHK	ENGR	SUPV	MGR

REVISIONS

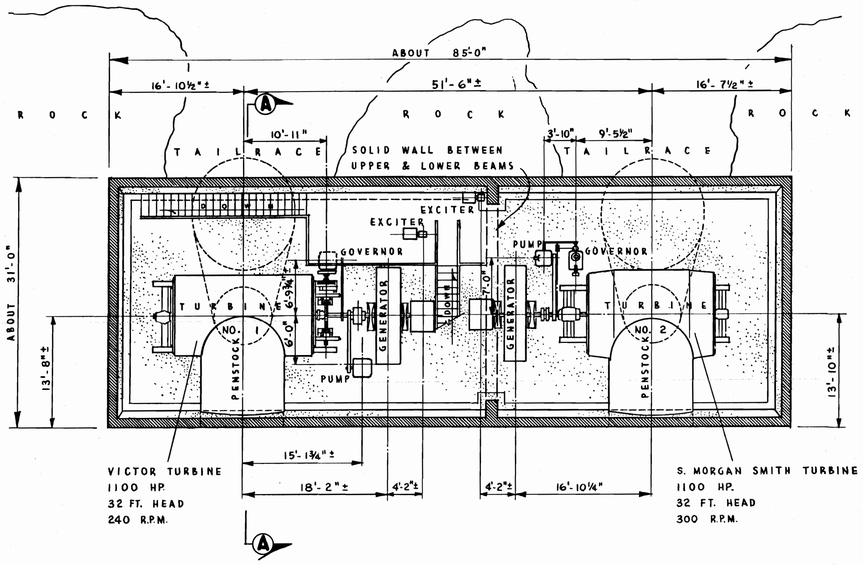
PORTLAND GENERAL ELECTRIC CO.
PORTLAND, OREGON

WILLAMETTE FALLS PROJECT
PRE 1909 VESTED WATER RIGHTS
FINAL PROOF SURVEY

APPROVALS	SCALE AS NOTED
OPERATIONS	DRAWN BY HJC
CHIEF ENGR.	CHECKED BY
	DATE 12/29/92
ENGR. SUPV.	G-20444 SHT 2/2 REV
ENGR. MGR.	

Willamette Falls

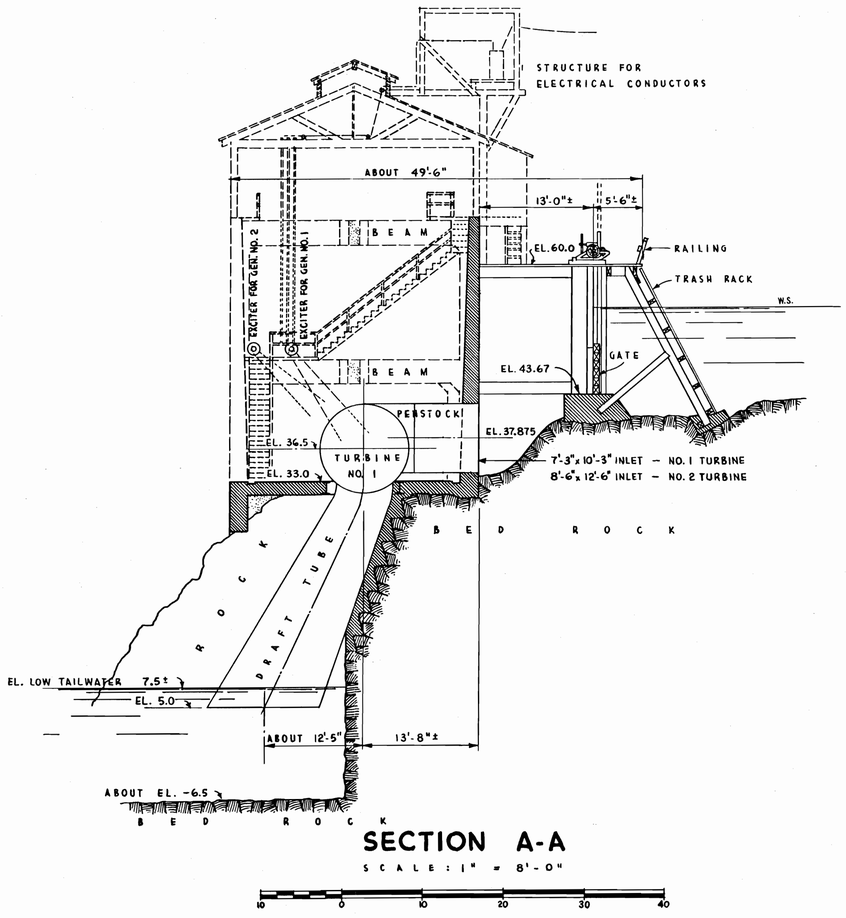
Exhibit	L	Sht 3A of 9
Exhibit	L	Sht 4 of 9
Exhibit	L	Sht 5 of 9
Exhibit	L	Sht 6 of 9
Exhibit	L	Sht 9 of 9



PLAN

SCALE: 1" = 8'-0"

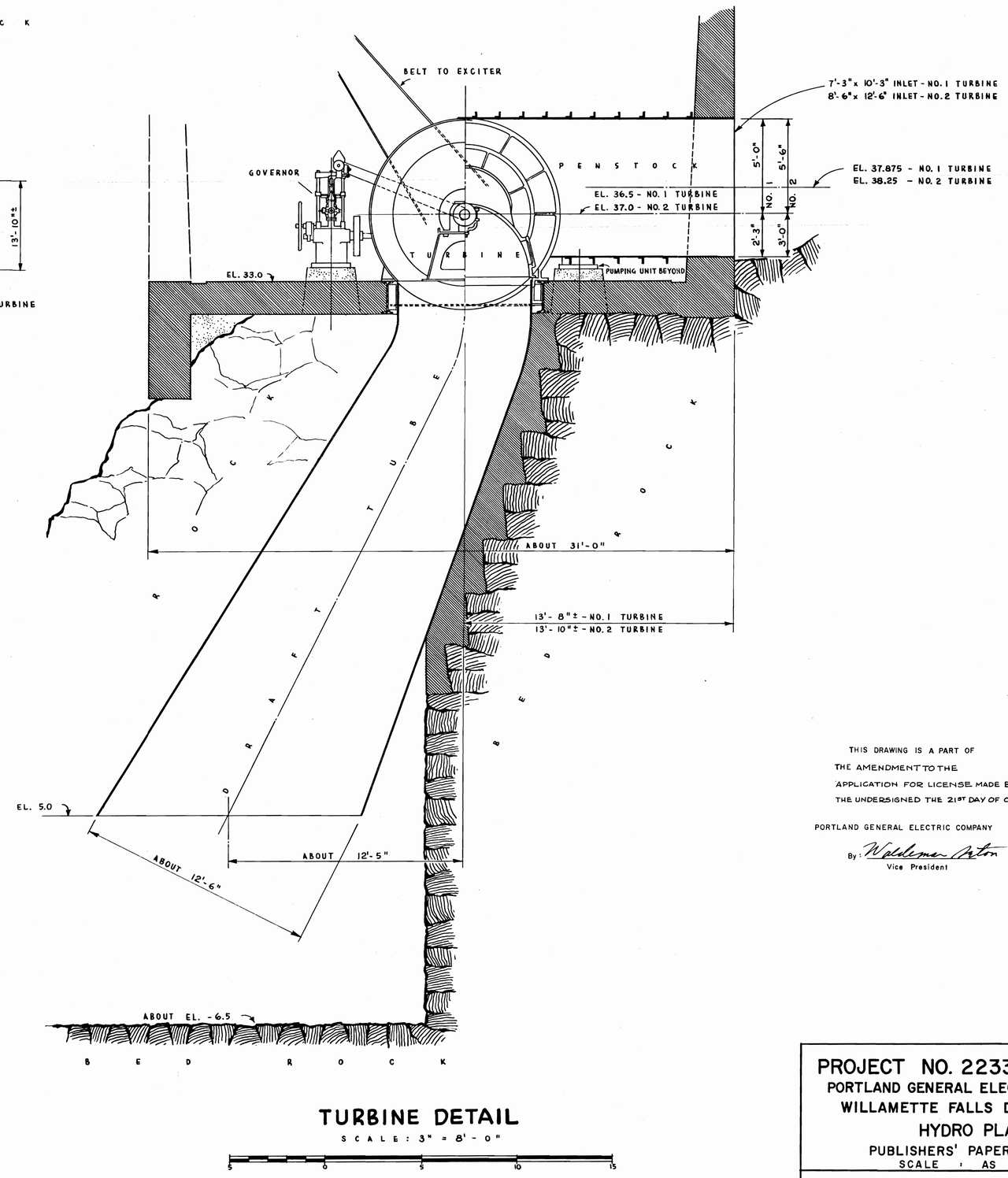
10 0 10 20 30 40



SECTION A-A

SCALE: 1" = 8'-0"

10 0 10 20 30 40



TURBINE DETAIL

SCALE: 3" = 8'-0"

5 0 5 10 15

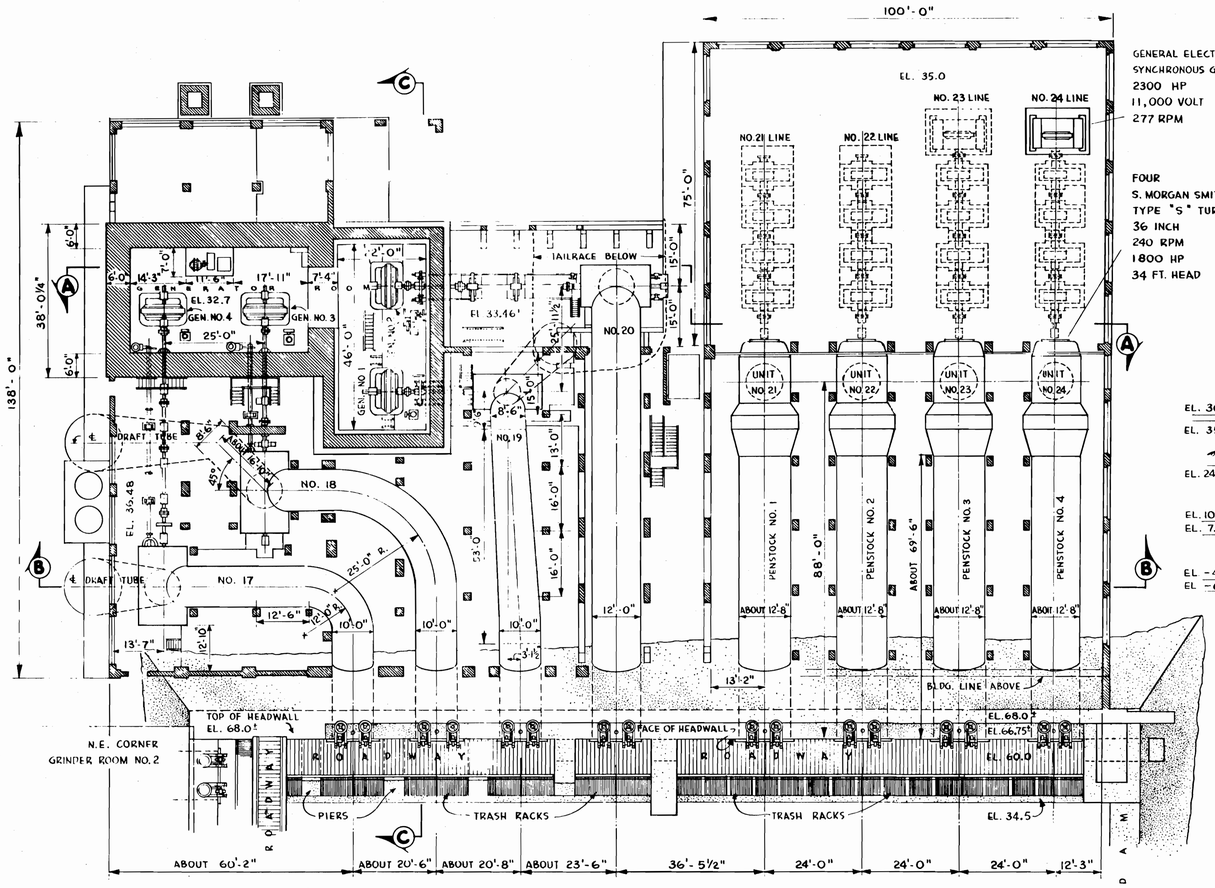
THIS DRAWING IS A PART OF
THE AMENDMENT TO THE
APPLICATION FOR LICENSE MADE BY
THE UNDERSIGNED THE 21ST DAY OF OCTOBER 1958

PORTLAND GENERAL ELECTRIC COMPANY

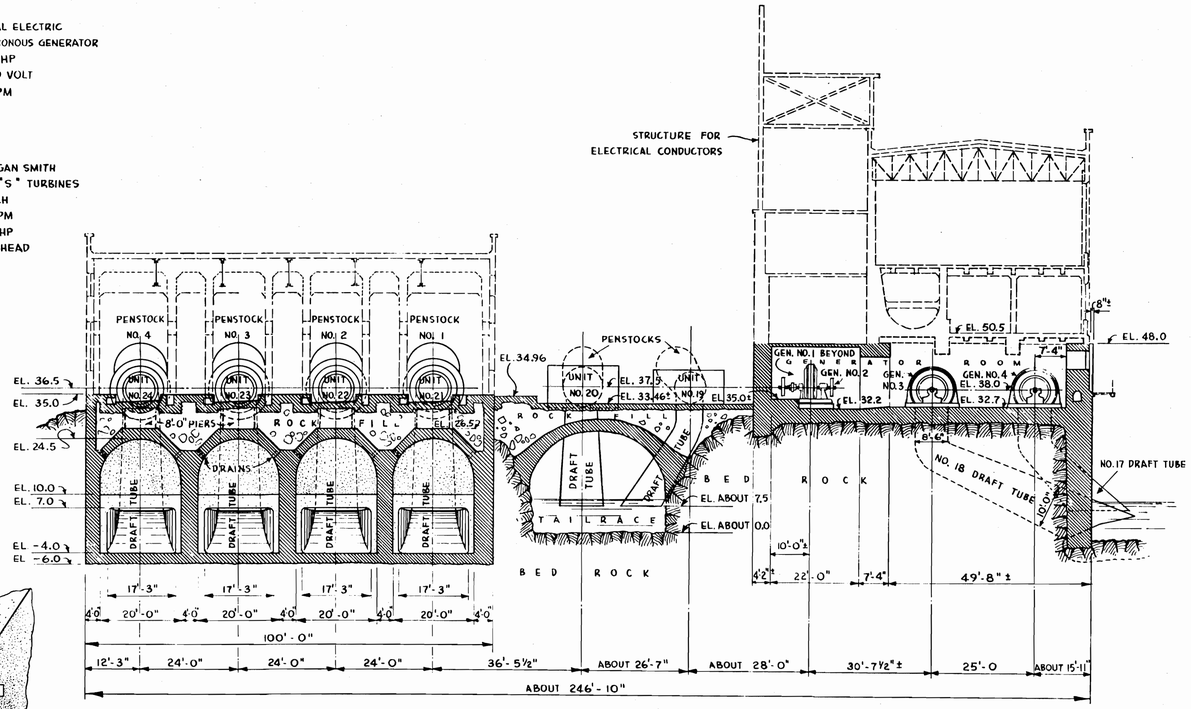
By: Waldemar Acton
Vice President

EXHIBIT "L"
SHEET 9 OF 9

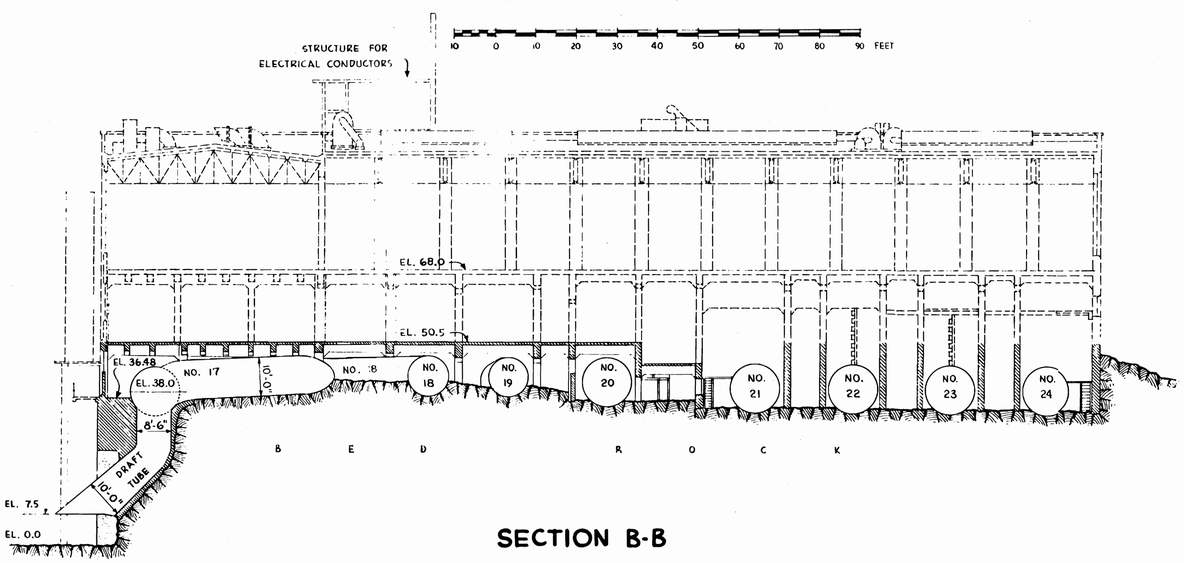
PROJECT NO. 2233 OREGON
PORTLAND GENERAL ELECTRIC COMPANY
WILLAMETTE FALLS DEVELOPMENT
HYDRO PLANT
PUBLISHERS' PAPER COMPANY
SCALE : AS SHOWN



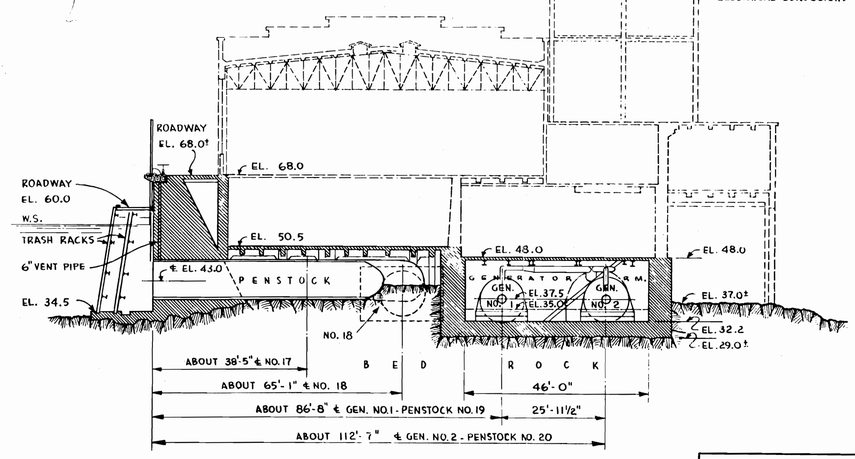
GENERAL PLAN



SECTION A-A



SECTION B-B



SECTION C-C

10 0 10 20 30 40 50 60 70 80 90 FEET

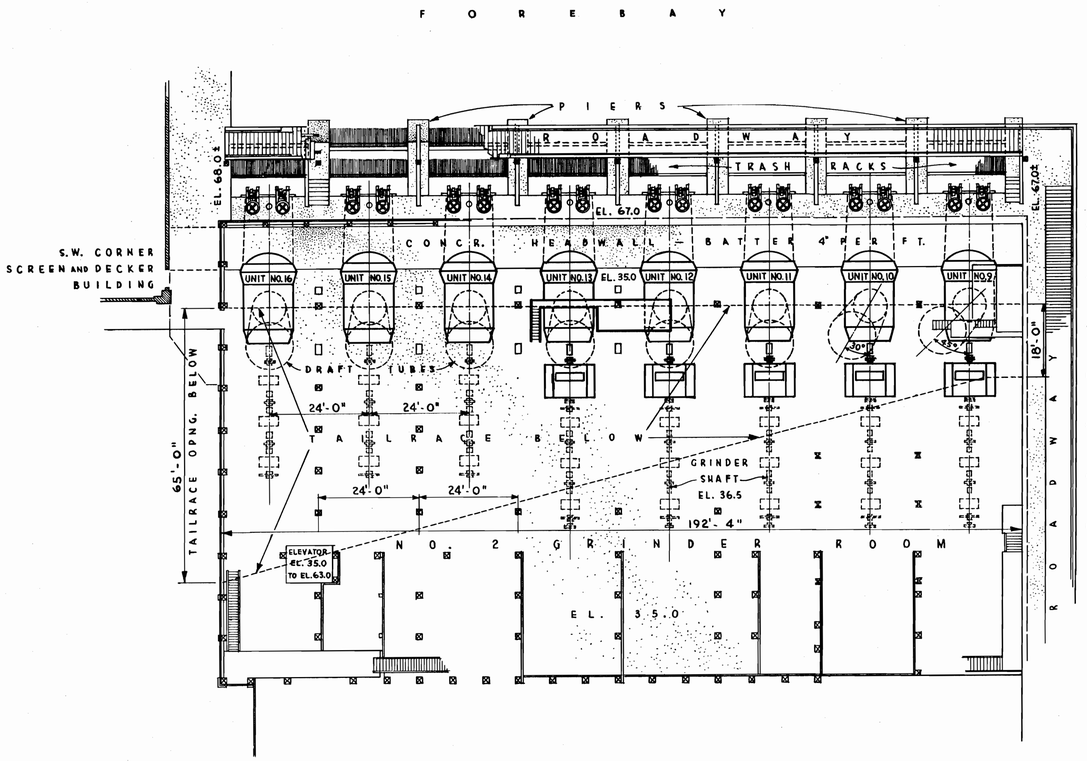
THIS DRAWING IS A PART OF THE AMENDMENT TO THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THE 21ST DAY OF OCTOBER 1958

PORTLAND GENERAL ELECTRIC COMPANY

By: Waldemar Paton
Vice President

EXHIBIT "L"
SHEET 6 OF 9

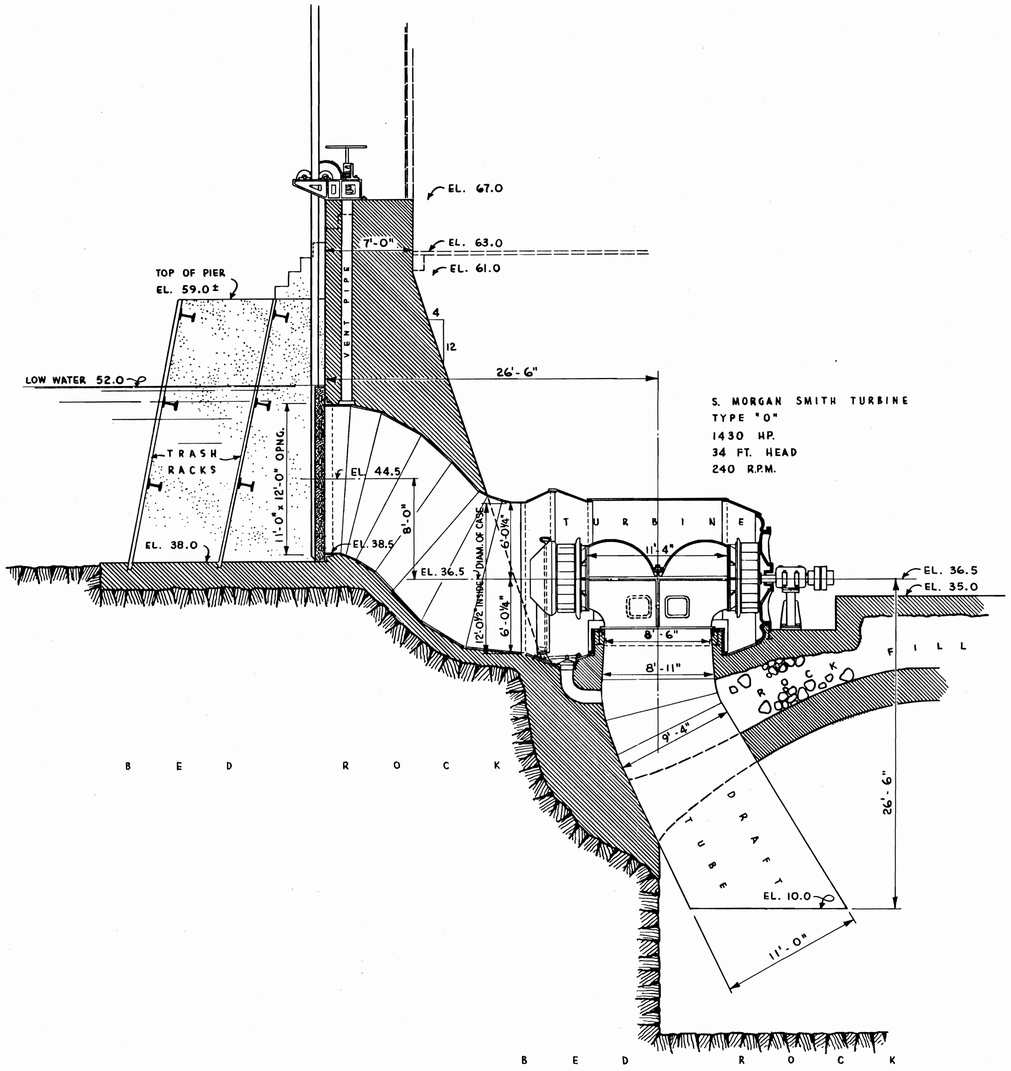
PROJECT NO. 2233 OREGON
PORTLAND GENERAL ELECTRIC COMPANY
WILLAMETTE FALLS DEVELOPMENT
GENERATOR ROOM & NO. 3 GRINDER ROOM
CROWN ZELLERBACH CORPORATION
SCALE : 1" = 16'-0"



GENERAL PLAN

SCALE : 1" = 16'-0"

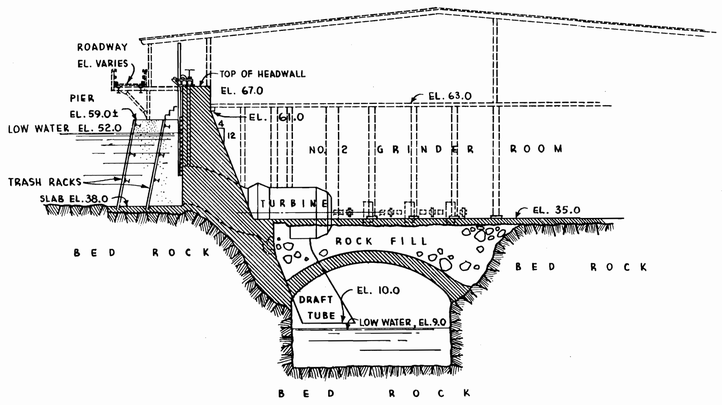
10 0 10 20 30 40 50 60 70 80 90 FEET



TURBINE DETAIL

SCALE : 3" = 16'-0"

5 0 5 10 15 20 25 30 FEET



TYPICAL SECTION

SCALE : 1" = 16'-0"

10 0 10 20 30 40 50 60 70 80 90 FEET

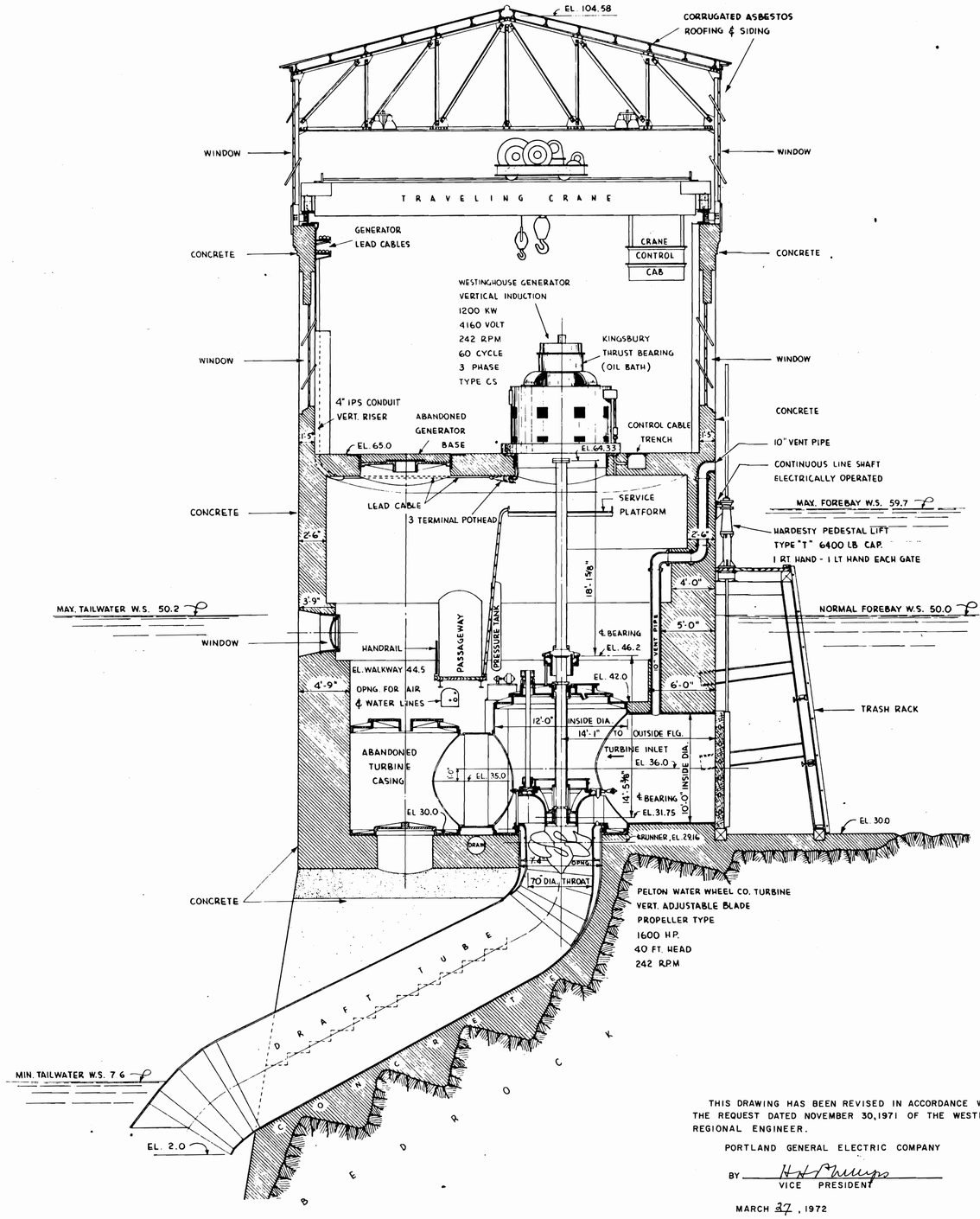
THIS DRAWING IS A PART OF THE AMENDMENT TO THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THE 21ST DAY OF OCTOBER 1958

PORTLAND GENERAL ELECTRIC COMPANY

By: Waldemar Orton
Vice President

EXHIBIT "L"
SHEET 5 OF 9

PROJECT NO. 2233 OREGON
PORTLAND GENERAL ELECTRIC COMPANY
WILLAMETTE FALLS DEVELOPMENT
NO. 2 GRINDER ROOM
CROWN ZELLERBACH CORPORATION
SCALE : AS SHOWN



THIS DRAWING HAS BEEN REVISED IN ACCORDANCE WITH THE REQUEST DATED NOVEMBER 30,1971 OF THE WESTERN REGIONAL ENGINEER.

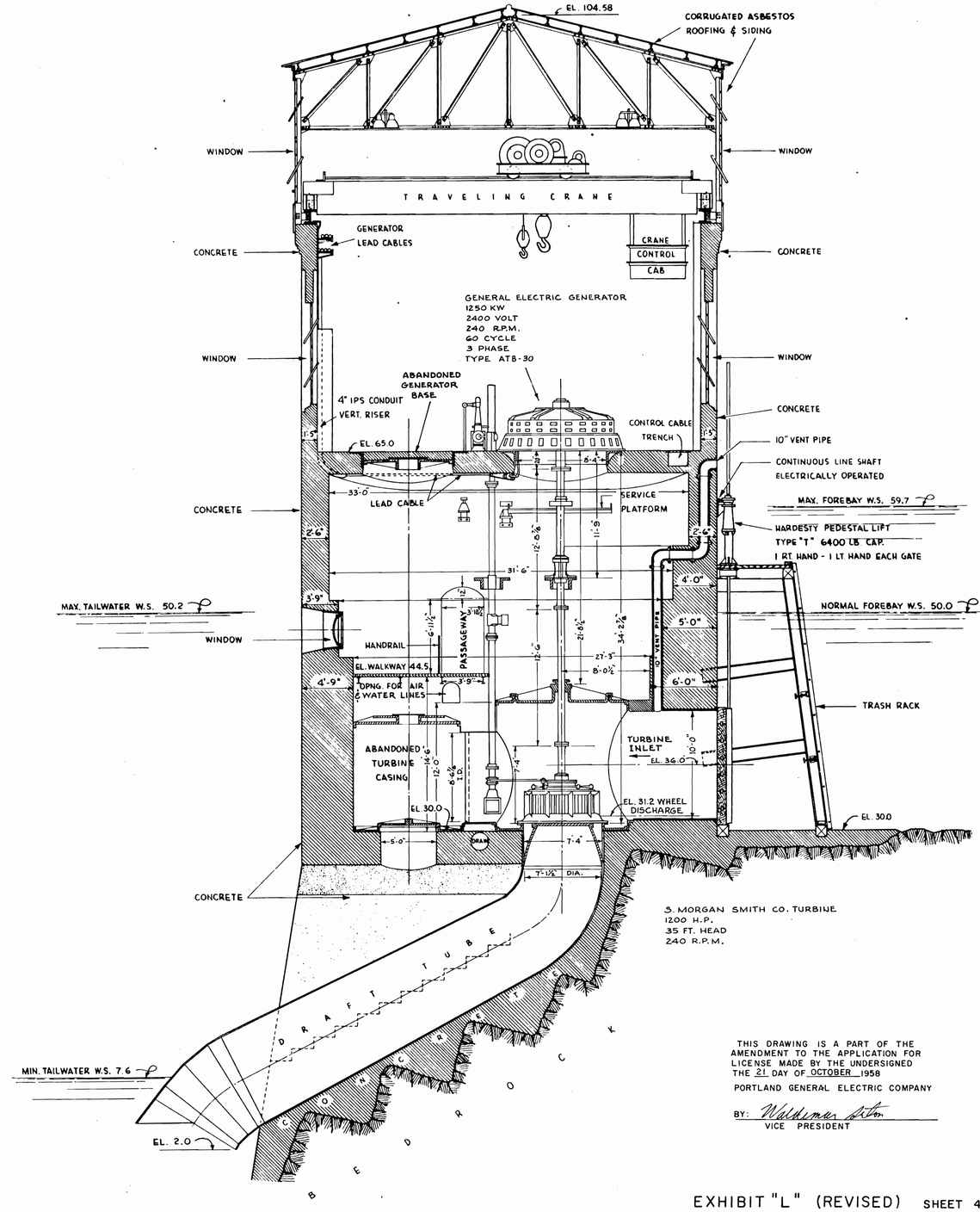
PORTLAND GENERAL ELECTRIC COMPANY

BY H.H. Phillips
VICE PRESIDENT

MARCH 27, 1972

SECTION A-A

(SEE SHEET 3A OF 9)



THIS DRAWING IS A PART OF THE AMENDMENT TO THE APPLICATION FOR LICENSE MADE BY THE UNDERSIGNED THE 21 DAY OF OCTOBER, 1958

PORTLAND GENERAL ELECTRIC COMPANY

BY: Waldemar Nelson
VICE PRESIDENT

SECTION B-B

(SEE SHEET 3A OF 9)

I CERTIFY THAT I SUPERVISED THE PREPARATION OF THE EXHIBIT DRAWINGS, AND THAT THEY ACCURATELY SHOW THE PRINCIPAL STRUCTURES AND APPURTENANT WORKS AS OBTAINED FROM THE RECORDS OF DESIGN AND CONSTRUCTION DRAWINGS IN PORTLAND GENERAL ELECTRIC COMPANY FILES.

N.W. PETTIJOHN
MARCH 20,1972

REGISTERED PROFESSIONAL ENGINEER 1113 OREGON JAN. 9, 1951 N. W. PETTIJOHN

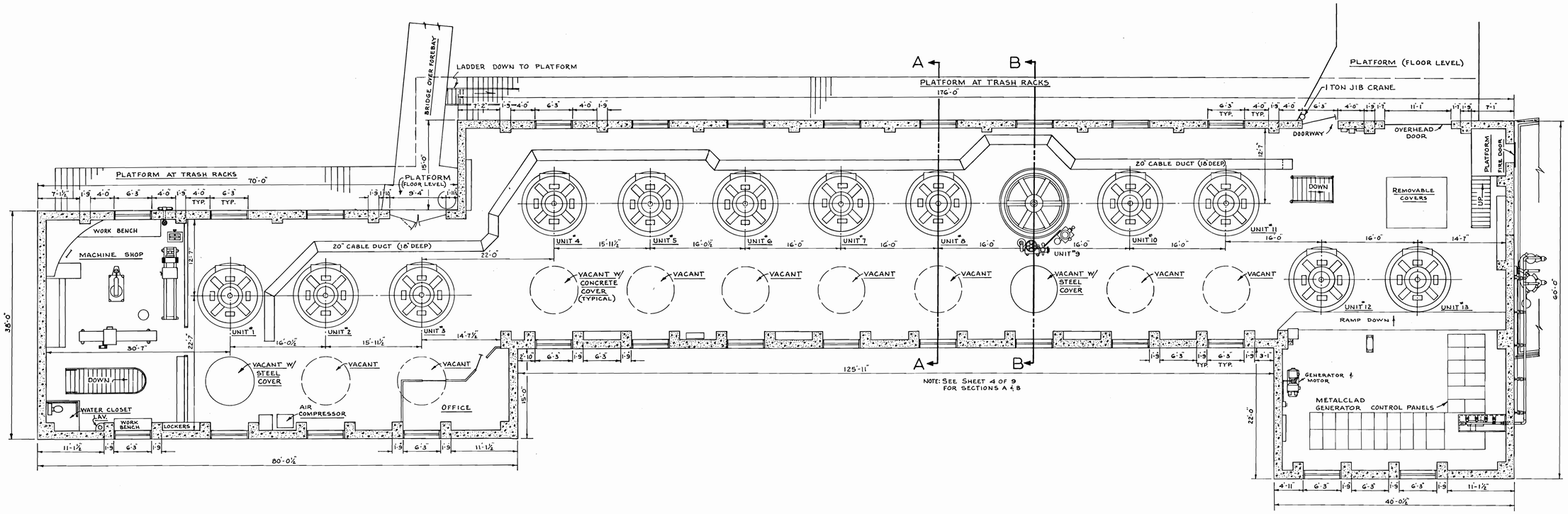
PETTIJOHN ENGINEERING CO. INC. WAS RETAINED BY THE LICENSEE TO PREPARE THE EXHIBIT MAPS REFERRED TO ABOVE.

5 0 5 10 15 20 25 FEET

SCALE: 3/16 INCH = 1 FOOT

EXHIBIT "L" (REVISED) SHEET 4 OF 9

PROJECT NO. 2233 OREGON
PORTLAND GENERAL ELECTRIC COMPANY
WILLAMETTE FALLS DEVELOPMENT
T.W. SULLIVAN HYDROELECTRIC PLANT
PORTLAND GENERAL ELECTRIC COMPANY



NOTE: SEE SHEET 4 OF 9 FOR SECTIONS A & B

NOTE:
UNITS #1 THRU. 8 AND 10 THRU. 13 ARE WESTINGHOUSE GENERATORS. UNIT #9 IS A GENERAL ELECTRIC GENERATOR.

GENERATOR FLOOR PLAN

10 0 10 20 30 FEET

SCALE: 1/8 INCH = 1 FOOT

I CERTIFY THAT I SUPERVISED THE PREPARATION OF THE EXHIBIT DRAWINGS, AND THAT THEY ACCURATELY SHOW THE PRINCIPAL STRUCTURES AND APPURTENANT WORKS AS OBTAINED FROM THE RECORDS OF DESIGN AND CONSTRUCTION DRAWINGS IN PORTLAND GENERAL ELECTRIC COMPANY FILES.

N.W. PETTIJOHN
MARCH 20, 1972

REGISTERED PROFESSIONAL ENGINEER
OREGON
JAN. 9, 1963
N. W. PETTIJOHN

PETTIJOHN ENGINEERING CO. INC. WAS RETAINED BY THE LICENSEE TO PREPARE THE EXHIBIT MAPS REFERRED TO ABOVE.

THIS DRAWING WAS PREPARED AT THE REQUEST DATED NOVEMBER 30, 1971 OF THE WESTERN REGIONAL ENGINEER AND IS SUBMITTED TO BECOME A PART OF THE LICENSE DRAWINGS

PORTLAND GENERAL ELECTRIC COMPANY

BY: H H Phillips
VICE PRESIDENT

MARCH 27, 1972

EXHIBIT "L" SHEET 3A OF 9

PROJECT NO. 2233 OREGON
PORTLAND GENERAL ELECTRIC COMPANY
WILLAMETTE FALLS DEVELOPMENT
T.W. SULLIVAN HYDROELECTRIC PLANT
PORTLAND GENERAL ELECTRIC COMPANY